Command and Operations School

Prospective

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Operational Readings

U.S. COAST GUARD ACADEMY
NEW LONDON, CONNECTICUT

2003

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United States Coast Guard

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COMDTINST 5351.1

DEC 4 1997

COMMANDANT INSTRUCTION 5351.1

Subj: COAST GUARD LEADERSHIP DEVELOPMENT PROGRAM

1. PURPOSE. This Instruction describes the Coast Guard's Leadership Development Program (LDP) and outlines responsibilities to carry it out. It outlines leadership competencies, provides a professional reading list, and introduces a leadership essay program to enhance leadership development.

2. ACTION. Area and district commanders, commanders of maintenance and logistics commands, commanding officers of Headquarters units, assistant commandants for directorates, chief counsel, and special staff offices at Headquarters shall ensure the contents of this Instruction are given widest distribution.

3. DIRECTIVES AFFECTED. None.

4. BACKGROUND. Coast Guard Goal One is to provide leadership and a working environment that enables all our people to reach their full potential and maximize Coast Guard mission success. The Leadership Development Program supports this goal. Over the past several years the Coast Guard has built a framework for strengthening leader development. We articulated our core values: Honor, Respect, and Devotion to Duty, values which frame the behaviors the Coast Guard expects from its people. The Commandant approved establishment of a Leadership Development Center, which will be an integral part of our Coast Guard Academy. Leadership work groups identified 21 basic leadership competencies consistent with our core values, missions, and work forces that are published in this Instruction. These provide a basis for describing specific leadership performance expectations for all work force levels. The Leadership Development Program includes all Team Coast Guard work force components ... active duty and reserve military, civilians (appropriated and non-appropriated), and Auxiliary. It will use a variety of methods to develop leadership skills (e.g., formal resident training, training aids, guidebooks, coaching, and self-development).

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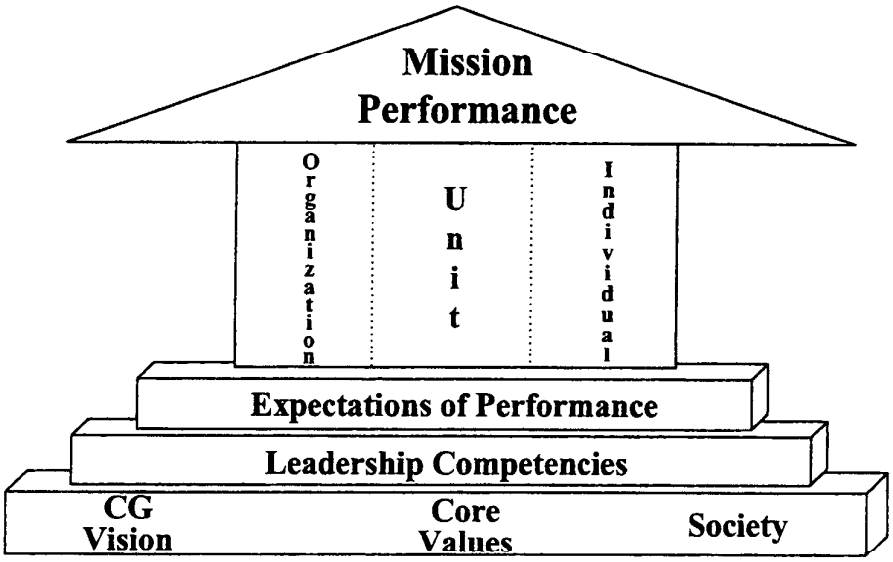
The Leadership Development Program has four principal elements:

- Establishing leadership competencies and expectations of performance for all work force components at every level;
- Standing up the Leadership Development Center (LDC) at the Coast Guard Academy. The LDC will include Officer Candidate School (OCS), Chief Warrant Officer Indoctrination, the Chief Petty Officers Academy, Officer-in-Charge/Executive Petty Officer Training, Command and Operations School, the Civilian Employee Orientation Program, and the Leadership and Quality Institute;
- Building core values, leadership competencies, and expectations of performance into existing resident training (e.g., "A" Schools, OCS, and the Academy); and
- Providing tools to help individuals and units improve leadership skills, e.g., support for continuing education, a professional reading list, a leadership essay program, better mentoring support, and other leadership training aids.

5. PROGRAM MODEL. As one of America's armed forces with a proud humanitarian heritage, the Coast Guard has long been distinguished by individuals willing to sacrifice personal interests to accomplish our missions and defend our Nation. This unique military and humanitarian Coast Guard identity demands leadership grounded in integrity as well as professional competence. It requires leaders who understand a broad range of leadership techniques and who can apply them properly and decisively across a wide variety of situations involving every component of Team Coast Guard. The Leadership Development Program is built on these principles.

   As depicted in the model below, the program foundation includes the Coast Guard's vision, core values, and societal influences. The building blocks are leadership competencies and expectations of performance. Next are organizational, unit, and individual processes that assess and develop the leadership skills needed for mission success. Responsibility for leadership development has always been shared by each **individual**, his or her **unit**, and the **organization**. The individual element includes identifying one's own strengths and shortcomings, developing a personal plan for improvement, and taking initiative in pursuing education. The unit provides support such as formal and informal indoctrination and training, counseling, and mentoring. The Coast Guard organization provides formal systems and processes such as assignments, policy, training, and education.

The Coast Guard's Leadership Development Program



6. MISSION AND VISION.

   a. **Mission**. The Coast Guard's Leadership Development Program provides a framework that helps every member of Team Coast Guard achieve his or her full potential and maximize mission performance.

   b. **Vision (Desired End State)**. A fully integrated Leadership Development Program encompassing the entire Coast Guard work force throughout their time in service.

7. DEFINITIONS.

   a. **Leadership**. The ability to work through others to accomplish a task.

   b. **Effective Leader**. A leader whose followers are committed to and achieve desired results by having the right tools, information, and working environment.

   c. **Leadership Development**. The system by which an organization grows its work force into leaders.

8. BASIC PRINCIPLES. The Coast Guard's Leadership Development Program (LDP) is:

   - Fully integrated;
   - Based on competencies and expectations of performance; and
   - Job-related.

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a. **Fully Integrated**. The LDP includes:

• All work force components	*Military, Civilian, and Auxiliary at every rate, rank, grade, and position*
• All methods	*Training and non-training*

(1) **Integration of Work Force Components**. *Every* member of Team Coast Guard has important leadership responsibilities. The LDP supports *all* members of Team Coast Guard.

(2) **Integration of Methods and Levels**. The new Leadership Development Center at the Coast Guard Academy will strengthen leadership resident training. However, because leadership skills are developed not just by resident training but by a wide variety of other means such as observing others, self-development, on-the-job training, and performance feedback, values and practices taught at resident courses will be reinforced by systems, policies, and daily activities in our workplaces. The LDP considers *all* factors that influence leadership development, including:

- Resident and non-resident training;
- Unit-level training;
- Self-development programs for individuals;
- Instruments for assessing unit and Coast Guard-wide work environments and culture;
- Instruments to assess individual strengths and needs;
- Systems and processes such as recruiting and hiring, pay and compensation, rewards and recognition, discipline, evaluations, assignments, and promotions; and
- The impact of Coast Guard goals, regulations, and policies.

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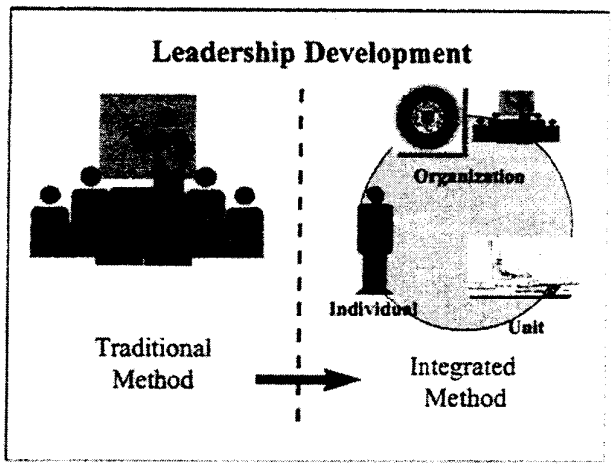
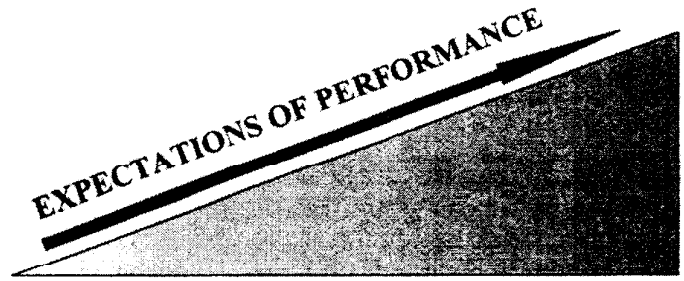


The traditional method for enhancing leadership emphasized formal training courses. The LDP includes training and non-training processes and involves the individual, unit, and organization.

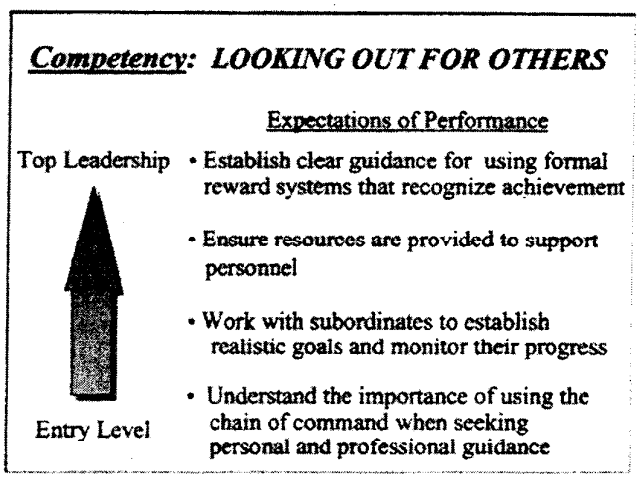
b. **Competencies and Expectations of Performance.**

(1) **Competencies**. Leadership competencies are measurable patterns of behavior essential to leading. The Coast Guard has identified 21 competencies which are consistent with our missions, work forces, and core values of Honor, Respect, and Devotion to Duty. Enclosure (1) describes the basic Coast Guard leadership competencies.

(2) **Expectations of Performance**. Expectations of performance will be developed to describe the knowledge, skills, attitudes, and abilities the Coast Guard requires of each individual. They will be aligned with core values and competencies. They are cumulative and carried on through one's career as shown by the picture below.



Example: To show how individual expectations change from entry level to top leadership, consider the competency, "Looking out for Others." It is described: *Successful leaders identify others' needs and abilities. They ensure fair and equitable treatment, project high expectations for subordinates and their teams, know their job, express confidence in their abilities, recognize achievements, and use reward systems effectively. Leaders appropriately support and assist in professional and personal situations and use formal and informal processes to positively resolve situations.*



As one moves from entry level to top leadership, the level of performance grows from awareness, to application, to overall responsibility.

Expectations of performance are developed using "needs assessments." Two needs assessments, for non rates and chief petty officers, have already been completed. Because they addressed the senior and junior ends of the enlisted work force, they will also help to develop performance expectations for the petty officer pay grades in between. Additional needs assessments will be conducted over the next several years to develop performance expectations for other positions and work force components. Needs assessments for ensigns and top leadership, military and civilian, are scheduled to begin in 1998. Needs assessment results will influence current training (e.g., recruit training, "A" Schools, CPO Academy, Officer Candidate School, the Academy, civilian developmental programs) and non-training processes (e.g., recruiting, compensation, rewards and recognition, evaluations, assignments, and promotions).

c. **Job-Related.** Coast Guard personnel have different leadership development needs depending on their job. Many factors create differences in leadership requirements. For example, a Chief Boatswain's Mate who is an Officer-In-Charge of a cutter has different leadership requirements than one who is a Chief Master-At-Arms at a shore station. Additionally, because of internal promotion and assignment systems, military personnel generally move to positions of increased leadership expectations throughout a career. Civilians and Auxiliarists, however, can move through positions of greater leadership responsibility by different methods. The Leadership Development Program will take these job-related differences into account. Enclosure (2) gives

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examples of leadership development tools each member of Team Coast Guard can expect from the Leadership Development Program.

9. PROFESSIONAL READING LIST. Life-long self-development is an important component of leadership development. To assist members of Team Coast Guard with their own development, enclosure (3) provides a professional reading list of books, magazines, and journals related to leadership. Individuals are encouraged to read materials on the list regularly and submit recommendations for new listings.

10. LEADERSHIP ESSAY PROGRAM. Enclosure (4) describes a Coast Guard leadership essay program designed to help individuals, units, and the entire Coast Guard share the leadership ideas and experiences of Team Coast Guard on a broad basis. Participation is voluntary.

11. RESPONSIBILITIES. Commandant (G-WTL), as program manager for the LDP, working with the Coast Guard Academy Superintendent and the Leadership Advisory Council will:

    a. Establish the Leadership Development Center at the Coast Guard Academy according to the following schedule:

• Command and Operations School	On line
• Chief Warrant Officer Indoctrination	October 1997
• Officer-in-Charge/Executive Petty Officer Course	April 1998
• Leadership and Quality Institute	May 1998
• Officer Candidate School	July 1998
• Civilian Employee Orientation Program	July 1998
• Chief Petty Officer Academy (East Coast)	October 1998

    b. Oversee the progress of needs assessments;

    c. Develop and publish expectations of performance for all of Team Coast Guard;

    d. Continually assess the performance of Coast Guard leaders against defined expectations. Help determine the causes of any significant leadership performance gaps and recommend appropriate remedies;

    e. Act as program manager for the leadership portions of resident-training courses, including:

        - Officer and enlisted accession-point training;
        - Military training such as "A" schools, CPO Academy, CWO Indoctrination, Command and Operations courses;
        - Mentoring Course;
        - Civilian Employee Orientation and Career Development; and
        - Leadership and Quality Institute courses.

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f. Develop a Coast Guard-specific CWO Indoctrination Course;

g. Support and help standardize unit-level leadership initiatives;

h. Develop and publish a Work Force Career Development Guide.

Robert E. Kramek

ROBERT E. KRAMEK
Admiral, U.S. Coast Guard
Commandant

Encl: (1) Coast Guard Leadership Competencies
(2) Table of Future Leadership Development Tools
(3) Professional Reading List
(4) Leadership Essay Program

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Coast Guard Leadership Competencies

DEFINITION

Leadership competencies are measurable patterns of behavior essential to leading. The Coast Guard has identified 21 competencies consistent with our missions, work force, and core values of Honor, Respect, and Devotion to Duty.

PURPOSE

Outlining our leadership competencies will help Team Coast Guard become familiar with these important concepts. Expectations of performance based on the competencies will be published in the future. Performance expectations are the leadership knowledge, skills, attitudes, and abilities individuals should possess at various levels. The competencies and expectations will be integral parts of our Leadership Development Program, the ultimate goal of which is enhanced *mission performance*.

CATEGORIES

The competencies generally fall into three broad categories: SELF, WORKING WITH OTHERS, and PERFORMANCE, although some competencies overlap categories. Together, these leadership competencies are keys to success. Developing them in all Coast Guard people will promote the continuous improvement necessary for the Coast Guard to provide valued service to the public and remain SEMPER PARATUS.

- Self—Fundamental to successful development as a leader is an understanding of self and one's own abilities, including personality, values, preferences, and potential as a Coast Guard member.

- Working with Others—Leadership involves working with and influencing others to achieve common goals. Coast Guard people interact with others in many ways, whether as supervisor, mentor, manager, team member, team leader, peer, or subordinate. Positive professional relationships provide a foundation for the success of our Service.

- Performance—Coast Guard people constantly face challenges in mission operations. To meet these challenges, leaders must apply leadership competencies in their daily duties.

DESCRIPTIONS

Descriptions of the 21 competencies shown within the categories of Self, Working With Others, and Performance are shown on the next three pages.

Competencies of Self

Competency	Behaviors
Accountability and Responsibility	• Understand the Coast Guard's character and structure as a military service committed to being "Always Ready" • Recognize and use the chain of command appropriately • Understand the impact of your behavior on others, your unit, and the Coast Guard organization • Take ownership of your areas of responsibility • Use public resources efficiently
Aligning Values	• Understand and embody the Coast Guard's core values: Honor, Respect, and Devotion to Duty • Align your personal behavior with the Coast Guard's core values • Hold peers and subordinates accountable to the core values
Followership	• Understand that all Coast Guard personnel are followers • Look to leaders for guidance and feedback on your performance • Seek and accept challenging tasks to learn and develop competence • Seek to understand others through listening and questioning • Work with leaders to ensure successful mission accomplishment
Health and Well-Being	• Promote a safe work environment for yourself and others • Recognize and manage stress • Set a personal health example, emphasizing physical fitness and emotional strength • Encourage others to maintain health and well-being
Personal Conduct	• Personify high standards of honesty, integrity, trust, openness, fairness and compassion • Be self-motivated, professional, and results-oriented • Have confidence in your own abilities and ideas • Learn your strengths and weaknesses • Use position and personal power appropriately
Self Awareness and Learning	• Seek opportunities for self-development and life-long learning • Choose to learn and grow from experience • Adapt your behavior and work methods to changing conditions and unexpected obstacles • Seek feedback on your personal and professional strengths and areas for improvement • Learn to manage your time effectively
Technical Proficiency	• Be prepared: learn, develop, and demonstrate technical and functional expertise in your areas of responsibility • Understand how your skills and actions contribute to mission readiness and performance • Keep current on technological advances • Effectively organize and prioritize tasks

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Competencies of Working With Others

Competency	Behaviors
Influencing Others	• Motivate others to achieve desired outcomes by directing, coaching, and delegating as the situation requires • Recognize the importance of building professional relationships • Develop networks of contacts and colleagues • Establish rapport with key players • Empower others by delegating power and responsibility and hold them accountable • Gain cooperation and commitment from others
Respect for Others and Diversity Management	• Understand and support the Coast Guard's commitment to respect for every individual in the workplace • Recognize and promote the value of diversity • Foster an environment that supports diverse individuals and perspectives, fairness, dignity, compassion, and creativity in the workplace
Looking out for Others	• Recognize the needs and abilities of others, particularly subordinates • Ensure fair and equitable treatment • Provide opportunities for professional development • Recognize and reward performance • Support and assist others in professional and personal situations
Effective Communication	• Learn to express facts and ideas succinctly and logically • Be an active and supportive listener • Encourage open exchange of ideas • Communicate face-to-face when possible • Write clearly and concisely • Speak effectively before an audience • Distinguish between personal and official communication situations and act accordingly
Group Dynamics	• Build commitment, pride, team spirit, and strong relationships • Recognize and contribute to group efforts • Foster group identity and cooperation • Motivate and guide others toward goal accomplishment • Consider and respond to others' needs and capabilities
Leadership Theory	• Study and understand different leadership theories and styles • Work with subordinates to develop their leadership knowledge and skills • Adapt leadership approaches to meet varying situations including crises
Mentoring	• Assist others in their development by sharing your experience and knowledge • Provide feedback to others on their leadership and career development • Help others identify professional goals, strengths, and areas for improvement

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Competencies of Performance

Competency	Behaviors
Vision Development and Implementation	• Set and work toward a vision for your unit, division, or department in line with the Coast Guard's overall vision, missions, strategy, and values • Establish and clearly communicate objectives • Initiate action and provide support and systems to achieve goals • Manage and champion organizational improvement
Customer Focus	• Focus on external requirements • Actively seek feedback and suggestions and encourage others to do the same • Ensure internal and external customers' needs are met
Decision-Making and Problem-Solving	• Learn to identify and analyze problems under normal and extreme conditions • Learn to consider and assess risks and alternatives • Use facts, input from systems, input from others, and sound judgment to reach conclusions • Learn to lead effectively in crisis, keeping focus on key information and decision points • Commit to action; be as decisive as a situation demands • Involve others in decisions that affect them • Evaluate the impact of your decisions
Conflict Management	• Encourage open communication about controversial issues • Promote collaboration to manage contention • Confront conflict constructively to minimize impact to self, others, and the organization
Performance Appraisal	• Use goal-setting, delegation, and effective communications to manage performance effectively • Articulate performance expectations to subordinates • Coach and provide feedback to subordinates continuously • Document performance • Seek out performance expectations for yourself and your unit
Management and Process Improvement	• Use goals, milestones, and control mechanisms to measure and manage performance • Evaluate progress and outcomes of current processes • Seek continuous improvement through periodic assessments • Improve products and services to meet changing customer needs
Workforce Management Systems	• Understand and support civilian and military promotion, advancement, training, assignment, and award systems • Support personnel working on advancement, special programs, training, and future assignments • Use formal reward systems to recognize positive performance and development

Leadership Development Tools

This table shows examples of leadership development tools that exist or will be developed. The *final tools will be shaped by the needs assessments to be completed over the next several years;* some of the items shown may be modified based on outcomes of the needs assessments.

Enlisted Work Force

Enlisted Leadership Development Tools	E-1/2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10
Standardized "A" School Leadership Curriculum		●							
Career Development Guidebook	●	●	●	●	●	●	●	●	●
CPO Academy Leadership Curriculum (Active Duty)						✓	✓	✓	
CPO Academy Leadership Curriculum (Reserve)						✓	✓	✓	
DoD Senior Enlisted Academies						✓	✓	✓	
Essay Program	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ethics in the Military Correspondence Course					●	●			
First-line Supervisor Correspondence Course (self-study w/case studies)			●	●					
Fundamentals of Coast Guard Leadership Correspondence Course (self-study)	●	●	●						
Leadership and Management School			✓	✓	✓	✓			
Leadership Case Study Individual Program		●	●	●	●	●	●	●	
Leadership Reaction Course (resident, hands-on)				●	●	●			
Mentoring in a Diverse Workforce Course					✓	✓	✓	✓	
Mentoring Program	✓	✓	✓	✓	✓	✓	✓	✓	✓
MRNs: Leadership Performance Based Qualifications		●	●	●	●	●			
MRNs: Leadership Sections of Correspondence Courses		●	●	●	●	●			
Officer-In-Charge/Executive Petty Officer Course				✓	✓	✓	✓		
Professional Reading List	✓	✓	✓	✓	✓	✓	✓	✓	✓

✓ = Present Leadership Tool ● = *Future/Potential/Being Developed Leadership Tool*

Check official source for exact eligibility requirements for existing courses (e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

Leadership Development Tools (continued)

Enlisted Leadership Development Tools	E-1/2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10
Recruit Training Company Commander Course				✓	✓	✓			
Recruit Training Leadership Curriculum	●								
Silver/Gold Badge CEA Training						●	●	●	●
Striker Leadership Program (computer-based)		●							
Successful Leadership Correspondence Course				●	●				
Top Leadership Development Seminar									●
TQM Facilitator Training				✓	✓	✓	✓	✓	
Tuition Assistance for Education	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit Leadership Program	●	●	●	●	●	●	●	●	
Unit "Welcome Aboard" Packages	✓	✓	✓	✓	✓	✓	✓	✓	
USCG Recruiter Training				✓	✓	✓			

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses
(e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

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Leadership Development Tools (continued)

Officer Work Force

Officer Leadership Development Tools	W-2 W-3	W-4	O-1	O-2	O-3	O-4	O-5	O-6	O-7 O-8 O-9	O-10
Standardized Accession Point Leadership Training	●		●	●	●					
Capitol Hill Workshop							✓	✓		
Capstone									✓	✓
Career Development Guidebook	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Civilian Personnel Procedures for Supervisors	✓	✓		✓	✓	✓	✓	✓	✓	✓
Command and Operations School	✓	✓		✓	✓	✓	✓	✓		
Council for Excellence in Government Fellows Program							✓			
DoD Senior Service Schools								✓	✓	
Essay Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ethics in the Military Correspondence Course					●	●				
Executive Development Seminar								✓		
Executive Potential Program							✓			
First-line Supervisor Correspondence Course (self-study w/case studies)	●			●	●					
Graduate School Programs				✓	✓	✓				
Human Resource Issues for Senior Managers Program							✓	✓		
ICAF							✓	✓		
Leadership and Management School	✓		✓	✓	✓					
Leadership Case Study Individual Program			●	●	●					
Leadership Reaction Course (resident, hands-on)	●		●	●	●					
Leadership Seminars				●		●		●		
Management Development Seminar							✓	✓		
Managing Diversity for Managers and Supervisors	✓	✓		✓	✓	✓	✓	✓	✓	
Mentoring in a Diverse Workforce Course	✓	✓		✓	✓	✓				

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses
(e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

Leadership Development Tools (continued)

Officer Leadership Development Tools	W-2 W-3	W-4	O-1	O-2	O-3	O-4	O-5	O-6	O-7 O-8 O-9	O-10
Mentoring Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mid-Grade Officer Correspondence Course						●	●			
Naval War College						✓	✓	✓		
Power of Vision							✓	✓		
Professional Reading List	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Seminar for New Managers							✓			
Successful Leadership Correspondence Course					●	●				
Top Leadership Development Seminar									●	●
TQM Facilitator Training	✓	✓	✓	✓	✓	✓	✓	✓		
Tuition Assistance for Education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit Leadership Program	●	●	●	●	●	●	●	●		
Unit "Welcome Aboard" Packages	✓	✓	✓	✓	✓	✓	✓	✓		
White House Workshop							✓	✓		
Women's Executive Leadership Program					✓	✓				

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses
(e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

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Leadership Development Tools (continued)

Civilian Work Force (GS)

Civilian (General Schedule) Leadership Development Tools	GS 1-6	GS 7-10	GS 11-12	GS 13-14	GS 15	SES
Aspiring Leader Program	✓ (5-6)	✓ (7)				
Basic USCG Orientation Self Paced Training (computer-based)	●	●	●	●		
Capitol Hill Workshops				✓	✓	
Career Development Guidebook	●	●	●	●	●	●
Career Enrichment Seminar	✓ (5-6)	✓				
Career Strategies Seminar			✓	✓		
Career Transition Workshop	✓	✓	✓	✓	✓	✓
Civilian Employee Orientation Program		✓ (9-10)	✓	✓	✓	
Civilian Personnel Procedures for Supervisors	✓	✓	✓	✓	✓	✓
Council for Excellence in Government Fellows Program				✓ (14)		
Employee Tuition Assistance Program	✓	✓	✓	✓	✓	✓
Essay Program	✓	✓	✓	✓	✓	✓
Executive Development Seminar					✓	✓
Executive Potential Program				✓		
Federal Executive Institute					✓	✓
First-line Supervisor Correspondence Course (self-study w/case studies)	●	●	●			
Human Resources Issues for Senior Managers				✓ (14)	✓	
ICAF				✓ (14)	✓	
Leadership and Management School	✓	✓				
Leadership Case Study Individual Program	●	●	●	●		
Management Development Seminar				✓	✓	

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses
(e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

Leadership Development Tools (continued)

Civilian (General Schedule) Leadership Development Tools	GS 1-6	GS 7-10	GS 11-12	GS 13-14	GS 15	SES
Managing Diversity for Managers and Supervisors	✓	✓	✓	✓	✓	
Mentoring in a Diverse Workforce Course		✓	✓	✓ (13)		
Mentoring Program	✓	✓	✓	✓	✓	✓
Naval War College			✓	✓	✓	
New Leader Program		✓	✓ (11)			
Power of Vision				✓ (14)	✓	
Professional Reading List	✓	✓	✓	✓	✓	✓
Seminar for New Managers				✓	✓	
Successful Leadership Correspondence Course		●	●	●		
Top Leadership Development Seminar						●
TQM Facilitator Training	✓	✓	✓			
Unit Leadership Program	●	●	●	●	●	●
Unit "Welcome Aboard" Packages	✓	✓	✓	✓	✓	✓
White House Workshop				✓	✓	
Women's Executive Leadership Program			✓ (12)			

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses
(e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

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Leadership Development Tools (continued)

Civilian Work Force (Wage System)

Civilian (Wage System) Leadership Development Tools	WG 1-8	WG 9-11 WL 1-5 WS 1-7	WG12-15 WL 6-14 WS 8-13	WL 15 WS 14-19
Aspiring Leader Program		✓		
Basic USCG Orientation Self Paced Training (computer-based)	●	●	●	●
Career Development Guidebook	●	●	●	●
Career Enrichment Seminar	✓	✓	✓	
Employee Tuition Assistance Program	✓	✓	✓	✓
First-line Supervisor Correspondence Course (self-study w/case studies)		●	●	●
Leadership and Management School	✓	✓	✓	
Leadership Case Study Individual Program		●	●	●
Managing Diversity for Managers and Supervisors	✓	✓	✓	✓
Mentoring in a Diverse Workforce Course			✓	✓
Mentoring Program	✓	✓	✓	✓
New Leader Program			✓	
Professional Reading List	✓	✓	✓	✓
Successful Leadership Correspondence Course			●	●
TQM Facilitator Training		✓	✓	✓
Unit Leadership Program	●	●	●	●
Unit "Welcome Aboard" Packages	✓	✓	✓	✓

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses
(e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

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Leadership Development Tools (continued)

Civilian Work Force (NAF)

Civilian (NAF) Leadership Development Tools	NF1	NF2	NF3	NF4	NF5	NF6
Basic USCG Orientation Self Paced Training (computer-based)	●	●	●	●	●	●
Career Development Guidebook	●	●	●	●	●	●
Civilian Employee Orientation Program				✓	✓	
First-line Supervisor Correspondence Course (self-study w/case studies)		●	●	●		
Leadership and Management School			✓	✓		
Leadership Case Study Individual Program		●	●	●	●	
Managing Diversity for Managers and Supervisors				✓	✓	✓
Mentoring in a Diverse Workforce Course			✓	✓	✓	
Mentoring Program	✓	✓	✓	✓	✓	✓
Professional Reading List	✓	✓	✓	✓	✓	✓
Successful Leadership Correspondence Course				●	●	
Unit Leadership Program	●	●	●	●	●	
Unit "Welcome Aboard" Packages	✓	✓	✓	✓	✓	

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses
(e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog).

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Leadership Development Tools (continued)

Auxiliary Work Force

Auxiliary Leadership Development Tools	Member	FSO VFC FC BA BC	ADSO DSO DCP DVC DC	VCO RCO DCO
Auxiliary Flotilla Leadership		✓		
Deck Watch Officer PQS	✓	✓	✓	
Essay Program	✓	✓	✓	✓
First-line Supervisor Correspondence Course (self-study w/case studies)		●	●	
Leadership and Management School	✓	✓	✓	✓
Leadership Case Study Individual Program	●	●	●	
Mentoring Program	✓	✓	✓	✓
New Auxiliary Member Course	✓			
Professional Reading List	✓	✓	✓	✓
Successful Leadership Correspondence Course		●	●	
Top Leadership Development Seminars				●
TQM Facilitator Training	✓	✓	✓	✓
Unit Leadership Program	●	●	●	●
Unit "Welcome Aboard" Packages	✓	✓	✓	✓
VCO Training				✓

✓ = Present Leadership Tool ● = Future/Potential/Being Developed Leadership Tool

Check official source for exact eligibility requirements for existing courses (e.g., Commandant Notice 1540, Servicewide Civilian Sponsored Training Programs Catalog, Auxiliary Web site).

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Coast Guard Professional Reading List

PURPOSE

This reading list is designed to offer Coast Guard people recommended books, magazines, and journals related to leadership. This list is not all-inclusive; the goal is to provide a starting point or expand existing knowledge and skills.

The reading list provides a tool for **individual** leadership growth—taking into account that responsibility for leadership development rests on each **individual**, his or her **unit**, and the **organization**.

SELECTING FROM THE LIST

Books are listed in four categories by rank and grade. Categories were created as a means to organize the many books available. Do not feel bound to those listed at your level; explore up and down the list based on your own interests.

To help people choose the books that will be most valuable to them, summaries of each title will be made available on the Leadership Development Center Web site at http://www.dot.gov/dotinfo/uscg/hq/uscga/ldc/ldc.html.

E-1 to E-6, GS-1 to GS-6, WG-1 to WG-11, WL-1 to WL-5, WS-1 to WS-7, NF-1 to NF-3, AUX MBR

Consider reading four to six books annually from the following list:

- *The Coast Guardsman's Manual* (8th Edition), George E. Krietemeyer, CAPT, USCG (Retired)
- *The Art of Communicating*, Bert Decker
- *Beyond Race and Gender*, R. Roosevelt Thomas, Jr.
- *Castro's Ploy—America's Dilemma: The 1980 Cuban Boatlift*, Alex Larzelere
- *The Coast Guard at War: Vietnam, 1965-1975*, Alex Larzelere
- *Coastal Forces*, Barry Clarke, Jurgen Fielitz, and Malcolm Touchin
- *A Code to Keep*, Ernest C. Brace
- *Guardians of the Sea: History of the U.S. Coast Guard, 1915 to the Present*, Robert E. Johnson

- *How Good People Make Tough Choices: Resolving the Dilemmas of Ethical Living*, Rushworth M. Kidder
- *Learning to Lead: A Workbook on Becoming a Leader*, Warren Bennis and Joan Goldsmith
- *Naval Ceremonies, Customs, and Traditions*, William P. Mack and Royal W. Connell
- *On Becoming A Leader*, Warren Bennis
- *On Leadership*, John W. Gardner
- *The Perfect Storm*, Sebastian Junger
- *Principle-Centered Leadership*, Stephen R. Covey
- *Sea of Grass: The Maritime Drug War 1970-1990*, Charles M. Fuss
- *The Seven Habits of Highly Effective People*, Stephen R. Covey
- *That Others Might Live: The U.S. Life-Saving Service, 1878-1915*, Dennis L. Noble
- U.S. Constitution

E-7, W-1 to W-2, Cadets and Officer Candidates, 0-1 to 0-3, GS-7 to GS-11, WG-12 to WG-15, WL-6 to WL-14, WS-8 to WS-13, NF-3 to NF-4, FSO, VFC, FC, BA, BC

Consider reading four to six books annually from the following list:

- *The Armed Forces Officer*, S. L. A. Marshall
- *Challenge of Command: A Reading for Military Excellence*, Roger H. Nye
- *The Change Masters: Innovation and Entrepreneurship in the American Corporation*, Rosabeth Moss Kanter
- *Command at Sea*, William P. Mack, VADM, USN (Retired) and Albert H. Konetzni, CDR, USN
- *Division Officer's Guide*, John V. Noel, Jr., CAPT, USN (Retired) and James Stavridis
- *Five-Star Leadership: The Art and Strategy of Creating Leaders at Every Level*, Patrick L. Townsend and Joan E. Gebhardt

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- *Flight of the Buffalo: Soaring to Excellence, Learning to Let Employees Lead*, James A. Belasco and Ralph C. Stayer
- *The General Danced at Dawn*, George M. Fraser
- *Grant & Lee: A Study in Personality and Generalship*, J. F. C. Fuller
- *Lincoln on Leadership: Executive Strategies for Tough Times*, Donald T. Phillips
- *Mastering Change: The Power of Mutual Trust and Respect in Personal Life, Business and Society*, Ichak Adizes
- *Military Leadership: In Pursuit of Excellence*, Edited by Robert L. Taylor and William E. Rosenbach
- *Naval Leadership: Voices of Experience*, Karel Montor
- *The Naval Officer's Guide*, William P. Mack, VADM, USN (Retired) with Thomas D. Paulsen, CAPT, USN
- *Out of the Crisis*, W. Edwards Deming
- *Reluctant Warrior: A Marine's True Story of Duty and Heroism in Vietnam*, Michael C. Hodgins
- *Taking Charge: Making the Right Choices*, Perry M. Smith
- *To Get the Job Done: Readings in Leadership and Management*, John B. Washbush
- *Type Talk: The 16 Personality Types That Determine How We Live, Love, and Work*, Otto Kroeger and Janet M. Thue
- *The Wisdom of Teams: Creating the High-Performance Organization*, Jon R. Katzenbach and Douglas K. Smith
- *Women and the Military: Over 100 Notable Contributors, Historic to Contemporary*, John P. Dever and Marcia C. Dever

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E-8 to E-9, W-3 to W-4, 0-4 to 0-5, GS-12 to GS-14, WL-15, WS-14 to WS-19, NF-4 to NF-5, ADSO, DSO, DCP, DVC, DC

Consider reading four to six books annually from the following list:

- *Beyond the Wall of Resistance: Unconventional Strategies That Build Support for Change*, Rick Maurer

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- *Call for Fire: Sea Combat in the Falklands and the Gulf War*, Chris Craig
- *Douglas Southall Freeman on Leadership*, Douglas Southall Freeman and Stuart W. Smith (editor)
- *The Empowered Manager: Positive Political Skills at Work*, Peter Block
- *The Fifth Discipline Fieldbook*, Peter M. Senge, et al
- *Hope Is not a Method: What Business Leaders Can Learn from America's Army*, Gordon R. Sullivan, GEN, USA (Retired) and Michael V. Harper
- *Implementing Organizational Change*, Gordon Lippitt, et al
- *The Influence of Sea Power Upon History, 1660-1783*, A. T. Mahan
- *The Joint Staff Officer's Guide*, National Defense University
- *Leadership and Management of Volunteer Programs: A Guide for Volunteer Administrators*, James C. Fisher and Kathleen M. Cole
- *Leadership and the New Science: Learning About Organization from an Orderly Universe*, Margaret J. Wheatley
- *Leadership: Development, Maturity and Power*, Lee and Norma Barr
- *The Military 100: A Ranking of the Most Influential Military Leaders of all Time*, Michael Lee Lanning
- *My American Journey*, Colin L. Powell
- *Naval Command and Control*, W. T. T. Pakenham
- *The New Leaders: Guidelines on Leadership Diversity in America*, Ann M. Morrison
- *The Parameters of Military Ethics*, Edited by Lloyd J. Matthews and Dale E. Brown
- *The Quiet Warrior: A Biography of Admiral Raymond A. Spruance*, Thomas B. Bue
- *Some Principles of Maritime Strategy*, Julian S. Corbett
- *True Faith and Allegiance: The Burden of Military Ethics*, James H. Toner
- *Typhoon, The Other Enemy: the Third Fleet and the Pacific Storm of 1944*, C. Raymond Calhoun, CAPT, USN (Retired)

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- *Win-Win Negotiating: Turning Conflict into Agreement*, Fred E. Jandt
- *Wolf: U-boat Commanders in World War II*, Jordan Vau

0-6 to 0-9, GS-15 to GS-18, NF-5 to NF-6, SES, VCO, RCO, DCO

Consider reading four to six books annually from the following list:

- *The Best and the Brightest*, David Halberstam
- *Built to Last: Successful Habits of Visionary Companies*, James C. Collins and Jerry I. Porras
- *The Nightingale's Song*, Robert Timberg
- *Nimitz*, Elmer B. Potter
- *On the Origins of War and the Preservation of Peace*, Donald Kagan
- *One Hundred Days: The Memoirs of the Falklands Battle Group Commander*, ADM Sandy Woodward with Patrick Robinson
- *Overcoming Organizational Defenses: Facilitating Organizational Learning*, Chris Argyris
- *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500-2000*, Paul M. Kennedy
- *Understanding Your Management Style: Beyond the Myers-Briggs Type Indicators*, Robert Benfari and Jean Knox

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JOURNALS & MAGAZINES

The following leadership journals and magazines may be relevant to the challenges Coast Guard leaders face.

Executive Excellence: This magazine of leadership development, managerial effectiveness, and organizational productivity is written for today's leaders and managers. Contributing editors include Stephen Covey, Peter Senge, Elizabeth Pinchot, Ken Blanchard, and many others. It contains insights of top business consultants, trainers, and corporate executives. Tel. 800-304-9782, ext. 115.

Harvard Business Review: This publication contains original research and first-hand perspectives from leading business thinkers around the world. Focused on the issues confronting top managers in today's complex environment, the *Harvard Business Review* applies research and practice to the strategic challenges and operating problems of the day.
Tel. 800-274-3214.

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Proceedings: The U.S. Naval Institute, a private, self-supporting, nonprofit professional society, publishes this magazine as a forum for the sea services. Regular departments include a leadership forum and professional notes. Tel. 800-233-8764.

Quality Digest: Each month *Quality Digest* provides the latest in management and quality techniques. Columnists include Ken Blanchard, Donald Wheeler, and A. Blanton Godfrey. Each issue is filled with information about Total Quality Management, employee involvement, service quality, Baldrige award updates, exclusive interviews, and articles by quality leaders. Tel. 800-527-8875.

AVAILABILITY OF BOOKS AND JOURNALS

Public and university libraries carry many of these books and journals. You may also contact the Academy library with questions about leadership reference material that your local library cannot answer. While the Academy library is not able to serve the reference needs of the entire Coast Guard at this time, they will do whatever they can to assist individuals and commands.

USCG Academy Library
Tel: 860-444-8553
E-mail: library@exmail.uscga.edu
library@exmail.uscga.edu/Internet (from CGSWII)

ADDITIONAL RESOURCES

Leadership Development Center
U.S. Coast Guard Academy (LDC)
15 Mohegan Ave.
New London, CT 06320-4195

Tel: 860-437-6838
E-mail: ldc@exmail.uscga.edu
LDC/ACAD-CA (from CGSWII)
Web site: http://www.dot.gov/dotinfo/uscg/hq/uscga/ldc/ldc.html

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KEEPING THE LIST CURRENT

The Leadership Institute and the Leadership Development Center staffs will update the reading list and encourage people to recommend books, articles, journals, and magazines. The list will be updated regularly, and the most current list will be available on the World Wide Web at http://www.dot.gov/dotinfo/uscg/hq/uscga/ldc/ldc.html.
Links to other reading lists are also available at this site.

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BOOK REVIEW SUBMISSIONS

We encourage all personnel (active duty, civilians, Reservists, and Auxiliarists) to submit book reviews with these specifications:

- Reviews should discuss the books as related to one or more of the 21 leadership competencies or the Coast Guard's core values.
- Reviews should be 200 words or less.
- Include your name; rate, rank, or grade; e-mail address; telephone number; and unit name.

Submit to: LEADERSHIP DEVELOPMENT CENTER
ATTN: READING LIST
US COAST GUARD ACADEMY (LDC)
15 MOHEGAN AVE.
NEW LONDON CT 06320-4195

E-mail: ldc@exmail.uscga.edu
LDC/ACAD-CA (from CGSWII)

PUBLICATION

Selected book reviews will be published on the World Wide Web at http://www.dot.gov/dotinfo/uscg/hq/uscga/ldc/ldc.html and in the quarterly Coast Guard newsletter, *The Leadership News*.

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Coast Guard Leadership Essay Program

PURPOSE

The leadership essay program is intended to provide:

- A medium for individuals to research and write about leadership issues
- Material for unit level discussions on leadership topics
- A means for the Leadership Institute and the Leadership Development Center to publish information about leadership for the entire Coast Guard
- When the topic is suitable, a tool for supervisors to use in working with subordinates on leadership improvement

ESSAY SUBMISSIONS

Members of Team Coast Guard are encouraged to share their ideas and experiences on leadership issues by submitting stories or short essays. Participation is voluntary.

- Base your submission on personal experience related to one or more of the leadership competencies or the Coast Guard's core values.
- Submissions should be 500 words or less.
- Include your name; rate, rank, or grade; e-mail address; telephone number; and unit name.

Submit to:

LEADERSHIP DEVELOPMENT CENTER
ATTN: ESSAY PROGRAM
US COAST GUARD ACADEMY (LDC)
15 MOHEGAN AVE.
NEW LONDON CT 06320-4195

E-mail:

ldc@exmail.uscga.edu
LDC/ACAD-CA (from CGSWII)

PUBLICATION

Selected essays will be published. They will also be posted on the World Wide Web at http://www.dot.gov/dotinfo/uscg/hq/uscga/ldc/ldc.html.

ACTION

Units can use the essays to hold leadership discussions with their personnel. Commitment to leadership begins with an immersion in what Eisenhower called "knowledge of craft." Serious study and exchange of dialogue on leadership issues is a time investment that can pay off in the form of fewer personnel problems and improved performance.

A sample agenda for a unit leadership discussion is provided in Exhibit 4-A on page 3.

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Sample Leadership Seminar Agenda

This outline provides a sample format for holding workplace leadership discussions based on leadership essays.

A seminar leader should prepare for and guide the seminar. If the essay being discussed does not include workplace examples or case studies, the seminar leader may choose to find related case studies from the news or the Coast Guard to use in group discussions.

I. **Opening**: CO, XO, or other senior staff member makes opening remarks and presents essay overview

II. **Introduction**

- Seminar leader makes remarks, presents essay overview (if not already done), and gives instructions for dialogue. At larger units, participants break into smaller discussion groups (ideal group size is 3-9 people)

III. **Group Exercise**

- Group discusses the essay and related Coast Guard issues
- If case studies are included in the essay or provided by the seminar leader, sample questions the group could address are:
  - ➔ What decisions would you make as a leader and why?
  - ➔ Looking back, what could have been done to prevent the incident from occurring, and what can be done in the future to prevent it from occurring again?
  - ➔ What could the leader have done differently?
- Group records discussion and main points
- Group provides feedback to the entire forum on discussions

IV. **Seminar Close and Evaluation**

- Seminar leader summarizes group viewpoints
- Seminar leader asks each participant to share an insight gained
- Seminar leader asks for and records positive impressions and constructive criticism of the seminar to consider in conducting future seminars

Exhibit 4-A

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LEADERSHIP AND MANAGEMENT EFFECTIVENESS FRAMEWORK

UNITED STATES COAST GUARD

Competencies and Behaviors

United States Coast Guard Academy
Leadership Development Center
November 1999

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COMPETENCIES OF SELF

Fundamental to successful development as a leader is an understanding of self and one's own abilities, including personality, values, preferences, and potential as a Coast Guard member.

1. Accountability and Responsibility

Definition: Assures that the integrity of the organization is maintained through the development of effective controls. Holds self and others accountable for policies and responsibilities. Can be relied upon to ensure that projects, within areas of specific responsibility are completed in a timely manner and within budget. Monitors and evaluates plans, focuses on results and measuring attainment of outcomes.

Behaviors

1. **Exercises appropriate controls to ensure the integrity of the unit's processes.**
2. **Takes responsibility for work products, services, and results.**
3. **Explains how organizational or unit results will be measured.**
4. **Monitors programs and/or activities and takes corrective action when necessary.**
5. **Encourages others to take ownership for their work products and services and results.**
6. **Hold subordinates accountable for work products and services to published standards.**
7. **Realistically assesses own strengths, weaknesses, and impact on others.**

2. Aligning Values

Definition: Identifies the internal and external politics that impact the work of the organization. Approaches each problem situation with a clear perception of organizational and political reality, recognizes the impact of alternative courses of action.

Behaviors

1. **Keeps current with internal and external politics and issues that impact the work of the unit.**
2. **Anticipates the internal and external implications of statements or actions.**
3. **Considers political and organizational reality, the media, and special interests, in decision making.**

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3. Followership

Definition: The credibility that comes from enthusiastic following also contributes to effective leadership, when members are acting in that mode. Members are more willing to make a commitment to leaders who in turn are committed to others.

Behaviors

1. **Demonstrates, by word and deed, enthusiastic commitment to the unit's missions, and regularly makes whatever contributions are necessary for unit achievement.**
2. **Demonstrates support, and encourages others to demonstrate support, to unit, command, and organizational leadership by appropriately utilizing the chain-of-*command*.**
3. **Pro-actively calls to the attention of leadership issues which could be potentially damaging to the command.**
4. **Willingly pursues those courses of action selected by legitimate authority, even if not in personal agreement.**

4. Health and Well-being

Definition: Deals effectively with pressure; maintains focus and intensity and remains optimistic and persistent, even under adversity. Recovers quickly from setbacks. Effectively balances personal life and work.

Behaviors

1. **Demonstrates belief in own abilities, ideas, and self-worth and maintains a positive view of self, even during difficult times.**
2. **Maintains a professional demeanor in stressful and difficult situations.**
3. **Maintains a healthy balance between personal life and work.**
4. **Encourages members to maintain a healthy balance between personal life and work.**

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5. Personal Conduct

Definition: Instills mutual trust and confidence; creates a culture that fosters high standards of ethics; behaves in a fair and ethical manner toward others, and demonstrates a sense of corporate responsibility and commitment to public service.

Behaviors

1. **Models and encourages high standards of honesty, integrity, trust, openness and respect for others.**
2. **Promotes fair and ethical practices in all organizational activities.**
3. **Demonstrates a sense of responsibility and commitment to public trust.**
4. **Demonstrates congruence between statements and actions. ("Walks the talk and talks the walk.")**

6. Self Awareness and Learning

Definition: Grasps the essence of new information; masters new technical and business knowledge; recognizes own strengths and weaknesses; pursues self-development; seeks feedback from others and opportunities to master new knowledge.

Behaviors

1. **Realistically assesses own strengths, weaknesses, and impact on others.**
2. **Seeks and makes use of feedback from others.**
3. **Invests time and energy in self-development and growth.**
4. **Integrates the acquisition of knowledge or skills (e.g., team sharing, lessons learned, sharing information databases) into day-to-day work.**
5. **Develops and implements methods to distribute/share knowledge throughout the unit and Coast Guard.**
6. **Creates an environment that encourages and makes allowances for further education and life-long learning.**

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7. Technical Proficiency

Definition: ***Understands and appropriately applies procedures, requirements,*** **regulations, and policies related to specialized expertise, and uses efficient and cost-effective approaches to integrate technology into the workplace and improve program effectiveness. Develops strategies using new technology to enhance performance. Understands the impact of technological changes on the organization.**

Behaviors

1. **Demonstrates technical proficiency and currency in areas of responsibility.**
2. **Appropriately applies procedures, requirements, regulations, policies, and standards related to specialized area of expertise.**
3. **Understands and considers the technical difficulty and complexity placed upon subordinates and others by nature of their work.**
4. **Ensures self and staff is trained and capable in new information technology**
5. **Strategically integrates information technologies into the workplace to improve organizational effectiveness**
6. **Identifies and recommends new technology capabilities to make work easier.**

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COMPETENCIES OF WORKING WITH OTHERS

Leadership involves working with and influencing others to achieve common goals. Coast Guard people interact with others in many ways, whether as supervisor, mentor, manager, team member, team leader, peer, or subordinate. Positive professional relationships provide a foundation for the success of our Service.

8. Influencing Others

Definition: Persuades others; builds consensus through give and take; gains cooperation from others to obtain information and accomplish goals; facilitates "win-win" situations.

Behaviors

1. **Identifies and understands the interests and positions of others in the negotiation process.**
2. **Applies appropriate negotiation approaches to find mutually beneficial solutions to problems and/or conflicts.**
3. **Persuades supervisors, subordinates, peers, and others to commit to a course of action.**
4. **Uses power, authority, and influence appropriately to achieve goals.**
5. **Uses networks to gain cooperation from internal and external sources to obtain information and accomplish goals.**
6. **Strives for consensus.**

9. Respect for Others and Diversity Management

Definition: Initiates and manages cultural change within the organization to impact organizational effectiveness. Values cultural diversity and other individual differences in the workforce. Ensures that the organization builds on these differences and that employees are treated in a fair and equitable manner.

Behaviors

1. **Explains the value of culture, ethnicity, gender and other individual differences at all levels of the Coast Guard.**
2. **Creates an environment in which individuals are equally respected and recognized for their perspectives and contributions.**
3. **Supports development opportunities to foster a diverse workforce.**
4. **Values and supports diversity issues.**
5. **Nurtures development of self-esteem in all members.**

10. Looking Out for Others

Definition: Inspires, motivates, and guides others toward goal accomplishments. Consistently develops and sustains cooperative working relationships. Encourages and facilitates cooperation within the organization and with customer groups; fosters commitment, team spirit, pride, and trust. Develops leadership in others through coaching, mentoring, rewarding and guiding employees.

Behaviors

1. *Empowers others by sharing power and authority.*
2. Inspires, motivates, and guides others toward goal accomplishment.
3. Fosters cooperation and teamwork within the unit.
4. Creates an environment that encourages and rewards cooperation, collective problem-solving and participative decision-making.
5. Builds trust and open communication among team members and with stakeholders.
6. Seeks consensus among diverse viewpoints to build commitment.

11. Effective Communications

Definition: Makes clear and convincing oral presentations to individuals or groups; listens effectively and clarifies information as needed; facilitates an open exchange of ideas, and fosters an atmosphere of open communication. Expresses written facts and ideas in a clear, convincing, and organized manner.

Behaviors

1. Orally presents ideas and facts in a clear, organized and convincing manner in a style, tone, and level appropriate to the audience and the occasion.
2. Listens to others and demonstrates understanding of what they are saying.
3. Participates an open exchange of ideas.
4. Expresses written facts and ideas in a clear, convincing and organized manner that is appropriate to the audience and occasion.
5. Reviews and critiques the writing of others in a constructive and substantive manner.
6. Drafts unit correspondence as per CG Correspondence Manual with proper grammar, spelling and punctuation.

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12. Group Dynamics

Definition: Considers and responds appropriately to the needs, feelings, and capabilities of different people in different situations; is tactful, compassionate and sensitive, and treats others with respect. Develops networks and builds alliances, engages in cross-functional activities; collaborates across boundaries, and finds common ground with key individuals, groups or customers. Utilizes contacts to build and strengthen internal support bases.

Behaviors

1. **Provides positive feedback in a manner that reinforces or elicits desirable behavior.**
2. **Considers and responds appropriately to the needs, feelings, and capabilities of others.**
3. **Provides constructive feedback.**
4. **Treats all individuals with sensitivity and respect.**
5. **Contributes to team cohesion.**
6. **Develops networks and builds alliances with key individuals or groups.**
7. **Collaborates with a variety of individuals and groups across unit and organizational boundaries.**
8. **Identifies concerns of stakeholders to find common ground across interests.**
9. **Identifies barriers between individuals or groups.**
10. **Works effectively outside the chain of command to accomplish unit goals to create a beneficial relationship.**

13. Mentoring

Definition: Makes self available to other members to assist in their vocational and personal development through performance coaching, personal helping and timely referral to appropriate professional services.

Behaviors

1. **Regularly makes self available to other members by utilizing informal contacts and established organizational mentoring networks.**
2. **Understands and effectively applies the principles of "performance coaching" to assist mentees in achieving their stated professional and personal objectives.**
3. **Responds quickly and effectively to requests for confidential, non-judgmental private assistance in resolving personal problems by employing the principles of "personal helping."**
4. **Recognizes the situations that require the assistance of specialized professional counselors, and makes appropriate and timely referrals.**

14. Leadership Theory

Definition: Influences others toward a spirit of service and meaningful contributions to mission accomplishment. Develops new insights into situations and applies innovative solutions to make organizational improvements; creates a work environment that encourages creative thinking and innovation; designs and implements new or cutting-edge programs and processes. Is open to change and new information; adapts behavior and work methods in response to new information, changing conditions, or unexpected obstacles. Adjusts rapidly to new situations warranting attention and resolution.

Behaviors

1. **Influences others to believe in their jobs and their commitment to make a meaningful contribution.**
2. **Creates and fosters a culture that encourages teamwork.**
3. **Demonstrates a commitment to quality public service in statements and actions.**
4. **Communicates and exemplifies the traditions and cultural expectations that embody the Coast Guard.**
5. **Develops insights, initiates solutions, and non-traditional approaches to improve unit effectiveness.**
6. **Creates an environment that encourages and rewards creativity and innovation.**
7. **Identifies new or innovative programs/processes that have the potential to contribute to the unit and Coast Guard.**
8. **Adapts behavior and work methods in response to new information, changing conditions, unexpected obstacles, or ambiguity.**
9. **Remains open to new ideas and approaches.**
10. **Works concurrently on related and/or conflicting priorities without losing focus or attention.**

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COMPETENCIES OF PERFORMANCE

Coast Guard people constantly face challenges in mission operations. To meet these challenges, leaders must apply leadership competencies in their daily duties.

15. Vision Development and Implementation

Definition: Takes a long-term view and acts as a catalyst for organizational change; builds a shared vision with others. Influences others to translate vision into action. Formulates effective strategies consistent with the business and competitive strategy of the organization and environment. Examines policy issues and strategic planning with a long term perspective. Determines objectives and sets priorities; anticipates potential threats or opportunities.

Behaviors

1. **Creates a shared vision of the future aligned with the Coast Guard's vision.**
2. **Articulates and actively supports the Coast Guard's vision in a way that employees at all levels understand the organization's goals, values, and strategies.**
3. **Acts as a catalyst for organizational change based upon a strategic view of the future.**
4. **Formulates effective unit strategies consistent with the overall business strategy of the Coast Guard.**
5. **Applies a long-term perspective in analyzing policy issues and developing strategic plans.**
6. **Adjusts strategic policies and plans in response to change, both internal and external.**
7. **Provides input for the development of unit strategies consistent with the Coast Guard vision.**

16. Customer Focus

Definition: Balances interests of a variety of customers; readily readjusts priorities to respond to pressing and changing customer demands. Anticipates and meets the need of customers; achieves quality end-products; is committed to continuous improvement of services. Creates and sustains an organizational culture which encourages others to provide the quality of service essential to high performance and continued public support.

Behaviors

1. **Identifies customers, partners and stakeholders.**
2. **Integrates customer needs and expectations into the development and delivery of services or products.**
3. **Establishes and uses feedback systems to meet customer requirements and expectations.**
4. **Continuously seeks to improve the quality of services, products and processes of the Coast Guard.**
5. **Maintains currency with laws, regulations, policies, procedures, trends, and developments, both international and domestic, and their impact on own unit.**
6. **Determines how the unit can become a cost-effective service provider by analyzing the best practices and lessons learned from other organizations.**
7. **Integrates national objectives and policies into accomplishing organizational goals and objectives.**

17. Management and Process Improvement

Definition: Identifies opportunities to develop and market new processes and solutions within unit. Is willing to take appropriate risks, initiates actions that may involve a calculated risk to achieve a recognized benefit or advantage.

Behaviors

1. **Initiates actions that may involve risk to achieve a recognized benefit or advantage.**
2. **Identifies new results, products, services, and capabilities that are of value to the unit and Coast Guard.**
3. **Develops new processes to produce results and capabilities that are of value to the unit and Coast Guard.**

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18. Decision-Making and Problem Solving

Definition: Identifies and analyzes problems; distinguishes between relevant and irrelevant information to make logical decisions; provides solutions to individual and organizational problems. Exercises good judgment by making sound and well-informed decisions. Makes effective and timely decisions, even when data are limited or solutions produce unpleasant consequences.

Behaviors

1. **Recognizes and defines problems and issues.**
2. ***Gathers relevant data to analyze problems and issues.***
3. **Develops alternative solutions and plans to solve problems.**
4. **Uses qualitative and quantitative data and analytical tools in problem solving to make decisions.**
5. **Acts decisively on own authority when timely action is needed, even in uncertain situations.**
6. **Makes and supports difficult or controversial decisions when necessary.**
7. **Exercises good judgment by making sound and well-informed decisions.**

19. Conflict Management

Definition: Identifies and takes steps to prevent potential situations that could result in unpleasant confrontations. Manages and resolves conflicts and disagreements in a positive and constructive manner to minimize negative impact.

Behaviors

1. **Manages conflicts, confrontations, and disagreements in a constructive manner.**
2. **Takes steps to resolve conflict situations.**
3. **Addresses and seeks to resolve formal and informal complaints from members.**
4. **Supports strategies and programs to manage conflict resulting from organizational change.**
5. **Implements ways to vent potentially destructive conflicts into healthy debate and**

20. Workforce Management Systems

Definition: Based on merit and needs of the service ensures staff are appropriately selected, developed, utilized, appraised and rewarded as well as takes corrective action. Demonstrates broad understanding of principles of financial management expertise necessary to ensure appropriate funding levels. Prepares, justifies, and/or administers the budget for the program area; set priorities; monitors expenditures in support of programs and policies. Identifies cost-effective approaches and implements strategies to make them work.

Behaviors

1. **Plans for necessary or mandated changes in size and composition of staff.**
2. **Takes an active role in recruiting and/or retaining staff.**
3. **Determines needs and provides opportunities for employee orientation and career development.**
4. **Uses human resources practices that further diversity.**
5. **Uses human resources practices that promote good labor-management and employee relations.**
6. **Supports programs and activities that promote employee well being such as safety, health, and work-life.**
7. **Prepares unit budget in accordance with Coast Guard policies and procedures.**
8. **Explains or justifies budget requests.**
9. **Tracks expense and monitors against budget to ensure cost-effective resource management.**
10. **Oversees or participates in managing procurement and delivery of equipment, contracts, facilities, supplies, or services.**

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21. Performance Appraisal

Definition: Ensures accurate, fair, and objective evaluations are provided to all assigned officer, enlisted, and civilian personnel in order to provide the essential human resource management information necessary to make promotion, assignment and career development decisions that are in the best interests of the service and its members

Behaviors

1. **Sets, and communicates on a timely basis, the standards of performance and measurements by which assigned personnel will be evaluated.**
2. **Regularly recognizes, and feeds back, observations of inadequate performance or inappropriate behavior, together with suggestions and opportunities for improvement.**
3. **Regularly recognizes, and feeds back, observations of exemplary performance and/or behavior, together with appropriate recognition.**
4. **Strictly and conscientiously adheres to the specific wording of the evaluation standards embodied in the reporting forms, and submits them on a timely basis in accordance with established procedures.**

LEADERSHIP

DOC GIBSON'S ANNOTATED BIBLIOGRAPHY

In Alphabetical (by author) Order - As of 01 April 1998.

I do not represent this list as being made up of the best on the subject, and it certainly is not exhaustive. (Online searches render 250,000 references to Leadership.) But I have read them all, and you are welcome to my impressions. May save you some time by focusing on the best, and avoiding some of the others. Doc.

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Bandura, Albert. *Self-Efficacy: The Exercise of Control.* New York: W. H. Freeman and Company, 1997. (This 600 page volume represents a compendium of Bandura's contribution over a life-time at Stamford University. His concept of "self-efficacy" is central to human motivation and performance. In your role as leader you must not only be concerned about motivating yourself, but you must motivate your followers. Understanding the contribution self-efficacy can make to this endeavor is critical. The processes for developing self-efficacy are best understood and practiced by the Marine Corps, as demonstrated by its "bullet-proofing" of recruits. This book is not for the faint-hearted. But if you can get through the first 200 pages it will be well worth the effort.

Barnard, Chester. *The Functions of the Executive.* Cambridge, MA: Harvard University Press, 1938. Now that his stuff is in the "public domain" a lot of it is being "borrowed," but the original is still better! It was in this book that Barnard first articulated the concept of "zone-of-indifference," which constitutes the area in which subordinates will comply almost automatically. A major activity of leaders is making sure that the "zone-of-indifference" is adequately formulated and understood by all. Many of our "people problems" arise because of dissimilar perceptions of the zone-of-indifference. When the Chief yells "jump" he wants to hear "how high," not "Chief, can we discuss this!" Increasing diversity, with all its potentials, brings great strain on zones of indifference. You could do well to learn more about this very important concept.

Bell, Chip R. *Managers as Mentors: Building Partnerships for Learning.* San Francisco, CA: Berrett-Koehler Publishers, 1996. One of two books on Mentoring in this Bibliography. There could have been 1000, but neither of us would have

read them all. Some good "how-to" stuff, along with a model of mentoring you may want to try. Mentoring is not rocket-science, but starting out with a little professional help can't hurt. Between this and the Wickman-Sjodin book you'll have the theory you need to get started. After than it's just plain experience that will help. Jump in! If you are sincere and compassionate it will be hard to do much harm, and there is the potential for an awful lot of good.

Bennis, Warren. *Managing People is Like Herding Cats*. Provo, UT, 1997. Warren Bennis is one of the icons of the leadership development business, but this book is more like a summer "B" movie, made on a low budget to make a quick buck. Wait for it in paperback. Most of what's in this book previously appeared as articles in *Executive Excellence* magazine. If you really want to read Bennis, get a copy of *Leaders* or *On Becoming a Leader.*

Bennis, W. and Biederman, P. W. *Organizing Genius: The Secrets of Creative Collaboration.* Reading, MA: Addison-Wesley, 1997. You'll enjoy reading this book. Chapter 1, "The End of the Great Man" pretty much sums up the theme. Today's highly technical, diverse world requires significantly more collaboration. There follows six case studies of excellent collaboration: Disney, Apple, the 1992 Clinton campaign, Lockheed "skunk works", Black Mountain College, and the Manhattan project. The last chapter pulls together the common factors from these examples of great collaboration. A fairly quick read that is fun, informative, and thought provoking. Should be one of the first ten you read.

Biehl, Bobb. *Mentoring: Confidence in Finding a Mentor and Becoming One.* Nashville, TN: Broadman & Holman. 1996. A good "journeyman" book on mentoring. Not worth buying but if a library has it, it will be worth your reviewing. Mentoring is less of a process than a relationship. This book will help you establish the right one.

Bower, Marvin. *The Will to Lead: Running a Business with a Network of Leaders.* Cambridge, MA: Harvard Business School Press. 1997 The former head of the Mckinsey consulting firm gives you his observations about how business has changed, and the need for collaboration among leaders at all levels of the organization. The theme is the same as the previous book by Bennis, but the approach is somewhat more academic, with examples but not case studies. With its business focus, it may be somewhat less useful for the CG. Not one of your top 10, but if you run out of things to read you won't be wasting your time on this one.

Branden, Nathaniel. *Six Pillars of Self-Esteem.* New York: Bantam. 1994. The "father of the concept of self-esteem" explains what he means, and how to build it. Few of us doubt the hypothesis that people who feel good about themselves are better performers and happier people. Some good guidelines on the processes of creating self-esteem, and its importance. You'll benefit from this

book, as will your mentees. Not a quick read - you'll have to do some thinking and re-reading. But if you want the original material - here it is.

Canfield, J. and Hansen, M. V. *The Aladdin Factor.* New York: Berkley Books. 1995. One of the better small books on self-esteem, which is the "aladdin factor." Don't buy it, but if you can borrow it you will find it worth reviewing. Not much in it you don't already know, but it says it in ways you may wish to use with your mentees. Feeling good about ones-self is so simple, so important, and sometimes so hard to do. You may find some help here.

Carnegie, Dale. *The Leader in You.* New York: Simon and Schuster, 1993. This simple little book, available in both hard and soft cover, is still relevant. It is used by many business organizations, and in the schools that bear his name. Most of what is in here you already know. The question is - have figured out how to actually do it? A good "first book" on leadership. Not as sophisticated as the Kotter and Drucker stuff - which may just be one of its charms! Give it a quick read, a pass it on to your Chief.

Cialdini, Robert B. *Influence: The Psychology of Persuasion.* New York: William Morrow, 1984. There are fewer than five books on this list I suggest you consider buying. This is one of them. If you accept the notion at leadership is the processes of exercising non-coercive influence over others, then you need to know how to do it. Turkeys and polecats are mortal enemies, right! If encountered, they will fight to the death. Then how did researchers get mother Turkeys to "nurse" replicas of skunks? The same way someone got you to buy something you really didn't want, or do something you really didn't want to do. With the election already in the bag - why Watergate? It's called the "rejection-then-retreat" approach, and it works every time. How did the Chinese communists get loyal American troops to admit to things through persuasion that they had failed to get them to admit to through savagery? Aside from the benefit you can get from this book in your leadership role, I wouldn't let any member of my family have a credit card until he/she had read this book.

Covey, Stephen R. *The 7 Habits of Highly Effective People.* New York: Simon and Schuster, 1989. Reading Covey is like getting your small-pox vaccination. You have to do it as part of the growing up process. He popularizes some good ideas, but when you get all through you'll think, "I knew that!"

Crabb, L., and Allender, Dr. D. *Hope When You're Hurting.* Grand Rapids: Zondervan Publishing. 1996. One of many good, small books out of the Christian ministry tradition. Most useful to give someone who is trying to heal him/herself. A good read for you, if you find yourself in that position. It is based on Christian teachings, so it may not be appropriate for everyone one. But when it does fit, it can provide a lot of solace and insight.

Drucker, Peter F. *Foreword: Not Enough Generals Were Killed.*, in Hesselbein, Francis, et al, *The Drucker Foundation: The Leader of the Future,* previously cited. (Drucker is another prolific leadership and management development icon. You would do well to read any of his recent books or articles.)

Egan, Gerard. *The Skilled Helper: A Problem-Management Approach to Helping.* Pacific Grove: Brooks/Cole Publishing 1998. This is the text that is used in the upper class "counseling" course at the CGA. There is a neat workbook that goes with it. It is a textbook, which means it is expensive ($55+) and not a quick read. But all the stuff you need to help develop yourself as a "personal helper" is there. You would probably get the most out of this volume if you worked on in it a group, to share ideas and the burden of completing it. Get at least one copy of the workbook, too. The case studies and work problems are excellent. Like it or not, you will do more and more "personal helping" as time goes on. the world is getting to be a much nastier place, and your folks will be looking for some help. Here is one place you can turn to improve your skills. Not to be taken lightly, but a real authoritative source.

Fayol, Henri. *The Administrative Theory in the State*, in Gulick, L. and Urwick, L. *Papers on the Science of Administration.* Clifton, NJ: Augustus M. Kelley, 1937. Check out Chapters 3 and 4 of the *Division Officer's Guide* and you will find some of Fayol's stuff almost word for word. Fayol's ideas have survived even longer than our 180's - strong praise indeed.

Fitzgerald, Catherine and Kirby, Linda K. *Developing Leaders: Research and Applications in Psychological Type and Leadership Development.* Davies-Black Publishing: Palo Alto, Ca. 1997. This not cheap ($50.00) book catalogs all the studies done relating Leadership Development to the MBTI. While all the articles are useful, the most relevant for us are: Kummerow and Olson, *Using the MBTI Step II With Leaders and Managers,* (What we do in our Workshop.) and Clancy's *STJ's and Change,* since there is a preponderance of this preference in Team Coast Guard. Not the first book you should try, but if you get really serious about your own leadership development you'll want to read it eventually. Let me know if you are going to try it and I'll send you a bottle of aspirin, along with a note of admiration for your tenacity.

Gardner, John. *On Leadership.* New York: The Free Press, 1990. On the book shelves of most Coast Guard flag officers. This book is a combination of information about leadership, and a personal credo. More than most other leadership books, Gardner focuses on values and principles. These days, that is a terribly important focus.

Graham, Pauline., Editor, *Mary Parker Follet: Prophet of Management.* Harvard Business School Press, 1995. This incredible lady foresaw just about everything that is currently happening to leadership and management - more than 50 years

ago. She zeroed in then on the importance of relationships - particularly to leadership. When most of her contemporaries were concerned with "how" management got done, she was working on "why" and "by whom." She is a literate lady, not easy to read. But his book is its own reward if you stick with it. If she had not been a woman in a man's time, her name would be as well known as Frederick Taylor or Henri Fayol!

Gulick, Luther. *Notes on the Theory of Organization,* in Gulick, L. and Urwick, L. *Papers on the Science of Administration.* Clifton, NJ: Augustus M. Kelley, 1937. This volume, which unfortunately is currently out of print, includes articles by most of the folks who set the standards for "Administrative Science" in the first thirty years of this century. If you can find a copy to read, you'll put it down realizing just how much of the "modern leadership-management" thought started with them. Since their writings are now in the public domain, it is not necessary legally to reference or credit them. Ethicality is another matter! I have copies of this article. Drop me a request at <auxjohn@netsense.net> and I'll send you one.

Halpern, Diane F. *Critical Thinking Across the Curriculum.* New Jersey: Lawrence Erlbaum Associates, 1997. If clear thinking is part of good leadership, this is the place to start. This is a "condensed" version of one of the most widely used texts in Critical Thinking. It will scramble your head before you get through - but you will emerge a more disciplined thinker. A great book for an informal "study group" to use. Sort of a PQS for thinking! There is also a workbook available - but you can get along without it.

Hershey, Paul. *The Situational Leader.* Escondido, CA: Center for Leadership Studies, 1984. This small text describes the "Situational Leadership" process advocated by this center. It is widely used in business, and by some of the military services. It is simple, intuitively logical, and therefore has great popular appeal. However, there has been virtually no research support for the theory. Don't buy this book, but if you can borrow it someplace look it over - and make up your own mind.

Hickman, Craig R. *Mind of a Manager: Soul of a Leader.* New York: John Wiley & Sons, 1992. One of the few books on the subject that links leadership practices with the MBTI. Not terribly profound. Scan it if you get a chance - but don't spend hard cash on it.

Hirsh, Sandra Krebs. *Work it Out.* Palo Alto, CA: Davies-Black, 1996. This is the book I use in the MBTI workshop at the CGA. Contrary to a popular book, there are a lot of Martian women, and not a few men from Venus. Our significant individual differences are a matter of personality, not gender, race, age or ethnic origin. Cadets learn why they should never ask an Extrovert to prepare an agenda, or expect a Perceptive to finish anything on time. Good stuff - and great fun!

Hoffman, Edward - editor. *Future Vision: The Unpublished Papers of Abraham Maslow.* Thousand Oaks, CA: Sage Publications - 1996. As the acknowledged leader of "humanistic psychology" Maslow laid the foundation for our understanding of *why* people do what they do. This is a collection of papers that were published after his unfortunate, untimely death. It is a wonderfully "philosophical" look back at a lifetime of academic service. There are some great thoughts in this material, as well as an opportunity to explore the full depth of one of the great minds of our generation. Get the paperback version.

Hoyt, Erich. *The Earth Dwellers: Adventures in the Land of Ants.* New York: Simon and Schuster, 1997. The largest known animal society was located on the Japanese island of Hokkaido. It covered 675 acres, encompassed 45,000 inter-connected units and contained 306 million members. It functioned flawlessly as an individual organism, perfectly adapting itself to its environment, even though none of its members had attended a single leadership or management workshop! Ants are one of four social insects that are genetically programmed to create and maintain complex social organizations. You will be fascinated at how "effortlessly" they do it. The central "secret" to their success is the fact that each individual member does its job perfectly without coercion, and will, without hesitation, sacrifice him or herself for the welfare of the colony. WHAT A CREW! Lacking specific genetic programming, we humans must achieve the same results through the mechanisms of leadership and management. If you are interested in taking a broad perspective on the subject of leadership and organizational behavior, you will really enjoy this book, written by an expert who takes an "ants perspective" on the subject. The Chapter on ant warfare makes the James Bond books dull by comparison. Since these creatures are destined to inherit whatever we leave of this earth, you many want to get to know them better. A great little book to have on a long deployment!

Hughes, Richard L., et al. *Leadership: Enhancing the Lessons of Experience.* Chicago: Richard E. Irwin, 1996. The Leadership text used at the United States Air Force Academy. Reads like what it is - a textbook. Not bad for reference, if you could pick up a used copy somewhere. Should be in every Group and District library.

Bradford, James C., editor. *Quarterdeck and Bridge: Two Centuries of American Naval Leaders.* Annapolis, MD: Naval Institute Press, 1997. The paperback version of this new book is "numero uno" on my "must buy list." It includes the biographies of 20 great Naval leaders, and helps us understand how they did what they did. The 1/c Cadets studying leadership at the CGA read this book without being threatened with punishment tours. You can't give higher praise than that! If you want to get some informal "leadership seminars" going at your unit, you could do a lot worse. Assign chapters to individual participants to discuss with the rest of the group. You'll learn a lot about leadership, yourselves, and our nation's maritime heritage. Not a bad day's work!

Jung, C. G. *Psychological Types*. Princeton: Princeton University Press - Ninth printing, 1991. This is the "hard core" basis of psychological type, written by Jung himself. It is probably the last book in this bibliography you should undertake, and then only if you have a certain amount of literary masochism. But this is the original reference, if you are interested!

Kelley, Robert E. *The Power of Followership*. New York: Doubleday Currency, 1992. A lot of us sometimes forget that everyone who "leads" also "follows." In fact, you can't have one without the other. This is best little book on followership. Should be on board every unit ashore and afloat. And should be read by all hands.

Klaus, T. and Roth, G. L. *counseling Helpsheets.* Loveland, CO: Group Publications. 1994. Another book out of the Christian ministry. Aimed specifically at teenagers with problems, it has a broader applicability. Arranged in a series of "scenarios" that walk you through specific problems. Not a bad publication for ISC's to have in their "lending libraries." If your problem (or your "helpee's problem" fits one of the scenarios, this text can be very useful. Caution: it is out of the Christian tradition - any may not be appropriate for everyone.

Koestenbaum, Peter. *Leadership: The Inner Side of Greatness.* San Francisco: Jossey-Bass, 1991. The Author's concept of a "Leadership Diamond," consisting of Vision, Objectivity, Ethicality and Courage is interestingly presented, and fleshed out. You will find a few good ideas in this volume to add to your own leadership model. However, I wouldn't spend the money buying it, and you can skim through a good deal of the 350+ pages. Not a real heavy weight!

Kotter, John P. *A Force for Change: How Leadership Differs from Management.* New York: The Free Press, 1990. Looking back, historians will credit John Kotter of Harvard as being one of the leading authors on the subject of Leadership. He is less well known than many of the "popular" authors on the subject because he maintains his scholarly orientation and integrity. While he is easy to read, he does not "simplify to popularize" the subject. In this book he builds on some of the ideas of the early administrative scientists, pointing out the differences between leadership and management, and the essential importance of both. My personal model of leadership has been highly influenced by his writings. His books tend to be relatively short - but don't let that fool you. Like MRE's they are densely packed with intellectual nutrition. This is one of the very few books on this list I actually suggest you buy.

Kotter, John P. *Power and Influence: Beyond Formal Authority*. New York: The Free Press, 1985. Even in a military organization, we cannot rely on "command" 24 hours a day, 7 days a week. This book is about "how to exercise the power and influence you need to get things done through others when your responsibilities exceed your formal authority." In the Kotter model, management is position power based ultimately on the capability to *coerce*. Leadership is personal power,

based on the capability to *influence*. Both sources of power are essential for organizational success. The trick is knowing which one to use, and when and how to use it. A second book you may wish to purchase - because you will read it more than once.

Kotter, John P. *The Leadership Factor.* New York: The Free Press, 1988. Of the four Kotter books cited in this bibliography, this is that last one you should read. I also recommend you NOT buy it. Most of what is in here is better said in the other books. You can see the evolution of his thinking in this book - but it is not nearly as useful for the practitioner as the others.

Kotter, John P. *Leading Change.* Boston: Harvard Business School Press, 1996. This book is about "successful change and the force that drives it." If you are familiar with the Coast Guard's TQM "PIG" (Process Improvement Guide) you will be right at home here. Kotter describes the Eight-Stage process leading to effective change, covering the booby-traps and high ground. If you plan on sticking around the Coast Guard for the next 10 years or so, you should read this book. It is not only a blueprint for organizational success, it just may save your personal bacon!

Kouzes, James M. and Posner, Barry Z. *Seven Lessons for Leading the Voyage to the Future*, in Hesselbein, Francis, et al. *The Drucker Foundation:The Leader of the Future.* San Francisco: Jossey-Bass, 1996. (Some great "popular sound bytes" by 31 of the most "recognized authors" on this subject. Worth reviewing, but not buying.)

Kouzes, James M. and Posner, Barry Z. *The Leadership Challenge:How to Keep Getting Extraordinary Things Done in Organizations.* San Francisco: Jossey-Bass, 1995. One of the most widely used books in business leadership development. Has some good leadership instrumentation - the LPI (Leadership Practices Inventory). Some academics dismiss it because it is highly readable and enjoyable. That tells you something. The paper-back version is worth buying.

Kramek, ADM Robert. *The State of the Coast Guard - 1997*, in *Coast Guard* Magazine, June 1997. (Everyone in team Coast Guard should read this to learn where we are going and how we are going to get there!)

Lanning, Lt. Col. (Ret.) Michael Lee. *The Military 100: A ranking of the Most influential Military Leaders of All Time."* New Jersey: Carol Publishing Group, 1996. This book is based on a simple thesis: "Throughout time, peoples fortunate enough to have great military leaders and innovators in warfare among their numbers have prospered, controlling their territory and dominating their neighbors. Civilizations without strong military leaders have found themselves subjugated or annihilated. In still other instances, military leaders have proved to be tyrannical despots to their own people as well as to their enemies." There

follows 100 "thumbnail" descriptions of his pick of the best - in rank order. You will enjoy the brief summaries of each leader - none exhaustive - and find yourself questioning his order of choice. Instructive - and FUN!

Lindenfield, Gael. *Build Your Self-Esteem.* New York: Harper Audio Cassettes, 1995. A neat change of pace. This is an audio cassette that you can listen to at home, in the car, etc. It's purpose is to help you feel better about yourself. it offers some practical suggestions you can start on tomorrow. I have loaned it out to folks who wanted to work on their self-esteem. All of them came back saying it helped. Not terribly expensive. Each command should probably have access to one some how. We have lots of resources for fixing things! Here's one for fixing people. What a revolutionary idea!

Linksman, Ricki. *How to Learn Anything Quickly.* New Jersey: Carol Publishing Group, 1996. One of a leader's primary responsibilities is to help followers grow. To do this, they must be able to learn. Does it surprise you that we all learn differently. What works for you may not work for me. This little paper- back will help you understand the learning process, and how to maximize your own efforts as well as those of others who turn to you for help. A version of this material is now used with all the 4/c Cadets in New London. And it works. A lot less expensive, and more useful, than the garbage you see on late night "infomercials." Each unit should have a copy of this available to the crew.

Maslow, Abraham. *Motivation and Personality - Second Edition.* New York: Harper & Row, 1970. The Vince Lombardi of motivational theorists. His stuff proves "what goes around, comes around." No one has authored a better over-all explanation of <u>why</u> we do things. If you haven't read the "original stuff," now is a good time.

Micklethwait, John & Wooldridge, Adrian. *The Witch Doctors: making Sense of the Management Gurus.* New York: Random House, 1996. If you like "man bites dog" stories, you will like this book. A couple of noted writers take on the current leadership and management fad-masters. "Add them together and the canon of Peter's (In Search of Excellence) work looks worryingly insubstantial and ephemeral . . How can we distinguish between the charlatans and the rest? There are a few rules-of-thumb to follow. The first is that anything that you suspect is bunk almost certainly is. Similarly, beware of all authors who emblazon the covers of their books with their academic honors, or who argue entirely by analogy." Most enlightening, and upsetting, are the reasons they give for predicting that otherwise rational managers will continue to pay millions of dollars to "charlatans" who can do them more harm than good. By paying big bucks to consultants we create a place to deflect blame when things don't work out, thereby saving ourselves. You'll enjoy this book. You will also put it down wondering just how responsible we really are.

Milgrim, Stanley. *Obedience to Authority*. New York: Harper and Row. 1974. In its own way, this little paper back could be a Stephen King novel - except everything in it is true. It reports one some of the most important social psychological experiments conducted in this century, at Yale University, 1960-63. If you ever wondered how the My Lai massacre could have happened, this little book will give you the answer. If you are standing around waiting for your troops, in the civil or military sector, to be more "assertive," you'll understand why you will wait in vain. I'm not going to spoil it for you. This is an inexpensive book when bought through amazon.com, and you will find some of it hard to believe. Give it a shot. It is a good chance of pace, and you will look at "authority" in a whole new light.,

Montor, Karel, et al. *Naval Leadership.* Annapolis, MD: Naval Institute Press,1987. The primary leadership text at the United States Naval Academy. Has some great anecdotal references to lives of Naval leaders. A little dated now, but still good stuff.

Oliver, RADM (Ret.) Dave Jr. *Lead On: A practical Approach to Leadership.* Novato, CA: Presido Press, 1992. This book is a quick, fun read. It is based on thirty years of service in submarines by a witty, articulate officer who relates his experiences while drawing leadership insights. Most of your crew will enjoy it, too. Not a profound text - but one you can recommend to most of your folks with the assurance they will enjoy it - and learn some things too. The fact that it is a "sea-service" story can't hurt!

Pearman, Roger R. and Albritton, Sarah C. *I'm not Crazy; I'm Just not You.* Palo Alto, CA: Davies-Black Publishing, 1997. If you can believe it, there are more books published on the MBTI (Myers-Briggs Type Indicator) than there are Commandant Instructions! There are many good ones, including this one. If you have, or are planning to utilize the MBTI with your unit (I can help - any you can't beat the AUX wage rate) you should have a couple of copies of this book around for folks to refer to "post-training." To maximize the potential benefits of a diverse workforce, we need to understand each other better. The MBTI is one way of making this happen. This book should be part of your MBTI process.

Proto, Louis. *How to be Your Own Best Friend.* New York: Berkley Books, 1994. The title pretty much says it all. This is a book you read for yourself, or give to someone who needs it. In the self-esteem building tradition. The people who most need to read it probably won't do so on their own. Be a good friend and get them a copy. It doesn't cost much more than a couple of cocktails, and the effects will last longer and be more beneficial. (No calories in self-esteem!)

Qubein, Nido R. *How to Be a Great Communicator: In Person, on Paper and on the Podium.* John Wiley & Sons, Inc., 1997. Nido says that the first requirement of good communications is "desire." If you have the desire to communicate better, this "fun to read" book can help. It is full of thought provoking one liners like, "I recognize three true basic skills in communication: connecting with an audience,

conveying messages people can understand, and checking their responses." None of this is rocket science. But if you will give what he suggests a try, it will work.

Schermerhorn, John R. Jr., et al. *Organizational Behavior - Sixth Edition.* New York: John Wiley & Sons, 1997. The most widely used college text in Organizational Behavior.

Schriberg, Arthur, et al. *Practicing Leadership: Principles and Applications.* New York: John Wiley & Sons, 1997. This small textbook is used at the United States Military Academy at West Point. It has a neat Chapter on "Building Your Personal Framework of Leadership" - an activity required by every CG Cadet as part of "Leadership Across the Curriculum." Would be a great text for Member Training on Leadership. Definitely worth your money!

Shepherd, GEN Lemuel C., and Rice, GEN W. H., in *Naval Leadership*, previously cited. These Marines sure know how to pack a lot of meaning in very few words. SEMPER FI!

Stavridis, CDR James. *Division Officer's Guide - Tenth Edition.* Annapolis, MD: Naval Institute Press, 1995. A required "sea-bag" book for all Midshipmen and Coast Guard Cadets. Worth reading and owning.

Storm, Hyemeyohsts. *Seven Arrows.* New York: Ballantine Books, 1972. More than a 1000 years before Carl Jung was born, the American Plains Indians were using a version of "psychological type" at least as sophisticated as the one eventually developed from Jung's work. This book recounts that effort, along with some wonderful allegorical stories. There is some mysticism here - which can be both enthralling and disturbing. You won't read many books like this one. (For an even more explicit description of the actual system, see Sun Bear's *Medicine Wheel* next cited in this bibliography.)

Sun Bear, Wabun Wind, and Crysalis Mulligan. *Dancing with the Wheel: The Medicine Wheel Workbook.* New York: Simon and Schuster, 1992. A graphic description of the Indian's version of "psychological type" (a la MBTI). Reading the words Indians used to describe each other 1000 years ago can be both enlightening and humbling. "Butterfly clan people can be open-minded to a point that infuriates all others. Some times their open-mindedness closely resembles total indecisiveness." Sound like anyone you know? Sound like you? If you want to really stretch your psychological horizons, and learn something wonderful about our Native Americans, here is a good place to start.

Tjosvold, Dean. and Tjosvold, Mary M. *Psychology for Leaders: Using Motivation, Conflict, and Power to Manage More Effectively*, New York: John Wiley & Sons, 1995. Will help you recall your "Psychology 101" college course. Not much here that you probably haven't read before. Worth reviewing, but not buying.

Van Fleet, David D and Yukl, Gary A. *Military Leadership: An Orgnizatonal Behavior Perspective.* Jai Press: London, England 1986. Kind of a strange "reference" text. Not one for reading. However,it has the most complete bibliography I have ever seen on Military Leadership, and it has a great section on *Critical Incidents from Cadet and Air Force Studies.* If you need some nice, short case studies for yraining you can easily change "plane" to "boat" and "airman" to "seaman" and no one will know. Don't buy it, but see if your library has it.

Wickman, Floyd & Sjodin, Terri. *Mentoring:The Moswt Obvious Yet Overlooked Key to Achieving More in Life than You Dreamed Possible.* New York: McGraw-Hill, 1997. In the last few years there has been an avalanche of books on Mentoring. This is one of the better ones. Some real good "how to" stuff, including "The Sixteen Laws of Mentoring." Mentoring is more of a relationship than a process. Most of the things Mentors do, supervisors and managers also do. But Mentoring is a leadership task, as it is based on influence and not coercion. There are few things you can do that are more fulfilling than helping others through a mentoring relationship. This book can help you get started.

Wilson, Edward O. *The insect Societies.* Cambridge, MA: Harvard University Press, 1971. Don't even mess with this book unless you have first read Hoyt's *The Earth Dwellers* previously cited. Then, if like me, you get hooked on these fascinating creatures who automatically do what we work so hard to get folks to do, you may want to undertake this book. Wilson is a world-class expert on social insects, and this is his seminal text - all 500 pages of it. Even if you can only understand half the words - my score so far - you will be enthralled by the story of creatures that have worked together in almost perfect harmony for over 125 million years. The bee is an expert at solar navigation, and because it is sensitive to ultra-violet light can sense the sun through clouds. It is also sensitive to the earth's magnetic field, can utilize the sun's polarized light, and maintain orientation to gravity while upside down. The perfect QM! What's this got to do with leadership? Leadership's objective is to advance the achievement of organizational goals by assuring the most effective division of labor and subsequent coordination of effort. It is an "outcome directed" activity. Learning about creatures who are genetically programmed to accomplish this helps one see how a "perfect system" functions. This stuff is not for everyone. But if you are a hard core MBTI "N" as I am, you will see real possibilities in this material for understanding leadership. You can also live a long and prosperous life and never touch this book. Different strokes for different folks!

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NOTE 1: If you are "on-line" you should have a bookmark at <www.amazon.com> This is an internet book store with 2.5 million tittles, good service and great prices. If a book exists, they will find it for you.

NOTE 2: The Leadership Development Center at the CGA is compiling a Leadership Bibliography for the use of all hands. If you come across a good book on the subject, shoot us your review of it and we'll add it to the rest. Leadership development is very definitely a "do-it-yourself" project. But we can share with each other which tools have a sharp edge, and which ones don't.

SEMPER PERATUS !

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United States Coast Guard

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United States Coast Guard

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COMDTINST 16214.3

DEC 14 1999

COMMANDANT INSTRUCTION 16214.3

Subj: NORTHERN RIGHT WHALE MANDATORY SHIP REPORTING SYSTEM

Ref: (a) Ports and Waterways Safety Act, 33U.S.C., Section 1230
(b) International Maritime Organization Resolution A.648(16), Principles for Ship Reporting Systems and Ship Reporting Requirements (NOTAL)
(c) Educational Efforts to Protect the Northern Right Whale, COMDTINST 16450.4

1. PURPOSE. This Instruction sets forth the policy and procedures for Coast Guard participation in the Mandatory Ship Reporting system (MSR) established in reference (a). The MSR was established off the eastern United States to protect the endangered northern right whale. This Instruction provides guidance to various Coast Guard units and staffs responsible for ensuring compliance with the MSR.

2. ACTION. Area commanders and district commanders and assistant commandants for directorates shall ensure compliance with the provisions of this Instruction.

3. DIRECTIVES AFFECTED. None.

4. BACKGROUND. Despite over 60 years of protected status, the northern right whale has shown no significant signs of recovery. The population currently numbers approximately 300 to 350 individuals. The MSR is the latest in a series of efforts aimed at protecting the northern right whale, which remains the most endangered species of large whale. Ship strikes account for nearly one third of all known right whale mortalities. Stranded animals routinely show signs of ship strikes such as propeller injuries and fractured or broken bones. In an effort to reduce the number of whales killed or injured by ship strikes, the United States proposed creation of a ship reporting system to educate merchant mariners on the plight of the right whale, and provide them with information about reducing the risk of ship strikes. The United States presented the proposal to the International Maritime Organization (IMO), which formally adopted

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the system in December, 1998, as part of Resolution A.858(20). The MSR commenced operation on 1 July 1999. It requires all commercial vessels, 300 gross tons and greater, that operate beyond the boundary line to report to the Coast Guard upon entering two designated reporting areas. In return for the report, vessels will receive a reply message containing information about the endangered status of the right whale, advice on how to reduce the risk of ship strikes, and current right whale sighting information.

5. REPORTING AREAS. The MSR encompasses two distinct reporting areas. The northeast area, WHALESNORTH, protects a critical right whale feeding ground. The geographic boundaries of this area include the waters of Cape Cod Bay, Massachusetts Bay, and the Great South Channel east and southeast of Massachusetts. Coordinates of the area are as follows: from a point on Cape Ann, Massachusetts at 42°39'.00N, 70°37'.00W; then northeast to 42°45'.00N, 70°13'.00W; then southeast to 42°10'.00N, 68°31'.00W; then south to 41°00'.00N, 68°31'.00W; then west to 41°00'.00N, 69°17'.00W; then northwest to 42°05'.00N, 70°02'.00W; then west to 42°04'.00N, 70°10'.00W; and then along the Massachusetts shoreline of Cape Cod and Massachusetts Bay back to the point on Cape Ann at 42°39'.00N, 70°37'.00W [NOAA Chart No. 13009 (see enclosure (1))]. The southeast area, WHALESSOUTH, protects the only known right whale calving grounds and operates from 15 November through 15 April. The geographic boundaries of the southeast reporting area include coastal waters within about 25 nautical miles along a 90 nautical mile stretch of the Atlantic seaboard in Florida and Georgia. The area extends from the shoreline east to longitude 80°51'.60W, with the southern and northern boundaries at latitudes 30°00'.00N and 31°27'.00N, respectively [NOAA Chart No. 11009 (see enclosure (2))].

6. REPORTING METHODS FOR COMMERCIAL VESSELS. The Coast Guard obtained a contractor to construct and operate the MSR communication system and database. Accounting for the numerous responsibilities and demands on our communication facilities, operational units, and merchant mariners, the MSR was designed as an automatic system. It is estimated that 95 percent of commercial vessel traffic will be able to report via INMARSAT C, the primary reporting method. The remaining five percent will use other satellite communications, or will be urged to report to the Coast Guard Communication Area Master Station Atlantic (CAMSLANT). However, the Coast Guard can not mandate the method by which a vessel can report into the system and can only recommend vessels follow the prescribed reporting methods. Upon entry to either WHALESNORTH or WHALESSOUTH, all vessels meeting the reporting requirements must report pertinent vessel information to the Coast Guard via the MSR. Ships are required to report directly to the MSR system and should not use e-mail batching or routing service companies, which can delay the receipt of MSR reply messages. Ship reports should be made via the recommended communication methods, which are listed below in order of precedence:

   a. Report directly via INMARSAT C to one of the following addresses:

      E-mail: RightWhale.MSR@noaa.gov or Telex: 236737831

   b. Vessels not equipped with INMARSAT C should report via alternate satellite communications equipment directly to one of the following addresses:

      E-mail: RightWhale.MSR@noaa.gov or Telex: 236737831

c. Vessels unable to use satellite communications equipment should contact CAMSLANT via SITOR/NBDP on published frequencies.

d. Vessels unable to use satellite communications or SITOR/NBDP should contact CAMSLANT via published voice frequencies.

7. REPORTING INSTRUCTIONS FOR COMMERCIAL VESSELS. Ship reports shall be made in accordance with reference (b). Reports shall be made directly to the MSR upon entering reporting areas. Vessels making numerous port calls within an area do not have to file additional reports. No reports are required when vessels are leaving port or exiting the reporting area.

a. Vessels shall report the following information:

Paragraph	Function	Information Required
System name	System identifier	Ship reporting system name (whalesnorth or whalessouth).
M	INMARSAT number	Vessel INMARSAT number.
A	Ship	Vessel name and call sign.
B	Date, time, and month of report	Six digit group giving day of month and time, single letter indicating time zone, and three letters indicating month.
E	True course	3-digit number indicating true course.
F	Speed in knots and tenths	3-digit group indicating knots and tenths.
H	Date, time, and point of entry into system	Date and time expressed as in (B) and latitude and longitude expressed as a four digit group giving latitude, the letter N indicating north, then a five digit group giving longitude, and the letter W indicating west.
I	Destination and ETA	Name of port and arrival time expressed as in (B).
L	Route information	Route info should be reported as either a direct rhumbline to port (RL) and intended speed expressed as in (F), or a series of waypoints (WP). Vessels reporting waypoints should include latitude and longitude, expressed as in (H), and intended speed between waypoints. For vessels transiting within a traffic separation scheme (TSS), give only the waypoints and intended speed for entry and departure of TSS.

b. The following are examples of ship reports using the standard IMO reporting format:

To: RightWhale.MSR@noaa.gov

WHALESSOUTH//
M/412345678//
A/BEAGLE/CDAR//
B/270810Z MAR//
E/250//
F/17.0//
H/270810Z MAR/3030N/08052W//
I/MAYPORT/271215Z MAR//
L/RL/17.0//

To: RightWhale.MSR@noaa.gov

WHALESNORTH//
M/487654321//
A/CALYPSO/JCOU//
B/031850Z APR//
E/315//
F/15.5//
H/031900Z APR/4100N/06908W//
I/BOSTON/040200Z APR//
L/WP/4210N/07000W/15.5//
L/WP/4218N/07029W/12.0//

8. COAST GUARD PARTICIPATION AND REPORTING METHODS. Although government vessels are exempt from participation in the MSR, the Coast Guard has voluntarily decided cutters 300 gross tons and greater that have record message traffic or INMARSAT C capability shall participate in the MSR. Cutters with INMARSAT C capability shall submit reports to: RightWhale.MSR@noaa.gov. Cutters making reports via record message traffic shall address messages for action to COGARD CAMSLANT PORTSMOUTH VA.

9. REPORTING INSTRUCTIONS FOR COAST GUARD CUTTERS. This section applies to only those Coast Guard cutters directed to participate in the system.

a. All vessels moored within an MSR reporting area for more than 24 hours shall submit a report as soon as practicable upon getting underway.

b. All vessels entering an MSR reporting area from sea shall submit a report upon entry.

c. Vessels that have submitted a report and remain in the vicinity of the MSR reporting area are not required to submit additional reports.

d. Vessels that leave the vicinity of the MSR reporting area for more than 24 hours shall submit a report upon re-entering the MSR reporting area.

e. Exit reports are not required.

f. Reports shall follow the format in reference (b). Cutters shall report the following paragraphs:

Paragraph	Function	Information Required
System name	System identifier	Ship reporting system name (*whalesnorth or whalessouth*).
A	Ship	Enter only "USCG" for cutter name and "USCG" for call sign.
B	Date, time, and month of report	Six digit DTG with time zone indicator and month.
E	True course	3-digit number indicating true course.
F	Speed in knots and tenths	3-digit group indicating knots and tenths.
H	Date, time, and point of entry into system	Date and time expressed as in (B) and latitude and longitude expressed as a four digit group giving latitude, the letter N indicating north, followed by a five digit group giving longitude, and the letter W indicating west.
I	Destination and ETA	Cutters on patrol should enter "sea" as their destination with no ETA. Cutters en route a port should provide the name of port and arrival time expressed as in (B).
L	Route information	Required only for cutters en route a port. Route information should be reported as either a direct rhumbline to port (RL) and intended speed expressed as in (F), or a series of waypoints (WP). Vessels reporting waypoints should include latitude and longitude, expressed as in (H), and intended speed between waypoints. For vessels transiting within a traffic separation scheme (TSS), give only the waypoints and intended speed for entry and departure of TSS.

g. When the need for operational security dictates, operational commanders may waive the requirement for participation in the MSR. Non-participation, however, should be the exception, not the rule.

10. REPORT DATA. All data from ship reports will be stored in the MSR database. Access to the database will be restricted to authorized Coast Guard and National Marine Fisheries Service (NMFS) personnel. Headquarters staff will use the data to track MSR compliance and the NMFS will use the data to analyze vessel traffic within right whale critical habitats. A version of the database, scrubbed of vessel names and call signs, will be made available to the public by the NMFS.

11. RECEIVING REPORTS. CAMSLANT has been designated the primary facility to receive reports from vessels that use non-satellite communication methods. When a vessel contacts CAMSLANT to make an MSR report, CAMSLANT will receive the data in the prescribed format and supply a reply message to the vessel. Reply messages will be provided daily by the contractor. Following transmittal of the reply message, CAMSLANT will forward the ship report to the MSR database via e-mail. Reports shall be sent to: RightWhale.MSR@noaa.gov. As stated earlier, the Coast Guard cannot legally mandate which communication method a vessel will use. Because of this, vessels reporting into the MSR may contact units other than CAMSLANT. If this occurs, take the report and provide the following reply:

    You are entering essential habitat for the endangered northern right whale. The right whale is vulnerable to being hit by ships and may not avoid approaching vessels. Collisions can damage vessels. Exercise prudent seamanship and advance planning to avoid right whales. Assume any whale sighted is a right whale. Monitor USCG Broadcast Notice to Mariners, NAVTEX, and NOAA Weather Radio for latest advisories and sightings. Consult US Coast Pilots and Notices to Mariners for ways to avoid hitting right whales and applicable regulations. Right whale critical habitats are marked on recently updated charts. Right whale information is available from shipping agents and port authorities. Please report all struck, dead or entangled whales immediately to the USCG on VHF Channel 16.

    After sending the reply, the unit shall forward the ship report information to CAMSLANT for entry into the database.

12. REPLY MESSAGE. The following is a sample of the automatic reply message that ships will receive upon reporting into either of the two areas via INMARSAT C or telex. Reply messages warn mariners about the plight of the northern right whale, list additional sources for right whale information, and provide right whale location information. The NMFS will automatically update reply messages based on surveillance flights and other right whale sighting reports. The contractor will forward a copy of the reply messages to CAMSLANT daily. Reply messages will vary slightly depending on the reporting area.

Northeast Reporting Area (Sample Reply Message)

You are entering essential habitat for North Atlantic right whales. The species is critically endangered and vulnerable to being hit by ships; whales may not avoid approaching ships. Collisions can damage sonar domes, propellers or shafts.

Exercise prudent seamanship and advance planning to avoid right whales. Assume any whale sighted is a right whale. Monitor USCG Broadcast Notice to Mariners, NAVTEX, NOAA Weather Radio, Cape Cod Canal Vessel Traffic Control and Bay of Fundy Vessel Traffic Control for latest advisories and sightings. Consult NAVTEX, INMARSAT C SafetyNET, US Coast Pilots, and Notices to

Mariners for ways to avoid hitting right whales and applicable regulations. Right whale critical habitats and Stellwagen Bank Marine Sanctuary are marked on recently updated charts.

Placards, videos and other material are available from shipping agents, port authorities, port pilots, and USCG. Please report all struck, dead or entangled whales immediately to USCG on VHF Channel 16.

Be advised that whales may or may not remain at reported locations for extended periods. Surveys do not detect all whales and are not flown in poor weather. Whales, including other whale species, may occur at unreported locations

Whales were sighted at:
[xxxx]N, [xxxxx]W @ [xxxx]h, [date]
[xxxx]N, [xxxxx]W @ [xxxx]h, [date]

13. COMPLIANCE AND ENFORCEMENT. Shipboard interviews and data analysis will be used to measure compliance with the MSR. Marine Safety personnel will conduct interviews during all regularly scheduled Port State Control boardings and U.S. flag vessel inspections. Interviews will be conducted on vessels meeting the reporting requirements in the ports of Boston, MA; Brunswick, GA; Jacksonville/Mayport, FL; and the ports located at St. Mary's entrance and within the Cumberland Sound including Fernandina Beach, St. Mary's, and Kings Bay. Interviews shall be conducted year-round in Boston and from 15 November to 15 April for ports in the southeast reporting area. Interviews should be used as an educational tool to inform vessels about the MSR and the established reporting procedures. If a vessel is found to have not reported into the MSR, no immediate actions will be taken against the vessel (e.g., CG-835's) until further guidance is issued by Commandant (G-MW). Any discrepancies found shall be forwarded to Headquarters in the weekly interview report. No civil penalties will be assessed if satisfactory compliance with the reporting requirements is attained. It is important to stress that, although this is a mandatory system, the emphasis is on reducing the risk of right whale ship strikes by educating merchant mariners about the problem. The interview process will build on the educational efforts already in place. In addition to interviews, compliance with the MSR will be analyzed through comparison of the database and the Advance Notice of Arrival data. These sources will indicate which ships pulled into ports and which ships reported into the MSR. Vessels failing to report into the MSR will be issued a letter from the NMFS explaining the MSR and the requirement to comply.

14. RESPONSIBILITIES. Successful operation of the MSR will require the cooperative effort of the offices of Marine Safety and Environmental Protection, Operations, and Communications. Required actions are as follows:

a. Commandant (G-MW) shall issue further guidance on enforcement if compliance rates are not satisfactory.

b. Commandant (G-MOC) shall:

(1) Collect weekly vessel interview reports and provide report data to Commandant (G-OPL) for compliance analysis.

(2) Provide Advance Notice of Arrival data for vessels calling in ports located within MSR reporting areas to Commandant (G-OPL) for compliance analysis.

c. Commandant (G-MWV) shall conduct compliance analysis of MSR database with Commandant (G-OPL).

d. Commandant (G-OPL) shall:

(1) Download MSR database for compliance analysis.

(2) Provide compliance results to Commandant (G-MOC).

(3) Provide names of vessels failing to report into the MSR to the NMFS.

(4) Administer requirements of database contract and MSR system operations.

e. Commandant (G-SCT) shall:

(1) Monitor the number of reports made via CAMSLANT, activities, groups, or other units.

(2) Notify Commandant (G-OPL) if the number of reports made via CAMSLANT, activities, groups or other units is excessive or burdensome.

f. Commander, Atlantic Area shall direct districts and area units to carry out MSR responsibilities in accordance with this Instruction.

g. CAMSLANT shall:

(1) Receive ship reports, provide reply messages, and enter MSR reports into the database.

(2) Enter MSR reports received by activities, groups, or other units into the database.

h. Commander, First and Seventh Districts shall direct units under their operational command to carry out MSR responsibilities in accordance with this Instruction.

i. Commanders of Marine Safety Offices with ports located within MSR reporting areas shall:

(1) Conduct shipboard interviews to ascertain compliance with MSR reporting procedures.

(2) Provide weekly interview reports containing the number of vessel interviews conducted, the number of vessels that submitted reports, the number of vessels that received reply messages, and the name and owner/operator addresses of vessels that did not comply. Reports shall be sent via e-mail to: fldr-G-MOC@comdt.uscg.mil.

(3) Continue educational efforts per reference (c).

j. Activities, groups, and other units shall:

(1) Receive MSR reports and provide the reply listed in paragraph 11.

(2) Forward ship reports to CAMSLANT for entry into the database.

15. RECOMMENDATIONS TO IMPROVE THE MSR. The MSR is part of the increasingly important role the Coast Guard is undertaking to help protect our ocean environment. It will require some changes during the initial operational period. Please provide input to your Headquarters Staffs on system problems and improvements. Changes made to operating procedures will be incorporated into future updates of this Instruction.

16. FORMS AND REPORTS. Weekly reports shall be made to G-MOC by marine safety personnel in key port areas in accordance with paragraph 13.g.(2) of this Instruction.

R. C. NORTH
Assistant Commandant for Marine
Safety and Environmental Protection

E. R. RIUTTA
Assistant Commandant for Operations

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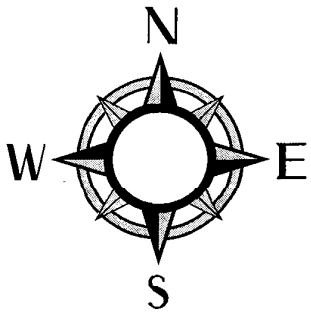

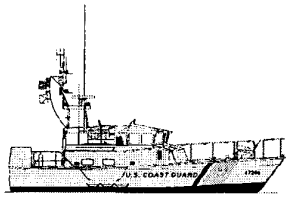

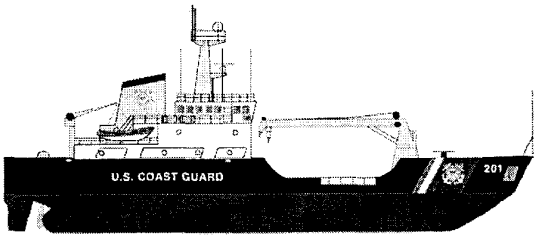

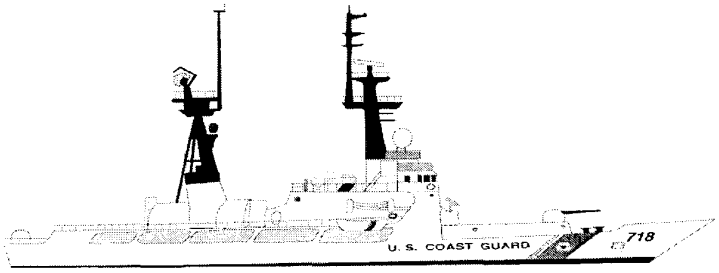

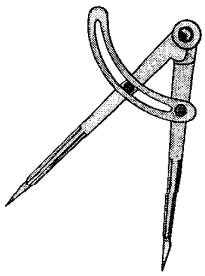

Coast Guard Navigation Standards

COMDTINST M3530.2A

U.S. Department of Transportation
United States Coast Guard

Commandant
United States Coast Guard

2100 Second Street, S.W.
Washington, DC 20593-0001
Staff Symbol: G-OCU
Phone: (202) 267-1768

COMDTINST M3530.2A
MAY 16 2002

COMMANDANT INSTRUCTION M3530.2A

Subj: COAST GUARD NAVIGATION STANDARDS MANUAL

Ref:
(a) U. S. Coast Guard Regulations, COMDTINST M5000.3 (series)
(b) Cutter Training and Qualification Manual, COMDTINST M3502.4 (series)
(c) Cutter Organization Manual, COMDTINST M5400.16 (series)
(d) Boat Crew Training Manual, COMDTINST M16114.9 (series)
(e) Boat Crew Seamanship Manual, COMDTINST M16114.5 (series)
(f) Boat Crew Qualification Guide, Vol I-Crew Member, COMDTINST M16114.10 (series)
(g) Boat Crew Qualification Guide, Vol II-Coxswain, COMDTINST M16114.11 (series)
(h) Group and Stations Communications Watchstander Qualification Guide, COMDTINST M16120.7 (series)
(i) Operational Risk Management, COMDTINST 3500.3 (series)
(j) Procedures for the Preparation and Disposition of Cutter Logs, COMDTINST M3123.12 (series)

1. PURPOSE. This Manual promulgates navigation policies and procedures for all cutters and shore based boats.

2. ACTION. Area and district commanders, commanders of maintenance and logistics commands, and unit commanding officers and officers-in-charge (CO/OIC) shall ensure the requirements of this manual are included as appropriate in the area and district training team curricula, TSTA, SEOPS, STANTEAM and other training and inspection programs. Internet release is not authorized.

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3. DIRECTIVES AFFECTED. Cutter Navigation Standards and Procedures, COMDTINST 3530.2 is hereby canceled.

4. SUMMARY.

   a. *This Manual is designed to assist the CO/OIC, navigator and coxswain in carrying out* their responsibilities as outlined in reference (a). Chapter one provides guidance, policy and procedures for safe cutter navigation. Chapter two provides guidance, policy and procedures for safe shore based boat navigation.

   b. This Manual is not all inclusive on cutter navigation due to many variables such as differing cutter types, personnel qualification and experience, operating areas, etc. Development and implementation of sound command navigation standards and proper risk management is imperative.

5. CHANGES. *Change recommendations should be routed via the chain of command to* Commandant (G-OCU) for cutters and (G-OCS) for shored based boats.

6. FORMS AVAILABILITY. The "CG" forms discussed in this manual, Deck Logs (CG-4380A, CG-4380B and CG-4380C), are available in Jetform Filler and through the stock system. Jetform Filler templates may be downloaded from http://www.uscg.mil/hq/g-s/g-si/g-sii/forms/formindx.htm. A sample Deck Log is available on the web at http://cgweb.comdt.uscg.mil/g-ocu/g-ocu.htm.

TERRY M. CROSS
Assistant Commandant for Operations

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CHAPTER 1. CUTTER NAVIGATION

A. Purpose. This chapter provides guidance, policy and procedures for safe cutter navigation and was developed to assist the commanding officer/officer-in-charge (CO/OIC), and navigator in carrying out their responsibilities outlined in U. S. Coast Guard Regulations, COMDTINST M5000.3 (series).

B. Command Responsibilities. CO/OICs shall:

1. Ensure compliance with the provisions of this Manual.

2. Assign, train and qualify navigation personnel in accordance with U.S. Coast Guard Regulations, COMDTINST M5000.3 (series) and the Cutter Training and Qualification Manual, COMDTINST M3502.4 (series).

3. Conduct navigation exercises in accordance with the Cutter Training and Qualification Manual, COMDTINST M3502.4 (series).

4. Develop Special Sea Detail, Anchoring and Mooring Bills in accordance with the Cutter Organization Manual, COMDTINST M5400.16 (series) and relevant sections of this chapter. Procedures will reflect cutter specific requirements.

C. Command Navigation Standards. This section outlines the minimum information required for inclusion in the Command Navigation Standards.

1. CO/OICs shall promulgate Command Navigation Standards that, at a minimum, include:

   a. Standard helm and engine order commands (see enclosure (1)).

   b. Standard linehandling commands. Enclosure (2) may be used for this purpose either in its entirety, or tailored as deemed appropriate.

   c. Standard navigation plotting symbols. Enclosure (3) may be used for this purpose either in its entirety, or tailored as deemed appropriate.

   d. Command definition of navigational zones to include restricted waters and open ocean. CO/OICs may also designate additional navigational zones to allow for specific manning and fix interval standards based on different operating environments.

   e. Standard navigation fix intervals for each navigational zone.

   f. Cutter's navigational draft.

   g. Definition of shoal water for the cutter and method to identify shoal water on charts.

   h. Specific charts of the cutter's allowance that comprise the "Ready Chart List".

i. Specific guidance concerning navigation of the cutter's small boat(s) while operating independently of the cutter.

j. Specific navigation team manning requirements for each navigational zone. Include provisions for navigating with electronic navigation systems and/or paper charts.

2. OICs of WLI's and WYTL's, while operating on rivers, and the WLR class shall also include in their Command Navigation Standards information similar to that described in Chapter 1, Section F, tailored as appropriate for the specific class of vessel and environment.

D. Navigation Briefs and Planning. This section discusses the purpose and outlines the requirements for navigation briefs.

1. Mission Analysis. CO/OICs shall incorporate the principles of effective mission analysis and risk assessment into their navigation planning in accordance with Operational Risk Management, COMDTINST 3500.3 (series). The mission analysis process may be tailored consistent with the complexity of the specific mission, but should not omit any step in the process.

2. Navigation Planning.

a. Navigation planning encompasses the development of long and short-term plans as well as contingency plans for a mission. The cutter's Watch, Quarter and Station Bill (WQSB), navigation standards, standing orders, operational bills and navigation checklists constitute pre-established long-term operational plans for safe and successful navigation. These plans provide a framework for the cutter while executing a mission, and may be tailored to meet the unique requirements of each mission.

b. The navigator is charged with preparing a plan for safe and prudent passage or short-term navigation plan. These plans may be very elaborate, consisting of complete track lines, piloting procedures, patrol areas, etc., or simply the conning officer's intentions for shifting berths. The plan shall be approved by the CO/OIC. Comply with the following when preparing all plans:

(1) Consult appropriate references. The publications listed below are essential references that shall be consulted during navigation planning, when applicable. Some of these references may be available as electronic data products readable by ECDIS, ECINS or ECS software applications. In all cases, the navigator must ensure all publication corrections have been applied.

(a) Coast Pilot.

(b) Fleet Guides.

(c) Sailing Directions.

(d) OPORDERS.

(e) Coast Guard Navigation Center, Navigation Information Service.

(f) Naval Operating Area Instructions.

(g) Light List(s) and the List of Lights.

(h) Radio Aids to Navigation, PUB 117A.

(i) Notices to Mariners, Local Notices to Mariners and Broadcast Notice to Mariners.

(j) NAVAREA, HYDROLANT, HYDROPAC Messages.

(k) Tide Tables.

(l) Tidal Current Tables.

(m)Nautical Almanac.

(n) Navigation Rules, International-Inland, COMDTINST M16672.2 (series).

(2) Determine when the Engineering Restricted Maneuvering Doctrine will be implemented.

(3) Conduct a navigation brief prior to getting underway, entering port and, if possible, prior to entering restricted waters. Navigation brief duration, content and attendance may be tailored to meet the requirements of a specific mission. Navigation briefs shall include the following information, when applicable:

(a) Anticipated time of setting Special Sea Detail, Anchoring and Mooring Bills, Navigation Detail, and Restricted Maneuvering Bill.

(b) Assignment of navigation team positions including review of duties.

(c) Review of charts and intended track.

(d) Chart datum (NAD 83, WGS 84, etc.).

(e) Chart shifts.

(f) Planned fix interval.

(g) Maximum allowable deviation from track.

(h) Speed of advance and maximum safe speed.

(i) Buoyage system.

(j) Expected sightings and description of key aids to navigation.

(k) Navigation equipment status.

(l) Status of electronic navigation sources (GPS, DGPS, LORAN) to include expected accuracy and outages.

(m) Engineering plant status.

(n) Hazards to navigation, danger bearings/ranges, danger soundings, navigation warnings, bridge vertical clearances, bridge signals and radio capability.

(o) Areas where the cutter can divert to anchor in emergencies.

(p) Anticipated traffic (include reminder to avoid meeting deep draft vessels at turns and intersections).

(q) Traffic Separation Schemes.

(r) Port or Vessel Traffic Service (VTS) requirements.

(s) Environmental considerations including tides, currents, weather (e.g., winds, precipitation, visibility), and designated environmentally sensitive areas (e.g., marine sanctuaries).

(t) Demarcation lines (Inland/International Rules of the Road).

(u) Communication requirements.

(v) Mooring or anchoring arrangements including time to moor/unmoor and pier heading.

(w) Ordnance disposal areas.

(x) Discuss risk assessment results for the particular mission.

(4) Cutters are encouraged to conduct a debrief following navigation evolutions to evaluate and recognize performance.

E. Standard Navigation Team Positions and Qualifications. This section states the general duties and qualification requirements for navigation team positions. Navigation team positions shall be assigned as appropriate based on cutter capability and billet structure.

1. Bridge Navigation Team Organization. Bridge Navigation Team members shall complete applicable sections of U.S. Navy Ship Control and Navigation Personnel Qualification Standard (PQS), NAVEDTRA 43492-2 (series) and/or cutter specific Job Qualification Requirement (JQR) for their assigned billets in accordance with the Cutter Training and Qualification Manual, COMDTINST M3502.4 (series).

a. Navigator. Duties and assignment of cutter navigators shall be in accordance with U.S. Coast Guard Regulations, COMDTINST M5000.3 (series). However due to the size, billet structure, and nature of duties of some cutters, it may not be possible to comply with the assignment criteria. In those cases, the assignment of the duties of navigator shall be based on the proficiency, training, maturity and judgment of the individual being considered for the position. Navigators shall be a qualified underway Officer of the Deck on the cutter presently assigned.

b. Navigation Evaluator. If not the navigator, this person is responsible to the navigator for evaluating fix accuracy from the bridge and CIC/CSC (if equipped), evaluating ship's projected movements and making reports to the conning officer as specified in Chapter 1, Section F.1.c. Coordinates the actions of all bridge navigation team members.

c. Navigation Plotter. Maintains the navigation plot. Plots and labels each fix on the chart in use. Extends the DR at least two fix intervals, computes set and drift since last fix, identifies nearest hazard to navigation, time and distance to the next course change, revises turn bearings and completes other tasks as directed by the navigator/navigation evaluator. The navigation plotter should not be the same individual as the navigation evaluator unless cutter personnel strength precludes this.

d. Bearing Book Recorder. Maintains the Standard Bearing Book (OPNAV Form 3530/3 or equivalent) in accordance with current directives. Maintains communications with the bearing takers, marks fixes at intervals specified by the navigation evaluator, and passes navigation information to the navigation plotter/navigation evaluator.

e. Bearing Takers. Obtain accurate bearings to navigation aids designated by the navigation plotter/navigation evaluator. Advises the navigation plotter regarding the navigation aids available for use, including when navigation aids are acquired visually or lost from sight.

f. Bridge Radar Observer. Provides all radar navigation data as directed by the navigation plotter/navigation evaluator. Performs the duties of shipping officer/radar operator on cutters without a CIC/CSC.

g. Leadsman. Passes soundings to the bridge for comparison with the fathometer and the charted depth.

2. CIC/CSC Navigation Team Organization. CIC/CSC Navigation Team members shall complete applicable sections of U.S. Navy CIC Common Core Watch PQS, NAVEDTRA 43311-4 (series) and/or cutter specific JQR for their assigned billets in accordance with the Cutter Training and Qualification Manual, COMDTINST M3502.4 (series). On cutters without a CIC/CSC, some sections of this PQS may be applicable for the Bridge Navigation Team (e.g., shipping officer, shipping radar operator).

a. Piloting Officer. Evaluates fix accuracy and makes recommendations to the navigation evaluator based on CIC/CSC's navigation plot. Keeps shipping officer advised of course/speed changes. Supervises the navigation radar operator, navigation plotter and navigation recorder.

b. Shipping Officer. Evaluates surface picture. Designates contacts to be watched or tracked in accordance with ship's directives. Verifies the recommended course is clear of all surface contacts.

c. Shipping Radar Operator. Provides all radar data as directed by the shipping officer.

d. Navigation Radar Operator. Provides all navigation radar data as directed by the piloting officer. Maintains communications with, and keeps the navigation plotter informed of designated points available for use.

e. Navigation Plotter. Maintains CIC/CSC's navigation plot. Plots and labels each fix on the chart in use. Extends the DR at least two fix intervals, computes set and drift and evaluates ship's projected movements, time and distance to the next course change, revised turning bearings and ranges, and completes other tasks as directed by the piloting officer.

f. Navigation Recorder. Logs all piloting officer recommendations as well as the standard fix report. Assumes responsibility from the bearing book recorder for designating times of fixes when CIC/CSC has been designated as the primary navigation plot.

F. Navigation Requirements. This section sets forth minimum requirements not addressed elsewhere in this manual. WLI's and WYTL's, while operating on rivers, and the WLR class are exempt from the specific requirements of this section. However, OICs of these units shall tailor the requirements of this section, as appropriate, for incorporation in their Command Navigation Standards.

1. General.

a. Checklists for getting underway and entering port/approaching restricted waters shall be created, maintained and completed in accordance with enclosures (5) and (6).

b. On ships with a CIC/CSC, the bridge navigation plot shall normally be designated as the primary navigation plot. Navigation information maintained in CIC/CSC shall normally be designated as the secondary navigation plot, supplementing the primary plot. The commanding officer may authorize a shift in the location of the primary plot to suit a particular situation (e.g., restricted visibility)

c. Whenever the Navigation Detail is set or otherwise deemed appropriate by the CO/OIC, the navigation evaluator shall report the following information to the CO/OIC, conning officer and navigator at each fix:

(1) Fix time.

(2) Fix type and quality.

(3) Fix position in relation to proposed track.

(4) Report CIC/CSC concurs, does not concur, or has no fix.

(5) Any recommendation to regain/maintain proposed track.

(6) Nearest hazard to navigation.

(7) Next aid to navigation.

(8) Distance to next turn.

(9) Time to next turn and turn bearing/turn range.

(10) Course after next turn.

(11) Set and drift (as required).

(12) Depth of water beneath the keel and comparison to charted depth.

d. Charts used shall be of the largest scale available. Prior to use, charts shall be corrected using all available information.

e. The ship's proposed track shall be laid down identically on all charts used for navigation and labeled with the course (true and magnetic) of each track leg. CIC/CSC navigation charts, if applicable, shall be compared to the bridge navigation charts.

f. All charts shall be reviewed to ensure that hazards to navigation, including overhead obstructions and shoal water, are properly displayed and/or highlighted.

g. If conditions permit, gyro error shall be determined at least once daily while underway. Each time gyro error is obtained, gyrocompass(es) and repeaters shall be compared and errors posted.

2. Fixes.

a. One of the following criteria must be met in order to constitute a proper fix:

(1) Electronic fix in the form of latitude and longitude obtained from electronic navigation systems (GPS, Loran, etc.) and plotted on a paper chart.

(2) Ship's position as plotted by an ECINS/ECS system using GPS input.

(3) The intersection of at least three visual lines of position (LOP), radar ranges, or a combination of visual LOPs and radar ranges from at least three prominent points of land or fixed objects. This includes "map matching" capability.

(4) When using relative bearings, a minimum of two visual LOPs and one radar range shall be used.

b. The ship's position shall be fixed at an interval that ensures safe navigation, not to exceed one hour.

c. A fix shall not be erased or deleted because it appears in error; rather, another fix shall be taken immediately to ascertain the ship's position.

d. Fixes shall be verified by all available means including soundings, AtoN, radar or other electronic means. Do not rely solely upon one positioning method.

e. Set and drift shall be determined at every fix if the fix interval is greater than three minutes. If the fix interval is less than three minutes, set and drift shall be determined at least every second fix. Set and drift shall be applied to subsequent dead reckoning (DR) positions to determine an estimated position (EP) in the event that planned fixes are not obtained.

f. Every fix shall be labeled and have a properly labeled DR track projected for at least two fix intervals.

3. Estimated Position. An EP is a DR position modified by additional information, which in itself is insufficient to establish a fix.

a. The following criteria constitute an EP: The intersection of less than three visual LOPs (true or relative), radar ranges, or a combination of visual LOPs and radar ranges from less than three prominent points of land or fixed objects .

b. Similar to fixes, EPs shall be verified by all available means including soundings, AtoN, radar or other electronic means.

4. Restricted Waters. This section establishes additional requirements while transiting in or near restricted waters.

a. Charts with tracklines in restricted waters shall be checked independently, by a second person, for accuracy.

b. In addition to the course of each track leg, the following items shall be accurately plotted and labeled on the chart:

(1) Distance of track leg.

(2) Danger bearings and ranges to navigation hazards not marked by navigation aids.

(3) Turn bearings (true and relative), turn ranges (in yards) and slide lines allowing for the ship's tactical data. Intended speed/rudder combination for each turn shall be indicated.

c. Bridge and CIC/CSC shall not shift charts at the same time, nor shall they shift during, or at the time of, an impending turn. The bridge or CIC/CSC shall have a fix plotted before the next station shifts charts.

d. Tide and current information shall be posted at all conning stations and in CIC/CSC, if applicable. Graphing of tide and current information is recommended.

5. Positioning Sources. Figure 1-1 depicts the preferred hierarchy of various positioning sources. Category I positioning sources are adequate for use as the primary source of own ship's position while operating in restricted waters. Category II positioning sources are not considered adequate for precision navigation and shall only be used as the primary source of own ship's position in open ocean.

POSITIONING SOURCES

CATEGORY I
Differential GPS
GPS PPS (Precise Positioning Service)
Combined GPS/GLONASS (see Note 1)
GPS SPS (Standard Positioning Service) (see Note 2)
Visual and/or RADAR (includes Mapmatch)
Inertial Navigation System
CATEGORY II
LORAN-C
Celestial

Figure 1-1

Note 1 The Russian GLONASS (Global Navigation Satellite System) constellation is not adequately developed to provide constant coverage worldwide. Computer software is required to predict the availability of GLONASS coverage. At times, when GLONASS enhancement to GPS exists, the resultant fix information can be very accurate. If the enhancement is not available, the fix information is derived from GPS only. The mariner must be cautious when evaluating the accuracy of this hybrid positioning source.

Note 2 – This assumes that Selective Availability (SA) is set to zero. When this instruction was promulgated (SA) was set to zero and the Department of Defense (DoD) had no intention of ever employing its use on a worldwide scale. However, personnel involved with navigation must be aware that DoD may regionally select signal degradation using SA or other tactics. Therefore, cutters deploying abroad may require the use of PPS or other enhancement to ensure accurate fix information is being received. When intentional GPS signal degradation such as SA is being used, SPS shall be considered a Category II source, not adequate for navigation in restricted waters.

6. ECS/ECINS. This section provides definitions that pertain to electronic navigation and sets forth when, and under what conditions, electronic navigation systems may be used.

   a. Definitions.

      (1) ENC - Electronic Navigational Chart is the database, standardized as to content, structure and format, issued for use with Electronic Chart Display and Information Systems (ECDIS) on the authority of a government hydrographic office. An ENC contains all the chart information necessary for safe navigation, and may contain supplementary information in addition to that contained on a paper chart, which may be considered necessary for safe navigation (e.g., sailing directions).

      (2) ECDIS - Electronic Chart Display and Information System is an internationally recognized navigation system that, when used with an ENC, is an internationally accepted alternative to navigating with a paper chart. ECDIS standards are established by the International Maritime Organization, the International Hydrographic Organization and the International Electrotechnical Commission. An ECDIS must have route planning and route monitoring functions, a continuous display of accurate and up-to-date chart and position information, the ability to perform and execute in a timely manner all routines currently provided by a paper chart, an adequate back-up system, capability for automated chart updating and a voyage recording function.

      (3) ECS - Electronic Chart System is a navigational aid that meets the recommended standards established by the Radio Technical Commission for Maritime Services (RTCM) for displaying vessel position and relevant navigational and nautical chart information on an electronic display. An ECS is a situational awareness tool and is neither an equivalent to, nor a replacement for, paper charts. "The Cap'n" is an example of an ECS that is commonly used aboard our cutters.

      (4) ECINS - Electronic Charting and Integrated Navigation System is the term for several electronic navigation systems presently installed on Coast Guard cutters, that, when used with approved electronic chart types, adequate positioning sources and adequate back-up arrangements, is an alternative to navigating with a paper chart aboard those cutters. Just like ECDIS, an ECINS must have route planning and route monitoring functions, a continuous display of accurate and up-

to-date chart and position information, the ability to perform and execute in a timely manner all routines currently provided by a paper chart, capability for automated chart updating, and a voyage recording function. The Coast Guard has already employed several systems that were purchased or developed with the intent of meeting or exceeding the functionality of the international standards for ECDIS and INS, but include deliberate additions to, and deviations from, those standards. Coast Guard operations may require that electronic charting equipment be integrated with other cutter systems. Coast Guard ECINS currently include the "Electronic Chart Precise Integrated Navigation System (ECPINS)" produced by Offshore Systems Limited (OSL), the Shipboard Command and Control System (SCCS) employing the Command and Display Control Integrated Navigation System (C-INS), the "Navi-Sailor 2400 ECDIS" produced by Transas, and the Vision 2100M IBS employing the Voyage Management System produced by Litton Marine Systems.

(5) Electronic charts - Charts that have been developed for display on an electronic medium. They come in a variety of formats including S-57 vector format, other vector formats that include NIMA produced Digital Nautical Charts® (DNCs), and raster formats which are electronically scanned versions of paper charts.

(6) Approved chart types - Coast Guard missions require cutters to operate in waters that are not adequately covered by official ENC. Until official ENC are available for all areas, the Coast Guard has approved the following chart types for use with Coast Guard ECINS:

(a) S-57 charts issued on the authority of a government hydrographic office (i.e., NOAA, Canadian Hydrographic Service).

(b) Digital Nautical Charts® (DNCs) issued by NIMA.

(c) Commercial vector charts that have been procured under contract with a source approved by Coast Guard Headquarters.

(d) If vector charts meeting the standards above are not available for a particular geographic area, then raster charts issued on the authority of a government hydrographic office or procured from a source approved by Coast Guard Headquarters are authorized.

(7) Up-to-date chart - A chart that has been corrected through the latest available update issued by the cognizant hydrographic office and Coast Guard Local Notice to Mariners.

(8) Adequate back-up arrangement - Redundant capability that enables the continuous operation of essential ECINS functions in order to ensure that a failure does not result in a potentially dangerous situation. Acceptable back-up

arrangements include fully integrated redundancy within the ECINS (e.g., an ECINS with multiple computers), redundant ECINS or an independent ECS.

(9) Adequate back-up positioning source - An adequate positioning source that does not rely on any common elements as the primary source (e.g. A back-up GPS receiver is not an adequate back-up for primary GPS). This requirement is intended to provide an alternative positioning data source in the event of catastrophic failure of the GPS constellation. Examples of adequate back-up positioning sources for GPS are LORAN, radar or visual lines of position.

b. An ECS using up-to-date approved chart types may be used as the primary means of navigation in open ocean. When using an ECS as the primary means of navigation, up-to-date paper charts shall be available to transfer the plot within one fix interval.

c. An ECINS using up-to-date approved chart types may be used as the primary means of navigation subject to the conditions set forth in enclosure (4).

7. Celestial Navigation. This section states the basic requirements for celestial navigation.

a. WAGBs (except MACKINAW), WHECs, WMECs and WIX shall maintain proficiency in the art of celestial navigation. To be considered proficient, cutters must be able to:

(1) Manually determine the time of sunrise and sunset.

(2) Manually determine the time of moonrise and moonset.

(3) Manually determine gyro error by azimuth of the sun or other celestial body.

(4) Manually determine gyro error by amplitude of the sun or other celestial body.

(5) Obtain an LOP from the sun.

(6) Observe Local Apparent Noon (LAN). Manually reduce sighting and determine ship's latitude.

(7) Obtain the ship's position by reducing star sights to a fix.

(8) Manually compute latitude and gyro error by Polaris.

b. All celestial work must be documented in the ship's Navigation Workbook. Units using the STELLA software package to perform celestial computations shall follow the guidelines in Chapter 1, Section G.3.

c. Weather and operations permitting, cutters shall take advantage of opportunities to maintain their proficiency in celestial navigation.

d. Nothing in this section shall be construed so as to relieve members of their responsibility for the completion of celestial navigation portions of relevant PQS.

G. Logs, Records and Checklists. This section outlines the procedures and requirements for maintaining navigational documents.

1. Corrections. Erasures are strictly forbidden in all navigation logs and records except in the Navigation Workbook. Corrections shall be made by neatly lining out and initialing an entry. Ball-point pen shall be used throughout, except in the Navigation Workbook where pencil is authorized.

2. Deck Logs. The Deck Log (CG-4380A, CG-4380B and CG-4380C) shall be maintained in accordance with Procedures for the Preparation and Disposition of Cutter Logs, COMDTINST 3123.12 (series).

3. Navigation Workbook. The Navigation Workbook is a record of observations and computations used for navigation of the ship. This shall include data relating to celestial lines of position, tides, currents and gyro error. In view of the large amount of data that may be recorded, ships may organize data into separate notebooks as directed by the CO/OIC. The Navigation Workbook and all electronic records shall be retained on board for a period of three years from the date of last entry.

   a. When using computer software for computations, the results may be printed and maintained with the navigation workbook or stored electronically, in a retrievable format.

   b. Units using the STELLA software package to perform celestial computations must print out the STELLA navigation log after each celestial observation.

   c. Locally prepared strip forms, if used, shall be affixed to or recorded in the workbook.

   d. If calculators are used, enough data must be recorded in the workbook to reconstruct the computation.

4. Standard Bearing Book. The Standard Bearing Book is a record of the data obtained to determine the ship's position by visual bearings, sextant angles, radar ranges and electronic LOPs. It shall be maintained in accordance with the procedures described below. The Standard Bearing Book shall be retained on board for a period of three years from the date of last entry.

   a. The chart number in use shall be recorded at the top of the initial page each day. Each shift of charts shall be noted in the first available blank line.

   b. The time zone and date shall be indicated.

c. Radar ranges shall be labeled YD (yards) or NM (nautical miles).

d. Soundings shall be recorded at the time each fix is obtained and labeled FT (feet), FM (fathoms) or M (meters).

e. All bearings are true, unless otherwise indicated by R (relative) or M (magnetic). When shifting to R (relative), the shift shall be noted on the first available blank line and the ship's heading shall be recorded with each fix.

f. All abbreviations shall be in accordance with Chart No. 1, Nautical Chart Symbols and Abbreviations.

g. Gyro error shall be recorded at the top of the initial page each day. Any revised gyro error shall be noted in the first available blank line. The radar range error, if determined, shall be entered at the top of the initial page each day.

h. A list of navigation aids (object list) must be maintained in the bearing book or maintained as part of a gazetteer containing object lists for all piloting charts. If a gazetteer is maintained, it must be kept in close proximity to the plotting station for ready reference. Object lists must include the chart number, noun name, latitude and longitude, and designation of the object. Object lists maintained on the bridge and in CIC/CSC must be identical.

i. The bearing recorder, at the end of the watch or navigation detail, shall sign the Standard Bearing Book on the next available line.

5. CIC/CSC Navigation Log. The purpose of the CIC/CSC Navigation Log is to provide a record of the data obtained to determine the ship's position by radar. It shall be maintained by CIC/CSC in accordance with the procedures described below. The CIC Navigation Log shall be retained on board for three years after the date of the last entry.

a. At the top of each page, enter the date, chart number and gyro error. Any revised gyro error shall be noted in the log. The radar range error, if determined, shall be entered at the top of the initial page each day.

b. The following information shall be logged at the time of each fix:

(1) Identification of landmarks utilized.

(2) Ship's position relative to track.

(3) Recommended course and speed.

(4) Nearest shoal water.

(5) Distance to turn.

(6) Time to turn.

(7) Nearest aid to navigation.

(8) Soundings at the time each fix is obtained, labeled FT (feet), FM (fathoms) or M (meters).

(9) Set and drift (as required).

(10) Any pertinent remarks (e.g., conn concurs or does not concur).

c. When the navigation detail is secured, an entry shall be made on the next available line in the log. A single line shall be drawn through the remainder of the page with the log keeper's signature appearing on the line.

d. Radar ranges shall be labeled YD (yards) or NM (nautical miles).

e. All abbreviations shall be in accordance with Chart No. 1, Nautical Chart Symbols and Abbreviations, unless promulgated separately in the log.

f. A list of navigation aids (object list) must be permanently maintained in the CIC Navigation Log or maintained as part of a gazetteer containing object lists for all piloting charts. If a gazetteer is maintained, it must be kept in close proximity to the plotting station for ready reference. Object lists must include the chart number, noun name, latitude and longitude, and designation of the object. Object lists maintained on the bridge and in CIC/CSC must be identical.

6. Captain's Night Orders. The Captain's Night Order Book has been traditionally maintained in bound ledger or loose-leaf form. The orders for each night are written and signed by the commanding officer. They include such items as courses and speeds to be maintained throughout the night, expected sightings, engineering data, the tactical situation, and supplementary orders to the Officer of the Deck (OOD). The Captain's Night Order Book shall be retained on board for three years after the date of the last entry. CO/OICs may optionally utilize electronic media to convey night orders to the crew. With either option, safeguards must be in place to ensure that the Deck Watch Officers and other key personnel acknowledge the orders. Similar to the traditional Night Order Book, electronic night orders shall be retained and accessible on board the cutter for three years.

HELM COMMANDS

This enclosure provides a list of commonly used helm commands and may be tailored as appropriate to meet the requirements of Chapter 1, Section C. Standard phraseology governing orders to the helmsman is required to ensure orders are understood and promptly executed. The helmsman shall repeat each command word-for-word and shall report when the ordered action is complete. The conning officer shall acknowledge the helmsman's responses with "VERY WELL".

COMMAND	**ACTION**
RIGHT (LEFT) STANDARD (FULL) RUDDER	Apply the ordered rudder. Standard rudder is the amount required to turn the ship on its standard tactical diameter. The rudder angle varies from ship to ship. Full rudder is normally the amount required for reduced tactical diameter.
RIGHT (LEFT) ## DEGREES RUDDER	Apply the ordered rudder. This order may be followed by a new course for the helmsman to steer, such as "STEADY ON COURSE 256" or another rudder command. If no course is specified the helmsman shall call out the heading at 10 degree increments, such as "PASSING 150, PASSING 160", until a course is ordered by the conning officer.
INCREASE YOUR RUDDER TO RIGHT (LEFT) ## DEGREES	Increase the rudder angle the amount specified to cause the ship to turn more rapidly. This order may be followed by a new course for the helmsman to steer or another rudder command. If no course is specified the helmsman shall call out the heading at 10 degree increments until a course is ordered by the conning officer.
EASE YOUR RUDDER/EASE YOUR RUDDER TO RIGHT (LEFT) ## DEGREES	Decrease the rudder angle by half the amount currently applied or by the amount ordered. This order may be followed by a new course for the helmsman to steer or another rudder command. If no course is specified the helmsman shall call out the heading at 10 degree increments until a course is ordered by the conning officer.
RUDDER AMIDSHIPS	Place the rudder at zero degrees.
MEET HER	Use the rudder as necessary to check the swing of the ship without steadying on any specific course.
STEADY, STEADY AS SHE GOES, STEADY ON COURSE ###	Steer the course on which the ship is currently headed or the ordered course. If the ship is turning and the command STEADY or STEADY AS SHE GOES is given, the helmsman notes the heading and brings the ship back to the heading. The helmsman should then reply "STEADY; COURSE ###".

COMMAND	**ACTION**
SHIFT YOUR RUDDER	Move the rudder to the same angle in the opposite direction from where it is currently ordered. This order may be given only when a specific rudder angle is in effect.
NOTHING TO THE RIGHT (LEFT) OF COURSE ###	Steer nothing to the right (left) of the course specified.
HOW'S YOUR RUDDER	This is a query from the conning officer to ascertain the current rudder placement. The helmsman replies, "MY RUDDER IS RIGHT(LEFT) ## DEGREES".
MARK YOUR HEAD	Respond "MARK ###". A command to the helmsman to state the heading of the ship at the moment the command was given.
COMMAND	The helmsman's response to the conning officer if he/she did not hear a command, misunderstood a command or believes a command is improper.
STEER ON	The helmsman steers on a range or object identified by the conning officer.

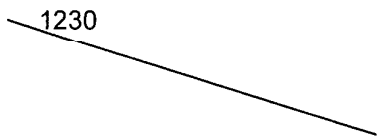
LINEHANDLING COMMANDS

This enclosure provides a list of standard linehandling commands and may be tailored as appropriate to meet the requirements of Chapter 1, Section C.

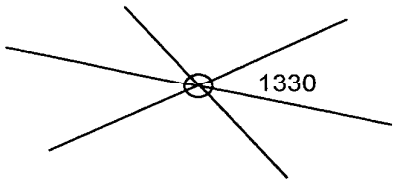
COMMAND	ACTION
PUT OVER/PASS (line number)	Pass the specified line to the pier and provide enough slack to allow linehandlers to place the line over the bitt, cleat or bollard.
HOLD (line number)	Do not let any more line out even though the risk of parting may exist.
CHECK (line number)	Hold heavy tension on the specified line but render it as necessary to prevent parting the line.
SURGE (line number)	Hold moderate tension on a line but render it enough to permit movement of the ship.
EASE (line number)	Let a line out until it is under less tension, but not slacked.
SLACK (line number)	Take all tension off a line and let it hang slack.
TAKE THE SLACK OUT OF (line number)	Take all the slack out of a line, but do not take a strain.
SHIFT (line number)	Shift a line to the specified location.
HEAVE AROUND ON (line number)	Take a strain on a line with the capstan.
TAKE (line number) *TO POWER*	Take the specified line to the capstan.
SINGLE UP (line number)	Take in all but one bight so there remains a single part to the line. May also be used to single up all normal mooring lines.
DOUBLE UP (line number)	Pass an additional bight on the specified line so there are three parts to the line. This may also be used to double up all normal mooring lines. Cutters without sufficient mooring line for three parts should just pass the bitter end of the single up to the pier.
AVAST or AVAST HEAVING	Stop taking a strain on a line with capstan.

COMMAND	ACTION
TAKE IN (line number)	Allow the pier linehandler enough slack to take the line off the fitting and bring the line aboard. Used when secured with your own line.
CAST OFF (line number)	When you are secured with another ship's lines, it means to cast off the ends of their lines.

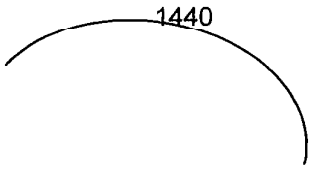
NAVIGATION PLOTTING SYMBOLS



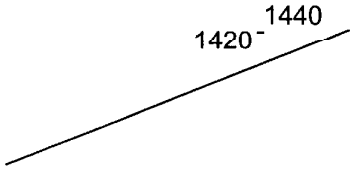
Single line of position
(Same for visual and electronic LOP)



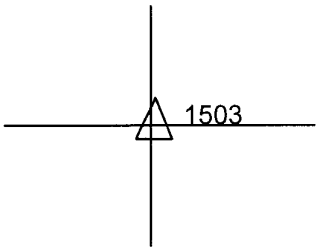
Visual fix



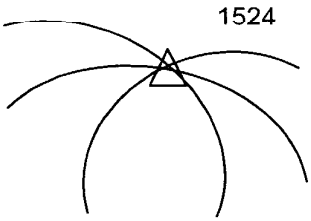
Distance arc or range



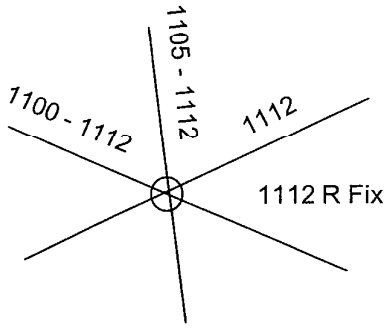
Advanced LOP
Original time and time LOP advanced to



Electronic fix



Electronic fix
using radar ranges



Running fix

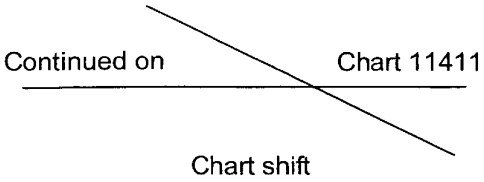
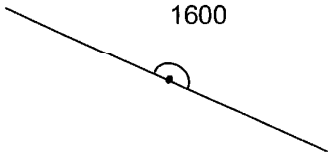
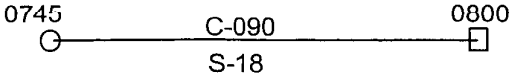


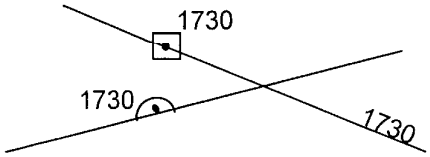
Chart shift



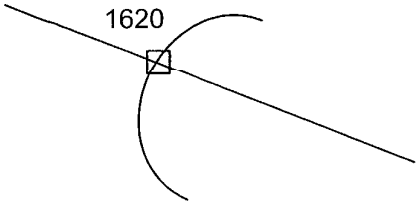
DR position.



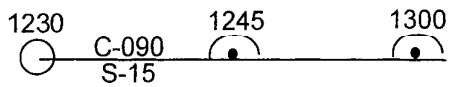
Actual course line
between a fix and an EP



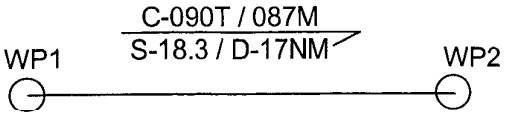
Estimated Position (EP) based
on DR position and single LOP



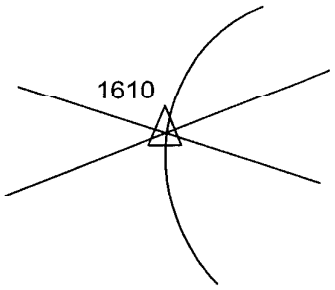
EP based on two LOPs.



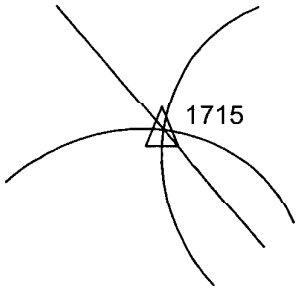
DR course line



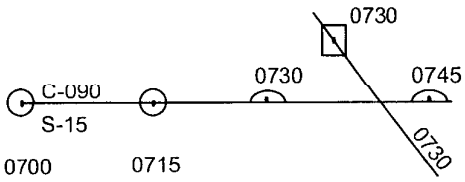
Trackline. Used between intended waypoints.

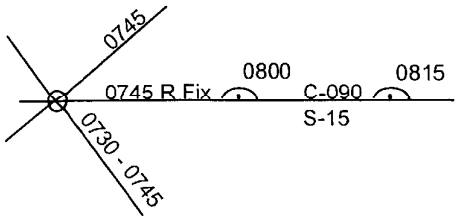


Two visual bearings and one radar range

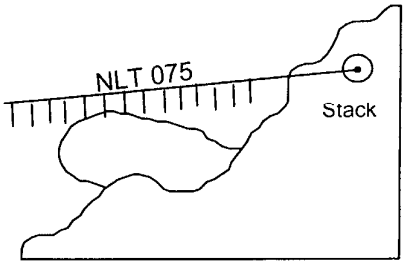


Two radar ranges and one visual bearing.

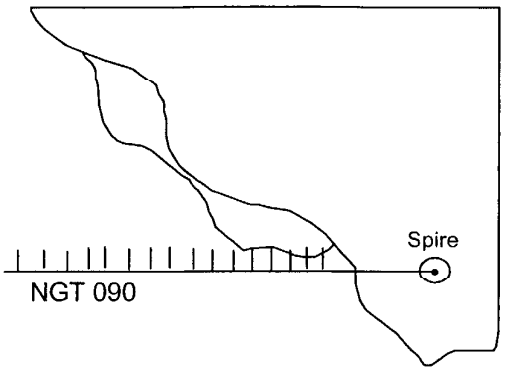




Examples of a DR course line with an EP and a DR course line with a running fix

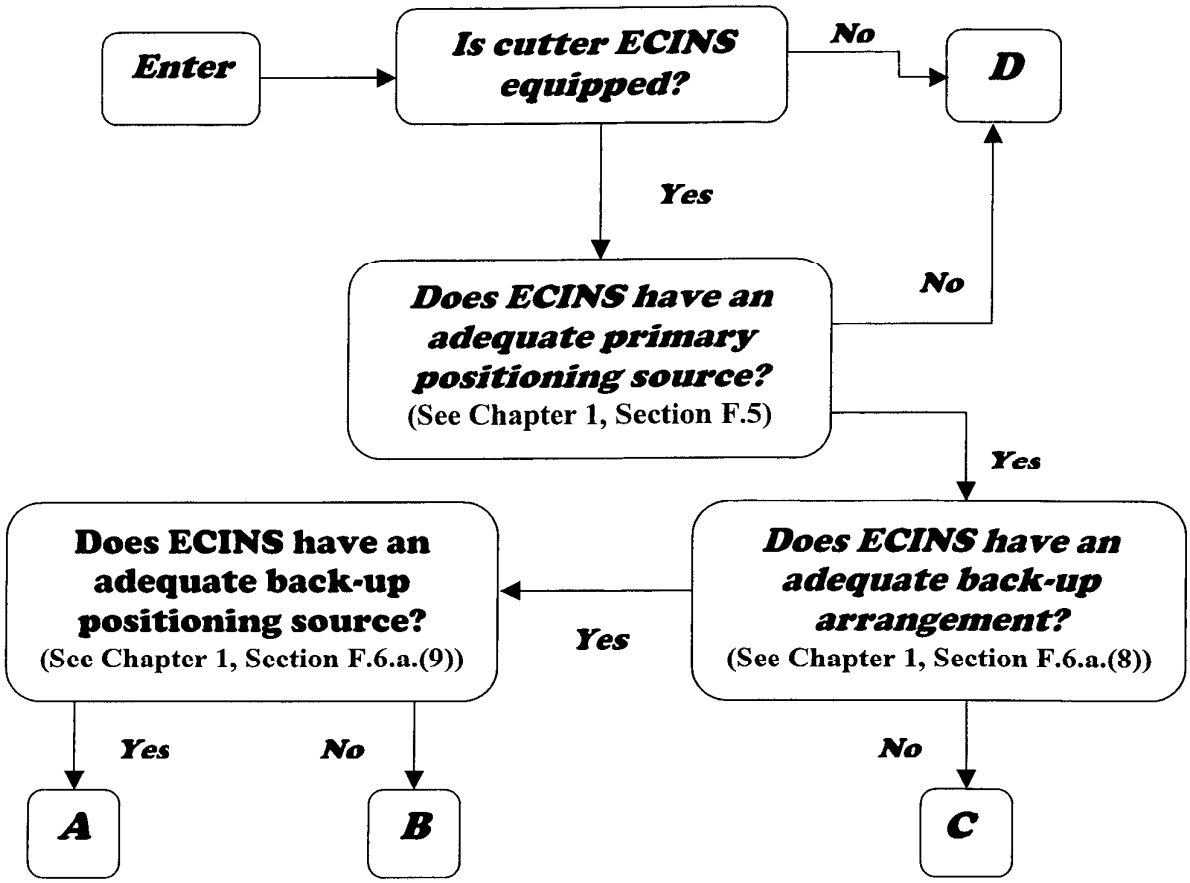


Danger bearing No Less Than 075 Deg T



Danger bearing No Greater Than 090 Deg T

PAPER CHART USAGE/MAINTENANCE REQUIREMENT FLOWCHART



A = Carry uncorrected paper chart. Use ECINS as primary means of navigation.

B = Carry uncorrected paper chart of the area. Use ECINS as primary means of navigation. Cutter shall correct and use paper charts in the event of positioning source failure.

C = Carry corrected paper chart of the area. Use ECINS as primary means of navigation.

D = Use corrected paper charts. ECINS/ECS (if so equipped) is to be used only as a situational awareness tool.

STANDARD GETTING UNDERWAY CHECKLIST

This enclosure provides a sample checklist containing common actions that must be taken prior to getting underway. This checklist may be tailored as appropriate to meet the requirements of Chapter 1, Section F.1.a.

Time prior to Getting Underway	Event
48 Hours	Establish getting underway schedule covering: propulsion plant light off, shift from shore to cutter power, disposal of cutter vehicles, light off and testing of electronic suite, U.S. and Guard Mail. Release MOVREP.
24 Hours	Conduct navigation brief Verify arrangements for tugs/pilots/linehandlers. Verify schedule for lighting-off power plant. Energize gyrocompasses. Check navigation lights for proper operation. Ascertain schedule of other vessel movements in harbor on underway day.
4 Hours	Energize all radars except those prohibited by local electromagnetic emissions restrictions. Validate DGPS/GPS datum. Reconfirm tugs/pilots/linehandlers. Verify arrangements for discontinuances of shore services.
2 Hours	Ascertain from the executive officer/executive petty officer any anticipated deviations from the Plan of the Day. Promulgate underway time to all hands. Energize and initialize all electronic navigation equipment. (Coordinate with shift from shore to cutter power.) Energize and calibrate all radar repeaters. (Post errors at each repeater and for navigation plotters.) Determine and post gyro, steering, and navigation repeater errors. Check/energize all other electronic equipment (e.g. fathometer, etc.). Conduct radio checks on all required circuits. (Include bridge-to-bridge radiotelephone)
1 Hour	Set condition Yoke. Tune and peak radars. Post tide/current/aids to navigation information on the bridge and CIC/CSC.

45 Minutes	Fix ship's position using all available positioning sources. Record draft of cutter fore and aft in cutter's deck log.
30 Minutes	Station the Special Sea Detail and Anchor Detail. In reduced visibility: 1. Station the low visibility detail. 2. Set material condition Zebra on main deck and below. Embark pilot. Display CODE HOTEL. Check steering in all available modes. Test sound-powered phone circuits in use. Receive department reports for readiness to get underway. Test anchor windlass. Prepare anchor(s) for letting go. OOD shift watch to the bridge.
15 Minutes	Obtain CO/OICs permission to shift to pilot house control (when equipped) and test main engine(s). Direct engineering control accordingly after ensuring that the screw(s) are clear. Test cutter's whistle/general alarms. Single up lines. Make SECURITE calls. Take in the brow and break all shore connections. Conduct time check. Report when "ready for getting underway" to the executive officer/executive petty officer.
10 Minutes	Warn engineering control to standby to answer all bells or of impending pilothouse control maneuvers.
Zero Time	Underway. Shift colors/close up international call sign (if appropriate). Make SECURITE calls. Report underway to VTS if appropriate.
After U/W	Return checklist to navigator for filing.

STANDARD ENTERING PORT/APPROACHING RESTRICTED WATERS CHECKLIST

This enclosure provides a sample checklist containing common actions that must be taken prior to Entering Port/Approaching Restricted Waters. This checklist may be tailored as appropriate to meet the requirements of Chapter 1, Section F.1.a.

Time prior to Entering Port/ Restricted Waters	Event
24 Hours	Conduct navigation brief.
3 Hours	Determine and post gyro, steering, and navigation repeater errors.
1 Hour	Pass the word, "Make all preparations for entering port. Cutter will anchor (berth _____ side to) at about _____. All hands shift into the Uniform of the Day." Lay out mooring lines if required. Set up and check all harbor and tug radio frequencies. Check into VTS when appropriate. Ascertain schedule of other vessel movements in harbor.
45 Minutes	Test cutter's whistle/general alarms. Station the Navigation Detail. Prior to approaching restricted waters, check steering in all available modes. Test backing bells. Hoist international call sign when entering inland waters (if applicable).
30 Minutes	Station the Special Sea Detail and Anchor Detail. Make anchor(s) ready for use. Inform the Anchor Detail of depth of water at anchorage, type of bottom, ready anchor, and scope of chain to be used. Inform first lieutenant as to range of tide and time of high water. Receive readiness reports for entering port. Make SECURITE calls. Request permission to enter port from the proper authority.
15 Minutes	If mooring to a buoy, lower boat with buoy detail as directed. Station linehandlers. Standby to receive tugs and pilots.
Upon Mooring	Secure main engines on _____ hour standby. Secure gyros and navigational radars as directed. Check out of VTS as appropriate.

If anchored, obtain navigation bearings and ranges, and determine swing and drag circles.
Record draft of cutter fore and aft.
Shift watch to quarterdeck.
Return checklist to navigator for filing.

Commandant
United States Coast Guard

2100 Second Street, S.W.
Washington, DC 20593-0001
Staff Symbol: G-OCU
Phone: (202) 267-1783

COMDTINST 16672.5
28 JANUARY 1999

COMMANDANT INSTRUCTION 16672.5

Subj: COAST GUARD DECK WATCH OFFICER EXAMINATION PROGRAM

Ref: (a) Cutter Training and Qualification Manual, COMDTINST M3502.4E
(b) Navigation Rules, International-Inland, COMDTINST M16672.2 (series)

1. PURPOSE. This Instruction establishes the Coast Guard's Deck Watch Officer (DWO) examination program, and minimum qualification requirements.

2. ACTION. Area and district commanders, commanders of maintenance and logistics commands, commanding officers of headquarter units and commanding officers and officers in charge of field commands shall ensure compliance with the provisions of this Instruction.

3. DIRECTIVES AFFECTED. Chapter 7, subsection D of reference (a) is cancelled.

4. DISCUSSION. Controlling the safe movement of a Coast Guard vessel as Officer of the Deck (OOD) is a challenging and highly demanding duty. Assuming such an important responsibility represents unconditional trust by the Coast Guard that our personnel and resources will be safeguarded to a person's absolute best ability. The intent of this examination program is to verify a DWO's knowledge of reference (b).

5. DEFINITIONS: For the purposes of this Instruction, the following definitions apply:

   a. Deck Watch Officer (DWO) Exam. The Coast Guard Institute administered test which is required for all personnel performing underway OOD duties and is also a performance qualification for advancement to BM1. It is similar in content to the merchant marine licensing examinations distributed by the National Maritime Center and covers both the 1972 COLREGS and the Inland Navigation Rules. There are two versions of this examination, the initial and the renewal.

DISTRIBUTION – SDL No. 135

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	2	2	2		2	2	1	2	1	1		1	2	2	1	1	1	1	1		1					
B		8	14		12	2	5	10	2	5			2	10	1	1	2	10	1	2		1	10	1	1	1
C			1	1	2	1	1		1	1	2	1	1	2		1	1	1	1	1	1	1	1	1		
D	4	1	1	2	1	1		1	1		1	1*	1		1	1	1	1	1	1	1				1	1
E	1	1							1					1	1				1	1						
F	2	2				1																				
G	1		1																							
H																										

NON-STANDARD DISTRIBUTION: *DI; CGLO ATG MAYPORT(2), CGLO ATG NORFOLK(2), CGLO ATGMIDPAC PEARL HARBOR (2), CGLO ATG PAC SAN DIEGO(2), CG STAFF OFFICER SWOSCOLCOM (CODE 67)(2), CGLO ATGPAC NORWEST DET (2)

(1) Initial DWO Exam. Required for those members who have not previously passed the DWO Exam and additionally for those who have exceeded a period of five-years since the date of their last examination. Initial DWO Exams are closed book in all cases.

(2) Renewal DWO Exam. Administered to members who have previously passed an Initial Exam or a Renewal Exam within the last five years. This five-year period of eligibility commences on the date of their last examination. This test is proctored open book, permitting the candidate to use a new, corrected-to-date, but otherwise unmarked copy of reference (b).

b. Inland DWO Exam. Previously administered by the Institute to those personnel assigned to inland tenders operating on the Western Rivers. *Effective immediately, this practice is discontinued. All Coast Guard* members must pass the DWO Exam discussed in paragraph 5.a of this Instruction (International and Inland Rules of the Road) to meet future testing requirements. Members who are currently in an Inland DWO Exam renewal status are authorized to take a Renewal DWO Exam provided that less than five years has elapsed since their last examination.

c. Merchant Marine Rules of the Road Examinations. The closed book Rules of the Road Exam (Module 054XX) or the open book Rules of the Road Exercise (Module 059XX) taken in conjunction with a maritime license application. **The Merchant Marine Rules of the Road Exam (closed book) is an authorized alternative** to the Coast Guard DWO Exam described in paragraph 5.a. Persons completing this exam are required to submit a *copy of their test score sheet to the Institute for entry into their database.* **The Merchant Marine Rules of the Road Exercise (open book) is not an authorized alternative** to the Renewal Coast Guard DWO Exam described in paragraph 5.a(2).

d. Coast Guard Rules of the Road Exam. A non resident course (0469) and related examination administered by the Coast Guard Institute. Successful completion is required for advancement to BM3 and QM3 and prior to coxswain certification. This examination **is not an authorized alternative** to the Coast Guard DWO exam described in paragraph 5.a.

e. Execution of Orders. Date member detaches PCS from duty station enroute an afloat assignment involving underway OOD/ship control duties.

6. POLICY.

a. Affected Personnel. Cutter Commanding Officers, Officers-in-Charge, Executive Officers, Executive Petty Officers and any other personnel assigned to underway OOD duties shall pass the appropriate (Initial or Renewal) DWO Exam.

b. Authorized Exam. The Coast Guard DWO Exam (International/Inland rules) and the Merchant Marine Rules of the Road Exam (closed book) are the only authorized examinations.

c. Merchant Marine Licenses. Contrary to previous policy, members who possess a valid Merchant Marine License are not waived from the requirements of this Instruction. To facilitate the transition to this standard, anyone holding a valid ocean or near coastal

license is authorized to take the Renewal DWO Exam **until 01 January 2000**. Members wishing to take advantage of this limited opportunity must mail or fax a copy of their license along with their examination application to the Institute. After 01 January 2000, members will be required to take the Initial DWO Exam if they don't meet the requirements of a renewal examination as described in paragraph 5.a(2).

d. PCS Orders. At a minimum, the applicable examination (Initial or Renewal) must be passed no more than one year prior to the execution of PCS afloat orders. This standard applies even if the member is currently assigned to a cutter and/or possesses a valid merchant marine license. **The commands of prospective CO/OIC/XO/XPOs shall ensure that the departing member complies with the policies contained within this Instruction before authorizing the member to execute PCS orders.**

e. TAD Assignments. Members assigned TAD to a cutter must have passed an authorized examination within the prior five years to temporarily serve as an afloat CO, XO or underway OOD.

f. Frequency. A member may take the DWO Exam at any time, even while assigned to shore duty. With the exception of those persons who have received PCS orders to an afloat CO/OIC/XO/XPO billet, there is no limit to the number of attempts a person can make to pass the examination. Prospective afloat CO/OIC/XO/XPOs must pass the examination within two attempts.

g. Failure to Pass DWO Exam.

(1) Prospective CO/OIC/XO/XPO. Failure to pass the examination within two attempts following receipt of orders shall result in the cancellation of those orders and be documented, at a minimum, via an administrative remarks entry. Suitable action for these unique cases shall be coordinated between the affected command, the Coast Guard Personnel Command, and the Office of Cutter Management.

(2) Personnel assigned to designated OOD Billets. While failure to pass the test shall not preclude the execution of orders, the examination must be passed prior to performing duties as an underway OOD. **This requirement can not be waived**. If the member fails to pass the examination within nine months after reporting, that fact shall be documented, at a minimum, via an administrative remarks entry, and the member will normally be transferred during the next assignment season. Suitable action for these unique cases shall be coordinated between the affected command, the Coast Guard Personnel Command, and the Office of Cutter Management.

7. PROCEDURES.

a. Preparation. A thorough knowledge from a concentrated study of reference (b) is required to successfully pass the examination. Taking the Navigation Rules correspondence course and/or memorizing sample test questions and answers will not likely provide adequate preparation. A consolidated collection of all examination questions is located on the Internet at http://www.uscg.mil/hq/gm/marpers/examques/index.htm. This web site is maintained by the National Maritime Center.

b. Examination Ordering, Grading, and Results.

(1) General. The Coast Guard Institute is the central data collection point for all Coast Guard personnel taking the DWO Exam. They provide support to the field by distributing examinations and answer sheets as well as grading the examinations and reporting the results. The Coast Guard Academy and Reserve Training Center Yorktown provide on-site test administration and forward completion data to the Institute.

(2) Ordering Procedures.

(a) The individual's unit is responsible for administering the DWO Exam. The unit's Educational Services Officer (ESO), or appropriately designated alternate, shall order, administer, and return the examination for the candidate. The unit shall follow strict accountability and security measures when in possession of a DWO Exam.

(b) DWO Exams are ordered from the Coast Guard Institute in the same manner as normal correspondence courses. Detailed ordering procedures, including course number, are contained in Education Services Officer Procedures Volume II (List of Correspondence Courses), Institute Publication 1550.1.

(c) Units unable to comply with the normal ordering procedures because of operational need or short notice PCS orders occurring outside of the normal assignment season should forward their CGI-2100 test request form to the Institute via overnight mail. If overnight return is requested, the unit shall include a specific address and either a pre-paid overnight return mailer or cost accounting data to cover that cost.

(3) Status Inquiries. Personnel may contact the Institute at **(405) 954-7263** to determine when they last took the examination.

(4) Exam Results. After grading an examination, the Institute forwards the results via letter to the member. The address for mailing Merchant Marine Rules of the Road examination results is:

Commanding Officer (ss)
U.S. Coast Guard Institute
5900 SW 64th St., rm 235
Oklahoma City, OK 73169-6990

//s//

E. R. RIUTTA
Assistant Commandant for Operations

Earning an Upper Level Merchant Deck License

Background

The Sea Duty Attractiveness Work Group identified earning merchant marine licenses as a way to increase the attractiveness of sea duty. The Marine Safety program also supported this initiative as a means to increase Coast Guard credibility with the merchant marine community. It also would more closely comply with the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). The Office of Cutter Forces (G-OCU) desires a program wherein the longer a cutterman remains in the community, the higher and more marketable his or her license will become, thus increasing retention as well as rewarding sustained performance.

Currently there are few cuttermen with upper level merchant marine licenses. Earning an upper level license (deck or engineering) requires even the Academy graduate cutterman to take many weeks of leave and spend thousands of dollars to complete the courses and exams that are required to earn a license. After January 31, 2002, the STCW 95 Convention will further increase the difficulty in earning a license by requiring more courses and more prior certifications.

As a response, a lengthy process was started in the Coast Guard to reduce licensing barriers to cuttermen through cross-programmatic coordination and liaison with industry and legislators. Underway OOD PQS was reviewed to determine which parts meet STCW 95 requirements for individuals, and then provide credit for completion. The U.S. Coast Guard Academy and the Office of Naval Engineering are reviewing basic STCW courses and the EOIT program for similar STCW and license overlap, and PCO/PXO School in New London is working at meeting some upper level STCW requirements through minor changes to its curriculum. Enlisted schools, TACT/TSTA, enlisted ratings exams, and other fleet training will be studied by G-OCU (and other HQ offices), along with the National Maritime Center (NMC) during the next few years.

It is not envisioned that the PQS system will be replaced; that system is required to maintain interoperability with the U.S. Navy (which does not have the same vested interest in licensing its officers or enlisted). Rather, training within current programs will be identified for overlap and qualified for credit where possible. Minor alterations to existing training programs will be made where they can be completed without a budget increase.

In the meantime, the process remains difficult. Some progress can be made by clearly identifying licensing steps for officers and enlisted. The information below is offered as a first step. It shows the process to earn upper level deck licenses. G-SEN is working on similar information for officer engineering licenses, and enlisted equivalency license information will follow. These licenses listed below all require certain basic forms, procedures, and courses. While much of this process will be targeted for streamlining, for now these are the forms and procedures that must be pursued.

General Procedures, Notes and Steps

1. The information below is intended to jump start the process and is not a detailed guide. Licensing regulations are found in 46 CFR Parts 10 and 12. Most procedures, required forms and information can be found at the below G-M Licensing website:

http://www.uscg.mil/STCW/m-pers.htm.

Some procedures may vary slightly from one Regional Exam Center (REC) to another. An informal phone call to your REC prior to mailing or delivering your application to confirm all application requirements are met may avoid potential future delay. Also, a visit to your local MSO, preceded by an informal phone call, is a good place to start. They will have additional helpful references such as COMDTINST M16000.8B, CG Marine Safety Manual, Vol. III, and Navigation and Vessel Inspection Circular (NVIC) 6-00.

2. A step in the process you want to start early is to request a Transcript of Sea Service (TOSS). Note: Form SF 180 (front and back) (request Pertaining to Military Records) may be found at the G-M Licensing website, however, contact your PERSRU YN, IAW Chapter 5-C PPPM (see link below) to obtain a TOSS. This is an updated procedure and likely to be more expeditious than using the SF 180. (IAW the PPPM, your PERSRU YN sends an e-mail or rapid draft to HRSIC. Note: Your YN will need to include your date of entry into the service and a summary of cutters you have served on in this request).
http://www.uscg.mil/hq/hrsic/pppmhtml/CHAP05C.html

3. Complete the application package and submit to the nearest Regional Exam Center (REC), or any REC listed at the website found in paragraph (1). Form CG-719B is the heart of the application, but the package must also include:

a. Form CG-719K; a current physical is the basis for this form which will be completed by your nearest servicing medical center.

b. A letter from your command saying that you are enrolled in an active urinalysis program.

c. Three letters of recommendation with original signatures.

d. Transcript of Sea Service (this may not be required just for your application, but will be prior to complete evaluation).

e. Fingerprints for an original Merchant Mariners License. (Contact your PERSRU, or other appropriate office, to complete the FBI fingerprint form (FD-258). These forms are not available at the G-M website).

f. Payment for the appropriate user fee (check or money order if mailing the application). Note: Licensing user fees are established by regulation. For an upper level license (3rd mate/assistant engineer and above) the cost is: Evaluation $100, Examination $110, and license issuance $45. You will also be issued a merchant mariner's document with an issuance fee of $45. Contact your REC and check out the G-M Licensing website for further details.

g. And, after January 31, 2002, if the license you are qualified to sit for is subject to the STCW code (most upper level licenses) then you must include completion certificates for STCW basic safety courses and applicable advanced STCW courses as required (See the G-M Licensing website and contact your REC for further details).

4. After your REC determines which level of license you qualify to sit for (based upon cutter class/tonnage and time afloat), you must take the appropriate exam. This is given at the nearest REC

(or any other) and can be up to five full days long. Preparations materials vary in price and quality but can last up to a year and cost thousands of dollars. Others cost only a few hundred and may just be a set of books. It is hoped that the GI Bill, VA, and tuition assistance may soon be authorized to cover these materials - at the moment they are not. Examples include a study guide book set by CAPT Joe Murphy @ Mass. Maritime which costs about $200-$300 for 6 books, and a Houston Marine course that costs from $1000 to $4000 depending upon the license level and options selected.

5. After an initial license is obtained, they may be upgraded as you acquire more sea time based upon tonnage followed by the appropriate exam and any additional training requirements.

6. Licenses must be renewed every 5 years.

Upper level Merchant Mariner licenses:

Original Master Ocean Unlimited: Typically obtainable by a WMEC or WHEC CO, or within 1 yr of tour completion.

Chief Mate Ocean Unlimited: Master 1600 tons if additional exam section completed; typically obtainable by a WMEC XO - although tonnage limited if not a 270' or 378'.

2nd Mate: Typically obtainable during OPS tour or perhaps other 2nd sea tour.

3rd Mate: Typically obtainable during first tour; tonnage limited if not 270'/ 378'.

STCW Requirements: Some STCW courses may be required with your application, others required prior to license examination, or some required simply before you "work" your Merchant Mariners license. These courses are being examined to find out if all or part of each is currently met by existing fleet training. For now, units have authority to obtain a reasonable number of quotas for crew members but have not been funded to do so. It is hoped that the GI Bill and tuition assistance may soon be authorized if it has not been already. STCW requirement will vary depending on the level of license.
The below list is provided simply as an introduction with comments for cutterman. Check out the G-M Licensing website for specific STCW requirements.

Initial

Deck General - (historically the hardest for military to pass; recommend a prep course @$250 to $4K; emphasizes shipping laws, port regs, CFRs & laws
Deck Safety - Pass grade of 70%, read CFRs, minor prep
Nav General - CGA grads and some senior QMs could pass with minimal prep
Nav Probs (2 parts: Celestial & Chart) - CGA grads and some senior QMs could pass with minimal prep
Rules of Road (50 questions @ 90%, same difficulty as closed book DWO exam
Licensed Mate STCW: Advanced FF, Bridge Resource Mgmt, ARPA, GMDSS
Basic Safety Trng: Basic FF, Pers Surv, Pers Safety, Soc Resp, 1st Aid
Must pass Lifeboatman & AB prior to exam after Feb 1, 2002

Recurring

Licensed Mate STCW: Advanced FF, Bridge Resource Mgmt, ARPA, GMDSS

(may end up being required every 5 yrs but not yet clear; the CFRs only state that proficiency be proven every 5 years)

Basic Safety Trng: Basic FF, Pers Surv, Pers Safety, Soc Resp, 1st Aid (may end up being required every 5 yrs; but TACT/TSTA every 2 yrs, PCO/PXO course also provide)

Renewal Request (must renew every 5 years or lose license)

Any questions or comments regarding the information contained in this document may be addressed to COMDT (G-OCU-2), Attn: LTJG Talisha Lawrence.

SUMMARY OF SIGNIFICANT CHANGES

NAVIGATION RULES

INTERNATIONAL-INLAND

COMDTINST M16672.2D*

Revised Inland Rule 9(e)(i): "In a narrow channel or fairway when overtaking, the power-driven vessel intending to overtake another power-driven vessel shall indicate her intention by sounding the appropriate signal prescribed in Rule 34(c) and take steps to permit safe passing. The power-driven vessel being overtaken, if in agreement, shall sound the same signal and may, if specifically agreed to take steps to permit safe passing. If in doubt she shall sound the danger signal prescribed in Rule 34(d)." *[**Note:** The underlined words were added to this new rule.]*

***Old Inland Rule 9(e)(i)**: "In a narrow channel or fairway when overtaking, the vessel intending to overtake shall indicate her intention by sounding the appropriate signal prescribed in Rule 34(c) and take steps to permit safe passing. The overtaken vessel, if in agreement, shall sound the same signal. If in doubt she shall sound the danger signal prescribed in Rule 34(d)."*

Revised Inland Rule 15(b): "Notwithstanding paragraph (a), on the Great Lakes, Western Rivers, or water specified by the Secretary, a power-driven vessel crossing a river shall keep out of the way of a power-driven vessel ascending or descending the river." *[**Note:** The underlined words were added to this rule.]*

Revised Inland Rules 23(a) and 23(a)(i) are the same as the corresponding COLREGS: "A power-driven vessel underway shall exhibit: a masthead light forward."

***Old Inland Rules 23(a) and 23(a)(i)**: "A power-driven vessel underway shall exhibit: a masthead light forward, except that a vessel of less than 20 meters in length need not exhibit this light forward of amidships but shall exhibit it as far forward as is practicable."*

Revised Inland Rule 24(f)(ii): "A vessel being towed alongside shall exhibit a sternlight and at the forward end, sidelights and a special flashing light; and" *[**Note:** The underlined words were added to this rule.]*

New Inland Rule 24(f)(iii): "When vessels are towed alongside on both sides of the towing vessels a sternlight shall be exhibited on the stern of the outboard vessel on each side of the towing vessel, and a single set of sidelights as far forward and as far outboard as is practicable, and a single special flashing light." *[**Note**: This is a new rule!]*

Revised Inland Rule 26(b)(i): "two all-round lights in a vertical line, the upper being green and the lower white, or a shape consisting of two cones with their apexes together in a vertical line one above the other;" *[**Note:** American fishing vessels of less than 20 meters when trawling no longer have the option of hanging a basket in the rigging instead of the two cone shapes displayed apex-to-apex. The COLREGS and Inland versions of Rule 26(b)(i) are now the same.]*

Revised Inland Rule 26(c)(i): "two all-round lights in a vertical line, the upper being red and the lower white, or a shape consisting of two cones with apexes together in a vertical line one above the other;" *[**Note:** American fishing vessels of less than 20 meters when fishing no longer have the option of hanging a basket in the rigging instead of the two cone shapes displayed apex-to-apex. The COLREGS and Inland versions of Rule 26(c)(i) are now the same.]*

Revised Inland Rule 26(d): "The additional signals described in Annex II to these rules apply to a vessel engaged in fishing in close proximity to other vessels engaged in fishing." *[**Note:** This means that COLREGS and Inland Rule 26 are exactly the same and all differences between them have been removed.]*

Revised Inland Rule 34(h): "A vessel that reaches agreement with another vessel in a head-on, crossing or overtaking situation, as for example, by using the radiotelephone as prescribed by the Vessel Bridge-to-Bridge Radiotelephone Act (85 Stat. 164; 33 U.S.C. 1201 et seq.), is not obliged to sound the whistle signals prescribed by this Rule, but may do so. If agreement is not reached, then whistle signals shall be exchanged in a timely manner and shall prevail." *[**Editorial note:** The words "head-on" replaces "meeting"; the legal citation for this rule was changed to reflect the entire Bridge-to-Bridge Radiotelephone Act.]*

*The spine of the new book may still show it to be COMDTINST M16672.2C, however the letter of promulgation signed by RADM North inside the front cover shows it to be COMDTINST M16672.2D, dated March 25th, 1999.

Source: *National Association of Maritime Educators*, Newsletter #85, November 1999
See Also: ALCOAST 211/00
Compiled by: Command & Operations School, US Coast Guard Academy
For Questions, Contact: Commandant, US Coast Guard, (G-MW) 202-267-0407

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FM COMDT COGARD WASHINGTON DC//G-M//
TO ALCOAST
BT
UNCLAS //N16672//
ALCOAST 211/00
COMDTNOTE 16672
SUBJ: SUMMARY OF SIGNIFICANT CHANGES TO NAVIGATION RULES, INTERNATIONAL-INLAND
A. NAVIGATION RULES, INTERNATIONAL - INLAND, COMDTINST M16672.2D
1. **PURPOSE:** THIS ALCOAST IDENTIFIES RECENT CHANGES MADE TO THE INTERNATIONAL AND INLAND NAVIGATION RULES.
2. ACTION: AREA AND DISTRICT COMMANDERS, COMMANDERS OF MAINTENANCE AND LOGISTICS COMMANDS AND UNIT COMMANDING OFFICERS SHALL ENSURE IMPLEMENTATION AND COMPLIANCE WITH THESE CHANGES.
3. **BACKGROUND:** REF A WAS PUBLISHED IN LATE SUMMER 1999. SINCE PUBLICATION WE HAVE RECEIVED MANY INQUIRIES CONCERNING WHAT CHANGES WERE MADE TO THE NAVIGATION RULES. THERE WAS ALSO SOME CONFUSION AS TO THE LATEST EDITION OF THE RULES. THE SPINE OF REF A MAY READ AS COMDTINST M16672.2C, HOWEVER, THE LETTER OF PROMULGATION, DATED 25 MAR 1999, SHOWS THE INSTRUCTION TO BE COMDTINST M16672.2D. THIS IS THE LATEST EDITION.
4. **DISCUSSION:** THERE WERE MANY REVISIONS BETWEEN VERSIONS 'C' AND 'D'. WHILE MOST OF THEM WERE MINOR GRAMMATICAL AND EDITORIAL CHANGES, THERE WERE SOME SIGNIFICANT CHANGES TO THE NAVIGATION RULES. THESE CHANGES SHOULD PROMPT COAST GUARD PERSONNEL, ESPECIALLY OUR CUTTER AND SMALL BOAT OPERATORS, TO REVIEW THE NAVIGATION RULES IN THEIR ENTIRETY, NOT JUST THESE CHANGES.
5. **THE FOLLOWING IS A SUMMARY OF THE SIGNIFICANT CHANGES:**
A. **INLAND RULE 9(E)(I):** THE TERM "VESSEL" WAS CHANGED TO "POWER-DRIVEN VESSEL". IN THE SECOND SENTENCE, THE PHRASE "OVERTAKEN VESSEL" WAS CHANGED TO "POWER-DRIVEN VESSEL BEING OVERTAKEN" AND THE PHRASE "AND MAY, IF SPECIFICALLY AGREED TO TAKE STEPS TO PERMIT SAFE PASSING" WAS ADDED.
B. **INLAND RULE 15(B):** THE TERM "VESSEL" WAS CHANGED TO "POWER-DRIVEN VESSEL".
C. **INLAND RULE 23(A)(I):** THE PHRASE "EXCEPT THAT A VESSEL OF LESS THAN 20 METERS AS IS PRACTICABLE;" WAS DELETED. THIS NOW MAKES INTERNATIONAL RULE 23 AND INLAND RULE 23 THE SAME.
D. **INLAND RULE 24(F)(II):** THE PHRASE "A SPECIAL FLASHING LIGHT" WAS ADDED.
E. **INLAND RULE 24(F)(III):** THIS RULE IS A NEW RULE.
F. **INLAND RULE 26(B)(I):** THE PHRASE "A VESSEL OF LESS THAN 20 METERS IN LENGTH MAY INSTEAD OF THIS SHAPE EXHIBIT A BASKET" HAS BEEN REMOVED. THIS NOW MAKES INTERNATIONAL RULE 26(B)(I) AND INLAND RULE 26(B)(I) THE SAME.
G. **INLAND RULE 26(C)(I):** THE PHRASE "A VESSEL OF LESS THAN 20 METERS IN LENGTH MAY INSTEAD OF THIS SHAPE EXHIBIT A BASKET" HAS BEEN REMOVED. THIS NOW MAKES INTERNATIONAL RULE 26(C)(I) AND INLAND RULE 26(C)(I) THE SAME.
H. **INLAND RULE 26(D):** THE WORDING WAS CHANGED TO MAKE IT

IDENTICAL TO THE INTERNATIONAL RULE 26(D).
I. **INLAND RULE 34(H):** THE TERM "MEETING" WAS CHANGED TO "HEAD-ON" AND THE LEGAL CITATION WAS CHANGED TO REFLECT THE ENTIRE VESSEL BRIDGE-TO- BRIDGE RADIOTELEPHONE ACT.
J. INLAND RULES ANNEX I SEC 84.01(B): A DEFINITION FOR HIGH-SPEED CRAFT WAS ADDED.
K. **INLAND RULES ANNEX I SEC. 84.05:** OLD PARAGRAPHS (B), (C), AND (D) WERE RELETTERED AS (E), (B), AND (C) RESPECTIVELY AND A NEW PARAGRAPH (D) WAS ADDED.
L. INLAND RULES ANNEX I SEC 84.17(C): SUBPARAGRAPH (C) WAS ADDED.
M. **INLAND RULES ANNEX I SEC 84.24:** PERTAINING TO LIGHTING CONFIGURATION OF HIGH SPEED CRAFT WAS ADDED.
N. **INLAND RULES ANNEX V SEC 88.13(B) AND (C):** WORDS WERE ADDED OR AMENDED TO READ AS THEY DO NOW.
O. INTERNATIONAL RULES ANNEX II SEC 2(C): SUBPARAGRAPH (C) WAS ADDED.
6. FOR FURTHER AMPLIFICATION OR CLARIFICATION OF THESE CHANGES OR OTHER RULES OF THE ROAD QUESTIONS, PLEASE CONTACT MR. DAVID BEACH, CGHQ(G-MWV) AT 202-267-6623.
7. INTERNET RELEASE AUTHORIZED.
8. RADM ROBERT C. NORTH, ASSISTANT COMMANDANT FOR MARINE SAFETY AND ENVIRONMENTAL PROTECTION, SENDS.
BT
NNNN

USCG NAVIGATION RULES CORRECTIONS

COMDTINSTM166722D Ed 1999 LAST NM 44/99

Page 2—International: Part A-General, Rule 1(c) line 4; read:
of war and vessels proceeding under convoy, or with respect to addi-...
(USCG) 52/00

Page 2—International: Part A-General, Footnote 1, lines 4 to 5; read:
of the Navy with respect to additional station and signal lights are found in Part 706 of Title 32, Code of Federal Regulations (32 CFR 706).
(USCG) 52/00

Page 3—Inland: Part A-General, Footnote 1, lines 4 to 5; read:
of the Navy with respect to additional station and signal lights are found in Part 706 of Title 32, Code of Federal Regulations (32 CFR 706).
(USCG) 52/00

Page 58—International: Rule 24(d), line 2; read:
apply shall also comply with Rule 23(a)(ii).
(USCG) 52/00

Page 137—Inland: Annex I, §84.05(d), line 3; read:
sel of less than 20 meters in length, the vessel shall exhibit one mast-...
(USCG) 52/00

Page 150—International: Annex II, paragraph 2(a), line 2; read:
ing, whether using demersal or pelagic gear, shall exhibit:
(USCG) 52/00

Page 150—International: Annex II, paragraph 2(b), line 2; read:
trawling shall exhibit:
(USCG) 52/00

Page 207—Waters Specified by the Secretary. 33 CFR §89.27(b)(1), line 2; read:
(EHL) to the Dupont Fixed Bridge at Mile 295.4 EHL.
(USCG) 52/00

RULES OF THE ROAD & COLLISION AVOIDANCE

RISK OF COLLISION - RULE 7

Read Rule 7 - Risk of Collision

Question arises: "**How far apart the vessels must be before risk of collision should be considered to exist and the obligation to keep course and speed first begins to apply to the stand-on vessel?**"

Rule 4 - "**Rules** in this section (Part B - Steering and Sailing Rules) **apply in any condition of visibility.**"

Rule 5 - "Look-out. Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means **appropriate in the prevailing circumstances and conditions** so as to make a full appraisal of the situation and of the risk of collision."

o Phrase indicates it is not always necessary to use radar to determine whether risk of collision exists.

o However, vessels in sight of one another have been held at fault for not using radar to determine risk of collision.

Rule 8 - Action to Avoid Collision

(a) Any action taken to avoid collision shall, is the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.

o this rule does not give a vessel which is initially required to maintain course and speed the right to take action at an early stage.

o Rule 17(a)(ii) only permits the stand-on vessel to maneuver when it becomes apparent the give-way vessel is not taking appropriate action.

(b) Change of course and/or speed shall be large enough to be readily apparent.

(c) Alteration of course alone may be most effective.

(d) Action shall result in passing at a safe distance.

(e) Slow or stop to avoid collision or allow more time to assess situation.

Section II - In Sight

Rule 11 - Apply to vessels in sight of one another.

Rule 13 - Defines overtaking.

o "Coming up from more than 22.5 degrees abaft the beam.

o In doubt whether overtaking, assume you are.

o Subsequent altering of bearing between the two vessels shall not make overtaking vessel a crossing vessel.

Rule 14 - Defines Head-on Situation

o Difference between Inland & International

Inland: "Unless otherwise agreed, shall
International: "Shall".

o See both mastheads nearly in range or both sidelights.

o If in doubt, assume it exists.

Rule 15 - Crossing

o If not meeting or overtaking.

o Vessel which has other on starboard side shall keep out of the way.

Rule 16 - Action of Give-way Vessel

o "take early and substantial action to keep well clear."

Rule 17 - Action by Stand-on Vessel

o Shall maintain

o "may take action when apparent other is not taking action" **MUST SOUND DOUBT SIGNAL BEFORE TAKING ACTION!**

o "shall take action when action of give-way vessel alone will not prevent collision." Rule of thumb for extremis is 4X rule: Distance = 4 X LOA.

o Shall not alter course to port.

Back to Rule 17 "may take action"

o option places greater emphasis for stand-on to continuously assess the situation

o **"A stand-on vessel which takes avoiding action before it can reasonably be assumed that the give-way vessel is not taking appropriate action is likely to be held mainly to blame if practically simultaneous action by the give-way vessel causes a confused situation which results in collision."**

o related to vessel size and characteristics

o Suggestion - "12X rule": "It is suggested that a stand-on vessel should not allow a give-way vessel to approach to a distance of less than about twelve times her own length in a crossing situation without taking avoiding action."

12X RULE DISTANCES

WHEC	-	1500 yards
WMEC 270	-	1000 yards
WMEC 210	-	840 yards
WLB	-	720 yards
WPB 110	-	440 yards

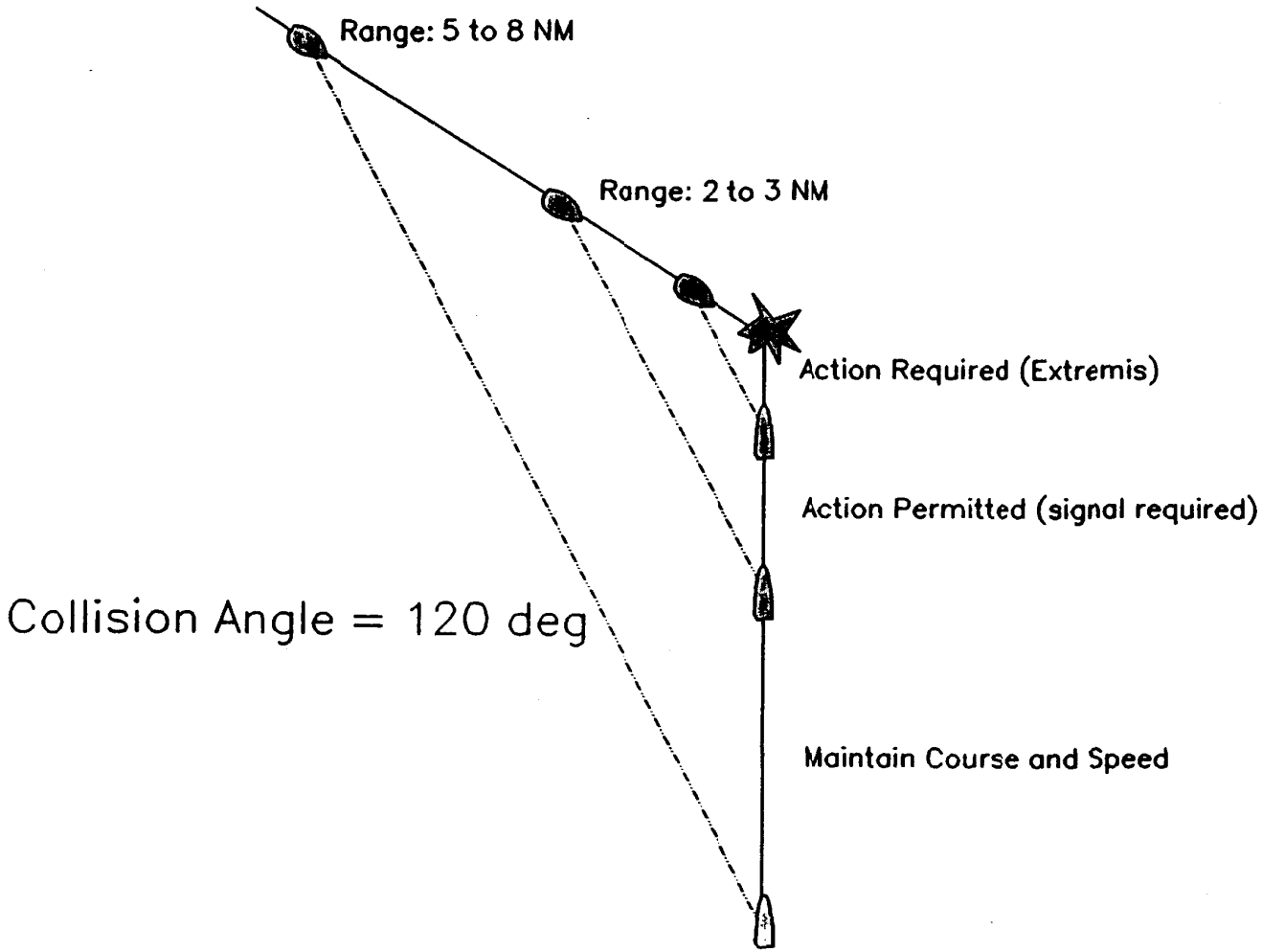
o Another suggestion - Lott's Principles, "Point at which the stand-on vessel should maneuver."
REMEMBER - LOTT WAS TALKING ABOUT "EXTREMIS"!

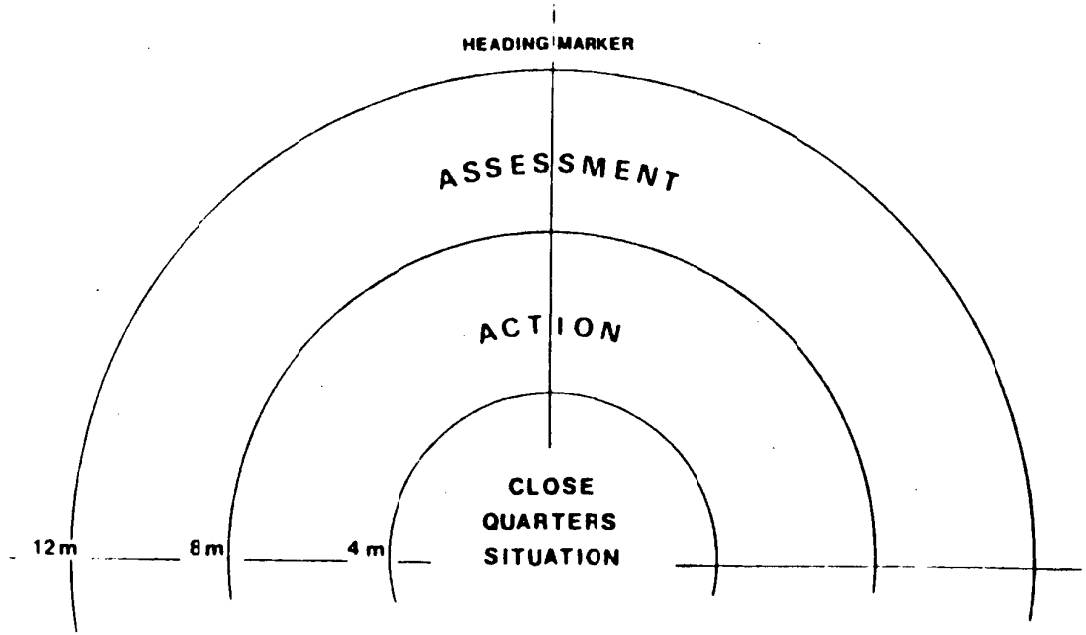
CAF times Advance plus safety distance.

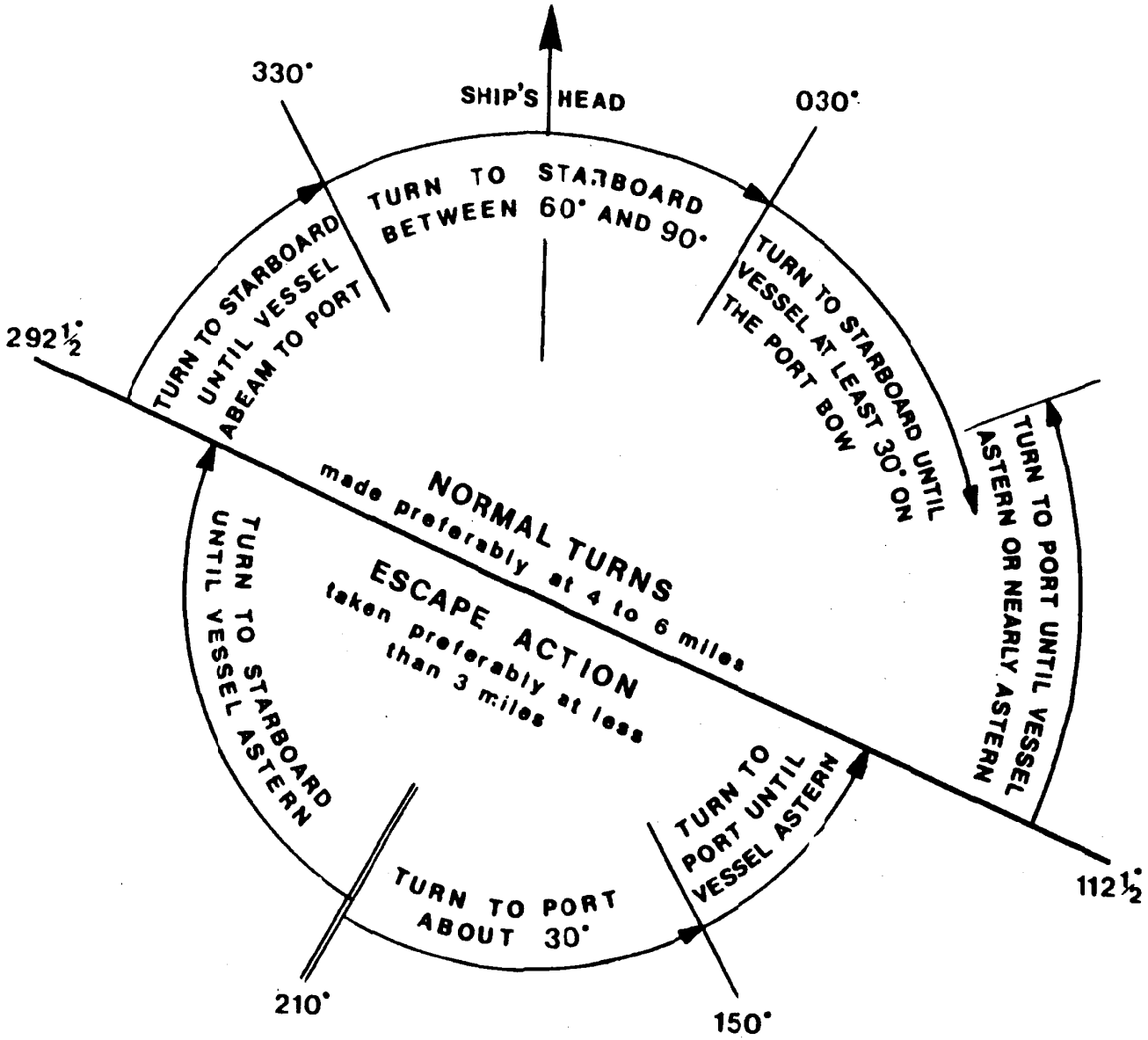
CA1-	0 to 30,	factor =	0.3
CA2-	30 to 60,	factor =	0.6
CA3-	60 to 120,	factor =	0.9
CA4-	120 to 150,	factor =	1.2
CA5-	150 to 180,	factor =	1.5

EXAMPLE: 120 degree collision angle. WHEC advance at 15 kts = 336 yards, Safety distance = 1000 yds
Distance is approximately 1400 yards (0.7 NM)

Rule 17 – Action by Stond–on Vessel




HEADING MARKER
ASSESSMENT
ACTION
CLOSE
QUARTERS
SITUATION
12m
8m
4m


SHIP'S HEAD
030°
330°
TURN TO STARBOARD BETWEEN 60° AND 90°
TURN TO STARBOARD UNTIL VESSEL AT LEAST 30° ON THE PORT BOW
TURN TO STARBOARD UNTIL VESSEL ABEAM TO PORT
292½°
TURN TO PORT UNTIL VESSEL ASTERN OR NEARLY ASTERN
NORMAL TURNS
made preferably at 4 to 6 miles
ESCAPE ACTION
taken preferably at less than 3 miles
TURN TO STARBOARD UNTIL VESSEL ASTERN
TURN TO PORT UNTIL VESSEL ASTERN
TURN TO PORT ABOUT 30°
112½°
210°
150°

APPENDIX A

Capabilities of U.S. Coast Guard Assets

A.1 GENERAL

This appendix lists capabilities of Coast Guard cutters, boats, and aircraft relevant to counter drug and alien migrant interdiction operations. The paragraphs below offer a brief description of the type unit and its strength and weaknesses for undertaking the CD and AMIO missions. Figures A-1 through A-6 list vital characteristics in tabular form. Notional migrant loading limits for Coast Guard cutters and boats are shown in figure 13-2.

A.2 CUTTERS

There are two major factors in determining a cutter's usefulness in undertaking counter drug and alien migrant interdiction duties: the physical capabilities of the unit, and the amount to which the unit has participated in these complex missions. Cutters that regularly engage in CD and AMIO will be better trained and ready for these operations. Missions assigned are generally standard across cutter classes, although geographic location of a cutter may effect how often the unit is directly involved.

As a general rule, the primary missions of Coast Guard cutters are:

1. High and medium endurance cutters (WHEC and WMEC): maritime law enforcement, SAR, and defense operations.

2. Buoy tenders (WLB): aids to navigation. Some buoy tenders conduct occasional law enforcement patrols to support fisheries conservation and counter drug operations. In times of mass migration, buoy tenders are often pressed into service rescuing migrants.

3. Icebreaking tugs (WTGB): icebreaking and aids to navigation. Most WTGBs, particularly those stationed in New England, conduct law enforcement patrols in the spring, summer, and fall.

4. Patrol boats (WPB): maritime law enforcement and SAR.

A.2.1 WHEC 378 Hamilton Class. The 378-foot WHEC is an outstanding platform for both AMIO and CD missions. This class of cutter is relatively fast and stable, with a good ride in all but poor sea conditions. Its large crew, adequate deck space, and accommodation ladder make it an ideal platform for embarking large migrant loads. The large size of the vessel makes it difficult to remain covert. It has excellent boat handling arrangements.

Hamilton-class cutters possess a state-of-the-art communications suite and are the only Coast Guard cutters equipped with a dedicated air search radar. Its fire control radar and ES gear offer sensors not available on smaller cutters. It can support either the HH-65 or HH-60 helicopter, and some variants of the SH-60, although the hangar can only accommodate the HH-65. The 378 has a moderate JP-5 capacity. The endurance of the WHEC is approximately 30 days, more than double the endurance of the Coast Guard's WMECs, and WHECs are fully capable of refueling at sea from Navy oilers.

A.2.2 WMEC 270 Famous Class. The Famous-class cutter is a very capable asset for both AMIO and CD missions. Its greatest strength is its impressive command, control, and communications suite that allows it to coordinate the operations of numerous surface and air assets simultaneously. Its fire control radar and SLQ-32 ES gear offer sensors not available on smaller cutters. It is a moderate speed vessel with a good ride in seas under ten feet but with severe pitching in larger head seas. An active fin stabilizer system reduces roll. All 270s can support the HH-65 helicopter and the B-class of 270s (hulls 905-913) can support the HH-60 as well, although the cutter's hangar can only accommodate the HH-65. The 270 has a large JP-5 capacity that requires infrequent re-supply.

Endurance of the 270 WMEC is good but limited by onboard fuel and food supplies. These cutters are fully capable of refueling at sea from Navy oilers.

The cutter's high freeboard and lack of an air castle make embarkation of migrants more difficult and a slower process than on other cutter classes. This is especially true when numerous ill, elderly, or infant migrants are being embarked. The boat launching arrangement for the RHIB is difficult to use in seas over eight feet.

A.2.3 WMEC 210 Reliance Class. The 210-foot cutter is an excellent AMIO and good CD platform. It is limited in its effectiveness against small, high-speed targets by its relatively slow speed and lack of advanced sensors. Employing the cutter's 7-meter RHIB as a pouncer can help alleviate the speed deficiency in some circumstances. Command, control, and communications (C3) capabilities are good but not extensive. These cutters handle rough weather well but roll severely in significant following or beam seas. They can support the HH-65 helicopter but do not have a hangar.

There is adequate deck space on these vessels to handle large numbers of migrants. The presence of an air castle and the flight deck overhang on the fantail offer more flexibility for embarking and housing small migrants loads than those of the 270 WMEC. The cutter has excellent boat launching arrangements.

Diesel fuel supply is excellent for extended operations but the 210-foot WMEC has a relatively small JP-5 supply, requiring occasional re-supply when engaged in continual helicopter operations.

A.2.4 WLB 225 Juniper Class. The Juniper-class cutter is a good AMIO resource, although its crew, normally tasked with aids to navigation missions, may be unfamiliar with AMIO procedures. These vessels possess large deck space, a decent ride, and easy embarkation for migrants along the buoy deck.

The relatively small crew for a vessel of its size limits the number of migrants that can be cared for aboard these vessels for extended periods.

Juniper-class cutters are moderately slow speed, with limited sensors and C3 capabilities. They are only marginally effective in CD when facing high-speed or low profile targets. They have no flight deck but possess decent boat lowering arrangements.

A.2.5 WLB 180 Balsam Class. The 180-foot buoy tender is a good AMIO resource. Its crew, normally tasked with aids to navigation missions, may be unfamiliar with AMIO procedures. These vessels possess moderate deck space, a fairly stable ride, and easy embarkation for migrants along the buoy deck. In beam or following seas above six feet these cutters roll heavily. The 180 WLB is an excellent heavy weather resource due to its solid construction.

Balsam-class cutters are moderately slow speed, with limited sensors and C3 capabilities. They are only marginally useful when facing high-speed or low profile targets. They have no flight deck but possess decent boat lowering arrangements.

A.2.6 WTGB 140 Bay Class. The WTGB is an icebreaking tug, with most hulls stationed on the Great Lakes. The WTGBs stationed in New England periodically participate in law enforcement patrols (primarily targeting fisheries regulations) and these crews are generally familiar with boarding procedures and the CD/AMIO missions.

While relatively slow and lacking advanced C3 and sensor capabilities, these cutters are sturdily constructed and are excellent resources in moderately rough weather. They roll heavily and boat launching is a challenge in all but calm seas due to the boat handling arrangements.

A.2.7 WPB 110 Island Class. The 110-foot WPB is an excellent CD and AMIO resource. Its prime strengths are its high speed and low profile, which make it moderately effective against high-speed targets and provide a higher than normal degree of stealth. It is limited by its generic sensors and communications capabilities, but can be used very effectively to intercept targets at long range with queuing from another air or surface unit. The small amount of open deck space and stability considerations limit the number of migrants these cutters can hold.

The cutter's boat handling arrangements are good but launching and recovering the 5.4 meter RHIB in seas over eight feet is a challenge. A major concern in the employment of the Island-class cutters is its endurance, which is limited to about five days of steady steaming.

The vessel rides relatively well in all seas conditions but should not be employed in seas over 12 feet except in emergencies. Speed in head seas is limited due to the cutter's thin hull construction,

particularly in hulls 1301-1316. Active fin stabilizers reduce roll significantly but the cutter pitches strongly into head seas over six feet. The small crew may face fatigue conditions during extended operations or patrols in six-foot or greater seas.

A.2.8 WPB 87 Barracuda Class. These new cutters are very good CD and AMIO resources. In essence, their capabilities are proportionally less than the 110-foot WPB in all respects: moderate speed, less endurance, and smaller crew. Its decent speed and low profile make it effective against higher speed targets. It is limited by its generic sensors and communications capabilities, but can be used very effectively to intercept targets at long range with queuing from another air or surface unit. It is best employed for coastal patrol or in concert with an aircraft or larger surface unit that can provide queuing for TOIs.

The Barracuda class cutters have a unique stern launch mechanism for their 5.4-meter small boat, allowing rapid launching in seas up to eight feet. The small crew and limited deck space restrict the number of migrants that can be embarked and cared for over an extended period. The crew may face fatigue conditions in seas over five feet or for operations beyond three days.

A.2.9 WPB 82 Point Class. The 82-foot cutters are good CD and AMIO platforms but are restricted by their marginal ride, small crew size, and lack of endurance. They possess decent speed but have limited sensors and virtually no C3 capability. Best use of these cutters is for coastal patrol or as a pouncer for larger units.

The vessel rolls severely in beam or following seas greater than five feet. Boat launching is challenging in all but calm conditions and dangerous in five-foot or greater seas.

	WHEC 378	*WMEC 270*	*WMEC 210*
Length	378 feet	270 feet	210 feet
Beam	43 feet	38 feet	34 feet
Draft	20 feet	14 feet	13 feet
Crew size	19 officers 148 enlisted	13 officers 86 enlisted	12 officers 63 enlisted
Propulsion	CODOG 2 gas turbines 2 diesels 2 shafts, CPP Bow thruster	2 diesels 2 shafts CPP	2 diesels 2 shafts CPP
Speed (max)	29 knots	19 knots	16 knots
Speed (econ)	11 knots	11 knots	10 knots
Sea State constraints	Max speed decreases in head seas above 15'	Limited to 12-15 kts in head seas above 10'	Limited to 10-12 kts in head seas above 10'. Heavy roll in beam or following seas above 8'
Endurance	30 days	14 days	14 days
Fuel capacity	215,000 gal DFM	83,540 gal DFM	48,359 gal DFM
Weapons	1-MK75/76mm main battery 1-MK15/20mm Phalanx 2-MK38/25mm 4-.50 cal machine guns	1-MK75/76mm main battery 2-.50 cal machine guns	1-MK38/25mm 2-.50 cal machine guns
Sensors	Surface search: AN-SPS-64(v) Air search: AN-SPS-40E Fire control: MK92 ES gear: WLR-1H	Surface search: AN-SPS-64(v) Air search: none Fire control: MK92 ES gear: SLQ-32(V)2	Surface search: AN-SPS-64(v) Air search: none Fire control: none ES gear: none
Communications	2-VHF * 2-UHF * 2-HF * 2-Satellite * INMARSAT * Link 11	2-VHF * 2-UHF * 2-HF * 2-Satellite * INMARSAT *	2-VHF * 2-UHF * 2-HF * INMARSAT *
Boats	25' motor surf boat 7 meter RHIB	25' motor surf boat 7 meter RHIB	25' motor surf boat 7 meter RHIB
Helicopters	1-HH65 or HH60	1-HH65 or 1-HH60 except hulls 901, 902, 903, 904	1-HH65
Hangar	Yes; retractable	Yes; retractable	None
JP-5 capacity	16,000 gal	20,668 gal	4683 gal

* denotes secure capability

Figure A-1. Coast Guard Cutter Capabilities

	WLB 225	*WLB 180*	*WTGB 140*
Length	225 feet	180 feet	140 feet
Beam	46 feet	37 feet	38 feet
Draft	13 feet	12 feet	13 feet
Crew size	6 officers 34 enlisted	6 officers 47 enlisted	3 officer 14 enlisted
Propulsion	2 diesels 1 shaft CPP Bow/stern thrusters	Diesel-electric 2 diesels 1 shaft Bow thruster (except hulls 388, 395, 396)	Diesel electric plant 1 shaft
Speed (maximum)	15 knots	13 knots	15 knots
Speed (economical)	12 knots	10 knots	12 knots
Seastate constraints	Very durable in heavy weather. Rolls heavily in beam or stern seas over 10 feet	Very durable in heavy weather. Rolls heavily in beam or stern seas over 6 feet	Severe roll in beam or stern seas greater than 6-8 feet
Endurance	10 days	7 days	5 days
Fuel	72,000 gal DFM	29,280 gal DFM 44,000 gal DFM (D14 and D17 units)	23,000 gal DFM
Weapons	1-25mm/MK38 (space and weight reserved) 2-.50 cal machine guns	2-.50 cal machine guns	2-.50 cal machine guns
Sensors	Surface search: Sperry RASCAR 2500C	Surface search: AN-SPS-64(V)	Surface search: AN-SPS-64(V)
Communications	2-VHF * 1-UHF * 3-HF * INMARSAT (D14 Units)	2-VHF 2-HF 1-UHF	2-VHF * 3-HF *
Boats	2 21' RHIBs	7 meter RHIB 23' UTL	5.4 meter RHIB
Helicopters	None; VERTREP only	None; VERTREP only	None; VERTREP only

* denotes secure capability

Figure A-2. Coast Guard Cutter Capabilities (continued)

	WPB 110	*WPB 87*	*WPB 82*
Length	110 feet	87 feet	82 feet
Beam	21 feet	19 feet	17 feet
Draft	7.5 feet	6 feet	6 feet
Crew size	2 officers 14 enlisted	1 officers/E-9 9 enlisted	1 officer/E-9 9 enlisted
Propulsion	2 diesels 2 shafts	2 diesels 2 shafts	2 diesels 2 shafts
Speed (maximum)	30 knots	25 knots	22 knots
Speed (economical)	11 knots	8 knots	8 knots
Sea State constraints	Head sea limits (hulls 1301-1316) 3-5': 25 kts 5-8': 18 kts over 8': 10 kts Slightly higher speeds available in these sea states for hulls 1317-1349.	Head sea limits (est): 3-5': 20 kts 5-8': 15 kts over 8': <12 kts	Head sea limits: 3-6': 14 kts 6-8': 12 kts over 8': <12 kts
Endurance	5 days	3 days	2 days
Fuel capacity	10,380 gal DFM	2800 gal DFM	1830 gal DFM
Weapons suite	1-MK38/25mm 2-.50 cal machine guns	2-.50 cal machine guns	2-.50 cal machine guns
Sensors	Surface search: AN-SPS-64(v)	Surface search: AN-SPS-73(v)	Surface search: AN-SPS-64(v)
Communications	2-VHF * 2-UHF * 2-HF *	2-VHF * 1-UHF * 1-HF *	1-VHF * 1-UHF 1-HF *
Boats	5.4 meter RHIB	5.4 meter RIB (stern launch)	4 meter RHIB
Helicopter types	None; VERTREP only	None; VERTREP only	None; VERTREP only

* denotes secure capability

Figure A-3. Coast Guard Cutter Capabilities (continued)

A.3 BOATS

A.3.1 47-foot Motor Life Boat. The newly designed 47-foot MLB is the Coast Guard's most capable small boat. It is an excellent coastal resource for both the CD and AMIO missions. These boats benefit from their relatively high speed and outstanding seakeeping abilities. To board another vessel, they must pull alongside it and transfer their boarding team directly aboard.

Drawbacks include limited sensors and communications gear and lack of endurance. In the coastal zone, however, these are the preferred small boat for all CD and AMIO missions.

A.3.2 44-foot Motor Life Boat. The 44-foot MLB is limited in its use for CD and AMIO due to its slow speed. It is primarily used for heavy weather search and rescue missions. If needed, these boats make effective boarding platforms but are virtually useless against high-speed or stealthy targets.

A.3.3 41-foot Utility Boat. The UTB is an excellent CD and AMIO response resource. The boat's moderately high speed and outstanding maneuverability make them excellent for patrols in the littoral region and for pouncers when queued by other assets. Due to their light construction, the 41-foot boat is limited to operating in sea conditions of eight feet or less. They are normally employed within 25 miles of the coastline.

	MLB 47	*MLB 44*	*UTB 41*
Length	47 feet	44 feet	41 feet
Beam	14 feet	13 feet	14 feet
Draft	4.5 feet	4 feet	4 feet
Crew size	4	4	3
Propulsion	2 diesels 2 shafts	2 diesels 2 shafts	2 diesels 2 shafts
Speed (maximum)	25	13	26
Speed (economical)	11	8	10
Sea State constraints	Can operate in seas up to 30' and winds to 50 kt.	Can operate in seas up to 20' and winds to 50 kt.	Can operate in seas up to 8' and winds up to 30 kt.
Endurance	8-12 hours	8 hours	6 hours
Weapons suite	Small arms Can mount .50 cal machine gun	Small arms	Small arms Can mount M60 machine gun
Sensors	Surface search: AN-SPS-69	Surface search radar	Surface search: Raytheon 1900
Communications	2-VHF * 1-HF	1-VHF * 1-HF	2-VHF * 1-HF

* denotes secure capability

Figure A-4. Coast Guard Boat Capabilities

A.4 AIRCRAFT

A.4.1 HC-130H. The HC-130H is the Coast Guard's premier long-range patrol aircraft. It is ideally suited for extended offshore missions; due to its lack of maneuverability it is not suited for harbor patrols or operations in confined areas. It is an outstanding search and surveillance platform: the aircraft is equipped with side windows for clear visual observation and the APS-137 radar is highly effective for locating surface targets at extended range.

FLIR-equipped HC-130H aircraft possess additional detection and monitoring capabilities. The TI-51 FLIR can be slaved to the APS-137 radar to act as a target identification tool. Due to its limited field of view, the FLIR unit is best employed using cueing from the APS-137 (FLIR will not be available on most Coast Guard HC-130H aircraft until late in 1999).

The HC-130H has a robust communications suite and can provide secure communications on HF, UHF, and VHF-FM frequencies. Due to its lack of a data link the HC-130H must communicate with Navy forces on voice circuits.

The HC-130H boasts an impressive loiter time. By securing one or more of the aircraft's four engines, it can conserve fuel while maintaining covert or overt surveillance of a TOI for extended periods. As the HC-130H is a large aircraft, covert surveillance is best performed by tracking a target using the APS-137 radar.

A.4.2 HU-25A/B/C Falcon. The HU-25 is the Coast Guard's medium range surveillance airframe. It is a relatively high-speed jet aircraft capable of speeds of 350 knots at sea level and over 400 knots at altitude.

The HU-25 has two large search windows in its main cabin designed to enhance its surveillance and search effectiveness. The aircraft has moderate endurance but can remain airborne for less than half the time of an HC-130H. This aircraft has excellent communications capabilities, both in the clear and secure modes, but does not possess a Navy-standard data link.

There are three variants of the HU-25 Falcon.

1. The A model offers a good surface search APS-127 radar and crew members can use handheld NVD to search for dimly lit targets.

2. The B model is designed primarily to search for and track oil spills; its SLAR unit and associated equipment make them especially useful in this role. The Coast Guard stations both of its HU-25B aircraft in Corpus Christi, Texas, and these aircraft deploy worldwide on oil tracking missions. The installed KS-87B camera takes high definition aerial reconnaissance photographs. Due to its extra equipment pods, the HU-25B has roughly 15% less endurance than the HU-25A.

3. The HU-25C is designed for air interdiction: it is equipped with the outstanding APG-66 radar that offers air-to-air, surface search, weather detection, and ground mapping capabilities. The associated WF-360 FLIR system provides the ability to track heat or infrared signatures.

A.4.3 HH-60J Jayhawk. The HH-60J is a medium range, twin-engine, single-rotor aircraft. The strengths of the aircraft include its load capacity, speed, and range. It has moderate endurance and can patrol at a maximum endurance airspeed of 70 knots for over six hours.

The HH-60J has good communications and sensor equipment. It can communicate on VHF-AM, VHF-FM, HF, and UHF but does not have SATCOM or data link. The RDR-1000C radar can be used for weather detection, surface search, or ground mapping, and is relatively effective for detecting mid-sized and small surface targets. A turret mounted FLIR can be attached and the FLIR image captured on videotape. All HH-60J pilots are qualified to fly wearing NVGs for night operations.

The HH-60J can operate from 270-foot WMECs (hulls 905-913 only) and 378-foot WHECs, although safety margins aboard 378s are reduced due to minimal rotor blade clearances with flight deck obstructions. Because HH-60J's only sporadically deploy aboard cutters most aircraft commanders do not hold current shipboard landing qualifications.

A.4.4 HH-65A Dolphin. The HH-65A is a short-range recovery aircraft. This twin-engine, single-rotor helicopter is fully equipped for instrument flight

conditions but is prohibited from flying in known icing conditions. The strengths of this aircraft include its speed, flexibility, and integrated electronics package.

The HH-65A has good communications equipment but limited sensors. Radios include VHF-AM, VHF-FM, HF, and UHF; secure communications are available on UHF and VHF-FM frequencies. The Dolphin has no data link or SATCOM equipment. The aircraft's weather radar is moderately useful for surface search but is relatively ineffective for locating small or stealthy targets. Aircrews use NVD to search for dimly lit targets and some aircraft carry handheld FLIR video cameras to enhance sensor capabilities.

Navigation inputs are processed through a central mission computer unit, which can generate search patterns from pilot-provided input. This minimizes the attention needed to navigate the aircraft and maximizes search effectiveness.

Endurance of the HH-65A is limited with a maximum endurance profile at 75 knots of 3.5 hours. The aircraft can sprint at speeds up to 165 knots for short periods and sustain speeds of over 140 knots.

The HH-65A is the Coast Guard's standard shipboard-deployable aircraft and operates from 378-foot WHECs and 270 and 210-foot WMECs. However, safety margins are reduced aboard 378s due to minimal clearances between the aircraft's rotor blades and flight deck obstructions.

	HC-130H	***HU-25A/B/C***
Endurance (max)	14:00 hours	5:45 hours (15% less for HU-25B)
Normal mission	8:00 hours	4:00 hours (15% less for HU-25B)
Normal patrol Speed	200 ktas	180 ktas
Maximum speed	315 ktas	410 ktas
Maximum range	3500 nm	1940 nm
Radius of action (.5 hr on scene)	1600 nm	800 nm
Crew size	2 pilots, 5 aircrew	2 pilots, 3 aircrew
Sensors	APS-137 radar SLAR (some a/c) TI-51 FLIR (some a/c) Handheld NVD	**HU-25A:** APS-127 radar Handheld NVD **HU-25B:** APS-127 radar SLAR KS-87B camera **HU-25C:** APG-66 radar WF-360 FLIR Handheld NVD
Communications	2-UHF/VHF-AM * (VHF-FM capable, in clear mode only) 1-VHF-FM 2-HF * 1-SATCOM *	2-VHF-AM 1-VHF-FM * 1-UHF * 2-HF * **In addition, HU-25C only:** 1-SATCOM 1-COTHEN

Note: * denotes secure capability

Figure A-5. Coast Guard Aircraft Capabilities

	HH-65A	*HH-60J*
Endurance (max)	3:30 hours	6:00 hours
Normal mission	2:30 hours (shore based) 2:00 hours (ship based)	4:00 hours
Normal patrol Speed	90-100 ktas	125 ktas
Maximum speed	165 ktas	180 ktas
Maximum range	375 nm	700 nm
Radius of action (.5 hr on scene)	150 nm	300 nm
Crew size	2/1 pilots 2 aircrew (3 if rescue swimmer or corpsman added)	2 pilots 2 aircrew (3 if rescue swimmer or corpsman added)
Sensors	Weather radar (limited for surface search) AN-AVS-6 NVD	Weather and surface search radar AAQ-15 FLIR (not all a/c) NVG
Communications	2-VHF-AM 1-VHF-FM * 1-UHF * 1-HF	2-VHF-AM/UHF * (VHF-FM capable, in clear mode only) 1-HF *

Note: * denotes secure capability

Figure A-6. Coast Guard Aircraft Capabilities (continued)

US COAST GUARD CUTTER TONNAGES

Cutter Name	Displacement (Full Load)*	Gross Tonnage **
HEALY	17,170	9787
POLAR CLASS	13,623	7765
MACKINAW	5252	2994
WHEC (378 FT)	3050	1740
ALEX HALEY	2929	1670
WLB (225 FT)	2000	1140
WMEC (270 FT)	1780	1015
WMEC (210 FT)	1050	598
ACHUSHNET	1746	995
STORIS	1916	1092
EAGLE	1816	1035
WLB (180 FT)	1038	591
WLM (175 FT)	840	478

* Full Load Displacement Values from Combat Fleets of the World, 2000 edition

** Gross Tonnage = Displacement Tonnage x .57 (Reference: Marine Safety Manual, Vol. III, COMDTINST M16000.8B, page 2-2)

Compiled by: Command & Operations School, November 2000

CHAPTER 5: SHIPHANDLING AND BOATHANDLING

A. General.

1. Purpose. This chapter discusses the fundamental principles involved in maneuvering single and twin screw vessels. The purpose is **NOT** to discuss in detail every potential maneuvering situation or to prescribe a correct way to approach a given shiphandling evolution. It is important to note that shiphandling, in the broadest sense, covers the maneuvering spectrum from being Dead in the Water (DIW) to full speed ahead. In this chapter we will limit the discussion to the lower, slower end of that spectrum. Since there are numerous publications written on the science of shiphandling (and many incorporate examples from the most experienced masters), it is recommended that all cutters obtain a cross section of these and incorporate them into their training programs. *Naval Shiphandling* and *Knight's Modern Seamanship* are both good reference books.

2. Shiphandling in AtoN Work. Shiphandling, especially in aids to navigation work, is an art learned by constant study, analysis, experiment, and practice (in short, experience). For a conning officer to develop, he/she must first possess an understanding of the fundamental effects of a ship's rudder, propeller(s), and general characteristics on the marine environment and apply that to his/her experiences. Good shiphandling is essential in aids to navigation work from the standpoints of safety and operational efficiency. When setting or retrieving buoys, one is often required to put a ship in places where no prudent seaman would voluntarily go. Constant vigilance is the watchword when working aids to navigation. The slightest inattention on the part of the shiphandler when a buoy is alongside or being hoisted can easily and immediately cause damage to the ship or injury to the crew.

3. Providing Development Opportunities. It is essential that Officers-In-Charge and Commanding Officers provide ample shiphandling opportunities for junior personnel. This should include a review of the evolution so errors in planned procedures can be worked out before hand. During the early stages of skill development, the conning officer should plot out all actions ahead of time, using vector diagrams. They can be sketched out quickly, until experience allows him/her to picture the situation. It is helpful to use these diagrams both to analyze shiphandling evolutions of other conning officers and to rehearse recurring situations that your vessel often finds itself in. Wardroom chalk talks and constructive critiques after shiphandling evaluations are valuable teaching tools.

B. Shiphandling Hints.

1. Principal Factors. The principal factors involved with the handling of a ship are the length, displacement, draft, speed (power), depth of water, force and direction of the wind and current, space available for maneuvering, and the effect of rudder and engines. Although buoy tenders may be either single or twin screw, the basic principles involving each are similar. In most instances, these principles may be

described for large vessels, but they apply to smaller tenders as well.

2. Proper Watch Atmosphere. The conning officer must demand that the bridge is taut and quiet. There should be no excitement or confusion when conning operations are being carried out. A few quiet, well articulated commands to the helm and judicious applications of the engine are all that is needed for well-trained personnel. The conning officer should ensure the absence of frivolity or loud, boisterous behavior from the watch team. Exuberant reports to the conning officer from the watch team will raise the tension level, contribute to tunnel vision situations, and cause confusion. Particular care should be given to using standard commands. Nonstandard commands can be easily misunderstood and cause additional confusion.

3. Avoid Deception. The marine world is a dynamic, constantly changing environment. One should never expect a ship to handle exactly the same as it did the last time he/she was in the same situation. Conditions will never be exactly the same. One should always be on the alert for a sudden sheer when transiting a confined channel or approaching a dock. A quick shot full ahead or back for a short period with the engine will break the sheer and straighten the ship out, provided too much way is not on. Speed through the water is deceptive. Keep a close eye on your overboard discharge and on relative movement of objects directly on your beam. While approaching a buoy and looking solely ahead, it may appear that the ship is almost stopped. In fact, you may be contemplating giving the engine a shot ahead. As soon as the buoy gets past the bow and is coming alongside, usually, the ship is moving faster than initially thought. **Remember you can always add speed to come ahead, but you cannot always take speed off quickly enough.**

   a. Full ahead on the engine in maneuvering should not be confused with speed. Although it is desirable to maneuver the engines gently when close to a dock or a buoy, there will be times when a quick shot ahead or astern is desirable, without increasing headway. Using full rudder and two-thirds or full speed ahead for a brief interval will be much more satisfactory than prolonged use of the engine under less power. Fewer engine turns results in moving a greater distance ahead before the desired turn is achieved. This is especially true when dead in the water or moving slowly in the direction you wish to turn. It is always the strong initial thrust that has the greatest turning effect. Also, simply jamming the controller handle full ahead and then immediately bringing it to stop may not give this effect if the propeller does not have sufficient time to come up to speed. Remember, the intent is to impart a quick move to the cutter, without building up momentum. The sudden bark of the engines is not always discernible. The conning officer should pay attention to the prop wash.

   b. Another good reason for going slowly is the chance of mechanical or human failure. The pilothouse control may suddenly go dead, a circuit breaker may trip if you have moved the control too quickly, a man on deck may hold the spring line when you want it checked, etc. In any of these events, if your headway is minimal, you will probably have time to counteract what has happened.

   c. When approaching the dock or buoy, if you find that the ship has too much

headway or if for any reason you feel uncomfortable with the approach, don't hesitate to back and stop. There is nothing wrong with turning around and coming in again, with a more prudent plan. Do not jeopardize the safety of the ship or crew for the sake of "pulling off" an evolution that has deteriorated. **Your pride is not worth your crew's safety.**

d. In any maneuvering situation the conning officer may direct the maneuver by ordering compass courses or by ordering rudder angles. Tight maneuvers (i.e., final approach to buoys or docks) usually dictate the use of rudder angle orders which afford greater control of the maneuver. This enhanced control factor is particularly important for the inexperienced shiphandler and/or helmsman. Compass courses should rarely be used in a final approach.

e. Finally, the conning officer should be aware that larger rudder commands are required at slow speeds to produce the desired response from the ship. Five to ten degrees of rudder may have negligible effect at slow speed.

C. Principles of Rudder and Screw Effect (Twin-screw).

1. Position of the Rudder. In steering a twin screw vessel, the position of the rudder depends upon the direction the ship is moving through the water, and not the direction in which the propellers are turning. The various forces set up by the action of a single screw balance out on twin screws, and for that reason can be disregarded. As long as both screws are working ahead or astern at the same speed, the force of water against the face of the rudder will control the steering of the ship.

2. Headway and the Rudder. When the ship has headway, and a turn to the right is desired, apply right rudder. The ship's stern will swing to port and thus change the heading of the ship to the right, or starboard. The ship pivots on a point well forward of amidship, and the stern, not the bow, swings when the rudder is put over. This swing, away from the direction to which the rudder is applied, causes the ship to change to the desired heading. Due to momentum along the ship's original course, the ship will range ahead along an arc for a ship length or two before beginning to gain ground in the desired direction. The net distance traveled on the original course is called advance. The net distance traveled laterally before steadying on the new course is transfer. To turn to the left when going ahead, apply left rudder.

3. Sternway and the Rudder. When the ship has sternway, the rudder effect is the opposite. Right rudder when the ship is going astern causes the stern to move to the right, changing the heading of the ship to port. Left rudder, vice versa. A twin-screw ship steers similarly to an automobile.

4. Effect of Screws. When both screws are turning ahead or astern at the same speed, the ship, if not influenced by external factors of wind and current and with the rudder amidships, will move straight ahead or back. If either screw is working singly, a turning moment is created which will swing the ship away from the side on which the screw is acting. For example, if the starboard screw is turning ahead alone, the ship will swing to port. If backing, then the ship's bow will turn toward the side which has the engine turning at the slower speed. The greater difference in speed, the sharper

the turn. When screws are opposed, the ship's bow will turn toward the side that is backing. Whether the ship will have headway or sternway will depend on the difference between the relative speed and power of the two engines and the amount of way that was on the ship when the operation was begun. To turn a twin-screw ship in place, the relative speed of the respective engines must be adjusted until they balance each other, discounting the effects of wind and current. In screws working opposed, remember that the screw backing must turn faster than the screw going ahead in order to balance the thrust. In turning a ship in place, it may be necessary to alternately stop and start the engine. Under some conditions, one screw backing two-thirds will about balance the other screw going ahead one third. The process of splitting the screws of a twin screw vessel and turning in place is called twisting.

5. Rudder and Screws. As stated before, the rudder is used in relation to the direction of motion of the ship through the water rather than in relation to the direction of rotation of the propellers. For example, when going ahead on both screws and it is desired to turn to starboard sharply, stop and back the starboard screw and apply full right rudder. However, when having sternway and desiring to turn the ship to starboard (stern to port), go ahead on the port engine, back on the starboard engine and full left rudder. When the ship is being swung in place with no way on, the rudder should be left amidships.

6. Steerage. When the ship is dead in the water, or nearly so, the ship lacks steerage way and the rudder will have little or no effect. This is true as the ship loses her way when coming to a stop or when starting to make way after being stopped. Control must then be accomplished with the engines until steerageway is gained.

7. Know Your Ship. The conning officer should know certain individual characteristics of his ship. For example, how much power to expect when certain speeds are ordered, how long it takes the engines to reverse, how far the ship will travel if the engines are reversed at various speeds, what effect certain degrees of rudder angle have, the diameter of the ship's turning circle, etc.

8. Standard Helm Commands. Since the standard orders to the helmsman should be familiar to all (they may be found in any standard text on seamanship and should be included in the CO's standing orders) they will not be repeated here. However, it is emphasized that only standard terminology should be employed. A confused helmsman can easily cause an accident.

D. Principles of Rudder and Screw Effect (Single-screw).

1. Propeller. In the following discussion, a right hand propeller is assumed.

2. Going ahead. The effect of the rudder is the same as described for twin-screw vessel when going ahead. Right rudder turns the ship's head to the right, left rudder to the left, and the ship pivots in a similar manner to a twin-screw vessel. Conversely, if there is no countering effect of the rudder, the sidewise thrust of the screw going ahead will swing the stern to starboard. This is more pronounced when the ship is starting to move after being dead in the water. An example of this tendency in a prolonged setting can be observed while breaking ice. The ship's head will naturally

"fall off" to port.

3. Backing. A different problem is involved when backing. The sidewise thrust of the backing screw has a tendency to swing the ship's stern to port. The sidewise thrust exerts the most effect at full speed astern. Additionally, the rudder has little effect until the vessel has gained considerable sternway. If the sidewise thrust of the screw to port is not too strong, the vessel may mind its helm and back "to the rudder." A single-screw vessel is more easily affected by current and wind when backing. It is a tendency of most vessels to back into the wind.

4. Combinations. The following are brief discussions of some possible combinations:

   a. Ship and screw going ahead. If the ship is stopped and the screw starts turning ahead, the screw current striking the rudder causes the ship to turn in the direction the rudder is put over. As the vessel gathers way, the effect of the screw current is lessened and the normal action of the rudder takes control. This is why a short application of full power ahead when the ship is stopped exerts the strongest turning effect without causing much advance. This is a most useful maneuver, but one which many shiphandlers are apparently hesitant to use. When the ship is proceeding normally and the rudder is suddenly put hard over, the stern will first move away from the direction of the turn. The ship then crabs off in the same direction as it slowly begins to turn. Due to momentum along the ship's original course, the ship will range ahead along an arc for a ship length or two before beginning to gain ground in the desired direction. The net distance traveled on the original course is called advance. The net distance traveled laterally before steadying on the new course is transfer.

   b. Ship and screw going astern. In this case the steering effect of the rudder is negligible until the ship gathers sufficient sternway. Meanwhile the screw current has started to swing the vessel's stern to port. However, if the screw is backed slowly, minimizing its thrust, full right rudder will take increasing effect and the stern will swing to starboard as sternway increases. If the rudder is put full left, the stern will swing rapidly to port. This tendency can be useful when turning in a short narrow space, provided the ship is turned to the right. By alternating full ahead on right rudder and full astern on left rudder, a ship may be turned quickly in a small area. The wind has a strong effect on vessels going astern. If there is much wind, the ship will back its stern up into it regardless of rudder or screw. Therefore, when turning in a narrow space with wind on one bow, make the turn away from the wind, backing the engine when the wind is well abaft the beam.

   c. Ship going ahead, screw going astern. It must not be assumed that the rudder will still affect the ship's head while the ship has headway. As soon as the screw is reversed, new forces are brought into effect. If the rudder is left amidships, the ship's head will fall off to starboard. If the rudder is put full right at the instant the screw starts astern, the ship's head will swing to starboard at first. The bow may continue going to the right but usually will stop, then slowly swing to port, the stern swinging to starboard as the ship gathers sternway and minds its helm. If the rudder is put full left at the instant the screw starts astern, the bow will swing

slightly to the left at first, but as speed decreases it will fall off to starboard, since all forces are acting together to swing the stern to port.

d. Ship going astern, screw going ahead. If the rudder is amidships, the sidewise pressure of the screw blades counterbalances the discharge current striking the rudder, and it is not possible to predict the direction in which the ship will swing. If the rudder is put full right, the stern will go rapidly to port; if put full left, the stern goes rapidly to starboard. However, if the ship is making considerable sternway and full power is not being used, the steering effect of the rudder may cause the ship to back to her rudder until the sternway has decreased, when the discharge current of the screw takes effect and causes the ship to react as described above.

e. Clarification. In the two cases described above, of a ship going ahead with screw backing and a ship going astern with screw going ahead, the predictions of the ship's action are predicated on the use of full power on the screw under average conditions. Should speed through the water be high and only half power used, some of the tendencies noted may be reversed.

f. A swinging ship carries considerable momentum and tends to swing in the direction in which it started. Therefore, if conditions permit, start the swing with the rudder before using the engine to change the direction of the ship's movement. In this manner, the swing can be started in the right direction and the rudder and engines used to best advantage to continue the swing. When maneuvering a single-screw ship, remember that the position of the rudder depends on what the propeller is doing rather than on the direction of the motion of the ship through the water.

g. Different conditions. Remember that differences in trim, wind, sea, current, suction of the bottom, size of rudder, and propeller all produce new forces, or modify existing forces. Vessels may at times act in a manner other than predicted.

E. Bow Thrusters.

1. General. The traditional principles of shiphandling apply directly to the control of the ship's stern and indirectly to the ship's bow. In essence, one moves the bow by controlling the movement of the stern. Bow thrusters introduce another dimension to shiphandling. They allow the shiphandler to control both stern *and* bow. This enables the ship to work in conditions, side currents, and winds, that made some work previously impossible...or at least unthinkable. Considering the extra capabilities the bow thruster provides, conning officers should take extra care not to place the ship in situations where loss of the bow thruster would leave the ship in a dangerous situation.

2. Operation. Operation of the conventional bow thruster is simple. The screw, situated in an athwartships tunnel, is turned in opposite directions to produce thrust to either side. The value to the conning officer is readily apparent. He/she can now wind the bow into a buoy or pier or away from it. In a loss of steering situation, the bow thruster may be used to maneuver the ship. When working a buoy or launching a small boat, the bow thruster can be used to maintain the ship's heading without

employing the screws and rudder or risking developing headway. When backing, the bowthruster can be employed like a rudder making it possible to back down more narrow channels. Note that the bow thruster has its greatest effect at slow speeds. As the speed of the ship is increased, the effect diminishes. At two-thirds speed, the bow thruster will have almost no effect.

3. Combinations. When used in combination with the maneuvers listed in 5-C and 5-D above, a multitude of maneuvers are possible.

F. Maneuvering With the Bow Thruster.

1. General. Bow thrusters improve the maneuverability of vessels. Their installation greatly reduces the wear and tear on main engines, extending their useful life.

2. Walking. The basic principle behind walking a ship sideways is to thrust in the direction you want to move and put the rudder in the opposite direction. Since the stern moves opposite the direction of the turn, a vessel walking to port is thrusting to port with right rudder. Another way to walk sideways, on a twin screw vessel, is to thrust in the direction you want to go and twist in the opposite.

3. As a Rudder. Bow thrusters can act as a rudder when a vessel is backing. A single screw vessel with rudder amidships can back in a straight line steering only with the bow thruster. The evolution is carried off at slow speed. In this instance the stern becomes the bow. To turn the new bow to starboard you thrust to port and vice versa. Twin screw vessels equipped with a bow thruster can oppose screws and use their thruster to spin them 360° in the ship's length. They also can make the vessel go sideways for a short distance.

4. Approaching a Buoy. When approaching a buoy close aboard, take care not to catch the buoy in the prop wash from the bow thruster, as this can cause the buoy to move rapidly away from the ship. If this happens, however, simply stop the bow thruster and wait for the buoy to swing back toward the ship. Do not apply the bow thruster in the opposite direction, hoping to bring the buoy alongside. The buoy, when swinging back towards its original position may move into the side of the ship or dive under the hull. Conning officers must learn in which area off the bow the buoy will be affected by the bow thruster wake and plan their actions accordingly. The prop wash can be used to the conning officer's advantage occasionally by providing a cushion between the ship's bow and a pier.

5. Fouling. As with all machinery, bow thrusters require special care to keep them operating properly. Care must be taken not to allow debris to be sucked into the propeller.

6. Noise. The bow thruster engine is quite noisy and makes deck communication difficult. Have prearranged signals worked out so communication between the bridge and safety observer is not interrupted. The use of portable radios, sound powered phones, or radio-headsets is encouraged.

7. Casualties. Operations and training without using the thruster is encouraged. This will assist in preparing conning officers to handle the vessel if the bow thruster fails.

G. Maneuvering Around Buoys.

1. General.

a. Maneuvering a buoy tender into the exact spot where a buoy is to be moored is not an easy task except under the most favorable conditions of wind and current. However, with a thorough understanding of the principles of handling ships in general, a knowledge gained from experience concerning the peculiarities of the individual ship, and a pilot's knowledge of the local conditions, a tender conning officer may maneuver the ship to drop the buoy's mooring with accuracy.

b. The following things should be considered by the conning officer before working a buoy.

(1) Current will have considerably more effect on your ship than wind. When the current is more than one knot you can usually ignore the effect of wind.

(2) Headway or sternway will allow easier maneuvering. Water across the rudder provides the turning force.

(3) A single screw cutter tends to back to port; however, it will eventually back into a strong wind as the side forces of the screw lessen due to increasing sternway. This lessening allows the force of the wind, acting on the sail area of the bow, to take over and push the bow to port (for a wind from the starboard side) causing a swing to starboard. A twin screw vessel can be backed straight by judicious application of screw(s) and rudder(s) but it will also want to back into a strong wind.

(4) With headway, a cutter's pivot point is usually somewhere just abaft amidships. Without headway, it tends to move forward, away from the applied forces of screw/rudder.

(5) In making a slow approach to a buoy, it will seem that the ship will never reach the desired objective. There is a point where the object, which has been moving almost imperceptibly, suddenly picks up speed. Find this point for your own reaction time.

(6) Cutter movement can be detected immediately by the use of natural ranges ashore.

(7) Discover how to give your crew the steadiest deck condition for working under any wind and wave conditions.

(8) Find out where your cutter's sail areas are for any wind conditions, and how wind will turn you or cause you to drift sideways. Certain rules of thumb will emerge for your particular ship. The wind has the same effect as current or a bow thruster but is acting on the portion of the vessel out of the water and not on the underwater hull.

(9) Practice crabbing your vessel across a current before you reach the buoy. See how much it takes to cause your bow to fall off to either side, and

what combinations return you to a stemming position most effectively. Discover as many combinations of screw/rudder as you can to achieve and hold equilibrium in a current. Often a vessel can maintain station in a current by applying a few turns and steering a particular heading. However, the vessel's position must be constantly evaluated so momentum will not be built in any particular direction, or to adjust to a change in wind or current.

(10) Learn to make your ship respond by using the elements. Never think of fighting wind or current; rather think of how best to use vector forces to assist you in handling the ship. On vessels without a bow thruster the wind and current can be used very effectively to maneuver around a buoy or for mooring. Ice also can be used very effectively as a maneuvering tool.

(11) In approaching a tight situation, try to consider all escape routes open to you and what forces you would apply to get clear. DON'T EVER GO IN WITHOUT LOOKING OVER SEVERAL WAYS OUT!

2. Approaching the Buoy.

a. Before approaching a buoy, consider the wind, current, swells, location of foul ground, and channel traffic. Take a fix to insure your position and that of the buoy in relation to shoals, etc. Unless local conditions make it inadvisable, it has been found that a buoy is best approached with the ship heading into the wind, seas, or current. Base your approach on whichever is the controlling or strongest factor. This permits the vessel to approach slowly, be stopped and straightened out if necessary. When alongside the buoy, it allows a quick application of rudder and engine, to correct a cant of the bow to either side, or to prevent drifting astern. Control your vessel so no quick water (wash) rises near a buoy about to be picked up. Never hook into a buoy while the vessel is in motion.

b. When approaching a buoy the wind or current may be brought a little on the opposite side to insure that the ship will set alongside the buoy. Once the buoy is hooked on, the bow of the tender must be turned back into the wind or current to avoid placing unnecessary strain on the gear. Keeping an eye on the flags or anemometer, or mounting a pennant or windsock on the jack will make maneuvering much easier. Experience is most important in this respect. Keeping the buoy or chain close aboard so hooking in and hoisting will be safer and easier, yet not allowing the ship to set down on the buoy or mooring, is very important. At no time should the bow be permitted to swing away from the current or wind so that the ship is set away from the mooring. Should this happen, hold everything and stand well clear on deck until the ship can be brought back under control by judicious backing and filling. After gaining experience you should be able to predict the next move required to keep the chain up and down based only on the amount and direction the vessel is off the wind.

c. For large buoys with a heavy mooring, many tenders work with the wind a point or two on the opposite bow to insure that the chain will lay alongside. However, if a ship is permitted to be set down on a lighted buoy, it may be dragged, or keel

hauled. This will result in damage to the buoy's lantern and superstructure.

d. If the buoy is located close to a shoal, rocks or other obstruction, do not assume that it is on station and proceed blindly. Take danger bearings, position angles, soundings and approach carefully in every case. Determine the position of the buoy and the shoal before starting your approach. Remember that you are being called upon to take your ship into situations the ordinary mariner would avoid. In working buoys located in shallow water the following points may be of assistance:

(1) Watch your bottom contours. Use the information provided by your fathometer, leadline or small boats in approaching an aid and determining its correct position.

(2) Use the small boats as much as possible to work aids in shallow waters. They should also be used to sound and mark the work area.

(3) It is often difficult to judge the speed of advance of the tender due to the presence of current. Watch natural ranges for an indication or carry some small pieces of driftwood to be dropped overboard to gauge movement or current.

(4) Identify a prominent object or natural range to steer on rather than give numerous rudder orders. Under certain conditions it may be better to give courses for the helm to steer.

(5) When entering a restricted area ensure that all charts are the largest scale available. All danger ranges and bearings should be on all charts in use.

(6) Personnel shall be assigned to monitor danger ranges and danger bearings. This person shall have no other duties assigned. Personnel assigned these tasks shall provide regular and timely updates to the conning officer and Commanding Officer. If the vessel is standing into danger the personnel assigned these duties shall immediately notify the conning officer and Commanding Officer and shall receive acknowledgment from them that they understand the situation.

3. Dredging the Anchor to Work Buoys. Buoys can be worked by dredging the anchor with the wind on the beam or stern in tight situations. The amount of anchor and chain needed varies with each situation and some trial and error is necessary to get the right scope. A good starting point is one and a half times the water's depth. The only hard and fast rule is that the anchor should never be across the bow but should tend from the side on which it is dropped.

4. Approaching the Buoy Down Wind Or With Following Current.

a. Occasionally local conditions require that a buoy be approached down wind or with a following current. In this case remember to approach the buoy with less headway as the ship is moving faster over the ground. In working offshore, in a moderate swell, the greatest stability of a vessel is usually obtained by holding the stern to the sea. The buoys may then be prepared with the least difficulty and danger.

b. The cutter may be positioned to permit it to proceed on the desired heading while the buoy is being prepared. This will place the vessel in the correct position when the buoy is readied for letting go.

c. When working with the wind astern with a single screw ship, take care not to get the wind too far on either quarter. Be especially aware of keeping the wind off starboard quarter, when working alongside a hazard with an onshore wind. Should the wind get too far around on the quarter, when the ship is backed to clear the buoy it may not have space to back into the wind. The result is ending up broadside on the hazard due to the setting action of the wind. The installation of bow thrusters on some tenders has eased this maneuver for those tenders.

d. As stated above, some ships lay more quietly stern to the sea. Buoys, unapproachable in rough weather in normal fashion (i.e., ship heading into the wind and seas), may be worked with the sea astern.

e. Working aids stern to the wind or sea requires excellent shiphandling skills and use of good judgment. If reasonably possible, breaking off to return another day when conditions improve is not the sign of a poor seaman, but a prudent one.

5. Approaching a Marker Buoy. COMDTINST M16500.1 (series), Aids to Navigation Manual - Positioning, deals comprehensively with the various methods of locating the position of a buoy. Assuming that the exact station of the buoy has been located and marked with a small marker buoy, the problem remains to bring the ship to that spot so the buoy sinker may be dropped exactly on station. Care must be taken in approaching the small marker buoy. The slightest setting down of the ship on the marker will drag it off position. Remember, a marker is only a reference point, once a ship has touched a marker buoy, do not trust its position further; take new angles or position and verify. If a ship approaches a marker buoy with too much headway and has to back down furiously to prevent overreaching, the wash propwash from the bow thruster may shift the marker out of position. In fast current areas, marker buoys are often ineffective. The sinker size required to keep the marker stationary quickly becomes too large to deploy from the focsle. In fast current the use of a range, if available, is preferred.

6. Handling A Tender Alongside Buoy.

a. A competent shiphandler should be able to work buoys on either side of the tender; working port side to with a single screw provides the best advantage. This enables the conning officer to throw the bow away from the buoy when backing.

b. It is wise to keep the buoy forward of the vessel's pivot point, particularly for single screw ships. Most good shiphandlers have a rule that a buoy should never be allowed to get past the pilothouse. In this manner, the shiphandler can always move the bow quickly toward or away from the buoy. With the buoy abaft the pivot point, appreciable time is consumed before the ship will move in the desired direction. In handling buoys alongside as well as in approaching them, keep wind and current in mind constantly.

c. While approaching, the stronger of the wind or current (if opposed) is determined, and the vessel stemmed in that direction. However, eddies near the buoy can change conditions observed a few yards away. Sometimes a heading which is a compromise between the two forces will serve best to keep the ship steady alongside the buoy. In this case, a natural range off the beam and off the bow simplifies station keeping.

d. The importance of not permitting the weight of the ship to bear heavily against or away from the mooring cannot be emphasized enough. This problem plagues the shiphandler not only in approaching and initially hooking in, but remains as long as the vessel has the buoy alongside. Even when a buoy has been hoisted and griped down, the conning officer must remain alert and be ready to maneuver to maintain chain position.

e. Without natural ranges to assist, you must rely upon "moving chain reports" for station keeping. If you cannot see the chain, then you must rely on the chain caller and you must be attentive to the chain reports.

f. Take care not to build up way on the vessel while maneuvering to hold the ship alongside the buoy. Counteracting ship motion may require vigorous corrective action. This can easily evolve into a vicious cycle with disastrous results.

7. Working in a Narrow Channel. If the wind is on one side of the channel and the cutter is to relieve a series of buoys, relieve the buoys on the windward side first. If the wind has not changed when it comes time to work the leeward buoys, use an anchor to help keep the tender off the bank or shoal. If the channel is wide enough to permit the tender to work across the channel, work the buoys stern to the wind. If it is necessary for a tender to go up a narrow channel to relieve buoys and there is insufficient room to turn around, go up with the flood tide, drop an anchor to swing on, and work the buoys on the way out, stemming the current. If more favorable conditions are predicted, prudence dictates that you wait.

8. In Shallow Waters.

a. It is generally best to bring a tender into an area of shallow or uncertain depths during high tide. While this may be necessary on some occasions, for example when turning room only exists at high tide, there are times when it is not the best course of action. For example, it may be easier to detect hazards, and thus to avoid them, at low water. Also, should a vessel ground at low water, its chances of refloating during the subsequent flood would be far greater than if it were to ground at high, or even half, tide.

b. When working buoys where there is insufficient water to float the ship at low tide, it is best to work the buoys on a rising tide. This will help to avoid being caught and laying aground over a full tide interval. Certain types of hull forms may safely rest aground without capsizing. The ship should rise on the following tide if maintained absolutely watertight, and if there is not excessive mud suction.

c. Working buoys with the anchor at short stay is not recommended on rocky bottom or when working near a dangerous rock in tidal waters. It may snag and

delay the prompt departure of the vessel long enough for damage to be sustained.

9. Miscellaneous Suggestions.

a. It is easier to add headway (momentum) than to take it off when working in tight quarters.

b. Remember to work with the elements rather than forcing the ship against them.

c. When working in swells with contrary wind or current, stem the swells, if possible, to minimize rolling.

d. Single screw tenders prefer to work buoys from the port side. This is because of the tendency of the bow to swing clear of the buoy as the ship is backing away.

e. When working buoys in shoal areas, take advantage of any stage of the tide or current that will tend to keep you off the shoal. Similarly take advantage of wind conditions.

f. Bear in mind that it is possible to set a buoy under sea and weather conditions that would make it dangerous to pick up a buoy.

g. If a choice must be made between maintaining the proper attitude of the vessel or staying on the buoy's charted position, seek safe water. The ship can always be maneuvered back to AP after the buoy deck has been secured and the buoy made ready to let go.

h. After the cutter is made fast to the buoy, find reference points on shore to detect any dragging. Once a ship fetches up on the mooring and does not drag, it is good practice to allow the ship to lay to the mooring and not work the engines unless necessary.

i. When backing away from a buoy, take care that the cage of a lighted buoy does not foul the anchor. Also, ensure that boats are not rigged out on the same side that buoys are being worked.

j. When setting a buoy, it is a good practice to have the wind or current a bit on the working side as the buoy goes overboard. This will facilitate backing clear, with the wind or current helping to set the ship off of the buoy.

k. When working in close quarters, it may become necessary to back the ship away from the danger before getting the mooring aboard. A cutting torch should always be immediately available on deck when working buoys, and more than one crew member should be trained in its use.

l. When a vessel equipped with a mechanical chain stopper is in a tight place, the chain may be quickly secured in the stopper and the vessel backed away to safety dragging the mooring along. However, in any case of dragging a mooring, unshackle the buoy and secure the chain with a pelican hook if time and conditions permit, as an added precaution.

m. The conning officer generally starts to maneuver the bow of the ship away from the buoy (so as not to damage the lantern) just after it is set. At the same time,

the crew is clearing the hoisting tackle from the bale on the buoy. This maneuver should not be premature or too drastic until it is sure that the hoisting tackle is completely unhooked and clear of the buoy.

n. As the ship swings away from a buoy do not attempt to clear the buoy by putting the engines ahead without insuring that your stern and screw(s) will not foul the mooring chain. Never put your screw(s) near a buoy's mooring chain.

o. When working in open waters, head the ship on a course to minimize rolling when buoys are being hoisted or moved. In rough weather await a quiet interval when the ship is fairly steady before making any hazardous lift. Also remember that lifting a load off the deck has an adverse effect on the ship's stability, usually causing an increase in the roll period. (See Chapter 7)

p. Should a buoy start to swing wildly, a quick buoy deck supervisor will touch it to the deck just enough to steady it, taking care not to give it enough slack to become unhooked. A couple of blocks or wedges can be thrown under the buoy. The preferred practice is to use steadying crossdeck lines of ample size and never give the buoy a chance to move uncontrolled. Should a buoy break loose and take charge, it is possible to lower the boom right down on top of it and wedge it over against the bulwarks or up against another buoy until it can be secured. This may be a little hard on the gear but it is nothing compared to what the buoy could do if permitted to take charge.

q. On sideloading buoy tenders, there is danger in permitting the ship to move ahead too far with a buoy over the side and suspended from the boom. If the boom happens to be topped high and the buoy starts moving aft alongside the ship, the boom may jackknife back over the bridge, resulting in extensive damage and possible injury. The use of a preventer (the whip leading to the opposite deck & forward), may prevent this condition.

r. Twin screw tenders are noted for their different handling characteristics. Some can be easily turned in their own lengths, others need plenty of headway or sternway, even in little wind. Nearly all twin screw tenders require way through the water before being able to turn in high winds.

s. There is never a time when working an aid takes precedence over your ship and the people aboard it. The decision to work a buoy is always the commanding officer's, but even after starting it may be necessary to break off work and secure until another opportunity presents itself. Our aids are highly reliable and long lived. Servicing operations are planned to occur before visiting the aid becomes imperative; therefore, commanding officers have latitude in backing off and returning at another date.

t. When departing an area where a buoy has been removed for the season, proceed in a direction, including turns, away from the shallows. Never turn toward the shoal. Keep constant fixes, never rely on old information; you may have been set by the elements back toward the shoal. If you are in doubt, stop the vessel and determine where you are. If you need assistance to control the situation, get help.

H. Towing.

Aids to navigation tenders are occasionally called upon to tow other vessels. General facts about towing are given in *Knight's* and other standard texts on seamanship. Some vessels, especially those that push a barge, are not the best platform available for towing. The 65' and 75' WLRs and WLICs, should be used to tow only as a last resort and should never attempt to tow unless mated to their barges. All buoytenders shall ensure that their towing kits are complete and ready for use at all times.

I. Small Boat Handling.

1. General.

   a. An important phase of aids to navigation work involves the servicing of unattended shore aids. Frequently helicopters can be used for these servicing jobs. However, when other means are not available, the tenders' small boats must be employed. This requires competency in handling small boats and making landings on exposed coasts. Officers and crew who are experienced small boat crewmembers are essential for aids to navigation work.

   b. It must not be assumed that one who is an otherwise competent seaman has the necessary knowledge and experience to make small boat landings under dangerous conditions. This is an art in itself, requiring special knowledge and skill only acquired by practical experience. When undertaken by the inexperienced, the danger involved is very great.

   c. The handling of a small boat follows the principles of handling a single screw ship as described in previous sections, with due allowance being made for the difference in size.

   d. An excellent reference for small boat operations is COMDTINST M16114.5 (series), Boat Crew Seamanship Manual. Although written primarily for MLB and UTB boat crews, its sections on Marlinspike Seamanship, Safety Equipment, and Boathandling apply to all small boat crewmembers.

2. Lowering the Boat.

   a. A variety of davit types exist, including the articulating single point davits used to lower the RHIB on the WLB, and the hydraulic davits on the SLEP WLBs. The procedure below applies to MSBs, MCBs and any other boat lowered using crescent davits. The safety rules and procedures apply to all types of davits with the main differences being in number of hoist connections and weight distribution. On single point davits it is advisable to embark and disembark only the coxswain if the boat is not waterborne to prevent accidents during lowering and hoisting of the boat.

      (1) The boat is designated by the commanding officer through the officer of the deck. The crew don the appropriate survival gear, as dictated by the weather, take their positions, and clear away the gripes.

      (2) Frapping lines are used to keep the boat from swinging. Frapping lines are

passed around the falls and kept taut by men on deck. Most ships have a traveling lizard around the falls to which the frapping line is secured.

(3) Steadying lines should be secured in the boat. Many ships use only the frapping lines and sea painter. A sternfast line, if used, should be led well aft. Never place hands on the gunwale of a boat being lowered or hoisted or laying alongside another craft or solid object.

(4) Members of the boat crew stand by the falls and sea painter. When all is in order, deck supervisor commands "lower away together," or, if the boat is on the cargo boom or articulated davit and in chocks, "hoist away" and "swing out and lower away."

(5) Strain is taken on the frapping lines to steady the boat. Any slack in the sea painter and sternfast is taken in on deck. The sea painter is secured by a fid in the boat. A crew member stands by to clear the sea painter by pulling the fid when ordered by the coxswain.

(6) Crewmembers must tend the falls to keep them clear and to keep the blocks from striking members of the boat crew after the falls are let go. The boat must be lowered smartly, especially in rough weather. The falls must be lowered together, with the stern leading slightly.

(7) While being lowered, boat crewmembers shall hold firmly to the monkey lines. During lowering the monkey lines are laid over the side of the boat next to the ship. This keeps them from becoming tangled in the boat. The boat is not lowered entirely into the water until the deck supervisor determines that sea conditions are favorable and gives the order, "up behind." The persons, or in some cases person, tending the falls throw off the turns or otherwise allow the falls to pay out freely. The stern is kept lower than the bow during lowering to prevent the boat from digging into the seas and filling with water.

(8) As soon as the boat is waterborne, the coxswain commands "unhook aft" then "unhook forward." The after fall is always let go first unless the ship has sternway. Secure fore and aft falls via frapping lines immediately after unhooking. Expert boat handling is demanded. Sternfast and steadying lines are cast off and the coxswain gives the stern a sheer-in with rudder to get the bow out. The strain on the sea painter sheers the boat away from the ship's side.

(9) When clear of the side, the coxswain commands, "cast off the sea painter." When the boat is clear, the crew on deck should rapidly haul the sea painter aboard to prevent its being fouled in the boat's propeller.

3. Hoisting a Boat.

a. The same principles of good seamanship followed in lowering a boat are applied when hoisting it aboard ship. The most important task of coxswain and crew is to keep their craft away from the ship's side to prevent damage. The boat should

never have to wait for preparations on deck. Boat falls should be overhauled, led along the deck, and well manned or taken around the drum of the winch.

b. When all is ready on deck and a lee has been made, the boat comes alongside and the sea painter is passed. The ship must have some way on, and once the sea painter is passed and secured the boat lays back and tows on it.

c. By proper use of the rudder, the coxswain can now hold the boat at the desired position off the ship's side. By moving the rudder, the sheer-in of the stern may be lessened and the boat brought in slowly to the ship. If the boat should lurch toward the ship, the danger of crashing against the side may be offset quickly by increasing the sheer-in of the stern and sheer-out of the bow, with rudder. The strain on the sea painter will then pull the boat clear. Do not make the sheer-off so radical that the sea painter must be cast off to avoid swamping.

d. When the boat sheers in under the davits, the falls, and steadying lines are passed. A line should be led from the stern of the boat to a point well aft on the ship to prevent the boat from lurching forward when it leaves the water. This sternfast is essential if the ship is pitching.

e. Crewmembers tending the falls while hooking on should hold them upright by the handles on each side of the block until a strain is taken and the boat hoisted clear of the water. Thus the block will not snap and whip about as the boat rises and falls in the seas.

f. If at the davits, when all is ready on deck and in the boat, hook forward, then aft, and hoist away. The boat should be hoisted quickly and steadily. Boat fenders should again be used to keep the boat from being damaged against the side of the ship.

4. Running a Line.

a. There are numerous occasions when a boat crew may be called upon to run a ship's line to a buoy, another vessel, or dock. When so ordered, the crew will coil most of the line in the stern sheets, and leave enough in the bow to make fast when the landing is reached. Be sure to have enough line to reach, and have plenty of good seizing stuff (small line used for binding) for securing. Have a hatchet or knife handy for cutting. If moving with the tide, take less line than you would otherwise. If against the tide, it is better to take all the line in the boat, pull up, make fast, and then bring the end back to the ship.

b. When required to layout a long heavy line in a strong current it may be necessary to have two boats. One to run away with the end, the other to under run the line at intervals floating it and pulling upstream with the bight. This lessens the line's resistance to the current.

c. When necessary to tow a heavy length of line, do not make it fast to the stern of the boat. Take a turn around the cleats forward so the stern may be free to pivot. This may prevent the boat from being set constantly to leeward in heavy seas with no means of bringing the boat's head up to the seas or wind. Be careful to keep

the line out of the propeller. Always have a knife or hatchet handy in the boat.

5. Running Before a Sea. One of the more risky situations arises when a power boat is running before a sea. When the hull is lifted by the stern, there is danger that steerageway and power may be lost. This may occur when the screw and rudder are clear of the water. The boat may then swing around broadside to the seas and capsize. Coxswains must call upon all their skills and expertise in the use of the rudder to keep the stern to the heavy seas. It is helpful to reduce speed, and to allow large swells to roll by.

6. Running into a Sea. Running into a sea is less hazardous, but not without peril in bad weather. Reduced speed will lessen the strain on boat engine and hull. To this end, the throttle should be adjusted so the bow will rise with oncoming waves rather than drive into them. Taking seas on one bow is sound seamanship. Avoid the trough except in an emergency. When moving broadside to the waves, swing the boat momentarily to take larger wave crests on the weather bow, then return to course when conditions permit.

7. Boat Handling in Rough Water.

   a. The forces exerted by waves and breakers are tremendous and must be understood and respected. A poorly or improperly handled boat is almost sure to be swamped, broached, or pitchpoled.

   b. Swamping results from seas breaking into the boat or from permitting a breaker to strike the boat on the bow or quarter and slew the boat around until the seas are on the beam.

   c. Pitchpoling results from permitting the boat to ride on the shoreward or front side of the sea. The stern is elevated and the bow depressed into the slower water at the base of the breaker. As the resistance on the bow increases, the stern is raised higher and higher until the boat is toppled over, end for end and bottom up.

   d. Adequate speed to overcome the force of breakers must be used when heading into them. Use only speed necessary to keep the boat under control and prevent being carried back by the surf. Too much speed will have a tendency to drive the boat into the oncoming sea or cause the bow to fall too heavily after topping a sea and will place unnecessary strain on the boat.

   e. If at all possible, handle the boat so the heavier breaking seas are avoided. If this is not possible, maneuver the boat to meet the breakers squarely so their force will be equally distributed on each bow.

   f. In running with a surf, maneuver the boat so the seas will break ahead. Adjust speed to permit the breakers to pass the boat. Do not try to ride the surf. Trim the boat by the stern and keep the stern in such a position that overtaking breakers will meet the stern squarely with equal force on both sides.

8. Landing Through a Surf.

   a. Rubber boats are especially helpful in landing in surf, with the usual procedure

being to ride in on the back of a wave. The following points are suggested as possible methods for reducing the difficulties of a surf landing. Since surf conditions are dependent on such variables as tide and wind, the prudent boat handler will wait for particularly vicious surf to die down before attempting an otherwise hazardous landing.

b. When approaching the outer line of breakers, bear in mind that the height of the sea viewed from offshore is deceptive. The seas will appear much smaller and less dangerous from seaward than they actually are. Watch the succession of seas and begin the run for the beach during a comparatively mild interval. When the run is started, use enough speed to keep the boat under control. Be prepared to check the way of the boat to permit overtaking seas time to pass.

c. Landing may also be accomplished by using a surfline anchor. Drop an anchor from the stern of the boat just outside the breakers; keep a strain on the line and pay out the anchor line as the boat moves through the surf. The surge of the sea usually will carry the boat toward the beach as quickly as desired. If not, headway can be increased by use of the engine.

d. The offshore end of the surfline can also be made fast to another small boat instead of to an anchor. The other boat may be anchored but usually it is kept underway when there is a strong current parallel to the shore so the line can be paid out in directions that will permit the boat to pass through the breakers end-on to the sea. The line should be cut instantly if the boat will not pass through the surf end-on.

e. In addition to employing a surf line (with anchor or small boat) attached to the offshore end of the line from the boat, an additional hauling line can be attached from the inshore end of the boat to the beach. Depending on surf conditions, and with competent assistance on the beach, the boat is simply hauled back and forth through the surf. This method is especially desirable when several trips must be made.

f. As soon as the boat lands on the beach, the crew should leap out and pull the boat up well out of the way of the seas.

g. At some locations, because of the changeable nature of the surf, it may not be possible to retrieve personnel. Therefore, some planning should be put into exposure and survival equipment when operating in remote areas.

9. Simple Landings.

a. When surf is not a major problem and a simple landing with a larger motor launch is to be made, and where the current or wind may turn the boat broadside to the beach, anchored surf lines may be effectively used.

b. As the boat heads in toward the beach, an anchor is dropped from the quarter, well outside the rough water. The boat under power then quarters off toward the opposite side and another anchor is let go from the opposite quarter. Preferably this is done to windward, in such a position as to give the largest possible span.

The boat is then headed for the beach, veering the surf lines as necessary. The bow is driven into the sand on the beach.

c. The boat is then held bow on to the beach, with the nose in the sand, the surf lines tending at an angle from each quarter and resisting the tendency of the boat to twist up broadside to the beach. Should the boat get broadside, it might sustain injury to the propeller or rudder and getting clear of the beach would be difficult.

d. With the boat held bow-on to the beach with surf line, getting clear involves nothing more than heaving on the surf lines and backing the engine. The surf lines may be used to overcome any tendency of the boat to back into the wind or sea or to back to port. As in all cases where lines are over the side, care must be taken that the lines do not foul the propeller.

e. In any case where a powerboat is landed on a sandy beach remember that the sand kicked up by the turbulence of the propeller stream or surf may enter the cooling system and possibly put the engine out of commission.

10. Summary.

a. Important rules to follow with small boat landings under difficult conditions are:

(1) Use only experienced personnel.

(2) Conditions never appear as dangerous from seaward as they really are.

(3) Keep the boat under control.

(4) The outermost series of breakers is usually the heaviest.

(5) In a strange locality, lie-to outside the breakers to study the particular conditions before attempting a landing.

(6) The primary danger, when running before a sea, is that of broaching.

(7) A number of heavy swells are often followed by a short and comparatively mild interval.

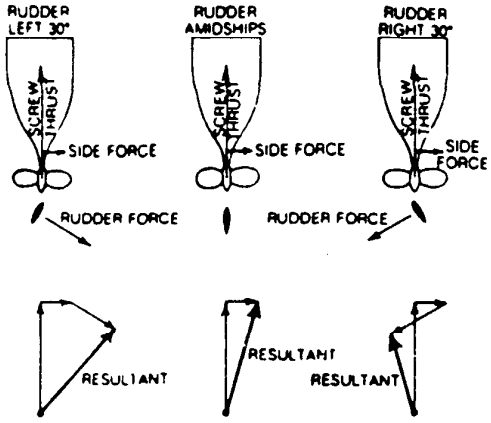
(8) Launching a boat through breakers is a more difficult and exhausting operation, though not a more dangerous one, than making a landing under similar conditions.

(9) An entirely different technique is required on a steep, rocky shore than is required on a gently sloping sand beach.

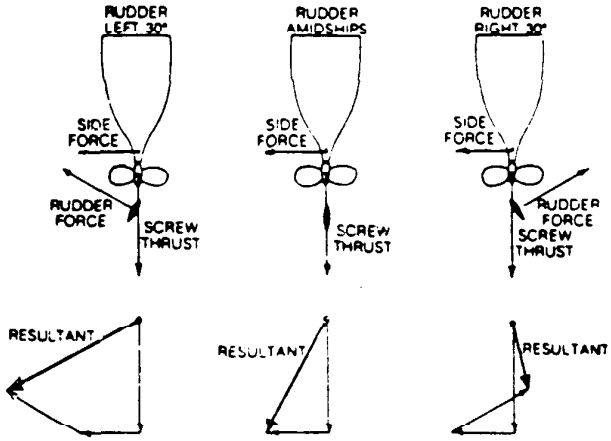
(10) On a rocky shore, the locality selected for landing should be free from nearby breakers. Small areas partially enclosed and subject to violent surge (to-and-from movements) of the sea should be avoided. The best landing place is one having a fairly steep face, where rocks are not covered and uncovered by the swell; ideally, the location should offer an adequate foothold. The swell here has less tendency to break or may not break at all.

VECTOR DIAGRAMS

Propeller and Rudder Forces

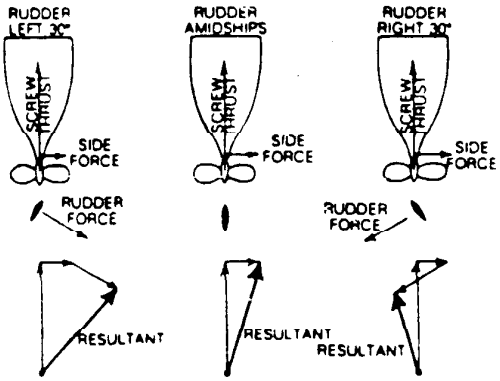


Resultant force on a single-screw ship when going ahead



SHIP MOVING ASTERN AT 10 KNOTS WITH ENGINE RPM FOR 10 KNOTS ASTERN

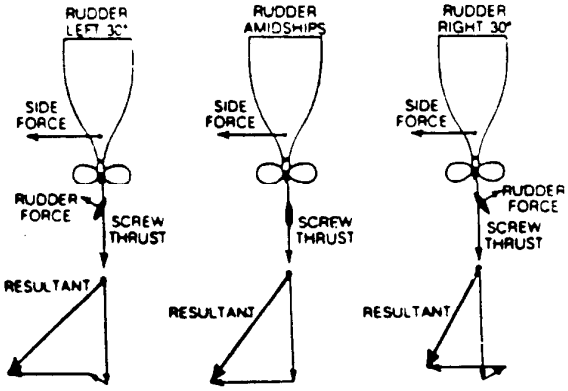
Resultant force on a single-screw ship when going astern



(a) ENGINE RPM FOR 5 KNOTS AHEAD SHIP DEAD IN WATER

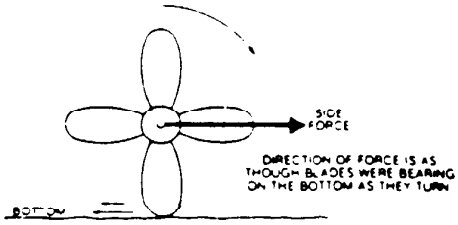
SINGLE SCREW GOING AHEAD

TWIN SCREW ENGINES OPPOSED



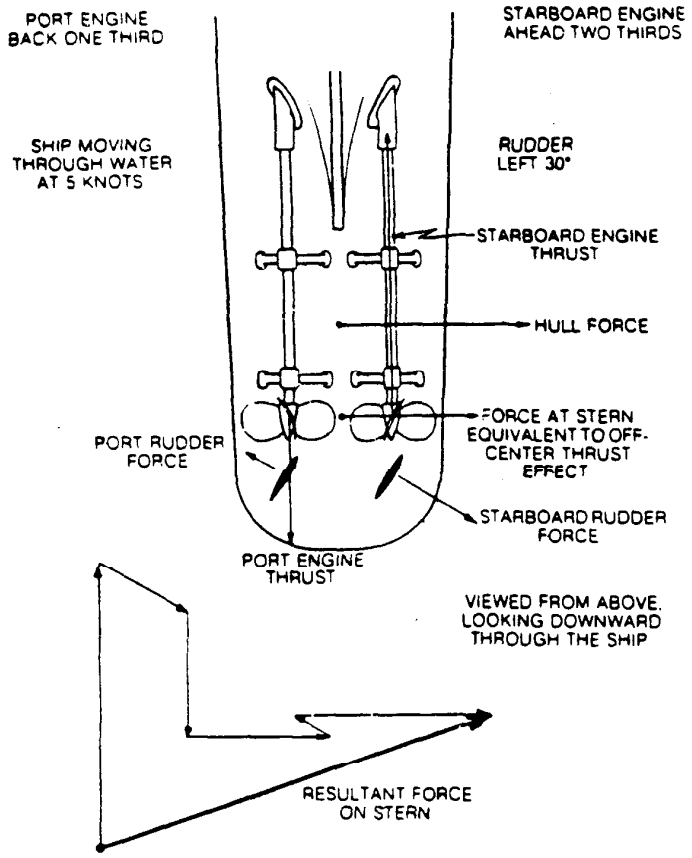
(b) ENGINE RPM FOR 5 KNOTS ASTERN SHIP DEAD IN WATER

Resultant force on a single-screw ship with no way on

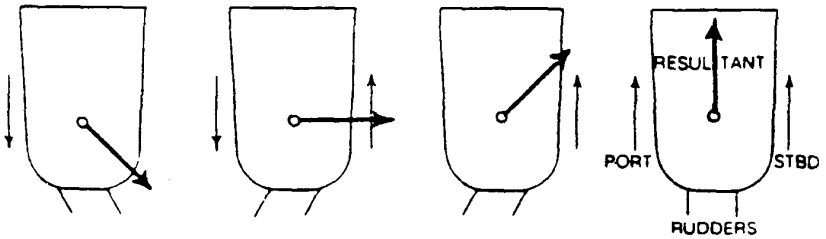


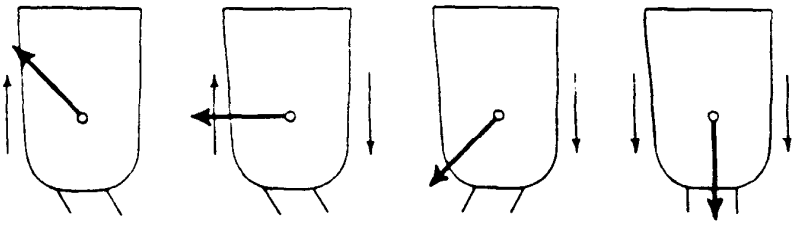
Side force on a propeller

TWIN SCREW FORCES



Resultant force on the stern of a twin-rudder, twin-screw ship





Resultant force with various screw and rudder combinations

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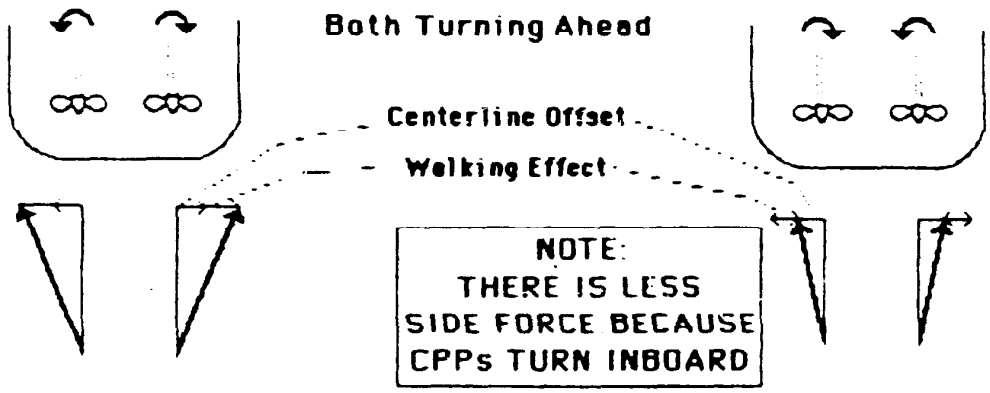
SHIPS WITH CONTROLLABLE PITCH PROPELLORS
DO NOT TWIST AS WELL
AS SHIPS WITH CONVENTIONAL PROPS

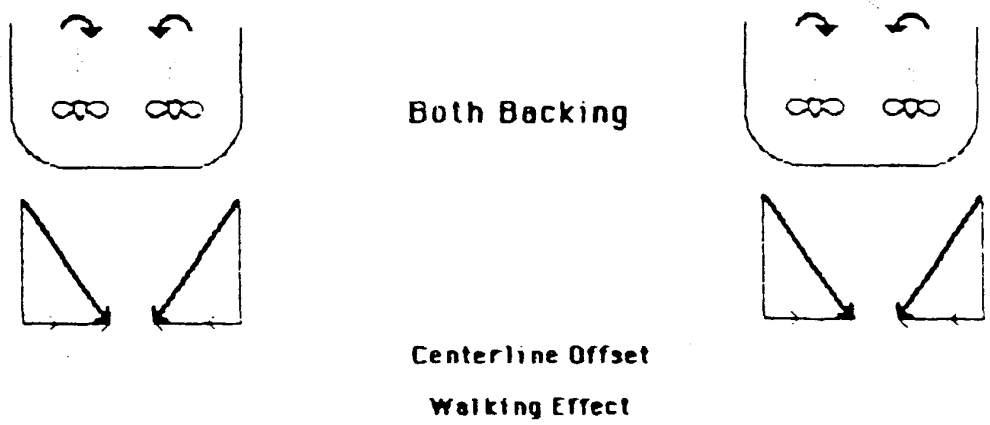
CONVENTIONAL PROPELLERS

CONTROLLABLE PITCH

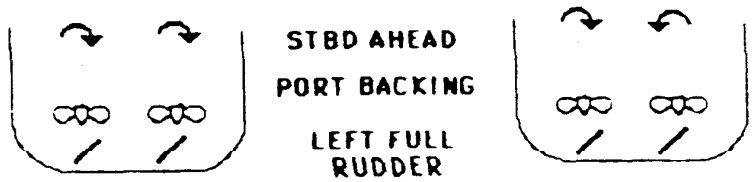


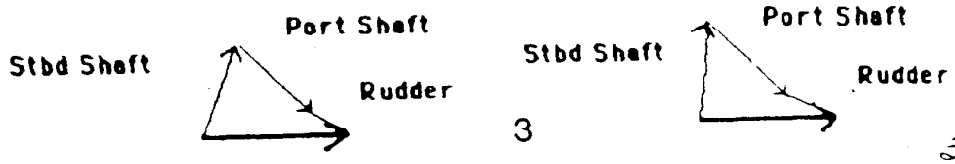
CONVENTIONAL PROPELLERS

CONTROLLABLE PITCH



Here are two ships twisting to port
The CCP ship has less total side force from the engines





ANCHORING
RULES OF THUMB

Anchors are designed to hold: Ref: CRENSHAW

70 knot wind from dead ahead,
4 knot current from ahead,
firm sand bottom in 40 fm of water,
with engines at stop

Holding power of different types of bottom: Ref: CRENSHAW

Firm sand	100%
Stiff-dense clay	150%
Sticky clay of medium density	66%
Soft Mud	33%
Loose, coarse sand	33%
Gravel	33%
Hard bottom (can't dig in)	0%

Rules for scope of chain:

US rule- 5 to 7 times the depth Ref: various

British rule- 70 times square root of depth (in ft) Ref: DANTON

Depth	Scope	Ratio(scope times depth)
60ft	90fm	9
90ft	110fm	7.3
120ft	128fm	6.4
180ft	157fm	5.2

Table form "SEAMANSHIP' (Naval Institute Press)

Depth	Scope
<10 fm	7 times depth
10 - 15 fm	6 times depth
15 - 20 fm	5 times depth
20 - 30 fm	4 times depth
> 30 fm	3 times depth

The anchor chain must tend horizontally from the anchor; Ref: DANTON
If it tends upward, holding power is reduced-

5 degrees up	75% holding power
15 degrees up	50% holding power

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ADDITIONAL SHIPHANDLING TIPS AND SAFETY PRECAUTIONS

(Adopted from Crenshaw's Naval Shiphandling, 4th ed and Shiphandling, USCG Institute)

In listing these shiphandling tips, no attempt has been made to record them in order of their importance, nor has any atempt been made to arrange them in groups. Some are not necessarily applicable to your labs on the single-screw T-Boats, but may be of use to you sometime in the future. They are listed piecemeal for what they are worth.

KEEP YOUR SHIPS STERN AWAY FROM DANGER. If the propellers and rudders become damaged, you are crippled. If the stern is free to maneuver, you can work your ship out of trouble.

DON'T TAKE A CHANCE. If you recognize it as a chance, it is probably too risky.

WHEN ORDERING RUDDER, LOOK IN THE DIRECTION YOU INTEND TO TURN. This is as good at sea as ashore.

CHECK TO MAKE SURE THAT THE RUDDER MOVED IN THE DIRECTION YOU ORDERED. Watch the helmsman move the wheel if you can see it. Check the Rudder Angle Indicator to see what the rudder actually did. Check the compass for direction and rate of turn.

WHEN ORDERING RUDDER, TELL THE HELMSMAN YOUR INTENDED FINAL COURSE. You may be distracted during the turn, and the ship will continue to swing.

WHEN SWINGING TO A NEW COURSE, BRING THE RUDDER AMIDSHIPS A NUMBER OF DEGREES BEFORE REACHING THE NEW COURSE EQUAL TO ONE-HALF THE RUDDER ANGLE BEING USED. When using 30° rudder, order the rudder amidships when you have 15° to go. This works remarkably well for coming smartly to a new course

BEWARE OF A SHIP LYING TO. It is often moving imperceptibly.

DON'T TRUST YOUR SENSE OF DISTANCE IN A FLAT CALM. This sense is bad under any conditions, but it is at its worst across a glassy sea.

DON'T ATTEMPT PRECISE MANEUVERS WHEN GOING ASTERN. Ships handle awkwardly when going astern, and occasionally veer erratically.

GIVE BUOYS A WIDE BERTH. You can't see the chain to the buoy mooring from the surface. Many a screw has been damaged on a buoy which had been "cleared."

NEVER TRUST A COMPASS OR A CHART. Keep checking the ship's heading by all means available. A compass doesn't announce its departure when it goes out. And all charts have minor inaccuracies; some have major ones.

IF BLOWN AGAINST A SHIP OR DOCK WHEN GOING ALONGSIDE, STAY THERE UNTIL COMPLETE PREPARATIONS HAVE BEEN MADE TO GET CLEAR. The ship is normally quite safe resting there, but can do major damage trying to pull clear without assistance.

NEVER TRUST A MOORING; CHECK IT. Anchor chains part. mooring shackles break, buoys break adrift, even bollards pull out of docks. Check the position regularly.

IN LOW VISIBILITY, KEEP THE RADAR TURNED FOR SHORT RANGE. The power setting and tuning of the main control console should be selected for best coverage of the band 0-5,000 yards Though we can expand the presentation by changing the scale setting on the remote scope on the bridge, we can't get optimum results unless the main console is properly adjusted. Remember, it is the contact at short range that presents the danger! (You should shift to a longer range for brief intervals however, to help you in keeping a proper lookout.)

WHEN SOUNDING FOG SIGNALS, SHORTEN THE INTERVAL ONCE EVERY FEW MINUTES. You may be synchronized with another ship and not hear its signal because of your own.

SOUND THE DANGER SIGNAL EARLY. This is legal, and it delcares that you do not understand the other ship's intentions. It will prompt it to commit itself and thus clarify the situation.

A SHIP ON A STEADY BEARING IS ON A COLLISION COURSE. Take precise bearings (preferably visual) on approaching ships, and check the trend.

TAKE AVOIDING ACTION EARLY. Signal your intention early by taking a positive action that is clearly visible from the other ship.

AVOID PASSING STARBOARD-TO-STARBOARD CLOSE ABOARD. The other ship may evaluate the situation as being nearly head-on and cause a collision situation by altering course for a port-to-port passing. It is safer to alter course to starboard at an early stage and pass port-to-port.

THE FASTER THE SHIP IS MOVING THROUGH THE WATER, THE BETTER CONTROL YOU WILL HAVE. The rudder force and the hull stability depend on speed. Wind and current are little felt by a ship moving at a good speed.

WHEN ADJUSTING POSITION ALONGSIDE WITH THE LINES OVER, DON'T WAIT FOR THE SHIP TO BEGIN MOVING BEFORE STOPPING THE ENGINES. The time lags are too long for this.

STEER YOUR SHIP AS YOU WOULD STEER A BOAT. Look ahead and steer where good sense indicates. Orient to the real world of landmarks, channels, buoys, ships and obstructions. Keep your head up and your eyes open. Charts, maneuvering boards and compasses are aids, not substitutes. If the navigator's recommended course doesn't look right, stop your ship and "let her soak" until you are sure the the course you are taking corresponds both with the indications of the chart and the physical situation which you can see.

WHEN FOLLOWING A TORTUOUS CHANNEL OR THE MOVEMENTS OF ANOTHER SHIP, STEER WITH RUDDER ANGLES INSTEAD OF ORDERING SUCCESSIVE COURSES. You are fitting curves to curves and you must adjust as you move along the curved path.

WHEN ENTERING A NARROW CHANNEL, TRY TO ADJUST YOUR SHIP'S HEADING TO COMPENSATE FOR THE CROSS WIND AND CROSS CURRENT BEFORE GETTING INTO THE NARROW PART.

WHEN REQUIRED TO MANEUVER BY THE RULES OF THE ROAD, TURN EARLY AND TURN PLENTY. Make your intention completely clear to the privileged vessel; you can refine your course later.

IN A TIGHT PLACE WHERE EVEN A SMALL MOVEMENT IN THE WRONG DIRECTION SPELLS TROUBLE, LEAVE A SPRING LINE SECURED TO CHECK A FAULTY MOVEMENT UNTIL THE SHIP IS ACTUALLY MOVING IN THE RIGHT DIRECTION.

IF YOUR SHIP LOSES POWER OR STEERING, NOTIFY ANDY SHIPS IN THE VICINITY IMMEDIATELY SO THEY CAN STAND CLEAR.

KEEP THE JACKSTAFF UP WHEN MANEUVERING IN PORT. It is a valuable aid in verifying the ship's head with respect to ships and landmarks and to judge the rate of swing of the bow in a turn.

LEARN THE IDIOSYNCRACIES OF YOUR OWN SHIP.

THE DIAMETER OF A SHIP'S TURNING CIRCLE IS SMALLER AT SLOW SPEEDS WHEN IN SHALLOW WATER.

SHIPS HAVE A TENDENCY TO FALL IN TO A TROUGH WHEN GOING AHEAD AT AN ANGLE WITH THE SEA. Backing tends to throw the stern up to the sea.

A SHIP GENERALLY BACKS INTO THE WIND.

A SHIP CANTS BEST WITH FULL RUDDER AND ENGINES FULL AHEAD.

STEERING IS USUALLY BAD AT FULL SPEED IN SHALLOW WATER.

A VESSEL HAVING NO WAY UPON IT AND NOT AFFECTED BY THE WIND WILL LIE BROADSIDE TO THE FLOW OR SET OF THE CURRENT.

WHEN YOU TURN A TWIN-SCREW VESSEL BY OPPOSING THE SCREWS, THE SHIP WILL SWING FASTER IF GIVEN A LITTLE HEAD OR STERN WAY.

SHIPS TURN MORE SLOWLY INTO THE WIND AND SEA THAN AWAY FROM THEM.

THE STERN SWINGS FIRST WHEN THE RUDDER IS PUT OVER. Keep it clear for swinging either way. Do not turn your bow away and in doing so slam your stern into the pier.

ALONGSIDE A WHARF WITH A TWIN-SCREW SHIP, SCREWS TURNING AHEAD CAUSE BANK SUCTION AND SCREWS TURNING ASTERN CAUSE BANK CUSHION.

WHEN ABOUT TO TOUCH THE DOCK WHILE MAKING A LANDING, HAVE NO FORE OR AFT MOTION ON THE SHIP.

DO NOT VEER LINES UNDER A STRAIN UNLESS ABSOULTELY NECESSARY. Use the engine to ease the strain. A person veering a line under a heavy strain may easily get caught in a bight.

BE AWARE THAT SIDE SUCTION MAY OCCUR WHEN YOU COME ALONGSIDE A SOLID PIER OR BULKHEAD. Keep a little further away from the pier and approach at a greater angle than usual.

REMEMBER THAT YOU ARE RESPONSIBLE FOR YOUR VESSEL'S WAKE. This wave can cause tremendous harm if not controlled.

Formation Steaming

IF YOU ARE CONFUSED, CONSIDER THAT THE OTHER SHIPS IN THE FORMATION ARE, TOO. When the situation seems confused, a normal maneuver by another ship may catch you by surprise.

WHEN UNCERTAIN WHAT TO DO, COME TO FORMATION COURSE AND SPEED. This will give time to clarify the situation.

DURING A COMPLEX FORMATION MANEUVER, REMEMBER THE DIRECTION TOWARDS OPEN WATER. This is the avenue to safety; you may need it.

JOIN OTHER SHIPS BY COMING UP FROM ASTERN. Relative speeds will be less and the whole maneuver will be more comfortable for yourself and your formation mates.

RULES OF THUMB FOR THE OOD

1. **Radian Rule-**
One degree of arc subtends approx. 1 yard for each 60 yards of range.

Example-Two fishing boats bear 090T and 095T, both at 6000yd. How far are they from each other?
Answer-500 yd- 6000 yards divided by 60 gives 100 yards per degree times 5 degrees gives 500yds.

2. **Double the angle on the bow-**
Sight an object on the bow, run until it's angle on the bow (Relative bearing) doubles- The range to it at the time of the second sighting equals the distance run.

Example- At time1200, a tower bears 030 Relative; at 1230, it bears 060 relative. Your speed was 10K, How far away was the tower at 1230?
Answer- 5nm- 30 minutes run at 10K is 5nm.

3. **30-60-90 rule for CPA-**
For a DIW object ahead if you come to a course that is 30 degrees off its bearing, your CPA will be half of the range to the object when you changed course.

Example- A vessel is DIW 2nm ahead bearing 270T. If you come to course 300T, you will pass the vessel at a CPA of 1nm.

4. **3 to 6 and 6 to 3 UNREP rule-**
When making an UNREP approach, the bearing of the guide should be-
3 degrees off base course when the range is 600 yards and,
6 degrees off at 300 yds,
for a distance of 90 feet when alongside

5. **Slow down rule of 50-**
In an unrep type approach, slow to the other vessel's speed at a distance equal to 50 yds times the speed difference in knots-

Example- The oiler is making 10K-
You are making 15K on approach-
Ring-up 10K when you are 250yd short of station

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U S. Department
of Transportation

United States
Coast Guard

SHIPHANDLING

U. S. Coast Guard Institute
Pamphlet No. D42601-0
(03/79)

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BASIC PRINCIPLES OF SHIPHANDLING

PHYSICAL CHARACTERISTICS OF YOUR SHIP

Before you act in the capacity of a conning officer, you should attempt to learn everything you can about your ship. You can usually find a wealth of material in the ship's characteristic cards, damage control books, ship's blueprints, etc.

Some of the more important characteristics you should learn about your ship are as follows:

DIMENSIONS

Ascertaining the ship's overall length and beam is necessary so that you will know the minimum dimensions of the berth it requires. Besides, if the ship is a tug, 95, or another type that frequently goes alongside larger ships, you must know the height of your masts so you can tell how high the ship's overhang must be for your vessel to fit under it. This information is also necessary for determining safe bridge clearances.

DRAFT AT VARIOUS LOADINGS

Draft determines the minimum depth of water you may safely navigate and the load stability condition at all times.

FREIGHT AND PASSENGER CAPACITY

Information about freight is necessary to ensure that the vessel is not overloaded, that it is full and down but with no list, hogging (bow and stern being lower than amidships), or sagging (opposite of hogging), and that it has the desired trim and stability. Passenger capacity for your vessel is decided by higher authority, based on the adequacy of messing and berthing facilities. If an emergency necessitates transportation of a large number of personnel, ensure ship's stability is maintained by making provisions to keep passengers clear of topside decks.

MAIN ENGINES

Capability

Capability includes maximum speed, best cruising speed, economical cruising speed, maximum backing power, and maximum propeller line pull. You should also know the time required and the power necessary for stopping your vessel from any given speed. Acceleration and deceleration time rates, in tabular form, should be available for your use on the bridge.

Engine Controls

You should have an accurate knowledge of the location and operation of all types of engine controls and all means of communication between engineroom personnel and yourself, as conning officer.

Logistics

Know the capacities of your fuel and water tanks. This information is vital in computing cruising radius and in damage control or preparing for heavy weather when you may have to ballast or shift fuel or water.

RUDDER

You must know the space you require for a turn at various speeds, which involves knowing the turning effect of the rudder at various angles.

MANEUVERING CHARACTERISTICS

Before delving into the mechanics of shiphandling, you must understand the forces that act on a ship under various speeds and rudder angles. If aware of these maneuvering characteristics, you can compensate for the undesired effects and utilize the helpful effects to best advantage. Without knowledge of these forces, shiphandling would be at best a trial-and-error procedure.

FORCE FACTORS

It is beyond the scope of this course to discuss hydrodynamic principles. Experts are not in complete agreement among themselves why the forces created by a ship's propeller and rudder react on the ship as they do. They do agree, however, that the forces so generated are the result of pressure differences. To understand how these pressure differences occur, let's consider the following definitions.

For all practicable purposes, water is incompressible. If force is applied to water, thereby causing high pressure, the water flows to a lower pressure area, producing a force known as DYNAMIC PRESSURE.

High- and low-pressure areas in a ship are created by the propeller and the rudder. As the propeller revolves to go forward, the shape and pitch of each blade develop a thrust derived from a low-pressure area on the forward face of the blades and a high-pressure area on the after face of the blades. As the ship moves in the direction toward the low-pressure area, the force set up by this displacement of water is transmitted along the propeller shaft to thrust the ship ahead or astern. This force is known as PROPELLER THRUST.

The rudder exerts its force in a somewhat similar fashion. When the rudder is set at an angle on a moving ship, a high pressure area is built up on the leading surface, and a low-pressure area forms on the trailing surface. Through this difference in pressure areas, the water exerts a force against the leading surface of the rudder. In turn, the rudder forces the stern in the direction opposite that to which the rudder is set. This force is known as RUDDER FORCE.

Before discussing screw and rudder combinations and how they affect the ship, we must consider some additional force factors.

Side Force

In the maneuvering of a single-screw ship, side force ranks next in importance to propeller thrust. Side force is defined as a force that moves (walks) the stern of the ship to one side or the other. The causes of side force are somewhat involved.

But all you need to know is that, as a result of the rotating propeller, a force is created, moving the stern of the ship in the direction of the propeller rotation. The effect will be as though the lower blades of the propeller were touching the bottom and pushing the stern to the side. (See figure 1.) Side force is at its maximum when the ship is dead in the water, and it decreases rapidly with an increase in ship speed. Likewise, side force is greater when the ship is backing than when it is moving ahead.

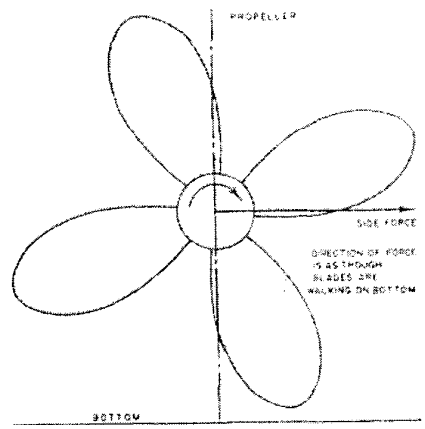


Figure 1 - Side force

Screw Current

Screw current, caused by the action of a rotating propeller, consists of two parts. The portion flowing into the pro peller is the suction current; that flowing away from the propeller is the discharge current. Suction current is a relatively minor force in shiphandling. Discharge current is a major force in shiphandling in two main respects. First, it produces a large force on the rudder with the screw going ahead. Second, it is a strong component of side force when the screw is backing, because of the part of the discharge current that acts against the ship's counter.

TURNING CIRCLE

A ship's turning circle is the path described by the ship in completing a full 360° turn with a constant rudder angle.

Such a turn is illustrated in figure 2. The diameter of the turning circle decreases with any increase in rudder angle. High speed also has a noticeable effect on the turning circle. Small changes in speed, however, do not significantly alter the diameter. The following definitions relate to various aspects of the turning circle.

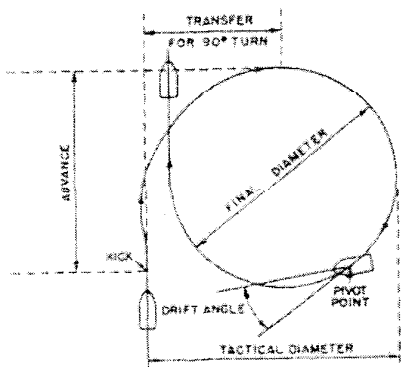


Figure 2 - Turning circle

1. ADVANCE: Distance gained toward the direction of the original course after the rudder is put over.

2. TRANSFER: Distance gained at right angles to the original course when turning. Figure 2 shows transfer for a 90° turn. For a 180° turn, transfer equals tactical diameter.

3. TACTICAL DIAMETER: Perpendicular distance between the path of the ship on the original course and the path of the ship when a 180° turn is completed with a constant rudder angle. The standard tactical diameter is prescribed in current tactical orders. To obtain the tactical diameter, you must know the rudder angle.

4. STANDARD RUDDER: Rudder angle necessary to turn ship in the prescribed tactical diameter.

5. FINAL DIAMETER: Diameter of the circle ultimately scribed by a ship that continues to circle with a constant rudder angle.

6. DRIFT ANGLE: Angle at any point on the turning circle between the intersection of the tangent at that point and the ship's keel line.

7. KICK: Swirl- of water toward the inside of the turn when the rudder is put over. Also, the momentary movement of the ship's stern toward the side opposite the direction of turn.

8. PIVOT POINT: The point on the centerline about which the ship pivots when the rudder is put over. Or, it may be the point of the ship upon which it turns and which scribes the turning circle.

Use of tactical characteristics in conning your vessel are discussed later in this pamphlet.

Making a Turning Circle

When the rudder is put over in making a turn, the stern is forced away from the direction of the turn. For several lengths the ship turns very slowly from its original course because of momentum. The ship then commences to gain ground in the new direction, moving sidewise through the water to a considerable degree. This movement naturally results in loss of speed and is why a vessel gains rapidly on the ship ahead while that ship is turning, but loses this distance during its own turn when the first ship completes its turn and steadies on the new course.

A ship's pivot point is nearly always about onethird the ship's length abaft its bow when moving ahead, and at or near its stern when moving astern. The location of the pivot point varies with the ship's speed: an increase in speed shifts the pivoting point in the direction of the ship's movement. In close waters the conning officer must always bear in mind the position of the pivot point before starting a turn. This is especially important when moving ahead, in order to prevent the stern from swinging to an undesirable location.

RUDDER EFFECT

Basically, a ship's rudder is used to attain or maintain a desired heading. The force necessary to accomplish this heading is created by dynamic pressure against the flat surface of the rudder. The magnitude of this force, as well as the direction

and degree to which it is applied, produces the rudder effect that controls stern movement and, through it, the ship's heading. Factors that have a bearing on rudder effect include number of rudders, rudder size, rudder angle, rudder location, headway, sternway, propeller direction, suction current, discharge current, and side force. As you can see, the degree of each factor and the possible combinations are virtually infinite.

FUNDAMENTALS OF SHIPHANDLING

To better understand the effect of various rudder and screw combinations upon your ship, assume that these ideal ship handling conditions exist: no wind, no current, no tide, plenty of sea room, and no interference from other vessels. You are conning a vessel with a single rudder and a single righthand screw (turns clockwise going ahead).

SINGLE SCREW

Going Ahead

In going ahead from a stopped position, the first noticeable effect is that the ship's stern swings to starboard because of side force. To counteract this swing, apply right rudder. The necessary force is obtained from the discharge current against the rudder surface. As the ship gathers headway because of propeller thrust, it reaches a speed where the wake current overcomes side force to a great extent. Now you can remove the right rudder; the ship will continue straight and will respond equally well to either left or right rudder. You can obtain rudder effect from the action against the rudder surface of both the dynamic pressure of the discharge current and the pressure of the water through which the ship is moving.

Stopping

With the ship going ahead at a good speed, suppose you want to stop. Back the screw. Propeller thrust is in direct opposition to the forward motion of the ship, causing the ship to start slowing. Side force and part of the discharge current tend to force the stern to port. You can compensate for this direction of movement by left rudder as long as the ship has sufficient forward motion to retain steering effect. As you further reduce forward motion, the steering effect reduces to zero. Furthermore, side force and that part of the discharge current acting against the ship's counter cause the stern to swing to port. You can partially compensate for this trend by shifting to right rudder to take advantage of the force of the suction screw current acting against the rudder surface.

Backing Down From a Stopped Position

Backing down in a straight line with a single-screw ship is virtually impossible without alternating the direction of the screw and the position of the rudder. Let's see why this is so.

In going astern from a stopped position, the stern swings to port because of side force and a portion of the discharge current. Even with full right rudder, you cannot counteract side force because the suction current acting against the rudder surface is a relatively weak force. As the ship gathers sternway, the water through which the ship is moving acts against the rudder surface, augmenting the force of the suction current. This force slows, but probably will not stop, the stern's continued swing to port. The best way to straighten out is to go ahead on your screw and, as the discharge current builds up, shift your rudder to left full. You then have two forces working to stop the port swing and bring the ship to the proper heading: the side force and the discharge current acting against the rudder surface. When the heading of the ship is satisfactory, continue the backing procedures as used initially.

CASTING

To turn a single-screw ship around short, put the rudder right full and engine ahead full. When you acquire headway, back the engine full. As the ship gathers sternway, shift the rudder to left full. When the vessel has gone far enough astern, go ahead full on right full rudder. Repeat the maneuver until the ship comes around to the desired heading. If you do not acquire sternway, there is no need to shift the rudder.

If there is not enough room to go ahead and astern, drop the anchor and steam around it with the helm hand over, paying out just enough chain for the anchor to hold.

If coming upstream with a flood tide or down river with the current, sheer toward the starboard bank, thus bringing the bow into slack water and the stern into the current. Continue as if turning around short with the helm and engines. You should, however, use extreme caution any time you place your bow into the beach.

To turn around to port is difficult in a narrow channel. What you gain by going ahead on left rudder is lost when it becomes necessary for you to back. Therefore, when you must turn to port, give left full rudder and when you have gone as far as prudent, let go the port anchor and veer to 10 or 15 fathoms of chain (the amount depends on the depth and nature of the bottom). Go full astern. If there is much way on the vessel, let the engine help to check it, not allowing all of the strain to come on the anchor windlass and chain. As the ship swings around to port under the drag of the chain, stop the way and let it bring up the chain. Heave in and proceed.

To turn against a strong current, steam over to the port side of the channel and stem into the current. Go right full rudder and ahead full until the bow starts swinging to starboard and then stop your engines. Let the current swing the vessel athwart the river. When the ship has reached ahead as far as prudent, go astern and shift the rudder to left full. This will have a tendency to hold the ship stern up against the current, and it will come around more quickly than if you had gone to the starboard shore and turned to the left.

Going Alongside

From the foregoing description of handling a single-screw ship using various rudder-screw combinations, you should have a pretty good idea what to expect of the ship under the ideal conditions specified. Now, let's consider some of the more common shiphandling situations you will encounter, such as going alongside. Remember, when going alongside be prepared to use fenders; you never know when an unexpected gust of wind or another vessel's wake may slam your vessel against the mooring facility. Before arriving at your moorage facility, you Should request line handlers. This way line handlers will already be at the dock and ready to handle your lines when your vessel arrives. However, when line handlers are not reasonably available, "dock jumpers" may be used. Before directing the "dock jumpers" to STEP to the dock, the shiphandler must maintain zero relative motion with the dock. "Dock jumpers" must wear PFD's, and they should step to the dock or dock ladder; not jump.

Port-side-to: It is almost always easier to dock a single-screw vessel port-side-to than starboard-side-to, because when you ease your bow in alongside your berth and back down to kill headway, the side force of the backing screw will swing your stern in alongside the berth. Figure 3 illustrates the effect of side force when backing.

Starboard-side-to: In a starboard-side-to landing, side force will swing your stern away from the berth when you back down. Consequently, you must make your approach for a starboard-side-to landing at slow speed to avoid having to back hard to kill headway. Another disadvantage of a starboard-side-to landing brought about by a slow approach is that the less headway you have, the less the steering effect of your rudder. Thus, the ship becomes harder to control.

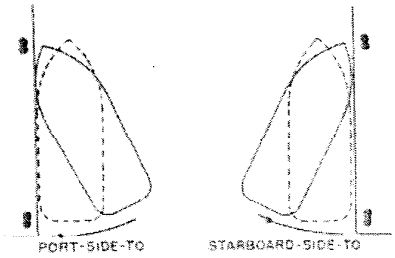


Figure 3 - Effect of side force when backing

WIND AND CURRENT

often you can take advantage of what may appear at first to be adverse conditions of wind and current. In these conditions, the art of shiphandling enters the picture. Plan your maneuvers so that you take into account all the known factors.

Current

Current from ahead: If you have plenty of room and a fairly strong current from ahead, ease your bow alongside and get out the forward bow spring line. The current will bring you into the dock, as diagramed in the first view of figure 4.

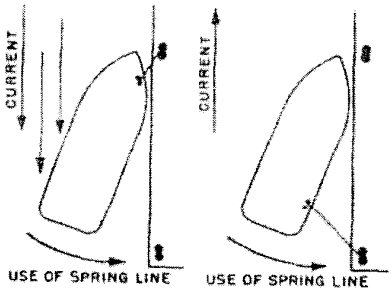


Figure 4 - Making use of current

Current from aft: When the current is from aft, putting out the after quarter spring line (second view in figure 4) produces the same result. Going alongside with a current from aft is more difficult, however, because the following current makes rudder effect very erratic.

Using current only: Going alongside by means of the current alone is impractical unless you have plenty of room to range ahead or astern. Often your berth will be restricted in size so that you must ease your bow in to go alongside and have no room to move ahead. This situation is no particular threat when the current is from ahead; but, in easing your stern alongside, you have to use your screw and rudder carefully. A following current in an approach to a small berth is much more serious, not only because of the lessened steering effect of your rudder but also because side force from the backing screw combines with the current to swing your stern away from the berth. A stern line is usually imperative in this situation.

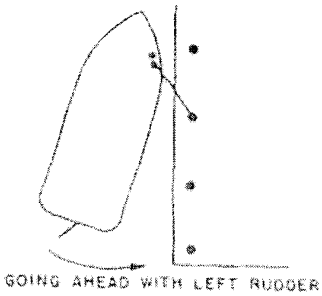


Figure 5 - Use of spring line

Short berth: Most single-screw ships maneuvering into a short berth prepare the No. 2 line (after bow spring) on the dock side and get its eye out to the dock as soon as possible. (See figure 5.) Belay the line on the No. 2 bitts on board and carefully check it as the ship makes headway. Go ahead on your screws with left rudder on. This combination will swing the stern toward the dock; however, exercise care to avoid parting the spring line at this point. If there is too much headway, back the screw to save the spring line. But do not forget: backing will force your stern further off a starboard-side-to berth.

Wind Effect

Wind effect is another element you must contend with when going alongside. You must also realize that wind is generally erratic in velocity; therefore, allow yourself a safety margin. Remember that the bow and stern may not be equal in sail area and- that wind effect on the ship as a whole will not be distributed uniformly. Another consideration is that, when you approach the lee side of a berth or another vessel, wind effect at the bow is reduced greatly while wind effect on the stern continues to act with full force. But, as with current, you can take advantage of the wind if it is blowing toward your berth. Make your approach so as to stop farther out from your berth than in a no-wind situation, and let the wind bring you in alongside. You probably will have to make some use of your screw and rudder to keep the ship parallel to the berth.

When the wind is setting you off your berth, the situation is more difficult. For a port-side-to landing, approach the pier at a greater angle than normally used and with slightly more headway. Put your bow line out to hold the bow, and use side force of the backing screw to bring the stern in. To make a starboard-side-to landing with the wind setting off your berth, again approach the pier at a greater angle than normally used and with slightly more headway. Put your bow line and No. 4 (after quarter spring) line out. If you go ahead slow on your screw with left full rudder, the side force, rudder effect, and the No. 4 line (acting as a spring) will force your stern in against the wind.

Getting Away From a Berth

The next operation to consider is getting underway. Again, take your time and evaluate existing conditions; then plan

your course of action. Wind effect should be apparent to you from the bridge. Current effect is more difficult to judge. If you are moored in a slip, current effect in the immediate vicinity of your ship may be completely different from that out in the stream.

Starboard-Side-To Berth

When possible, the best way to clear a starboard-side-to berth is to back with left rudder. Side force and suction current on the rudder will swing your stern out from the berth so that you can back clear safely. If there is no room astern, you can move your stern out from the dock by using your No. 2 line as a spring and going ahead slow with right full rudder.

Port-Side-To Berth

Unlike the method of clearing a starboard-side-to berth, trying to back away from a port-side-to landing tends to send your stern against the dock. The best procedure for getting away is to leave your No. 2 (after bow spring) line out and go ahead with left hard rudder until the stern is clear. The left rudder and the lever effect of the No. 2 line will bring the stern far enough out for you to get away, at the same time restricting the forward motion of the ship. When the stern is clear, take in the No.2 line, shift your rudder, and back.

Current From Ahead

With a strong current running from ahead, you probably could clear either a starboard-side-to berth or a port-side-to berth by slacking your head line and letting the current take the bow. Once it is well off, let go all lines and go out ahead. But when you have put your rudder away from the pier, your stern will swing in that direction as you go ahead, especially when you are leaving a starboard-side-to landing. Be careful to avoid using too much rudder until you are well clear of the berth.

Current From Aft

With a current from aft, slacking the stern lines will carry the stern off in the same manner. If you are lucky enough to be in a set direction off the pier, all you have to do is let go all lines and allow the current to carry the ship broadside out into the stream.

BANK CUSHION AND SUCTION

Two other factors that are fundamental in shiphandling are bank cushion and bank suction.

With a ship going ahead, close and generally parallel to a bank, sea wall, or another ship, bank cushion forces the bow out and suction pulls the stern in. You can easily understand these forces if you consider (1) how the bow funnels the water into a narrowing area and (2) how the screws suck in water from ahead and discharge it astern.

When a ship backs down, the effect is reversed. Discharge current from the screws builds up a cushion at the stern, with the result that the stern goes out and the bow goes in.

When going ahead, you can counteract bank cushion and bank suction by intelligent use of the rudder. Going astern, however, requires a combination of speed and rudder.

SINGLE-SCREW PECULIARITIES

The preceding topics on shiphandling give you merely an idea of some well known idiosyncrasies of single-screw vessels. This course cannot go into detail concerning unusual circumstances wherein a ship will act in a noncharacteristic manner. You must learn from experience the habits peculiar to your own particular ship.

CHARACTERISTICS OF TWIN

SCREW Effect of Screws

When both screws are turning ahead or astern at the same speed, the ship, if not influenced by external factors of wind and current and with the rudder amidships, will move straight ahead or back. If either screw is working singly, a turning moment is created which will swing the ship away from the side on which the screw is acting. For example, if the starboard screw is turning ahead alone, the ship will swing to

port. If backing, then the ship's bow swings to starboard as the stem goes to port. When the screws are turning at different speeds in the same direction, i.e., one turning ahead one-third, the other ahead full, the bow will turn toward the side which has the engine turning at the slower speed, and the greater the difference in speed, the sharper the turn. When the screws are opposed, the ship's bow will turn towards the side that is backing, i.e., port screw ahead, starboard screw backing, the bow will turn to starboard. Whether the ship will have headway or sternway will depend on the difference between the relative speed and power of the two engines and the amount of way that was on the ship when the operation was begun.

In order to turn a twin-screw ship in place, you must .adjust the relative speed of the respective engines until they balance each other (not turning at the same number of revolutions necessarily), discounting, of course, the external effects of wind and current. In screws working opposed, remember that the screw backing must turn faster than the screw going ahead in order to balance the thrust. In turning a ship in place, you may need to alternately stop and start the engine. Under some conditions, one screw backing two-thirds will about balance the other screw going ahead onethird.

Rudder and Screws

As stated before, the rudder is used in relation to the direction of motion of the ship through the water rather than in relation to the direction of rotation of the propellers. For example, when you go ahead on both screws and want to turn to starboard sharply, stop and back the starboard screw and apply right full rudder. However, when having STERNWAY and desiring to turn a large ship to starboard (stern to port), go ahead on the port engine, back on the starboard engine, and apply left full rudder. When you are swinging the ship in place with no way on, leave the rudder amidships. When the ship is dead in the water, or nearly so, it lacks steerageway and the rudder will have little or no effect. This is true when the ship loses its way when coming to a stop or when starting to make way after being stopped. You must then accomplish control with the engines until you gain steerageway.

Going Alongside With No Set

Under these conditions, you may dock the vessel equally well on either side. Make ready the lines and fenders and approach the berth at an angle of 10 to 20 degrees, maintaining only sufficient speed for steerageway. Stop the engines and allow the bow to approach fairly close to the dock, at which point you should put over the rudder in the direction away from the pier. The latter action will bring the stern in so the ship is parallel with the berth. You can then stop head-way by backing the outboard engine, or, if the ship has reached a parallel position before it loses headway, it will be better to back both engines to prevent the stern from swinging into the pier.

Going Alongside Being Set
On The Dock

Making a landing when being set on the dock may be a dangerous operation that must be skillfully handled. The ship should be brought to a stop parallel to the pier and, as a general rule, about half a beam's length away. The current or wind will set the ship on the pier. A close landing under these conditions is dangerous if the set is underestimated. Therefore, allow plenty of room for error of judgment. Should the set be unexpected and the ship too far in, diminish the relative value of the set by going ahead faster and making the landing in a shorter time, thus decreasing the time during which the set is effective. This requires good judgment and instantaneous decision.

The set may be strong enough, however, to cause damage when the vessel comes up against the pier. You somewhat overcome this by bringing the ship in faster, canting the bow outboard, and, when close to the dock, backing down hard on the inboard engine. The increased speed cuts down the effectiveness of the set, while backing the *engine straightens out the ship, stops the* headway, and creates a wash to cushion the ship against the pier.

Going Alongside While
Being Set Off

If the current is such as to set the ship off the dock, make the approach at a fair angle and with considerable speed. Pass the lines as soon as possible and bring the stern in by putting the rudder away

from the pier. Stop the headway by backing the outboard engine, which also helps to bring in the stern. However, it is often necessary to back down on a forward quarter spring while holding the bow, breast, or bow line. If the set is strong, careful handling is needed to prevent parting the lines.

Going Alongside, Current From Ahead

When the current is running parallel to the face of the pier, it is best to stem it when going alongside. In this way the ship can maintain steerageway, as it is moving faster through the water than over the ground. Make the approach slowly with reference to the dock, and on a parallel heading. It is dangerous in this case to come in at an angle, as the current may take charge and force the bow in against the pier. Bring the ship above the point of mooring and pass the lines to the pier before stopping the headway. Put bow lines ashore first and allow the vessel to drift in on the spring lines leading forward on the dock. Use the rudder to swing the stern, and prevent undue strain on the lines by an occasional kick ahead on the engine(s).

Clearing a Pier, No Wind or Current

This is not a difficult operation. Slack off the lines and observe whether the ship will drift clear. If not, it will be necessary for you to force the stern away from the pier.

On a twin-screw vessel, back the inboard screw and turn ahead the outboard screw judiciously to keep the vessel turning in place, or turn ahead the outboard screw alone against a spring to force the stern out. However, since the bow comes in against the dock, the fenders must be tended. If there is plenty of room astern, by backing the inboard screw, and later as the bow swings in, by backing the outboard screw to stop the swing of the bow, you may back the vessel away without the bow touching the pier. The discharge current of the inboard screw also will tend to keep the bow off when the current reaches the bow. As soon as the stern is well clear, steer the vessel by the engines until you obtain astern steerageway.

Clearing a Pier While Being Set On

A twin-screw vessel should first go ahead on a spring_with the outboard screw, tending fenders at the bow. This will throw the stern out against the set. Then back the ship immediately with plenty of power on the inboard engine, casting off the spring. The wash of the inboard engine should tend to keep her off. Now back the outboard screw to get the ship away as quickly as possible.

Winding Ship

It is occasionally necessary to turn a ship from one side to the other at the same berth at a dock. You may accomplish this turn by making use of the current or wind. It is safer to let the stern rather than the bow swing outboard, as there is a chance of damaging the rudder and propellers when the stern is toward the dock.

When the current is weak and from astern, slack all lines except a spring led aft from the bow. If the stern fails to drift out into the current, back the inboard screw of a twin-screw ship, back the screw of a single-screw ship starboard-side-to, or go ahead slowly if a single-screw ship is port-side-to. As the stern swings out, the current will catch it and swing it rapidly around. Let go all after lines, and by backing a bit, keep the bow clear of the pier. As the vessel swings around, lead out a spring forward from a point well aft on the forecastle of the opposite bow in order to increase the effectiveness of the rudder in controlling the swing of the vessel. When the line has a clear lead, take a strain and cast off the original spring. Then proceed ahead slowly with the engine and use the rudder to ease the ship into the berth.

If the engine is not available, you may use winches in which case you should run a long line from the outboard aft quarter, well forward to the dock. This forward spring is an aid in completing the swing if the current is insufficient. Place the fenders or a camel at the bow and allow the ship to take up on the after bow spring. Slack the inboard lines and cast off. Ensure ship's anchor is made ready to let go, and consider possibly using ship's boats.

Loading at a Pier

When it is necessary to move a vessel up and down a pier to load various items, you can save time by handling the ship on one line. This line is the spring leading aft from a point forward, depending on which point is most suitable for keeping the vessel alongside the wharf. Pass the line ashore with the end lead aft on the pier, and take a turn or two on the cleat on deck. Go ahead slowly on the engines and let the ship fetch up on the line so it is breasted snugly in against the pier. Judicious use of the rudder will swing the bow in or out as desired or will hold the ship steady. Should the current be strong, additional lines may be necessary. When the load is raised from the pier, you should keep a close eye on the side of the ship next to the pier and ensure that no damage to the pier is caused by the listing of the ship.

BOW AND STERN WAVE SYSTEM (WAKE)

When a ship is underway, there is a change of level of the bow and stern from the still water condition in response to the elevation and depression of the water level about the hull resulting from the bow and stern wave systems. Up to moderate speeds the ship usually experiences a bodily sinkage or squat without and appreciable change in trim. At higher speeds, the sinkage at the bow ceases and the bow begins to rise, while the stern continues to settle. Squatting and changing in trim do not increase resistance but are symptoms of increased wave-making resistance.

The wave system, known as a Kelvin Wave Group (see figure 6), caused by the passage of a ship consists of curved waves that spread out sideways, nearly parallel to the sides of the bow, and transverse waves, nearly perpendicular to the direction of the motion of the ship, which follow astern at approximately the speed of the ship. It is these transverse waves that play an important part in the squatting of a ship. As the speed is increased, the crest of the bow wave moves back along the ship, and the bow tends to ride up on its own bow wave. At the same time, if the stern is riding in a depression of the transverse wave system, the stern will sink. If the first depression of the transverse wave system is at the stern, the ship can be considered to be riding on the back of its own bow wave as indicated in Figure 7. It is the coincidence of this first depression with the stern (and its wave system) that determines the critical speed.

Both sinking and squatting are increased in shallow water. The proximity of the bottom causes increased relative velocity as the water flows under the ship, and the waves of the wake are more pronounced. Squatting can become a serious problem in shallow water, both from its effect on the propulsion of the ship and from the danger of the resultant wake.

In a typical situation of attempting to make high speed in shallow water, a ship making turns for 20 knots in 20 feet of water might only be making 13 to 15 knots over the ground. The squat would be so severe that the stern would be riding about 4 feet lower then normal, while the bow might be 2 feet above the normal level. With our ship drawing 12 to 13 feet at the propellers, this would mean that at the bottom of their travel the blade tips would be only 3 to 4 feet from the bottom. Severe pounding would most probably be felt at the propellers as the blades passed through the area of varying velocities and eddies between the bottom of the ship and the bottom of the channel.

The severe squatting experienced in shallow water is attended by a huge stern wave that towers over the fantail of the ship. If we stand on the fantail of a ship while attempting high speed in shallow water, the crests of the outward moving bow waves abreast the stern would be nearly at eye level, and the transverse stern wave should stand menacingly 15 feet higher than the level of the deck at the stern.

The danger from these waves is not to our ship but to the other ships in the harbor, and to the dock and other structures at the water's edge. It is as though the ship were racing about the harbor towing a train of tidal waves astern. Such waves can lift large ships bodily and cause them to roll heavily. Such waves can sever mooring, break up nests, and throw ships against their docks. Such waves can cause damage to beach structures as far away as 1,000 yards from the ship's track.

Consequently, though we should steam at sufficient speed to keep good control of the ship, we should limit our speed in the harbor to that which will cause no damage.

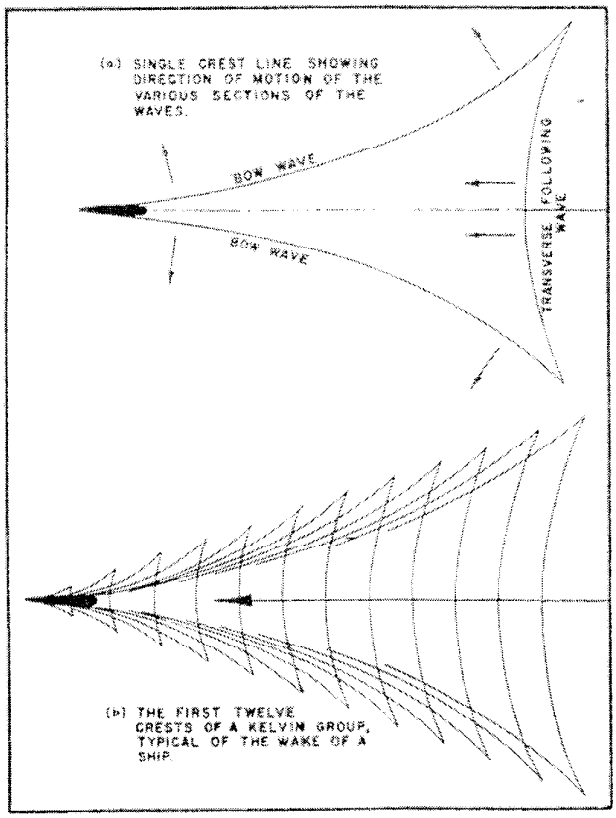


Figure 6 -- Wave system in the wake of a ship

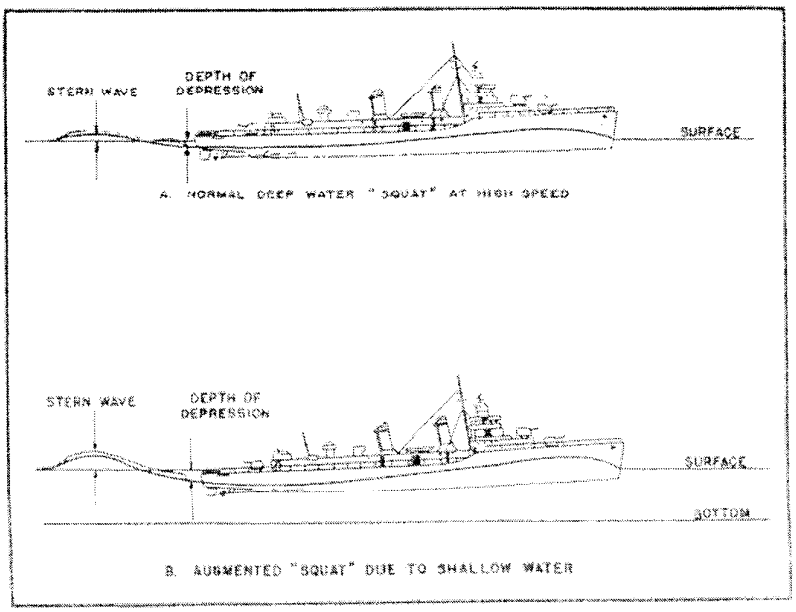


Figure 7 -- "Squatting" at high speeds

Ships Do Not Always Obey the Rules

Although most ships follow the maneuvers cited in the foregoing topics, learn the idiosyncracies of your own ship. All ships do not handle alike. Some ships will straighten out with only the slightest touch ahead on left rudder, as they should; others may require ahead full for a moment in order to straighten out. Some low-powered deep draft vessels with little or no drag will take a long time to swing and will be hard to stop once they get going. Some ships may swing their bow toport on backing. This occurs when they are trimmed by the head and have a starboard list.

A FEW RULES WORTH REMEMBERING:

The diameter of a ship's turning circle is least at slow speed.

Ships have a tendency to fall into a trough when going ahead at an angle with the sea. Backing tends to throw the stern up to the sea.

A ship generally backs into the wind.

A ship cants best with full rudder and engines full ahead.

Steering is usually bad at full speed in shallow water. When steering by twin screws alone, set one screw at two thirds speed and vary the other accordingly.

A vessel having no way upon it and not affected by the wind will lie broadside to the flow or set of the current.

When you turn a twin-screw vessel by opposing the screws, the ship will swing faster if given a little head or stern way.

Keep your stern away from danger. If your propellers and rudder become damaged, you are crippled. If your stern is free to maneuver, you can work your ship out of trouble.

The pivoting point of a ship going ahead and swinging is *generally from one-quarter to one-*third the length of the ship from the bow.

Ships turn more slowly into the wind and sea than away from them.

The stern swings first when the rudder is put over. Keep it clear for swinging either way. Do not turn your bow away and in doing so slam your stern into the pier.

Don't take a chance. If you recognize it as a chance, it is probably too risky.

When ordering rudder, look in the direction you intend to turn.

When ordering rudder, tell the helmsman your intended final course. You may be distracted during the turn, and the ship will continue to swing.

Don't trust your sense of distance in a flat calm. This sense is bad under any conditions, but is at its worst across a glossy sea.

If blown against a ship or pier when going alongside, stay there until complete preparations have been made to get clear. You are normally quite safe resting there, but you can do major damage trying to pull clear without assistance.

Alongside a wharf with a twin-screw ship, screws turning ahead cause bank suction and screws turning astern cause bank cushion.

When about to touch the dock while making a landing, have no fore or aft motion on the ship.

Do not veer lines under a strain unless absolutely necessary. Use the engine to ease the strain. A person veering a line under a heavy strain may easily get caught in a bight.

Be aware that side suction may occur when you come alongside a solid pier or bulkhead. Keep a little further away from the pier and approach at a greater angle than usual.

Remember that you are responsible for your vessel's wake. This wave can cause tremendous harm if not controlled.

ORDERS TO THE HELMSMAN

The one element of shiphandling in which standard terminology is an absolute necessity is the giving of commands to your helmsman. There is no room for misunderstanding or ambiguity, because the time you require to clarify the situation may be long enough to be disastrous. There should be no confusion between you and the helmsman if you ALWAYS use standard commands.

Never use the words "port" or "starboard" when giving orders to the helmsman; use "left" and "right" because they are clearer and more distinct.

You must demand that your helmsman repeat distinctly, word for word, every order you give the helm and that the helmsman also advises you, using standard terminology, when the order has been carried out. Additionally, when making a swing, tell the helmsman if you want the headings sung out during swing, and how often.

Because of their importance, the most common standard commands used in the Coast Guard and their meanings are listed below:

RIGHT (LEFT) RUDDER: Apply right (left) rudder instantly in an indefinite amount. This order must be followed instantly by the number of degrees of rudder desired.

RIGHT (LEFT) STANDARD RUDDER: Standard rudder is the amount of rudder required to turn a particular ship within a certain prescribed tactical diameter. Standard rudder is determined in advance for each vessel to ensure that all ships in a formation turn in the same space. It is usually 20° on most Coast Guard ships.

RIGHT (LEFT) FULL RUDDER:- Full rudder is a certain number of degrees greater than standard rudder. A rudder usually is capable of a 35° swing on either side of centerline, but full rudder usually means 30° rudder.

HARD RIGHT (LEFT) RUDDER: This order usually adds the extra 5° on the full rudder angle.

INCREASE YOUR RUDDER TO___DEGREES: Increase rudder angle. This command is given when, with rudder already over, it is desired that the ship turn more rapidly.

EASE YOUR RUDDER: Decrease rudder angle. This command is given when the ship, turning with right (left) rudder, is turning toward or is nearing the heading desired. Example: "Ease to fifteen (ten, five, etc.)."

RUDDER AMIDSHIPS: Rudder angle zero. This command is given when the ship is turning and it is desired that the ship swing less rapidly. (As a rule, this order is merely "MIDSHIP?").

MEET HER: Use the rudder as necessary to check, but not stop, the swing of the ship. This command can be used when the ship is nearing the desired course.

STEADY (STEADY AS YOU GO) (STEADY AS SHE GOES): Steer the course on which the ship is heading when the command is received. This command is given when, in changing course, the new course is reached or the ship is heading as desired. The helmsman responds: "STEADY AS YOU GO. Course___Sir."

SHIFT YOUR RUDDER: Change from right to left rudder (or vice versa) an equal amount. This command is given, for example, when the ship loses headway and gathers sternway, to keep it turning in the same direction.

MIND YOUR RUDDER: A warning that the ship is swinging to left (right) of course because of bad steering. It is also a command to steer exactly, using less rudder.

NOTHING TO THE RIGHT (LEFT) OF: A warning to the helmsman that the conning officer does not desire the ship to be steered to the right (left) of the course ordered because of the presence of some danger. This command is NOT to be used in lieu of a necessary course change.

HOW IS YOUR RUDDER?: A question to the helmsman. The helmsman should reply: "Five (ten, fifteen, etc.) degrees right (left) rudder, Sir.'

HOW DOES SHE HEAD or MARK YOUR HEAD": A question to the helmsman. The helmsman should give the ship's head at the time, for example, "Two seven five, Sir."

KEEP HER SO: A command to the helmsman when reporting ship's heading and when the conning officer desires to steady the ship on that heading.

COME RIGHT (LEFT) TO_____: Put the rudder right (left) and steady on new course _____.

STEER ONE NINE ZERO: This command is used for a minor change of heading to the number of degrees specified.

STEADY ON TWO TWO FIVE: This command is used to state the course on which the ship is to be steadied.

RIGHT (LEFT) HANDSOMELY: Turn the rudder a small amount. The command is given when only a slight change of course is desired.

VERY WELL: Reply of conning officer to the helmsman, meaning "The situation is understood."

You, the conning officer, and the helmsman must understand each other at all times. If you issue several orders in rapid succession, you may confuse the helmsman unless the helmsman makes the correct reply and takes the proper action on each order. When you give contradictory orders without enough time between them for the helmsman to react, the helmsman should properly reply to and take action on the last order only.

TACTICAL CHARACTERISTICS IN PILOTING

INTRODUCTION

This section will introduce the methods available whereby you can use the known tactical data pertaining to your vessel to keep it on the intended track in pilot waters and to bring it safely and accurately to anchor in an assigned berth. Each ship in the Coast Guard has its own characteristics, and the data for each will be slightly different. Tactical data for ships should be available on the bridge at all times while under way and in a form which will lend itself to the requirements of the captain, the officer of the deck, and the navigator.

DISCUSSION

The purpose of this section is to discuss the importance of a ship's tactical characteristics as they pertain to the piloting of a vessel in restricted waters. They are particularly important in bringing a ship to anchor in an assigned berth. So far in our study of shiphandling, we have assumed that at the instant of an ordered course change, the ship came immediately to the new course. Similarly, when a new speed was ordered, we have assumed that the ship's engines responded immediately to deliver the new speed. All of the material discussed so far has reflected these assumptions.

It is apparent that, in practice, these instantaneous responses to course and speed change do not occur. To increase or decrease speed by 10 knots may require from 1 to 20 minutes, depending upon the initial speed, the acceleration used, the power available, and the engineering plant installed. A course change of 90° may require as much as half a mile of sea room to complete, depending upon the rudder used, the type of ship, the wind and sea, and many other factors. The question is: when do you make allowance for the time and travel you require to effect these changes in course and speed, and when do you ignore them?

In the open reaches of the ocean, you can ignore the time and travel required to effect course and speed changes, because the accuracy of the plot which you will be able to maintain is less than the amount of travel affected. You can only expect, in general, an accuracy of about 1 to 3 miles in fixing your position; and by comparison, the travel of your ship used in changing course or speed is negligible.

In restricted waters, however, the situation is entirely different. Here you frequently need to know your position within 10 to 15 yards, and the effect of the travel in the time required to change course and speed is so large by comparison that you must take it into account.

This section will concern itself with the quantitative effects of course and speed changes on the travel of a ship, and the techniques and methods which a navigator uses to allow for these effects when piloting a ship in restricted waters.

TURNING CHARACTERISTICS

When you are approaching an anchorage, turning onto a range, piloting in a restricted channel, maintaining an intended track, or at any time when precise piloting is necessary, you must allow for the turning characteristics of your ship. The standard method of finding your ships turning characteristics is to turn her in a number of complete circles under varying conditions and to record the results of each. The variables to use are: right and left rudder of specified angles, steady speeds of different value, and differences in draft and trim. When determining turning data, you should note and allow for the effects of wind and sea. Most course changes are not as much as 360°, but by studying the complete turning circle, you can determine your ship's behavior for turns of any extent. Before considering the track actually followed by a ship during a turn, you should have an understanding of the following definitions. You can more easily understand these terms by referring to figure 8.

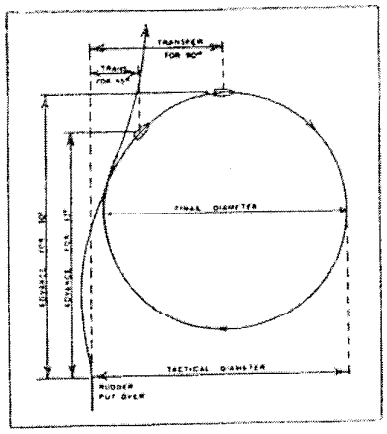


Figure 8 - Advance, transfer, and tactical diameter

1. Turning circle is the path followed by the pivoting point of a ship in making a turn of 360° or more. For a typical ship, the stem will be inside and the stern outside this circle.

2. Advance is the distance gained in the direction of the original course, measured from the point at which the rudder is put over. The advance will be maximum when the ship has turned through 90°.

3. Transfer is the distance gained at right angles to the original course, measured from the line representing the original direction of travel to the point of completion of the turn.

4. Tactical diameter is the distance gained to the right or left of the original course when a turn of 180° has been completed.

5. Final diameter is the distance perpendicular to the original course between tangents drawn at the points where 180° and 360° of the turn have been completed. Should a ship continue turning indefinitely with the same speed and rudder angle, she will continue turning in a circle of this diameter. It will always be less than the tactical diameter.

6. Standard tactical diameter is a stated distance (usually 1500 yards which must be used by all ships in a formation as the tactical diameter.

7. Standard rudder is the amount of rudder angle necessary to cause the ship to turn in the standard tactical diameter.

8. Angle of turn is the arc, measured in degrees, through which a ship turns from the original course to the final course. (See figure 9.)

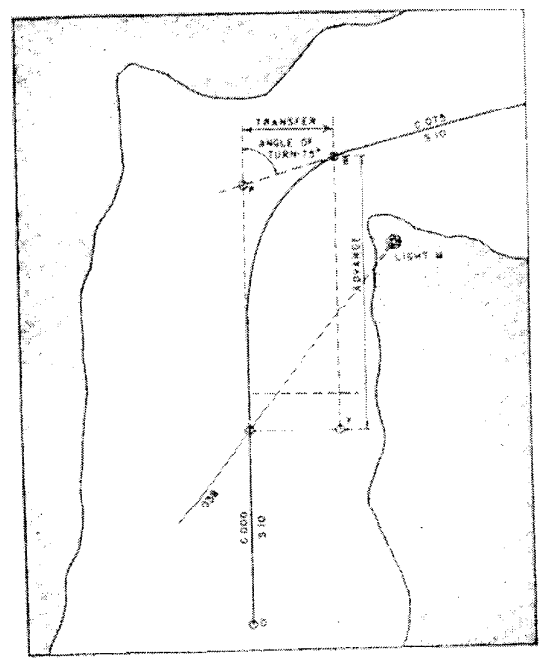


Figure 9 - Turn bearing

The speed at which a ship makes a turn may affect the turning diameter markedly if the "speed-length ratio" (ratio of speed to the square root of the length) is large enough. Thus, a 300-foot ship at 30 knots has a considerably larger turning circle than at 15 knots. Tactical diameters are not inversely proportional to the rudder angle. While turning diameters decrease with increase in rudder angle (up to a certain point), the relationship is not an inverse proportion. Furthermore, the rudder angle for minimum turning diameter varies from one design to another. The rudder angle for minimum diameter depends upon many factors of ship and appendage form as well as speed. The majority of ships have a limiting rudder angle of 35°; some have larger ores. A short vessel will have a smaller turning circle than a longer one with the same general characteristics.

Standard Tactical Diameter, 1500 Yards—Standard Rudder 15°

Angle of Turn	Advance	Transfer	Angle of Turn	Advance	Transfer
15°	500	38	105°	993	853
30°	680	100	120°	933	1013
45°	827	207	135°	827	1140
60°	940	347	150°	687	1247
75°	1007	513	165°	533	1413
90°	1020	687	180°	367	1500

Table 1

Sample Tactical Data for Turning

Table 1 is a sample of the type of table prepared after tactical data has been taken for the turning characteristics of a ship. The data included herein is representative and is to be used solely for solving problems in this course.

It will be noted that table 1 is prepared for every 15° of a turn. Data required for increments between these fifteen degree points may be obtained by interpolation.

Computing the Turn Bearing

From table 1, you can see that during conditions where precise piloting is required, you must know at what point the rudder must be put over, so that when you have made allowance for the advance and transfer of the ship, the ship will steady on the desired heading at the time you reach the desired track or point. To accomplish this, you must predetermine the bearing to a known object from a point on the original track line at which the rudder must be put over. When you reach this turn bearing, order the rudder put over.

In allowing for the advance and transfer, you should use standard tactical diameter and commence the turn using standard rudder.

Exercise: Your ship is standing up a channel on course 000° T and must round a point of land by changing course to 075°T. (See figure 9.)

Required: Determine the turn bearing on Light M so as to be on course 075° T upon arriving at point B.

Solution: Draw a line parallel to your ship's present course being made good (000° T), at a perpendicular distance equal to the transfer for a 75° turn (513 yards). The intersection of this line with the final course, 075° T, will be the point B at which you must complete the turn. From this point, measure back along the line a distance equal to the advance, 1007 yards, locating point X. From point X, drop a perpendicular to the original course line. This will locate the point at which the rudder must be put over to complete the turn at the required point. The bearing, 038° T, from that point to Light M is the turn bearing.

The problem is now complete, and you have the following data: This ship continuing on course 000° T arrives at a point where Light M bears 038° T, distance 630 yards. At this point, you give the command "Right Standard Rudder." When you have completed the turn, your ship will be heading on the final course at point B. The solid line, DB, represents the actual track of your ship.

Exercise caution when selecting objects to use for turn bearings. The ideal object for a turn bearing is one that is perpendicular to the tack line, i.e., on the beam, but seldom will you find an object exactly on the beam.

An additional point you should remember about turn bearings that are too near the course or its reciprocal is that the bearings change very slowly on bow and stern objects. When you have determined the exact point on the track where you must put the rudder over to be on track at the end of the turn, you do not have sufficient leeway in turning to allow for errors compounded by poor turn bearings.

Acceleration and Deceleration

Speed changes are usually of less concern to the navigator than are course changes. There are many times, however, when you may desire to allow for the acceleration or deceleration. Exercises are given on the following page.

Knots		Minutes		Rate
Change of Speed		Time Required for Change	Total Elapsed Time	Knots per Minute
From	To			
Acceleration				
0	10	3	3	$3\frac{1}{3}$
10	15	1	4	5
15	20	2	6	$2\frac{1}{2}$
20	24	4	10	1
24	28	6	16	$\frac{2}{3}$
28	31	9	25	$\frac{1}{3}$
Deceleration				
31	28	3	3	1
28	24	4	7	1
24	20	2	9	2
20	15	1	10	5
15	10	1	11	5
10	0	2	13	5

Table 2 - Acceleration and deceleration

Exercise 1. Your ship is standing up a channel at speed 15 knots, and the captain desires to slow to 10 knots at the latest possible time so as to pass a construction barge at that speed.

Required: determine how far before reaching the barge you should ring up 10 knots in order to slow your ship to the actual speed of 10 knots at the time the barge is abeam.

Solution: From table 2, you find that to decelerate from 15 to 10 knots requires 1 minute. Since the rate of deceleration between these speeds is constant, the average of the initial speed and the final speed will be the average speed for that minute, or 12 1/2 knots. In one minute at 12 1/2 knots, your ship will travel 417 yards. Therefore, by measuring back 417 yards along the DR track from a point abeam of the construction barge, you can locate the point at which you should ring up speed 10 knots on the engines.

Exercise 2. Your ship is standing down the channel at speed 10 knots. The captain has stated that he desires to make speed 24 knots as soon as the ship is clear of the channel, in order to make a rendezvous on time.

Required: Determine (1) how far along the DR track line you should consider your ship to have traveled between the time speed 24 is rung up on the engines and the time your ship actually gets up to speed 24 knots through the water and (2) how much time is required.

Solution: From the table 2, note that three different rates of acceleration will be used for this speed change. For this reason, you must calculate the distance traveled during the period of acceleration in three separate parts: one part for each rate of acceleration. From speed 10 to speed 15 requires one minute, at an average speed of 12 1/2 knots. During this time your ship will travel 417 yards. From speed 15 to speed 20 requires 2 minutes at an average speed of 17 1/2 knots. During this time your ship will travel 1167 yards. From speed 20 to speed 24 requires 4 minutes at an average speed of 22 knots. During this time your ship will travel 2933 yards. By adding the three distances computed, you find that the total distance traveled from the time you ring up the new speed until your ship is actually making it is 4517 yards, or about 2 1/4 miles. The time elapsed is the total of the times noted in the table and used above. It will therefore require 7 minutes.

As you can see from the two exercises, the determination of distance traveled between the time a speed is ordered and the time a ship actually is making it good through the water, is easily accomplished and can be quite accurate. The time involved can be determined by direct reading from the table. Many navigators use the average of the initial and final speeds as the effective average speed during the time of acceleration or deceleration. Although this is not as accurate as the method you used in the examples, it is usually sufficiently accurate for most navigational work.

ANCHORING IN AN ASSIGNED BERTH

Anchorage Charts are simply harbor charts with anchorage berths overprinted in colored circles of various diameters corresponding to the swinging area required by naval ships of various types and sizes. On these charts, series of berths of like size are laid out in straight lines, referred to as lines of anchorages. Usually, adjacent circles are tangent to each other. The center of the circle marks the center of the berth, and each berth is designated by a number of letter which is printed inside the circle.

This orderly arrangement greatly simplifies the assignment of anchorages, especially when a fleet, or a large part of it, is to occupy a harbor in company. In harbors for which no standard anchorage chart is available, berths are assigned by giving the bearing and distance from a known object to the center of the berth, together with the diameter of the berth. It is the duty of the navigator to cause the ship to be maneuvered in such a manner that the anchor may be let *go in the center of the ship's assigned berth.* This should be accomplished with a maximum permissible error of ten yards.

For this discussion the following terms are defined:

1. Letting go circle is a circle around the center of the berth, with a radius equal to the horizontal distance between the alidade and the hawse pipe.

2. Approach track is the track a ship must make good in order to arrive at the center of the berth.

3. The letting go bearing is the bearing from the point of intersection of the letting go circle and the final approach track to any convenient landmark. The bearing is generally selected near the beam. It is good practice to have letting go bearings charted on both sides of the final approach trackline in case one side is obscured by a passing vessel, etc.

4. Range circles are distance circles of varying radii from the center of the berth, with distance measured from the letting go circle.

When your ship has been ordered to anchor in a specific berth, consult the chart and prepare for the approach to the anchorage as follows:

1. From the center of the berth, lay off the letting go circle with a radius equal to the horizontal distance between the alidade or radar antenna in use and the hawse pipe. (See figure 10.)

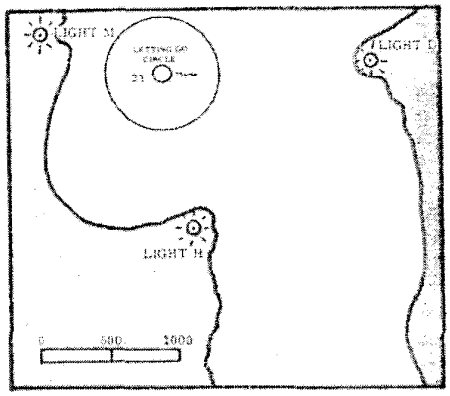


Figure 10

2. From the center of the berth, lay off the intended track, selecting appropriate approach courses and navigational aids for fixing your ship's position enroute, and locate turn bearings marks at predetermined points where turns are necessary. Your final approach should be with your ship heading *into the current, if possible; or, if the wind has* the. greater effect, then into the wind. In either case you should steady your ship on the final approach track 500 yards before reaching the letting go point. It is also of great value if you can select an approach track which runs through the center of the berth to a navigational aid or to a range. (See figure 11.) As you approach the anchorage, you can maintain the constant bearing of the aid or range from the center of the berth. If no such aid is available, or if the aid previously selected becomes obscured, your positions with consecutive fixes with respect to the approach track (to the right of it or to the left of it) will permit you to recommend a change of course to conn the ship back on the approach course.

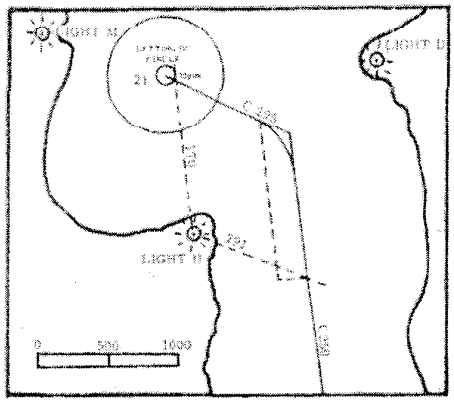


Figure 11

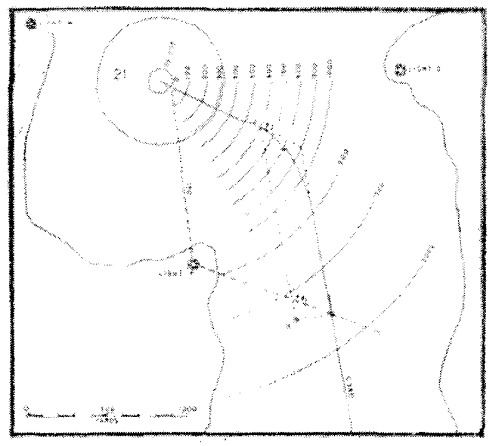


Figure 12 - Anchoring in an assigned berth

3. From the center of the berth, lay off range circles of varying radii, including the radius of the letting go circle. In most cases you must draw in only the arcs of the range circle adjacent to the approach track. In practice, it is customary to draw arcs every 100 yards out to 1000 yards and then at 1200 yards, 1500 yards, and 2000 yards. Label the letting go circle 0 yards; measure the range circles from the letting go circle, and label 100 yards, 200 yards, etc. as the case may be. (See figure 12.)

When bringing your ship to anchor, you should advise the commanding officer, the officer of the deck, and the first lieutenant of the depth of water and the character of the bottom in the assigned or selected anchorage. In addition, you should notify them of the distance and location of the nearest (and other) shoal water in the vicinity of the anchorage.

Exercise. Assume your ship has been assigned Berth 21 for anchoring. (See figure 12.) The initial approach into the harbor is on a course of 350° T. The approach track to the berth is to be such that the Light M is dead ahead. Distance from the hawse pipe to the alidade is 75 yards.

Required:

(1) Approach track to the berth.
(2) Letting go bearing on light H.
(3) Turning point.
(4) Turn bearing on light H.

Solution: Plot the approach track from light M back through the center of the berth. Measure the direction (295° T). Plot the initial approach track into the harbor. Plot the letting go circle (75 yards), using the center of the berth for the center of this circle. Label this circle 0 yards. The intersection of the letting go circle and the approach track is the "letting go" point. Light H bears 170° T and is the letting go bearing.

Plot range circles from the center of the berth; however, measure the ranges from the letting go point. Thus the distance from the letting go circle to the first range circle is 100 yards, but the radius used in plotting this circle is 175 yards: the radius of the letting go circle plus the 100 yard range circle.

By use of the table of tactical data, you can determine the advance and transfer and can plot this information, locating the point at which the rudder must be put over and the point at which you will complete the turn. You can then determine the turn bearing (291° T) on light H.

As your ship enters the harbor and proceeds along the track, take frequent fixes to ensure that the desired track is maintained. As you cross the range circles, advise the captain of the distance to the letting go point so that the speed may be adjusted to bring the ship nearly dead in the water when the letting go point is reached.

When light H bears 291° T, the rudder is put over and the turn commenced. The rate of turn can be adjusted so that, upon completion, light M bears 295° T, dead ahead. The heading of the ship should be adjusted so that a constant bearing of 295° T is maintained on light M. Plot bearings on light H and M continuously and advise the captain of the distance to go. When light H bears 170° T and light M, 295° T, recommend that the anchor be let go. At that instant, take bearings on all navigational aids visible in order that you can accurately determine the exact location of the anchor. Also observe the ship's exact heading at the time of the final fix. Then plot a distance of 75 yards from the fix in the direction of-the observed heading. You then know the exact position of the anchor. The anchor should be within ten yards of the center of the berth.

When your ship is underway within the confines of a harbor or an inland body of water, you are faced with different problems from those you face in the open seas. Sometimes the channel narrows until at times it is scarcely wider than the ship itself. The depth of water may decrease until the bottom is only a few feet from your keel. Landmarks are so plentiful that any single one tends to be lost in the multitude. Even the buoys and beacons may appear to have been scattered haphazardly as the various channels meet and intertwine.

When moving about in such waters, your first concern is to make certain that you know your position and to ensure that the course you are following is in safe water. This sounds as though it is the duty of the navigator, but you, as the conning officer, also have a share in this task. In a restricted harbor, the navigator has his hands full just keeping track of the ship's location. With a well trained piloting team, he can plot the ship's position accurately about once each minute. Thus he can tell you where the ship has been a few moments ago and can lay out the major segments of your track ahead and tell you when to turn. But when you begin threading the buoys on a narrow channel, when you are required to maneuver to pass other shipping, or when you are making complex turns using the engines, the ability of the navigator to keep abreast of the situation is strained. He can no longer keep the position accurately plotted and lay out the maneuver of the moment, and still advise you in sufficient time for you to depend entirely on his advice.

CONNING CHART

As the conning officer, you should have access to a harbor chart for your own exclusive use in order to keep track of the ship's position, to identify buoys and landmarks, and to check the charted depth of the channel. If you were to use the navigator's chart for information, you might interfere with his plotting because he would have to step aside every few moments to allow you to examine his chart. Your having your own harbor chart is a minor extravagance that pays big dividends in the long run.

Your conning chart, which is sometimes referred to as a "sweat chart," should be up to date and should have the latest recommended track for passing through a harbor. If the navigator knows in advance the ship's destination, he should chart the recommended courses and speeds on your chart.

Some conning officers like to have their conning chart mounted on a convenient desk or surface immediately in front of their conning position so they can check off the ship's progress. Others prefer to have the chart mounted on a thin board or else simply folded conveniently so that they can orient the chart to the ship's heading and sight across the chart when identifying landmarks. The first method has the advantage of having the conning chart oriented to true north (as is normal when using charts) and this minimizes the chance of ordering an incorrect true course. The second method has the advantage of maintaining the relative picture oriented correctly with the ship's head.

PREPARATION FOR HANDLING IN PORT

Before conning a ship in a restricted harbor, you should carefully study the harbor chart. Trace the intended course with the navigator to ensure that you both are aware of all the dangers that might be encountered. You should check the charted depth of water throughout the track to make sure that you have not overlooked any shallow spots. Select your turning points and plan your speed while there is ample time to study the situation. Make note of any dangerous spots and select "danger bearings" on prominent objects to mark the separation between danger and safety. The safety with which you handle the ship in a harbor is dependent to a large measure in the thoroughness with which you have studied your chart.

NAVIGATING BY EYE

Having considered the foregoing topic which stressed the importance of the conning chart, perhaps you are inferring that you should depend on your chart to the exclusion of all other information. Actually, you must also navigate by eye. Visual navigation not only helps to guard against a navigator's mistake but also speeds the piloting process when a situation moves too fast for the piloting team to encounter. For example, when maneuvering on various courses and speeds in a well marked harbor would rquire navigating by eye. Doing so does NOT lessen the need for the navigator, for he must at all times be ready to navigate through the unmarked sections of the harbor. Also, do not forget to use lookouts to aid in searching for ships, bouys, beacons, floating objects or anything else of interest to the conning officer.

Navigating by eye is neither as difficult nor as inexact as you might think. You can make your first rough location of the ship's position by identifying enough landmarks to decide the general area in which the ship is located. Then by checking bearings, estimating ranges, and utilizing pairs of landmarks as they come into line and establish a range, you can refine your position until you are confident that it is correct within relatively narrow limits. As you approach the more restricted part of the harbor, your estimations become more exact because you are getting nearer to the navigation markers upon which you are fixing your position. You can frequently check your position as you pass buoys close aboard, leave headlands abeam, or steer for known objects ahead.

For the simple entry into or departure from a harbor, you usually have the assistance of the harbor ranges. There is normally a series of ranges marking the center of the main channel, and you simply shift from one range to the next as you proceed through the harbor. It is quite simple to steer so as to keep the range markers in line and thus proceed accurately along the track marked by the ranges. If your ship is exactly on the range, you have a very good fix each time you pass a channel buoy.

In the absence of a harbor range, you can establish a similar piloting aid by selecting courses that head directly for prominent objects in the harbor. You can easily follow the track thus selected by adjusting the ship's head so that the bearing to the selected object remains constant and equal to the course of the selected track. In this manner you obtain the equivalent of a range by substituting a single landmark and the ship's gyrocompass for the two landmarks of a range.

GAUGING THE SET

Whether steering the harbor range or following a constant bearing to a fixed object ahead, you have a good check on the cross-channel set. The set may be due to wind or cross-current, and it is helpful to have an estimate of how much of each you are feeling. This information may be convenient later, since the wind effect is usually felt to about the same extent all over the harbor, but the current at any point is dependent upon the channels in the vicinity.

The set you experience parallel to the ship's head is more difficult to estimate than the cross-channel set. However, since the effect of wind from dead ahead or dead astern is usually negligible except when handling alongside, you can attribute all fore and aft set to current without being far wrong. To determine fore and aft set, compare your speed through the water, measured by rpm, against the speed you are actually making good over the ground, as reported by the navigator.

Though you can measure the set you are actually experiencing, you must also be able to anticipate the current you are going to encounter. The most obvious means of determining the current in the channel is to observe the current wake at a buoy or past some pilings. A one-knot current causes a definite ripple, a three-knot current will cause swirls and eddies for several yards, and a five-knot current will cause a boiling wake to stretch out downstream for fifty yards.

The angle of lean of the harbor buoys is also a good indication of the direction and strength of the current. Some are so delicately balanced that they lean heavily to the side even in very light currents. It is a good habit to make a mental note of the current indicated at each channel buoy as you proceed along your way.

FOLLOWING THE CHANNEL

Since it is often impractical to mark an extremely long and/or winding channel with ranges, the edges of the channel are marked with channel buoys. These buoys are usually placed in pairs on opposite sides of the channel so that the channel can be followed by simply steering toward the midpoint between the next pair of buoys. Along difficult sections of the channel, the buoys are placed more frequently.

As the channel widens into the open sections of the harbor, the need for paired channel buoys no longer exists. Here only the shoal water and submerged dangers are marked, and only an occasional fairway buoy is added to indicate the recommended channel. Under these conditions the pattern is not very easy to follow; you should take extra care in identifying each buoy.

When only one side of the channel is extensively marked or when you are following one side of a wide channel, you are faced with the problem of adjusting your course to markers on one side only. You must follow the channel by keeping an appropriate distance out from the line of buoys marking this side. As the channel winds, you must adjust your course to the new line of buoys.

It is usually safe to proceed directly from one channel buoy to the next if you ensure that you remain inboard of the line connecting the two buoys. If you lay down a track parallel to the line connecting successive buoys and at a convenient distance, such as 50 yards, inboard of the buoys, you will. have an ideal track to follow. Between buoys you can check your position by fixes and can catch your drift readily by watching the bearing on the next buoy ahead. This buoy is nearly dead ahead and should draw to the off-channel side as you approach it. If the bearing draws to the channel side, you are being set out of the channel and must take corrective action. Some aids to navigation are located outside channel limits, and the safety with which you handle the ship is dependent to a large measure in the thoroughness with which you have studied your chart. Also bear in mind that buoys can drag their moorings and move off their charted position, and lighted buoys may have their lights extinguished. Consequently, conning officers must not depend on buoys exclusively as navigational aids.

HANDLING THE SHIP IN A CANAL

Occasionally your ship must make a passage through a canal, and you must be prepared for the problems of such waterways. Because a canal is a man-made channel, it is only as wide- as absolutely necessary for its purpose. Therefore, you find yourself in a waterway much narrower than is normal: and you seem to be in danger of going aground on both sides of the channel at the same time.

In addition to the obvious limitations to maneuvering in a canal, there are several unexpected effects which you may encounter in these narrow channels. As you attempt to proceed at a higher speed, the ship may appear to sink alarmingly with respect to the banks of the canal. If you stray from the center of the channel, your steering is affected. There is a tendency for the ship to move bodily toward the near bank, and there is an opposing tendency to force the bow away from the near bank. Although these effects are more noticeable in large ships, it is worthwhile for all shiphandlers to become acquainted with them.

In a restricted channel where the cross-sectional area of the ship becomes 4ri appreciable-part of the cross-section of the channel, the sinkage of the ship with speed is much more pronounced than that experienced at sea or even that experienced in shallow water. A large ship, when traveling at 12 knots in a 45-foot channel 500 feet wide, might sink bodily 8 feet below its normal level when dead in the water in the channel. Just before reaching critical speed (where the bow commences to rise and the stem to sink), the ship rides in a deep depression in the surface of the water that extends nearly the entire length of the ship. You must consider this sinkage in determining whether the channel depth is sufficient to allow the passage of your ship.

This increased sinkage is caused by the increased velocity with which the water, displaced forward, must flow aft about the ship as the ship moves ahead. This increased velocity and the attendant decrease in pressure causes the level of water to be lowered all along the midship section. Since the area of the passage between the ship and the boundaries of the canal is decreased, the velocity of the water moving astern must increase to fill in behind the ship

at a given ship's speed. The action of the propellers in taking their suction from the restricted area increases the sinkage experienced by from 10 percent to 15 percent.

As the ship strays from the center of the channel and streams closer to one bank than the other, the passage between her side and the nearer bank becomes even more restricted; the velocity of flow on that side must therefore increase, and the water level between the ship and the near bank is lowered. This tends to force the ship into the near bank, an effect known as bank suction. If a ship is maintained on a course parallel to the adjacent bank, she will move bodily into the bank.

As the ship approaches the bank, the bow wave on the near side becomes augmented and tends to push the bow away from the bank. Thus, in addition to the bank suction tending to draw the ship bodily into the bank, there is the bank cushion which applies a twisting movement to the ship and tends to make the ship sheer away from the bank.

In practice, a ship can usually steam safely near one bank of a canal, but she must maintain a slight inclination away from the near bank to overcome the bank suction, and she will usually require several degrees of rudder toward the near bank to hold the ship's head steady against the bank cushion.

A dangerous situation can result when the ship momentarily gets too close to the side of a canal. The bank cushion may become too large to be overcome by the rudder, and the bow may be forced away from the near bank. This will cause the stern to swing towards the near bank; the bank suction will then become stronger on the stern, and the sheer will be increased as the stern is drawn toward the near bank. The resulting sheer may be so great that the ship will cross the canal and go around on the opposite bank before she can be gotten under control again.

Another problem in navigating in a canal occurs when a ship passes sections where the bank has been cut out to form docks for mooring ships or for other purposes. The pilots of the Suez Canal, where cutouts are provided to allow large ships to pass one another, have reported a serious tendency for ships to veer into the cutouts as they come abreast of them. This has caused passing ships to veer toward and collide with ships waiting in the cutouts when it initially appeared that they were passing with a safe margin.

The tendency to veer into a cutout is caused by the removal of the bank cushion as the ship comes abreast the interruption in the canal bank. When the force tending to push the bow away from the bank is removed, the rudder used to counteract the force commences to turn the ship toward the near bank and into the cutout. Unless this rudder angle is removed immediately, the ship will turn in response to her rudder. When passing interruptions in the canal bank, you must be alert to detect and counteract any changes in the forces on your ship.

The severe sinking, the bank cushion, and the bank suction described above are usually troublesome only to large ships in very restricted canals. A cutter can maneuver safely quite close to the bank of a canal with little noticeable effect. Moreover, these are dependent on the ship's speed through the water. Moderate speed should be the rule when navigating a canal.

Normally a canal is just as easy a place in which to handle the ship as is a narrow marked channel in the harbor, but the proximity of the banks makes it seem more confined. The canal has one distinct advantage, however, in that the current, if any, flows parallel to the banks, so there is no cross-channel set due to current. Furthermore, canals are very thoroughly marked, and one is seldom in doubt about his position.

The most difficult part of handling a ship in a canal is following sharp turns in the channel when there is considerable current flowing. If you are going upstream and you turn late (figure 13), the current can get on your inboard bow, retard your turn, and cause you to go into the bank. If you get caught in such a position, the best action is to back to kill the ship's headway, and then drift downstream with the current. If you can kill the ship's way with respect to the water, the ship will be carried downstream at a nearly constant distance from the bank regardless of the orientation of the ship. Once straightened out, you can start ahead again and make your turn in proper fashion.

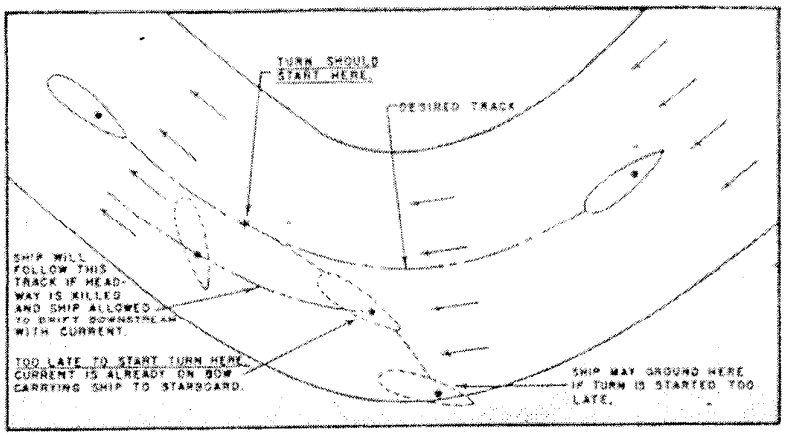


Figure 13 - Following a turn in a canal or narrow channel while going upstream

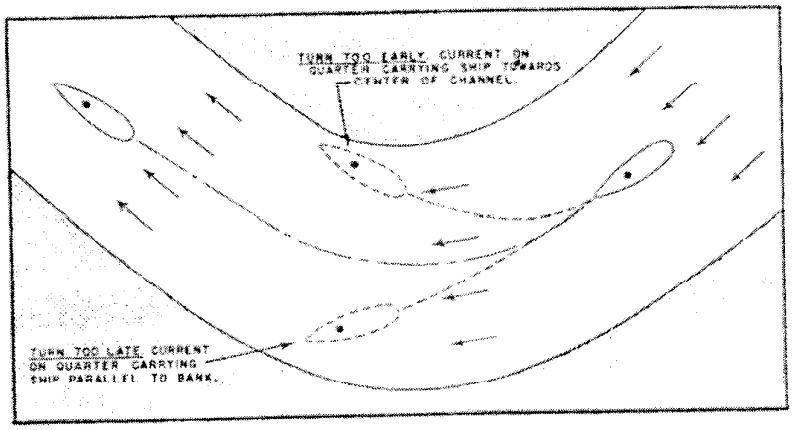


Figure 14 - Following a turn in a canal or narrow channel while going downstream

You should take care to ensure that you start your turn at the correct moment, and you do not get the ship across the current. The proper heading for the ship at any moment during the turn is approximately parallel to the banks at that point in the turn. It is easy to check the correctness of your heading by observing the banks, and, if you detect deviations early, you readily eliminate them by increasing or decreasing the amount of rudder being used.

Making a turn going downstream (figure 14) presents different problems. The current adds to the ship's speed through the water so that speed over the ground increases. On the other hand the action of the current tends to reduce rather than augment the effect of beginning the turn at the wrong time. Whether you turn too early or too late, the current tends to help your turn and carries you downstream instead of forcing you toward the bank.

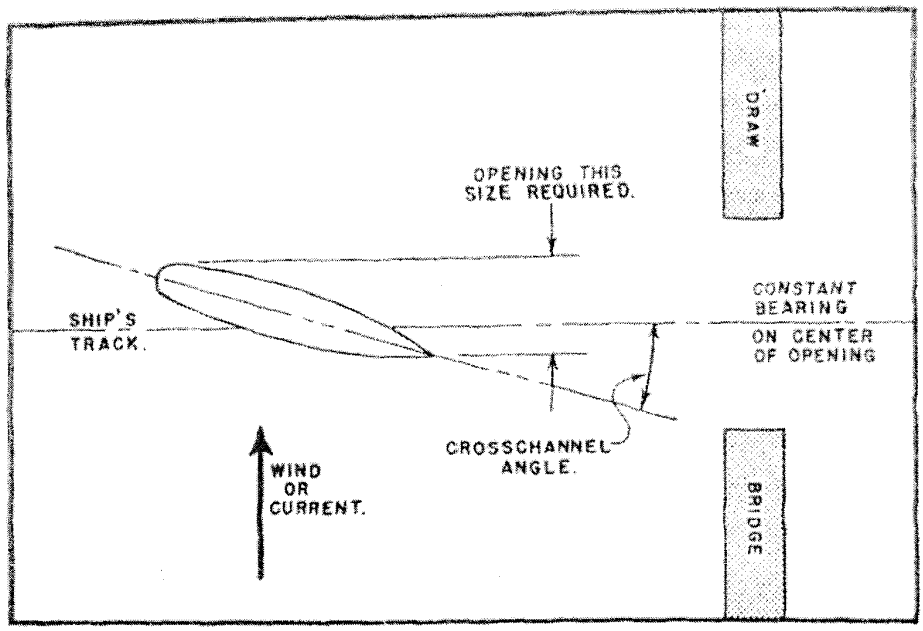


Figure 15 - Passing through a restriction while set cross-channel

PASSING THROUGH RESTRICTIONS

Occasionally in a canal or harbor you must pass through a very narrow restriction such as the opening in a drawbridge or the entrance through a breakwater. Often there is a cross-current or crosswind, and the opening is scarcely larger than the beam of the ship.

In approaching such a restriction, maneuver to approach the center of the opening on a constant bearing course. This requires that you alter your ship's head until the bearing on the center of the opening is steady. The difference between the bearing of the center of the opening and the ship's head when the bearing is steady determines the cross-channel angle at which you will pass through the opening. Having thus determined this cross-channel angle, you can project the extremities of the ship at this inclination to estimate whether you can safely pass through the opening. Figure 15 illustrates this projection and shows that with a large cross-channel angle you need a much larger opening than simply the ship's breadth.

If you find that you have too large a cross-channel angle to allow you to pass through the restriction, two courses of action are open. First you can increase your speed. Doubling your speed will half the cross-channel angle. However, you must also bear in mind that doubling your speed will also quadruple the motion of the ship and greatly increase the damage should you strike something.

The second course of action, other than waiting for more favorable conditions, is to turn the ship as you go through the restriction (see figure 16). In this case, swing the ship parallel to the channel just as you arrive in the restriction, and thus eliminate the cross-channel angle. Of course, as soon as you make this alteration, you will begin to be set across the channel, but before you have moved appreciably across the channel, you will be through the restriction. Since the difference between your heading and your track can be considered to be the same after the turn as before, you will simply be altering your track over the ground by the amount of the cross-channel angle. It is necessary, of course, that the restriction be short enough and that you have sufficient room on the other side of the restriction to take the attendant excursion to leeward and still return to the center of the channel.

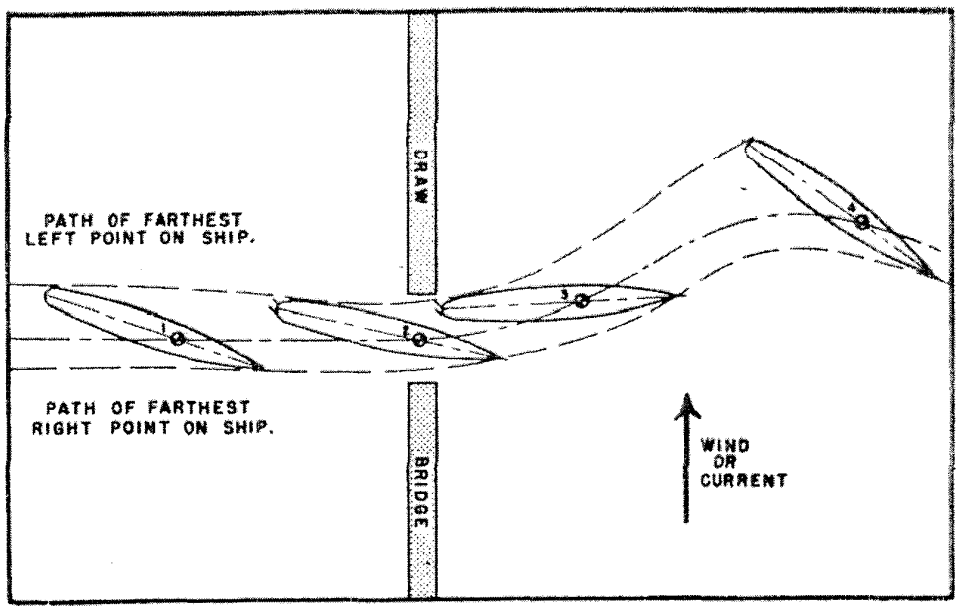


Figure 16 - Turning through a narrow restriction with a strong cross-channel set

When turning through a restricted gate, it is wise for you to pass the bow as close to the windward side of the opening as possible. Just as your bow arrives in the restriction, you should kick your stern upwind to keep it clear of the leeside of the gate. While doing this, allow the bow to fall downwind as necessary; but, since the bow is already safely through the gate, the present problem is to get the stern through. Hence; as soon as the bow has passed the windward restriction, move to the lee wing of the bridge to have a good vantage point for twisting the stern through.

HANDLING IN A RESTRICTED HARBOR AT NIGHT

Handling a ship in a restricted harbor at night is often required of you. In this case you are deprived of many of the usual visual aids and must depend more thoroughly on navigational aids while moving about the harbor. In preparation for handling the ship at night, you should memorize beforehand the characteristics of the important navigational lights. You should plan to accomplish your passage utilizing only the lights you have studied and should lay out your course accordingly. Remember to be watchful to recognize that some aids to navigation could be extinguished, off station, or even destroyed.

Although in darkness you are deprived of certain aids to which you have become accustomed, you still have adequate information to handle the ship safely and efficiently. The harbor ranges are lighted and most of the buoys and beacons are clearly distinguishable once they have been identified. Though you cannot see as well as in daylight, you can distinguish unlighted objects at surprising distances even on the darkest nights. Finally, other ships may be well marked with lights which you can see clearly at all reasonable distances in the harbor. The most troublesome part of shiphandling at night is the lack of the incidental information one acquires by such actions as observing the surface of the water or locating a shoal by the color of the water.

It is more difficult for you to orient yourself in a busy, complex harbor surrounded by a city than in a secluded waterway. In the vicinity of a city, the harbor lights must compete for recognition with the street lights, traffic lights, neon signs, and automobile headlights along the waterfront, whereas in the quiet anchorage the few navigational lights stand out clearly.

One gets an eerie, somewhat detached feeling steaming about in a harbor at night. Although you can fix your position just as accurately as in the daylight, the familiar surface indications on the water, the buoys, and the shore line are no longer visible. You cannot judge distance with any accuracy; you must rely almost completely on the distances reported by the navigator or from the radar. You cannot get a feel for set and drift; you hear the reports and adjust them mentally, but your ability to doublecheck what is being reported is reduced.

HANDLING ALONGSIDE AT NIGHT

The difference between handling the ship in night and handling it in daylight comes most sharply into focus when you are making a landing. As you approach, you find you are less able to judge distances correctly or to grasp the relative-orientation of the ship and its surroundings. The dock seems remote and detached, and then, suddenly, you are upon it; you had no feel for your approach speed.

The solution for these disadvantages obviously is caution. You should make your approach slowly and sufficiently wide to ensure that you can accommodate yourself to the unexpected. Seek your way with patience instead of dashing in rapidly.

You can greatly reduce the difficulty of making a pier or nest at night by the use of lights. If you can use floodlights to illuminate the pier face or the side of the other ship, the problem is greatly simplified. Additionally, having your own forecastle and fantail illuminated with floodlights is helpful to you in keeping the picture of the ship's orientation and makes linehandling easier for the linehandlers. Finally, you can use your searchlights to pinpoint any area of doubt. An occasional sweep of the water between the ship and the dock tends to complete the picture and gives you a better estimate of the intervening distance.

In the use of lights at night, all hands must take steps to avoid directing the rays of any light into your eyes. A momentary exposure will destroy your night vision for several minutes-and these might be the crucial minutes. All floodlights should be hooded so that no rays shine toward the bridge. Reflecting objects should be kept out of the beam of the searchlight. The deck force must be trained to keep their flashlights pointed away from the bridge. Although the reflected light from the floodlit areas will also affect your night vision, this effect is considerable less than that caused by direct rays.

Handling the ship in restricted waters is one of the most interesting phases of shiphandling. You are in close proximity with the dangers and difficulties of confined waters and are continually facing absorbing problems that test your shiphandling skills. Since things happen quickly, you must be well prepared for the events as they occur. As the boundaries move in, you must handle your ship more exactly. Restricted waters are not the place for dash and daring; they are the place for care and precision.

When we leave the calm but congested environment of the harbor and head for the open sea, we must readjust our thinking. At the harbor entrance, as our bows first rise to the swells of the open sea, we shift to an environment where 2,000 yards is a short distance and speeds from 12 to 18 knots are the normal operating speeds. Our ability to estimate distance and to judge motion is greatly reduced as the familiar checkpoints of the harbor slip behind us. We must be ready to meet the extremes of weather and sea condition in a world where the environment can shift from a distant passing situation to an urgent collision situation in an extremely short time.

The annals of the sea are full of moving tales of the seaman's fight against the elements as he dares the mighty ocean in his relatively frail craft. As the wind changes the sea from a pleasant calm to a refreshing swell, to a troublesome chop, to a pounding sea, and finally to the brutal crushing fury of a full gale, the shiphandler's attention shifts from the niceties of perfect maneuvers to the problem of simple survival. There is no more fearful sight than to see a tremendous wave towering above our bridge, combing and curling as it crashes toward us. There is no greater moment of incredulous relief than the moment we perceive that the ship is being borne up and over the menacing mountain of water instead of being buried beneath its immensity. If we are to be able to cope with the sea in its ugliest moods, we must study the mechanism of waves and see how they act upon the ship.

THE FORMATION OF WAVES

We will not investigate the causes and peculiarities of the different types of storms. Rather than probing into the reasons why the storm came into being, we will consider what to do about it once it is upon us. We will look into the character of the wind and the waves and find out how to handle the ship safely in spite of them.

When the wind blows, the friction of the air against the surface of the water tends to drag the water along with it. When the air stream begins to play upon the surface of the water, it accelerates the particles on the surface; but as these particles of water begin to move, they pile up in certain areas ahead because the particles in these areas have not been accelerated as much. The individual particles soon find their motion opposed by a piled up mass of water, and the motion of the individual particle is reversed as the gravitational result of the piling-up overcomes the wind action. Then, after the initial pile of water particles has moved on, the motion of the individual particle is reversed a second time by the front slope of the following pile. The piles of water particles, or waves, formed by the action of wind move along quite rapidly across the surface of the water. The movement of the individual particles in the pile is oscillatory due to the action of gravity as they are alternately at the front slope and the back slope of the wave. There is also the unidirectional average movement called the surface current, resulting from the drag of the wind. In a typical situation the wind might be blowing at 30 knots, the waves moving in the direction of the wind at 20 knots, the individual particles of water on the surface surging forward and backwards a total of 5 feet, and a average surface current due to the wind of 2 knots.

Normally, the stronger the wind, the higher the waves will be. The higher the waves, the faster they will move, because the particles on the leading face are carried higher and will reach a higher velocity as a result of the greater distance to accelerate. Also, the higher the waves, the greater will be the distance between crests. Thus, as the wind increases we can expect the waves to grow larger, to move faster, and to have a greater distance between crest and crest.

It takes an appreciable time for a wave system to be set up, and, because of the movement of the waves, it also takes a considerable distance. The highest waves for a given wind velocity are found where the wind has been blowing steadily for days

across hundred of miles of deep, unobstructed sea. Under these circumstances a 40-knot wind might produce waves averaging 20 feet in height from trough to crest, and 30-foot waves would be encountered frequently. Under more severe conditions much higher waves are occasionally encountered, but it is quite difficult to judge the height of waves from a ship because of the severe plunging and rolling encountered in such seas.

HANDLING THE VESSEL IN ROUGH SEAS

We can thus consider that in rough weather the surface of the water is a series of troughs and crests moving along at some mean velocity, but that except for a small surface current, the surface of the water is not moving along with the wind. The force that a moving fluid can exert at a given velocity is proportional to its density, and since water is so much denser than air, the combined effect of the wind and the waves on the ship is almost solely that due to the waves. The wind becomes an important effect in the survival of the ship only at hurricane velocities where the wind is so strong that it can cause a ship to carry a large list to leeward.

Each type of ship reacts differently to the action of the waves. According to its mass distribution and righting characteristics, each ship has natural frequency in roll and pitch. This is the frequency at which the ship would tend to roll in calm water if she were listed slightly to one side and then released. A ship will tend to roll at this frequency under all conditions of wave motion, and the most severe rolling will occur when the frequency of the wave motion approximates the natural frequency of the ship. Actually, this frequency is usually measured by its period (the time required to go from even keel to extreme right, to extreme left, and back to even keel), and a ship's natural period of roll is a matter of interest to the shiphandler. The normal period of roll for most Coast Guard cutters is 7 to 9 seconds.

The greater the righting moment for a given inclination (the moment tending to return the ship to an even keel when inclined) the shorter will be the period of roll. If a ship is losing its righting moment due to the free surface effect or a change in its mass distribution due to flooding, its period of roll will increase. If a ship's period of roll increases, it is losing its stability. Each watch stander should know the natural period of roll for the ship so they will be quick to notice any change in this important characteristic.

The first action of the ship which should be examined is simple rolling. When heading into or running with a sea, ships frequently roll 20° to either side. This is considerably increased when heading diagonally across the seas, and the maximum rolling normally occurs when the sea is on the beam or the ship is in the trough of the waves. If the period of the waves approximates the natural period of the ship, a resonant condition exists, and the ship will roll severely with deep, steady rolls. The list caused by a turn at high speed, coupled with the normal wave motion, can produce an augmented roll which can be quite large. There are few ships which have not experienced a roll of 50° at some time during their service.

Obviously, rolling of the magnitude mentioned above is of concern to the conning officer of the ship. If the ship were to take a single roll of 30° unexpectedly during a meal, damage could easily be done in broken crockery and glassware alone. The damage to spare parts and stores mounts with each roll unless such gear has been stowed perfectly. The' damage to office machines, furniture, instruments, etc, is always great during severe rolling as these objects get away from the grip of the user. When a ship rolls deeply, she occasionally dips her side under the water. Such rolling is not only uncomfortable and fatiguing to the crew, but dangerous to life and limb, and almost always accompanied by material damage to the ship and her equipment. The good shiphandler is always alert to minimize the ship's roll, and the shiphandler makes sure to warn all hands ahead of time to make preparations for rolling when it cannot be avoided.

Usually the best way to minimize the roll is to run with the sea at a few knots faster or slower than the waves. This means we will have a low, but steady, relative motion with respect to the waves, and thus will avoid the unsteady motion experienced when going at about the same speed as the waves. When traveling about the wave speed, we are alternately accelerated by the front slope of the wave and retarded by the rear slope. Since the water at the crest of a

wave is momentarily traveling at about the velocity of the wave, we will have less rudder effectiveness due to the low relative velocity at the rudder when the stern is on the crest. This combined with the tendency to skid as we hang on the crest of the wave, makes it desirable to go at a speed different from that of the waves.

Heading directly into the waves also minimizes the roll, but this usually makes the pitch a maximum. This is not quite as good a solution as running before the sea, because the general action of the waves on the ship is more violent. The momentum of the waves is opposed to the motion of the ship in this case.

The more the sea is brought to the beam, the more the ship will roll. The athwartships inclination of the surface of the water is greatest in this orientation, so the amplitude of the force which is initiating the roll is at a maximum. The period of the initiating force is also important, and if the period of the waves is nearly the natural period of the ship, maximum rolling will be experienced. On the other hand, if the period of the waves is much longer than the natural period of the ship, the ship may ride quite comfortably parallel to the trough as she rides up and over the waves with little inclination.

The most severe pitching is experienced when headed directly into the sea. In this case the bow is carried up by the oncoming wave, and then the ship plunges into the trough as the wave passes. The resonant period of the ship in pitch is often matched by the waves, and, from the point of view of possible damage, pitching is equally as important as roll. When a ship buries her bow under tons of water while bucking into a rough sea, there is a tremendous stress on her hull.

In rough weather, severe damage can be done to a ship by the action of the waves. In addition to damage simply from the violent motion of the ship, deck equipment can be bent and torn loose by the impact of the water as the waves sweep over the deck. Plates are sprung and warped, and whenever a leak occurs, water damage follows. (See figure 17.) The more the ship is punished by the seas, the less efficient it is. The crew, though veterans of the stormiest weather, become fatigued by the struggle to exist, because they must continually hold on to keep from being thrown from their feet and hence can get no real relaxation, day or night.

Obviously, we must learn to operate in rough weather or the ship will be useless in a storm. On the other hand the ship will be of no service to anyone if it is lost because the crew did not take sufficient precaution. How rough can the weather be without severely damaging our ship? Where is the point at which we must cease thinking of the operations and take steps to protect the ship from the storm? These are important questions that must always be borne in mind.

These are certainly matters of degree, and the point of decision must change with the operation. The risk taken must be justified by the importance of the mission. It is imperative, however, that the shiphandler know when the ship is in danger, and it is vital that the shiphandler know what to do about it.

Simple rolling up to 30° to the side is acceptable as one of the normal problems found at sea. As long as the gear which has been stowed in the proper manner in the proper place is still secure, we must recognize that any damage caused by loose gear is caused by improper securing. On the other hand, when gear is breaking loose from its regular stowage, when lifeboats are dipping, and when the decks are being swept by combers, it is time to search for means of reducing the effect of the weather. Heading into the sea or away from it will normally reduce the roll to an acceptable level, and changing speed will often alter the rolling by changing the frequency with which we are cutting the waves.

Ships can be driven into the seas until their keels come clear of the water all the way back to the bridge, and they can disappear in their own spray as they bury themselves into the waves. They can do this occasionally with little apparent damage, but abuse such as this will eventually cause extensive damage in buckled bulkheads, lost deck gear, cracked plates, etc. Any weakness on the forecastle will be searched out as the waves cave in the gun mount, rip off the fire plugs, and sweep away the hose and line reels.

There are two good indications when the ship is being driven into the sea too severely. The first is the pounding experienced when the bow comes clear of the water and crashes into the next wave. This produces a shock that can be felt throughout the ship and is an indication of the severity of the force of the waves. The second effect is a vertical vibration of low frequency which is set up as the whole ship bends longitudinally under the weight of water picked up by the forecastle as the ship plows under the waves. Unless there is an overbearing operational need to do otherwise, the course and speed should be set so that neither this pounding nor vibration is encountered.

In selecting the course and speed for the easiest riding, it is usually necessary to try a few experiments before a completely satisfactory combination is found. Generally, downwind courses are much more comfortable courses than those into the wind. Avoid courses near the trough, unless the seas are long and steady. If pitching is the problem, try courses inclined to the direction of the seas; this will make the wave fronts appear less abrupt. In most cases, when heading into the seas, the ship will ride better at a low speed. A difference of only two knots may be the difference between severe pounding and acceptable pitching.

SURVIVAL IN MOUNTAINOUS SEAS

We have discussed means of making the ship ride more easily in a rough sea, and we have discussed how to avoid the relatively minor damage caused by rolling and pitching. However, when the ocean goes wild during a hurricane, these relatively minor factors are set aside and we are faced with stark survival. A full gale in the North Atlantic or a typhoon in the South China Sea can toss the mightiest ship about as though it were a toy boat. The waves lose their normal form as their tops are sliced off by the howling wind, and the air is a mixture of rain and spray. Visibility drops with the barometer. The waves dwarf a ship, and they seem intent on the destruction of every living thing.

If we are to survive these extreme storms, we must have the principles of heavy-weather shiphandling foremost in our minds. If we lose electrical or propulsive power, we lose the ability to control the ship and then we are at the mercy of the sea. A ship without its engines and rudder will soon broach and expose its vulnerable sides to the onslaught of the waves. The seas will find a ship's weaknesses as they cascade over its helpless form, and the ship will soon begin to take on water. Finally, with its stability reduced by the free surface of the water in the ships hull, it will succumb to a mighty wave, will capsize, and be lost to the storm. Sea anchors and oil bags still have their place in modern seamanship under specialized circumstances, but by the time it is apparent that the ship is in extremis, the weather is usually much too severe for the crew to work on the decks streaming gear of any kind.

The guiding principles of survival in a severe storm are: maintain power, maintain buoyancy, and maintain stability.

To preserve these vital properties we must make certain of the watertight integrity of the ship. At the first sign of a severe storm the ship should be secured for heavy weather. All topside gear should be secured with extra lashing, inboard lifelines should be rigged, and all watertight hatches should be battened down and checked. The most common cause of loss of power is the grounding of the main switchboards when salt water gets to them. We must make sure that all hatches or ventilation ducts in the vicinity of the generators or switchboards are firmly secured.

The buoyancy and stability of the ship go hand in hand. To keep the center-of-gravity down, the ship should be properly ballasted. Free surface should be avoided wherever possible, and all tanks should be either completely full or completely empty. All compartments which should be dry must be kept that way. Bilges should be pumped, and if water leaks into any normally dry compartment, it should be pumped out immediately. If the ship is properly ballasted, if the free surface has been kept to a minimum, and if buoyancy has been maintained, we should come through any storm with flying colors.

The trick of controlling the ship in a typhoon is to keep out of the trough. As indicated in Figure 17A, if the ship is proceeding at an angle to the seas, there is a tendency to force the ship to align its self parallel to the trough as it crosses the wave fronts. When the ship goes up the forward face of a wave, gravity tends to force its bow down into the trough. As the ship goes down the trailing face of the wave, gravity again tries to twist it into the trough by skidding the ships stern down the face of the wave.

If the ship gets caught in the trough the waves will crash into its broadside and it will roll wildly. Once in the trough, it is very difficult to get out, because any control we can exert on the ship is overwhelmed by the action of the waves. The side forces available from the engines and rudder are small compared to the force of the sea. Our best chance lies in going ahead at maximum speed to ensure maximum rudder force and in seizing any opportunity to turn out of the trough. In most cases it is advisable to turn downwind, because it allows us the greatest interval before being struck by the next succeeding wave.

Once we are heading nearly parallel to the wind and seas, it is possible to maintain our heading, if the helm is handled skillfully. The choice whether to head into or away from the wind is an important one. Ships are built to take the most severe waves from ahead. The bow is shaped for it, and, generally speaking, the rest of the forward structure is designed to take heavy seas. On the other hand, if we head into the wind, we add our own velocity to that of the sea, and the resulting impact is greater. We must maintain an adequate speed ahead to ensure that we can steer or else we will lose control of our heading and broach, so we cannot slow below a certain minimum.

If we head downwind, on the other hand, we reduce the relative velocity of the waves by the amount of our speed, but we are exposing our stern to the wave fronts and it is neither shaped nor reinforced to resist the direct action of the waves. However, if we can maintain a speed so that the relative velocity of the waves is low, the stern will be able to stand up under the reduced action of the waves. As long as the waves do not crash down upon our fantail and poop our ship, running before the wind is the most gentle method of riding out a severe storm.

The choice of whether to head into the seas or to run with them will also depend upon the location of the center of the storm. In a cyclonic storm the wind blows nearly toward the center of the storm except in the vicinity of the eye, where it blows tangentially, and our selection of the direction in which to ride out the storm must be modified by our desire to get out of the storm as soon as possible. A less advantageous inclination to the sea can be accepted if it will carry us out of the path of the storm and away from the most intense portion.

As in most phases of shiphandling, safety in a severe storm depends upon forehandedness. The ship that is properly ballasted and carefully secured for the storm will have a minimum of trouble riding out the most severe storm. The skipper who has studied the ship and is alert to the signs of the sea will be able to handle the ship in spite of the weather. A sound ship handled on sound principles of shiphandling can weather any storm. The shiphandling skill of the person at the conn is the keystone to safety at sea.

Two final words of caution. First, the effect of "free surface" water in bilges and compartments is particularly important during heavy weather when a ship's stability is severely tested. Pumps must be kept operable to remove water; electrical switchboards must be kept dry. This points up to the need for making watertight closures well in advance of the onset of the worst part of the storm. To minimize free surface effect it is advisable, particularly when bad weather is expected, to keep all tanks containing liquid either full or empty.

Secondly, ships traveling through regions where the air temperature is below freezing may acquire thick deposits of ice as a result of spray freezing on the rigging or deck areas (figure 17B). On vessels in heavy seas and freezing weather, deck ice may accumulate very rapidly and increase the topside weight to such an extent as to seriously reduce the stability of the vessel.

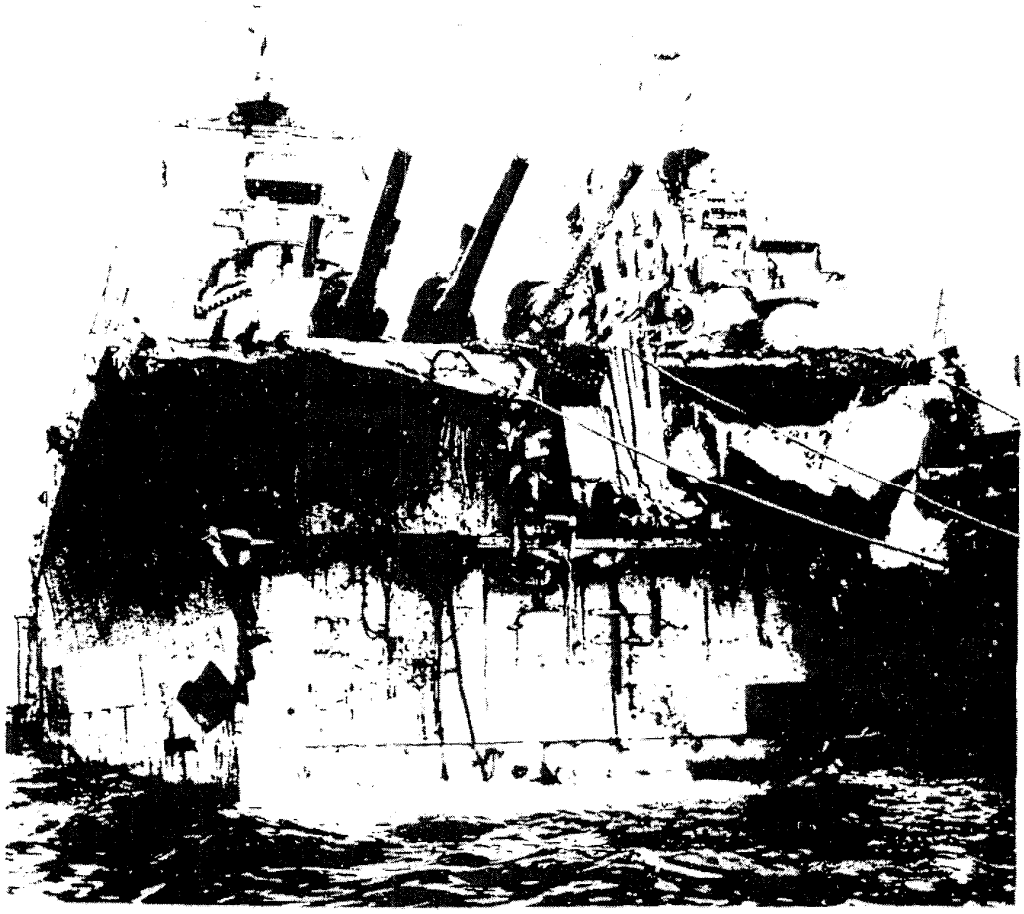


Figure 17 - USS Pittsburgh, bow ripped off in a typhoon

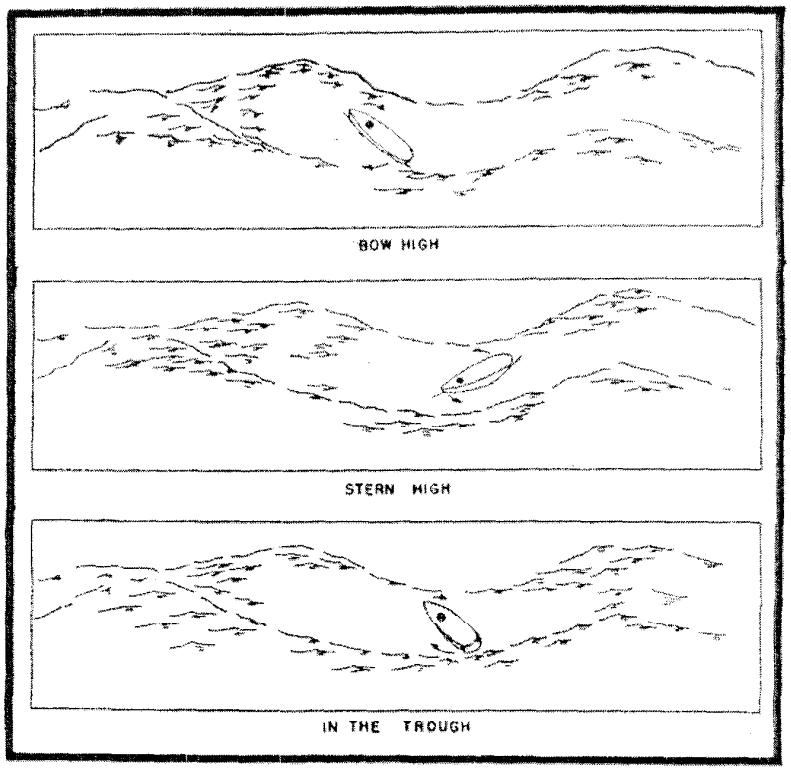


Figure 17A - In heavy seas the ship always seeks the trough

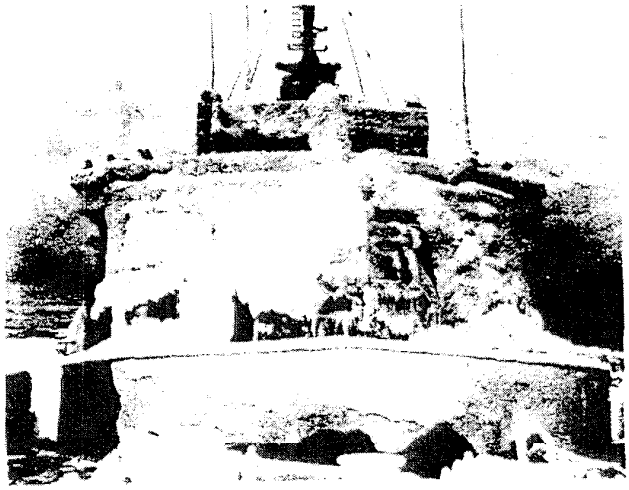


Figure 17B - Deck ice

SMALL BOAT OPERATION IN SURF

At times your ship's small boats will be used in operations under surf conditions. As a shiphandler you may be directing the operations of your small boats. For this reason you should have a good working knowledge of surf and the procedures for handling boats in surf.

You can acquire the skills required for handling boats in rough water and surf only by continuous training and experience under such conditions. A knowledge of the surf and its makeup, along with the principles of proper small boat operation, will definitely aid the boat handler in acquiring these skills.

Understand and respect the power of waves and breakers; their power is tremendous. A poorly or improperly handled boat is almost sure to be swamped, broached, or pitchpoled. This holds true in all cases, regardless of whether the boat is designed specifically for heavy surf operation or not. One example is the Coast Guard 44' Motor Life Boat. The fact that it is designed to absorb these forces does not justify improper handling. Broaching, swamping or pitchpoling exerts unnecessary forces on the hull of such a craft.

Broaching results from permitting a breaker to strike on the bow or quarter and to slew the boat around until the seas are on the beam. There is a dangerous probability of being swamped or capsized.

Swamping results from seas breaking into the boat or results from broaching.

Pitchpoling results from permitting the boat to ride on the shoreward or front side of the sea. The stern is elevated and the bow is depressed into the slower water at the base of the breaker. As the resistance on the bow increases, the stern is raised higher and higher until the boat is toppled over, end for end and bottom up.

Understand and evaluate surf conditions according to these principles:

a. Wind, disturbing the equilibrium of the water, raises waves. Whenever the wind blows, an irregular sea develops with waves traveling with the wind.

b. The size of the wave, its height and length, depends on the wind speed, the Fetch (distance over which the wind has blown), and the length of time it has been blowing.

c. When the wind-raised waves travel out of a storm area, they advance as swells. These swells are not regular and uniform and may vary greatly in height and length.

d. As this sea or swell travels into shallow water, each wave crest grows steeper until it breaks. The foaming white water advances towards the shore line and rushes the beach.

Thus, surf is caused by winds, local or distant. However, the nature of the surf depends on the character of the waves that approach the shoreline and on the manner in which these waves are changed as they go from deep water into shallow water.

There are three main types of breakers: (see figure 18)

Spilling type. Both sides of the wave grow more concave as the wave advances, until the wave is so steep that is breaks down by spilling. This type is gener ally associated with steep and deep waves on flat beaches.

Plunging type. The back of the wave continues to be well rounded, but the front of the wave becomes so concave that the crest of the wave suddenly falls for ward and breaks. This type of wave can occur on all beaches, but mainly on steeper ones.

Surging type. This type generally occurs on steep beaches. This type of wave neither plunges nor spills but surges into a peak up the beach face.

In addition to the ratio of the wave height to wave length, the beach slope, winds, and currents, the presence of an offshore bar will also influence the breaker characteristics.

When waves run from deep into shallow water, their period, or time interval in which a wave record repeats itself exactly, will generally not change. However, the length and speed of the wave decreases and the height increases. Theoretical studies report that a wave will break on the beach when the wave face slope becomes 90°. This usually occurs at a depth of water between (1) and (1.5) times the height of the wave. However, when a bar is present, it may cause the waves to break in water up to 1.7 times the breaker height.

On moderately steep beaches waves tend to break farther out at low tide and near the shore line at high tide. The presence of a bar would be indicated by one line of breakers at high tide, but several diminishing lines at low tide.

LONGSHORE CURRENT

Waves generally approach the shore at an angle. When they do, they break at an angle to the shore line, and a current is set up parallel to the beach.

This longshore current is a very treacherous phenomenon when landing a boat through surf. It is largely responsible for the tendency to broach. As the boat advances into the surf zone, the velocity of this longshore current increases as a result of:

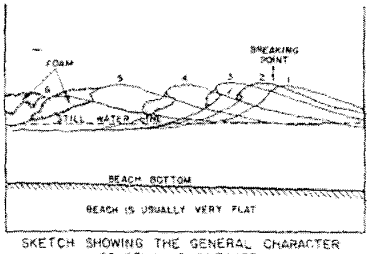
1. increasing breaker height
2. increasing angle of the breaker with the beach
3. steeper beach slopes

The velocity of the longshore current decreases with increasing wave period. Observations of the longshore current have determined that sustained velocities of more than three knots have been reached. However, they seldom exceed one knot.

RIP CURRENT

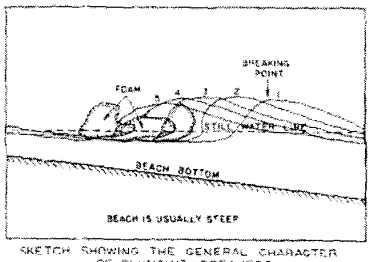
Rip current is a narrow seaward-moving water current that returns to deep water the water carried landward by waves. This can be very useful to the boat handler when approaching the beach.

SPILLING BREAKER



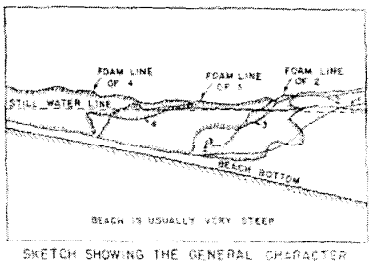
SKETCH SHOWING THE GENERAL CHARACTER OF SPILLING BREAKERS

PLUNGING BREAKER



SKETCH SHOWING THE GENERAL CHARACTER OF PLUNGING BREAKERS

SURGING BREAKER



SKETCH SHOWING THE GENERAL CHARACTER OF SURGING BREAKERS

Courtesy of Robert L. Wiegel, Council on Wave Research, University of California

Figure 18 - The three types of breakers

This large volume of seaward-moving water breaks down the incoming waves. This in turn provides a path, from outside the surf to the beach, where the waves will be appreciably smaller.

The boat handler is also able to better control his boat as a result of the resistance set up by the seawardmoving current.

The boat handler can locate a rip current from outside, the surfline by observing the discoloration of the water caused by sand particles from the bottom along with foam lines running along both sides at right angles to the beach. The height of the waves on each side is another distinctive characteristic because smoother water will lie in the area between them.

HANDLING BOATS IN SURF

The underlying causes for the development of breakers and surf is the alteration that occurs in the shapes of waves as they move in shoreward over a shoaling bottom after they have reached the point where the depth is less than one-half their own length.

As the wave advances into shoal water, it not only becomes steeper as a result of its decreased length usually combined with an increased height, but it changes quite abruptly, just before it finally breaks. Anyone who has come in through surf in a small boat knows how abruptly this change occurs.

The boat, which may merely rise and fall bodily with the longer swell offshore, is pitched up more and more steeply as it rides in on the back of a chosen roller. Finally, the bow may be lifted far above the stern just before the breaker developes.

This tendency is further influenced by the changing of the wave's shape. As the wave travels toward the beach, it becomes elliptical in shape. This influences the orbital velocities of the water particles, causing the velocity to be greatest near the crest and trough.

A small boat floating on the top of a roller may be swept forward with surprising rapidity just as the top of the crest falls forward. For this reason you may have difficulty bringing even a surf boat in through high breakers.

Unless you handle the boat well, it could easily be carried forward over the crests. The bow may pitch down into the trough ahead. If so, the boat will be in imminent danger of pitchpoling or broaching because its stern continues to be swept forward in the air.

An important consideration in connection with boat operation is the speed of a breaker which depends on the depth of water at the time of breaking. Since the depth of water at the time of breaking is directly related to a breaker height, the speed of a breaker depends upon its height only. The higher a breaker, the greater its speed will be as it advances shoreward.

In high breakers, you must handle surf and landing craft skillfully because the breaker speed exceeds the top speed of most boats used for this specialized operation.

Experience has shown that the following procedures hold true for nearly all boats:

a. The boat handler should lay outside the breaking point of the in-rolling waves, and make his approach at a low rate of speed.

b. As the last big wave of a set runs in and passes the center of gravity of the boat, lifting the forebody, apply full ahead throttle to bring the boat riding in just behind the breaking wave.

c. Control the position on the wave and the tendency to override with the throttle.

d. Carefully counteract the broaching tendency in the longshore current. This may be difficult since the boat will be making very little speed through the water. Here experience in properly positioning the boat on the wave is most vital. (Figure 19 shows correct positioning.)

e. The wrong procedure in positioning the boat on a wave is to place the boat's center of gravity forward of the wave crest. In this position the boat may be overrun by the wave, swamped and broached. (Figure 20 shows the wrong and dangerous positioning

Crossing out through the breaker line is not so difficult as running in towards the shore.

The critical point, however, is when the boat crosses the in-running wave. The boat must be well over the crest before the wave starts to break. Should it break before the boat crosses the crest, the released energy will tend to push the boat back and under, possibly swamping it.

An alternate method for crossing can be made successfully through the foaming white water of an initially expended breaker. The boat's power and control are essential in the crossing-out maneuver.

Although adequate speed is necessary to overcome the force of the incoming breakers, this speed should be carefully regulated. Too much speed will tend to drive the boat into the oncoming sea or cause the bow to fall too heavily after topping a sea, thus placing unnecessary strain on the boat.

If at all possible, manage the boat to avoid the heavier breaking seas. If you cannot maneuver the boat in this way, meet the breakers squarely so that their force will be equally distributed on each bow.

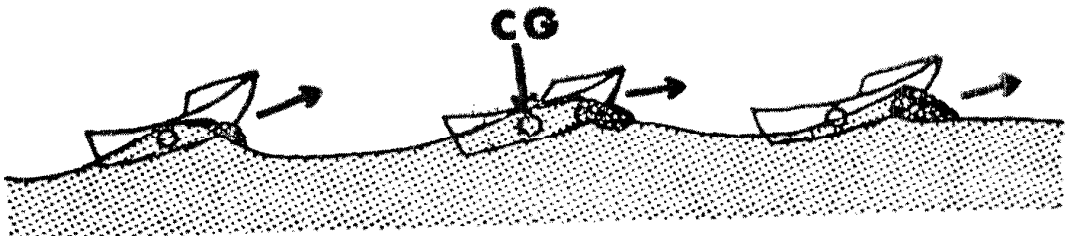


Figure 19 - Correct positioning

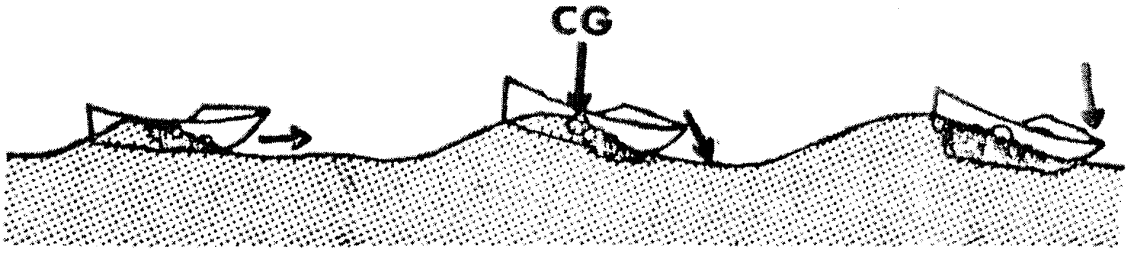


Figure 20 - Wrong and dangerous positioning

To bring a ship to anchor or to an anchor moor in a smart seaman like manner is the mark of an efficient ship. In general, this evolution consists of three main elements: shiphandling, navigation, and deck seamanship.

You have already considered shiphandling in the foregoing sections of this pamphlet, and you have navigated a channel and conducted a. precision anchoring exercise in a previous section. To be a proficient shiphandler in anchoring and mooring, you will also need a working knowledge of the procedures used on deck. Therefore, this section will cover the deck seamanship aspect of anchoring and mooring with bower anchors.

LETTING GO A SINGLE ANCHOR

On ships with two anchor windlasses, both ship's anchors are made ready for letting go. The anchor detail receives certain information from the bridge prior to anchoring. For example, the bridge will designate what anchor (port or starboard) is to be used. Nonetheless, both anchors are made ready for letting go to the farthest extent possible in the event one fouls, or one is needed to slow the ship in an emergency. In addition, the bridge will inform the forecastle of the depth of water of the anchorage. The depth of water is needed by the anchor detail to determine the amount of chain the ship will ultimately veer out. The bridge will also tell the forecastle what sort of holding ground (mud, sand, etc.) the anchor will dig into, as this will indicate how well the anchor can be expected to hold. For example, a rocky bottom is not considered to be good holding ground for an anchor.

The exact procedure may vary for making the anchor ready for letting go, but in general the following tasks must be performed: the anchor windlass is tested; the anchor is walked out of the hawsepipe using the wildcat to ensure it will not hang up in the pipe; the brake is set; and the wildcat is disconnected. In addition, all stoppers but one, the housing stopper, are disconnected prior to letting go. The anchor buoy line is attached to one of the anchor flukes. The buoy so attached is used to mark the location of the anchor while the ship moves around it, and to aid in locating it if the chain should part or be slipped in an emergency. Another task prior to letting go is to inspect the chain locker for any such loose gear as hand tools that might become wedged in the chain pipes or come flying out, endangering the crew on deck. When the anchor is ready for letting go, that fact is reported to the conning officer on the bridge. While the anchor detail gets the ground tackle ready, distances to the anchorage are relayed to the first lieutenant from the bridge. The ship should be moving (usually backing) when the anchor is dropped. This keeps the chain from piling up. Piling may damage the chair., mid, if the pile is on top of the anchor, the chain might foul the anchor. Further, moving aft is a precaution against damaging such things as the sonar dome with the anchor chain. At the command "Stand By," the brake is released and two seaman, one with a maul, take stations at the stopper. Personnel manning the brake must wear goggles for protection against flying chips of debris. When the command "Let Go" is given, one seaman pulls the pin from the stopper's pelican hook. The seaman with the maul knocks the bail off the tongue of the pelican hook and steps clear. The seaman tending the anchor buoy tosses the buoy over the side. At the same instant the colors are shifted, the jack is closed up, and the anchor ball is hoisted.

The anchor chain goes rattling out with a roar, until an instant of slackening speed indicates that the anchor has hit the bottom. At this instant, the person on the brake begins to set up on it. The chain is stopped completely by applying the brake. The anchor is then set by backing down with the engines. The amount of chain let out before setting the anchor depends upon the depth of the water, the type of bottom, and the type of anchor. Then the brake is eased off, and the chain is veered (allowed to run out by slackening the brake) until the desired scope has been reached.

As each chain marking passes the wildcat, the report is made to the conning officer "(number) fathoms on deck." An alternative report is "(number) fathoms at the water's edge." To report the length of chain veered out is called reporting the scope of chain. In addition, the direction the chain is tending is indicated by pointing the arm and/or reporting "Chain tending (number) o'clock." The amount of strain on the anchor chain (light, medium, or heavy) is also indicated. A typical anchor report would -be: "chain tending three o'clock, medium strain, 75 fathoms at the water's edge." The way reports are given may vary from ship to ship, depending on the preference of the commanding officer. These reports are of the utmost importance to the conning officer, with them, the ship can be maneuvered properly. For example, if the chain tends around the stem, the situation is reported to the bridge. In this situation, when the chain is making a sharp bend around the ship's stem, damage to one or more chain links or to some underwater hull appendage is likely to result. Detachable links are particularly susceptible to damage in this fashion. A heavy strain at 12 o'clock might be an indicator that the anchor is dragging.

When the desired scope of chain is out, the brake is set and the order is given to "Pass the stopper." The stoppers are applied, the strain on each is equalized, and the chain is slacked between the anchor windlass and first riding stopper.

Scope of Chain

A ship will normally anchor in water less than 20 fathoms, and under favorable conditions will use a scope of chain which is between five and seven times the depth of the water. However, if a ship at anchor is subjected to heavy weather, a strain much stronger than normal is placed on the chain and the catenary of the chain is decreased. More and more of its length lifts off the bottom as the strain increases; yet much of the holding power of an anchor is a result of the chain lying on the bottom. If the scope is not long enough, the chain lifts all the way to the shank, and the anchor breaks out and drags before developing the full safe load on the chain. If the scope is too long, however, the breaking strain is reached before the entire length of chain lifts off the bottom, and the chain will part.

HEAVING IN THE ANCHOR

When the special sea detail (or anchor detail) is stationed, the forecastle detail should have the necessary equipment ready for use. The equipment includes a fire hose (tested for adequate water pressure) to wash the mud off the chain and anchor, wrenches for chain stoppers, small grapnel for recovering the anchor buoy, and paint pots and brushes to renew markings on the chain. It may not always be feasible to accomplish this remarking, but an opportunity should not be missed through lack of preparation.

Prior to heaving in, connect the anchor windlass and take a strain on the chain sufficient to slack the stoppers. Remove the stoppers and bring the anchor buoy aboard. Heaving in begins at the command "Heave around!" If the chain has been subjected to any severe strain during the time at anchor, inspect each link for distortion and sound each with a hammer as each comes aboard. Report each chain marker as it appears. Report, also, the amount of strain on the chain and the direction in which the chain is tending.

Heave the windlass around slowly at first until the ship's deadweight is overcome, and it begins to move toward the anchor. In the event that wind or current effect is putting undue strain on the windlass, inform the bridge so that the conning officer may relieve the strain by using the ship's engines. If the chain tends across the stem, order the windlass operator to avast heaving until the ship swings clear. Here again the bridge can assist with engines and rudder.

Chain lockers on modern ships are of the self-stowing type. However, you should have at least one person assigned to guard against any possible pileup in the chain locker. They can keep the chain from piling up by pushing over any accumulation with a length of two-by-four. Personnel must be especially cautioned against dropping this board or anything else into the locker.

When the anchor is just about to break out, and the chain is nearly vertical, make the report "Anchor at short stay." Just as the flukes break out and the crown is still in the mud, word is passed "Anchor is up and down." Next comes "Anchor aweigh!" when the anchor leaves the bottom and "Anchor in sight; clear (or foul) anchor!" when it comes into view.

Patent anchors frequently come up with flukes inboard, and on some ships they can foul the forefoot in this position. Usually the only way you can detect this fouling is by the sudden strain on the windlass, which you must instantly stop to avoid parting the chain. A quick veer, braked to a sudden stop, will usually turn the flukes over the right way, but sometimes the anchor may require dropping again. However, most anchors will come right on in even with flukes inboard; the ship's side around the hawsepipe turns the flukes over when the shank enters the pipe. On some ships the inboardpointing flukes engage the side and will prevent the anchor from housing properly. A quick veer will usually correct this situation. If not, attach a bull rope to a fluke and heave the rope from on deck to hold the flukes upright as you take in the chain.

MOORING WITH TWO ANCHORS

A ship at anchor is usually lying in a tideway, heading up against the tidal current. At each change in the direction of the current, the ship swings around its anchor and heads in the opposite direction. If a ship is riding to a single anchor, the radius of swing is the horizontal distance from the anchor to the hawsepipe, plus the length of the ship. Sometimes, it is necessary to confine the ship to a smaller circle of swing, and this is done by mooring with two anchors laid in a line which parallels the direction of the current. The upstream anchor is called the RIDING anchor, and the other the LEE anchor. The ship rides between them to equal lengths of chain, and its area of swing is thus confined to a circle whose radius is not much greater than its own length, as shown in figure 21.

Mooring with two anchors is normally accomplished by either of two methods; the ordinary moor or the flying moor. The procedures for making these moors are lengthy, complicated and vary from ship to ship. Therefore, this course will not discuss the actual procedures for making these moors.

MEDITERRANEAN MOOR

The Mediterranean moor, consists of dropping both anchors, widely spaced, and backing the stern into a pier or mole where it is secured by a stern line and two quarter lines, preferably crossed under the stern. This

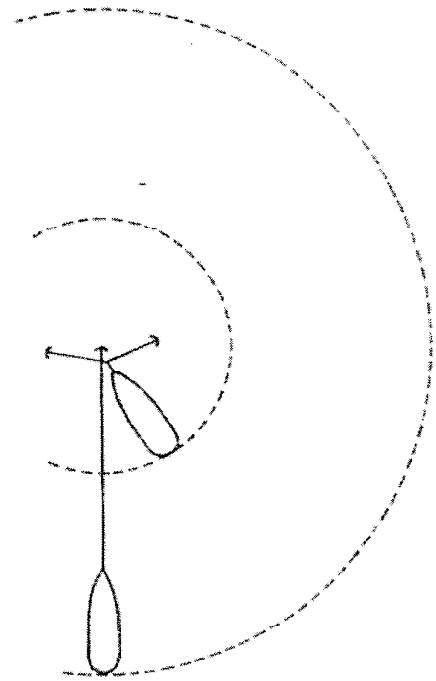


Figure 21 - Space advantage in mooring

moor allows greater utilization of the dock space and enables each ship to place her own brow to the pier.

For best security of the moor, the chains should tend 60° out from each bow, but crowded harbor conditions seldom allow such separation. Frequently it is necessary to settle for as little as 30°. Even this gives a secure moor for all except the most severe winds.

The first step in preparing for a Mediterranean moor is to decide how far from the mole to drop the anchors. This distance depends on the length of the ship, the amount of chain to be used, and the angle that the chain will tend.

It is desirable to have the anchors well out, because with only one windlass, you must work the anchors one at a time. Safety requires that you accomplish this time-consuming task as far from shore as possible. A good scope of chain is 75 fathoms, allowing a 30-fathom margin for error on the shorter chain (105 fathoms).

In a situation in which you are aboard a large cutter using 75 fathoms of chain and the stern is close to the mole when the moor is secure, you should drop the anchor approximately 280 yards from the mole (figure 22). The most advantageous approach is parallel to the mole. Let go the first anchor when the hawse is about 50 yards short of the centerline of the berth and let go the second when the bow is about 50 yards past the line. After dropping the first anchor, put the rudder hard over to prevent the chain from getting under the ship. After letting go the second anchor, twist the ship and back toward the mole, veering chain as necessary. Handle on the wildcat the cable of the first anchor and handle the other anchor from its compressor.

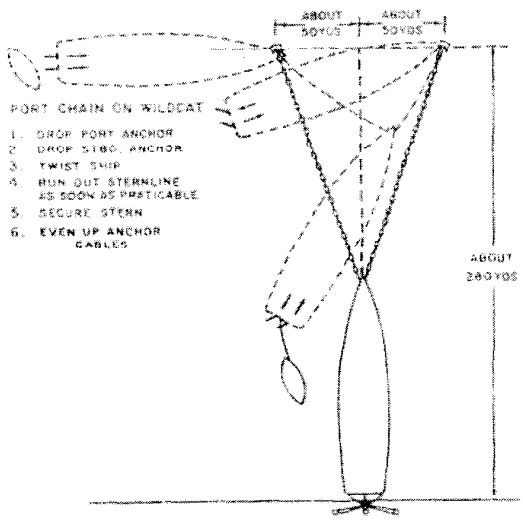


Figure 22 - Steps in making a Mediterranean moor

(For the benefit of those who are not familiar with the rig, a chain compressor is a leverlike device mounted in an opening in one side of the chain pipe. When set up, it holds the chain against the opposite side of the pipe. The force is applied by means of a light tackle secured to the end opposite the fulcrum. It provides an auxiliary means of controlling and securing the chain.)

As soon as possible, run the stern line to the mole and take particular care to keep the slack out of this line so that it does not become fouled in the screws.

If the construction of the stern permits, cross the quarter lines, because this ensures a more secure moor.

After you have secured the stern, make the moor taut by heaving in and equalizing the strains on the anchors. Both chains must take a moderate strain and stand well out of the water in order to hold the stern off the mole.

FOUL WEATHER MOOR

An approaching storm warrants the attention of all hands. The preferred course of action may be to seek the open sea. If this is not possible, the ship must ride out the gale at anchor as best she may.

No doubt you have witnessed the pronounced yawing of a ship riding to a single anchor. During a violent storm, this yaw may be as great as 80°, and a ship is in greater danger of dragging anchor or even parting her anchor chain. Dropping a second anchor underfoot will greatly reduce this surging. But a better method of ship control is the FOUL WEATHER MOOR (also known as the hammer lock moor).

There is no special problem in accomplishing this moor. You merely make a second anchor ready for letting go. The key to the operation is the spot at which the second anchor is dropped. Determine the location of the drop point from the predicted path of the storm.

The most desirable situation is to present to the wind the open end of the V formed by the anchor chains. To accomplish this you must take into consideration your position on earth and the direction to which the storm will pass.

All storms rotate and winds within them blow in a circle rather than a straight line. Hence, in relation to a fixed position on earth, the direction of the wind shifts as the storm moves along its course. In the Northern Hemisphere the wind direction is counterclockwise and in the Southern Hemisphere, clockwise. Thus, in the Northern Hemisphere, if the storm is expected to pass to the east, use the starboard anchor as the riding anchor. If it will pass to the west use the port anchor. In the Southern Hemisphere, the reverse is true.

If the ship is riding to the wrong anchor when information on the storm is received, heave in and drop the correct anchor. Otherwise, merely ready the secured anchor for letting go and veer the riding chain to the proper scope.

When the ship has begun to yaw, drop the second anchor at the end of the arc that bears in the direction from which the wind is expected to change its own direction. Dropping the second anchor in this position will ensure a wide out-of-step moor (the underfoot anchor not in line with the ship and riding anchor). Veer the chain of the second anchor to about 10 fathoms more than the depth of the water. You may use more chain for a better drag, but do not pay out a scope that will allow the anchor to hold.

Figure 23A shows a ship with a foul weather moor. A storm is passing eastward (backing wind).

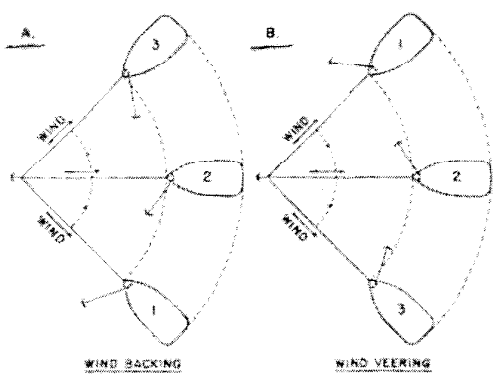


Figure 23 - Foul weather moor

The ship is riding to the starboard anchor; the port anchor underfoot with 20 fathoms of chain is slowly dragging because of the chain's short scope. A longer scope would permit the anchor to hold. Although dragging, the anchor underfoot holds the bow steady against the wind and prevents yaw. Its drag allows the ship to swing slowly as the wind changes direction. Figure 23B illustrates the same situation, but with the storm center passing to westward (wind veering).

Should the storm depart from its predicted track and pass on the side opposite to the one you are prepared for, you will still have a foul weather moor. In this case the anchor underfoot will pass underneath the riding anchor chain as it drags. There is no appreciable danger that the chains will become fouled, but to preclude this possibility you should weigh the anchor underfoot as soon as the weather subsides.

BUOY MOOR

A pad eye on the top of a mooring buoy contains a large ring to which a ship shackles its anchor chain. Small ships formerly moored by the bight of the chain, with the end secured back on deck. Although this practice provided a convenient means for a quick release, it caused a good deal of bending damage to the chain and has been discontinued from general usage.

Upon approaching the buoy, the ship lowers a boat containing a buoy party of three or four personnel, each person wearing a PFD. The ship reduces headway so as to come to a dead stop with its bow half a ship's length from the buoy. The boat brings its stern under the ship's bow. The end of a 5-inch dip rope and the end of about a 2 1/2-inch messenger are lowered to the boat, together with the eye of about a 1 3/4-inch diameter wire, containing a mooring hook or a shackle large enough to engage the ring of the buoy. The boat proceeds to the buoy, and two personnel get on the buoy. The buoy party secures the wire to the ring of the buoy by means of the mooring hook or the shackle. The dip rope is passed through the ring and is bent to the messenger which is used to haul the end of the dip rope back on board. The buoy party gets back into the boat while the ship hauls its bow over the buoy. The personnel must not remain on the buoy during this process, because the buoy always cants and, at times, spins.

Disconnect the chain from its anchor and secure the mooring shackle to it by means of a detachable link. Bend the pin of the shackle to the bow by a lanyard to prevent it from being dropped into the water.

Bend one end of the dip rope to the chain just above the shackle and lead the other to the capstan. By walking out the

chain and heaving on the dip rope, maneuver the shackle out to the buoy. When the end of the chain is in position, the buoy party should be ready to secure it to the ring. After they have done this, they cast off the wire and the moor is complete.

The above is only a general description of the routine for mooring to a buoy; there may be variations in certain instances.

Trolley method

The trolley method is a simple method for easing out the end of the chain to the buoy by letting it slide down the wire shackled to the buoy.

Use one or more shackles over the buoy wire as trolleys. Connect the chain to these trolleys by means of short wire straps passed around studs of the chain links (figure 24)

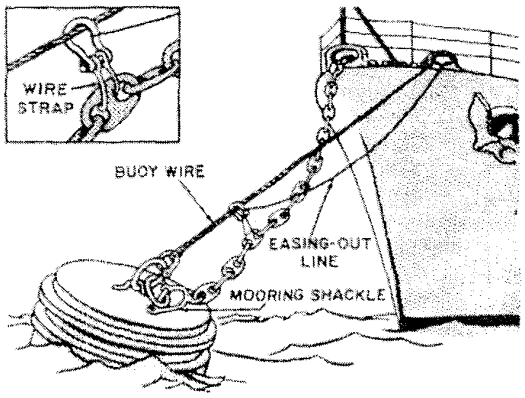


Figure 24 - Trolley method

Connect the first trolley to the fourth or fifth link, providing enough chain for the personnel on the buoy to complete the moor without difficulty.

Other preparations on deck are much the same as for the ordinary method of mooring to a buoy, except that sufficient chain for the maneuver is roused up and allowed to hang in a bight over the side during the approach, and it is not necessary to use a dip rope. The easing--out line, in addition to controlling the travel of the chain during the mooring operation, also prevents the bitter end of the chain from dropping into the water during the approach.

With this method, the buoy party in the boat takes only the end of the wire to the buoy. The party either shackles the wire directly to the ring of the buoy or passes a short wire strap through the ring and the eye of the wire. The party shackles the ends of the strap together. Always provide the buoy party with a strap when the size of the ring on the buoy is not known. If possible, the buoy party should connect the buoy wire to a ring other than the one to which the chain will be shackled.

Maneuver ship to bring it to a stop with the bow abreast of the buoy and about 10 yards away.

After the buoy party has secured the buoy wire, they heave it taut and keep it that way. You should allow the chain to slide down the wire by slacking off the easing-out line and then secure the mooring shackle to the ring of the buoy. After you have slacked the wire and cast off, the moor is complete.

On ships with unusually large and heavy chain, it is a good idea to pass a line from the deck through the ring of the buoy and secure it to the mooring shackle or the first link. Then, by using this line and the easing-out line, you and the personnel on deck are able to assist the personnel on the buoy to get the mooring shackle into position.

BOW AND STERN BUOY MOOR

The bow and stern buoy moor is used by all navies. It is seen and used throughout the world where harbors are small and congested, or in areas where ships are out of service. It eliminates the need for any involved rigging process such as an Eldridge Moor. But, since it leaves the ship hanging in the bight of a span, the buoys must be well anchored.

In this type of moor, moor the ship's bow to the forward buoy in the same manner as described under Buoy Moor. At the same time, run a stern line or cable to the stern buoy. The ship approaches at an angle of about 20° to the two buoy's geographical line of bearing. While lines are being passed to the bow buoy party, similar lines are being passed from the ship by boat to the stern buoy party. After the lines are

made fast to the buoys, make adjustments from on deck to spot the ship equidistant, bow and stern, from the respective buoys. Most ships use a chain forward and a wire rope aft.

SECURING THE CHAIN'S BITTER END

For a number of years there has been a widespread belief that the bitter end of the anchor chain was supposed to be secured in the chain locker by a weakened link or shackle. Various means were devised to carry out this erroneous requirement even to securing the end with sail twine.

The small grain of truth in the belief is that the breaking strength of the shackle used to secure the chain to a pad eye in the chain locker-is slightly less than the breaking strength of the chain. Actually, as set forth in the Nav Ships Technical Manual, the breaking strength of the shackle shall approximate the weight of 300 fathoms of the chain. The breaking strength of the pad eye must be 1.75 times that of the shackle. For proper installation, you should also consult the ship's prints.

Towing is an evolution requiring the coordinated teamwork of several departments for efficient and safe execution. Circumstances requiring knowledge of these subjects arise only in emergencies, when there is little or no time to consult plans and instructions. The shiphandler must be thoroughly familiar with all general aspects of such matters. Moreover, each person must have detailed knowledge of pertinent arrangements and instructions in their ship.

TOWING

Generally every Coast Guard vessel is equipped to take another in tow or be taken in tow. This provision is a battle readiness requirement. Each class of ship is furnished with anchor handling and towing arrangement plans. A shiphandler should be familiar with plans for the ship, because they provide detailed information on the accepted towing arrangement.

Primarily these plans show only components of the towing hawser in use. Usually, they do not give location or method of rigging the towline when preparing to take another ship in tow.

Before we discuss towing itself, let us examine the rigging required.

Towing Astern

Practically all seagoing tows are taken astern, alongside towing being confined to harbors and inland waterways.

Towing barges, and the like, astern is referred to generally as TANDEM towing. In the broad sense, tandem means one behind the other. In towing, the term frequently is used to distinguish a particular RIG for towing two or more barges or lighters in a single line. We use the term here in the latter sense to differentiate between this rig and other methods called CHRISTMAS TREE, MODIFIED CHRISTMAS TREE and HONOLULU.

All four of these methods of rigging for towing are illustrated in figures 36 and 37. In the tandem method, each barge is towed by a line secured directly to the barge ahead. In the Christmas tree rig, all the barges are towed from a single hawser by means of pendants shackled to flounders (sometimes called bails or fish plates) inserted in the towing hawser. In the modified Christmas tree, all units are towed from a common flounder, but the last barge is towed as a separate unit. The Honolulu method was devised to handle two tows, a large and a small; for example, a ship and a barge. They are towed from separate hawsers.

For multiple tows the Christmas tree rigs are preferred because they are stronger and any unit can be taken from the tow at anytime without disrupting the whole tow.

Scope of Hawser

In towing in a seaway, it is important to try to keep the ships "in step"; that is, to adjust the scope of the towline so that the ships meet and ride over seas at the same time. (See figure 25.) If the length of the hawser is such that one vessel is in the trough while the other is on a crest, the towline will slacken for an instant and then tauten with a sudden jerk, producing a stress much heavier than normal.

With a towing machine it is an easy matter to make minor adjustments in the scope which will bring the ships into step. With the fixed method it is almost impossible, except when the towed vessel has the anchor chain shackled to the hawser. In that case, veering or heaving in on the windlass will make the necessary adjustment.

In cases where the scope of hawser veered out is within the control of one ship or the other, it should be veered to a scope sufficient to provide a good catenary, but not long enough to permit the towline to drag on the bottom. When towing a large vessel, 200 fathoms is about the minimum for a good shock-absorbing catenary. If circumstances make it impossible for you to provide a sufficiently long scope, speed must be reduced. In any event, there should never be enough stress on the towline to hoist its entire length clear of the water.

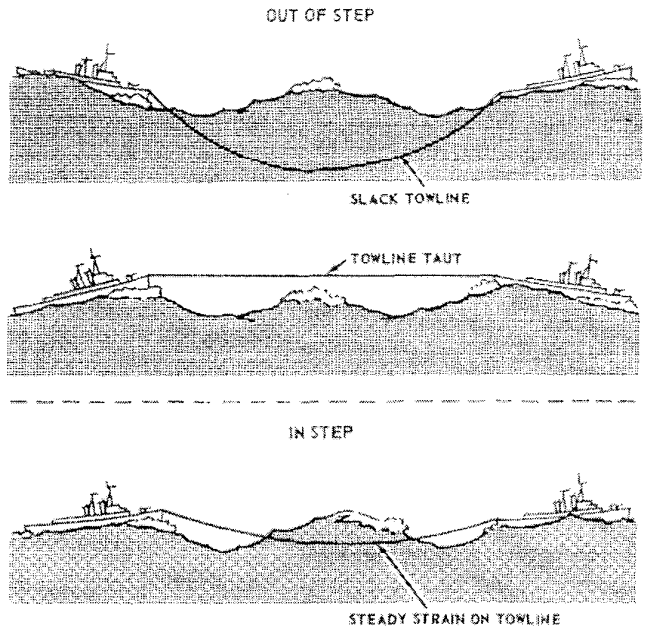


Figure 25 - Proper catenary for towing

Towing Speeds

The speed at which a vessel can be towed depends upon its size, condition, and type, whether or not it can provide any assistance with its own screws, sea and weather conditions, and whether or not a towing machine is being used. In general, under good conditions, a large vessel may be towed at from 5 to 9 1/2 knots.

An increase of speed may be obtained when towing a vessel if the screw is allowed to turn over. In this or in any case where a vessel with an unlocked screw is being towed, the main engine lubrication system must be in operation to prevent bearing failures when the propeller starts to turn.

In determining the towing speed, the primary factor to be considered is the towing hawser. Speed of the vessels must be kept at a point where the towing hawser will not be over-stressed.

Using Mooring Bitts for Towing

Aboard a WPB 95- or 82-foot vessel, and even on larger vessels, it is sometimes necessary to use the mooring bitts to tow another vessel. These bitts are located on or near the stern on either the port or starboard sides.

Figures 28 and 29 illustrate the correct and incorrect methods of securing the line. In the correct method, the after bitt (the one toward the direction of the tow) takes the greater strain.

If using the bitt towing method when towing two or more boats, the towline is run through the stern chock or even through the side chocks on either side. To eliminate the chafing which may occur while towing when the line is run through the chock, chafing gear must be installed at this point. This can be done by wrapping the hawser or line with canvas and securing it with marline hitches. If the towline is wire it may be necessary to serve the hawser with small line to eliminate chafing.

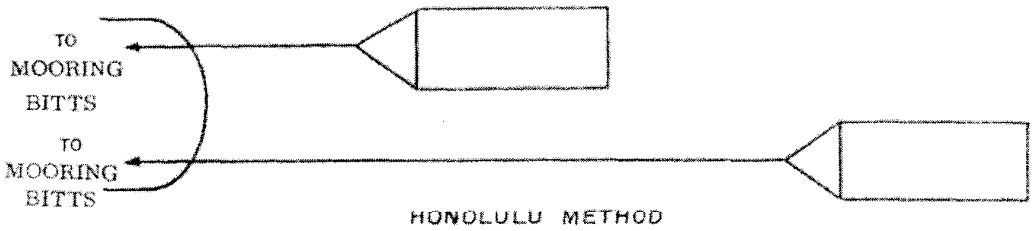


Figure 26 - Honolulu method

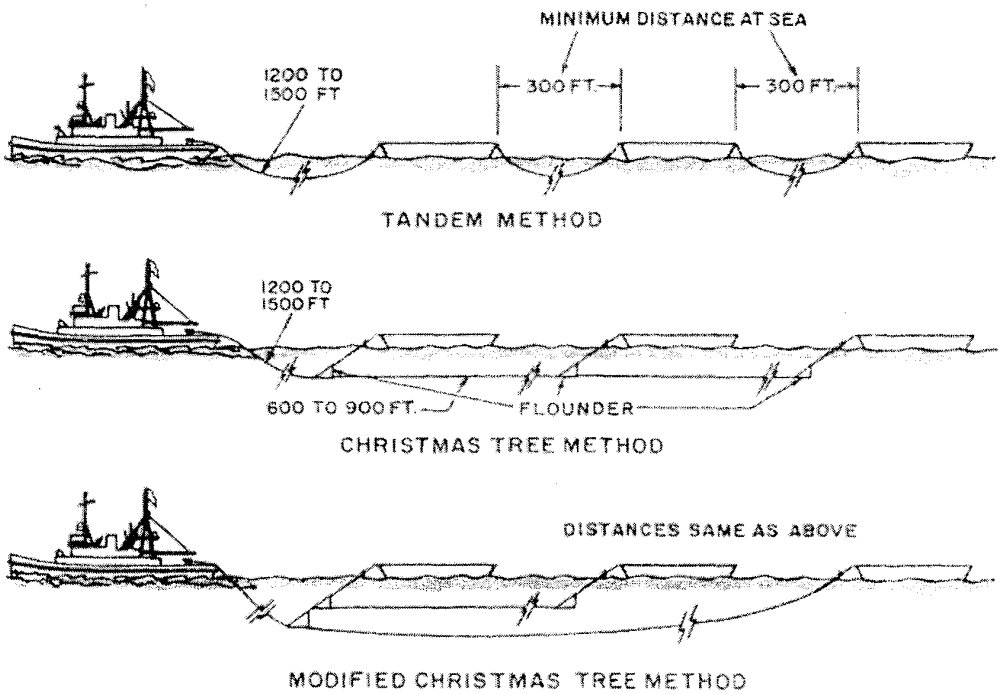


Figure 27 - Astern towing methods

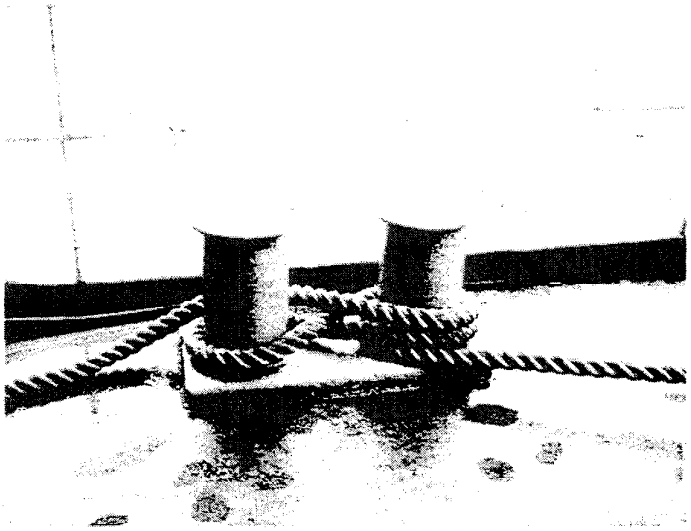


Figure 28 - Correct method of securing tow line to a set of bitts

Note: There should be at least three or more figure eights taken after initial fastening of the tow line; however only one is shown above.

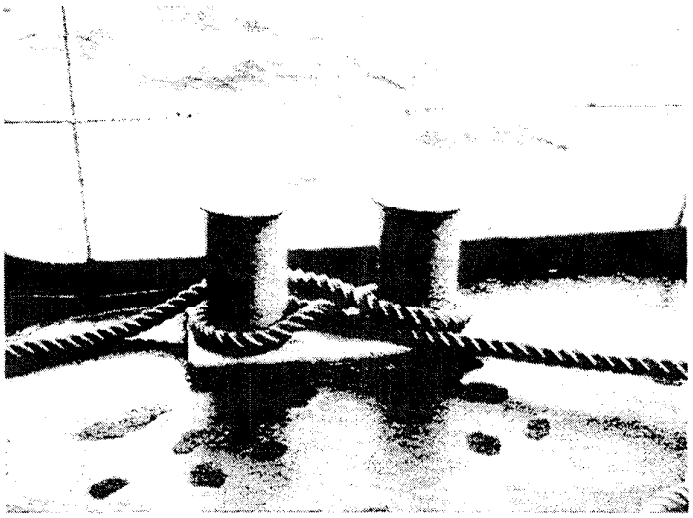


Figure 29 - Incorrect method of securing tow line to a set of bitts

There are numerous towing arrangements used in towing operations. Figure 30 shows an additional towing arrangement using a pelican hook for quick release. When pelican hooks are used as shown for letting go in an emergency, the strain is taken momentarily on the hook. This relieves the strain on the shackle so that it can be disconnected and the hawser can be slipped when ordered. This arrangement, with the pelican hook taking the steady strain, offers the quickest method of releasing in an emergency. (In the method described earlier, the line would have to be axed to be released in an emergency.)

In these methods of towing, the towing vessel tends the hawser or line and makes all necessary adjustments to the towline.

TOWING PROBLEM

The great problem in towing on the high seas lies in the alternate straining and slacking of the towing hawser, caused by the pitching of the ships and the tendency of the tow to sheer off or range up on the towing vessel. To compensate for this action, an automatic tensioning TOWING MACHINE has been devised.

Towing Machines

Electric automatic towing machines are manufactured in various sizes to accommodate different vessels. These machines are provided wth an automatic spooling device. The automatic tension control relieves the shocks and variations in tension occurring while towing in a seaway by automatically paying out and recovering the towing hawser.

The function of the automatic towing machine is to cushion and to relieve surges from the towing hawser which are caused by the pitching or yawing of the vessel in rough weather when surges frequently repeat. The automatic feature is particularly advantageous because its operation is dependent on fluctuations in hawser tension. Serious overloads and shocks on the towing hawser and fittings are thus avoided. Higher safe towing speeds, with corresponding higher average tensions, may be maintained than is practicable with fixed towing for the same size hawsers.

For proper operating procedures and maintenance, you should consult the instruction book provided for your particular style towing machine.

Maintenance

Wire towing hawsers should be treated *periodically with an approved preservative to* prevent deterioration of the inner strands of wire.

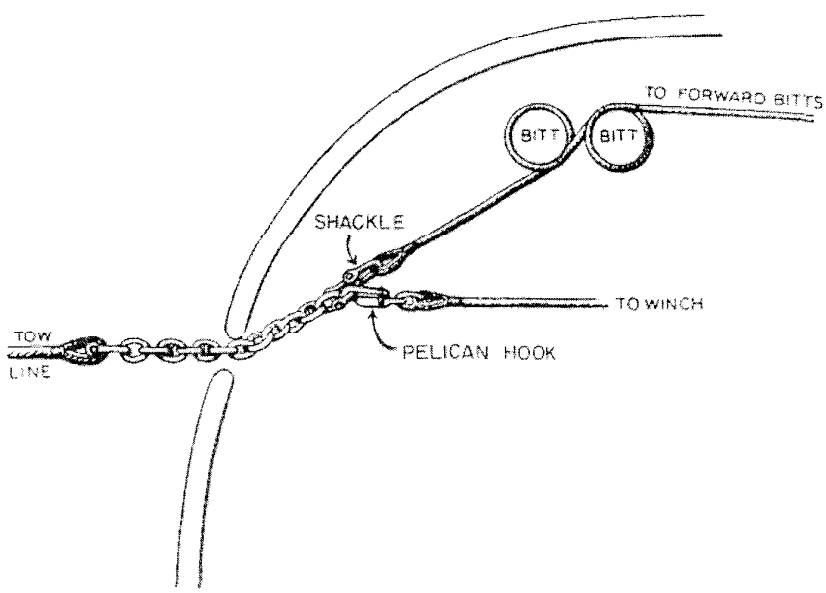


Figure 30 - Towing by bitts

Inspection and Test of Towline

Towing hawsers should be inspected thoroughly during overhaul periods of vessels in shipyards. The hawsers should be prooftested if inspection reveals any unsatisfactory conditions.

Protection of Equipment

The officer in charge of towing operations on each vessel will take steps to reduce chafing and wear on the towing equipment, to prolong its life as much as possible.

TOWING APPROACHES

The approach to a disabled ship or boat is determined by size, type, and maneuvering characteristics of the towing vessel; how the disabled ship or boat lies in the water; the relative drift.

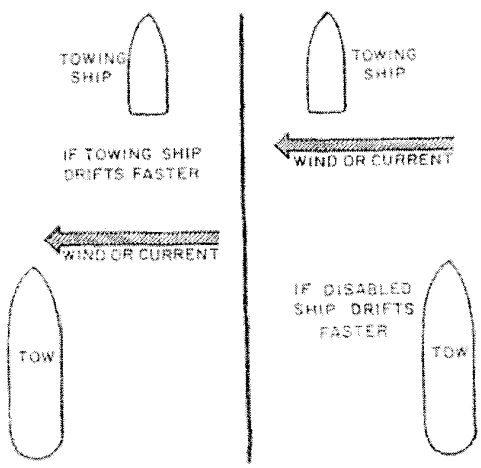


Figure 31 - Using drift to gain time while connecting towline

Size, type, and maneuvering characteristics are important not only during approach but also during hookup. If the ship is large and sluggish, the approach must terminate in a position requiring the least amount of maneuvering during hookup. A small, highly maneuverable vessel, on the other hand, need not be so restricted in the approach, because it is better able to compensate for unexpected occurrences.

Regardless of the characteristics of the towing vessel, however, the CO must use all available facilities to determine the safest and best approach, and the wise CO will terminate the approach in the best possible position to facilitate the more rapid and safe hookup.

The next aspect to consider in approaches is how the disabled vessel lies in the water. How it lies depends on a combination of several factors -- size, draft, extent of damage affecting stability or trim, state of wind and sea, extent and location of superstructure sail area, and ocean current. If stability is not greatly altered, most ships will wallow in the trough in a rough sea. In a strong breeze and a moderate sea, the high part of the superstructure will act as a sail and may cause it to present the opposite end to the wind. Ships with a deep draft and low superstructure will be relatively unaffected by the wind and probably will lie broadside to the sea.

Relative drift is an important factor, and it must be established before selecting the approach. The purpose is to find the best position for stationing the towing ship.

To determine relative drift, the towing vessel advances on the other ship on the.same heading and stops ahead or astern of it. Usually, a position astern is better because it then is easier for bridge personnel to observe the tow.

In some instances, relative drift is readily aparent, because one ship rapidly drifts away from the other. At other times, however, difference in drift is minute or the heading of one or both ships changes, making determination more difficult. It is a good idea therefore, to take ranges and bearings about every 3 minutes and plot them on a maneuvering board with own ship at the center. After plotting three or four ranges and bearing, it is not difficult to find relative movement.

If the disabled ship drifts faster, the towing ship will station itself downcurrent or downwind from the tow. If the reverse is true, it will station itself upcur rent or upwind. The idea, of course, is that with one ship drifting down past the other, more time is allowed for connecting the towline before the towing ship will have to reposition itself. (See figure 31.) If there is no

relative drift, the towing ship can take position as close to the tow as is prudent, but it must not go so close that the helm cannot be put over without danger of throwing the stern into the tow.

The four basic approaches are parallel, crossing the T, 45°, and backdown.. (See figure 32.)

Parallel Approach

The parallel approach may be used under good weather conditions when the disabled vessels drift rate is slow. Here the towing ship approaches the tow from astern on the windward side (view A, figure 32). Lines are passed to the forecastle of the tow as the towing ship steams past.

The parallel approach method requires expert ship handling because the towing ship must pass close enough to send over a messenger line and then back down and stop a short distance ahead of the tow. The recommended distance ahead is one-third the length of the towline. If your ship is to pick up a tow in danger of being washed on to a beach, or if for any other reason the time required for a second pass would be disastrous, you must get the towline messenger over on the first pass. Otherwise the disabled vessel will be out of luck. However, if you have another fully equipped party near the stern, it will give you a second chance to get the towline over.

Crossing the T

Crossing the T (view B, figure 32) is a good approach for a twin-screw vessel to use when there is a heavy sea or when relative drift rate is rapid. The towing ship uses the screws to maintain its position and heading. It crosses the bow of the disabled ship on a heading almost perpendicular to that of the tow, and passes the messenger just before the bow crosses that of the tow.

A large single-screw ship should be careful with a crossing the T approach. If the wind is on its inboard quarter or outboard bow, it may take charge as soon as the ship stops, making it fall off into the trough 180° from the disabled ship. Usually, when the ship begins to fall off, no amount of maneuvering will stop it.

45° Approach

The 45` approach is fairly easy to make, quite safe, and can be made either from windward or leeward. As in the parallel approach, however, there is some danger of being run down when approaching from leeward.

The towing vessel approaches on a heading about 45° from that of the tow (view C, Figure 32), aiming for a point (closest point of approach) about 100 to 150 feet from its bow. The messenger is passed at this point. The towing vessel should stop downwind or downcurrent from the tow if the tow is drifting faster, and upcurrent or upwind if the reverse condition is true.

Backdown Approach

The backdown or stern to approach (view D, figure 32) is used by tugs, or other vessels designed for towing. Such a vessel can back its stern under the bow of a tow and easily pass the hawser. This approach is difficult for a single-screw ship, however, because it will back into the wind. Then too, relative drift may cause the two vessels to separate rapidly. If as a LAST RESORT it becomes necessary to use this approach, you must complete the backing down maneuver before passing any lines.

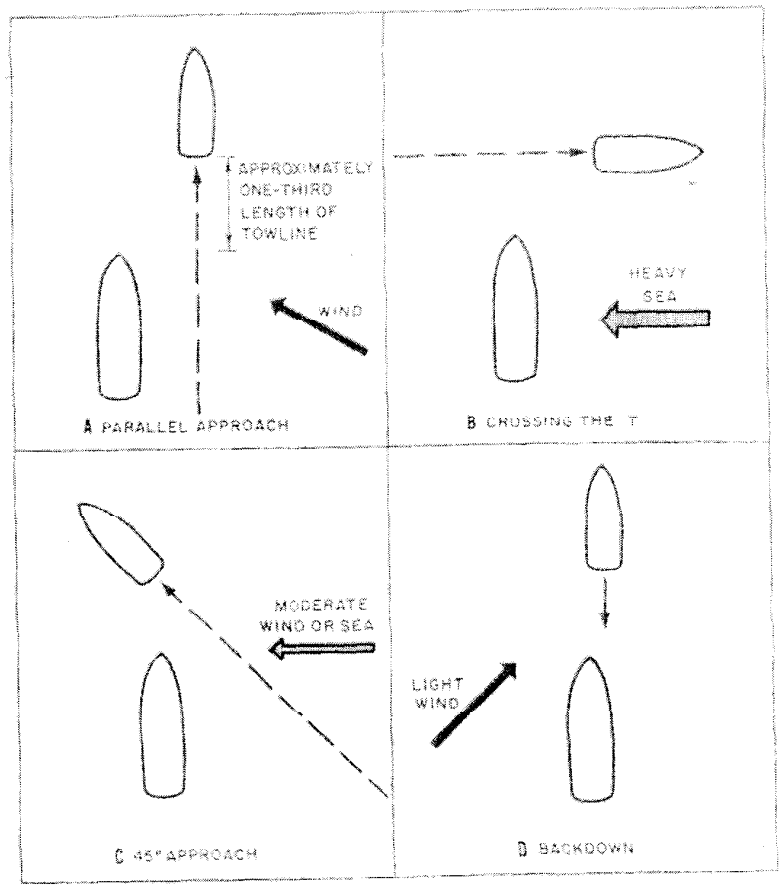


Figure 32 - Four basic approaches to a tow

Heavy Weather Procedures

Under extreme weather conditions it may not be safe to get close enough to the tow to make any of the foregoing approaches. In such instances it is a good idea to float the messenger to the tow on oil drums, lifejackets, or powder cans, etc. If an approach must be made, however, the towing ship should slowly pass the tow (1 or 2 knots) and stop ahead of the tow at a distance equal to about two-thirds the length of the towline. Any position closer might be dangerous, and a greater distance would preclude making the connection.

Approaches to a small boat are basically the same as for a larger vessel. (See figure 32.) There are some differences, however. A small boat drifts faster than a large vessel, but it is more maneuverable than a large vessel. In your Coast Guard experiences you will need to know all types of towing methods. Your experience, extreme caution, and forethought about any situation which may arise are all important in an assistance case.

Rigging for Towing

Most Coast Guard cutters are equipped with standard towing bitts and a towing rail aft. Smaller cutters such as the 82 Footers have their towing bitts located on the mast: 65-foot harbor tugs have some bitts located on the after end of the stack. We will describe the equipment and procedures for towing with a 210foot WMEC. With some variation this description could be applied to other classes of Coast Guard vessels. The towing bitts on this cutter are located about 40 feet forward of the stern. Figure 33 shows what these bitts look like. The after rail on the vessel has been reinforced to

serve as a towing rail. The towing hawsers and related equipment are stowed on the second deck just aft of the towing bitts.

When the word is passed to prepare for towing, the hawser to be used is broken out. It is faked down either in a fore and aft position as illustrated by figure 34 or it is laid out on deck as shown in figure 35 with each upper bight stopped off with small stuff. This prevents the hawser from taking charge while being payed out. While it is being payed out, however, it is necessary to station a person close enough to cut each lashing as illustrated. Note that when the hawser is faked down, as shown in figure 34, the eye end of the towline is next to the bitts and the bitter end is outboard. The hawser should never run out over the faked down line.

The messenger, which is the first line to be run in a towing operation, is faked down near the stern, clear of the hawser and free to run. The messenger is secured to the towing hawser with several lashings spaced a foot or two apart. The first lashing is spaced about 10 feet from the eye to allow slack for shackling. This will give the people on the bow of the tow enough slack to work with. Figure 36 shows the methods of securing the messenger to the towline if the towline is a steel cable.

ADDITIONAL EQUIPMENT: Several heaving lines should be ready for use; also, a shoulder line-throwing gun should be avail able, fenders should be located at logical positions, and axes or hatchets should be ready for use in cutting the stoppers or the hawser. When using nylon as a towing hawser, a fire hose should be faked out for use in cooling the hawser should it become hot. Remember, nylon will fuze and burn under friction. A large roll or skein of marline and large pieces of canvas are necessary for use as chafing gear.

When the tow is ready the messenger and tow lines are passed. When the tow signals that it is shackled on, the towing vessel will begin to move ahead with the hawser paying out. Usually one full turn is taken around the bitts befor the hawser is veered. As the hawser is paid out at the bitts, the stoppers, if used, are released at the proper time. When the distance between the ships is correct, additional turns are taken on the bitts. The personnel backing up the person on the bitts must give slack quickly so the person at the bitts can take the turns IMMEDIATELY.

Figures 37 and 38 show the correct and incorrect methods of securing the hawser around the horns of the bitts. At least one complete round turn should be taken before figure eighting, and the last turn on the bitts should never be half hitched to secure the hawser. The towing cutter will have to pay out the hawser unless the towed vessel shackles into its anchor chain and can veer enough chain. When the vessels are in step and the hawser is secured, it will be necessary to install chafing gear.

The bridge must be kept well informed of all that is taking place. The towing watch should be well-instructed in their duties and know how to use the gear present in case it becomes necessary to cut or release the tow. A 40-inch length of cord, attached to a 30-inch portion of the hawser, can be used to inform you when the breaking point of the nylon hawser is close.

BEING TOWED

When being towed, ships and cutters usually use either the anchor chain or a bridle. A bridle is a preconstructed appendature which is kept on a ship ready for use when being towed. When its use is necessary, it is hauled out and fitted to the deck bitts. It is then led through the bullnose and brought back on deck over the lifeline, ready to be fitted to the towline when it is received aboard.

When the anchor chain is used, the anchor is stopped off with the chain stopper and unshackled. Plenty of chain is roused out on deck so that there will be enough working slack to shackle to the hawser. (If the weather is sloppy, it is advisable

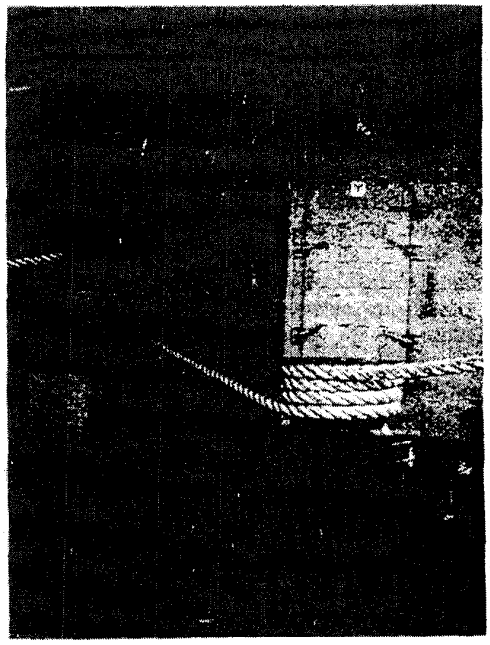


Figure 33.

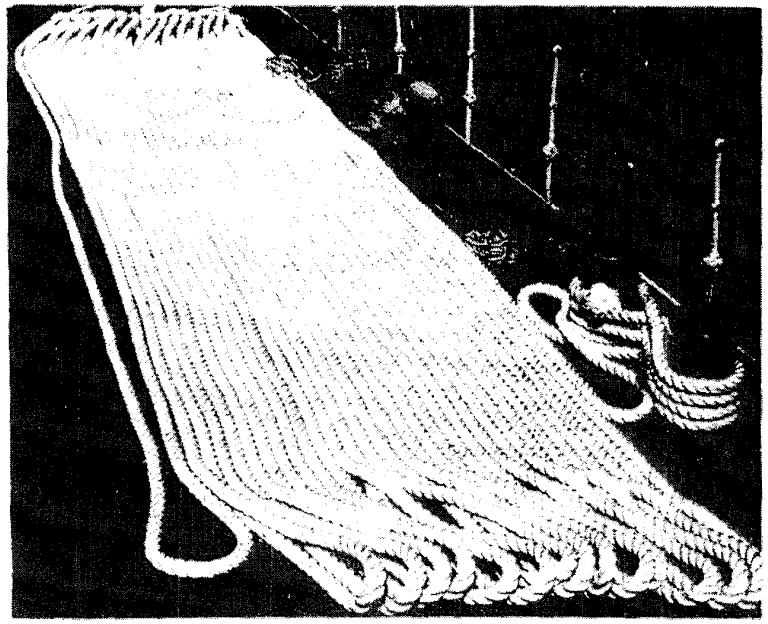


Figure 34 - Eight-inch nylon hawser faked down

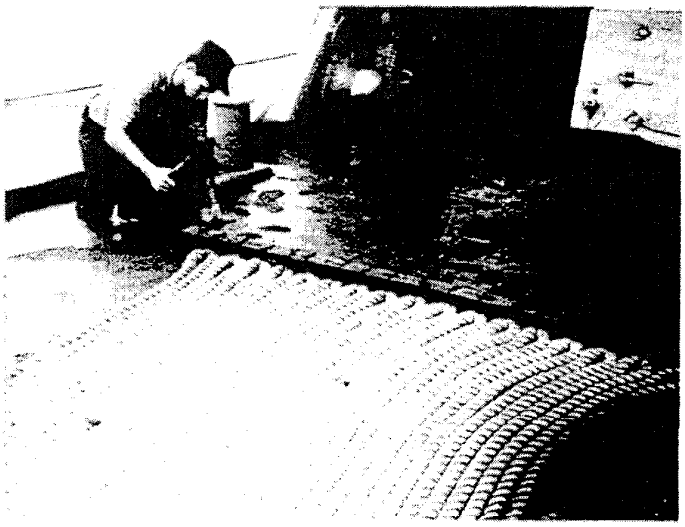


Figure 35

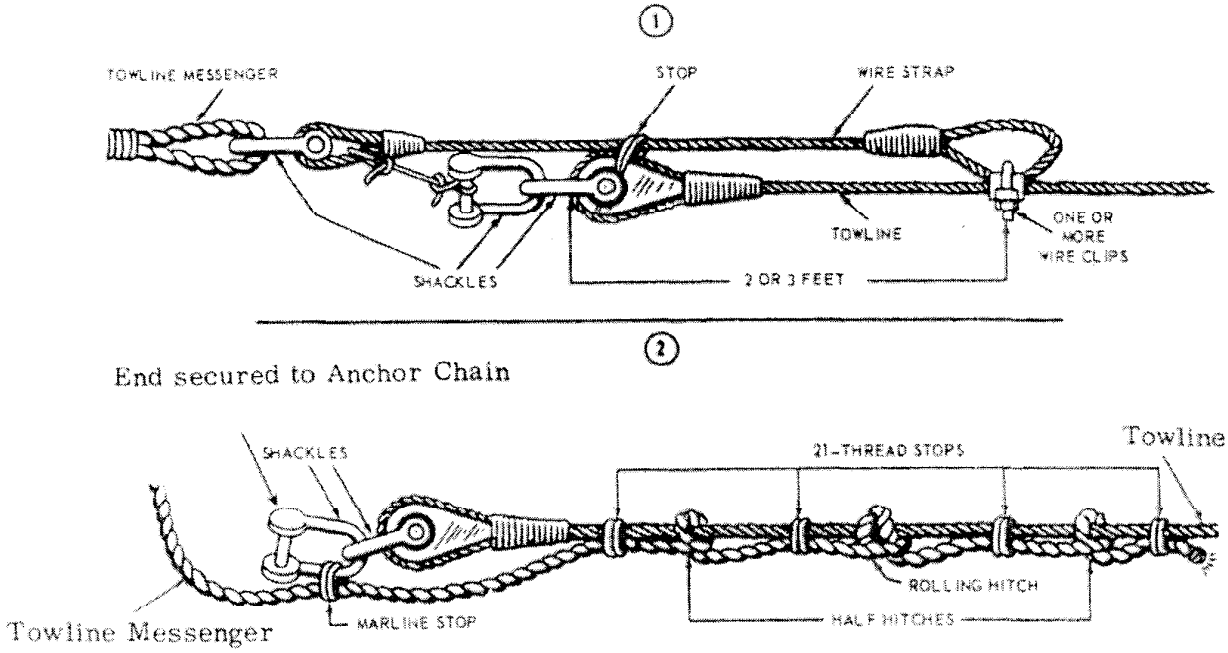


Figure 38 - Two methods of securing messenger to towline

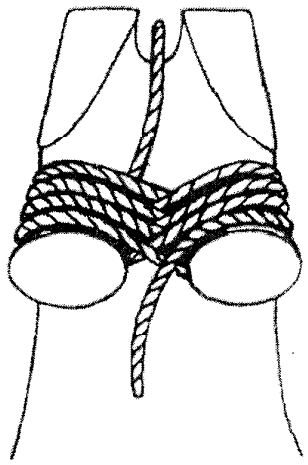


Figure 37 - Correct. Notice hawser comes up between horns

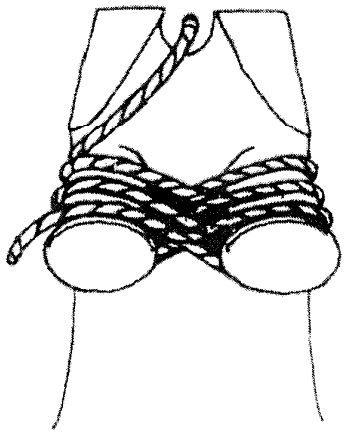


Figure 38 - Incorrect. Notice hawser around left side of horn which does 'NOT allow proper distribution of stress. Also, the hawser could work off the horn.

to stop off the anchor chain to be connected with small stuff to prevent it from taking charge.) The anchor chain is then run through the bullnose and brought back on deck over the lifeline. (This procedure is used in both cases because the size of the eye with the thimble inserted in the towline causes difficulty in bringing it through the bullnose.)

During the approach of the towing vessel, personnel are stationed at intervals along the side on which the towing vessel is approaching in order to receive the towline messenger. A heaving line or two should be ready in case the towing vessel's line doesn't make it. When the messenger is received aboard the vessel to be towed, it should run aft to bring enough hawser aboard to hook up with and also to get the messenger line out of the area of operation. The windlass can be used to bring the messenger aboard if power and a free capstan head are available; however, bringing it aboard by hand is much faster.

When the hawser is aboard, untie the messenger, coil it, and stow it out of the area of operation until it is needed again. Shackle the hawser to the chain or bridle, and use seizing wire to mouse the pin of the shackle.

In any towing situation, large or small, the two vessels must be in step. If they are out of step, the towline whips out of the water. This subjects it to unnecessary and dangerous strain. When towing by anchor chain, the chain is veered until about 30 to 60 fathoms is out. This will provide the proper catenary and facilitate towing in step. (Once the chain is veered to the proper scope, the stopper is placed on the chain so the strain is taken off the capstan. (See figure 39.)

Each ship must have a means of quickly casting off the towline in an emergency. On the towing cutter this can be accomplished by cutting with an axe or letting the bitter end of the hawser run out. However, on the tow there should be a detachable link somewhere between the windlass and the stopper. If a wire bridle is being used, an acetylene cutting torch should be available.

DROPPING THE TOW HAWSER

When the time arrives to drop the towing hawser, the tow engages its anchor windlass if the method of securing to the anchor chain is used, casts off the stopper, and heaves in on the chain to facilitate unshackling of the hawser and bendng on of the messenger. The hawser is held by the messenger and the two are lowered over the side for the towing vessel to take aboard. As in any operation, team work and cooperation are the keynote to a smooth operation and both crews should work together. On the towing cutter, the hawser can be hauled in faster by running it in by hand. Nylon will not float, therefore it must be brought aboard rapidly to prevent it from being fouled in the screws or hanging up on the bottom.

ALONGSIDE TOWING

Most harbor and inland waterway towing is accomplished by tugs using the alongside method; that is, with the tug secured alongside the tow. The reason for the alongside method is the greatly increased maneuverability of a tug with the tow alongside rather than astern. If properly made fast, the tug can steer both itself and the tow, and the space required for maneuvering is much less than that required for a stern tow.

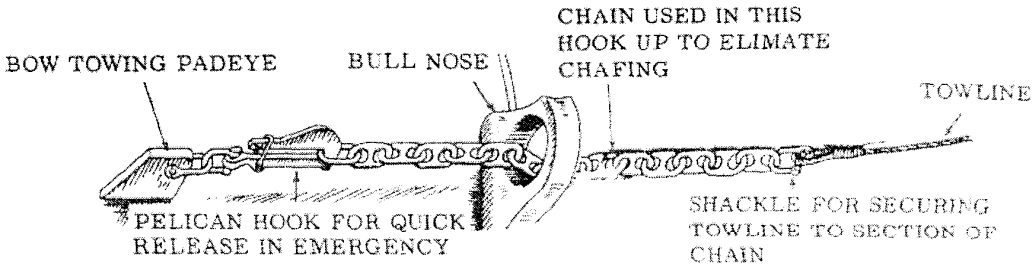


Figure 39 - Typical towing arrangement on bow of some ships

For alongside towing the tug generally secures to one side of the tow with its own stern abaft of the stern of the tow to increase the effect of its screw and rudder. The side chosen depends upon the amount of maneuvering the towing ship must accomplish with the tow. If a sharp and difficult turn is to be made under headway, the tug should be on the inboard quarter (the side toward which the turn is to be made). Here it is properly placed for backing to assist the turn, for as it slows, the tow's bow will turn toward the side the tug is on.

If a turn is to be made under no headway, the tug is more efficient on the starboard side of the tow. When the tug backs to turn, the port send (side force) of the screw will combine with the drag of the tow to produce a turning effect,greater than that which could be obtained with the tug on the port side. The best position for a long back in a straight line is to have the tug on the port side, because then the drag of the tow tends to offset the port send of the backing screw.

If all turns are to be made with the tug's screw going ahead, it will be more favorably placed on the outboard side of the tow (the side away from the direction toward which the most turns are to be made).

The upper view of figure 40 shows a tug secured to a tow's starboard quarter. The towline leads from the forward bitts on the tow side of the tug to after bitts on the tow. The tug secures its line first, then ranges ahead to take up the slack. Another headline called the BACKING LINE, is led out one of the tug's bow chocks to a forward point on the bow. The tug end of this line is taken to the capstan and heaved until the towline is taut. This brings the tug to the proper position, slightly bow-in to the tow. A stern BREASTLINE leading from aft on the tug to aft on the tow is used to keep the tug's stern from drifting out.

The bottom view of figure 40 illustrates how a tug can take two small tows alongside, one on either side. Figures 41 and 42 show correct and incorrect methods of securing alongside towing lines on the tug.

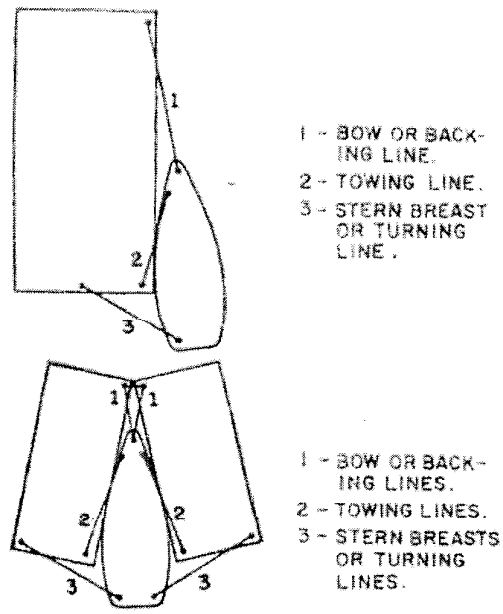


Figure 40 - Alongside towing

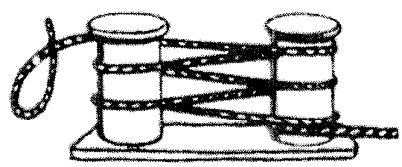


Figure 41 - Correct method of making a side-tow hitch with fiber rope

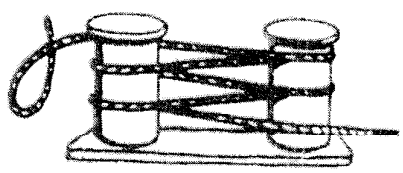


Figure 42 - Incorrect method of making a side-tow hitch with fiber rope

Areas of the harbor subject to wave action should be avoided whenever possible. The tug and tow seldom pitch in the same tempo, so that, when both start pitching out of harmony, the lines take a heavy strain and may part. When equipped with a rudder the tow assists in steering. Size and loading of the tow may be such that the view of the tug's conning officer is obstructed. In that case, a lookout is stationed aboard the tow and keeps the conning officer fully informed of activity and hazards in the blind area.

Shifting The Tow

Occasionally it is necessary to shift a tow from one side to the other or from alongside to astern.

With the tow on the starboard side as shown in view A of figure 43, run a second bow line out the port forward chock, around the bow, and to the after inboard corner of the tow. Cast off the stern breast, and fake it down on the port side.

Pick up a good forward speed (about 6 knots) and apply left rudder. When the tow is in the turn (view B), stop the en gine, cast off the towline, and begin to back down. With the tow crossing the tug's bow as in view C, slack the old bow line, shift the rudder, and kick ahead. As the tow comes down on the port side, steady the tug, keeping way on and allowing the tow to swing around broadside to the tug (view D). Pass towline and stern breast and set taut on all lines.

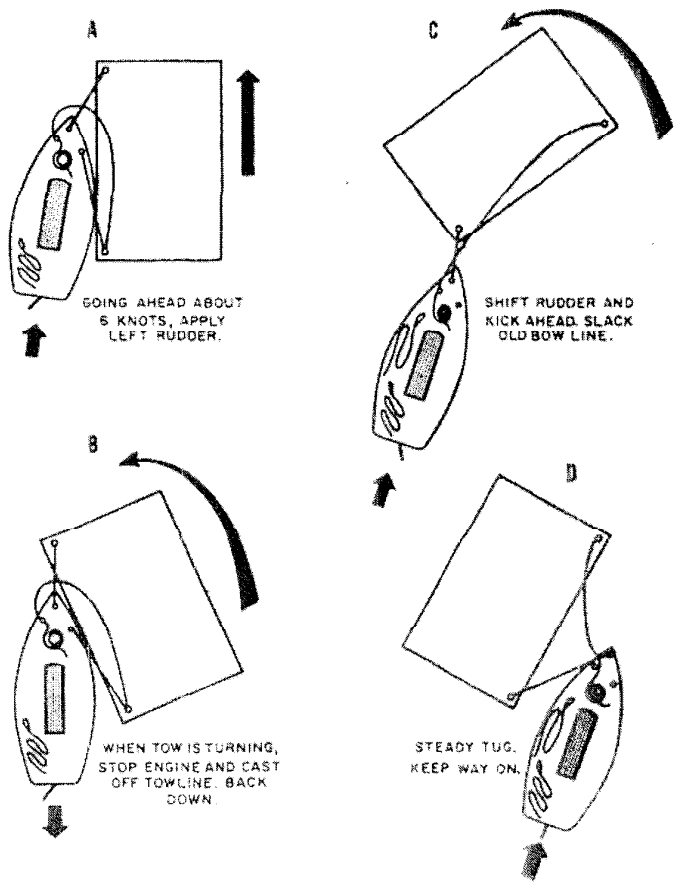


Figure 43 - Shifting tow to other side

Shifting a tow from alongside to astern usually is necessary when a tug is to tow a barge or other vessel from port to port. The tow is taken alongside within the harbor and shifted astern outside.

The shifting procedure is simple. The towing hawser is connected to the towing bridle before getting underway. Outside the harbor, the lines used for towing alongside are cast off, allowing the tow to drift away from the tug. Then, slowly accelerating, carefully altering course, and judiciously paying out the towing hawser, the tug gets underway with the tow and comes to the required course.

When towing alongside with a small boat, the principles described and method of securing and positioning of the small boat are the same as for the larger vessel.

TOWING A VESSEL IN ICE

Towing is possible through slush, brash, pancake or open pack ice with a towline. When towing through an ice field, the tow should be held close to the towing vessel's stern as possible. A heavy fender or fenders should be placed around the stern of the towing vessel to prevent any damage to either ship. When towing close up, a bridle should be used. Difficulty may be experienced when towing heavy vessels close because their bows are too high for the short scope of towing line required.

TOWING SIGNALS

The following sound signals are used as a means of communication between the towing vessel and tow.

Signal	Meaning
1 short blast	I am putting my rudder right.
2 short blasts	I am putting my rudder left.
2 short, 1 long blast	Haul away.
2 short, 5 short blasts	Let go.
2 long blasts	Go ahead.

1 short, 2 long blasts	Pay out more line.
1 long, 2 short blasts	Stop.
3 short blasts	Avast hauling.
2 long, 1 short blast	All fast.
3 groups of 5 short blasts	I am letting go.

A short blast must not exceed 2 seconds duration; a long blast must not be less than 6 seconds in duration. NOTE: In the event that you are required to tow a vessel of foreign registry, consult PUB 102, The Internation Code of Signals for single-flag signals for towing.

TOWING SAFETY PROCEDURES

Towing is the most common type of assist made by Coast Guard. It is also the most controversial. Conditions of the sea and weather have a great bearing on towing techniques, as does the type of craft you are towing.

Since towing is the most common assist, crews must be experts in its practical application. The towing operation can be a safe and controlled procedure which is carried out in a coordinated and seamanlike manner. It can also quickly become an uncontrolled evolution leading to the possibility of serious personal injuries and/or severe property damage or total loss.

In all towing evolutions the primary objective is to ensure personnel safety. This primary objective is to save lives and avoid personal injury. Saving property is of secondary importance, and must never take precedence over assuring personnel safety. This is not only for the persons aboard the assisted vessel, but the Coast Guard crew as well.

The following operational and safety procedures are recommended as a minimum guide for towing evolutions:

Do not use excessive speed with a tow. This is a frequent mistake for beginners. Always begin your tow slowly; increase speed very gradually.

Many cleats and bitts on small pleasure craft are not secured to withstand the stresses of towing and will rip out. Be certain whatever the towline is secured to is solid. Anything built into a boat's frame is usually safe. Beware of cleats and bitts which are merely screwed to the deck of the towed vessel.

If towing over the stern, keep as much of your towline neatly laid on deck as possible when taking on a tow or taking in from it. Too much line out during these two critical periods, when you are not moving ahead or are possibly backing down, is asking for a fouled screw. It may sound like simple advice; however, many experienced "salts" sadly learned too late that someone aft neglected this point.

If nylon line is used for towing, before taking a strain, tie a forty inch piece of string to the towline so that each end of the string is thirty inches apart. Once you have commenced towing, if the nylon stretches so that the string is straight or breaks, you have reached the safety limit for that line; reduce speed or use heavier line.

Keep personnel from in back of the towline and caution personnel in the towed craft to stay clear or protected from it. Through the common use of nylon and other synthetic lines today, deaths and injuries from whiplash are increasing.

- Chafing gear for your towline, no matter how small the tow should be used and checked frequently.

- When towing vessels with built in machinery plants, always check before towing to ensure their shaft is disengaged, or has been locked. It is surprising how many vessel owners forget this when they are being towed. If it is not checked, damage may be done during the tow to the machinery or clutches of the towed vessel by the reverse rotation of the screws.

Establish communications with the disabled vessel-determine its material condition and the physical condition of persons on board.

Consider existing and forecast weather, currents, tidal effects and sea state for present position and destination of the tow.

Maintain a navigational plot.

Determine the relative advantages of placing Coast Guardsmen on board the disabled vessel and/or removal of the persons on board. DIRECT PERSONS ON DISABLED VESSEL AS WELL AS ON YOUR VESSEL TO DON PFD's

Determine the best approach to the disabled vessel--brief crew and persons on the disabled vessel on hookup and breakaway procedures.

If no communications exist, provide a portable radio where possible. Otherwise establish visual or sound signals with persons on board the disabled vessel.

Ensure that the helm of the disabled vessel is manned and ready to be steered as directed.

When getting underway: Ensure that the procedure is done slowly and steadily. Keep vessel in step.

Set towing watch--observe action of tow--select heading or course that minimizes strain on gear and towed vessel.

If at night: Illuminate tow-display proper towing lights.

Considerations for transiting bars or inlets: Determine conditions--when in doubt, stay out--request back-up/escort boat--consider removal of persons on board the towed boat--advise home unit of conditions and plan of action--consider use of drogue-adjust tow line as necessary to keep in step while transiting-adjust speed as conditions warrant.

When in protected area: Shorten tow as necessary for safe navigation or take in tow alongside.

Remember, always swing as wide as necessary around buoys, boats, or channel turns to allow your towed vessel to follow.

When docking towed vessel: Slow down to just enough speed to maintain steerageway and be aware of set and drift—advise disabled vessel of docking plan and/or release of towline.

Towing is a very serious business requiring much thought and decisiveness on the part of the coxswain. By inadvertently neglecting a few of these basic principles a routine towing mission could become a nightmare.

IN ALL TOWING SITUATIONS, LET SAFETY BE YOUR GUIDE.

Waves and the Mariner

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Several famous ocean storms in the last decade have inflicted serious tragic loss of lives and ships. They have a common denominator: Waves! In the Halloween storm of 1991, made famous in the "Perfect Storm" saga, the loss of the **F/V Andrea Gail** and its six-man crew was from massive waves verified to be near 100 feet. In 1998, two simultaneous late October storms, one known as the APL China "Bomb" in the north Pacific, involved serious damage and loss of hundreds of containers impacting five commercial ships and was also attributed to extreme waves. Damage estimates were in the hundreds of millions of dollars. At the same time, Category 5 Hurricane Mitch in the Caribbean caused the capsizing of the tall sailing ship **Fantome** and the loss of its 31 hands on board.

Oceanic waves fall into three categories: ripples, seas, and swells.

Waves form from energy imparted to the sea from wind force. They do not undergo deflecting forces such as the earth's rotation or the Coriolis effect. They begin as ripples when wind begins blowing across the ocean's surface. Wind force, direction, and length of time determine how waves will evolve and how large they become. As ripples form, they disappear if wind ceases, or grow into seas (wind energy producing waves that will continue even if the wind drops off). Seas will then mature as swells (seas that have moved away from their area of origin and are not related to local wind effects). Thus, wave formation and growth are dependent on:

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Waves and the Mariner

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1. Wind Strength, measured in knots using the Beaufort scale.

2. Duration, the time in hours that wind blows over an area of the ocean.

3. Fetch, the distance in nautical miles over which the wind blows.

There is a maximum wave height for each combination of wind strength, duration, and fetch. These wave conditions, when reached, are called "Fully Developed Seas" or FDS. The largest waves are frequently found in the Southern Hemisphere Oceans, where strong winds can blow over vast expanses of exposed ocean for extended periods.

Waves have four components: height, length, period, and velocity (or speed). These components are directly or indirectly related to one another.

See Figure 1 for typical wave shape. Wave tops are called crests and bottoms are called troughs. Thus wave height is the distance from trough to crest and wavelength is the distance from crest to crest or five times its period squared. The wave period is the time interval between the passage of successive crests in seconds. Wave velocity (or speed) is three times its period. Waves are not symmetrical in shape. Crests are by nature steeper and narrow than troughs, with normal sea level slightly below one-half a wave's height. For an FDS, there is a relationship between wavelength, period, and velocity (or speed). For example, an individual wave with a period of 5 seconds will have a length of 125 feet (5x5x5=125) and a speed of 15 knots (3x5=15).

Wave height is not specifically related to wave period or speed; however, its steepness (wave height divided by length or its rise over the run) is an important factor in understanding wave height. Waves will typically break when its steepness exceeds 1/7 in the open ocean. This is even more critical in ocean currents such as the Gulf Stream or the Kuroshio Current. As all mariners are aware, wave heights are not uniform. The most visible waves that the naked eye observes are Significant Wave Height (SWH). SWH is the average height of the highest one-third of the waves present in any given area. SWH for a given value in open ocean conditions allows determination or other critical wave heights:

Average Wave Height = 0.64% of SWH

Continued on Page 10

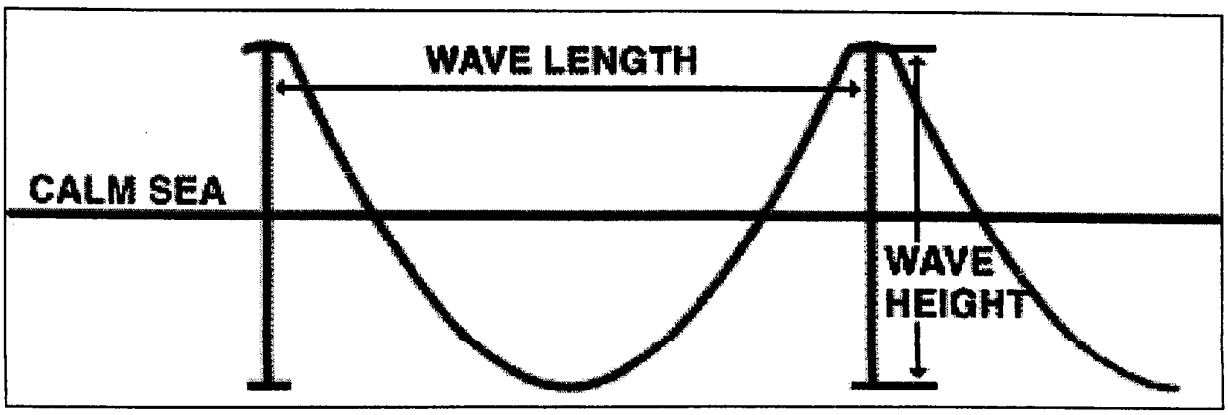

Figure 1. The four components of a wave: length, height, period, and speed. As winds produce waves over the open ocean, the larger waves will continue to grow until a Fully Developed Sea (FDS) is produced.

Fetch	BEAUFORT NUMBER																											Fetch
	3			4			5			6			7			8			9			10			11			
	T	H	P	T	H	P	T	H	P	T	H	P	T	H	P	T	H	P	T	H	P	T	H	P	T	H	P	
10	4.4	1.8	2.1	3.7	2.6	2.4	3.2	3.5	2.8	2.7	5.0	3.1	2.5	6.0	3.4	2.3	7.3	3.9	2.0	8.0	4.1	1.9	10.0	4.2	1.8	10.0	5.0	10
20	7.1	2.0	2.5	6.2	3.2	2.9	5.4	4.9	3.3	4.7	7.0	3.8	4.2	8.6	4.3	3.9	10.0	4.4	3.5	12.0	5.0	3.2	14.0	5.2	3.0	16.0	5.9	20
30	9.8	2.0	2.8	8.3	3.8	3.3	7.2	5.8	3.7	6.2	8.0	4.2	5.8	10.0	4.6	5.2	12.1	5.0	4.7	15.8	5.5	4.4	18.0	6.0	4.1	19.8	6.3	30
40	12.0	2.0	3.0	10.3	3.9	3.6	8.9	6.2	4.1	7.8	9.0	4.6	7.1	11.2	4.9	6.5	14.0	5.4	5.8	17.7	5.9	5.4	21.0	6.3	5.1	22.5	6.7	40
50	14.0	2.0	3.2	12.4	4.0	3.8	11.0	6.5	4.4	9.1	9.8	4.8	8.4	12.2	5.2	7.7	15.7	5.6	6.9	19.8	6.3	6.4	23.0	6.7	6.1	25.0	7.1	50
60	16.0	2.0	3.5	14.0	4.0	4.0	12.0	6.8	4.6	10.2	10.3	5.1	9.6	13.2	5.5	8.7	17.0	6.0	8.0	21.0	6.5	7.4	25.0	7.0	7.0	27.5	7.5	60
70	18.0	2.0	3.7	15.3	4.0	4.1	13.5	7.0	4.8	11.9	10.8	5.4	10.5	13.9	5.7	9.9	18.0	6.4	9.0	22.5	6.8	8.3	26.5	7.3	7.8	29.5	7.7	70
80	20.0	2.0	3.8	17.0	4.0	4.2	15.0	7.2	4.9	13.0	11.0	5.6	12.0	14.5	6.0	11.0	18.9	6.6	10.0	24.0	7.1	9.3	28.0	7.7	8.6	31.5	7.9	80
90	23.6	2.0	3.9	18.8	4.0	4.3	16.5	7.3	5.1	14.1	11.2	5.8	13.0	15.0	6.3	12.0	20.0	6.7	11.0	25.0	7.2	10.2	30.0	7.9	9.5	34.0	8.2	90
100	27.1	2.0	4.0	20.0	4.0	4.4	17.5	7.3	5.3	15.1	11.4	6.0	14.0	15.5	6.5	12.8	20.5	6.9	11.9	26.5	7.6	11.0	32.0	8.1	10.3	35.0	8.5	100
120	31.1	2.0	4.2	22.4	4.1	4.7	20.0	7.8	5.4	17.0	11.7	6.2	15.9	16.0	6.7	14.5	21.5	7.3	13.1	27.5	7.9	12.3	33.5	8.4	11.5	37.5	8.8	120
140	36.6	2.0	4.5	25.8	4.2	4.9	22.5	7.9	5.8	19.1	11.9	6.4	17.6	16.2	7.0	16.0	22.0	7.6	14.8	29.0	8.3	13.9	35.5	8.8	13.0	40.0	9.2	140
160	43.2	2.0	4.9	28.4	4.2	5.2	24.3	7.9	6.0	21.1	12.0	6.6	19.5	16.5	7.3	18.0	23.0	8.0	16.4	30.5	8.7	15.1	37.0	9.1	14.5	42.5	9.6	160
180	50.0	2.0	4.9	30.9	4.3	5.4	27.0	8.0	6.2	23.1	12.1	6.8	21.3	17.0	7.5	19.9	23.5	8.3	18.0	31.5	9.0	16.5	38.5	9.5	16.0	44.5	10.0	180
200				33.5	4.3	5.6	29.0	8.0	6.4	25.4	12.2	7.1	23.1	17.5	7.7	21.5	23.5	8.5	19.3	32.5	9.2	18.1	40.0	9.8	17.1	46.0	10.3	200
220				36.5	4.4	5.8	31.1	8.0	6.6	27.2	12.3	7.2	25.0	17.9	8.0	22.9	24.0	8.8	20.9	34.0	9.6	19.1	41.5	10.1	18.2	47.5	10.6	220
240				39.2	4.4	5.9	33.1	8.0	6.8	29.0	12.4	7.3	26.8	17.9	8.2	24.4	24.5	9.0	22.0	34.5	9.8	20.5	43.0	10.3	19.5	49.0	10.8	240
260				41.9	4.4	6.0	34.9	8.0	6.9	30.5	12.6	7.5	28.0	18.0	8.4	26.0	25.0	9.2	23.5	34.5	10.0	21.8	44.0	10.6	20.9	50.5	11.1	260
280				44.5	4.4	6.2	36.8	8.0	7.0	32.4	12.9	7.8	29.5	18.0	8.5	27.7	25.0	9.4	25.0	35.0	10.2	23.0	45.0	10.9	22.0	51.5	11.3	280
300				47.0	4.4	6.3	38.5	8.0	7.1	34.1	13.1	8.0	31.5	18.0	8.7	29.0	25.0	9.5	26.3	35.0	10.4	24.3	45.0	11.1	23.2	53.0	11.6	300
320							40.5	8.0	7.2	36.0	13.3	8.2	33.0	18.0	8.9	30.2	25.0	9.6	27.6	35.5	10.6	25.5	45.5	11.2	24.5	54.0	11.8	320
340							42.4	8.0	7.3	37.6	13.4	8.3	34.2	18.0	9.0	31.6	25.0	9.8	29.0	36.0	10.8	26.7	46.0	11.4	25.5	55.0	12.0	340
360							44.2	8.0	7.4	38.8	13.4	8.4	35.7	18.1	9.1	33.0	25.0	9.9	30.0	36.5	10.9	27.7	46.5	11.6	26.6	55.0	12.2	360
380							46.1	8.0	7.5	40.2	13.5	8.5	37.1	18.2	9.3	34.2	25.5	10.0	31.3	37.0	11.1	29.1	47.0	11.8	27.7	55.5	12.4	380
400							48.0	8.0	7.7	42.2	13.5	8.6	38.8	18.4	9.5	35.6	26.0	10.2	32.5	37.0	11.2	30.2	47.5	12.0	28.9	56.0	12.6	400
420							50.0	8.0	7.8	43.5	13.6	8.7	40.0	18.7	9.6	36.9	26.5	10.3	33.7	37.5	11.4	31.5	47.5	12.2	29.6	56.5	12.7	420
440							52.0	8.0	7.9	44.7	13.7	8.8	41.3	18.8	9.7	38.1	27.0	10.4	34.8	37.5	11.5	32.5	48.0	12.3	30.9	57.0	12.9	440
460							54.0	8.0	8.0	46.2	13.7	8.9	42.8	19.0	9.8	39.5	27.5	10.6	36.0	37.5	11.7	33.5	48.5	12.5	31.8	57.5	13.1	460
480							56.0	8.0	8.1	47.8	13.7	9.0	44.0	19.0	9.9	41.0	27.5	10.8	37.0	37.5	11.8	34.5	49.0	12.6	32.7	57.5	13.2	480
500							58.0	8.0	8.2	49.2	13.8	9.1	45.5	19.1	10.1	42.1	27.5	10.9	38.3	38.0	11.9	35.5	49.0	12.7	33.9	58.0	13.4	500
550										53.0	13.8	9.3	48.5	19.5	10.3	44.9	27.5	11.1	41.0	38.5	12.2	38.2	50.0	13.0	36.5	59.0	13.7	550
600										56.3	13.8	9.5	51.8	19.7	10.5	47.7	27.5	11.3	43.6	39.0	12.5	40.3	50.0	13.3	38.7	60.0	14.0	600
650													55.0	19.8	10.7	50.3	27.5	11.6	46.4	39.5	12.8	43.0	50.0	13.7	41.0	60.0	14.2	650
700													58.5	19.8	11.0	53.2	27.5	11.8	49.0	40.0	13.1	45.4	50.5	14.0	43.5	60.5	14.5	700
750																56.2	27.5	12.1	51.0	40.0	13.3	48.0	51.0	14.2	45.8	61.0	14.8	750
800																59.2	27.5	12.3	53.8	40.0	13.5	50.6	51.5	14.5	47.8	61.5	15.0	800
850																			56.2	40.0	13.8	52.5	52.0	14.6	50.0	62.0	15.2	850
900																			58.2	40.0	14.0	54.6	52.0	14.9	52.0	62.5	15.5	900
950																						57.2	52.0	15.1	54.0	63.0	15.7	950
1000																						59.3	52.0	15.3	56.3	63.0	16.0	1000

Figure 2. Table for calculating variables for wave height: the time in Hours (T) that wind must blow to generate waves of Significant Wave Height (SWH) or (H) in feet and Period (P) in seconds. Fetch is area is in nautical miles (NM).

Waves and the Mariner

Continued from Page 8

Highest 10% of Waves = 1.29% of SWH

Extreme or Highest Waves = 1.87% of SWH

For example if SWH is 10 feet in a given area, the Average Wave Height is 6.4 feet, the highest 10% of the waves is 12.9 feet, and the Extreme or Highest Waves will be 18.7 feet.

Waves generally develop slowly and for any given wind speeds it take hours for an SWH to develop. For example, in Figure 2 (from Marine Weather, Nathaniel Bowditch, Ocean Waves section p. 116 Beaufort number), Beaufort force 8 wind (34-40 knots) requires 40 hours to generate its SWH, with unlimited fetch, of 27.5 feet. Changing any combination of wave components will increase or decrease wave height proportionally. If, for example, a Beaufort force 8 has a fetch less than 10 nautical miles, the SWH will be 7.3 feet, regardless how long the wind blows. It becomes apparent that limiting fetch is a key to limiting wave height. It is also important to note that waves rarely obtain their FDS because of the changing wind direction and speed at any given fixed point from a moving ocean storm system. The 1991 "Halloween Storm" was an exception, as it was essentially stationary for days at a time. Normal time for a wind speed and direction coming from the same direction is 27 hours. However, a change in wind direction does not alter waves already in motion to change their direction. A wave will continue along the same path until it is refracted by shoaling (see below) or perhaps an island.

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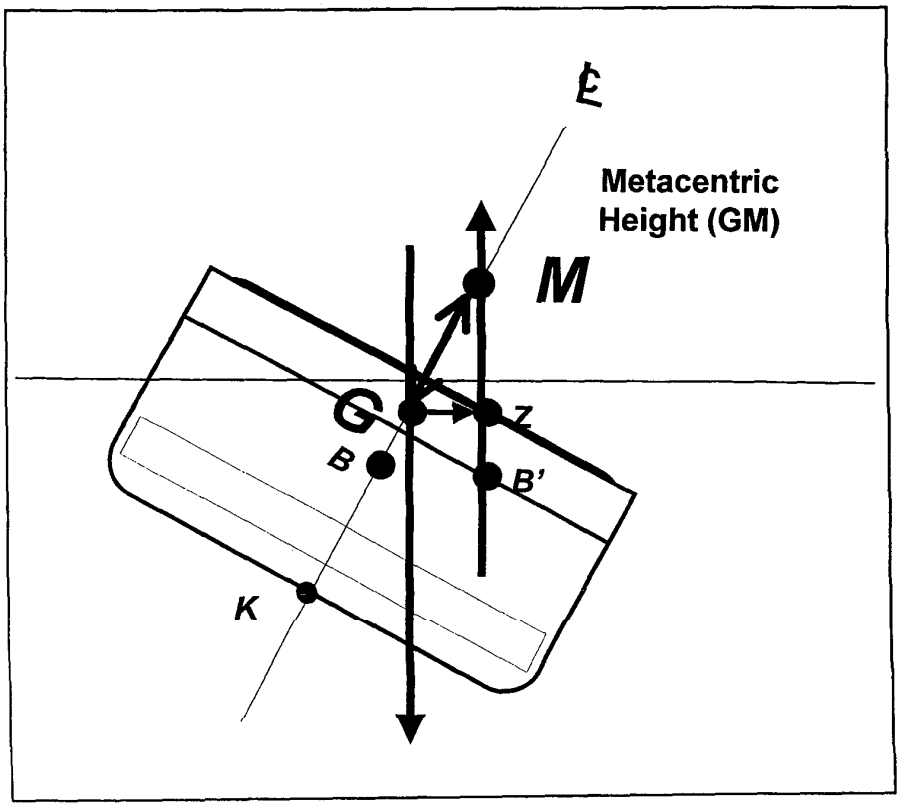


Figure 3. Waves are the limiting factor in ship motion when integrated with physical aspects of ship stability. These are Roll Period (seconds), which is a ship's stability indicator, determined prior to heading out to sea by the formula: P (period) = .44 x B (ships beam)/ (square root of GM). GM being the distance between a vessel's center of gravity (G) and its metacenter (M). Both G and M can be found in a ship's stability book. However, it is important to note that any change in ballasting, cargo shift, or rigging will effect GM, which in turn effects P, and a vessel's overall stability. (Reference: Formulae for the Mariner by Richard Plant)

The Six Degrees of Freedom for Ship Motion

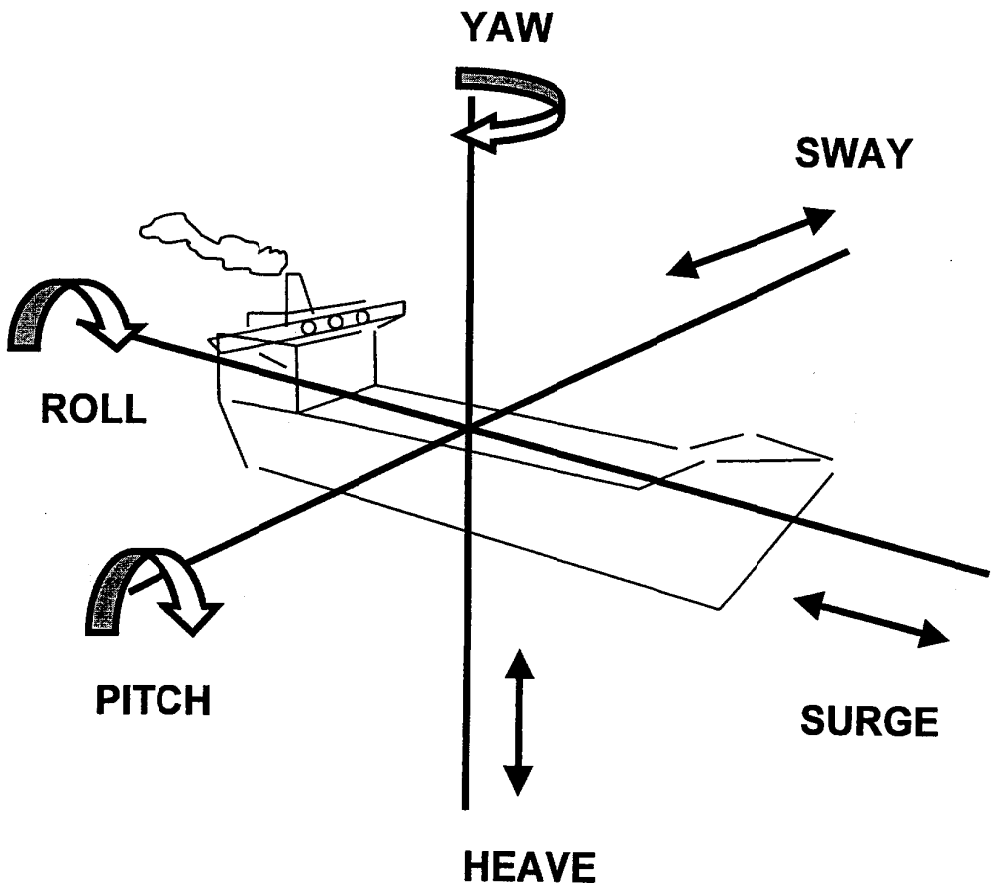
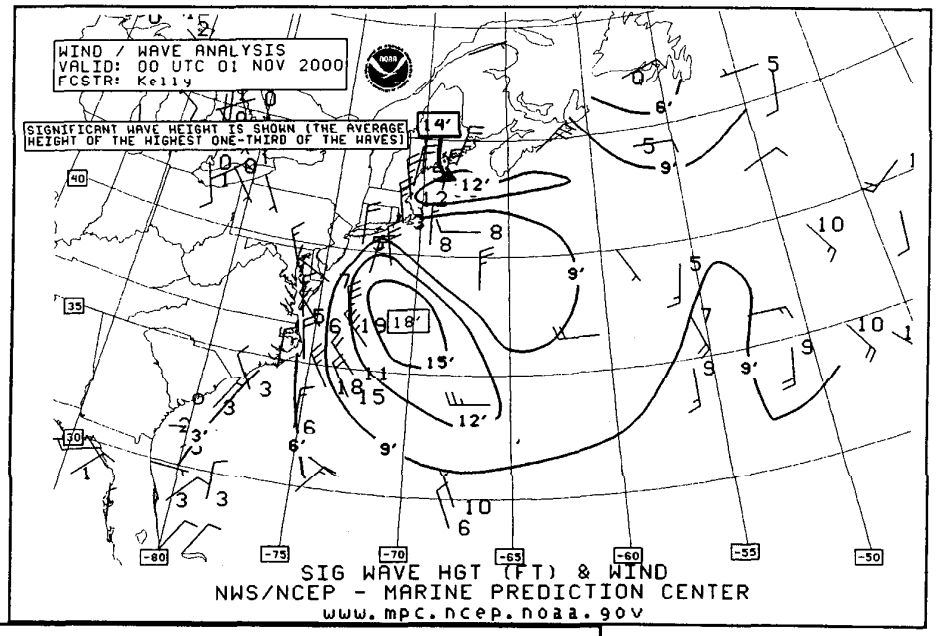


Figure 4. There are six degrees of motion for a vessel as shown. The one motion most critical is roll because it is largely influenced by cargo loading and shifting, as well as Sea State conditions. Excessive rolling will overload fittings and cause containers to be lost overboard and quickly fatigue a crew. A ship's rolling period, measured in seconds, is a direct indicator of stability. When wave period is half of a ship's roll period, synchronous rolling may occur and in rough seas this extreme rolling, in combination with a loss of water plane area and surfing, may lead to excessive vessel motion such as snap rolling or capsizing.



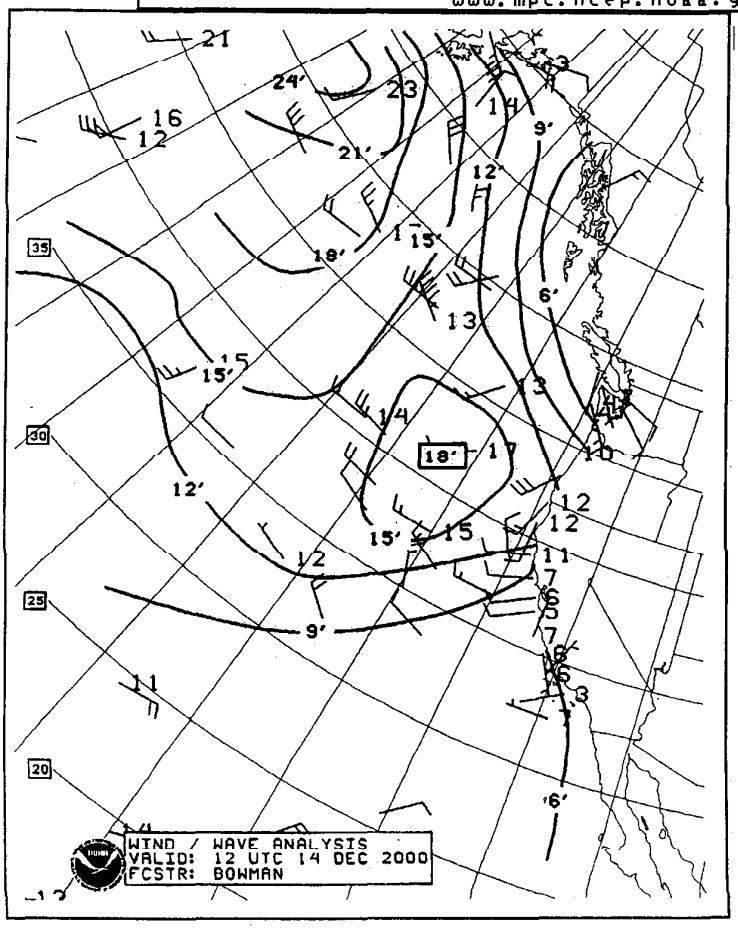
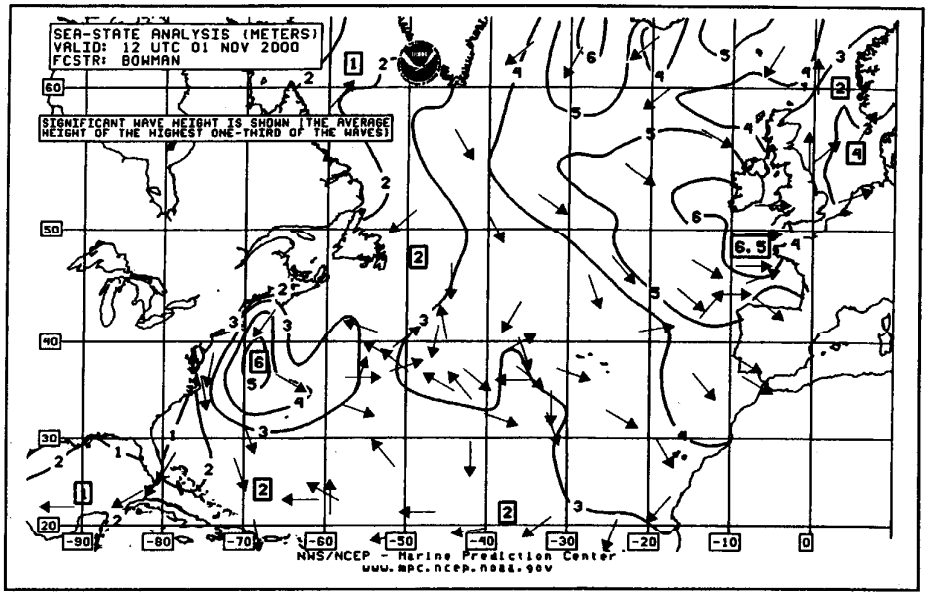


Figure 5. Regional Sea State Analysis - The Regional Seat State Analysis is broadcast on the High Frequency (HF) and Single Side Band (SSB) radio-facsimile program twice a day per ocean at 0315 UTC and 1515 UTC for the Western Atlantic and 1510 UTC and 2149 UTC for the eastern Pacific Oceans. This product is issued every three hours and available for Internet viewing. For example, the top figure is for the 0000 UTC 01 NOV 2000 western Atlantic ([TIF|GIF|B/W GIF] for Internet access) with analysis of ship synoptic reports and automated weather stations such as CMANs or buoys for sea state coded in "feet"and observed wind speed in "knots." The Regional Sea State Analysis analyzes significant wave heights (approximately 1/3 the highest waves present) as solid three feet "isopleth" or significant wave height contour intervals. Relative maximum and minimum significant wave height values are centrally depicted inside the highest "isopleth" or wave height contour.



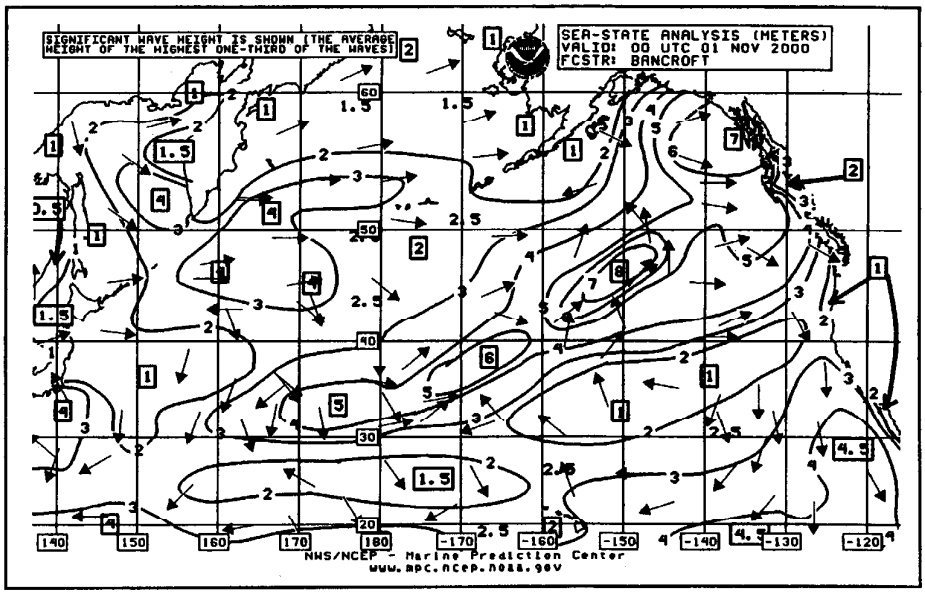
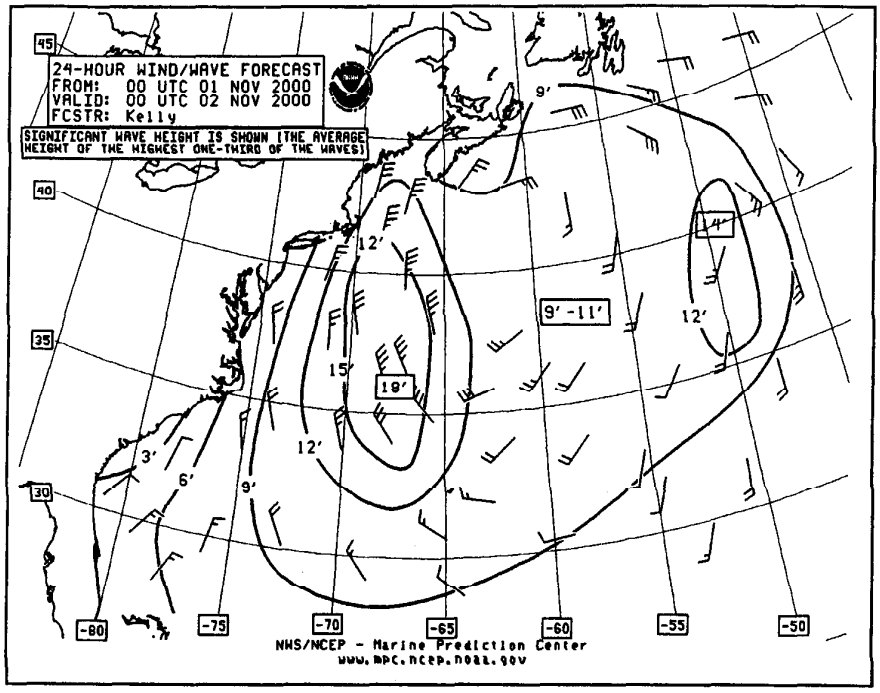


Figure 6 A and B. Sea State Analysis - This product is produced twice a day per ocean at 0310 UTC and 1759 UTC for the North Atlantic, and 0310 UTC and 1500 UTC for the North Pacific Oceans. Transmission is via HF and SSB from the U.S. Coast Guard Communications Stations at Boston, MA and Pt Reyes, CA, respectively (TIF|GIF|B/W GIF for Internet access). These products are full oceanic coverage with analysis of ship synoptic reports and automated weather stations such as CMANs for significant wave height in "meters" (the highest one-third of the waves present). The sea state analysis product depicts solid "one" meter significant wave height "isopleths" or wave height contour intervals of significant wave height. Relative maximum and minimum significant wave height values are centrally depicted and inside or adjacent to the highest "isopleth" or significant wave height contour. Primary swell direction arrows are also depicted as reported from ships participating in the Voluntary Observation Program. When viewed together with the surface analyses, the user should have a complete picture of surface weather conditions in a very timely manner.



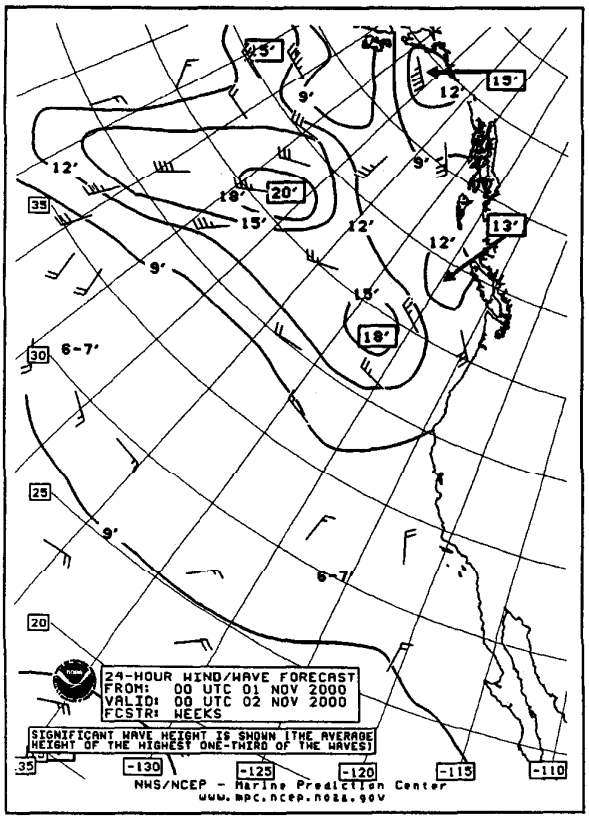


Figure 7 A and B. 24 Hour Wind/Wave Forecast - These Charts are produced twice a day from 0000 UTC and 1200 UTC forecast models for both the Atlantic and Pacific Oceans. The products are broadcast at 0815 UTC and 1915 UTC in the Atlantic and 0818 and 1943 UTC in the Pacific Oceans via HF and SSB from the U.S. Coast Guard Communications Stations at Boston, Massachusetts, and and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access). The products depict 24-hour forecasts of wind (increments of 5 knots) superimposed over significant wave heights depicted as "isopleths" of or wave height contours of "3 feet" intervals. Relative maximum and minimum significant wave height values are centrally depicted and inside or adjacent to the highest "isopleth" or significant wave height contour. During appropriate weather conditions, such as "North Wall" episodes occurring along the northern wall of the Gulf Stream in the western Atlantic, substantially higher wind/wave height values are highlighted. Arrows will point to a superimposed hatched area of the Gulf Stream. The "North Wall" event is normally confined to the adjacent areas of the northern edge of the Gulf Stream. Another item that may be highlighted on the forecast is "Swell fronts" which may originate from tropical systems. These "Swell fronts" can be hazardous conditions to marine operations and those in coastal areas. A scalloped line is used to depict the front and is labeled appropriately such as "SWELL FRONT FROM HURRICANE "DEBBY." Arrows will be from the text to the leading edge of the "Swell front." Additionally, depiction of superstructure icing, displayed by a half moon with one or two lines crossing through the center, will depend on the forecast for light or heavy accumulation.

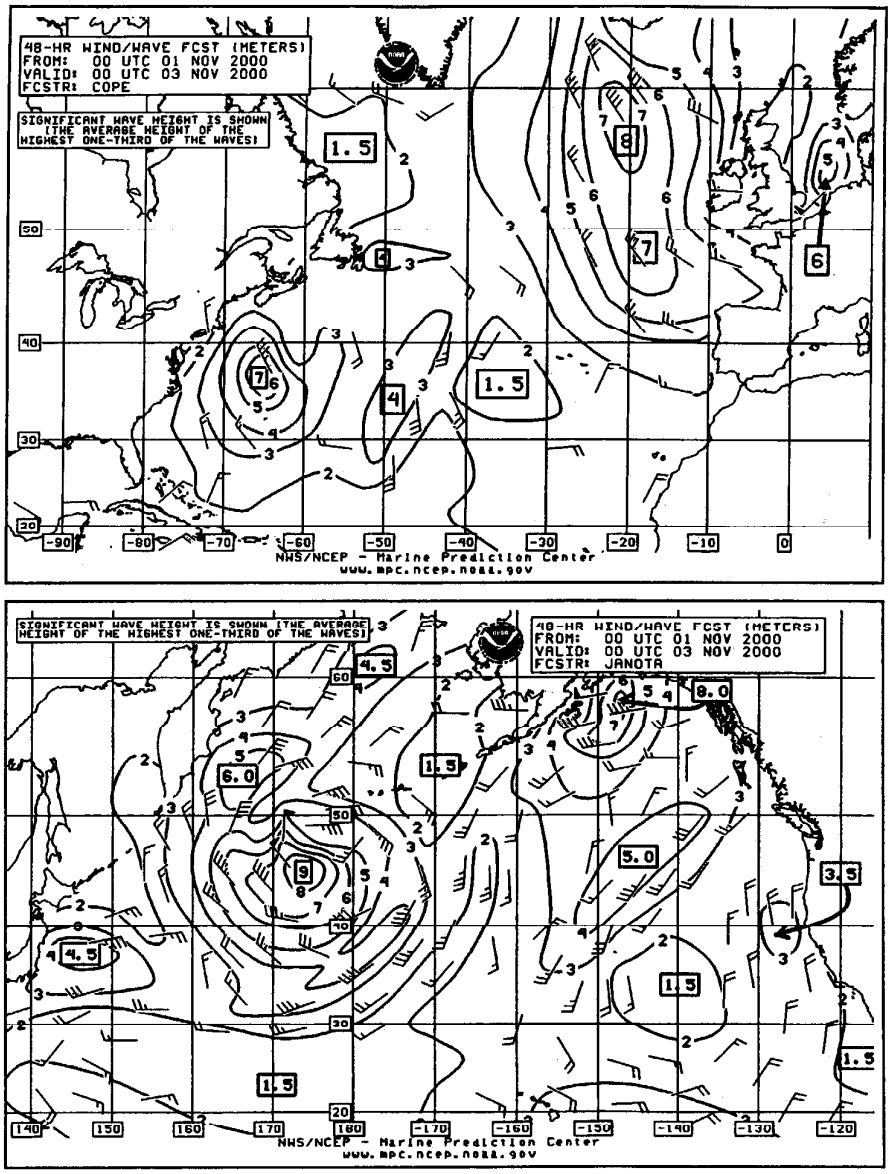


Figure 8 A and B. 48 Hour Wind/Wave Forecasts - These forecast products are generated twice daily for both the Atlantic and Pacific Oceans. The forecasts are valid at 0000 UTC and 1200 UTC for each respective forecast cycle. They are transmitted at 0905 UTC and 2005 UTC for the Atlantic and 0848 UTC and 2013 UTC for the Pacific Oceans from the U.S. Coast Guard Communications Stations at Boston, Massachusets, and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access). The products are based on the significant wave height forecast model runs from NCEP (WaveWATCH 111) and the U.S. Navy. The significant wave heights (the highest one-third of the highest waves present) are forecast cycle. The wave heights are depicted in "isopleths" or solid contours of one meter increments with relative maximum or minimum significant sea state values enclosed inside under or adjacent to the highest wave height contour. Also, the ice edge is displayed as a bold jagged line during the winter months. These products will provide a complete picture of forecast surface conditions when used in conjunction with the 48-hour surface forecasts. The 48-hour wind/wave forecasts highlight where the most significant combined sea heights prevail. Also, forecast wind speeds in five-knot increments are plotted on this chart.

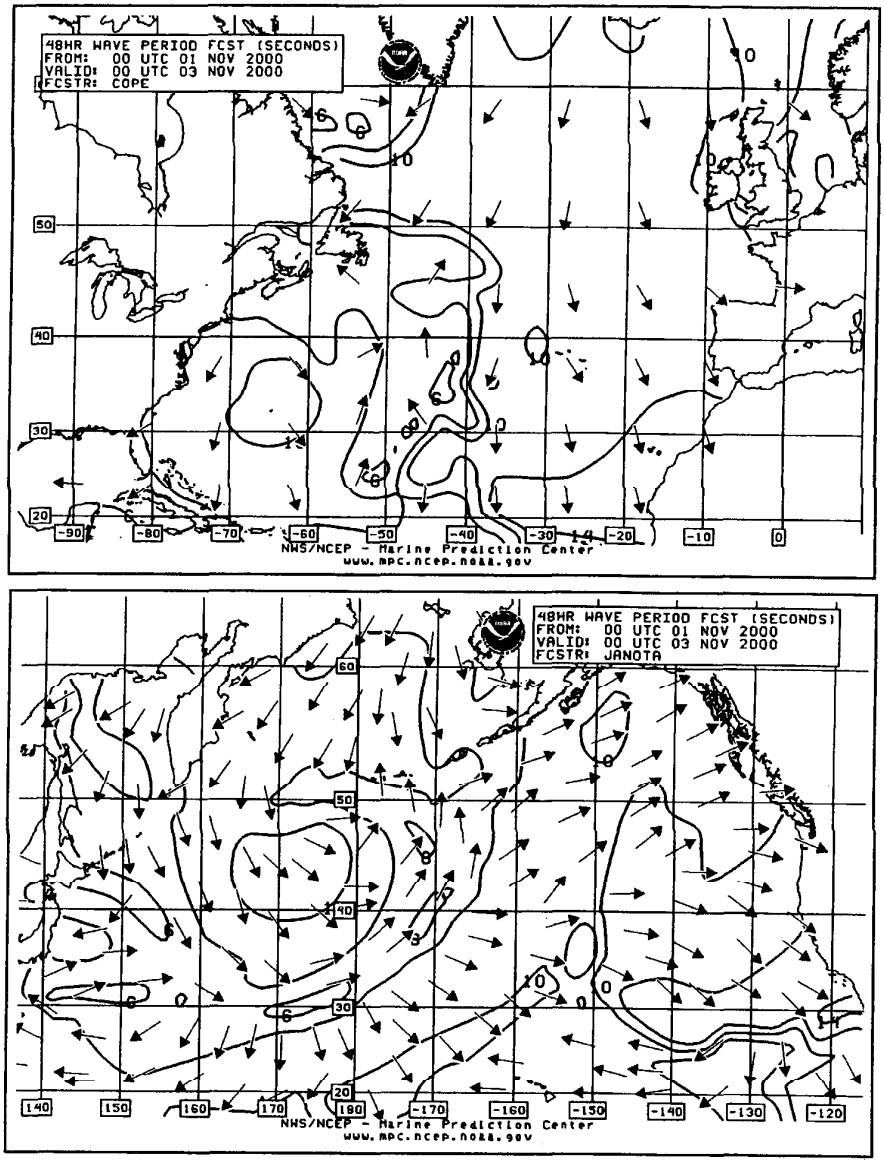


Figure 9 A and B. 48 Hour Wave Period Forecasts - These are computer-generated products and are issued twice a day from the 0000 UTC and 1200 UTC WaveWATCH 111 model forecast for both the Atlantic and Pacific Oceans. These products are transmitted at 0915 UTC and 2015 UTC in the Atlantic and 0848 UTC and 2023 UTC in the Pacific Oceans respectively via HF and SSB broadcasts (TIF|GIF|B/W GIF for Internet access). The 48-hour Wave Period and Direction (Peak Period and Direction) Forecasts are manually edited, and represent "peak period" from either locally generated "wind wave" (" sea," in cases with strong local winds) or the dominant wave system ("swell") that are generated elsewhere as a "wind wave." Note that the peak period field shows discontinuities. These discontinuities can loosely be interpreted as swell fronts, although in reality many swell systems overlap at most locations and times. A swell front is the leading edge of wave periods with higher energy that typically originates and moves away from a storm center. Arrows on the 48 Hour Wave Period Forecast chart point toward the prevailing or dominate swell direction. Swell fronts that can also originate from individual wave trains that can converge along a narrow band of differing periods. The wave trains themselves travel at different speeds and thus can converge from different directions.

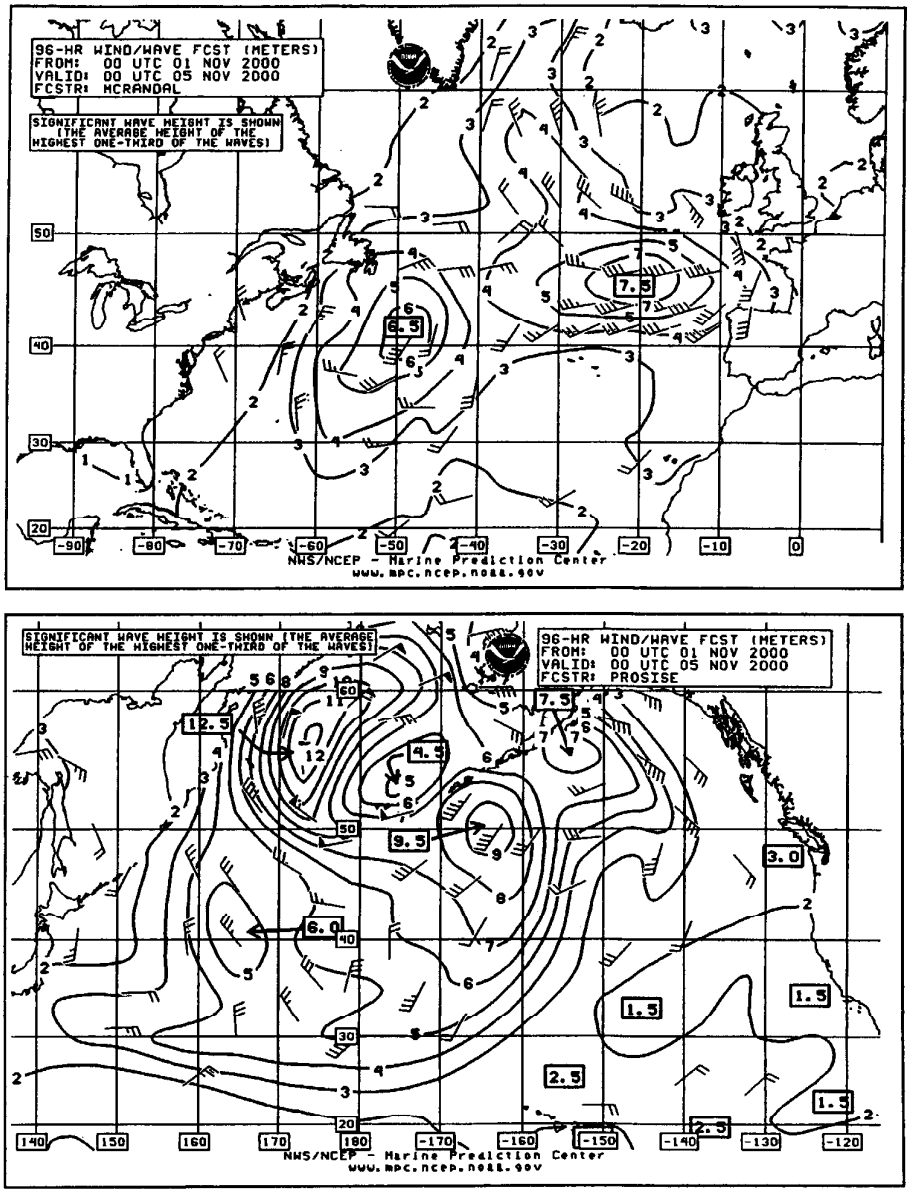
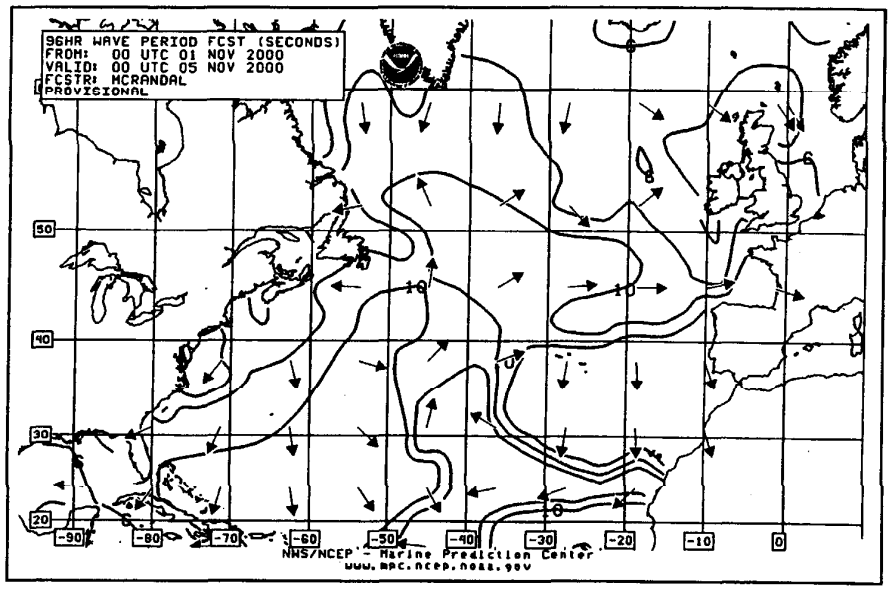


Figure 10 A and B. 96 Hour Wind/Wave Forecasts - These forecast products are generated once daily for both the Atlantic and Pacific Oceans. They are transmitted at 2055 UTC for the Atlantic and 2053 UTC for the Pacific Oceans from the U.S. Coast Guard Communications Stations at Boston, Massachusetts, and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access). The products are based on the significant wave height forecast model runs from NCEP (WaveWATCH 111) and the U.S. Navy. The "isolpleths" or wave height contours of significant wave (the average one-third of the highest waves present) are depicted in solid contours of one-meter increments with relative maximum or minimum sea state values enclosed inside or adjacent to the area of interest. Forecast wind speed in five-knot increments of 25 knots or more are superimposed on the significant wave height "isopleths" or wave height contours on this chart. Also, the ice edge is displayed as a bold jagged line during the winter months. These products will provide a complete picture of forecast surface conditions when used in conjunction with the 96-hour surface forecasts. The 96-hour wind/wave forecasts highlight where the most significant sea state heights prevail.



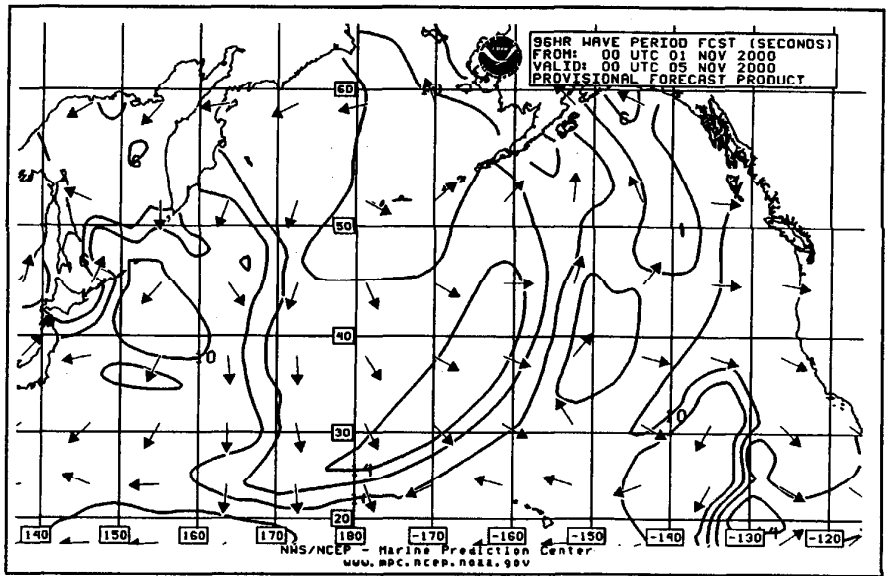


Figure 11 A and B. 96 Hour Wave Period Forecasts - These peak period and direction products are produced directly from the same computer output as the 48 Hour Wave Period Forecasts with no manual editing. The 96-hour products are experimental products. As of 20 December 2000 this 96-hour product will be produced operationally from the 1200 UTC NCEP (WaveWATCH 111) forecast model for both the Atlantic and Pacific Oceans. These forecast products are generated once daily for both the Atlantic and Pacific Oceans. They are transmitted at 2105 UTC for the Atlantic and 2103 UTC for the Pacific Oceans from the U.S. Coast Guard Communications Stations at Boston, Massachusetts and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access).

Waves and the Mariner

Continued from Page 10

When waves enter shallow water, which is defined as a depth less than one-half of a wave's length, movement is slowed by contact with the bottom, thus increasing its height. This is called shoaling, and when a wave is slowed it becomes unstable and breaks. The normal ratio is 5/3 for waves to break (three feet of seas in five feet of water). A continual line of breakers is called surf. Ocean waves will often pass over a shoal and increase dramatically in size without breaking. These are called ground swells and often occur after the passage of large storms. If waves encounter an island, then its refractive effects can lead to confused, steep, and breaking waves on its lee side. It is believed that the tall ship **Fantome** experienced such waves in the lee of Roaton Island, off the coast of Honduras, while trying to shelter from Mitch. It is important also to note that a ship's stability and motion and response issues factor very much for safety and performance decision making (Figures 3 and 4).

MPC produces Wind and Wave Analyses and Forecasts charts available via radio facsimile High Frequency (HF) or Single Side Band (SSB) radio broadcasts from the U.S Coast Guard, Boston Massachusetts, and Point Reyes, California, as well as the website: (http://www.mpc.ncep.noaa.gov). The wave heights depicted by the MPC are SWH (Figures 5 A/B, 6 A/B, 7 A/B, 8 A/B, and 10 A/B). These are the core products available for mariners. However, in open water it is important to remember that waves and swells travel in Great Circle paths (following the earth's curvature, not straight lines or Rhumblines). Thus waves or swells will arrive at angles that are as much as 30 degrees from a direct Rhumbline from it origins. Hurricane waves are difficult to forecast because their initiating wind fields are often not well known and they frequently have a changing fetch and direction of movement (Steve Lyons, Wave Relationship Notes: Western Region National Weather Service Workshop, Naval Postgraduate School, Monterey CA, May 2000). Thus, a mariner should realize that the direction of swells arriving at his location does not mean the direction to the storm that caused them. Wave systems often travel in wave trains or groups, which travel at half the speed of their individual waves. This is because leading waves tend to slow as they propagate out from their origins, thus allowing wave trains behind them to catch up and absorb their energy. The MPC Peak Wave Period and Direction charts (Figures 9 A/B and 11 A/B) will sometimes depict "wave front" regions. This is significant because the potential for waves in the one-tenth of the highest Waves or Extreme Waves range could possibly occur. This would not be depicted on the MPC Wind and Wave Forecast Charts (Figures 8 A/B and 10 A/B) for the same period, as it would show SWH only.

There is also a website for National Data Buoy Center Marine Observations (http://www.ndbc.noaa.gov) which can provide real time buoy information via a telephone service called Dial-A-Buoy (1-228-688-1948). Data taken within the last hour is available for some 119 moored and Coastal-Marine Automated Network (C-MAN) buoys and stations inside and nearby offshore and territorial waters of U.S. Buoys provide SWH. Period information for each buoy is also available. Using SWH and period, it is possible to determine wavelength, velocity (or speed), average wave height, the highest 10 percent, and the highest or extreme waves. Buoy reports provide additional information such as swell height, swell period, wind wave height, wind wave period, wave steepness, and average period. Steep and very steep waves have the potential of damaging or capsizing vessels. Important safety decisions can be made using this real-time accurate information. Mariners who have an interest in further improving their skills in wave height analysis and forecasting and integrating their safety decision-making are invited to inquire about the Heavy Weather Avoidance course at MITAGS with Michael Carr at 443-989-3254 or mcarr@mitags.org.⚓

SEA STATE[1]	FULLY RISEN SEAS[2]										WIND			
	WAVE HEIGHT (feet)				SIGNIFICANT RANGE OF PERIODS (seconds)				WIND[2]					
	AVERAGE	SIGNIFICANT (avg. of 1/3 highest)	AVG. OF 1/10 HIGHEST		T_{max} (period of max energy)	T_z (average period, sec.)	L (avg. wave length, ft.)	WIND SPEED (knots)	MINIMUM FETCH (nm)	MINIMUM DURATION (hrs)	BEAUFORT No.[4]	WIND DESCRIPTION	WIND SPEED (knots)	APPEARANCE OF THE SEA[5]
0	0	0	0	~	~	~	~	~	~	~	0	CALM	<1	Sea like a mirror.
	0.05	0.08	0.10	up to 1.2 sec.	0.7	0.5	0.83	2	5	0.3	1	LIGHT AIRS	1-3	Ripples with the appearance of scales are formed, but without foam crests.
1	0.18	0.29	0.37	0.4-2.8	2.0	1.4	6.7	5	8	0.7	2	LIGHT BREEZE	4-6	Small wavelets, still short but more pronounced; crests have glassy appearance and do not break.
	0.6	1.0	1.2	0.8-5.0	3.4	2.4	20	8.5	9.8	1.7	3	GENTLE BREEZE	7-10	Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.
2	0.88	1.4	1.8	1.0-6.0	4.0	2.9	27	10	10	2.4				
	1.4	2.2	2.8	1.0-7.0	4.8	3.4	40	12	18	3.8	4	MODERATE BREEZE	11-16	Small waves, becoming longer; fairly frequent white horses.
	1.8	2.9	3.7	1.4-7.6	5.4	3.9	52	13.5	24	4.8				
3	2.0	3.3	4.2	1.5-7.8	5.6	4.0	59	14	28	5.2				
	2.9	4.6	5.8	2.0-8.8	6.5	4.6	71	16	40	6.6				
4	3.8	6.1	7.8	2.5-10.0	7.2	5.1	90	18	55	8.3	5	FRESH BREEZE	17-21	Moderate waves, taking a more pronounced long form; many white horses are formed. (Chance of some spray.)
	4.3	6.9	8.7	2.8-10.6	7.7	5.4	99	19	65	9.2				
5	5.0	8.0	10	3.0-11.1	8.1	5.7	111	20	75	10				
	6.4	10	13	3.4-12.2	8.9	6.3	134	22	100	12	6	STRONG BREEZE	22-27	Large waves begin to form; the white foam crests are more extensive everywhere. (Probably some spray.)
	7.9	12	16	3.7-13.5	9.7	6.8	160	24	130	14				
6	8.2	13	17	3.8-13.8	9.9	7.0	164	24.5	140	15				
	9.8	15	20	4.0-14.5	10.5	7.4	188	28	180	17				
	11	18	23	4.5-15.5	11.3	7.9	212	28	230	20				
7	14	22	28	4.7-16.7	12.1	8.6	250	30	280	23	7	MODERATE GALE	28-33	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. Spindrift begins.
	14	23	29	4.8-17.0	12.4	8.7	258	30.5	290	24				
	16	26	33	5.0-17.5	12.9	9.1	285	32	340	27				
	19	30	38	5.5-18.5	13.6	9.7	322	34	420	30	8	FRESH GALE	34-40	Moderately high waves of greater length; edges of crests break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.
	21	35	44	5.8-19.7	14.5	10.3	363	36	500	34				
	23	37	46.7	6.0-20.5	14.9	10.5	376	37	530	37				
	25	40	50	6.2-20.8	15.4	10.7	392	38	600	38				
8	28	45	58	6.5-21.7	16.1	11.4	444	40	710	42				
	31	50	64	7.0-23.0	17.0	12.0	492	42	830	47	9	STRONG GALE	41-47	High waves. Dense streaks of foam along the direction of the wind. Sea begins to roll. Spray may affect visibility.
	36	58	73	7.0-24.2	17.7	12.5	534	44	960	52				
9	40	64	81	7.0-25.0	18.6	13.1	590	46	1110	57				
	44	71	90	7.5-26.0	19.4	13.8	650	48	1250	63	10	WHOLE[6] GALE	48-55	Very high waves with long overhanging crests. The resulting foam in great patches is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes a white appearance. The rolling of the sea becomes heavy and shock like. Visibility is affected.
	49	78	99	7.5-27.0	20.2	14.3	700	50	1420	69				
	52	83	106	8.0-28.2	20.8	14.7	736	51.5	1560	73				
	54	87	110	8.0-28.5	21.0	14.8	750	52	1610	75				
	59	95	121	8.0-29.5	21.8	15.4	810	54	1800	81				
	64	103	130	8.5-31.0	22.6	16.3	910	56	2100	88	11	STORM[6]	56-63	Exceptionally high waves. (Small and medium-sized ships might for a long time be lost to view behind the waves.) The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.
	73	116	148	10.0-32.0	24	17.0	985	59.5	2500	101				
	[7] >80	[7] >128	[7] >164	[7] 10-(35)	[7] (26)	[7] (18)	~	>64	~	~	12	HURRICANE[6]	64-71	The air filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

From a table compiled by Wilbur Marks, David Taylor Model Basin

[1]Sea states refer only to wind waves. Swells from distant or old storms are often superimposed on the wind wave pattern.

[2]Practical Methods of Observing and Forecasting Ocean Waves, Pierson, Neuman, James, H.O.Pub. 603, 1955.

[3]Wind required to create a fully risen sea. To attain a fully risen sea for a certain wind speed, the wind must blow at that speed over a minimum distance (fetch) for a minimum time (duration).

[4]The Beaufort Number is a wind force scale. While wind and seas are causally related, Beaufort Number and sea state are not the same. For example, it is common to have force 7 winds, but because of limited fetch or duration, a sea state of only 2.

[5]Manual of Seamanship, Vol. II. Admiralty. H.M. Stationary Office, 1952.

[6]For whole gale, storm, and hurricane winds (50 knots or more) the required durations and fetches are rarely attained. Seas are therefore not fully arisen.

[7]For such high winds the seas are confused. The wave crests are blown off, and the water and air mix.

Figure 5. – Sea State Description

Some Technical Terms Used in This Month's Marine Weather Reviews

Isobars: Lines drawn on a surface weather map which connect points of equal atmospheric pressure.

Trough: An area of low pressure in which the isobars are elongated instead of circular. Inclement weather often occurs in a trough.

Short Wave Trough: Specifies a moving low or front as seen in upper air (constant pressure) weather charts. They are recog-nized by characteristic short wavelength (hence short wave) and wavelike bends or kinks in the constant pressure lines of the upper air chart.

Digging Short Wave: Upper air short waves and waves of longer wavelength (long waves) interact with one another and have a major impact on weather systems. Short waves tend to move more rapidly than longer waves. A digging short wave is one that is moving into a slower moving long wave. This often results in a develop-ing or strengthening low pressure or storm system.

Closed Low: A low which has developed a closed circulation with one or more isobars encircling the low. This is a sign that the low is strengthening.

Cutoff Low: A closed low or trough which has become detached from the prevailing flow it had previously been connected to (becoming cutoff from it).

Blocking High Pressure: A usually well developed, stationary or slow moving area of high pressure which can act to deflect or obstruct other weather systems. The motion of other weather systems can be impeded, stopped completely, or forced to split around the blocking High Pressure Area.

Frontal Low Pressure Wave: refers to an area of low pressure which has formed along a front.

Tropical Wave or Depression: An area of low pressure that originates over the tropical ocean and may be the early stage of a hurricane. Often marked by thunderstorm or convective cloud activity. Winds up to 33 knots.

Wind Shear: Refers to sharp changes in wind speed and/or direction over short distances, either vertically or horizontally. It is a major hazard to aviation. Wind shear above Tropical depressions or storms will impede their development into hurricanes.

Closed off Surface Circulation: Similar to a closed low. Refers to a surface low with one or more closed isobars. When there are falling pressures, the low is considered to be strengthening.

Good to Know:

A *good* ship captain always knows what the weather *is* at any moment;
A *very good* one also knows what the weather *will* be;
An outstanding one also knows what the weather *might* be in the future!

- Command at Sea

Practice, which forms intuition, is necessary to build confidence (& competence)!

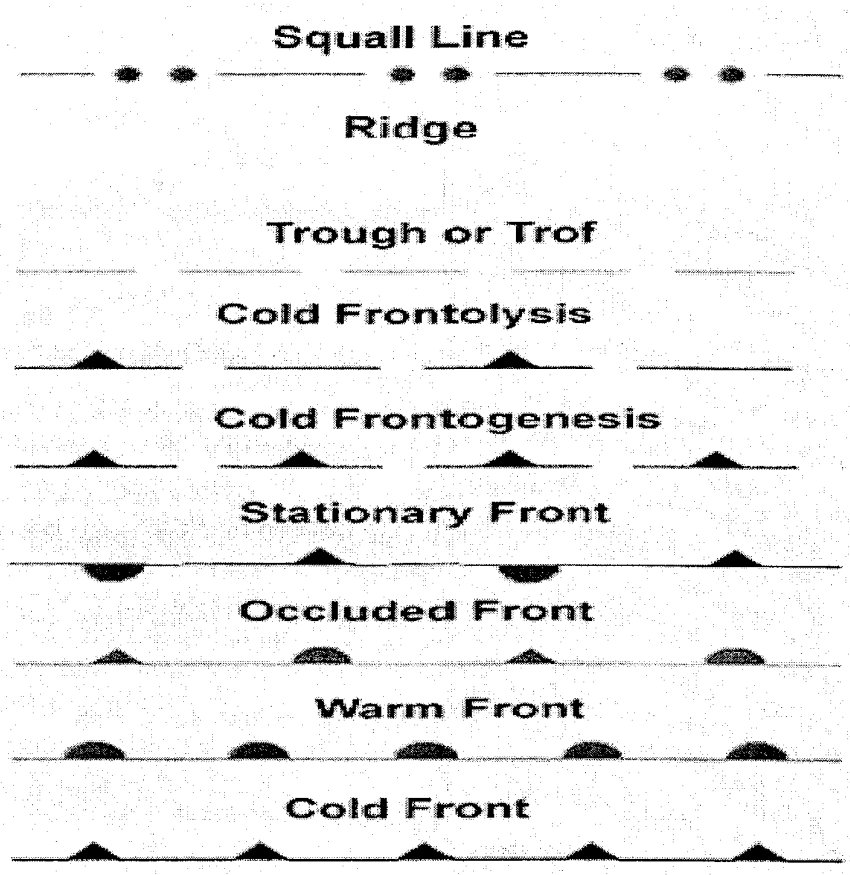
- Cushman-Roisin

With weather, as with everything else…, there are conservative & there are risky courses of action…. *We feel it is always better to take the most conservative approach.*

- Dashew

Key Terms and Symbols

FRONTS



Cold front

-The leading edge of a relatively colder air mass which separates two air masses in which the gradients of temperature and moisture are maximized. In the northern hemisphere winds ahead of the front will be southwest and shift into the northwest with frontal passage.

Frontogenesis

-The formation of a front occurs when two adjacent air masses with different densities and temperatures meet and strengthen the discontinuity between the air masses. It occurs most frequently over continental land areas such as over the Eastern US when the air mass moves out over the ocean. It is the opposite of frontolysis.

Frontolysis

-The weakening or dissipation of a front occurs when two adjacent air masses lose contrasting properties such as the density and temperature. It is the opposite of frontogenesis.

Occluded front

- The union of two fronts, formed as a cold front overtakes a warm front or quasi-stationary front refers to a cold front occlusion. When a warm front overtakes a cold front or quasi-stationary front

the process is termed a warm front occlusion. These processes lead to the dissipation of the front in which there is no gradient in temperature and moisture.

Ridge

- an elongated area of relatively high pressure that is typically associated with a anticyclonic wind shift.

Stationary front

- A front that has not moved appreciably from its previous analyzed position.

Trough

- [Trof], an elongated area of relatively low pressure that is typically associated with a cyclonic wind shift.

Warm front

- The leading edge of a relatively warmer surface air mass which separates two distinctly different air masses. The gradients of temperature and moisture are maximized in the frontal zone. Ahead of a typical warm front in the northern hemisphere, winds are from the southeast and behind the front winds will shift to the southwest.

LOW & HIGH PRESSURE SYSTEMS AND MISCELLANEOUS KEY TERMS USED

Low Pressure

High Pressure

Low pressure with a number such as 99 means 999 mb and with 03 means 1003 mb. High pressure with a number such as 25 means 1025 mb.

Extratropical low

- A low pressure center which refers to a migratory frontal cyclone of middle and higher latitudes. Tropical cyclones occasionally evolve into extratropical lows losing tropical characteristics and become associated with frontal discontinuity.

Low pressure

- An area of low pressure identified with counterclockwise circulation in the northern hemisphere and clockwise in the southern hemisphere. Also, defined as a cyclone.

High pressure

- An area of higher pressure identified with a clockwise circulation in the northern hemisphere and a counterclockwise circulation in the southern hemisphere. Also, defined as an anticyclone.

New

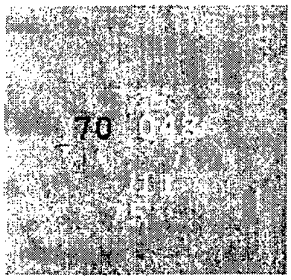
- The term "NEW" may be used in lieu of a forecast track position of a high or low pressure center when the center is expected to form by a specific time. For example, a surface analysis may depict a 24-hour position of a new low pressure center with an "X" at the 24-hour position followed by the term"NEW", the date and time in UTC which indicates the low is expected to form by 24 hours.

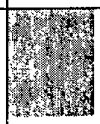
Rapidly intensifying

- Indicates an expected rapid intensification of a cyclone with surface pressure expected to fall by at least 24 millibar (mb) within 24 hours.

Station plot

Click for information on *coding* used with the surface preliminary analysis or for a list of "present weather" symbols.

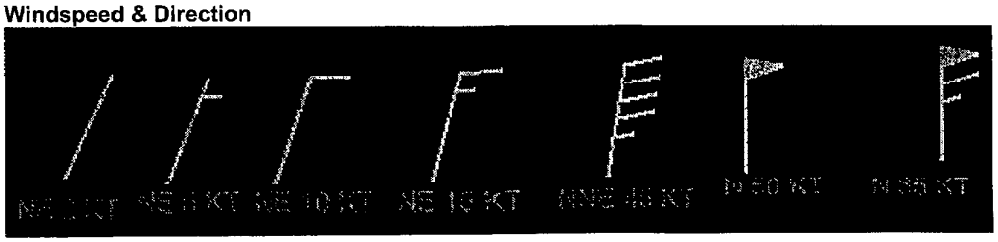


Weather Parameter	Weather Symbol Decoded
Station ID	KPZH
Temperature (fahrenheit or celsius)	70 degree F
Present weather	thunderstorm
Dew point temperature (fahrenheit or celsius)	68 degree F
Wind speed, direction, sky cover	 SSW 25 kt overcast
Station Pressure (mb)	048 = 1004.8 mb
3 hour pressure tendency	-7 \ = -0.7 mb pressure decrease with steady pressure fall
optional wave height (feet or meter)	11 ft
Sea Surface Temperature (fahrenheit or celsius)	75 degrees F

Squall

- A sudden wind increase characterized by a duration of minutes and followed by a sudden decrease in winds.

Windspeed & Direction



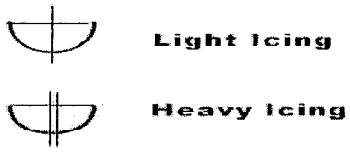
FOG

Fog
- Over the marine environment the term fog refers to visibility greater than or equal to 1/2 NM and less than 3 NM. Fog is the visible aggregate of minute water droplets suspended in the atmosphere near the surface.

Dense fog
-Over the marine environment the term dense fog refers to visibility less than 1/2 NM. Fog is the visible aggregate of minute water droplets suspended in the atmosphere near the surface. Usually dense fog occurs when air that is lying over a warmer surface such as the Gulf Stream is advected across a colder water surface and the lower layer of the air mass is cooled below its dew point.

Sea fog
- Common advection fog caused by transport of moist air over a cold body of water.

FREEZING SPRAY



Freezing spray
- Spray in which supercooled water droplets freeze upon contact with exposed objects below the freezing point of water. It usually develops in areas with winds of at least 25 knots.

Categories of Freezing Spray/Icing

Light	Moderate	Heavy
Less than 0.7 cm/hr	0.7 cm/hr to less than or equal to 2.0 cm/hr	Greater than 2.0 cm/hr
Less than 0.3 ins/hr	0.3 ins/hr to less than or equal to 0.8 ins/hr	Greater than 0.8 ins/hr

CONVENTIONS USED WITH WARNINGS FOR EXTRATROPICAL SYSTEMS

Extratropical Systems

Complex gale/storm
-An area in which gale/storm force winds are forecast or are occurring, but in which more than one center is the generating these winds.

Developing gale
-Refers to an extratropical low or an area in which gale force winds of 34 knots (39 mph) to 47 knots (54 mph) are "expected" by a certain time period. On surface analysis charts a developing gale indicates gale force winds within the next 36 hours. When the term developing gale is used on the 48 hour surface forecast and 96 hour surface forecast charts, gale force winds are expected to develop by 72 hours and 120 hours, respectively.

Developing storm
-Refers to an extratropical low or an area in which storm force winds of 48 knots (55 mph) or greater are "expected" by a certain time period. On surface analysis charts a developing storm indicates storm force winds forecast within the next 36 hours. When the term developing storm is used on the 48 hour surface and 96 hour surface charts, storm force winds are expected to develop by 72 hours and 120 hours, respectively.

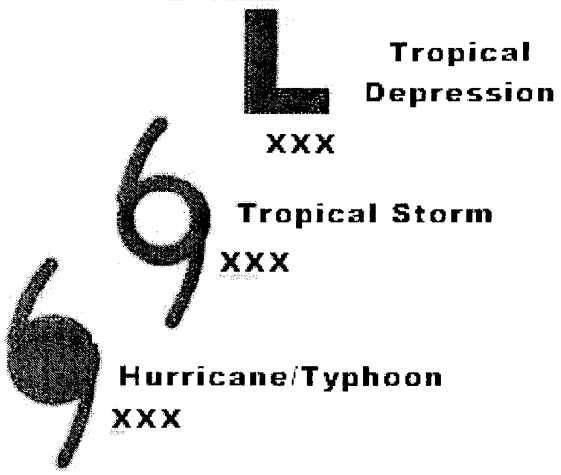
Gale
- Refers to an extratropical low or an area of sustained surface winds (one minute) of 34 knots (39 mph) to 47 knots (54 mph).

Storm
- Refers to a extratropical low or a area of sustained winds (one minute) in excess of 48 knots (55 mph).

Small Craft Advisory
- Refers to areas within the coastal waters with sustained winds (one minute) of 18 knots (21 mph) to 33 knots (38 mph).

CONVENTIONS USED WITH WARNINGS FOR TROPICAL SYSTEMS

Tropical Systems



Hurricane
- A tropical cyclone with closed contours, a strong and very pronounced circulation, and one minute maximum sustained surface winds 64 knots (74 mph) or greater. A system is called a hurricane over the North Atlantic, Gulf of Mexico, North Pacific E of the dateline, and the South Pacific E of 160E.

Tropical cyclone
- A non-frontal, warm-core, low pressure system of synoptic scale, developing over tropical or subtropical waters with definite organized convection (thunderstorms) and a well defined surface wind circulation.

Tropical depression
- A tropical cyclone with one or more closed isobars and a one minute max sustained surface wind of less than 34 knots (39 mph).

Tropical storm

- A tropical cyclone with closed isobars and a one minute max sustained surface wind of 34 knots (39 mph) to 63 knots (73 mph).

Typhoon

- Same as a hurricane with exception of geographical area. A tropical cyclone with closed contours, a strong and very pronounced circulation, and one minute maximum sustained surface winds of 64 knots (74 mph) or greater. A system is defined as a typhoon over the North Pacific W of the dateline.

SEAS

Combined seas

-The combination of both wind waves and swell which is generally referred to as "seas".

Primary swell direction

- Prevailing direction of swell propagation.

Significant wave height

- The average height (trough to crest) of the 1/3rd highest waves. An experienced observer will most frequently report the highest 1/3rd of the waves observed.

Swell

- Wind waves that have moved out of their fetch or wind generation area. Waves generated by swell exhibit a regular and longer period than wind waves.

MISCELLANEOUS TERMINOLOGY

High Seas

- That portion of the Atlantic and Pacific oceans which extends from 20 to 40 nm off the Western and Eastern US coasts and extends to 35W in the Atlantic ocean and to 160E in the Pacific Ocean. The area includes both the coastal and offshore waters.

Offshore waters

- That portion of oceans, gulfs, and seas beyond coastal waters extending to a specified distance from the coastline, to a specified depth contour, or covering an area defined by a specific latitude and longitude points.

A Guide to Surface-Analysis Charts

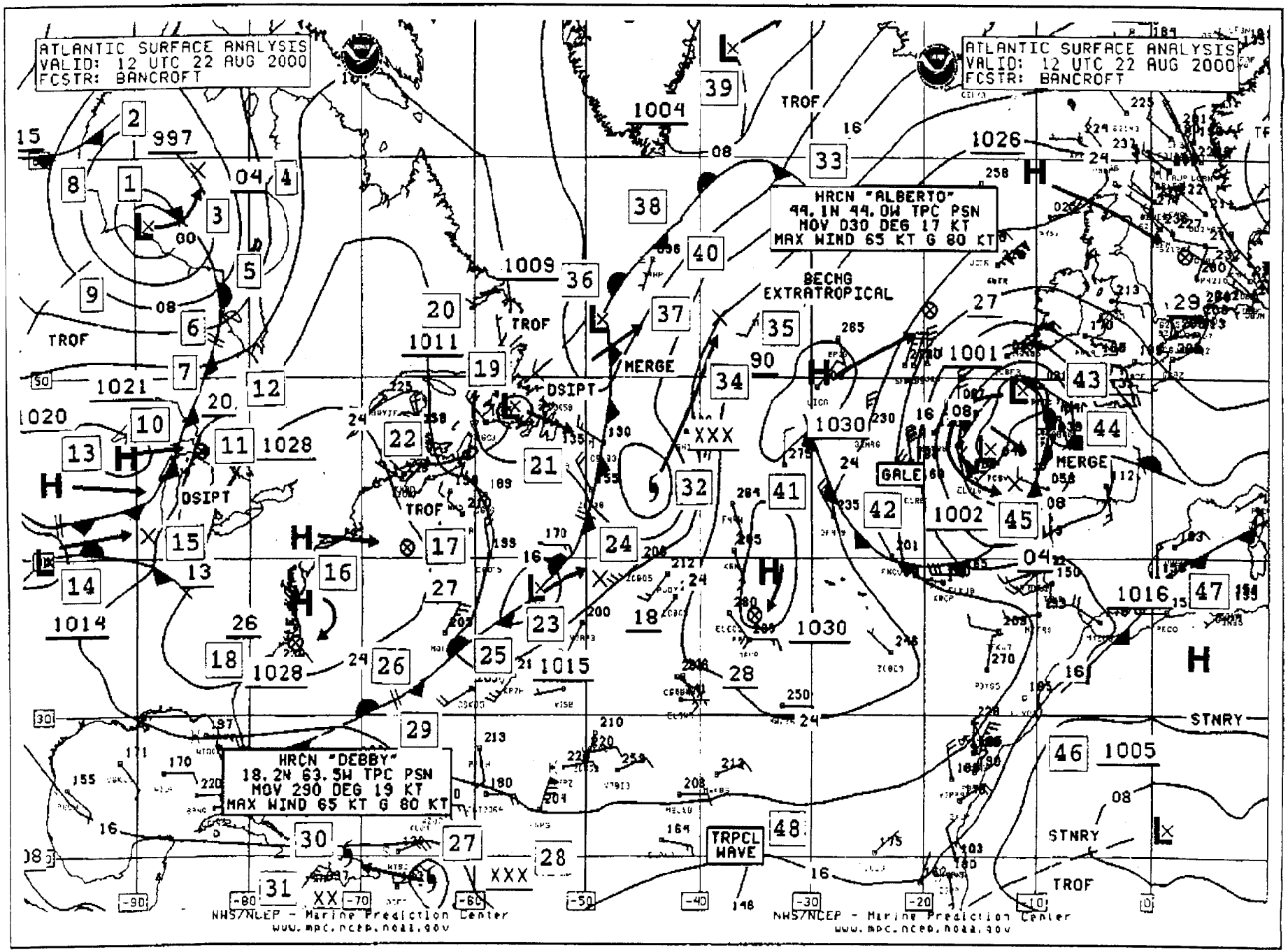
George P. Bancroft
Marine Prediction Center

The surface analysis is perhaps the most widely used chart in the marine community. Since these analyses show both the current weather situation and also serve as a forecast tool for the user, it is vitally important that the mariner understand the symbols and terminology that MPC uses on the charts.

In the example pictured here, the North Atlantic analysis is prepared for the area from 15N to 65N latitude and between 10E and 100W longitude, but is broadcast over HF radiofacsimile and posted to the Internet in two parts with 10 degrees of longitude overlap between the eastern and western parts (Parts 1 and 2). The two parts were meshed together for display. Note that MPC also issues an oceanic surface analysis for the North Pacific in two parts. The boxes in the upper left and upper right show the chart's valid time and date: 1200 UTC (noon, Greenwich time) 22 August 2000. The forecaster's name is on the line below: George Bancroft. The chart below was chosen for its variety of symbols and combination of tropical and extratropical cyclone activity.

Analyses of surface isobars (lines of equal atmospheric pressure at sea level) are shown in 4-millibar increments, with the isobars labeled every 8 mb (last two whole digits of pressure in millibars). Low and high pressure systems are depicted as "L" and "H" with an underlined pressure label nearby given in whole millibar units of 3 or 4 digits. The Marine Prediction Center also includes forecast tracks for pressure systems (denoted by arrows) and forecast positions valid 24 hours after the chart's valid time ("X" for lows and circled X's for highs, and tropical cyclone symbols). The 24-hour forecast pressures are shown near the forecast positions as the last two whole digits of pressure, underlined, or undetermined pressure "XX" for tropical cyclones. The first two digits, the 9 or 10, of the forecast pressure are left out to distinguish forecast positions from actual (synoptic) positions. If there is a 24-hour forecast of a pressure system that

Continued on Page 37


ATLANTIC SURFACE ANALYSIS
VALID: 12 UTC 22 AUG 2000
FCSTR: BANCROFT
HRCN "ALBERTO"
44.1N 44.0W TPC PSN
MOV 030 DEG 17 KT
MAX WIND 65 KT G 80 KT
HRCN "DEBBY"
18.2N 63.5W TPC PSN
MOV 290 DEG 19 KT
MAX WIND 65 KT G 80 KT
BECMG
EXTRATROPICAL
TROF
MERGE
DSIPT
GALE
TRPCL
WAVE
STNRY
NWS/NCEP - Marine Prediction Center
www.mpc.ncep.noaa.gov

Surface-Analysis Charts

Continued from Page 35

was not present at analysis time, it would be labeled as "NEW".

Fronts (warm, cold, occluded, stationary) and low-pressure troughs are also shown. If a front is dissipating, it is broken into alternating pips (filled triangles or half-circles) and line segments. Fronts that are forming are depicted as broken lines of pips, without the alternating line segments. A pair of parallel line segments ("=") appears at a junction between one type of front and another. Troughs are shown as dashed lines labeled as "TROF".

As an example, the North Atlantic surface analysis is shown here. Boxed numbers have been placed adjacent to various features, and are organized as increasing from west to east. The same numbers appear below with accompanying explanations. This example follows a format similar to that found in the article *An Introduction to Surface-Analysis Charts* found in Cruising World magazine (November 2000), by Michael Carr and Lee Chesneau.

1. Inland low ("L") is over Hudson Bay near 57N 89.5W.
2. The central pressure is 997 mb.
3. The low has a forecast track (arrow) that takes it NE to a position near 59.5N 85W 24 hours later, marked by an "X".
4. The 24-hour forecast pressure is "04" (1004 mb).
5. An occluded front extends SE from the low center.
6. The "=" marks the transition from an occluded front to a cold front.
7. The cold front extends SW to near 42N 97W.
8. Another cold front is shown entering the NW corner of the chart.
9. A low-pressure trough (labeled as "TROF") extends SW from the Hudson Bay low. This is an elongated area of relatively low pressure often accompanied by clouds, precipitation, and shifting winds.
10. A high-pressure center appears farther to the south ("H") near 46N 91W and has a central pressure of 1021 mb.
11. The high is forecast to be near 46N 84W 24 hours later, marked by a "circled X".
12. The 24-hour forecast of central pressure of the high is "20" (1020 mb).
13. Another high to the west with central pressure 1020 mb is forecast to move east and dissipate ("DSIPT") within 24 hours.
14. Another inland low is on the west edge of the chart near 40N 98W with a central pressure of 1014 mb and a stationary front extending E from the center to 39N 85W.
15. The low is forecast to be near 41N 89W ("X") 24 hours later, with a forecast pressure of "13" (1013 mb).
16. Near the coast, a complex area of high pressure has centers near 41N 75W and 38N 76W, both with pressures of 1028 mb.
17. The northern high-pressure center is forecast to be near 40.5N 67W ("circled X") 24 hours later, with a forecast pressure of "27" (1027 mb).
18. The southern high-pressure center is forecast to move SE initially, then curve SW, to a 24-hour forecast position near Cape Hatteras with a pressure of "26" (1026 mb).
19. A low-pressure center is shown over the island of Newfoundland.
20. Its central pressure is 1011 mb.
21. The low is forecast to move ESE and dissipate ("DSIPT") within 24 hours.
22. A low-pressure trough ("TROF") extends SW from the low.
23. Another low to the south is near 38N 54W, with a central pressure of 1015 mb.
24. The low is forecast to move ENE to near 39N 49W 24 hours later, with a forecast central pressure of "18" (1018 mb).
25. A stationary front extends southwest from the low to 30.5N 67W and northeast from the low center to 42N 50W.
26. The symbol ("=") marks the transition from a stationary front to a dissipating stationary front, which extends southwest to near Florida.
27. Hurricane Debby is centered near 18.2N 63.5W.
28. The central pressure of Debby is shown as "XXX", which stands for the central pressure of any named tropical cyclone. These pressures are so low that drawing all the isobars

Continued on Page 38

Surface-Analysis Charts

Continued from Page 37

would make the chart illegible. Beginning in the 2001 Atlantic hurricane season, MPC will begin showing estimated central pressures of tropical cyclones instead of "XXX".

29. Information about Debby's synoptic position, motion and maximum winds is contained in the rectangle above Debby's hurricane symbol.
30. Debby is forecast to move WNW to a 24-hour forecast position near 20N 71W, and remain a hurricane.
31. The "XX" represents an undetermined 24-hour forecast of central pressure located near the forecast hurricane symbol.
32. Hurricane Alberto is centered near 44.1N 44.0W with central pressure "XXX".
33. Information about Alberto's synoptic position, motion and winds is in the rectangle above and to the right of Alberto's hurricane symbol.
34. Alberto is forecast to move NE and lose tropical characteristics, becoming an extratropical low-pressure system (typically associated with fronts) near 53N 38W, marked by an "X", 24 hours later.
35. Since Alberto will be extratropical in 24 hours, its forecast central pressure is shown ("90") or 990 mb.
36. The low-pressure center north of Alberto near 53N 49W has a central pressure of 1009 mb. A low-pressure trough ("TROF") extends SW from the center to the island of Newfoundland.
37. The low is forecast to merge with Alberto within 24 hours.
38. A stationary front extends NE from the low center to 59N 30W. A cold front trails SW from the low to 42N 50W, where the "=' symbol marks the change to a stationary front.
39. A weak low centered near Greenland, with central pressure 1004 mb, is forecast to move NE, to a 24-hour forecast position north of the chart area. A trough ("TROF") extends south from the center.
40. A ship, call sign "Y4HP", near 55N 44W, reports a pressure of 1009.6 mb ("096") and a SSW wind of 5 kt (one-half of a wind barb). Each full wind barb is 10 kt, and a pennant is 50 kt. A weather symbol appears to the left of the ship's location (dense fog).
41. An elongated area of high pressure dominates this portion of the Atlantic and contains 3 centers. The northern center, near 59.5N 10W with a 1026 mb center, is forecast to move SE, to be near 56N 3E with a pressure of "29" (1029 mb) 24 hours later. The central high-pressure center at 50N 30W with pressure label 1030 mb is forecast to move NE to a 24-hour position near 53N 19.5W with pressure "27" (1027 mb). The southern center near 39.5N 34W with pressure 1030 mb is forecast to be near 36N 35W with a pressure of "28" (1028 mb) 24 hours later.
42. The area near the European coast is dominated by a primary gale-force low near 46N 14W with pressure 1002 mb and a secondary center at 49N 11W with a central pressure of 1001 mb. A dying occluded front surrounds the primary low center.
42. A short occluded front extends SE from the secondary low center.
43. From the frontal change symbol ("=") near 47N 9W, a warm front extends E and a cold front curves SW and then NW.
44. The secondary low center is forecast to move SW and then SE to 44N 12W by 24 hours with the 24-hour forecast pressure label "04" (1004 mb). The primary low is forecast to merge with it ("MERGE" label).
45. This part of North Africa is dominated by a 1005 mb low centered at 21N 1E and a 1016 mb high near 34N 4E. Both are stationary ("STNRY"). A low-pressure trough extends SW from the low.
46. A cold front extends SW across the western Mediterranean Sea.
47. A tropical wave, or trough embedded in the trade-wind easterlies, is depicted with a trough symbol and the label "TRPCL WAVE". A tropical wave is often accompanied by showers and a small wind shift.⚓

"Big whirls have little whirls which feed on their velocity. Little whirls have lesser whirls. And so on to viscosity." *–L.F. Richardson*

Mariner's Guide to the 500–Millibar Chart

Joe Sienkiewicz and Lee Chesneau
National Weather Service

Detailed stock and bond information is available daily. For those willing to expend the time and effort to analyze these data the rewards can be gratifying. The same can be said in maritime circles of the surface and 500–millibar charts, provided on marine radiofacsimile by the U.S. Coast Guard from NMF (Marshfield, MA) and NMC (Pt. Reyes, CA). Both transmit five 500–millibar (mb) charts each day (two analyses, two 48–hour forecasts and one 96–hour forecast).

For your investment decisions you can depend on your broker, just as you can turn to your weather forecaster for route decisions. In both cases it is the prudent individual who uses all available resources and makes his own final decision.

The professional mariner and ocean sailor can use the 500–mb analyses and forecasts in combination with surface pressure charts to better understand and anticipate the workings of the atmosphere. With a little bit of knowledge and pattern recognition experience, you will be able to make more educated decisions concerning upcoming weather and the movement of low pressure systems.

Surface Weather Chart Basics

Surface weather charts that depict isobars, high and low centers and a variety of weather fronts are familiar to mariners. The general perception is that lows are associated with bad weather and highs mean light winds near the center with generally fair weather, but there is more to it than that. Isobars are lines of equal pressure on the surface of the earth – at the bottom of the atmosphere. Therefore, this surface pressure is a direct measure of all of the processes that are happening from upper and mid-levels in the atmosphere down to the surface! These processes include cold air sinking, warm, moist air rising, precipitation, and air streams or jet streams coming together (converging) or spreading apart (diverging). The surface pressure pattern is actually a two dimensional representation of the three dimensional atmosphere!

If you look at a surface map and think that the low over Chicago today will be over New England tomorrow and affecting my vessel the day after, you are forecasting by continuity. This is moving the existing state of the atmosphere (lows, highs and fronts) around the earth without taking account of all the processes involved. In the early part of this century that is the way meteorologists first forecast storm systems.

If you learn anything from this article remember that the atmosphere is dynamic! The surface pressure field responds to changes in the atmosphere aloft and vice versa. Storms have life cycles; they are born, some grow and strengthen, and eventually they spin down and die. The intensity and length of life of a low is a direct result of interaction between the lowest level in the atmosphere and mid and upper levels. An excellent measure of this interaction is the 500–mb height field. (Note: Z time is the same as UTC.)

Joe Sienkiewicz and Lee Chesneau are High Seas Forecasters in the Marine Forecast Branch of the National Meteorological Center located in Washington, D.C. Both have written excellent articles for the Mariners Weather Log *in the past, in addition to their strenuous marine forecast duties.*

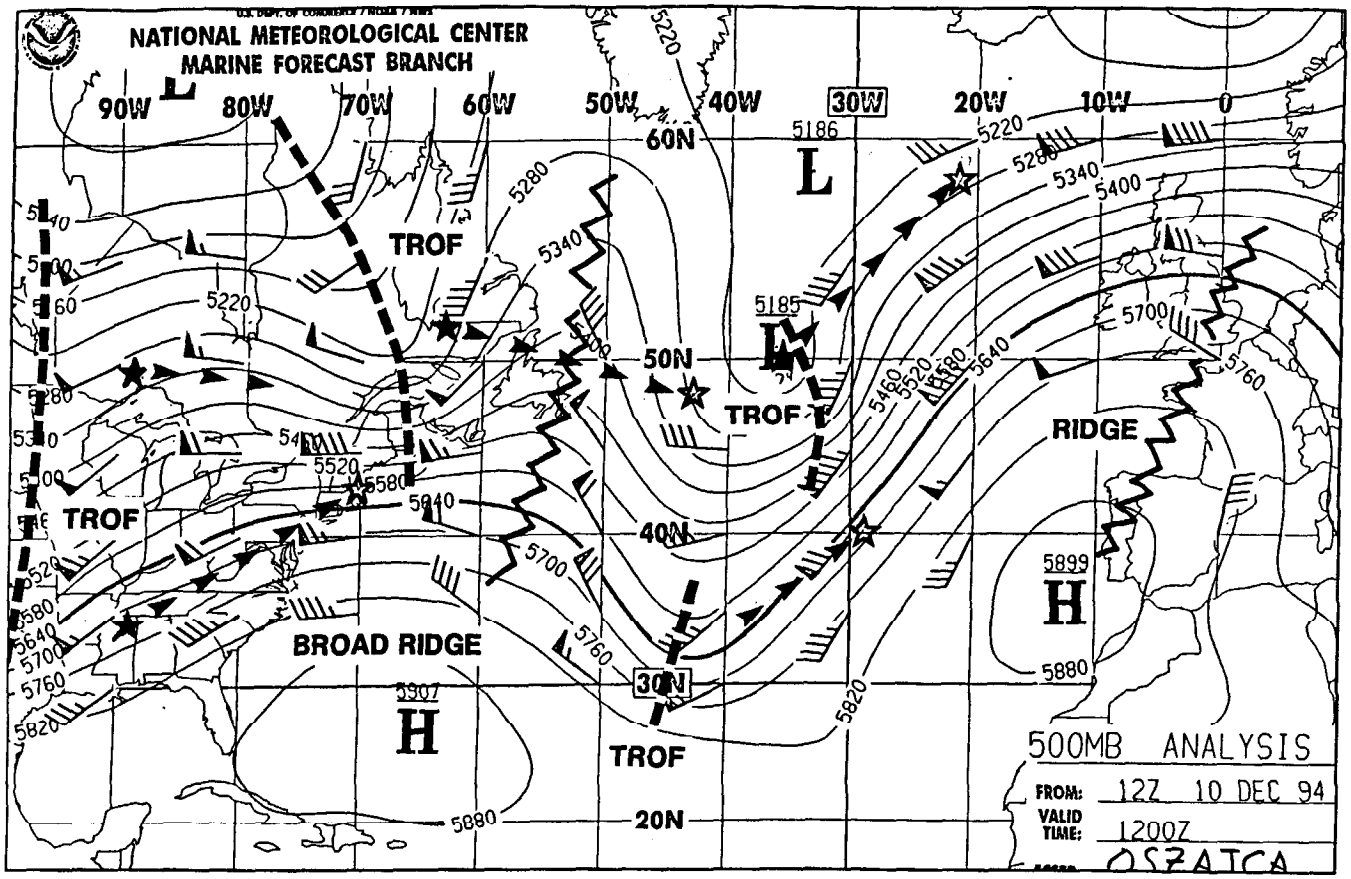


Figure 1. The 500-millibar analysis for 12Z December 10, 1994. Short wave troughs are shown by a dashed line. Zigzag lines indicate ridge axes. The location of surface low pressure centers at 12Z December 10 are indicated by a star. Observed 24 hour tracks of lows are shown by arrow heads, and the observed position of low centers at 12Z December 11 are shown with an open-faced star.

The 500-millibar Basics

The 500-mb surface is a constant pressure surface approximately midway up in the troposphere (the lowest layer of the earth's atmosphere). The pressure exerted by the air column above this level is exactly 500 mb, but the height of this surface varies. The 500-mb constant pressure surface generally averages approximately 5600 meters (18,000 feet) in height but can vary from roughly 4700 meters in an extremely cold (more dense) atmosphere to nearly 6000 meters in a very warm (less dense) atmosphere.

The solid contours shown on the 500-mb chart (Figure 1) represent geopotential height (basically, height in whole meters with a slight difference). The number 5640 means 5640 meters. In a sense you are looking at a topographic map of the 500-mb pressure surface. **The 500-mb heights are higher in warmer air masses (less dense) and lower in colder air masses (more dense).** Therefore, the heights generally are lower to the north and higher to the south. In Figure 1, look at the height differences from the contour at 30°N, 30°W (5820) and south of Iceland near 60°N, 20°W (5220) meters (approximately 600 meters difference).

The closer the 500-mb height contours are together, the stronger the horizontal and vertical temperature contrasts and the faster the wind speed at 500 mb (the wind at this level is for the most part parallel to the height contours). A simple rule of thumb– **the tighter the height contours, the higher the wind speed, the stronger the temperature difference below 500 mb.** In Figure 1, a strong band of southwesterly winds extends from near 30°N, 40°W to northern Scotland– good indication that a moderate to strong surface front exists in this area.

Winds at 500 mb are generally not the actual jet stream, which is usually between 200 and 300 mb. Jet streams exist due to horizontal temperature contrasts. In an extremely cold atmosphere, the arctic jet stream can extend down to 500 mb. However, meteorologists do call wind speed maxima at 500 mb jets or jet streaks. On the 500-mb charts distributed over radiofacsimile, only 500-mb heights and winds are depicted. The distribution of height contours and therefore the strength of 500-mb winds implies the

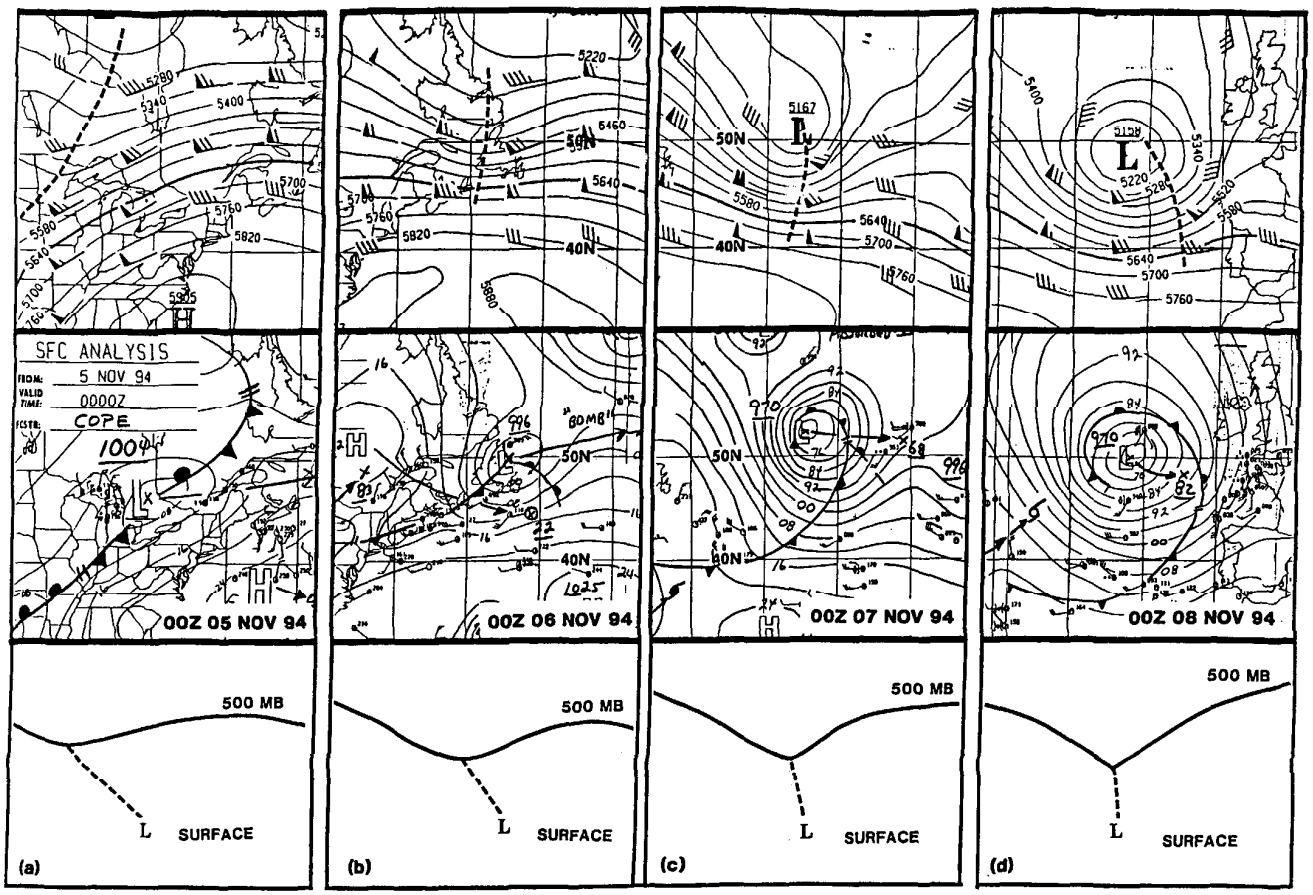


Figure 2. The four panel diagram shows the 500-mb analyses and short wave trough axes (dashed line), surface pressure analyses, and vertical cross-sections of 500-mb pressure surface, surface low position and vertical trough axis (dashed line) for (a) 0000Z November 5, (b) 0000Z November 6, (c) 0000Z November 7, and (d) 0000Z November 8, 1994.

strength of horizontal temperature contrasts.

L's and H's represent areas of relatively higher and lower heights. An L or H with a closed contour around it implies that the high or low has a closed circulation with the wind circulating around it. In Figure 1, a 5899 closed high can be seen just west of the Straits of Gibraltar. An open 5185 low can be seen at 50°N, 37°W (there is no closed height contour and no closed circulation).

Troughs are areas of relatively lower heights and are U or V-shaped in the contours. Several troughs axes are indicated in the chart by dashed lines. For example, a trough extends from just east of Hudson Bay to the Canadian Maritimes. A more complex area of troughing can be seen in the mid-Atlantic with one trough along 35°W and a second between 40° and 50°W south of 40°N.

Ridges are areas of higher heights and are shaped like an upside down U or V and are indicated by a zigzag line. A strong ridge extends north northeastward from off the African Coast to the British Isles. A broader, flatter ridge can be seen off the southeast U.S. coast extending to between 50°W and 60°W.

On the charts distributed over radiofacsimile by NMC and NMF, the **5640**-meter height contour is enhanced in bold. Some basic rules of thumb used by marine meteorologists concerning the **5640** contour and 500 mb wind maxima are as follows:

— In wintertime the 5640 contour is an excellent indication of the southern extent of surface winds of force 7 westerlies or greater. In summer the 5640 height contour is more representative of force 6 surface westerlies.

— The surface storm track is usually 300 to 600 nautical miles north and parallel to the 5640 height contour.

— Fronts (cold fronts, in particular) and surface storm centers move at approximately ⅓ to ½ the 500-mb wind speed.

— The surface wind speed, especially in the west to

southwest quadrant (in the cold air) of a surface low is approximately 50 percent of the 500-mb wind speed.

Long Waves—Short Waves

If you could look at a time lapse movie loop of the 500-mb height contours over the Northern Hemisphere for a year, you would see a westerly circulation undulating northward and southward as what appear to be waves of troughs and ridges pass around the globe. The bigger waves appear to stand still or move slowly for a period of time and then either break down or move westward. When a larger wave moves westward, it is said to retrograde. The smaller waves move quite rapidly from west to east and tend to enhance or flatten as they pass through the larger waves.

The bigger waves are called long waves or long wave troughs and have a wavelength between 50 to 120 degrees of longitude and number from approximately three to seven around the Northern Hemisphere. These waves are responsible for the overall weather pattern or storm track. For example, prolonged drought or excessive storminess over an area is a result of the long wave pattern.

The long wave pattern tends not to fluctuate significantly for a period of 10 days or more. It can be difficult to pick out the long waves on the mercator projection charts distributed on radiofacsimile over NMF and NMC. This is due in part to the type of projection and extent of the area covered by these charts. A hemispheric chart projection of the mean 500-mb pattern for a period of several days is more useful for this purpose.

The smaller wave troughs that travel rapidly in the westerly flow are called short wave troughs or simply short waves. Short waves are associated directly with specific low pressure systems. They tend to have a life cycle of less than a week and rotate through the longer wave troughs. Their size tends to be on the order of 1000 to 2500 kilometers in scale.

The long waves and short waves interact like wind waves and swell. When in phase, a wind wave tends to enhance the swell making a significantly higher amplitude wave. When out of phase, the wind wave will tend to dampen or flatten the swell. Similar interactions occur in the atmosphere. When in phase, short waves help to enhance the longer wave pattern and are themselves enhanced or gain amplitude (this results in stronger surface lows). When out of phase, the short waves can dampen the long wave pattern and in turn their amplitude can be reduced (flattened).

Short Waves and Surface Lows

Let's take a look at the 500-mb and surface pressure patterns associated with a developing Atlantic low pressure system in the fall of 1994. The four panels 24 hours apart (Figure 2) show the development of a short wave trough (dashed line) and surface cyclone as they move off North America in strong west to east or zonal flow. The low then strengthens to a storm over the central North Atlantic.

In the first frame the 500-mb short wave trough is still west of the Great Lakes with the 1004-mb surface low over southeastern Ontario. For the development of a mid-latitude low pressure system, it is necessary for the short wave trough axis in the vertical to tilt back toward cold air (lower heights) with height. A typical distance is a quarter wavelength separation between the surface low and 500-mb trough at the early stages of development. You can see that the surface low is approximately half way between the 500-mb trough axis and the 500-mb ridge over eastern Canada— a quarter wavelength.

Twenty-four hours later, the short wave trough is over the Canadian Maritimes with a 996-mb surface low just crossing the coast of Newfoundland. The 500-mb short wave has flattened as it crosses over the top of the ridge to the south. The surface low has deepened 8 mb over the past 24 hours and the distance between the 500-mb trough axis and surface low has closed by about half the original distance. To indicate that this low is expected to deepen explosively over the next 24 hours, the forecaster has written the word "bomb" along the expected track of the low. In the future the Marine Forecast Branch will refer to lows deepening 24 mb in 24 hours as "rapidly intensifying" as opposed to "bombs."

In the third panel explosive deepening has indeed taken place. The surface low has deepened 26 mb over the past 24 hours. The 500-mb short wave trough has amplified (become more U or V shaped or extended north to south). We no longer have just a 500-mb trough but now have a 5167-meter low center just to the west of the surface low. The upper-level low is beginning to "close off" meaning height contours are beginning to encircle the low at 500 mb. The closing off of the 500-mb low indicates the closed circulation has grown with height from the surface to 500 mb. Closing off is a good indication that the surface low is beginning to slow. There is still some tilt of the trough to the west suggesting that the surface low will still deepen a little more.

In the last frame the surface low and 500-mb low are vertically stacked with little or no tilt of the upper-level trough. This indicates that the atmospheric column has become more homogeneous in tempera-

ture and moisture content. The surface low has matured (968 mb at 1200Z) and is beginning to fill or weaken. A well defined closed circulation now extends to greater than 500 mb.

In this sequence we have seen three stages in the life cycle of a short wave trough. First is the developing phase where the 500-mb short wave trough lags behind the surface low and amplifies with time. The tilt of the trough axis in the vertical decreases with time and the surface low deepens. The second or closing off phase is shown in panel C as height contours begin to encircle the newly formed 500-mb low and close off the vortex. The circulation has become closed from the surface to 500 mb and the surface low slows its forward motion. In the mature phase, the 500-mb low is vertically stacked above the surface low. There is no more deepening and the cyclone begins to fill.

To summarize, this low pressure system in 72 hours moved from the Great Lakes to 20°W and deepened 36 mb. The rapid speed of motion was a direct result of the 500-mb flow being west to east or zonal.

Behavior of Short Wave Troughs

Let's follow the 500-mb wind maxima through the life of two short wave troughs as they interact. The 500-mb and surface analyses for every 12 hours from 1200Z October 12 to 0000Z October 15, 1994 are shown for this mid Pacific development in Figure 3.

At 12Z October 12, a benign looking 1010-mb low can be seen at 33°N, 176°E with a weak short wave 500-mb trough at approximately 172°E (there is some tilt with height, so further deepening is expected). Upstream, south of Kamchatka, is a moderate northwest flow to 65 knots and a fairly flat short wave trough (second dashed line) along 163°E. However, energy at 500 mb is poised to dig southeastward from the second short wave toward the 1010-mb low. Without the 500-mb chart one would not expect much in the way of deepening of this surface low.

By 00Z October 13, the two short waves have begun to phase as indicated by the two dashed lines beginning to line up and have amplified over past 12 hours (become more V or U shaped). There is also some short wave ridging (upside down U curvature of the height contours) to the east as indicated by the zigzag line. The surface low has deepened 10 mb—nearly 1 mb per hour during the past 12 hours.

Twelve hours later the surface low has deepened another 15 mb to 985 mb and the pressure gradient has dramatically tightened in the northwest quadrant of the low. Storm force winds should be expected in this region. At 500 mb the wind maxima has now spread to the east of the trough. An 80-knot maxima exists in the northwest flow along 40°N. The trough axes are lined up as the two short waves are now phased.

At 00Z October 14, the open trough at 500 mb has closed off a 5436-meter low— a circulation now extends up to 500 mb. The 500-mb wind maxima continues to grow to the east of the storm as the low moves slowly northeastward. The low is now vertically stacked and has nearly completed its deepening. One ship observed a 50-knot northeast wind north of the storm system.

By 12Z October 14, although the 500-mb low is at 5416 meters, the closed contours have opened up. The 500-mb low is lifting northeastward while the surface low is elongated toward the northeast as indicated by a second low shown near the intersection of the warm and cold fronts. The wind maxima at 500 mb is evenly distributed east and west of the 500-mb trough but is growing on the east side, so the 500-mb low is beginning to open up and lift out. Twelve hours later the 500-mb low has opened up and dissipated. The 500-mb wind maxima to the west of the system is gone and the bulk of the wind energy is now east of the northeastward-pointing short wave trough axis. The surface low is elongating northeastward— the direction the toward which the strongest 500-mb winds are blowing.

In review, the greatest deepening in the surface low took place during the first three time periods as the two 500-mb short wave troughs phase, and the strong wind maxima begins to extend around the base of the 500-mb short wave trough. The cyclone is vertically stacked at 00Z October 14 with the closed 500-mb low right over the surface low and wind maxima continuing to strengthen east of the 500-mb trough axis. Little or no deepening should be expected after this point. In the final two frames, we see the wind maxima weaken west of the system and strengthen to the east of the 500-mb trough axis, the closed 500-mb low opens up to a trough and the surface low begins to weaken and elongate northeastward. This sequence is fairly typical for the formation of a low and evolution of the 500-mb trough and associated wind maxima.

500 Millibar Patterns

Now that we have gone over the behavior of 500-mb short wave troughs and surface cyclones, let's take a look at some typical 500-mb flow patterns.

Zonal Pattern

Rapid west to east flow where the 500-mb

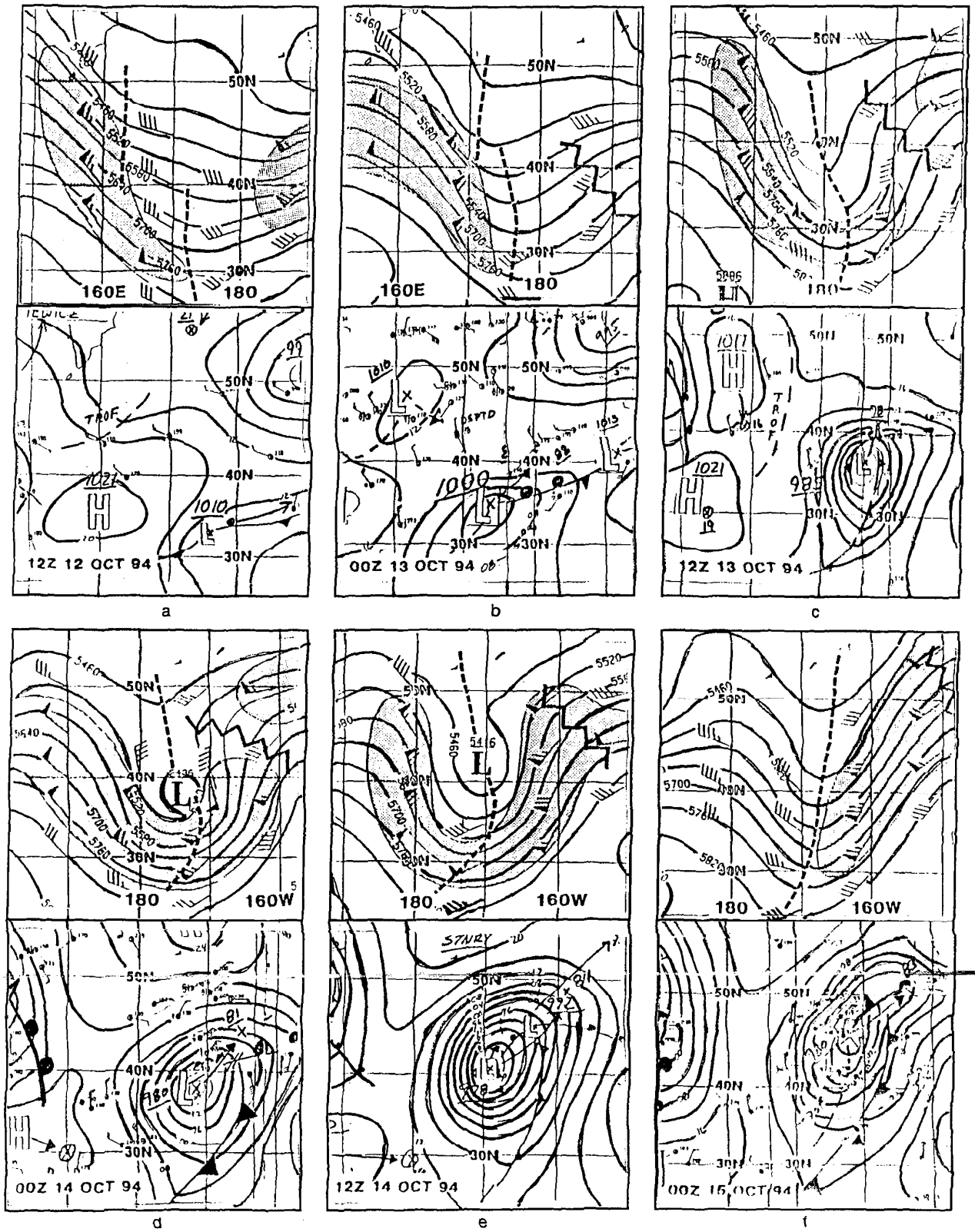


Figure 3. Six panel diagram showing 500-mb and surface pressure analyses for: (a) 1200Z October 12, (b) 0000Z October 13, (c) 1200Z October 13, (d) 0000Z October 14, (e) 1200Z October 14, and (f) 0000Z October 15, 1994.

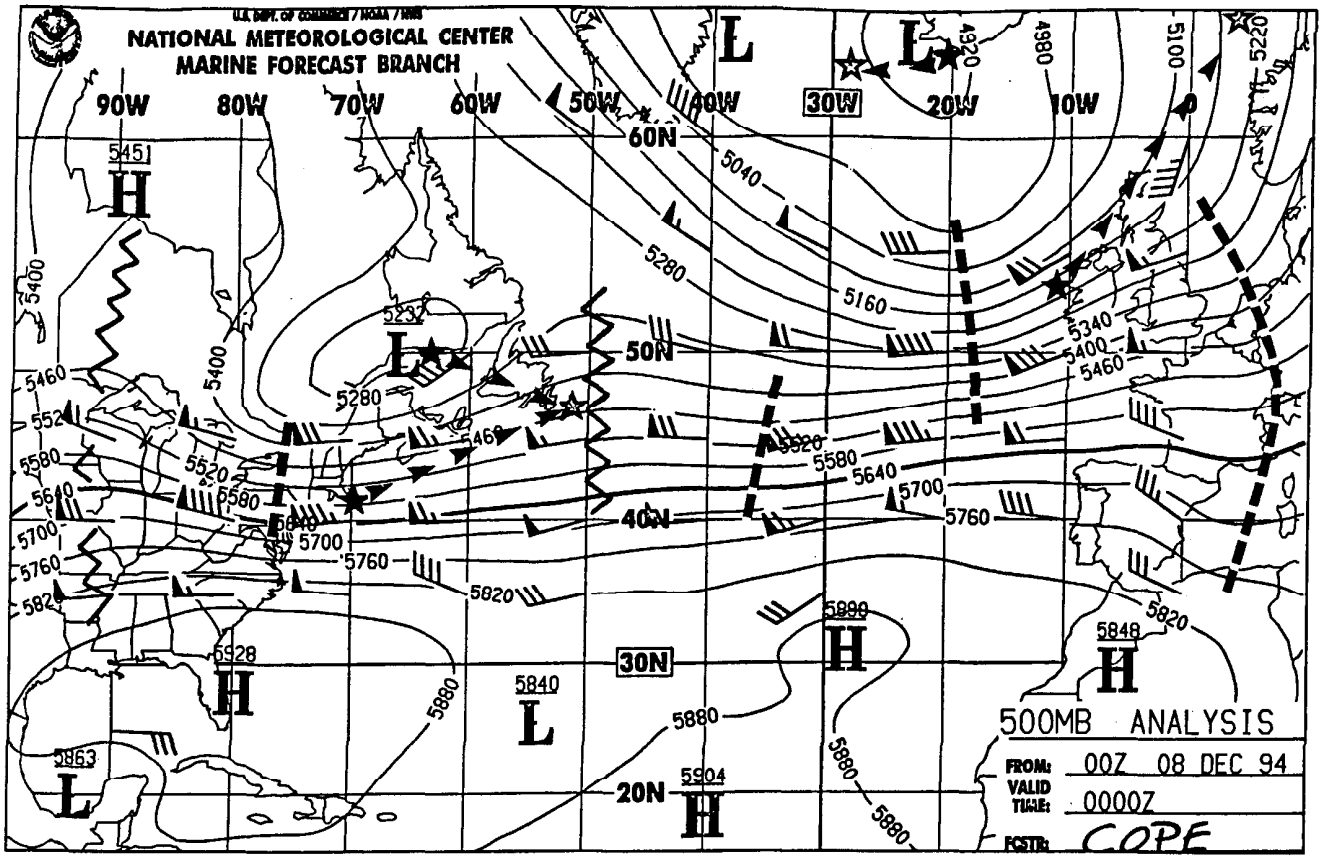


Figure 4. 500 mb analysis for the North Atlantic for 0000Z December 08, 1994 showing a zonal pattern. Short wave troughs and ridges are indicated with dashed and zigzag lines, respectively. Positions and tracks for surface lows are as indicated in figure. 1.

height contours are aligned west to east is called zonal flow (see Figure 4). Any short waves embedded in zonal flow tend to move rapidly from west to east. It is not unusual to see surface lows or fronts move 35 to 50 knots. A good rule of thumb: **a low or front embedded in zonal flow in winter will move, on average, between 30 to 50 percent of the 500-mb wind speed.**

In Figure 4 westerly flow at 500 mb extends from central North America across the Atlantic to western Europe with a 90-knot maxima over Ohio and near 50°N, 20°W. Fronts embedded in these areas may move as rapidly as 40 to 45 knots. Positions of surface lows are indicated with a filled-in star; 24-hour forecast positions valid at 0000Z December 09 are indicated by an open star with the 24-hour low track shown by arrowheads.

Zonal flow patterns tend to be unstable and short-lived. They often break down into a more amplified pattern fairly rapidly. When a transition from a zonal to a more amplified or meridional pattern is taking place, a strong surface storm will usually develop. The 500-mb chart shown in Figure 4 is 2½ days earlier than the more amplified pattern shown in Figure 1. The surface low center off the New England coast in Figure 4 moved east northeastward at nearly 30 knots to southeast of Newfoundland where it merged with an older low (nearly vertically stacked) located over the Gulf of St. Lawrence. The resultant low strengthened rapidly to 975 mb by 0000Z December 09 and the 500-mb pattern was amplified.

Another low embedded in strong 500-mb southwesterlies off Ireland, moved northeastward at 35 knots across Scotland to the Norwegian Sea. A third low nearly vertically stacked under the closed 4891-meter 500-mb low off Iceland drifted west towards 30°W.

Notice two distinct ribbons or streams of flow. The dominant flow is west to east from North America to Europe. The second stream drops southeastward from Greenland and merges just west of Europe with the more southerly stream. Merging streams create areas of constricted height contours, generating higher 500-mb wind speeds and strong temperature differences below 500 mb (strong fronts). Think of this as the northern stream supplying very cold air and southern stream supplying relatively moderate warm air and moisture. It is not unusual to see as many as three streams at 500 mb.

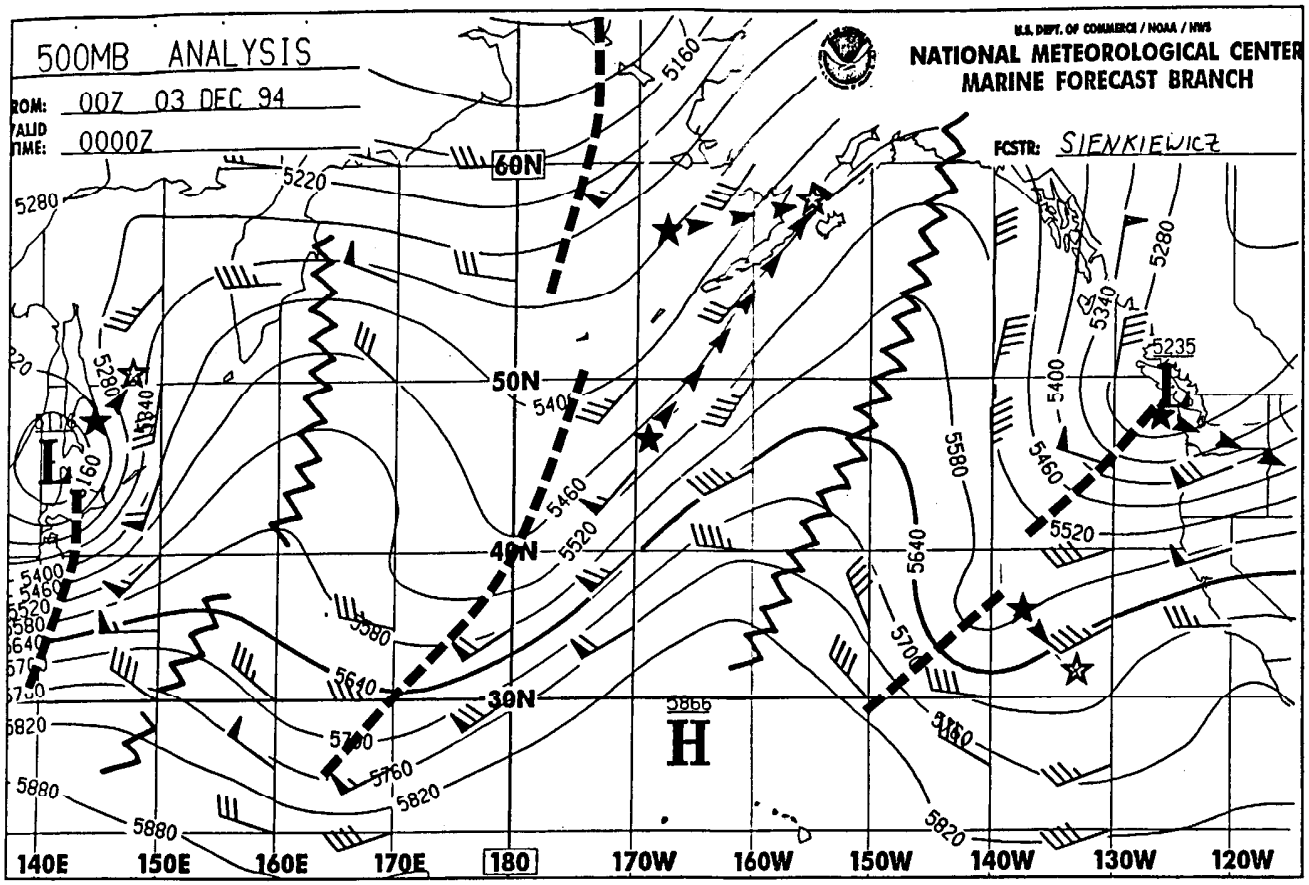


Figure 5. The observed 500-mb chart is for the North Pacific at 0000Z December 03, 1994 and shows a meridional pattern. Meridional patterns tend to move cold air south and warm air north.

Meridional Pattern

In a meridional pattern the contours have more amplitude (north-south orientation) than in a zonal flow (see the example from the North Pacific in Figure 5). Meridional patterns tend to move cold air south and warm air north. Surface lows and 500-mb short waves will move more toward the north or south than in a zonal pattern (along a meridian). Look at the 24-hour tracks in this example. The surface low at 47°N, 169°W moved northeastward at 30 knots to just off Kodiak Island. The low and short wave trough west of California moved southeastward. The surface low, associated with a closed low north of Japan, moved slowly northeastward. A large ridge extends from Alaska to west of Hawaii and northerly flow east of the ridge brings cold air southward from interior British Columbia and Northwest Territories out over the waters west of the Pacific Northwest. Southwesterly flow is moving warm moist air from south of 30°N near 170°E northeasterly toward Alaska.

The concept of different streams can easily be seen on this chart. East of Japan the northern stream weakens as it moves over a ridge along 160°E. The southern stream is stronger west of 170°W and less amplified than the northern stream. Farther east the northern stream is stronger in the northerly flow east of 140°W with a weaker southern stream trough near 35°N, 140°W.

The stream concept is important because the interaction between short waves embedded in different streams and in particular where the short waves phase together are areas for potentially significant surface low development.

Remember that the 500-mb field is in motion. Therefore, it is a good idea to look at the 500-mb forecasts to see how the pattern is expected to evolve. It is not unusual to have a progressive meridional pattern where short wave troughs and ridges, although they are amplified, continue their eastward progression. In the fall of 1994, both the Atlantic and Pacific had strong, progressive meridional patterns.

Blocking Pattern

A high amplitude ridge that blocks the west to east progression of the westerlies is aptly named a

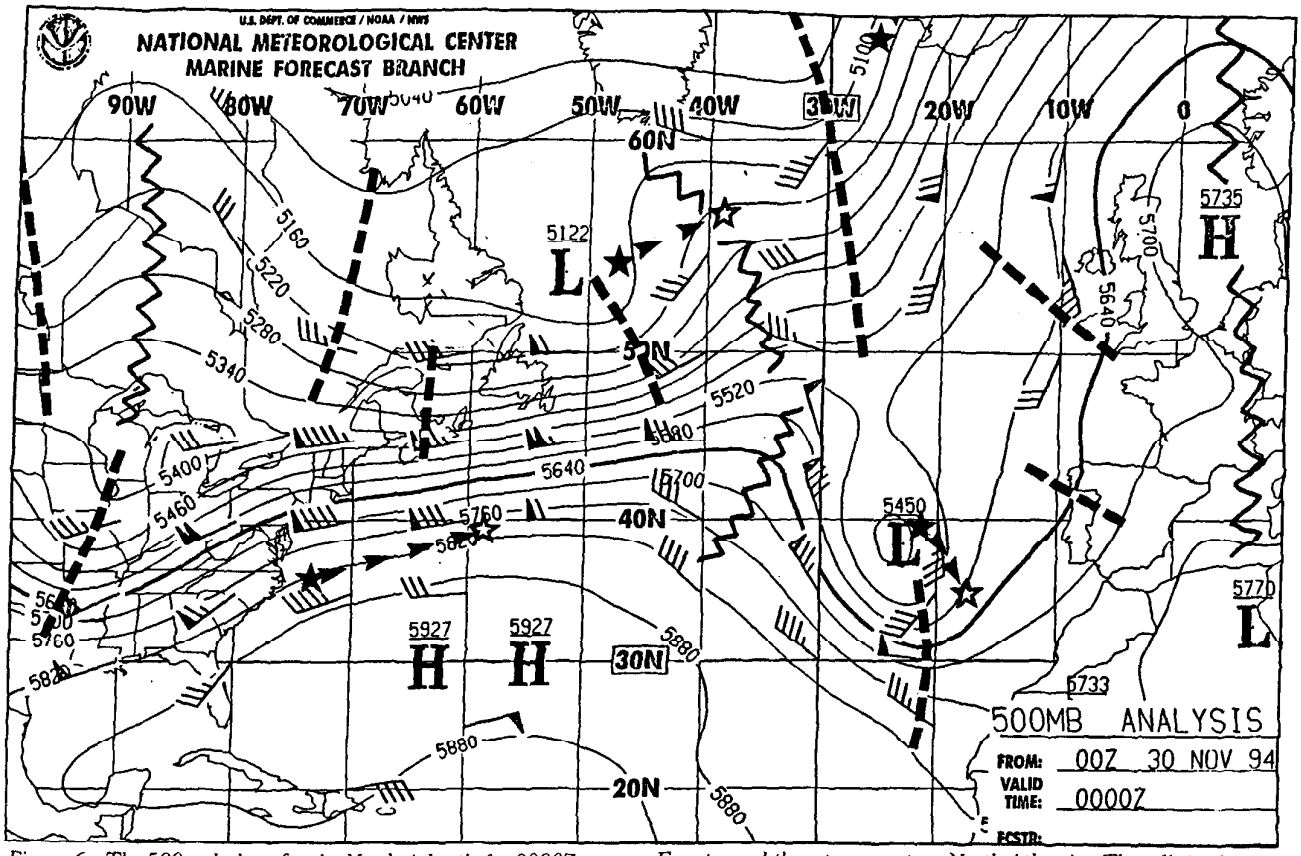


Figure 6. The 500-mb chart for the North Atlantic for 0000Z November 30, 1994. This chart shows a blocking pattern over Europe and the extreme eastern North Atlantic. The split in the westerlies can be seen at 50°N, 25°W.

blocking ridge. Figure 6 shows a blocking pattern with a large ridge blocking the westerlies over western Europe and the eastern North Atlantic.

In a blocking pattern, short waves will be steered northward or northeastward over the blocking ridge. If the amplitude of the ridge is large enough, then short wave troughs approaching from the west may try to undercut or drive under the block. This undercutting helps to set up a split in the westerly flow to the west of the blocking ridge and eventually helps to break down the block.

In Figure 6 the split in the westerlies can easily be seen near 50°N, 25°W. The 5450-meter closed low near 38°N, 24°W is a result of the westerlies trying to undercut the blocking ridge. Due to the strength of the northwest flow to the west and northwest of the 500-mb low, the low is said to be "digging" to the southeast. Thus the surface low and 500 mb both move southeastward.

Closed lows that form to the west of a blocking ridge and dig southeastward tend to be fairly strong and it is not unusual to have surface winds at 45 to 50 knots to the west and southwest of the surface low.

Two lows near Iceland and south of Greenland are moving northeastward and north northeastward due to the blocking ridge to the east. Blocks may last 10 days or more.

Cutoff Lows

If a 500-mb pattern becomes amplified enough then it is possible for a low to form on the southern boundary of the westerlies and become "cutoff" as shown in Figure 7. The closed circulations associated with the lows over eastern Kansas, the mid Atlantic (40°N, 45°W) and Spain are cutoff from the main stream of zonal westerlies north of 55°N. Weak ridging separates the higher latitude westerlies from the three cutoffs. Cutoffs tend to remain stationary and persist for several days. They may be accompanied at the surface by strong winds (in particular, in the north to northwest flow to the west of the developing low), showers, and thunderstorms. Also, it is not unusual to have strong easterlies to the north and northeast of the center due to the strong pressure gradient between the cutoff and strong surface high to the northeast or east. Cutoffs either gradually weaken or are picked up by the higher latitude westerly flow when the pattern amplifies again and the capping

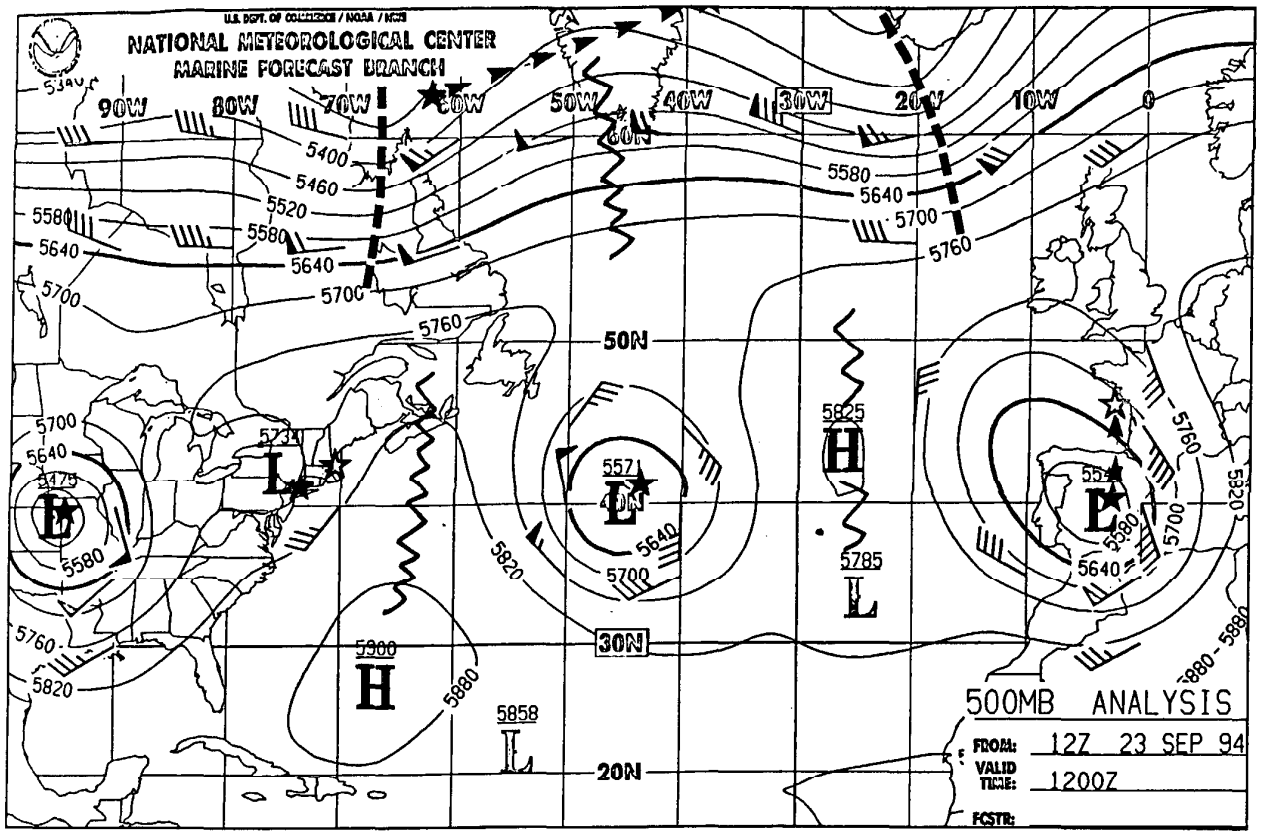


Figure 7. This 500-mb analysis for the North Atlantic at 1200Z September 23, 1994 shows three cutoff lows. These systems play a significant role in any surface features beneath them. Cutoff lows tend to persist and remain stationary for several days. They are often accompanied by strong surface winds to the west of developing surface lows.

ridge breaks down. They tend to occur most in the spring and fall when the westerlies migrate north and south, respectively.

These are just samples of several basic 500-mb patterns. At any given time a variety or combination of patterns may exist over an ocean basin. It is not unusual in the Pacific to have strong zonal flow over the western Pacific with a meridional or even a blocking pattern over the eastern Pacific.

Derivation of the 500-mb Height Field

You might wonder how the 500-mb height field is determined over the oceans. Globally, each day at 0000 and 1200Z over the continents, at selected island sites, and on several specially equipped merchant ships, weather balloons are launched to sample the vertical structure of the atmosphere. One of the mandatory levels at which the height, wind, temperature, and humidity data are measured is the 500-mb level. Although balloon data is scarce over the oceans, ship surface weather observations, commercial aircraft reports at jet stream level and satellite derived moisture profiles and wind estimates are all combined and quality-controlled to help determine the initial state or three dimensional structure of the atmosphere over the oceans. In addition, 6-hour forecasts from the operational computer forecast models are used as a first estimate as to the initial state of the atmosphere. Think of all the global observations being used to tweak the previous computer model forecasts in the right direction, which makes for relatively consistent model forecasts. Note that your ship observations have an impact in determining the three dimensional structure of the atmosphere.

The highly sophisticated operational forecast computer models that simulate the atmosphere are then run using the analysis determined from a combination of the observed data and previous model forecasts. The 500-mb height fields from the analysis process and 48- and 96-hour forecasts from the NMC Global Spectral Model are transmitted via radiofacsimile. Studies have shown that 500-mb forecasts tend to be more accurate than surface pressure forecasts.

The Bottom Line

One way to use the 500-mb charts is to set up

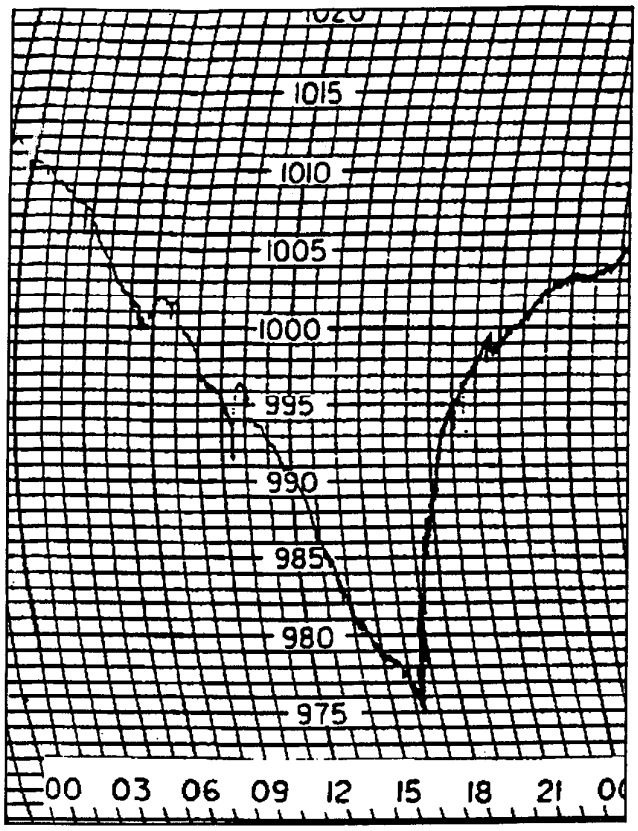


*Figure 8. Barograph trace from **President Washington** enroute from Oakland, CA to Guam for October 13, 1994. Its pressure was 10 mb lower than was analyzed on the 12Z chart.*

a display of both surface and 500-mb analyses along with the 48- and 96-hour forecasts in the chartroom or on the bridge.

You may want to outline the wind maxima associated with each trough expected to affect you and gain experience that way. Is the wind maximum to the west, evenly distributed or to the east of the short wave trough? In other words will the trough dig, lift out, or just stay steady state in the overall flow? Take a look at the previous forecasts. Are there any big changes from the earlier series of surface and 500-mb analyses and forecasts to the current series?

Remember that the 500-mb pattern and specific short waves are linked and associated with the motion and life cycle of surface storm systems. Look at the progression of the 500-mb pattern from analysis time to 48 hours to 96 hours. Is the pattern becoming more meridional, zonal, or blocked over the next 4 days? Next look at specific short waves and associated surface features that will be affecting you over the next several days. Think of the examples in the article. You may want to mark the position of surface lows on the 500-mb chart to see how the surface low relates to the 500-mb short wave trough (does the trough tilt with height or is the system vertically stacked).

The bottom line is that through some experience on your own and with knowledge gained through this article and elsewhere you can begin to see through repetition how the 500-mb pattern and surface pressure fields are linked. Also, pattern recognition will give you a better idea as to how and why storm systems develop and move the way they do. Talking to Port Meteorological Officers, Marine Forecasters and taking courses at schools like MITAGS all help you to gain experience in using the 500-mb chart.

A yacht delivery captain was visiting the Marine Forecast Branch at NMC on the afternoon of October 12th, 1994. He was shown a 3-day loop on a computer workstation of the surface pressure and wind forecasts in 6-hour increments of the development of the storm shown in Figure 3. He was amazed that in 24 hours (by 12Z on the 13th) storm conditions were forecast to develop so rapidly out of what looked like a benign low. He was then shown the 500-mb height field forecasts for the same period. As we reviewed each forecast time step, it was explained that at 500 mb you could see the ingredients for rapid development (strong northwest flow at 500 mb, phasing of two short waves, and sharp rapid amplification of the 500-mb short wave) before you could see them at the surface. The development of the storm was no surprise, however, even the computer model forecast was too slow at deepening the storm system.

American President Lines' ***President Washington*** went through the center of this low at approximately 1630Z on October 13. Its barograph trace (Figure 8) showed a central pressure of 975 mb with an extreme pressure rise to the west of the storm center. The 975-mb central pressure was 10 mb deeper than the 985 mb indicated on the 12Z October 13 analysis. The ***President Washington*** also experienced 55-knot winds to the west of the occluded front shown at 12Z October 13. While 500-mb analyses and forecasts don't always provide the answer, a much clearer picture of the surface weather conditions is presented with a knowledge of conditions at both levels.

No matter how you receive weather information a basic understanding of 500-mb patterns and relationships to the surface pressure field will help you make more educated decisions for a safe and economical transit.

Hurricane Avoidance Using the "34-Knot Wind Radius" and "1-2-3" Rules

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The Maritime Institute of Technology and Graduate Studies (MITAGS) offers both two- and five-day Coast Guard approved weather courses which meet International Maritime Organization Standards of Training and Conduct for Watchkeepers (STCW) requirements.

It is no secret that a hurricane (or typhoon) is a very powerful and dangerous weather system. A fully developed category 5 hurricane (on the Saffir-Simpson Hurricane Scale), the highest classification a hurricane can attain, will have winds in excess of 135 knots and will control over one million cubic miles of atmosphere.

Hurricanes can also create waves over 50 feet high in the open ocean. Further, the low pressure at the center of one of these hurricanes can cause the ocean's surface to rise and produce a coastal surge that can be 20 feet or more above the normal high water mark. While it is hard to grasp the power of a typical hurricane, if the energy from one were converted to electricity, it could supply the United States power demand for six months.

Although the subject of how hurricanes form is complex there are some general constants. All hurricanes originate near the equator and sustain themselves by capturing and condensing the warm moist air that is present at these latitudes. A hurricane begins to form when there is a buildup of equatorial heat and this heat is unable to move away to the earth's polar regions quickly enough to keep the earth's atmosphere in balance.

Because a hurricane expedites removal of heat from equatorial regions to cooler polar areas it is similar to a circuit breaker in an electrical system or a relief valve on a radiator. It quickly transfers heat from hot equatorial regions to cool polar areas. Hurricanes are so good at removing heat that water temperatures behind a hurricane are often reduced several degrees.

Avoidance is an essential ship routing tactic in dealing with hurricanes and, though recognized limits do exist in both hurricane track and intensity forecasting, there are two reliable rules that should be used by mariners. These are the "34-knot wind radius" and the "1-2-3" rules.

Continued on Page 5

Hurricane Avoidance
Continued from Page 4

Thirty-Four-Knot Wind Radius Rule

The 34-knot wind radius rule states that ships should stay outside the area of a hurricane where winds of 34 knots or greater are analyzed or predicted. Often this area is not symmetrical around a hurricane, varying within semi-circles or quadrants.

Thirty-four knots is chosen as the critical wind speed because as wind speed doubles its generated force increases by a factor of four (see side bar on wind force), and when 34 knots is reached, sea state development significantly limits ship maneuverability. When ship maneuverability is limited, then course options are also significantly reduced.

Hurricane advisory messages produced by the National Weather Service, National Hurricane Center provide 34-knot wind radius analysis and forecast. For example; advisory #30 for Hurricane Bonnie, produced on August 26, 1998, provided the following information on location of 34-knot winds:

0900Z Wed 26 Aug 1999:
34 knot winds.....200NE 150SE 125SW 150NW
(Thirty-four knot winds found out to 200 miles from center in NE quadrant, 150 miles of center in SE quadrant, 125 miles of center in SW quadrant, and 150 miles of center in NW quadrant.)

Forecast for 27 Aug 1999:
34 knot winds.....200NE 150SE 50SW 75NW

Using this information, a chart can be constructed showing the area to be avoided, and this area should be compared with National Weather Service, Marine prediction Center sea-state and wind-wave analysis and forecasts. Subsequent forecasts should be used to validate and update conditions, which are then used to update a ship's route.

The 1-2-3 Rule: Constructing an Area to be Avoided Around a Tropical Cyclone's Track

The 1-2-3 rule states that track error forecasting for a hurricane is 100 miles either side of a predicted track for each 24-hour forecast period. Thus, for a 24-hour period, an error of 100 miles (1 day x 100 miles) to the left or right of an official predicted track is applicable. For 48 hours the error is 200 miles (2 x 100), and for 72 hours the error is 300 miles (3 x 100).

Averaging errors in track deviation from predicted path for the period 1988-1997 substantiates this rule of thumb:

Forecast Interval (Hours)	Avg. Error (nm) (left & right of track) Atlantic Ocean	Avg. Error (nm) (left & right of track) Pacific Ocean
24	88	71
48	166	137
72	248	195

Therefore, when a hurricane's track is plotted, a 100-mile error for each 24-hour period must be applied and a vessel within this adjusted area must take action as if a hurricane were bearing directly toward them, which may become the case.

Combining both the "34-knot wind radius" and "1-2-3" rules allows calculation of the **area to avoid** when a hurricane- or a hurricane-force mid-latitude low

Continued on Page 6

Wind Force

Force per square foot experienced when wind is blowing perpendicular to a surface is calculated using this formula:

$$F = 0.004V(\text{squared})$$

F = wind force measured in pounds per square inch
V = wind velocity in knots

Wind Speed	Force (lbs./square foot)
10	0.4
15	0.9
20	1.6
25	2.5
30	3.6
34	4.6

Source: U.S. Navy Sailors Handbook

Hurricane Avoidance

Continued from Page 5

pressure system is detected. An example of this technique is diagramed in Figure 1. Mariners transiting hurricane- and typhoon-prone regions who make use of these two well-proven techniques will reduce risk to life, cargo, and vessel damage.

Author Biographies

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George Burkley is a 1989 graduate of the California Maritime Academy and has served as a merchant ships officer and an aviator in the U.S. Naval reserve. He currently is the Marine Science Department Head at MITAGS, instructing in radar/ARPA, electronic navigation, and heavy Weather Avoidance.

Lee Chesneau is a senior marine forecaster with the NWS's Marine Prediction Center, Camp Springs, Maryland. He is the Outreach Coordinator and liaison to the Maritime Institute of Technology Conference and Training Center in Linthicum Heights, Maryland, commonly known in the maritime industry as MITAGS. He co-instructs two-day marine Weather Safety Seminars jointly with Navigator Publishing and MITAGS, as well as the five-day Heavy Weather Avoidance courses at MITAGS.

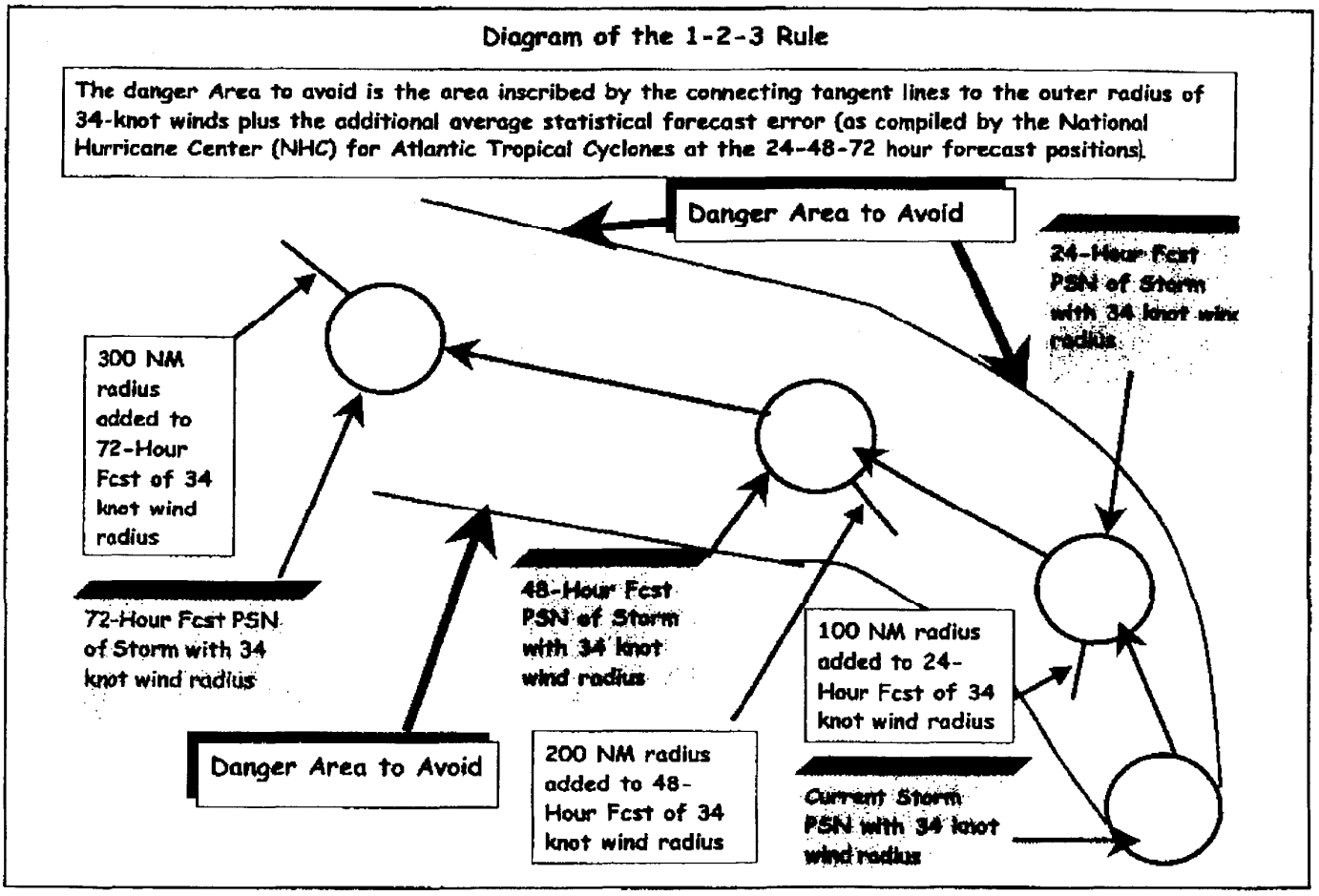

Figure 1. Diagram of the 1-2-3 rule.

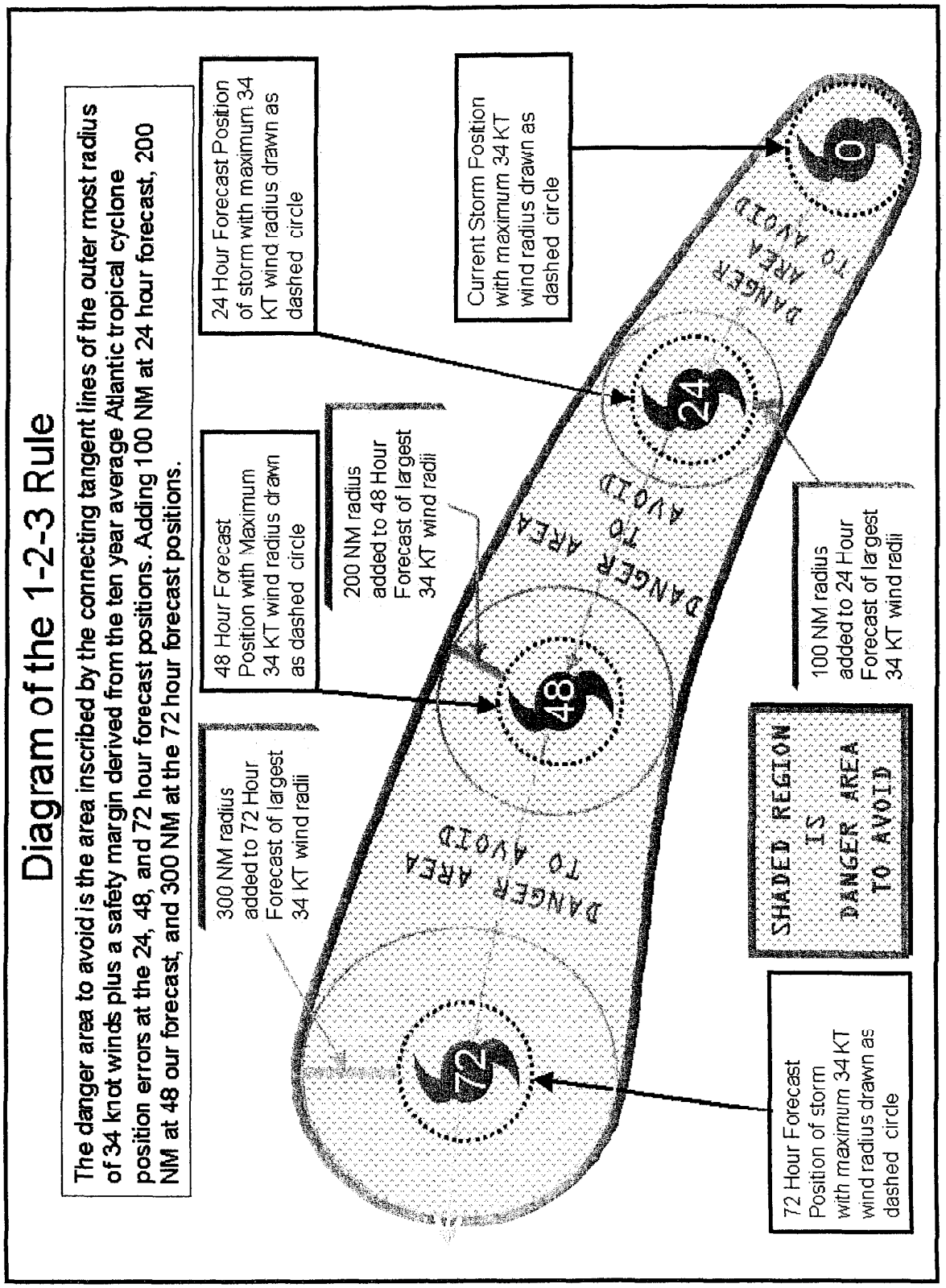

FIGURE 29: Diagram of the 1-2-3 Rule used to construct the MINIMUM DANGER AREA TO AVOID in attempting to navigate around tropical cyclones in the North Atlantic Basin.

Hurricane Avoidance Afloat

1. **Early warning that a hurricane is approaching:**

   a. Swell (several days warning)
      - increasing = storm getting closer
      - decreasing = storm moving away
      - veering = storm passing to right
      - backing = storm passing to left

   b. Clouds (~1 day warning)
      - Watch where cirrus clouds converge on the horizon:
        - Convergence point veering = storm passing to right
        - Convergence point backing = storm passing to left

   c. Barometer (~12-24 hr warning)
      - Falling = storm getting closer
      - Rising (after falling) = storm moving away

   d. Winds (~ 12 hr warning)
      - Increasing = storm getting closer
      - Decreasing = storm moving away
      - Veering = storm passing to right
      - Backing = storm passing to left

2. **Calculating bearing from ship to storm center:**
   - Add 120 degrees to observed true wind
   - Subtract 360 degrees if necessary

3. **Determining semi-circle:**
   - Gradually veering observations (changing clockwise) – dangerous semi-circle
   - Gradually backing obs (changing counterclockwise) – navigable semi-circle
   - Steady observations, increasing (e.g., wind & swells) – in storm's path

4. **Rules to minimize damage (if in/near a tropical cyclone in the N. Hem):**

   a. Right or dangerous semi-circle:
      Bring wind on starboard bow (045° R), make as much speed as possible

   b. Left or navigable semi-circle:
      Bring wind on starboard quarter (130° R), make as much speed as possible

   c. On storm track, ahead of center:
      Bring wind on the starboard quarter (170° R), make as much speed as possible

   d. On storm track, behind center:
      Steer best riding course that maintains constant or increasing distance from eye

Mariners Tropical Cyclone Risk Analysis Checklist

☐ 1. **Review regional tropical cyclone climatology for area of expected operations.**
- → Look for tropical cyclone track and development tendencies.
- → Locate areas of possible rapid intensification (Gulf Stream, Gulf of Mexico).
- → Consider likely areas for sea room in order to maneuver for avoidance.

☐ 2. **Obtain latest Marine Prediction Center & Tropical Prediction Center analysis/forecast charts; including surface, upper level, & Sea State (wind/wave) charts.**
- → Evaluate evolution of wind/ wave over the forecast period.
- → Look for evolution of synoptic patterns & possible relationship to any tropical cyclone track and intensity changes.
- → Obtain Sea Surface Temperature charts in order to refine location of Gulf Stream & areas with abundant warm water/warm-core ocean eddies.

☐ 3. **Locate & plot tropical (easterly) waves, disturbances, and tropical cyclones.**

☐ 4. **If available, examine current satellite imagery.**

→View relationship and evolution of cloud features and intense convection with respect to any current orpotential tropical cyclone. Note evolution & change of Central Dense Overcast (CDO) associated with any activetropical cyclone as this can sometimes provide a general indication of the extent of 34 KT winds.

☐ 5. **Obtain latest tropical cyclone advisory messages. Plot current/forecast positions of all active/suspected tropical cyclone activity.**

☐ **Ensure vessel will meet requirements of 34 KT rule**

☐ **Calculate and plot for the 1-2-3 rule**
- → Ensure vessel meets MINIMUM requirements of this rule.

☐ **Conduct forecast track comparison of latest 24-hour period (previous 5 advisories).**
- → Evaluate any increase to buffer zone around the tropical cyclone based on forecast track tendencies observed over the last 24 hour forecast period

☐ 6. **Plot completed tropical cyclone danger area to avoid chart.**

☐ 7. **Determine possible courses of action (at least 2) for vessel to take in order to remain clear of the Danger Area To Avoid in the tropical cyclone.**
- → Evaluate courses of action based on:
  1. Current Forecast Track
  2. Historically Possible Forecast Track (even beyond the 72 hour forecast period)
  3. Worse Case Forecast Track
- → Consider impact of changes in wind, wave, & weather conditions and how they may impede movement of vessel in each course of action.
- → Be aware of sea height impacts that dynamic fetch & Gulf Stream Current with opposing winds can have on vessel movement in each course of action.

☐ 8. **Evaluate current/nearby port & hurricane haven locations that may be considered for tropical cyclone avoidance.**
- → Consider tropical cyclone forecast track to haven
- → Evaluate berthing & shelter requirements. Consider berthing availability.
- → Compute time/distance considerations of ship versus tropical cyclone both into port or sortie from port.
- → IF ALREADY IN PORT, MAKE EARLY DETERMINATION TO REMAIN IN PORT OR EVADE AT SEA.

☐ 9. **Calculate Closest Point of Approach (CPA) to tropical cyclone for all courses of action based on latest forecast/advisory.**

☐ 10. **Make decision on course of action to follow and execute. Continue to closely monitor tropical cyclone's progress returning to step 1 of the risk analysis when new meteorological analysis & forecast information becomes available.**

SECTION 3

SHIPHANDLING IN HEAVY WEATHER (INCLUDING HELO OPS)

0630. Maintaining Headway in Heavy Weather - Into Sea

a. **Factors for Consideration.** There are three primary factors to be considered when a ship is heading *Into Sea*:

- **The force of impact of the waves on the bow.**
- **The amount of *Pitching* being experienced.**
- **Whether waves are breaking on board.**

b. **Force of Impact on the Bow.** The force of impact of the waves on the bow is governed by the formula for *Kinetic Energy* (ie *Force* = ½ *Mass* x *Velocity* squared, or KE =$\frac{1}{2}mv^2$). Due to the squared function of *Velocity* in this formula, it follows that even a small speed reduction will greatly reduce the *Force* of impact of the waves on the bow.

c. **Pitching and its Effects.** The amount a ship *Pitches* is mostly governed by its natural *Period of Pitch* compared to the *Period of Encounter*, but other factors such as the *Trim*, the shape of the bows and the lightness (or otherwise) of construction will substantially vary the **effect** of *Pitching* in a particular ship, as follows.

- **Trimmed by the Head.** If a ship heading *Into Sea* is *Trimmed* by the head, it will probably *Pitch* sluggishly and tend to bury its bows in the waves.
- **Trimmed by the Stern.** If a ship heading *Into Sea* is *Trimmed* too much by the stern, its bows will tend to pay off to one side or the other, and it may be difficult to keep it heading into the wind and *Sea*.
- **Shape of the Bow and Slamming.** Ships whose bows are flared will be forced to reduce speed when *Pitching* badly sooner than ships with comparatively straight-sided bows due to '*Slamming*' (pounding). The effect of *Slamming* is unmistakable - there is usually a bang as the ship hits the wave, the ship staggers slightly and then shakes, sometimes quite violently. The movement is not unlike that of a dog shaking a rat.
- **Construction of the Ship and Possibility of Slamming Damage.** Although modern warships are relatively lightly built compared to the armoured ships of a earlier generations, they are designed to be able to proceed through heavy *Seas* at reasonably high speeds. **However, if *Slamming* does occur in a modern warship, the effects can be serious and damage is likely to occur unless action is taken quickly to stop the ship** *Slamming* (eg by slowing down or altering course - see Para 0630d).
- **Waves Breaking on Board.** Waves breaking on board are potentially very dangerous and can cause substantial damage on the upper decks. Weapons and sensors may be adversely affected. See Para 0614a.

d. **Remedies for Pitching.** The shape and construction of the ship cannot be altered by those operating it, but three remedies are available to counter *Pitching* and its effects:

- **Changing Trim.** The effect of *Pitching* can be modified by altering the ship's *Trim*. The best condition for a ship heading *Into Sea* is for it to be *Trimmed* slightly by the stern and lightly laden forward, so that the propellers and rudder are well immersed with the bows having a good reserve of buoyancy.

- **Changing Speed.** Changing speed will alter the *Pitching* of the ship because it changes the *Period of Encounter* (see Paras 0622). **Early action to reduce speed is preferable to suffering damage from *Slamming*.** <u>However, it does not follow that a reduction of speed will always reduce *Pitching*, or that an increase of speed will always increase *Pitching*.</u> The larger ships of a formation are sometimes more uncomfortable and may ship more water than smaller ships after reducing speed; in such circumstances it may be better for the large ships to continue at their original speed and zigzag, so as to maintain the same speed of advance as the remainder of the formation. Care should be taken not to take this idea of higher speed into heavy weather to extremes, which has occasionally occurred in the past. After increasing to a relatively high speed and perhaps being able to 'leap from *Crest* to *Crest* with panache' comfortably for a while, should a large wave come out of sequence, it is likely the ship will bury its bows into the *Trough* with the risk of serious damage as it *Slams* at high speed and takes the unbroken wave 'green' over the bow. **In summary, the speed needed for a comfortable motion will be low enough to avoid the risk of *Slamming* and high enough to make the *Period of Encounter* as different as possible from the ship's natural *Period of Pitch*.**

- **Changing Course.** Altering course to bring the *Seas* on the bow may reduce *Pitching* but the resulting motion may be more uncomfortable and more water may be shipped. However, it may sometimes be necessary to do this in order to prevent the stern being continually lifted out of the water, causing the propellers to race and strain the propeller shafts and bearings.

0631. Maintaining Headway in Heavy Weather - Beam to Sea

a. **Factors for Consideration.** *Rolling* does not always have the dramatic impact of *Pitching* and *Slamming*, but the *Rolling* caused by a *Beam Sea* may be so excessive that personnel have difficulty in keeping on their feet and working efficiently. It can also cause equipment which is in use, or which has been badly secured, to break adrift. To give some perspective to these effects, it should be noted that during an exceptional *Roll* to 41° recorded by an RN warship in the South Atlantic, the entire contents of the main galley servery were deposited high on the adjacent bulkhead; fortunately no one was injured. Ships seldom suffer hull damage through *Rolling*, but *Seas* riding over low decks may cause damage to upper deck fittings and equipment, particularly if the wave breaks on board (see Para 0614a).

b. **Remedies for Rolling.** Alterations of speed will **NOT** affect *Rolling*. The best way to reduce *Rolling* is to alter course and make the *Period of Encounter* as different as possible from the ship's natural *Period of Roll*. *Stabilisers* should also be operated.

0632. Maintaining Headway in Heavy Weather - Stern to Sea

a. **Factors for Consideration.** There are two primary factors to be considered when a ship is heading *Down Sea*:

- **The risk of *'Broaching-To'*.**
- **The risk of being *'Pooped'*.**

In general, if one has to choose the lesser of two evils, being *Pooped* is much less hazardous than *Broaching-To*, but if at all possible, both should be avoided.

b. **Broaching-To.** If the ship's length is **similar** to the wave *Length* and the ship's speed is **similar** to *Wave Speed*, a ship may run for some time on the *Crest* of a wave. If the ship *Pitches* forward onto the downward slope of the wave, the stern lifts and the rudder exerts less control (see Fig 6-6, Position 1). If the wave breaks as the ship moves down its slope, the entire ship will be carried forward by the faster-moving breaking water (see Para 0614a) and the ship will begin to *Surf* down the wave. The forward motion of the water relative to the rudder and propellers reduces steering control still further, causing a *Yaw* to develop which is usually impossible to correct. The bow will then bury itself deep into the *Wave Trough* and the stern will swing round until the ship lies broadside to the waves (see Fig 6-6, Position 2). This is called *'Broaching-To' (or 'Broaching')*. The ship will then roll heavily and if a following wave breaks over it in sequence with the ship's *Roll* to leeward, it may heel further, possibly capsizing and sinking (see Fig 6-6, Position 3).

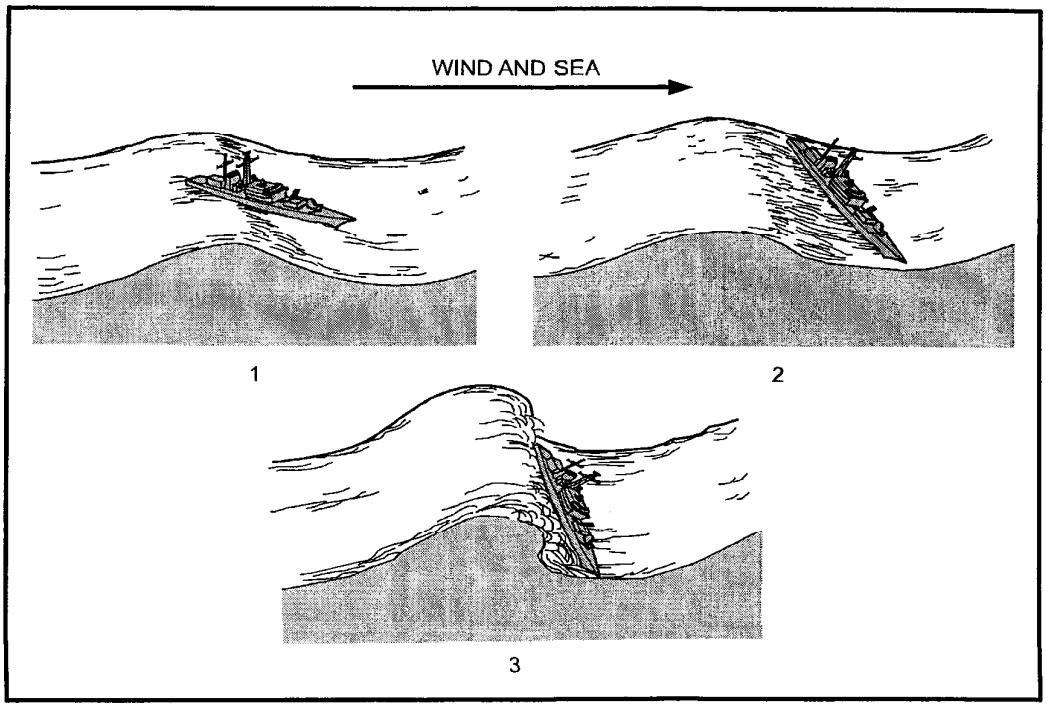

Fig 6-6. Stages in a Ship Broaching-To

(0632) c. **Avoiding Broaching-To.** The following measures should be taken to avoid *Broaching-To*. Once the process of *Broaching-To* starts, it is very difficult to stop it.

- To avoid risk of *Broaching-To*, **ship's speed should not exceed 60% of *Wave Speed.*** This figure is based on proven practical experience, but when used also increases the risk of the ship being *Pooped* (see Para 0632g opposite).
- **The possibility of *Broaching-To* (or being *Pooped)* decreases greatly if the wave *Length* is either much greater or much smaller than that of the ship.** Judging the *Wave Speed* is important; waves of 200 metres or more in *Wave Length* usually have a speed of at least 30 knots and waves of 100 metres travel at under 15 knots.
- Loss of effective steering control while hovering on the *Wave Crest* for a time may indicate that *Broaching-To* is imminent. **If a *Broach-To* starts, the only possible counter-measure is to order "Full Astern Both Engines" and try to pull the ship out of it.** However as the propellers and rudders will be in a severely reduced flow of water, it is unlikely to be very successful.

Example. *With a Wave Speed of 26 knots, a ship whose length approximates to the Wave Length, proceeding at 20 knots (ie 77% of Wave Speed) is likely to Surf on the Crest of wave, experience unstable steering and* ***Broach-To****. The safe speed in this example would be 15½ knots (ie 60% of wave speed), but attracts an increased risk of being* ***Pooped*** (see Para 0632g opposite).

d. **Broaching-To in Shallowing Water.** When running *Down Sea* towards shallowing water, the waves will become higher and steeper, so increasing the danger of *Broaching-To* (or *Pooping,* depending on ship's speed). In an estuary, if there is the risk of *Broaching-To*, there will be the added danger of *Yawing* right out of the navigable channel and running aground. It is not advisable to increase speed to proceed above *Wave Speed* as this may result in losing steering control for a period while ship's and *Waves' Speed* coincide. If unable to avoid the situation, being *Pooped* is preferable to *Broaching-To* and thus ship's speed should not exceed 60% of *Wave Speed.*

e. **Steering.** Steering when running *Down Sea* in heavy weather is always liable to be difficult and allowance must be made for *Yawing* on either side of the intended course. Constant supervision by the OOW is necessary and if steering manually, a reduction in the length of time each helmsman is closed up may be required. Auto-steering will often prove superior to manual steering in these conditions, provided adequate rudder limits are set.

f. **Drogues.** To avoid being blown along at the speed of the waves, very small vessels may stream a *Drogue* aft, to reduce their speed and avoid the risk of *Surfing*. See Paras 0527g and 0634e.

(0632) g. **Pooping.** If the ship's length is **similar** to the wave *Length* and the ship's speed is **slower** than *Wave Speed*, a wave may overtake it and break on the ship (see Fig 6-7, Position 1). The water will then sweep along the upper decks from aft at 1½ times *Wave Speed* (see Para 0614a), normally causing substantial damage (see Fig 6-7, Position 2). This is known as *'Pooping'* (or being *'Pooped')* and if it occurs to RN warships with flight decks aft, damage to the hangar door and aircraft inside is likely to occur, as well as to other parts of the upper deck. A ship may be *Pooped* without having lost steering control. **While still serious, *Pooping* is much less dangerous than *Broaching-To*.**

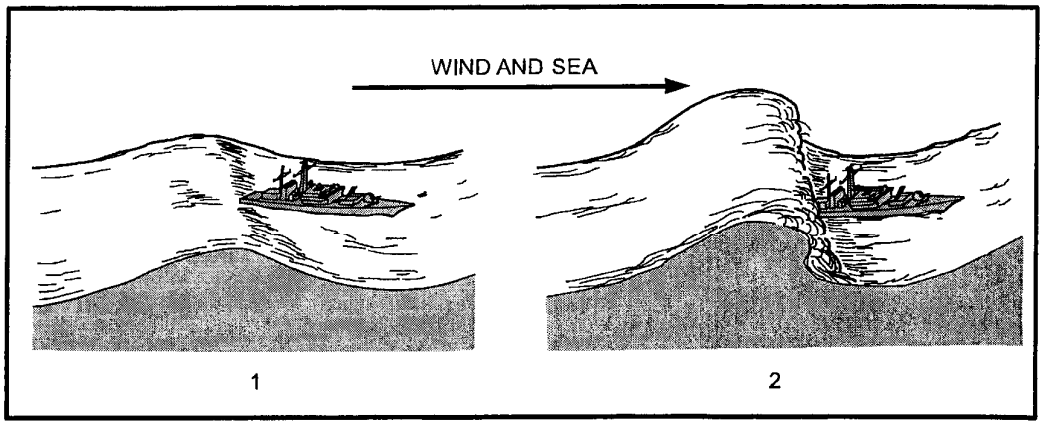

Fig 6-7. Stages in a Ship Being Pooped

h. **Avoiding Pooping.** By slowing down with a following *Sea* in order to avoid the risk of *Broaching-To,* the risk of *Pooping* is unavoidably increased. Unless it is possible to alter course, or even turn *Into Sea*, it may be impossible to avoid being *Pooped.*

- **The possibility of being *Pooped* (or *Broaching-To)* decreases greatly if the wave *Length* is either much greater or much smaller than that of the ship.** Judging the *Wave Speed* is important; waves of 200 metres or more in *Wave Length* usually have a speed of at least 30 knots and waves of 100 metres travel at under 15 knots.
- If proceeding at the recommended speed to avoid risk of *Broaching-To*, (ie ship's speed not exceeding 60% of *Wave Speed*), some reduction in steering control may be experienced as waves overtake the ship. However, any loss of steering control should not be substantial and it should still be possible to control the ship, even while the *Pooping* wave is breaking on board.

i. **Pooping in Shallowing Water.** When running *Down Sea* towards shallowing water, the waves will become higher and steeper, so increasing the danger of being *Pooped* (or *Broaching-To,* depending on ship's speed). **If unable to avoid the situation, being *Pooped* is preferable to *Broaching-To* and thus ship's speed should not exceed 60% of *Wave Speed.*** It should be noted that *Wave Height* is likely to increase in the vicinity of the continental shelf due to the sudden decrease in depth (see Para 0614b).

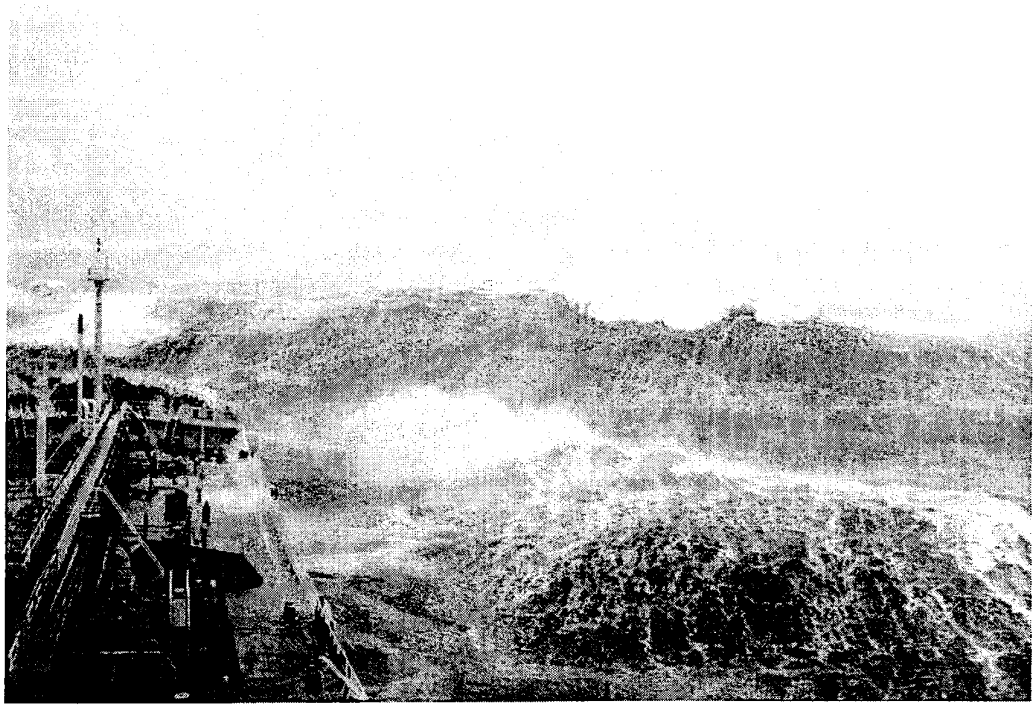

Fig 6-8. North Atlantic in Force 12 Conditions (Ship Suffered Considerable Damage)

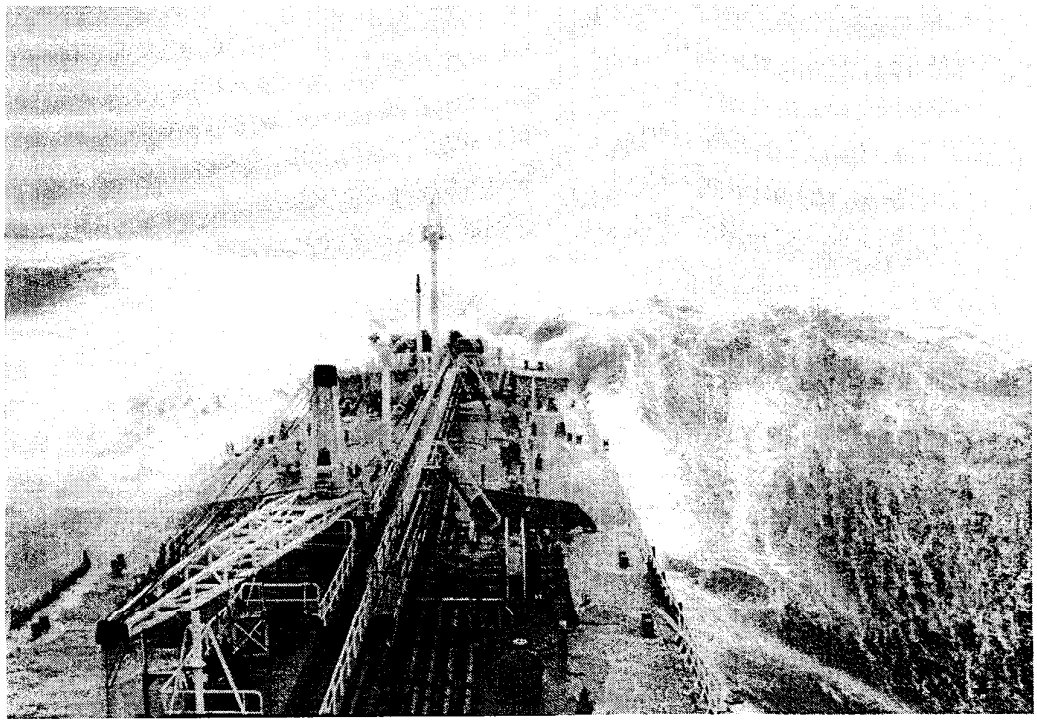

Fig 6-9. North Atlantic in Force 12 Conditions (Ship Suffered Considerable Damage)

0633. Turning the Ship Across the Sea in Heavy Weather

Turning a ship across the *Sea* in heavy weather (from heading *Into Sea* to heading *Down Sea* or vice versa) has been described poetically as *"The greatest act of seamanship in existence"*. There is some truth in this poetic view, as there can be considerable risk in attempting to turn a ship round in heavy weather, and in some circumstances it may not be physically possible to achieve it. In heavy weather, groups of relatively low waves alternate with groups of high ones (see Paras 0613b/c), and in selecting the most suitable moment to start the turn, a good understanding of waves patterns, good seamanship and an element of seaman's instinct is required (see Figs 6-8 /6-9 opposite).

a. **Starting Into Sea - Turning Out of Wind.** When turning OUT of wind and *Sea*, the critical moment will always be half-way through the turn, when the wind is abeam. The ship will then be at its most reluctant to turn further (out of wind), and to maximise the turning power available, this (half-way) stage should occur during one of the calmer periods of waves. The procedure from the start of the turn is as follows:

- Start the turn so that the smallest waves occur **at the half-way point**.
- From a moderate speed *(Into Sea)*, start the turn using full rudder and sharp bursts of ahead power (to create propeller wash over the rudders and so a large *Turning Moment* but without gaining too much headway), possibly combined with reversing the inner propeller to check headway if necessary, thus avoiding *Slamming* into the waves.
- Once the turn is well under way and the risk of *Slamming* directly into a *Head Sea* is no longer a threat, complete the turn as rapidly as possible. To avoid *Stalling* at the half-way point while turning out of wind, use high power on both propellers for a short time. Maintain the turn through the half-way point (ideally during one of the calmer periods -see Para 0613b/c) before steadying on a *Down Sea* heading, reducing power as appropriate.
- If high ahead power is used at the right moment, the heel caused by its use in the turn will tend to counteract the heel caused by wind and *Sea*, and so help to make the ship more stable while turning. In very high Sea States, or if insufficient power is used, or if the wave pattern has been misjudged, the ship may *Roll* heavily at the mid-point of the turn when the *Sea* is on the beam.

b. **Starting Down Sea - Turning Into of Wind.** When turning INTO wind and *Sea*, the ship is unlikely to *Stall* at the half way point. As the turn starts at slow speed, it is best to turn the ship with one of the calmer periods (see Para 0613b/c) at the beginning. The procedure is as follows.

- Reduce to the slowest speed practicable *(Down Sea)*, while avoiding *Pooping*.
- Start the turn so that the smallest waves occur **as the turn starts**.
- Use full rudder for the turn. It should not be difficult to reach the half-way point, still at relatively slow speed. **The ship will *Roll* very heavily.**
- At the half-way point use plenty of ahead power. When the ship answers and the rate of turn increases, reduce power sharply to avoid *Slamming*, while maintaining sufficient power to keep the ship turning into wind.
- Hold the ship steady *Into Sea* at slow speed, *Heaving-To* if required.

0634. Heaving-To and Sea Anchors

a. **Heaving-To: Factors for Consideration.** The weather may become so violent in the open sea that the overriding needs are to avoid damage and keep the ship afloat. The aim of *Heaving-To* is to keep the ship as steady as possible and to prevent *Seas* from breaking on board and so damaging or flooding it. No two situations are alike and the ship's stability, handling qualities, the forecast trend of the weather and the sea room available must be taken into account to decide which is the best method of *Heaving-To* in the prevailing circumstances. The three methods of *Heaving-To* are:

- **Lying with the *Sea* on the bow at minimum speed to keep steerage way.**
- **Lying with the *Sea* on the quarter at slow speed.**
- **Stopping and allowing the ship to drift near the *Eye* of a *Tropical Storm*.**

b. **Heaving-to with the Sea on the Bow.** *Heaving-to* with the *Sea* on the bow may be necessary due to lack of sea room to leeward. The advantages and disadvantages are as follows:

- **Speed.** A speed of anything from 6 to 12 knots rung on will be needed to keep the ship bow-to-wind, but even then, the ship may make little headway and may possibly lose ground to leeward.
- **Motion.** Heavy *Pitching* and *Slamming* may occur, even if the power used is reduced to the minimum to maintain steerage way (see Para 0630).
- **Possible Damage.** The engines are being used to drive the ship against the *Sea* and so the likelihood of damage is increased. There may be a risk of structural damage to the hull in ships with wide-flared bows.
- **Single Propeller Ships**. Due to *Paddlewheel Effect*, RN warships with a single propeller may find it easier to steer with the wind fine on the port bow.

c. **Heaving-to with the Sea on the Quarter.** *Heaving-To* with the *Sea* on the quarter is possible if there is sufficient sea room downwind. The advantages and disadvantages are as follows:

- **Sea Room Downwind.** There must be plenty of sea room to allow the ship to be driven *Down Sea* for a protracted period.
- **Speed.** Speed must be carefully adjusted to avoid *Broaching-To* or being *Pooped* and the steering must be closely supervised (see Para 0632).
- **Motion.** Heavy *Rolling and Pitching* may occur, but *Slamming* is unlikely and motion is likely to be easier than with the *Sea* on the bow, unless *Broaching-To* or *Pooping* occurs.
- **Possible Damage.** Heading *Down Sea* will avoid *Slamming* and possible damage forward that may occur if *Heaving-To* with the *Sea* on the bow. However, if the ship is *Pooped,* damage aft may occur (warships usually have low freeboard at the stern and are not designed to take *Seas* from aft). If it *Broaches-To,* serious damage or loss can occur (see Paras 0632 and 0640e).

d. **Heaving-to by Drifting with Engines Stopped Near the Eye of a Tropical Storm (Tropical Revolving Storm).** It has been argued that *Heaving-To* by drifting with the engines stopped is the only logical method to adopt if a ship is near the centre of a *Tropical Storm* (see Paras 0640 and 0642). This is because the *Sea* is confused and does not come from any particular direction and thus it is impossible to drive the ship either *Into Sea* or *Down Sea*. Using engines in these conditions is at one moment likely to push the ship into a huge wave and possibly drive the focsle under, while at the next moment, the ship may be accelerated down the *Crest* of a wave coming from astern and subsequently *Broach-To*. Well documented cases (see *Note* below) have been reported of ships riding successfully, directly under or near the centres of *Tropical Storms*, with engines stopped. The following factors are relevant:

- **Leeway and Surface Drift.** A ship may be expected to make 2 to 3 knots *Leeway* in gale / storm force winds and it may even reach 5 knots in a *Tropical Storm*. *Surface Drift* may add to this depending on the *Fetch* (see Para 0611) involved (see Para 0625). Plenty of sea room all round is needed, because the wind may change direction as the *Eye* of the *Tropical Storm* passes.
- **Time.** Ships riding out a *Tropical Storm* with engines stopped may have to drift for up to 12 hours and possibly longer.
- **Stability and Watertight Integrity.** Adequate stability and good watertight integrity are essential.
- **Motion.** Heavy *Rolling* and *Pitching* may occur but *Seas* are unlikely to be taken on deck.
- **Damage.** No damage is likely to be sustained.
- **Attitude.** The ship is likely to lie with the wind approximately abeam, with waves approaching from all directions.
- ***Heaving-To* by drifting with the engines stopped is NOT SUITABLE if the wind and *Sea* are from roughly the same direction for prolonged periods. The use of this method should be confined to the area near the *Eye* of a *Tropical Storm*.**

Note. *Documented cases of ships stopping engines near the centre of a Tropical Storm include:*
(1) Freighter of 14,000 tons Displacement during a Hurricane in the Caribbean Sea (pre 1940).
(2) US Destroyer with total power failure during Typhoon in December 1944 (see Para 0640).
(3) USAT PVT GEORGE EF PETERS during Typhoon in July 1949.
(4) USNS SGT JOSEPH E MULLER during Typhoon Ruth in October 1951.

e. **Sea Anchors And Drogues**. Riding to a *Sea Anchor* streamed over the bow can be effective in keeping a vessel into wind and *Into Sea*, and reducing its *Drift Rate* to leeward. *Sea Anchors* giving an effective *Drag* were easy to make in the days of sail, when ships could construct them from their heavy wooden spars and canvas. However, most modern ships would need a very large *Sea Anchor* to be effective and it is unlikely whether one of sufficient size could be constructed with the materials available in RN warships. Nonetheless, it is worth while bearing in mind that streaming a ***Drogue*** aft (see Para 0527g) could at times be of assistance in a small ship (see Paras 0632g-i). This has to be balanced against the risk of a line becoming entangled with a propeller.

0635. Helicopter Operations in Marginal or Heavy Weather

In heavy weather, particularly in FF/DD size ships and below, the aircraft should be secured inside the hangar if possible. However, in certain circumstances it may be necessary to operate aircraft in marginal conditions and/or stow embarked aircraft on the Flight Deck. Apart from all the normal *Pitch / Roll /* wind limits, there are 3 additional key hazards to helicopter operations from marginal and heavy *Sea* conditions: *Tail Rotor Immersion (TRI), Damage on Deck (DOD)* and *Damage on Take-Off or Landing (DOTOL).*

a. **Tail Rotor Immersion (TRI).** *Tail Rotor Immersion (TRI)* occurs when the aircraft's overhanging tail rotor (a standard situation for a Lynx on the spot in a T42) is immersed in the ship's wake. If the aircraft is 'rotors running' this will cause catastrophic damage; if the aircraft is not 'rotors running' some damage is still likely to occur. There are 3 situations when *TRI* is likely to be encountered:

- **At High Speed.** When the ship is at high speed, particularly in shallow water, a *Wake* plume is generated. When this plume is combined with even a moderate *Sea* (Sea State 4) or above, there is a significant danger of *TRI.*
- **In High Short Seas at any Speed.** There is a risk of *TRI* at any speed in high short seas (Sea State 5 or above). In these conditions, a resonant hull response, combined with a set of large waves, can submerge the stern momentarily and damage the tail rotor. This can occur at speeds as low as 2-3 kn.
- **With a Large Following Swell / Sea.** *TRI* can also occur if a large following *Swell / Sea* (usually Sea State 6 or greater) results in part of the stern taking water. In extreme cases this may escalate to *Pooping.* It should be noted that with heavy *Swell* conditions, the wind <u>may</u> be benign.

b. **Damage on Deck.** *Damage on Deck (DOD)* results from medium to heavy spray hitting aircraft rotors when 'rotors running' and through heavier waves impacting on a ranged aircraft. One countermeasure is to make maximum use of sheltered helo spots (Fly 1 and Fly 2 in T42). There are 2 situations when *DOD* is likely to be encountered:

- **Manoeuvring Across the Sea.** When the ship makes a turn which drives the up-sea quarter into the dominant *Sea / Swell,* it results in waves slapping heavily against the weather quarter, creating heavy spray or waves which carry across the Flight Deck. This effect can occur at Sea State 3 or lower if the ship is accelerating into the turn or is at high speed.
- **Strong Winds.** In Sea State 5 or above with strong winds from astern, there is a risk of *Sea / Swell* positively reinforcing the ship's *Wake Waves (Wash).* The relative wind then carries the resultant *Wave* 'plume' over the Flight Deck.

c. **Damage on Take-Off or Landing (DOTOL).** *Damage on Take-Off or Landing (DOTOL)* can occur when the bow creates heavy spray due to a combination of high winds from directly ahead, ships speed and Sea State. The spray may then be carried aft, hazarding a take-off or landing. **The following countermeasures may be taken:**

- Avoid violent alterations across the direction of the *Sea / Swell* with aircraft 'rotors running' on deck.

- Where possible, be steadied on the intended *Flying Course* in sufficient time to allow a judgement of conditions, noting that the worse Sea State - the longer the ship will need to be on a *Flying Course* to make this judgement.
- Keep the time spent 'rotors running' on deck to an absolute minimum. If the aircraft is held on deck consider stopping rotors.
- Ensure good communications between the PWO, Bridge and Flight Deck. The latter are well placed to spot changes in the prevailing conditions.

d. **Variability of Key Factors.** The infinite variety of weather conditions make it impossible to predict the consequences for every situation. **The key factors in assessing risk of damage are: the *Swell* / Sea State, ship's course and speed and the wind.**

0636-0639. Spare

CHAPTER 5 -- PRACTICAL DAMAGE CONTROL AND STABILITY (PREPARATION AND PROCEDURES)

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CHAPTER 5

Practical Damage Control and Stability (Preparation and Procedures)

5.1 STABILITY

A ship's stability is measured by its tendency to right itself or overturn when inclined by an external force. Ship's personnel can adversely affect a ship's stability by improper loadout and/or liquid load distribution. Flooding water due to piping ruptures, punctured hulls or fire-fighting water can also greatly reduce stability. High weight addition, such as topside icing, may also reduce a ship's ability to return to the upright position. The synopsis of a letter shown in Figure 5-1 illustrates the import-ance of understanding the impacts weather and sea conditions can have on ship's stability.

5.1.1 Weight Growth. Ships are assigned a specific stability status which dictates allowable weight growth and movement of the ship's center of gravity. The four stability status categories are:

1. Status 1. A reasonable increase in weight and rise of the ship's center of gravity are acceptable. Added weight and moment resulting from change will not require any compensation, if not excessive.

2. Status 2. Neither an increase in weight nor a rise of the ship's center of gravity can be accepted.

3. Status 3. A reasonable increase in the ship's center of gravity must be avoided.

4. Status 4. A reasonable rise of the ship's center of gravity is acceptable, but an increase in weight must be avoided. Compensation for added weight may be obtained by removal of an equal or greater weight at any level.

Ship's Damage Control Book, Section IIA, defines ship's assigned status. NSTM, Chapter 079, Volume 1, Stability and Buoyancy, contains stability calculations and effects of flooding, as well as methods to improve ship's stability and combat battle damage. Other publications which discuss stability include:

1. NSTM, Chapter 096, Weights and Stability

2. NSTM, Chapter 997, Docking Instructions and Routine Work in Dry Dock

3. U.S. Navy Salvors Handbook

4. Repair Party Manual.

5.1.2 Embarked Loading Calculations and Approval. *Embarking commands planning to* load non combat-essential items (in addition to those in the tactical embarkation plan) such as TVs, comp-uters, safes, desks, refrigerators, file cabinets and other such items which will affect safety, reserve buoyancy and stability of the ship, shall, prior to embarkation, provide the *commanding officer (CO) the weight and in*tended location of such equipment. The ship's damage control assistant (DCA) shall calculate the weight and moment addition to the ship and provide those figures to the commanding officer. The CO shall assess the impact of the load and provide approval for loading only that equipment which will assure the maintenance of combat capability, safety and adequate reserve buoyancy and stability. While this requirement applies to all ships, emphasis regarding these calculations must be placed on embarkations of aircraft carriers and amphibious ships.

5.1.3 Drydocking. For information on docking and duties see the following references:

1. Ship's Organization and Regulations Manual

2. NSTM, Chapter 997.

5.1.4 Weight and Moment Calculations. The purpose of making weight and moment calculations when considering alterations or other changes is to determine the effect on reserve

The following is synopsized from the "Nimitz Letter," written 13 February 1945, by the Commander in Chief, U.S. Pacific Fleet. Admiral Nimitz's letter addresses the survivability of ships in severe weather and discusses the devastation to his fleet:

	All of FARRAGUT Class				Both FLETCHER Class	
	HULL	MONOGHAN	DEWEY	ALYWIN	SPENCE	HICKOX
Outcome	Sunk	Sunk	Survived	Survived	Sunk	Survived
Fuel on hand (approx)	70%	76%	(?)	80%	15%	14%
Water ballast	No	No	Yes	(?)	Very little	Fully ballasted
Condition "A" taken*	Yes	(?)	Yes	(?)	No	(?)
Top weight jettisoned or below	No	(?)	Yes	(?)	(?)	(?)
Free water in ship	Yes	(?)	Some	Yes	Yes	Some
Rolled over and recovered	70°	(?)	75°	70°	Hung at 50° then capsized	70°

*Condition ZEBRA

"On 18 December 1944, vessels of the Pacific Fleet, operating in support of the invasion of the Philippines in an area about 300 miles east of Luzon, were caught near the center of a typhoon of extreme violence. Three destroyers, the HULL, MONAGHAN and SPENCE, capsized and went down with practically all hands: serious damage was sustained by the CL MIAMI, the CVLs MONTEREY, COWPENS, and SAN JACINTO, the CVEs CAPE ESPERENCE and ALTAMAHA, and the DDs AYLWIN, DEWEY, and HICKOX. Lesser damage was sustained by at least 19 other vessels, from CAs down to DEs. Fires occurred on three carriers when planes were smashed in their hangars; and some 146 planes on various ships were lost or damaged beyond economical repair by the fires, by being smashed up or by being swept overboard. About 790 officers and men were lost or killed and 80 were injured. Several surviving destroyers reported rolling 70° or more; and we can only surmise how close this was to capsizing completely for some of them. It was the greatest loss that we have taken in the Pacific without compensatory return since the First Battle of Savo."

The debilitating effect of these losses to operating force combat capability led Admiral Nimitz to provide direction to overcome inadequacies which contributed to harsh lessons learned:

1. All commanding officers shall subscribe to a unified philosophy to ensure safety at sea. The first requisites in a seaman and Naval officer shall be good seamanship, self-reliance and a sense of ultimate responsibility. Modern Naval devices shall be considered aids to exercising these requirements.

2. Subordinate commanders and commanding officers shall take heed to early and immediate signs of weather data from Fleet Weather Central. They shall question how weather data coincides with the present conditions in their ship's operating area.

3. Subordinate commanders shall use foresight to give up the attempt to maintain fleet courses, speeds and formations during the storm and give all their attention to saving the ship. Badly damaged ships are a loss to current and future operations. The ships that are allowed to drop behind may be useful to later operations.

4. Commanding officers should remember that an adversary may be experiencing the same operationally restricting weather conditions.

5. Commanders frequently guarding unique weather transmissions shall ensure appropriate retransmission and tactical direction to subordinate units regarding weather warnings. They shall be conscious of the seaman's relative inexperience in hurricane seamanship and take early avoidance action.

6. Seniors shall consider seakeeping ability of the smallest ships and the potential lack of experience, providing early tactical direction to preserve their warfighting capability.

7. Unit commanders should be advised and encouraged to take early action for the safety of the ship and the lives of the crew.

8. Commanding officers shall continually refresh themselves and provide for crew training to counteract the adversity of heavy weather. Useful references include:

- American Practical Navigator (Bowditch)
- Modern Seamanship, 16th Edition (Knight)

9. The commanding officer shall ensure provisions are made for the immediate delivery of weather advisories and plan appropriate courses of action which shall include:

- The stability characteristics of the ship, including an evaluation of liquid loading and free surface effect.
- Establishment and maintenance of ship's intact watertight integrity.
- Securing the ship for sea, with special attention to boats, aircraft and heavy equipment.

Figure 5-1. Ship Survivability in Severe Weather Conditions: Nimitz Letter Synopsis

bouyancy and stability of the ship. An increase in net weight reduces the reserve bouyancy and a net rise in the center of gravity reduces stability. NAVSEA categorizes the ship's weight and stability class and must approve any modifications.

5.1.4.1 Forces. When a ship is floating, the forces of gravity and buoyancy are acting upon it. Buoyancy is the upward force acting on the ship's underwater hull, and gravity is the downward pull acting on the ship's mass. The two forces are equal in magnitude, and when a ship is floating on an even keel, are aligned in the same vertical line.

5.1.4.2 Reference Points. Figure 5-2 provides reference point locations as described below:

1. K - Keel. The baseline reference point from which all other measurements are compared.

2. B - Center of Buoyancy. That point through which all the forces of buoyancy may be consid-ered to act in a vertically upward direction. The center of buoyancy is always located at the geo-metric center of the underwater portion of the hull, thus B moves to the new geometric center as a ship is inclined.

3. G - Center of Gravity. That point through which the weight of the entire ship's structure and contained load may be regarded as acting vertically downward. The weight distribution of the ship must be altered in order for a shift in G to occur. *Weight changes and effects on stability* are illustrated in Figure 5-3. The following three principles summarize the potential shifts in G:

(a) G moves in the same direction as a weight shift or transfer.

(b) G moves toward weight additions.

(c) G moves away from weight removals.

4. M - Metacenter. The intersection of two or more successive lines of the force of buoyancy as the ship is inclined through small angles of heel. In initial angles of inclination (0 degree -7 degrees), the metacenter remains virtually on the centerline of the ship.

5. GZ - Righting Arm. The perpendicular dist-ance between the forces of buoyancy and gravity as a ship is inclined. As a ship is inclined due to an external force, B moves to the new geometric cen-ter of the underwater hull, causing a separation between the forces of gravity and buoyancy. As illustrated in Figure 5-4, this separation creates a moment to force the ship upright. The greater the separation between the forces, the greater the ship's tendency to return upright.

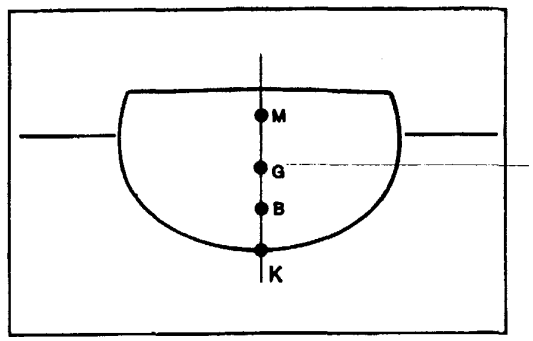

Figure 5-2. Reference Point Locations

Action	Stability	Center of Gravity	Center of Buoyancy
Weight shift up	Decrease	Up	No change
Weight shift down	Increase	Down	No change
Weight shift transverse	Decrease	Port/starboard	To low side
Weight added at "G"	Decrease	No change	Up
Weight added above "G"	Decrease	Up	Up
Weight added below "G"	Increase	Down	Up
Weight removed at "G"	Increase	No change	Down
Weight removed above "G"	Increase	Down	Down
Weight removed below "G"	Decrease	Up	Down

Figure 5-3. Weight Changes and Effects on Stability

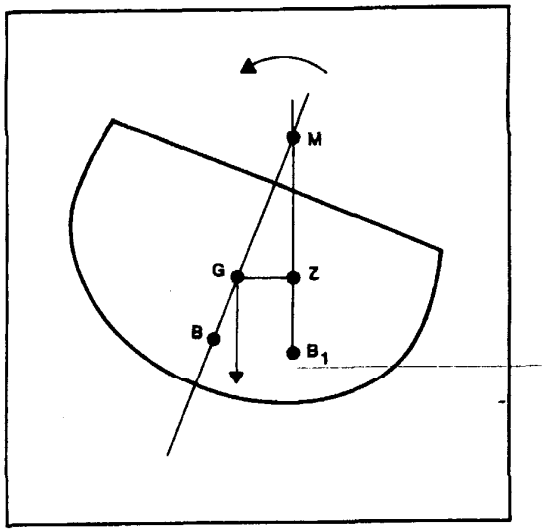

Figure 5-4. Righting Arm

5.1.5 Stability Conditions. The relative positions of G and M describe a ship's initial stability. Figure 5-5 illustrates the three possible stability conditions. Ships are designed so that G will remain well below M, but a rise in G will occur when any of the following three situations exist:

1. Failure to Ballast. Any weight removed be-low the original center of gravity causes an upward shift in G. Ships shall operate in accordance with their liquid load instruction to ensure proper stabi-lity. If rough weather is encountered or exp-ected, ships shall take proper measures in accord-ance with their Damage Control Book to keep G low.

2. High Weight Addition. All high weight addi-tions, such as topside icing or addition of firefigh-ting water high in the ship, cause an upward shift in G. A significant upward shift in G may place the ship in danger of capsizing. If icing conditions exist or are expected to exist, commanding officers shall ensure the ship makes all preparations in accord-ance with the Cold Weather Bill. When damage has occurred, priority must be given to the removal of high flooding or firefighting water.

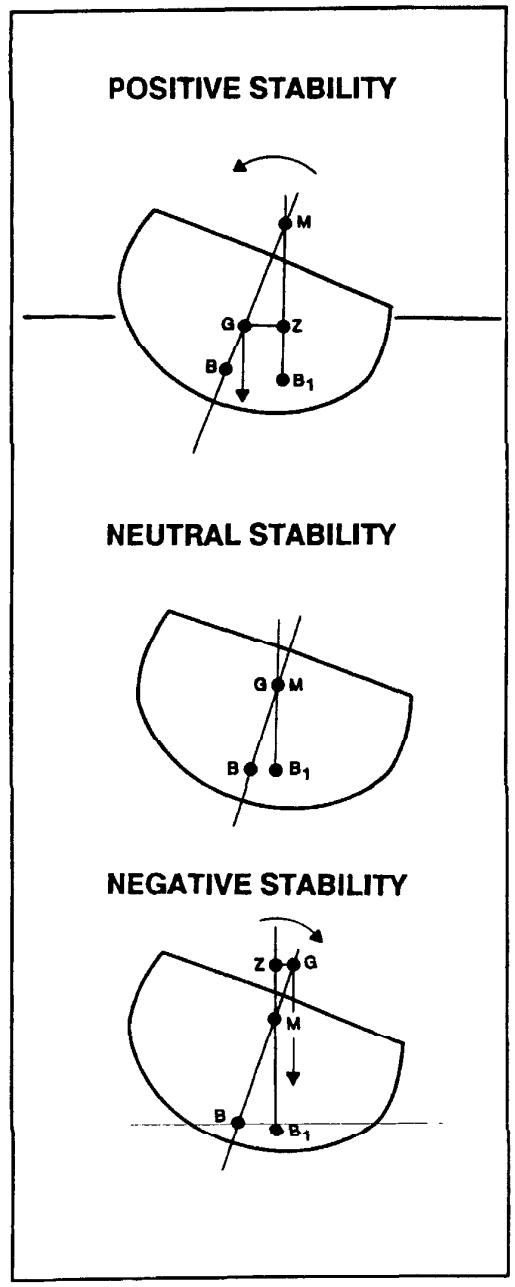

Figure 5-5. Stability Conditions

3. Shipboard Damage. Ruptures in ship's systems, punctures in the hull or firefighting water may cause a tremendous reduction in stability due to free surface effect or free communication effect. Free surface effect is the constant shift of water in a partially flooded compartment as the ship is incli-ned, resulting in a reduction of

righting arm. Free communication effect occurs when the hull of the ship is punctured and water is allowed to move freely in and out, also causing a reduction in righting arm.

Ships may develop a list due to shipboard damage. Not only does a list reduce stability, it also may affect the mobility of the ship's crew, operation of engineering or combat systems equipment and ability to conduct flight operations. List in excess of 15 degrees will seriously hamper crew mobility, thus reducing damage recovery capabilities and will likely be detrimental to combat systems' operability. Corrective actions for list are detailed in NSTM, Chapter 079, Volume 1, and in ship's Damage Control Book, Section II A.

5.2 DESIGN CRITERIA

U.S. Naval Surface Ships are designed to certain limitations which are outlined in Design Data Sheet (DDS) 079-1. The criteria takes into consideration that ships may be subjected to external influences as well as underwater flooding. Sufficient initial stability and buoyancy are required.

5.2.1 Summary of Types of Criteria. The criteria ships are designed to resist fall in two different areas - intact and damaged - and are outlined below:

1. Intact Criteria:

(a) Beam winds combined with rolling

(b) Lifting of heavy weights over the side

(c) Towing pull for tugs

(d) Crowding of personnel to one side

(e) High speed turning.

2. Damage (underwater flooding) Criteria:

(a) Damage to a specified length in the hull

(b) Angle of list does not exceed 15 degrees

(c) Beam winds and seas.

5.2.2 Design Limitations. The stability characteristics of most U.S. Naval Surface Ships and the nature of their load are such that provided:

1. Limiting drafts specified in the damage control book are not exceeded prior to damage

2. There are no abnormal topside weights

3. The liquid loading instructions are followed and

4. A proper degree of watertight integrity is maintained,

a satisfactory condition with regard to stability and reserve buoyancy will exist.

5.3 FLOODING

One of the most important damage control measures is the control of flooding. Until the rate of flooding has been controlled, drainage by fixed systems or portable pumps is ineffective. A hole in the hull with an area of one square foot, fifteen feet below the surface, will admit water at the rate of 13,900 gpm. It is essential that compartments flooded by any considerable underwater damage be isolated from other compartments by watertight subdivision before dewatering efforts of adjacent compartments will accomplish a positive degree of success. Small leaks into compartments on the fringes of the damaged area can be controlled by the installed drainage system and portable pumps. Flooding boundaries must be established to prevent progressive flooding. After boundaries are set, repair party personnel must reinspect and ensure that boundaries hold.

5.3.1 Flooding Load-Sagging. The load on the ship's girder is increased by the presence of flooding water. The increase in stresses caused by augmented load depends on both the amount and location of the flooding. Damage and consequent flooding in the middle section increases sagging stresses, which increases tension at bottom and compression at top of the hull girder, as Figure 5-6 illustrates. Measures to correct trim caused by damage in the middle length should be

aimed to reduce sagging stresses. This may be accomplished by one or all of three methods:

1. Pump the liquid in the midships region over-board (either flooding water or liquid in intact tanks -- consider stability before pumping low weights overboard).

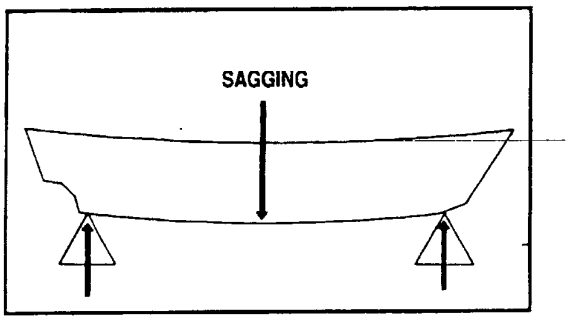

Figure 5-6. Flooding Load - Sagging

2. Transfer liquids from midships region to ends.

3. Counterflood high end (assuming good freeboard).

5.3.2 Flooding Load-Hogging. Flooding at the ends produces trim and increases hogging stresses, which in turn increases the tension at the top and compression at the bottom of the hull girder, as Figure 5-7 illustrates. Measures to reduce hogging stresses include:

1. Transfer liquids toward midships.

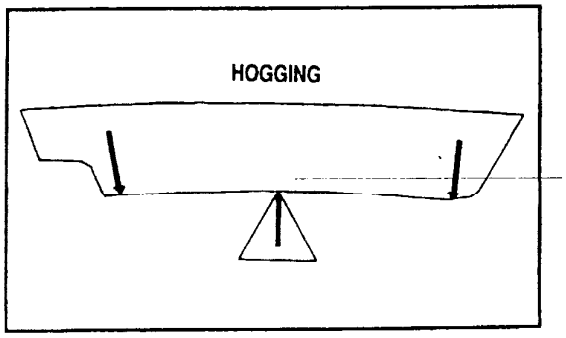

Figure 5-7. Flooding Load - Hogging

2. Pump liquid near damage overboard (flooding water or liquid in intact tanks -- consider stability before pumping low weights overboard).

3. Flood midships tanks (assuming good freeboard).

5.3.3 Counterflooding. At times, counterflooding may be required to halt listing or gain safe righting moments. However, counterflooding can be dangerous and result in loss of ship if not prop-erly accomplished and controlled. A recommenda-tion by the DCA to counterflood shall be accompli-shed only with the approval of the commanding officer and only when all aspects have been carefully considered.

5.3.4 Pressure Exerted Against Bulkheads. Seawater weighs approximately 64 pounds per cubic foot. The pressure over one square inch at a depth of 1 foot is 0.444 pounds; at nine feet it is 3.996 pounds; at 20 feet it is 8.88 pounds. The pressure at any point is equal in all directions, whe-ther downward toward the deck or horizontally toward a bulkhead. A bulkhead 20 feet wide and flooded to a depth of five feet is subjected to a total pressure of 16,000 pounds. At eight feet high and 20 feet wide flooded to a depth of 15 feet over the deck, a bulkhead will have a total pressure of 112,640 pounds on it. If the ship remained entirely motionless in all three planes, the pressure at any given point would remain constant and the problem of shoring would be relatively simple, but, of course, the ship is not motionless.

Therefore, the pressure is variable and works to weaken the bulkheads. Shoring is a means to stabilize this effect.

5.3.5 Critical Stability. It is vital following damage to evaluate whether stability is critical. Stability is critical if any of the following conditions exist:

1. The extent of flooding exceeds floodable length.

2. The ship is logy, with a slow, erratic period of roll and a tendency to hang at the end of a roll. The ship's metacentric height is very small or slightly negative.

3. The ship's list becomes excessive or the low deck edge is almost continually awash.

4. High winds or rough seas, combined with extensive flooding, are prevailing.

These thumb rules for critical stability may vary slightly from ship to ship. For amplifying informa-tion see Section IIA of the ship's Damage Control Book.

5.4 STRUCTURAL DAMAGE

Structural damage can impair the stability, buoyancy and fighting capability of the ship. Buckled or twisted strength members or hull plates and exterior hull gashes or holes require immediate correction. Structural damage can result from enemy action, fire, explosion, collision, grounding, adverse weather or high sea states.

5.4.1 Structural Repair. This section will explain how damage control equipment can be used to minimize the effects of damage, confine it, restore buoyancy and stability and restore firemains, electric power, air pressure toweapons systems and drainage line suction.

5.4.1.1 Underwater Explosion Damage. Underwater explosion damage can impair the strength of a ship in two ways: structural strength members may rupture or buckle and compartment flooding can occur, increasing load on the damaged ship girder. An underwater explosion frequently opens a larger hole in the shell of a large ship than it does in a small one. The large ship is better able to survive the loss of structural strength because a smaller proportion of the main structural members, heavier and more numerous than in small ships, will be damaged. The chances of structural failure in a large ship due to an underwater explosion or bomb hit are small.

Underwater explosions in the midships region of a small ship may rupture a large portion of the main strength members. With extensive damage to the main strength members, the ship may break up unless the strength of the fractured members can be replaced before the ship is subject to the action of heavy seas.

Partial reinforcement or restoration of main strength members is necessary before proceeding at reduced speeds. Such repairs may require addi-tional reinforcement, necessitating assistance from repair ships or facilities.

5.4.1.2 Explosion at Ends of Small Ships. An explosion at either the bow or stern of a small ship usually causes intense local destruction but does not seriously threaten combat capability or ship loss. The effect of such an explosion is to shake the ship like a whip. Waves of flexural vibra-tion pass down the length of the hull, producing stresses like those in hogging and sagging, of shor-ter duration but greater intensity. The result, alth-ough not usually obvious, can be structurally damaging. It consists mainly of compression fail-ures in the midships region, evidenced by wrinkled deck plating, wrinkled shell plating, buckled longit-udinal girders, and buckling, laying over of flanges, wrinkling or other failure of members in the mid-ships portion of the ship that contribute to longitu-dinal strength. Such failures may be hidden from sight -- below the waterline, under boilers, behind stores and equipment or beneath the surface of subsequent leakage water. It is a feature of comp-ression members that once buckled they can never again develop even a fraction of their original strength. Attempted straightening is useless; the only answer is immediate reinforcing by shoring and later replacement.

A ship that has suffered compression failure amid-ships is in as precarious a condition as if the main strength members had been carried away. The action that should be taken in such a case is:

1. Reduce speed.

2. Change course to minimize hogging, sagging and pitching.

3. Make an immediate careful inspection of the damage in the midships region to locate evidence of wrinkled shell or deck plating, buckled or failed longitudinals and buckling of stanchions or bulk-heads that brace the hull girder. Look for hidden damage behind machinery or under stores. If there is any flooding amidships, examine the damage using shallow diving equipment. Examine fuel tanks for evidence of contamination.

4. Tactical situation permitting, proceed immed-iately for the nearest safe anchorage, commencing repairs en route, where possible.

5. To prevent total ship loss, consider beaching the ship, taking into account the weather condition.

Corrective measures are necessary wherever fracture of strength members is apparent. (In case of buckling from compression failure, other measures may be indicated.) Corrective measures include:

1. When damage has occurred to any portion of the main deck, shift or add weights to the area directly below the damage.

2. When damage has occurred to any portion of the keel, shift weights away from the damaged section or add weights forward and/or aft of the damaged area.

3. Excess loads produced by heavy cargo or severe flooding on a member should be transferred and/or distributed by adequate shoring to members able to withstand the stresses imposed.

4. When replacing or repairing a damaged member, new members should be fastened in place to extend well beyond the region of damage.

5. Expansion joints should never be welded or otherwise fastened.

5.4.1.3 After A Midships Hit. In case of structural failure such as that caused by a mine or torpedo hit amidships, steps to be taken are similar to those for an underwater explosion at the ends of a light ship. If the hull contains flooding water, the ship girder must be examined to determine the extent of damage. Excessive "working" of bow or stern beyond normal flexure in a seaway is an indication of lost strength. In most cases, the ship girder fails in compression before it reaches the limit of its tensile strength; it is this compression failure which starts the breaking up of the ship. Repairs to main strength members top or bottom must take into account both tension and compression stresses.

Compression stresses require more cross-sectional area material than tension stresses. The material can be either shapes or plates, with stiffeners running parallel to other intact stiffeners in the vicinity. Stiffeners should be spaced no more than 100 times the plating thickness or stiffener thickness, whichever is smaller. (When possible, this distance should be reduced to about 60 times the smaller thickness.)

Compression failures, buckling or wrinkling in the midships region are just as dangerous as complete rupture of structure. Wrinkled shell and deck plating must be replaced, not straightened, for the restoration of strength. Buckled or ruptured longitudinal beams must be replaced with shapes of greater cross-sectional area.

The new shapes should be welded to the intact sections of the original longitudinals, extending 8 to 10 feet beyond each side of the damaged area, continuously welded to undamaged members. Material for repairs can, if necessary, come from the structure of the upper decks and superstructure where it does not affect the structural strength of the ship girder. Wire rope in combination with turnbuckles can also be used to stabilize a working hull, to prevent further damage or facilitate welded repairs.

5.4.2 Shoring. Shoring is the process of placing supports against the side of, below or above a structure to prevent metal fatigue, sagging and bulging. Ships have had to shore ruptured decks, strengthen weakened bulkheads and decks, build up temporary bulkheads and decks against the sea, support hatches and doors and provide support for equipment that has broken loose.

5.4.2.1 Varying Pressure on Bulkheads. A bulkhead will bulge and pant as pressure on it varies and will weave as the ship itself changes shape in a seaway. Hence, the pressure on shoring increases and decreases and the bulkhead will tend to move away from the shores. Shoring is intended to support; it is not intended to push warped bulkheads back to their original positions or shapes. Excessive shoring pressure may cause a bulkhead to collapse or rupture, especially at boundaries.

5.4.2.2 When to Shore. There are no fixed rules by which a determination can be made to shore. After inspection of the damaged area, the exercise of good judgment will be the principal guide to action taken. Deep bulges in plating, bowed frames and stanchions, loose rivets,

cracked seams and panting of bulkheads are indications of the need to shore. Panting causes metal fatigue, which in time can result in cracking and splitting. If in doubt, it is prudent to provide shoring.

The need to shore patches and loose machinery is in most cases obvious. However, weakened supports under guns and machinery units may not be readily noticed and must therefore be carefully inspected.

5.4.2.3 Planning. Contingency plans should be available for shoring each major bulkhead, including a drawing which indicates such impediments as boilers, pumps, pipe lines, lockers, stores and sheathing. The plan should describe where shoring supplies are located and provide a route to move them to the desired point with the least interruption of watertight integrity. Whenever possible, stores should be stowed away from sides and bulkheads so there is ready access for shoring and patching.

5.5 GROUNDING/STRANDING

When groundings occur through accident or because ships are beached to prevent them from sinking, grounding places heavy demands on the ship's structure and other survivability systems. Survival will depend upon taking immediate corrective actions. If not already, the ship must be sent to general quarters and material condition ZEBRA set. Investigators must immediately proceed to survey the damage, with particular attention to flooding in the grounded area of the ship. Damage control personnel should take appropriate actions to include:

1. Distribution of liquid load
2. Flooding to stabilize the ship
3. Shoring of watertight boundaries
4. Removal of topside weights.

In the event a ship has lost stability, is foundering or is threatened by severe structural failure, the commanding officer may deliberately beach the ship in anticipation of later salvage. This should only be accomplished as a last resort and preferably at a point where the water is relatively quiet, shoals gradual and the bottom flat, soft and free of rocks or reefs. The stranding of a ship will involve three major factors:

1. Ability to refloat the ship
2. Structural strength of the ship
3. Stability of the ship.

When immediate danger is past, a detailed survey must be conducted to determine the conditions of the grounding, thoroughly define damage to the ship and evaluate the occurrence (or potential for occurrence) and means for control of environmental pollution. Actions must be taken to prevent the ship from broaching by having tugs or other assist ships hold the stern to the sea, laying ground tackle astern or making the ship heavy through ballasting.

5.5.1 Ability to Refloat. In an unintentional grounding, an impulse may be to use the engines to refloat. Prior to this application, consideration should be given to depth of water, sea floor and composition damage to the propellers and hull. Ship's screws become less effective in shallow water; attempting to back down may cause propeller wash to drive silt or bottom aggregate in and around the hull. If wind or tide carry the ship further aground, chances of refloating will be jeopardized by attempting to maneuver with screws and rudder. If when propellers are reversed there is no tendency of the ship to back away, no further attempts to move the ship by means of the screws should be made. Instead, the ship should be weighted down by flooding tanks and, if necessary, one or more hold compartments, to fix the hull firmly in position. Weighing the ship down should be considered if the tide is rising and adverse sea conditions exist, and is necessary if heavy surf may drive the ship harder aground, or cause it to broach.

After weighing down, a careful investigation shall be made to sound all voids, check fuel tanks for leakage and examine the interior of the hull for signs of structural damage. Soundings shall be taken to determine the slope and nature of the bottom in the direction toward which the ship will be refloated. Prevailing currents should be noted. Ground tackle should be rigged and kedge anchors laid to seaward as quickly as possible. When salv-age assistance is available, beach gear ready and the tide right, the ship can be lightened while main-taining a strain on all

cables. Engines should be warmed but not turned over (to avoid filling main condensers with mud or sand, damaging the prop-ellers or fouling the ground tackle). Shifting fuel oil or ammunition fore and aft may produce a change of trim that will aid in coming clear. On smaller ships, if suction seems to hold the hull fast it may be helpful to have the crew sally ship to start it rolling. Carriers may consider using the thrust of aircraft engines to assist. Other means to move the ship are to heave sideways on bow and stern kedge anchors or a similar pull by the salvage ship.

5.5.2 Hull Strength. When the ship is aground, the beach exerts an upward force on the hull equal to that portion of the ship's weight which is not supported by the buoyancy of the water. If aground at one end, sagging stresses are increased, resulting in a need to remove weight from the midships region and relocating it at the ends of the ship. If aground on a ledge or pinnacle amidships, hogging stresses are increased. Weight should be removed from the ends and relocated amidship. Irregular rock or coral formations or sharp changes in gradient produce concentrated pressures that can crush hull plating and result in flooding. Such damage can be intensified if the hull works or shifts position.

5.5.3 Stability. Figure 5-8 illustrates the Effects of Tide on Grounding forces. The grounding force "P" acts perpendicular to the waterline at the angle of heel shown. If the moment of the force "P" above "G" (ship floating freely) equals the moment of the net buoyant force "B," the ship will remain at this angle of heel. If the moment of force "P" is

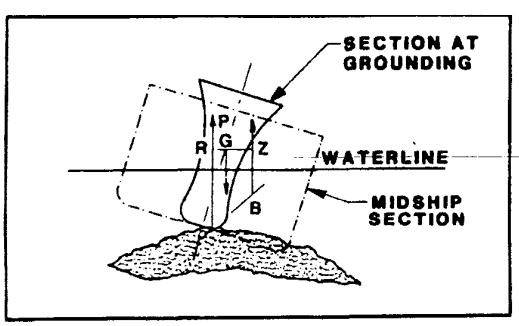

Figure 5-8. Effects of Tide on Grounding Forces

greater than the righting moment, the ship will continue to heel. Unless a net positive righting moment develops at some larger angle of heel, the ship will capsize.

The grounding force is the difference between the displacement of the ship floating freely and aground. The greatest grounding force will occur when the waterline of a ship grounded at high tide drops to that of a low tide. As the tide drops, the buoyant force of water becomes less, while the grounding force gets proportionally larger. In most cases, the following will constitute good procedure:

1. No attempt should be made to refloat the ship under its own power if wind and sea conditions indicate the possibility of the ship's working harder aground, pounding or broaching to sea.

2. Anchors to seaward should be quickly laid, if possible, to prevent the ship from working further ashore.

3. The ship should be weighted down, not lightened, in an effort to keep it from working harder on the beach and to prevent damage caused by working and pounding on the bottom.

Specific data for computing list, trim and stability will be found in each ship's damage control book. Reference to stranding problems is made in in NSTM, Chapter 079, Section 19.

5.5.3.1 Jettisoning Weight to Improve Stability. Jettisoning is a difficult and time-consuming task and shall only be resorted to when:

1. Heavy localized damage dangerously reduces hull strength.

2. List or trim impairs efficiency of the ship as a weapons platform (wartime).

3. List or trim impedes progress of the ship through the water (wartime).

4. It is imperative that range of stability be increased to prevent capsizing.

5. The ship is stranded and must be lightened for salvage purposes.

5.5.3.2 The Damage Control Assistant (DCA). The DCA is responsible for maintaining a listing

of topside material which can be jettisoned, instructing repair parties in jettison procedures and carrying out jettison procedures when directed. Personnel not actually employed in fighting the ship or immediately required for other ships or damage control will augment the repair parties in disposing of topside weights. A sample jettison list is shown in Figure 5-9. The DCA's list might also include weight in tons, height above mean base line (MBL) in feet and increases in metacentric height (GM) in feet for each item.

Item	Location	Weight/ tons	Procedure
Motor whaleboat	Port	2	Lower and tow
Motor whaleboat	Starboard	2	Lower and tow
Torpedoes	Centerline	1.5	Fire on safe bearings
Anchors	Port and Starboard	4	Break at 5 fathoms shot
Boat davits	Port	0.5	Unbolt at the base and drop over the side

Figure 5-9. Sample Jettison List

5.5.4 Removal of Stranded Ship by Salvage Ship. The line pull required to refloat a grounded ship may be computed by determining the product of the number of tons aground and the coefficient of friction of the type sea floor. Tons line pull "P" equals tons aground "A" multiplied by the sea bottom coefficient of friction "F." P tons = A tons x F. The Coefficients for Various Sea Floors are shown in Figure 5-10.

It may be anticipated that each 100 horsepower of the salvage ship's engines will produce one ton of line pull.

Sea Floor	Coefficient of Friction
Silt	0.2 to 0.4
Mud	0.2 to 0.4
Sand	0.4 to 0.6
Coral	0.6 to 0.8
Rock	0.8 to 2.0

Figure 5-10. Coefficients of Various Sea Floors

0524. Making the Approach

a. **Approach Requirements.** The plan of approach must allow for holding the *Towing Ship* close enough to the *Casualty* to pass the *Tow* and starting the *Casualty* making way in a controlled manner.

b. **Control of the Tow.** Given their very limited *Turning Moment* when *Towing* (see Para 0521), warships almost always have to start the *Casualty* making way either directly into-wind or directly down-wind, only altering to the required course when a good speed has been built up and steering in the *Casualty* can be effective. **Attempts to start the *Casualty* making way across the wind normally cause control to be lost.** In the worst case this can result in the *Towing Ship's* stern being dragged (up-wind) by the bow of the *Casualty* flying into wind, so that both ships end up in a bow-to-stern configuration.

c. **Methods of Approach.** The choice of approach will be dictated by the type of ships involved, the *Casualty*'s aspect to the wind, drift direction / rate, any damage or flooding sustained, the ease with the *Towing Ship* can hold close enough to the *Casualty* to pass the *Tow* and the anticipated ease (or otherwise) of starting the *Casualty* making way in a controlled manner (see Para 0524b above). The methods of approach are as follows:

- **Converging Approach from the Windward Side of the Casualty.** This is the most commonly used method when the *Drift Rates* of ships are similar. The *Towing Ship* starts the *Casualty* making way into-wind. See Para 0524d.
- **Basic Downwind Approach from the Windward Side of the Casualty.** This method is used when the *Drift Rates* of ships are dissimilar and it is possible to start the *Casualty* making way down-wind. See Para 0524e.
- **Upwind Approach from the Leeward Side of the Casualty.** This (relatively hazardous) method may be used when *Drift Rates* of ships are dissimilar and it is essential to start the *Casualty* making way into-wind. See Para 0524f.
- **Downwind Approach to Casualty with Wind Abaft the Beam.** This method should be used for a *Casualty* with the wind abaft the beam and will thus be sailing ahead boldly. The *Towing Ship* starts the *Casualty* making way down-wind. See Para 0524g.
- **Downwind Approach to Casualty lying Stern to Wind.** This method should be used for a **stern-down** *Casualty* with the wind directly astern. The *Towing Ship* starts the *Casualty* making way down-wind. See Para 0524h.
- **Downwind Approach to Casualty lying Head to Wind (Tow Stern First).** This method should be used for a **bows-down** *Casualty* with the wind well forward of the beam or lying head to wind. The *Towing Ship* starts the *Casualty* making way **stern-first**, down-wind. See Para 0524i.
- **Cross-Wind Approach to Casualty lying Head to Wind (Tow Bows First).** This (difficult) method should be used for a **bows-down** *Casualty* with the wind well forward of the beam or lying head to wind. The *Towing Ship* starts the *Casualty* making way **bows-first**, into-wind. See Para 0524k.
- **Other Approaches for a Ship to be Towed Stern-First.** These methods mirror those at Paras 0524d-g, for ships in normal *Trim*. See Para 0524j.

(0524) d. **Converging Approach from the Windward Side of the Casualty.** This approach should be adopted when the two ships have similar lateral *Drift Rates* when stopped (see Para 0524b). The procedure is as follows:

- Select an approach track that converges at an angle of about 25° to the heading of the *Casualty* (see Fig 5-8). The track should aim to pass 30 metres upwind of the *Casualty*'s bows, allowing for any 'sailing' movement of the *Casualty*, ahead or astern.
- The gun-line should be fired from the focsle at a range of about 50 metres, before the bows come level; the gun-line and *Messenger* should then be walked aft. Alternatively, the gun-line may be fired from aft / Flight Deck.
- While the *Messenger* is being walked aft, the *Towing Ship* should move to a position about 50 metres ahead of the *Casualty*.
- Once the *Towing Ship's* stern is reported clear of the *Casualty's* bow, the overlap situation no longer exists and it is usually safe for one of the *Conning* officers to transfer from the Bridge to the *TCP* and take the ship from there (see Para 0523r).
- The *Tow* may be passed from about 50 metres ahead of the *Casualty*. **Once connected, as much of the *Towing Hawser* as possible should be kept inboard to allow the *Towing Ship* to *Turn at Rest (Cast)* into wind (see Para 0526b).** The full *Tow* should be streamed when turn is complete.
- During this initial phase (immediately after the *Towing Ship* has stopped), it is likely that the *Casualty*'s lateral drift will initially exceed that of the *Towing Ship* (see Para 0523.l).
- If an approach is made too wide to make contact with the gun-line, the quickest solution is usually to go round again and make another approach, rather than attempt a *Sternboard* across the wind.

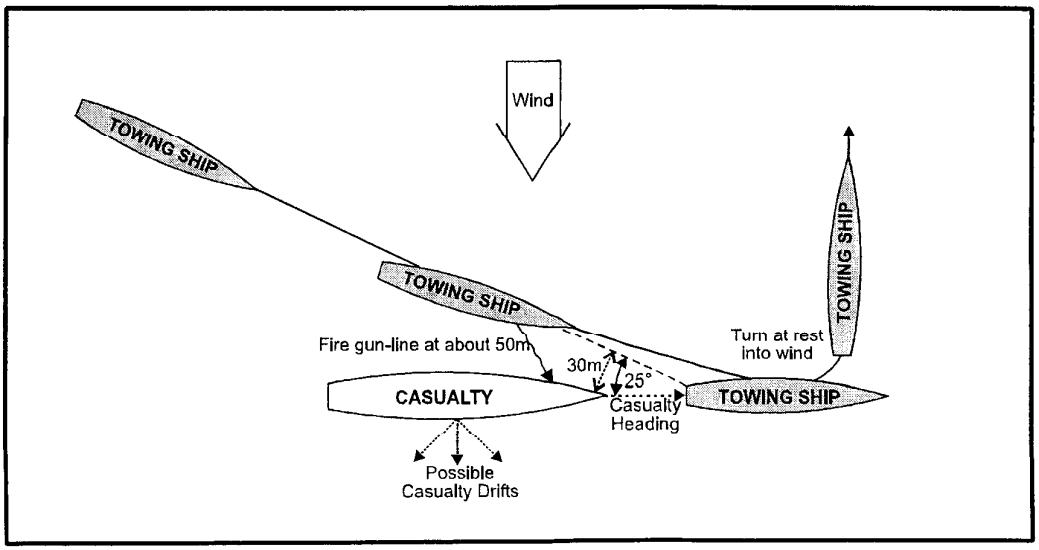

Fig 5-8. Converging Approach from the Windward Side of the Casualty

(0524) e. **Basic Downwind Approach from the Windward Side of the Casualty.** This approach should be used when *Drift Rates* are dissimilar and it is possible to start the *Casualty* making way down-wind. **It has a much less hazardous approach than the upwind method** (see Para 0524d opposite) **as the *Casualty* is drifting away from the approaching *Towing Ship*; thus if a misjudgement has been made, the *Towing Ship* can usually escape by applying plenty of astern power.** The approach should be made at about 90° to the *Casualty's* heading. The procedure is as follows:

- Select an approach track into wind that converges at an angle of about 90° to the heading of the *Casualty* (see Fig 5-9). The track should aim to pass 30 metres ahead of the *Casualty*'s bows, allowing for any 'sailing' movement of the *Casualty*, ahead or astern.
- The gun-line should be fired from the focsle at a range of about 50 metres, before the bows come level; the gun-line and *Messenger* should then be walked aft. Alternatively, the gun-line may be fired from aft / Flight Deck.
- While the *Messenger* is being walked aft, the *Towing Ship* should move to a position about 50 metres ahead of the *Casualty*.
- Once the *Towing Ship's* stern is reported clear of the *Casualty's* bow, the overlap situation no longer exists and it is usually safe for one of the *Conning* officers to transfer from the Bridge to the *TCP* and take the ship from there (see Para 0523r).
- The *Tow* may be passed from the position about 50 metres ahead of the *Casualty* and may be fully streamed.
- Gentle progressive power will be needed to turn the *Casualty* downwind while keeping the *Towing Ship* stern to wind. If the *Casualty* gathers too much headway while beam-to-wind, it is likely to fly up into wind and make the task of starting it making way downwind much more difficult.

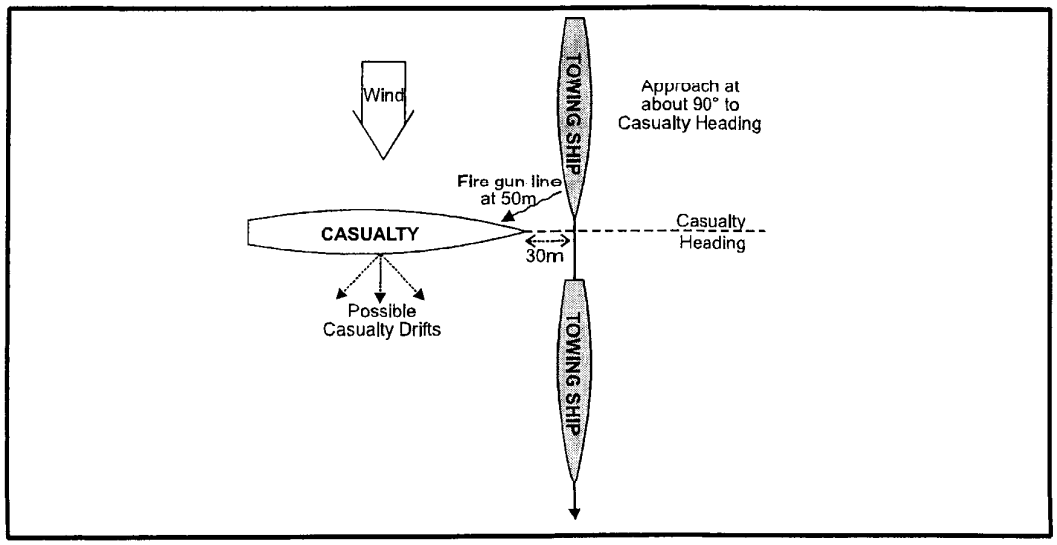

Fig 5-9. Basic Downwind Approach from the Windward Side of the Casualty

(0524) f. **Upwind Approach from the Leeward Side of the Casualty.** This (relatively hazardous) approach may be used when *Drift Rates* are dissimilar and it is essential to start the *Casualty* making way into-wind. **It involves fine judgement if the *Casualty* is 'sailing' ahead (see Para 0523.l), as the approach course leaves the *Towing Ship* very little room to escape if the *Casualty* sails ahead faster than anticipated.** The best approach courses range between 45°- 90° to the *Casualty's* heading. However, the further off the wind the *Towing Ship* makes its approach, the more difficult it will be to round out and hold the bows head-to-wind. The procedure is as follows:

- Select an approach track into wind that converges at an angle of between 45° and 90° to the heading of the *Casualty* (see Fig 5-10). The track should aim to pass 50 metres ahead of the *Casualty*'s bows, allowing for any 'sailing' movement of the *Casualty*, ahead or astern.
- The gun-line has to be fired into or across the wind, and this should be done as soon as it is in range; the gun-line and *Messenger* should then be walked aft.
- While the *Messenger* is being walked aft, the *Towing Ship* should move to a position about 50 metres upwind of the *Casualty*. The *Tow* may be passed from this position and may be fully streamed.
- Once the *Towing Ship's* stern is reported clear of the *Casualty's* bow, the overlap situation no longer exists and is usually safe for a *Conning* officer to transfer from the Bridge to the *TCP* and take the ship (see Para 0523r).
- Gentle progressive power will be needed to arrest the *Casualty*'s lateral drift and tendency to 'sail' while keeping the *Towing Ship* head to wind.

Note. *This difficult method was demonstrated successfully by a CVS which took an O Class RFA under Tow in 20 knots of wind. The RFA lay beam to the wind but was sailing ahead at about ½ knot. The approach was made at 80° to the RFA's heading and the CVS's bows were held into wind with large amounts of engine power while the Tow was passed. Once the Tow was connected and streamed, the CVS turned the RFA into wind with ease and brought it ahead.*

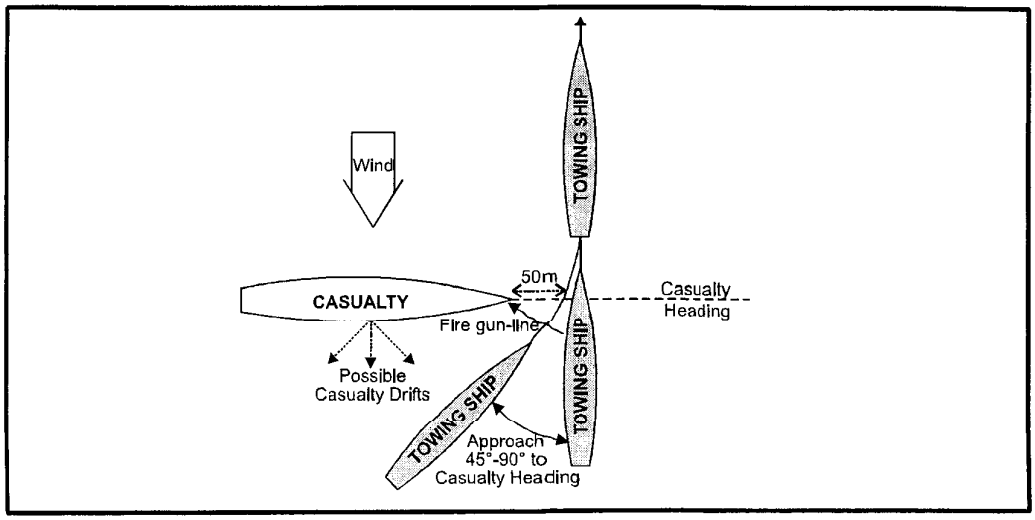

Fig 5-10. Upwind Approach from the Leeward Side of the Casualty

(0524) g. **Downwind Approach to Casualty with Wind Abaft the Beam.** This approach should be used for a *Casualty* which has the wind abaft the beam and will thus be sailing ahead boldly. This situation is most likely if the *Casualty* has all its superstructure forward (eg oil-rig support ships) or is *Trimmed* heavily by the stern due to flooding aft (eg from a collision or action damage). The *Casualty Drift Rates* will be dissimilar to those of most warships, but it should be possible to start the *Casualty* making way downwind. The same procedure applies as in Para 0524e (Basic Downwind Approach), **except that**:

- The approach is made directly downwind (not at 90° to the *Casualty's* heading) - see Fig 5-11.
- Due to the magnitude of the *Casualty's* likely headway, particular caution is needed to avoid passing too close to its bow and a separation of 100m is prudent. The gun-line should be fired as soon as it is in range, but due to the wide separation, it may not be possible to make contact until the *Towing Ship's* stern is clear of the *Casualty's* bow and the separation is reduced to 50m.
- Once the *Towing Ship's* stern is clear of the *Casualty's* bow, it may be necessary to turn partly parallel to the *Casualty* in order to keep the *Towing Ship's* stern close to the *Casualty's* bow. Otherwise the *Casualty's* headway may cause it to overtake the *Towing Ship* and an awkward bow-to-stern situation might arise.
- The *Tow* may be passed from the position about 50 metres downwind of the *Casualty* and may be fully streamed.

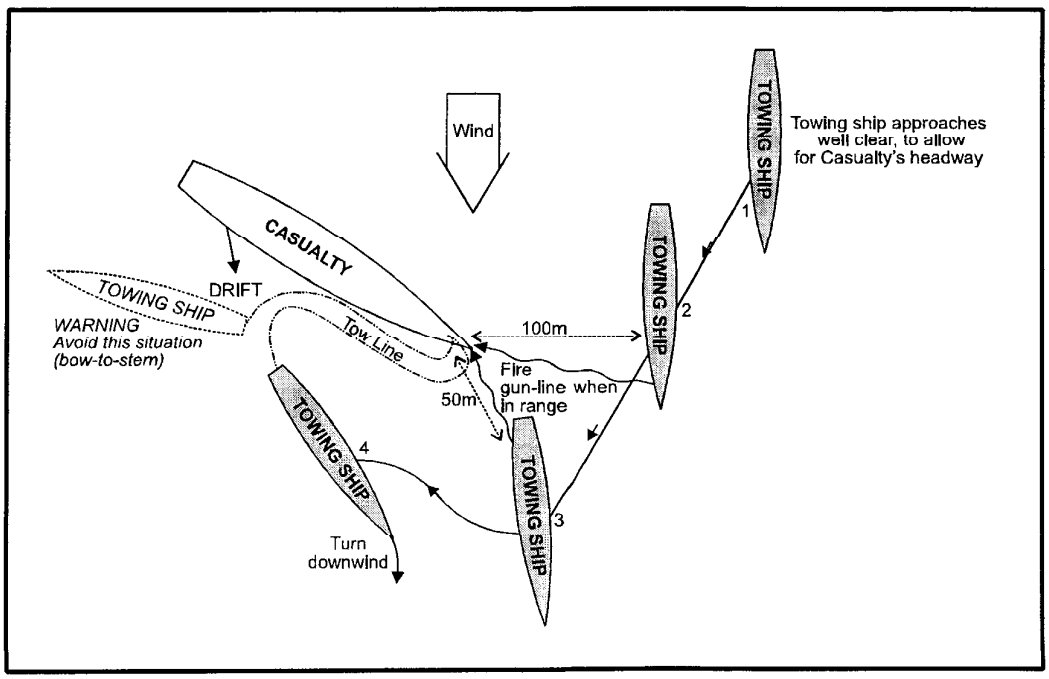

Fig 5-11. Downwind Approach to Casualty with Wind Abaft the Beam

(0524) h. **Downwind Approach to Casualty lying Stern to Wind.** This approach should be used for a *Casualty* which has the wind directly astern and will thus be sailing (ahead) in the same direction as the normal drift downwind. **This situation is most likely if the *Casualty* is *Trimmed* very heavily by the stern due to flooding aft (eg from a collision or action damage - see Para 0523i.).** The *Casualty Drift Rate* will be dissimilar to that of most warships, but it should be possible to start the *Casualty* making way down-wind. The procedure is as follows:

- Select a slightly converging approach track downwind that is nearly parallel to the heading of the *Casualty* (see Fig 5-12). If there is a slight windward side then, if possible, the approach should be made from that side. The track should aim to pass 30-50 metres abeam of the *Casualty*'s bows.
- The gun-line should be fired from the focsle at a range of about 50 metres, before the bows come level; the gun-line and *Messenger* should then be walked aft. Alternatively, the gun-line may be fired from aft / Flight Deck.
- While the *Messenger* is being walked aft, the *Towing Ship* should move to a position about 50 metres ahead of the *Casualty*.
- Once the *Towing Ship's* stern is reported clear of the *Casualty's* bow, the overlap situation no longer exists and it is usually safe for one of the *Conning* officers to transfer from the Bridge to the *TCP* and take the ship from there (see Para 0523r).
- The *Tow* may be passed from the position about 50 metres ahead of the *Casualty* and may be fully streamed.
- Gentle power will be needed to start the *Casualty* making way downwind.

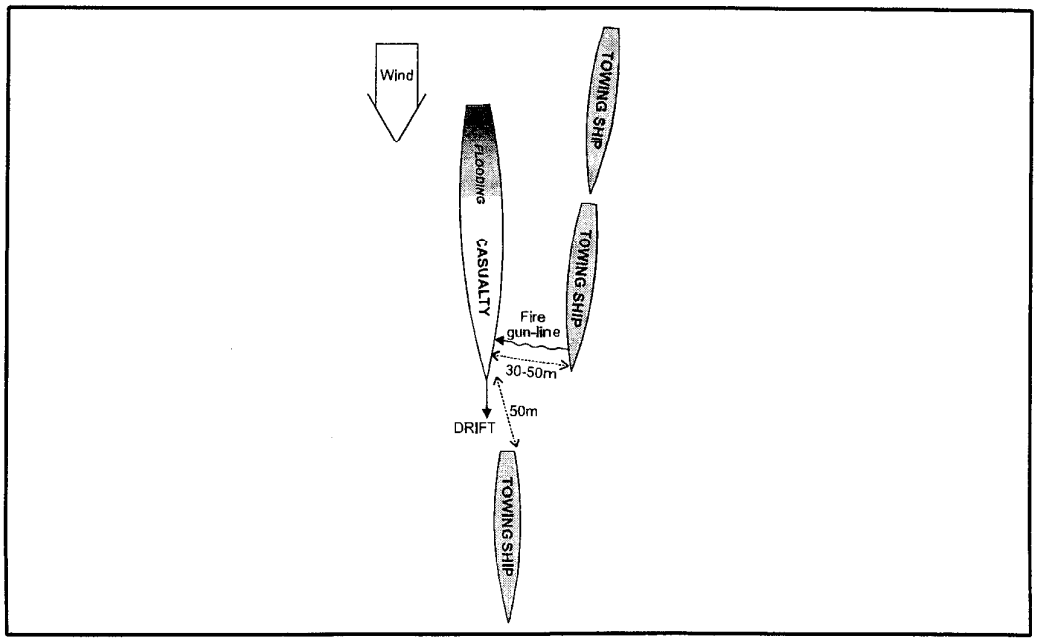

Fig 5-12. Downwind Approach to Casualty lying Stern to Wind

(0524) i. **Downwind Approach to Casualty lying Head to Wind (Tow Stern First).** This approach should be used for a *Casualty* which has the wind well forward of the beam or head to wind and will thus be drifting and sailing astern. **This situation is most likely to occur if the *Casualty* is *Trimmed* heavily by the bow as a result of substantial flooding forward (eg from a collision or action damage); if so, the *Casualty* is best towed stern-first, as it will be unmanageable if towed ahead (see Para 0523i).** The *Casualty Drift Rate* will be dissimilar to that of most warships, but (as in Para 0524h) it should be possible to start the *Casualty* making way down-wind, only **stern-first**. The procedure, with changes from Para 0524h emboldened, is as follows:

- The approach should be made on a slightly converging approach track downwind that is nearly parallel to the **reciprocal** of the *Casualty's* heading, **as it is intended to *Tow* it stern first** (see Fig 5-13). If there is a slight windward side then, if possible, the approach should be made from that side. The track should aim to pass 30-50 metres abeam of the *Casualty*'s **stern.**
- The gun-line should be fired from the focsle at about 50 metres, before the bows **come level with the *Casualty's* stern**; the gun-line / *Messenger* should then be walked aft. While the *Messenger* is being walked aft, the *Towing Ship* should move to a position about 50 metres **astern** of the *Casualty*.
- Once the *Towing Ship's* stern is reported clear of the *Casualty's* **stern**, the overlap situation no longer exists and it is usually safe for one of the *Conning* officers to transfer from the Bridge to the *TCP* and take the ship from there (see Para 0523r).
- The *Tow* may be passed from the position about 50 metres **astern** of the *Casualty* and may be fully streamed. Gentle power will be needed to start the *Casualty* making way downwind.

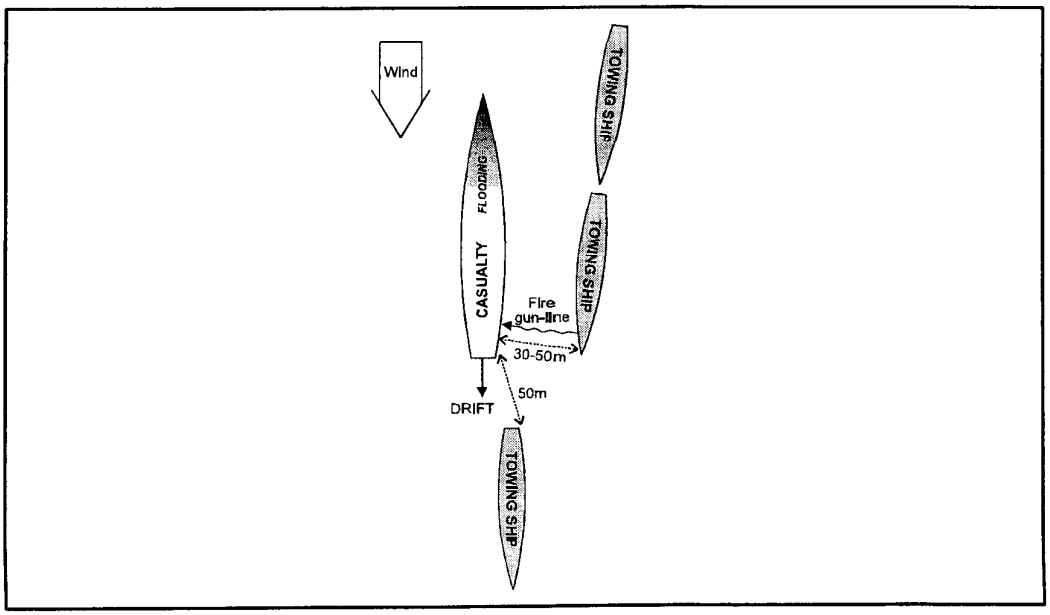

Fig 5-13. Downwind Approach to Casualty lying Head to Wind (Tow Stern First)

(0524) j. **Other Approaches for a Ship to be Towed Stern First.** It may be necessary to *Tow* a ship stern-first when its *Trim* is normal (eg when its bows are damaged but significant flooding has been prevented). In this event, mirror images of the approaches at Paras 0524d-g may be used, substituting the stern for the bow in each case.

k. **Cross-Wind Approach to Casualty lying Head to Wind (Tow Bows First).** This approach should be used for a *Casualty* which has the wind well forward of the beam or head to wind and will thus be drifting and sailing astern. **This situation is most likely to occur if the *Casualty* is *Trimmed* heavily by the bow as a result of substantial flooding forward (eg from a collision or action damage); if so, the *Casualty* is best *Towed* stern-first (see Para 0524i), as it will be unmanageable if *Towed* ahead (see Para 0523i). However, if it is essential for operational reasons to attempt to *Tow* bows-first (eg if *Casualty* is about to ground on a lee shore), the following approach may be used, although it will be difficult for a warship to pass the *Tow*, maintain position to start the *Casualty* making way into-wind and keep control thereafter.** The procedure is as follows:

- The approach should be made across the wind, passing 30-50 metres upwind of the *Casualty's* bow, allowing for its *Drift Rate* (see Fig 5-14).
- The gun-line should be fired from the focsle at a range of about 50 metres, before the bows come level; the gun-line and *Messenger* should then be walked aft. Alternatively, the gun-line may be fired from aft / Flight Deck.
- While the *Messenger* is being walked aft, the *Towing Ship* should move to a position about 50 metres on the bow of the *Casualty*.
- Once the *Towing Ship's* stern is reported clear of the *Casualty's* bow, the overlap situation no longer exists and it is usually safe for one of the *Conning* officers to transfer from the Bridge to the *TCP* and take the ship from there (see Para 0523r).
- The *Tow* may be passed from about 50 metres on the bow of the *Casualty*. **Once connected, as much as possible of the *Towing Hawser* should be kept inboard to allow the *Towing Ship* to *Turn at Rest (Cast)* into wind (see Para 0526b).** The full *Tow* should be streamed when turn is complete.
- During this initial phase (immediately after the *Towing Ship* has stopped), it is likely that the *Casualty*'s drift will initially exceed that of the *Towing Ship* (see Para 0523.l) and this may make the passing of the *Tow* difficult as the distance between ships increases (Fig 5-14, Position 3a). However, once the *Towing Ship* (broadside to the wind) builds up *Leeway*, its *Drift Rate* may well exceed that of the *Casualty* (head to wind), and thus start to overtake it (Fig 5-14, Position 3b). In either case, the *Towing Ship's* need to *Turn at Rest* into wind before staring to *Tow* will be made more difficult (Fig 5-14, Position 4).

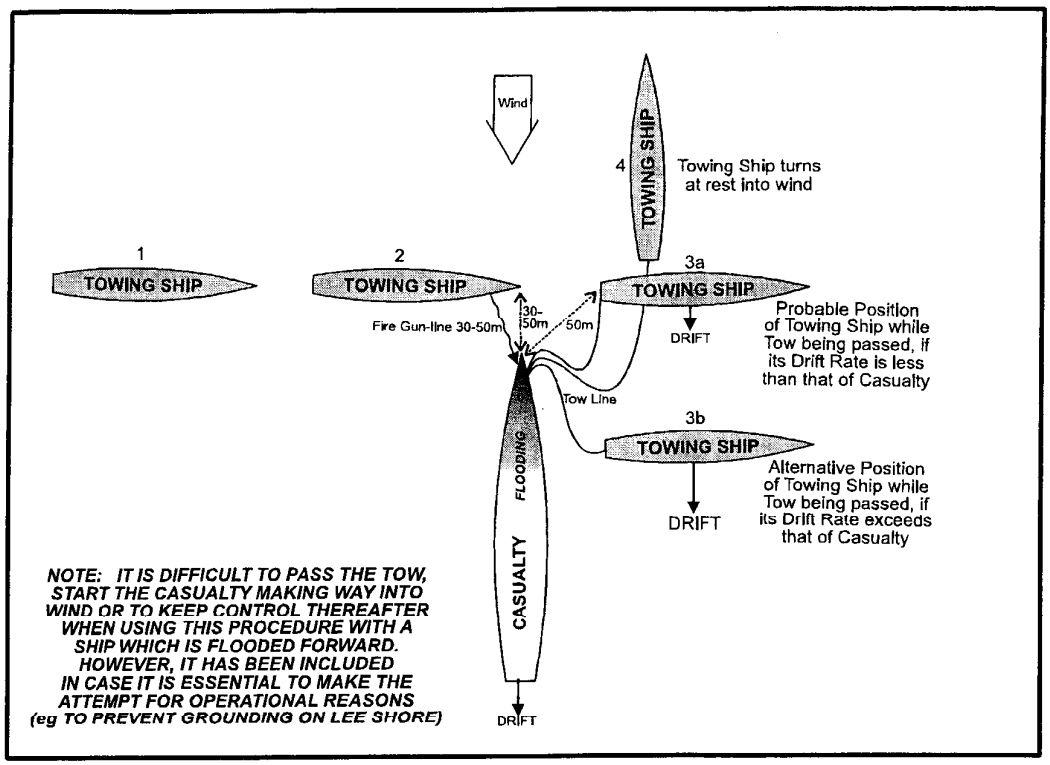

Fig 5-14. Cross-Wind Approach to Casualty lying Head to Wind (Tow Bows First)

Notes:

1. It may seem at first glance that the most obvious method of approaching a ship lying head to wind is to make an approach into-wind parallel to the Casualty, but this choice would almost certainly lead to more difficulty and is not recommended. If such an approach were to be adopted, on passing the bows of the Casualty, once the Towing Ship applied astern power to stop there is a risk that it might fall off the wind. Unless substantial engine power is used to prevent this (at a time when the Messenger / Tow is being passed), the Towing Ship might find itself broadside to the wind <u>and</u> directly upwind of the Casualty, which is a much more hazardous position than likely to be encountered during the other into-wind approach at Para 0524f. Once broadside to the wind, the Towing Ship would soon start to make leeway, which, if it exceeded that of the Casualty, will cause the Towing Ship to drift directly over the Towing Hawser onto the Casualty's bows.

2. There is an additional reason for not attempting an into-wind approach described at Note 1 (above). The only likely circumstances in which it may be essential to Tow a ship bows-first when it is lying head to wind as a result of being Trimmed heavily down by the bows, is if it is vital to move it upwind without delay and this need outweighs the manoeuvring difficulties of controlling it (see Para 0523i). Such circumstances may occur when there is little searoom to leeward (ie the Casualty is close to a lee shore), and thus it may not be navigationally possible to make an approach from astern of the Casualty.

0525. Passing the Tow

There are 5 methods of passing the *Messenger* to the *Casualty,* as shown below:

a. **Gun-Line.** Firing a gun-line is the normal method of transfer and requires the ships to close to between 30 -50 metres, depending on the strength and direction of the wind.

b. **Helicopter.** The optimum flight path of a helicopter carrying a *Messenger* is 185 metres upwind of the deck from which it has taken off, so the *Towing Ship* should stop with the Flight Deck 185 metres down-wind of the *Casualty*. A light 12 mm *Messenger* is used, one end of which is held by a rope stopper passed through a ring in the floor of the helicopter. When the helicopter reaches the *Casualty*, a weighted *Heaving Line* is attached to the *Messenger* and the end dropped down on deck. Once the ship has the *Heaving Line* in hand, the stopper is released and the *Messenger* is let go.

c. **Seaboat (Rigid Inflatable Boat - RIB).** Under most weather conditions, *RIBs* are sufficiently seaworthy to take a 12 mm *Messenger* to the windward bow of the *Casualty*. However, in strong winds and high seas, the *RIB* may be sent to a more sheltered position, on the lee bow of the *Casualty,* while the *Messenger* is being passed inboard. If the *Messenger* drifts near the *Towing Ship's* propeller, the shaft should be stopped (eg apply the *Shaft Break*).

d. **Rocket Line Thrower.** Submarines (and many commercial vessels) are equipped with rocket line-throwing apparatus. These have up to 500 metres of line and thus much greater range than a gun-line. The *Towing Ship's* approach should allow the rocket line to be fired down wind. See Para 0529.

e. **Streaming a Polypropylene Messenger with Float.** This is a slow and uncertain method of establishing contact which depends partly on precise positioning of the *Towing Ship* relative to the *Casualty,* and partly on the ability to grapple the floating *Messenger*. There are two options:

- Either, the *Casualty* lays out the *Messenger* (upwind) as the ship drifts down-wind; the *Towing Ship* approaches on the windward side and grapples the *Messenger*.
- Or, the *Towing Ship* lays out the *Messenger* on the lee side of the *Casualty*, then stops ahead and waits for the *Casualty* to drift down onto the *Messenger*.

f. **Risk to Propellers.** The Admiralty Manual of Seamanship (BR 67) requires a nominated person in a suitable position to watch the *Towing Hawser* during streaming (and recovery) and to show a red flag or bat if the propeller is in imminent danger of fouling the *Towing Hawser*. It is then for the Command to decide what action to take and whether to apply the *Shaft Brake* (if fitted).

0526. Starting the Tow Making Way

a. **Initial Manoeuvres.** When the *Towing Hawser* has been secured in the *Casualty*, the *Towing Ship* should move slowly ahead directly into-wind/down-wind (see Paras 0524e-i), or *Turn at Rest* ***(Cast)***, before moving slowly ahead into-wind (see Paras 0524d /j). These manoeuvres are required for the reasons (repeated below) from Para 0524b:

> *'Given their very limited Turning Moment when Towing (see Para 0521), warships almost always have to start the Casualty making way either directly into-wind or directly down-wind, only altering to the required course when a good speed has been built up and steering in the Casualty can be effective. Attempts to start the Casualty making way across the wind normally cause control to be lost. In the worst case this can result in the Towing Ship's stern being dragged (up-wind) by the bow of the Casualty flying into wind, so that both ships end up in a bow-to-stern configuration.*

b. **Turning at Rest.** In the cases where the *Towing Ship* has to *Turn at Rest* ***(Cast)*** into-wind, (see Paras 0524d and j), it is essential to keep the *Towing Ship's* stern as close as possible to the *Casualty*, so that the maximum amount of the *Towing Hawser* can be retained on deck until the ship starts its *Turn at Rest* ***(Cast)***. The reason for this is that the *Towing Ship's* stern will swing away from the *Casualty* during the turn, and given the very poor *Turning Moment* available (see Para 0521), should the *Towing Hawser* come taught before the turn is finished, great difficulty will be experienced in completing it. Upper deck teams will need careful briefing on this as they will otherwise be tempted to stream the whole *Tow* as quickly as practicable which will lead to the ships drifting apart.

c. **Towing Hawsers Supplied to RN Warships.** RN warships now use polyamide multi-plait *Towing Hawsers* (see BR 67 Chapter 4). Although wire *Towing Hawsers* were apt to part if they came out of the water, this is NOT always the case with polyamide multi-plait *Towing Hawsers*. These *Towing Hawsers* should ideally be kept in the water but can survive under load out of the water; they are designed to stretch up to 25% and to absorb sudden loads but this is not a carte-blanche to treat them carelessly, as excessive strain will still cause them to part. The use of a 'stress line' (see BR 67 Para 04003c) attached in two places to a near part of the *Towing Hawser* is a very useful aid to indicate by how much the *Towing Hawser* has stretched and therefore how near it is to its elastic limit and parting. See Para 0527 and Annex 5A for details of *Safe Towing Pulls* at various speeds for the *Towing Hawsers* supplied to RN warships.

d. **Minimising Strain on the Towing Hawser as Towing Starts.** Assuming that the *Towing Ship* is either pointing directly into-wind/down-wind or has successfully *Turned at Rest* into-wind, and that the whole *Tow* is streamed (without touching bottom in shallow water), the *Towing Ship* should come very gently ahead. This should be either at minimum power or by intermittent power ahead, to apply load to the *Towing Hawser* in a gradual, progressive manner. Sudden bursts of high power causing a jerk on the *Towing Hawser* (and thus excessive strain leading to parting) should be avoided. If, as is often the case, the heading of the *Casualty* has to be altered very substantially in this initial manoeuvre, patience is required; a 'slow-and-steady' technique is much preferable to a 'gung-ho' attitude. Given a gentle, steady pull on the *Towing Hawser*, the *Casualty* should start to make way in the required direction, after which speed can be built up.

0527. Towing in the Required Direction at the Required Speed

This paragraph starts from the assumption that the *Casualty* is making way at a reasonable speed under *Tow*, either directly into-wind or directly down-wind (see Para 0526).

a. **Calculating a Safe Towing Speed.** The speed of a *Tow* depends on the tonnage and type of ship under *Tow*, the power of the *Towing Ship* and the strength of the *Towing Hawser*. If a *Safety Factor* of between 4 and 7 is applied to the strength of the *Towing Hawser* in use, a *Safe Towing Pull* can be established by using the graph at Fig 5A-1. This *Safe Towing Pull* in tonnes can then be translated into the *Towing Speed* for the particular ship under *Tow* by reference to the graph at Fig 5A-2 (propeller(s) trailing) or Fig 5A-3 (propeller(s) locked).

Example. *From the Annex 5A graphs, it can be seen that the 64mm Towing Hawsers in FF/DDs are able to Tow a 15,000 tonne merchant ship (propeller trailing) at just under 8 knots with a Safety Factor of 7, or at 11 knots with a Safety Factor of 4; a 50,000 tonne merchant ship (propeller locked) could be Towed at just over 4 knots with Safety Factor of 7. or at 5½ knots with a Safety Factor of 4, etc.*

Note. *Unlike tugs (whose Towing Hawsers are matched to their maximum Bollard Pull), the engine power available in RN warships exceeds the breaking strain of their Towing Hawsers, so only comparatively low propulsion powers are required to conduct a Tow.*

b. **Choice of Safety Factor.** In selecting the level of *Safety Factor* to be used, the following points should be considered:

- **Urgency of the Tow.** Operational priorities, hostile action or heavy weather may dictate that a lower *Safety Factor* be used in order to achieve a faster *Towing Speed*, or the *Tow* of a larger ship than would otherwise be the case.
- **Duration of the Tow.** For long distance tows, a higher *Safety Factor* should be applied, as the wear and tear on the *Towing Hawser* will have to be sustained over a more protracted period.
- **Weather.** It may be necessary to accept a lower *Safety Factor* initially in order to make a faster transit out of the path of heavy weather, or alternatively, if caught in adverse conditions, to increase the *Safety Factor* and accept a lower *Towing Speed* in heavy weather.
- **Pitching Out of Phase.** If the *Casualty* and *Towing* Ship are *Pitching* out of phase, there will be additional strain on the *Towing Hawser* and a lower *Safety Factor* should be used.
- **Casualty Yaw.** If the *Casualty* is *Yawing*, this will generate additional strain on the *Towing Hawser* and a lower *Safety Factor* should be used. This also applies to making deliberate turns, where the induced *Yaw* for the turn has a similar effect.
- **Underwater State of Casualty.** Increased resistance to motion caused by the state of the *Casualty's* bottom (foul or clean), and any underway projections or damage to the hull should be taken into account and the *Safety Factor* reduced accordingly.

(0527) c. **Altering Course.** Once the *Casualty* is making way at a reasonable speed under *Tow*, either directly into-wind or directly down-wind, it will usually be necessary to alter course, probably across wind and sea, in order to make harbour, a 'Place of Safety' (see BR 45 Volume 4 Chapter 13) or a rendezvous with tugs to take over the *Tow*. In a warship, altering the course of the *Tow* out of wind is one of the more difficult aspects of *Towing*, due the poor *Turning Moment* available (see Para 0521), and it is usually essential that the *Casualty* is capable of being steered (see Para 0527g) in order to achieve it. The procedure is as follows:

- The *Towing Ship* first informs the *Casualty* of the intention to alter course.
- When both ships are ready, the *Towing Ship* makes a cautious alteration of course, to induce a *Yaw* in the *Casualty* and so bring hydrodynamic forces to bear, to make it alter course (see Para 0133).
- The *Casualty* assists the turn by using its rudder(s), if available.
- Any large alteration of course should be made in steps by the *Towing Ship* to avoid excessive strains on the *Towing Hawser* or the catenary alternately slackening and tautening.

d. **Altering Course when Risk of Collision Exists.** In situations where there is a risk of collision with an approaching ship, decisive action must be taken early if the *Towing Ship* and *Casualty* have to give way under the *IRPCS* (see BR 45 Volume 4 Para 09047). This is particularly important at night as the lights of both ships can be confusing, especially if the *Casualty* has taken a sheer and an approaching ship may see different coloured sidelights on the *Towing Ship* and *Casualty*.

e. **Towing Hawser and Anchor Cable Catenary - Options.** In an ideal situation, the *Towing Hawser* should be secured to several shackles of anchor cable which have been veered from the *Casualty* to form a catenary which generally remains in the water (see Para 0523c). The weight of anchor cable damps any sudden strains which occur in the *Towing Hawser* as a result of the relative movements of the two ships. The depth of the catenary depends partly on the *Towing Speed* and partly on the amount of cable veered. On approaching shallow water, it may be necessary to reduce the amount of cable veered to prevent the *Towing Hawser* touching the sea bed as the ships slow down. However, in reality this arrangement is not always possible. If *Towing* a damaged or partially flooded *Casualty* stern-first (see Paras 0524i) it is most unlikely that anchor cable will be available and this may also be the case when *Towing* a *Casualty* bows-first if the anchor windlass is out of action. In addition, modern polyamide multi-plait *Towing Hawsers* supplied to RN warships can be used with care when completely out of the water, without necessarily parting (see Para 0526c). Nevertheless, if anchor cable can be used with the *Towing Hawser* and the catenary kept in the water, this will ensure that the risk of parting the *Towing Hawser* is minimised.

f. **Chafing of Towing Hawser and Anchor Cable.** To counter the effect of chafing, the *Casualty* should freshen the nip in chain cable at least once every 24 hours; it will be necessary to reduce speed (see Para 0528) while this is done. A polyamide *Towing Hawser* on a *Towing Pendant* or secured to a *Towing Slip* right aft will not usually chafe.

(0527) g. **Yaw and its Correction**. Most vessels under *Tow* will *Yaw*, but provided it is not excessive and the *Casualty* can be steered, *Yaw* should not cause difficulty. However excessive *Yaw* will put heavy strain on the *Towing Hawser* at the end of each *Yaw*, nip the anchor cable in the hawsepipe and increase chafing there. It is possible to reduce *Yawing* in a number of ways, as follows (assuming *Towing* bows-first):

- **Increase Trim by the Stern.** Not being *Trimmed* sufficiently by the stern is the most usual reason for a *Tow Yawing*. The best way of increasing a *Casualty's Trim* by the stern is to transfer liquids or ballast from forward to aft, as this will not alter its buoyancy. If this is not possible, *Trim* may have to be corrected by flooding or adding ballast. If this has to be done, care must be taken not to alter the *Casualty's* stability or reserve of buoyancy in a way which reduces its seaworthiness dangerously. See also Para 0523o.

- **Altering the Towing Speed.** *Yawing* caused by *List* usually decreases at **higher** speed (see also Para 0523h); *Yawing* caused by not being *Trimmed* sufficiently by the stern usually decreases at **lower** speed (see also Para 0523i). Depending on the cause of the *Yaw*, speed may be adjusted to minimise it.

- **Setting the Casualty's Rudder.** If the *Casualty's* steering gear is damaged, its rudder may still be workable by hand. If the rudder can be set over, the *Casualty* may be steadied at a constant angle of *Yaw* to one side of the *Towing Ship's* track. It may be necessary to alter the lead of the *Tow* to prevent a bad nip or unnecessary chafe.

- **Towing Another Ship Astern.** Securing a second rescue ship with a hawser astern of the *Casualty*, to be used as a 'powered rudder', has been successful on a number of occasions. The second ship keeps slight strain on its hawser and sheers to one side in order to keep the *Casualty* on course. Alternatively the second ship can merely be added to the *Tow*. On one occasion in the past, a ship which had lost its rudder was *Towed* for a long distance in high winds and heavy seas with a second ship astern to steady its course.

- **Shifting the Point of Tow.** A *Casualty* which is *Yawing* from side to side may be steadied at a constant angle of *Yaw* by shifting the point of *Tow* aft on the inner bow. But this is only practicable if the resultant angle of constant *Yaw* is not too great and if the *Towing Hawser* or cable is not subject to chafe.

- **Towing a Drogue.** A *Drogue* streamed astern of the *Casualty* may steady it, especially if it is a fairly small ship with fine lines. The type of *Drogues* which have proved successful are: a bight of 48 mm buoyant rope; a shackle of ship's cable streamed on a *Messenger*; a provision net filled with mats, *Towed* on a two-legged bridle; and a kite otter used for minesweeping.

- **Setting a Sail.** Setting a sail in the *Casualty* either right forward or right aft may reduce the *Yaw*. A small awning can be used with an improvised rig.

- **Propellers.** A stopped propeller may *Drag* in such a way as to reduce the *Yaw*.

(0527) h. **Length of Tow.** *Towing Hawsers* in RN warships are intended to be used fully streamed. However in certain circumstances (eg trying to haul a crippled ship out of an enclosed bay or creek, or when approaching shallow water with the risk of the *Towing Hawser* touching the sea-bed) it may be necessary to shorten the *Tow*.

- **Heading Towards Open Water.** If in constrained water (eg trying to haul a crippled ship out of an enclosed bay or creek) but heading towards open water, only part of the *Towing Hawser* should be streamed initially and an improvised securing point on deck used. The *Towing Ship* should manoeuvre with great care to avoid parting the *Towing Hawser* or damaging the improvised securing point. The full *Towing Hawser* should be streamed to the *Towing Slip* as soon as practicable.

- **Approaching Shallow Water.** If approaching shallow water, it may require the *Casualty's* anchor cable to be *Hove-in* and then part of the *Towing Hawser* recovered on deck to an improvised securing point (as above). The *Towing Ship* should manoeuvre with great care to avoid parting the *Towing Hawser* or damaging the improvised securing point.

0528. Slowing Down, and Recovering or Transferring the Tow

a. **Casualty's Tendency to Yaw into Wind when Slowing Down.** When a *Casualty* is *Towed* across the wind it has a tendency to *Yaw* into the wind. This *Yaw* often causes the *Casualty* to lie slightly upwind of the *Towing Ship's* track, even when steering to maintain course. When the *Towing Ship* slows and pull of the *Towing Hawser* is reduced, the *Casualty* will normally *Yaw* into-wind. If the *Casualty* is being *Towed* at a reasonable speed at this stage, it should be able to counter this *Yaw* by using its rudders or one of the other methods at Para 0527g. This is appropriate when slowing down to freshen the nip of the *Casualty's* anchor cable (see Para 0527f). However, if speed is reduced further (as in recovering / transferring the *Tow*), it will become more and more difficult to control the *Casualty's* heading. As when starting a *Tow* (see Paras 0524b and 0526a), in the worst case during slowing down, the *Casualty*'s *Yaw* into-wind can result in the *Towing Ship's* stern being dragged (up-wind) by the bow of the *Casualty* flying into-wind, so that both ships end up in a bow-to-stern configuration.

b. **Turning Casualty into Wind before Slowing Down.** The situation at Para 0528a (above) may be avoided by turning the *Casualty* directly into-wind before slowing down. It may be possible to turn directly down-wind if constrained upwind, but turning down-wind and keeping the *Casualty* heading down-wind when slowing is much more difficult.

c. **Gradual Slowing Down.** Once turned into-wind, the *Towing Speed* should be reduced in small steps so that the steadying pull of the *Towing Hawser* is not reduced too sharply at any stage. Unless the *Casualty* is particularly small, it will tend to carry it way for a long time and for this reason plenty of sea-room is required for slowing down. While slowing down, even when heading directly into-wind, the *Casualty* can take an unpredictable sheer without warning, particularly when almost stopped in the water as it tries to lie beam to the wind. However, at such very low speeds (virtually stopped), it is normally possible for the *Towing Ship* to maintain *Station* on the *Casualty* without too much difficulty. **Thus the greatest vigilance is necessary when manoeuvring the *Towing Ship* during the whole slowing down phase of a *Towing* operation.**

d. **Recovering the Tow.** Once at very slow speed or stopped in the water, provided the *Casualty* is able to *Heave-in* its anchor cable and disconnect the *Towing Hawser*, recovering the *Tow* is straightforward. Equally, if anchor cable has NOT been used, *Slipping* the *Towing Hawser* from the *Casualty* is not usually a problem. However, if anchor cable has been veered and the *Casualty's* anchor windlass is out of action, the situation is much more difficult (see Para 0528e below).

e. **Transferring or Slipping the Tow.** If the *Casualty's* anchor cable has been veered and its anchor windlass is out of action, breaking the cable on the *Casualty's* deck and *Slipping* it will not solve the problem, as warships do not normally have winches of sufficient power aft to recover that weight of cable. It may be possible to bring a large tug alongside the warship, and for an improvised method to be devised for transferring the warship's *Towing Hawser* to the tug *(this was the method eventually used in the incident described in the Note to Para 0523c)*. If in shallow water, the warship may be forced to *Slip* its *Towing Hawser*, having first carefully buoyed it, so that it may be recovered by a more fully equipped salvage vessel.

This chapter is an extract of the

BOAT CREW SEAMANSHIP MANUAL,

COMDTINST M16114.5A dated 16 JUL 85.

It is reproduced here because it is one of the best 'Soup to Nuts' primers on Coast Guard towing. Even though the illustrations show UTBs and MLBs, much of the information applies equally to all Coast Guard towing operations.

CHAPTER 12. TOWING

A. INTRODUCTION. Every year the Coast Guard tows thousands of vessels to safety. If you can name all of the sizes and designs of boats in a major port at any given time then you may have an idea of how many different vessels Coast Guard personnel have had to assist. Obviously, a single method of towing will not be adequate for all these boats. There are, in fact, a number of ways to take a disabled vessel in tow. The one selected depends upon the size of the distressed craft and the prevailing weather conditions. Nonetheless, regardless of the towing method employed, safety is always one of the most important considerations. One careless moment is all it takes to hazard or lose the vessel in tow. Likewise an unguarded instant can cause injury or death to unwary people on either boat. Undoubtedly you have already heard a few of the gruesome stories about the damage a parted towline can do. There are numerous other ways accidents can happen during a towing evolution. Nearly everything you do when you take a boat in tow is potentially dangerous. No two tows are exactly alike. This is why all small boat crewmembers must be familiar with every aspect of towing fundamentals. Indeed, this is the purpose of the following chapter. Knowing how to use the rules and principles included in the subsequent pages will help you do your job, that is, to save life and property. Remember, if it were an easy job anyone could do it.

The 41' UTB and the 44' MLB are the two primary Coast Guard boats used in towing. For this reason most of the textual information included here refers to these two standard towing platforms. However, most of the material discussed is generally applicable no matter what kind of Coast Guard boat is used for towing. Certain procedures and equipment of particular note when the towing platform is one of the many nonstandard boats is contained in Appendix A. Read this appendix after you have finished the chapter.

Regardless of the type of platform used for towing, all boats performing Coast Guard towing evolutions are bound by the policy outlined in the Coast Guard Addendum to the National SAR Manual. The pertinent sections of this publication have been reproduced in Appendix B for your convenience. Read this appendix before continuing. Items of particular importance have been highlighted for your convenience.

B. TOWING SAFETY PRECAUTIONS.

1. **Introduction.** Safety of personnel is of paramount importance in towing evolutions. Property is a secondary concern and must never take precedence over personnel safety. In the interest of safety the following list of precautions should be considered in every towing evolution.
   a. Remove all personnel from the disabled boat if necessary.
   b. Have all persons on board don PFD's. However, do not allow the disabled boat to become further endangered while waiting for the personnel on board to don PFD's. Immediately take whatever action is necessary to remove the personnel from danger. If personnel do not have PFD's provide them.
   c. When using a heaving line or a shoulder line throwing gun to pass the towline, throw or fire the line well over the boat so that it drops over the distressed vessel's deck. DO NOT fire or throw a line directly at the boat. Warn the other boat of your intentions and call out "HEAD UP".
   d. Establish and maintain communications: to include backup communications with the towed boat. Depending on prevailing conditions, the towed boat should be contacted at least every twenty minutes. Specifically, determine the following information from the operator:
      (1) Condition of towline, chaffing gear, towline attachment point and fairlead hardware.
      (2) Level of water in the bilges.
      (3) Physical condition of the people on board.

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e. When underway keep personnel on board both boats clear of the towline.
f. Keep the towline attachment point as low and as close to the centerline of the tow as possible.
g. Do not attach the towline to lifelines, stanchions, grab rails, or ladders.
h. Do not attach the towline to cleats or bitts that are only screwed on to the disabled boat's deck.
i. Do not use any line provided by the disabled boat for towing for you can never be certain of the condition of such line.
j. Do not use knots to join towlines unless there is no alternative.
k. Always hand tend your towline until it is secured to the other boat. Then secure it to your boat's towing bitt.
l. Do not secure the towline to your towing bitt with half hitches. They can jam or fuse under strain.
m. Ensure that the breaking strength of all shackles used is equal to or greater than the breaking strength of the towline. (See Chapter 1, Table 1-3)
n. Keep the towline clear of your boat's screws.
o. Use chafing gear to avoid damage to the towline.
p. Do not tow a boat if it is beyond the capabilities of your boat unless in an emergency and with the concurrance of higher authority.
q. Do not tow at excessive speed or beyond the design speed of the towed boat. See paragraph E4.
r. Avoid sudden maneuvers and turns.
s. Use a drogue to reduce or prevent yawing of the tow if necessary.
t. If practical, have someone at the helm of the disabled boat. Direct the person to steer directly behind your boat. If all personnel have been removed from the towed boat, secure its rudder amidship. If the towed boat is an outboard, direct the operator to lower the unit to its normal operating position.
u. Keep the tow trimmed aft. If it is safe to leave personnel on board the distressed craft, direct them to don PFD's, get as far aft and as low as possible on or near the centerline of the boat. Their weight will lower the center of gravity and increase the stability of the tow. REMEMBER, however, other factors MUST be taken into consideration in determining where to place personnel remaining on the towed vessel. These factors are, but not limited to:
   (1) Condition of vessel (i.e., structural damage)
   (2) Structural design of the vessel (i.e., height of transom above the water. Do not have a high or low freeboard aft?)
   (3) Trim and load of vessel.
   (4) Number of personnel onboard the vessel.

WARNING

Overloading astern or along either side of a boats centerline may swamp or capsize the vessel during a towing evolution.

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v. Maintain a constant towing watch and frequently account for all people on board the boat either visually or by radio.
w. Ensure that the breaking strengths of all bridles used are equal to or greater than the breaking strength of the towline.

C. STATIC AND DYNAMIC FORCES IN TOWING.

1. **Introduction.** There are numerous forces at work during a towing evolution which affect the towing boat, the towed boat, deck fittings on both boats, as well as the towline and the bridle, if used. While not all encompassing, this section gives a basic understanding of how these forces operate and will assist you in determining what adjustments to make to the towing equipment and

when to make them. Essentially all forces are classified as either static or dynamic (See Figure 12-1).

a. Static forces are a function of the weight (mass) characteristics of a boat and are therefore classified as internal forces. The towing boat must overcome these forces. When they are applied to the towed boat, static forces are the forces required to overcome the resistance of the towed boat to being placed in motion (inertia) by the pulling boat. Static forces then, are encountered before and as the towed boat begins to move. Additionally, force is required to turn a towled boat to bring it in line with the towing boat. These can be minimized by beginning the tow slowly and by gradually building up to towing speed. REMEMBER, some FORCES are experienced before the towing vessel starts to move and as it begins to move. These are minimized by starting a tow off at a SLOW speed and slowly increasing your speed in the SAME direction as the disabled vessel is heading. In other words, in a situation where a disabled vessel approaches the towing limitations of your boat in terms of LENGTH and WEIGHT, DO NOT attempt to get the disabled boat moving and its heading changed at the same time. It would be more prudent to get the vessel moving through the water and then, using its rudder, if possible, to effect a change in heading. It may be necessary, however, because of navigational hazards to initially change the heading of the vessel to be towed before getting it underway.

b. Dynamic forces are associated with the movement of the boat and the ever changing environment. The speed and direction of the wind and the height and direction of the seas create forces acting on both the towed and towing boats. The frictional force resulting from the movement of a boat through the water is, as well, an example of a dynamic force. There are Constant and Intermittent dynamic forces.

(1) **Constant Force.**

(a) As a vessel moves through the water, the water layer next to the hull (called the boundry layer) moves along with it. The movement of the boundry layer with the hull through the water creates friction between adjoining water molecules and is called frictional resistance. It increases with increases in hull speed.

(b) Frictional resistance acts on both the towing and towed vessels, and is overcome by the towing vessels engine(s). However, the strain on the towline, due to frictional resistance comes from the resistance of the towed vessel. If the towed boat is a deep draft vessel and the towing speed is high, the frictional resistance of the towed boat severly strains deck fittings and the towline.

(2) **Intermittent Forces.** Intermittent forces are due to frictional resistance of wind, waves, chop, swells, or a boats wake.

(a) Forces due to frictional resistance of a boat's hull to wind (drag) effects not only the towing rig, but also control, speed and efficiency of the tow.

(b) Resistance caused by intermittent and varying forces of waves or sea conditions encountered by the boat in tow may cause heavy stress on deck fittings and towing rig. These forces are called "SHOCK LOADS" and are caused by the waves/sea irregular patterns and resistance to the towed vessel as it is towed through the water. Shock loading varies with the state of the sea, speed of the vessel and LENGTH of the towline. The length of towline determines the amount of shock load it can absorb. Increasing the length of the towline increases the shock load it can absorb.

CAUTION

SHOCK LOADING may cause severe damage to both the towing and towed vessels, as well as overloading the towline. When heavy seas are encountered shock loading can usually be decreased by reducing speed.

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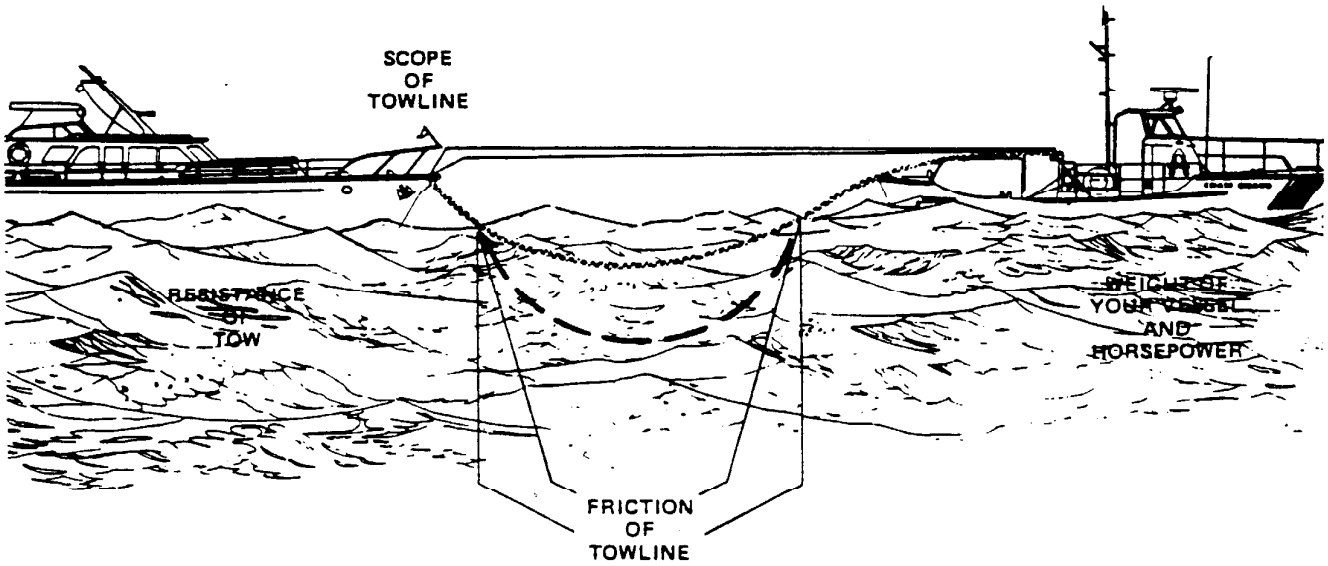

Figure 12-1 Forces Exerted on Towline

(c) These forces act upon: (a) the towing vessel; (b) the towed vessel, and (c) the towing rig between them. All of these forces result in strain on the towing and towed hull, their fittings and the towing rig (towline and bridle). Understanding these forces and their causes will enable the coxswain to avoid exceeding the physical stress limits of the equipment or vessels and prevent unnecessary damage or personnel injuries due to such failure.

D. TOWING EQUIPMENT.

1. **Introduction.** You probably have a good general idea of what towing equipment is. Naturally, it includes the towlines and bridles, deck fittings, as well as the hardware for attaching the towline such as kickerhooks and shackles. Drogues and fenders also fall into this category. Before you learn how to use towing gear you must know what it is designed to do and what the strengths and weaknesses of each item are. These subjects are addressed below.
2. **The Towline.** It is probably obvious to you that the towline is the most important piece of equipment used in towing. Keep a minimum of four turns of line on the towline reel. Paying out the entire length could result in loss of both the tow and the towline (See Figure 12-2). Secure the towline to the reel with small stuff thus permitting the line to lay evenly on the reel. If it is necessary to slip the towline the bitter end can be easily released by cutting the small stuff with a knife. The boat outfit lists for the 41′ UTB and the 44′ MLB specify the following length and type of towline.

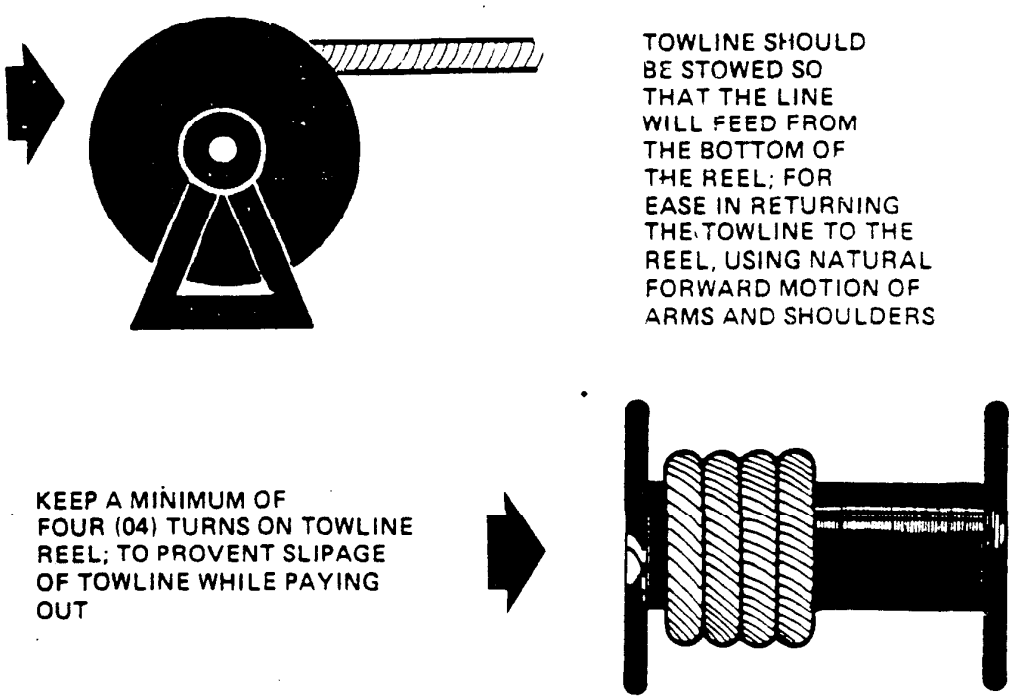

Figure 12-2 Storage of Towline

a. 41′ UTB: 600 feet of 2-3/4 inch 2-1 double braided nylon line.
b. 44′ MLB: 600 feet of 3 inch 2-1 double braided nylon line.

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Off shore or heavy weather towing often requires a minimum separation of two to three wave lengths between the towing and the towed boat to minimize the stress caused by surging and wave motion, on the towline connecting points, especially on the towed boat. A minimum of 500 feet of towline is frequently necessary to achieve this separation. Less than this length may make towing offshore or towing in heavy weather unsafe. Standard SAR boats should not carry less than 500' of towline. The size and length of towline for every Coast Guard boat are determined by the bollard pull and by the weight of the boat. These factors in turn are used to calculate the strengths of the towing bitt for each boat. Both the 41' UTB and the 44' MLB are designed to tow vessels up to 75' in length and up to 100 displacement tons. The breaking strength of the 2-3/4" double braided nylon line carried on the 41' UTB is 257,000 pounds. It weighs 22 pounds per 100 feet. The breaking strength of the 3 inch double braided nylon line carried on the 44' MLB is 285,000 pounds and weighs 26 pounds per 100 feet. These figures are calculated with the safety factors included. Both of these line sizes will allow the 41' UTB and the 44' MLB to tow up to their towing design characteristics. They will, in fact, part before damaging the towing boat's fittings which, as you will recall, is consistent with what you learned in Chapter One. The point to be made here is that you cannot tow beyond the design characteristics of any towing boat by simply increasing line size. FIRST, excessive strain could damage the towing boat's deckfittings if the breaking strength of the line exceeds the tolerances designed into the deck fittings. SECOND, even though larger sized line could probably be used to tow a larger vessel in calm waters, towing speed would have to be very slow and can result in excessive crew fatigue. Additionally if weather deteriorated, control of the vessel in tow would be virtually lost resulting in danger to personnel on both boats. THIRD, towing a large vessel can increase the danger of capsizing the towing boat should the towed boat begin to yaw, that is veer to one side of the towing boat or the other, thus actually exerting a pulling force on the side of the towing boat through the towline. Such a force will cause the towing boat to heel over in the water.

NOTE

Towline length and size will vary on non-standard boats due to design characteristics and storage space available.

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3. **Towline Thimbles.** Thimbles are designed to equalize load on the eye and provide maximum protection to the inner top of the eye from abrasion and wear. Thimbles may be used with towlines for these reasons. For lines 2-1/2 inches in circumference (13/16" diameter) and smaller, round grommet type thimbles are satisfactory. For line 2-3/4 inches in circumference (7/8" diameter) through 15 inches (5" diameter) use synthetic line thimbles. The thimbles for a single-part line (single line) with an eye splice are designed to take the Breaking Strength (BS) of a single line and are stamped "For use with single- part line with minimum breaking strength LESS than xxxxx pounds". (See Figure 12-3). Thimbles for continuous loop (doubled) are designed to take TWICE the BS of the line and are stamped "For use with double-part line with a minimum BS LESS than xxxxx pounds".

CAUTION

DO NOT use the old fashioned teardrop-shaped thimbles with synthetic fiber line: they do not fit snug nor hold their position within the eye splice. DO NOT use a thimble for single-part line in a continuous loop of line (doubled).

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4. **Inspecting the Towline.** The towline is the most important piece of gear used in towing operations and successful towing depends on it being in the best of conditions. It should be inspected frequently for damage resulting from cutting, abrasion, fusing, and snagging. A heavily used line, as in towing operations, will indicate reduced Breaking Strength and overloading by it having compacted or becomes hard. It should be downgraded (not used for towing) even though there is no apparent physical damage. It should also be inspected on a regular basis to ensure it satisfies the minimal length requirements. (See Table 12-1, Figures 12-4, 12-5 & 12-6).

Table No. 12-1

TOWLINE INSPECTION CHECKLIST

CHARACTERISTIC	DOWN GRADE	DISCARD
Length of towline less than 500' (*).		X
Towline other than authorized.		X
Bulk of surface strands of cover reduced by 50% or more for a distance equal to 4 or more line diameters.	X	X
Core visible through cover, result of cover damage.		X
More than 3 consecutive pulled cover strands (which cannot be worked into cover braid).	X	X
3 or more adjacent cut cover strands (line to 4 ½" circumference).	X	X
4 or more adjacent cut cover strands (line 5" circumference and over).	X	X
Core damage, pulled, cut or melted strands.	X	X
Line suspected of having been overloaded.		X
Burns or melting visible for a length of over 4 line diameters on cover.	X	
Abrasion on inside radius of eye, with bulk of surface strands reduced by 50% or more.		
Damage to female (throat) side of the eye.		

(*) Towline length will vary on non-standard boats due to design characteristics and storage space available. District Commanders provide guidelines for towline lengths and sizes for non-standard boats.

5. **Towing Bridles.** There are cases in which a towline led from the stern of the towing vessel to a single attachment point on the bow of the disabled vessel is not appropriate (i.e., a single fixed point, such as a bitt or sampson post is not available to secure the towline to). In these cases it is necessary to use a towing bridle leading from the towline to the bow cleats of the towed boat. Towing bridless may be constructed of double braided nylon and wire (wire rope bridle are used for towing larger commercial fishing fleet boats). The two most common types of bridles you will use are single and double leg bridles.
   a. The single leg bridle is normally used to tow sailboats (See Figure 12-7). The bridle is secured to the base of the sailboats mast, providing the mast is designed to withstand the stresses of towing, by taking one round turn with the bridle leg around the base of the mast and securing the bridle to the towline with a shackle.
   b. The double leg bridle (Y bridle) is used in situations where it can be rigged from the distress vessel so that both legs exert an equal pull on the hull. Although no specific length is required, the legs must be suitably long enough to reduce yawing. The breaking strength of the bridle legs must be equal to or greater than the strength of the towline (this is also true of the wire bridle). (See Figure 12-7). There are two basic types of double leg bridles: those having an eye

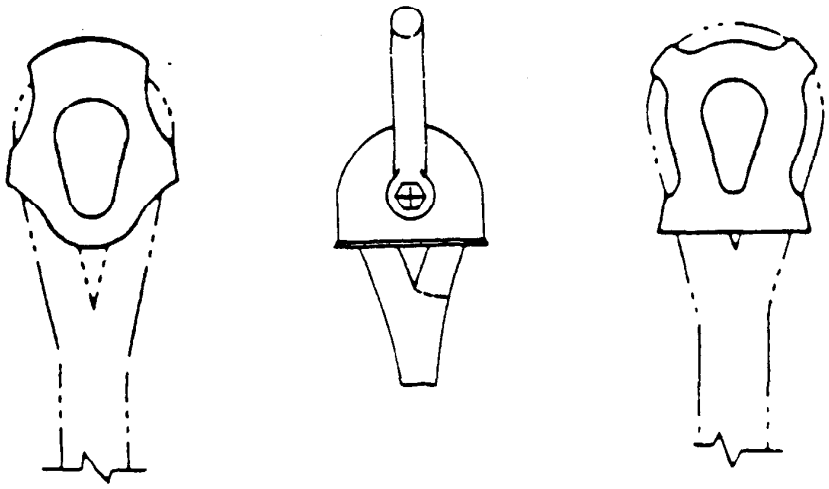

Figure 12-3 Synthetic Line Thimble for Single-part Line With Eye Splice

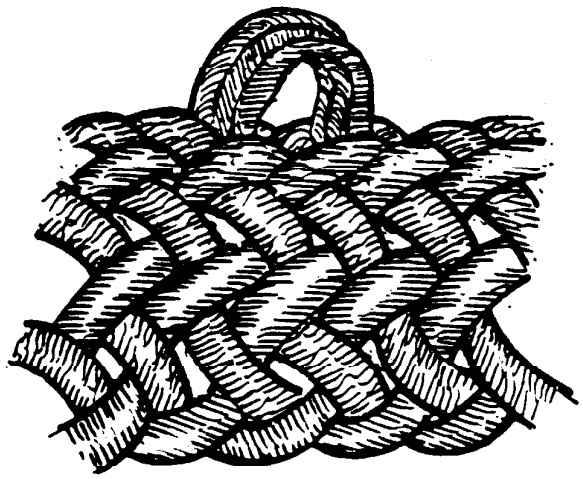

Figure 12-4 Pulled Strand

splice in both ends of their legs, and those without an eye in their bitter ends. The Y bridle is secured to both bows of the towed boat or both quarters of the towing boat so that both legs exert an equal pull. In all instances, insure that the bridles are protected with appropriate chafing gear.

c. There are two other bridles which should NOT be routinely used; the cabin and the hull bridle. The cabin bridle, which runs around superstructural housing of the distressed boat and the hull bridle, which runs around the hull, are EXTREMELY DANGEROUS and are used if a distressed boat has no and/or inadequate deck fittings (fittings not secured to the deck with through bolts and backing plates). It requires considerable line to construct a hull or cabin bridle, which is not readily available on board Coast Guard small boats. However, far MORE important is the fact that the amount of line and the way it is placed around a vessel to be towed, makes control of it very difficult even in calm waters. Furthermore, the configuration is such that the WAIST and/or TAG lines (lines used to secure the hull or cabin bridles in position) breaking strengths may not be enough to endure the "static" and "dynamic" towing forces. There are many different methods to construct these two bridles, depending upon the design and type of boat to be assisted. Consequently, it is extremely difficult to recommend a SAFE procedure for constructing them.

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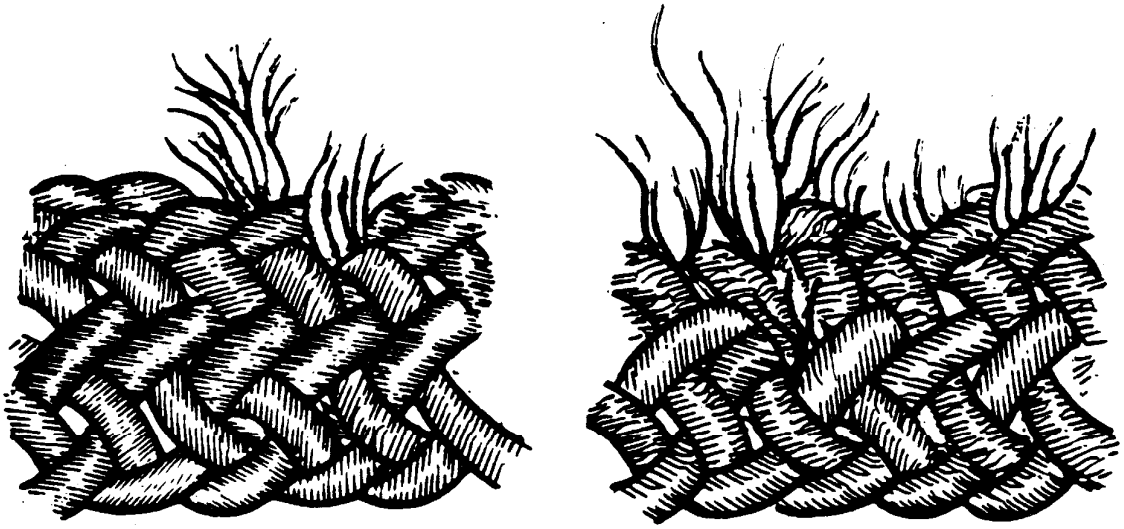

SINGLE CUT STRAND

MULTIPLE CUT STRANDS

Figure 12-5 Cuts, Abrasions and Snagging

WARNING

Cabin and Hull bridles should NOT be used. If a distressed boat has no and/or inadequate deck fittings, a prudent action may be to anchor the vessel. REMOVE the POB and advise the operator to seek commercial assistance for towage

d. **Inspecting Towline Bridles.** As mentioned, bridles are constructed from double braided nylon and wire rope. Inspection of these bridles should be accomplished in conjunction with the inspection of the towline. "Double Braided Nylon Bridles", as with the towline, should be inspected frequently for hardness, damage resulting from cutting, abrasion, fusing, and snagging. "Wire Rope Bridles", are normally constructed of 6x37 (6-strands with 37 wires per strand) GALVANIZED steel wire. Bridles of this type should be inspected frequently checking for fishhoops (broken ends of wire protruding from a wire rope), kinks, worn and corroded spots. Worn spots show up as shiny flattened surfaces.

e. **Determining Wear of Wire Rope.** To determine the wear, you must know (1) the original diameter of the wire rope, (2) the present diameter of the wire rope at the wear place, and (3) the diameter of a single wire in one of the strands of the wire rope. The actual diameter is found by measuring with a "vernier caliper" or a "micrometer", as shown in Chapter 1, Appendix A, Figure A-1. The measured diameter of the wire rope is "SUBTRACTED" from the original diameter. If the difference is half the diameter of a single wire, the safe working load (SWL) is reduced materially. If the difference is EQUAL to or GREATER than the diameter of the single wire, the wire rope should be replaced. Even if no worn spots are apparent, wire rope should be

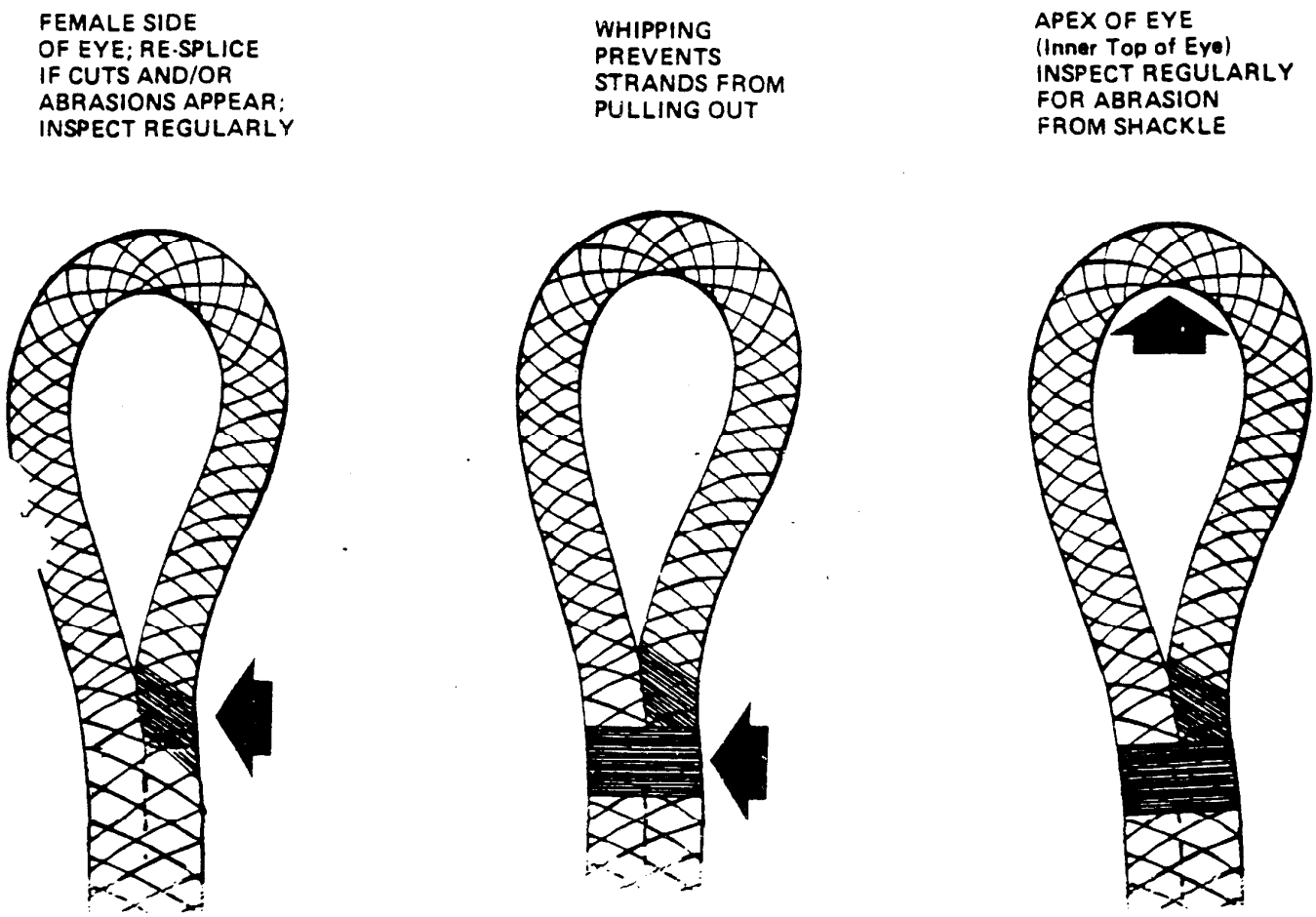

Figure 12-6 Inspection Points for Eye Splices

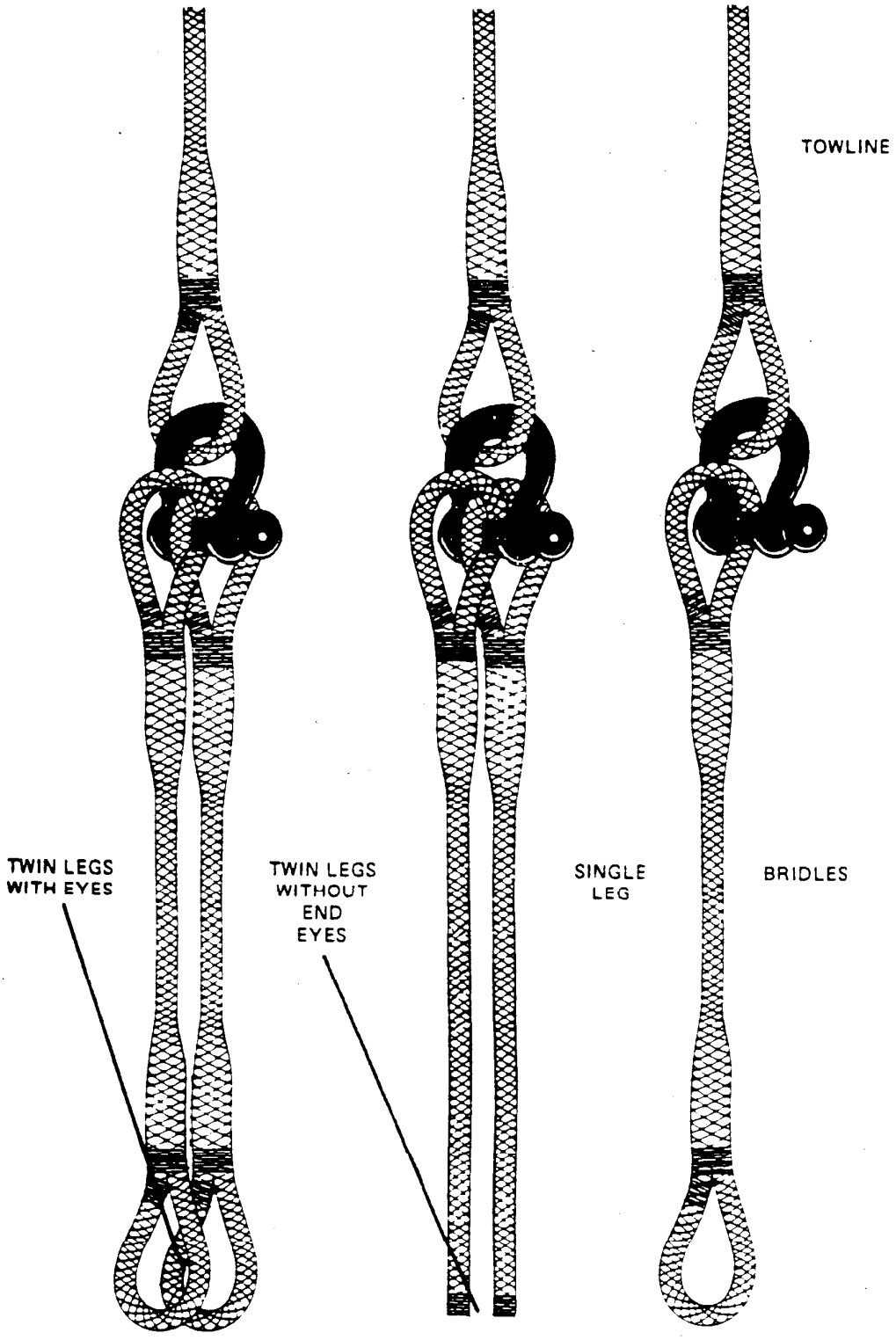

Figure 12-7 Towing Bridles

measured frequently to determine overall wear. Three or more measurements should be taken at intervals of about five feet and the average determined. The same rule applies here as with worn spots:
THE WIRE ROPE IS REPLACED IF THE OUTER WIRES ARE WORN TO ONE HALF THEIR ORIGINAL DIAMETER. For detailed information on computing the breaking strength (BS) and safe working load (SWL) of wire rope and line see Chapter 1, Appendix A.

NOTE

Both towlines and double braided nylon bridles should be down graded and NOT used for towing if HARDNESS of the line is detected. Inspection of the towline and bridles (if used) should be accomplished upon completion of each towing evolution or whenever severe SHOCK LOADING has occured or OVERLOADING is suspected.

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6. **Messenger Lines.** A towline, as you may already know, is too heavy to be cast more than a few feet. In rough weather it may be impossible to pass a tow line directly to a distressed boat. In such case you must use a messenger to pass it. The messenger line is simply a length of light line which can be cast, propelled or floated considerably further than the towline alone. One end of the messenger line, of course, is attached to the towline for the object is to get the light line to some one on the distressed boat. Then the person can pull the towline across the distance separating the boats, using the messenger line. The method of casting and the device attached to the other end of the line determines what the messenger line is called. There are four different types.
   a. The Heaving Line. The heaving line is a light, flexible line with a monkey fist at the throwing end. The line itself must be in good conditioon, at least fifteen to twenty fathoms in length, and free of rot and weathered areas. See Figure 12-8). The other end of the heaving line is secured to the towline with a clove hitch, bowline, or two half hitches. (See Figures 12-9, 12-10 and 12-11). Conditions permitting, a leeward heave (down wind) is the best method of casting the heaving line. Having the wind working with the line and monkey fist increases the range of the line. The heaving line with monkey fist is the preferred type of messenger
   b. The Bolo. The bolo is a heaving line made of shotline which has a toggle placed about one fathom from the weighted end and through the shotline. With the index and middle finger of your throwing hand grasp the toggle extensions so that the line runs between the two fingers. Using the toggle as support the weighted end is then swung overhead to obtain as much momentum as possible before casting the line. The length of the heaving line should be the same as described earlier for the heaving line. The other end is also secured to the towline in the same fashion.
   c. Polyethylene Float Line. Polyethylene float line, used with a ring buoy or life jacket, may be floated from upstream so the line is carried by the current to someone on the distressed boat.
   d. The Shoulder Line Throwing Gun. The SLTG may be successfully used to indirectly pass a towline when weather conditions are such that your boat cannot get close enough to the distressed vessel to employ one of the other methods. It is often the only means of sending a messenger if high winds and heavy seas exist. Use of the SLTG was discussed in Chapter Five.
7. **Towing Hardware.** The towline must be attached both to your boat and to the boat in tow. On your boat the towing bitt as well as various cleats and bitts are used to secure it. On the boat in tow the towline may be secured to similar deck fittings or to the trailer eyebolt. The towline may be attached to the towed boat by either a shackle or a kicker hook. A more detailed explanation of this hardware will be deferred to Section D where the procedures for using it will be discussed simultaneously. (See Figures 12-12 and 12-21).
8. **Fenders.** Fenders are used to protect a boat when it is maneuvering around dock piles, when it is laying alongside other vessels, or when it is engaged in an alongside tow. They are usually either

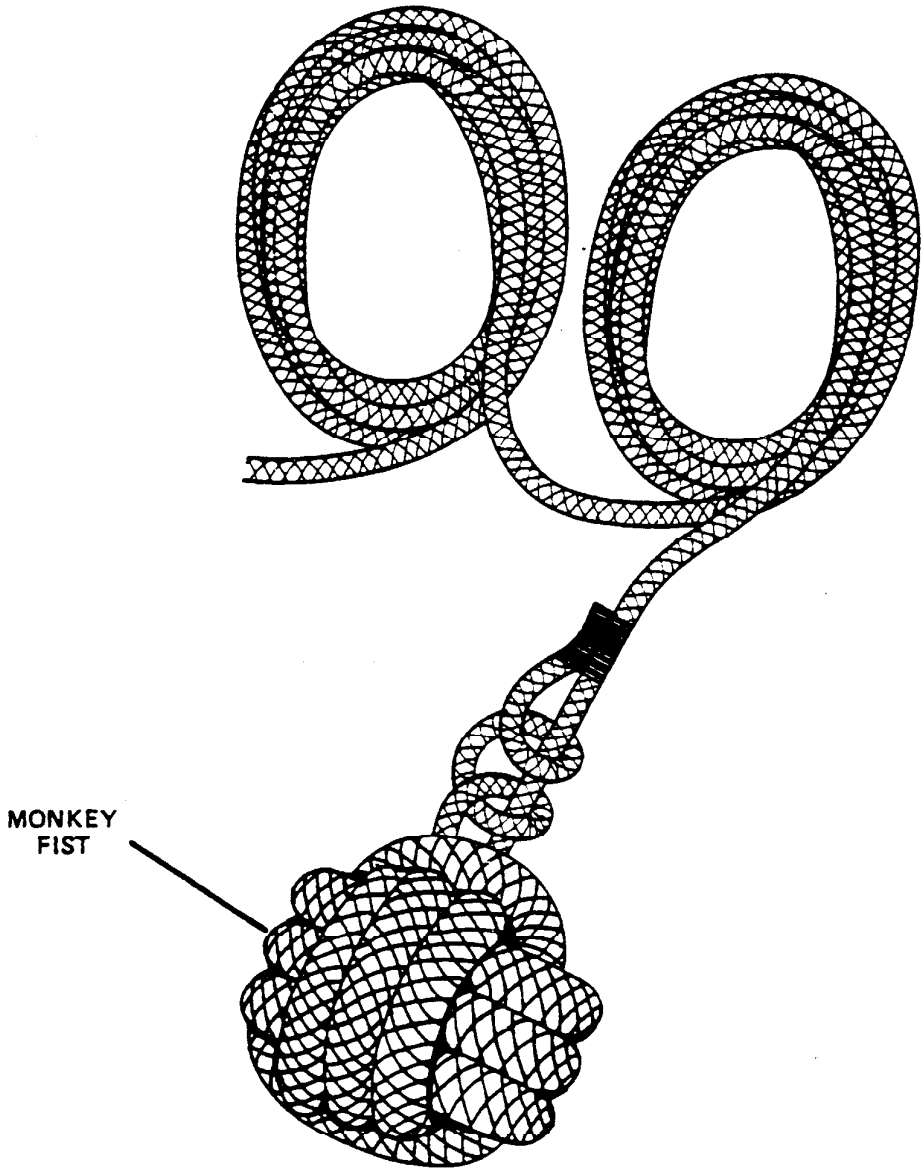

Figure 12-8 Heaving Line

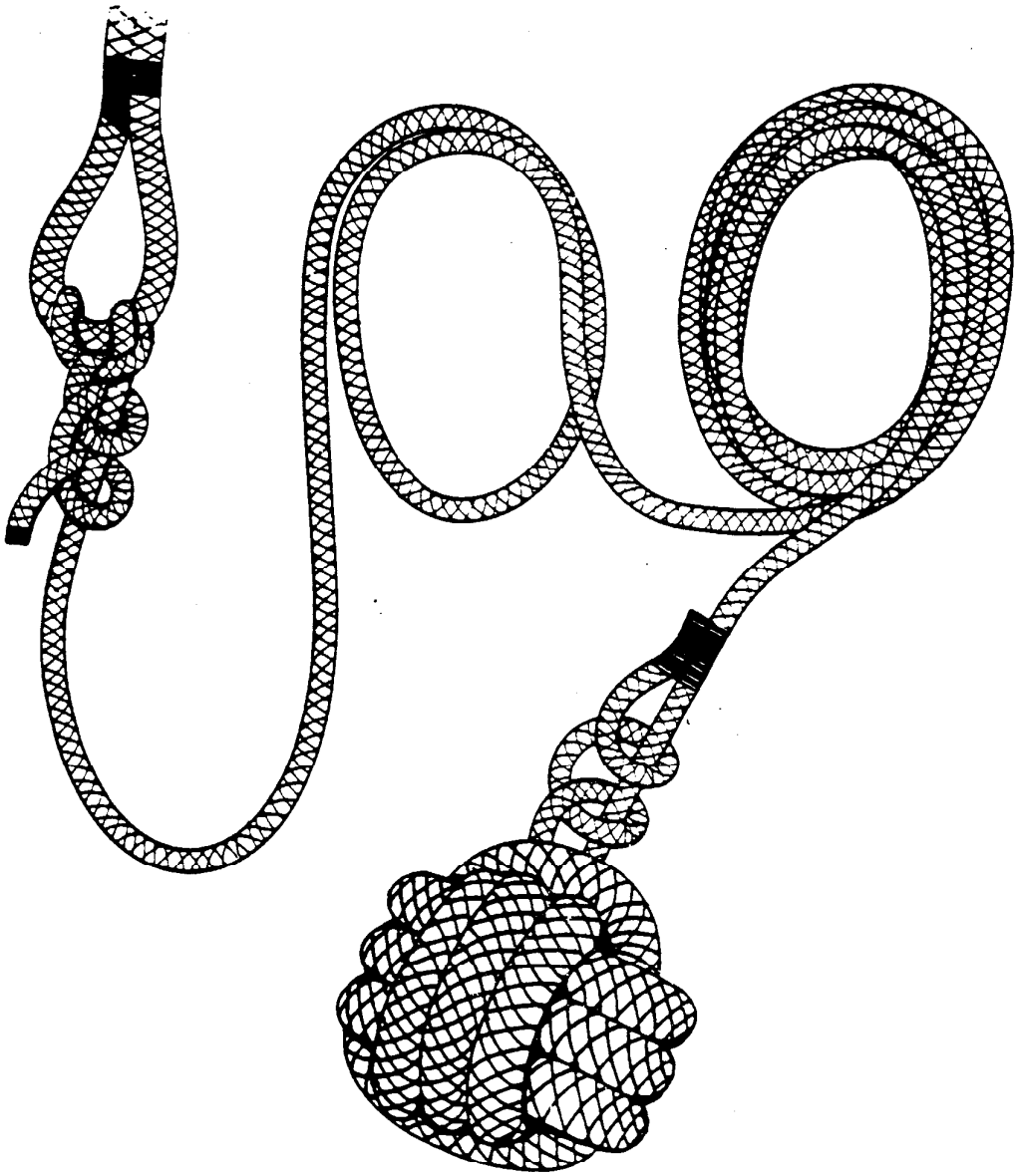

Figure 12-9 Bending Heaving Line to a Towline With Clove Hitch and Two Half Hitches, Method No. 2

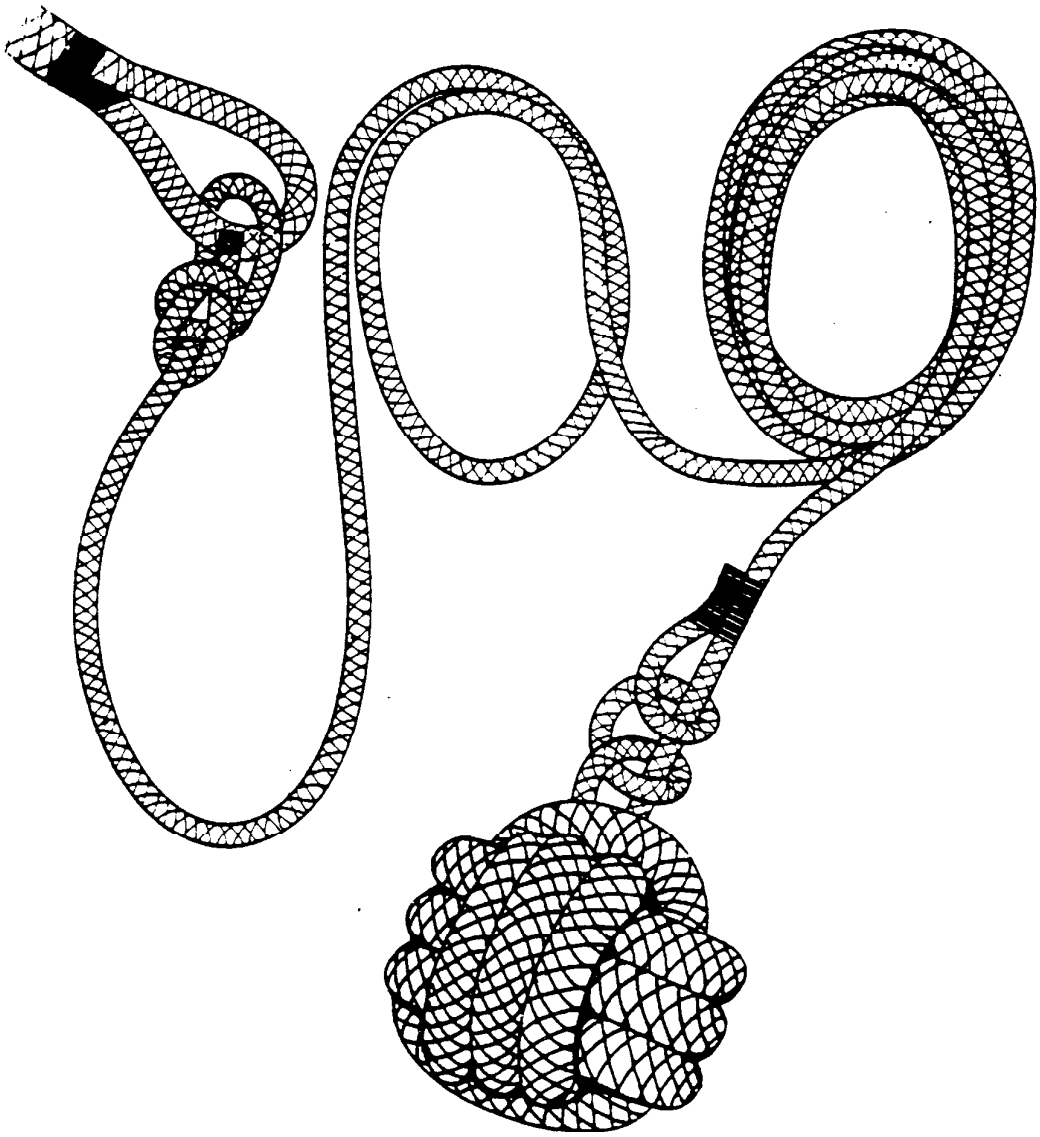

Figure 12-10 Bending Heaving Line to a Towline With a Bowline

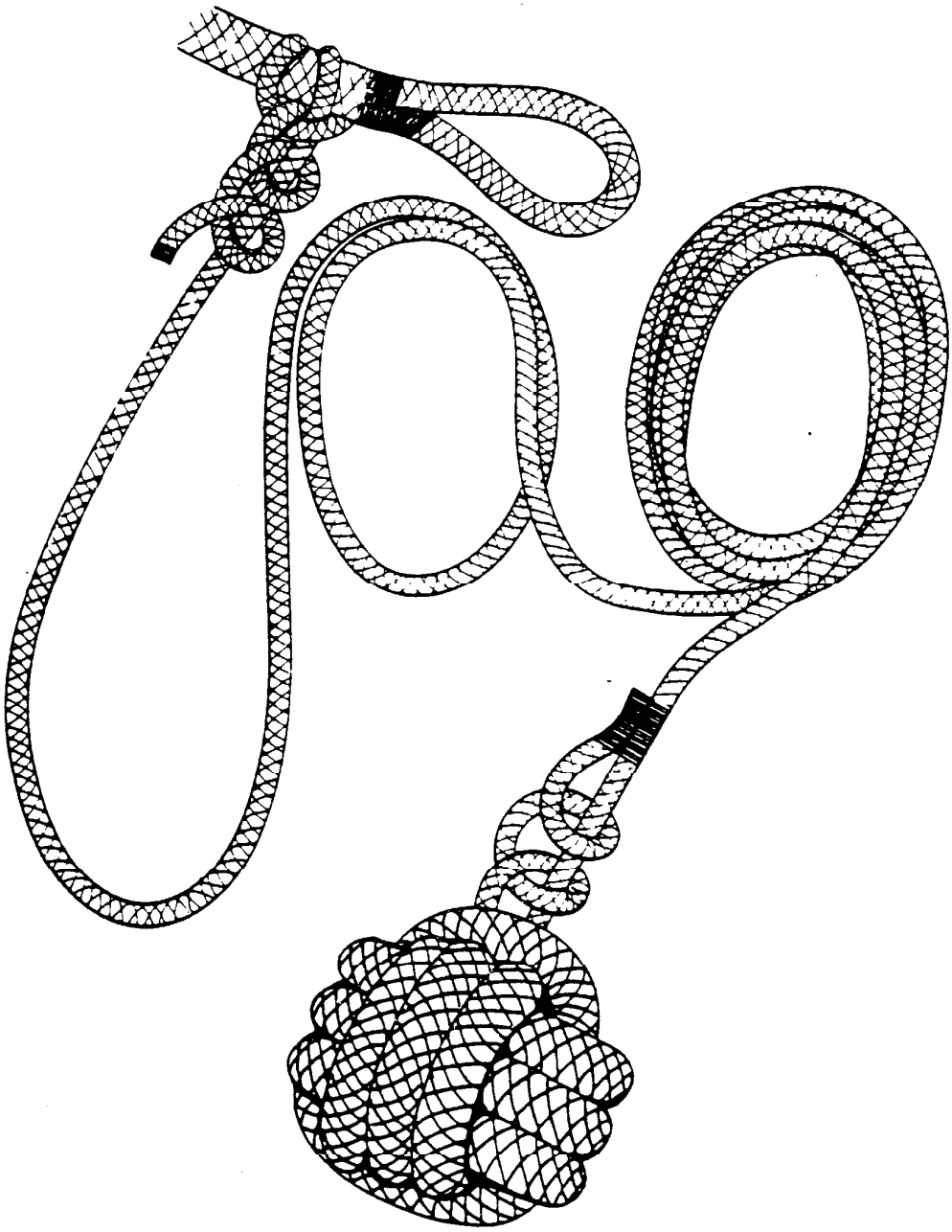

Figure 12-11 Bending Heaving Line to a Towline With a Clove Hitch and Two Half Hitches (Method No. 1)

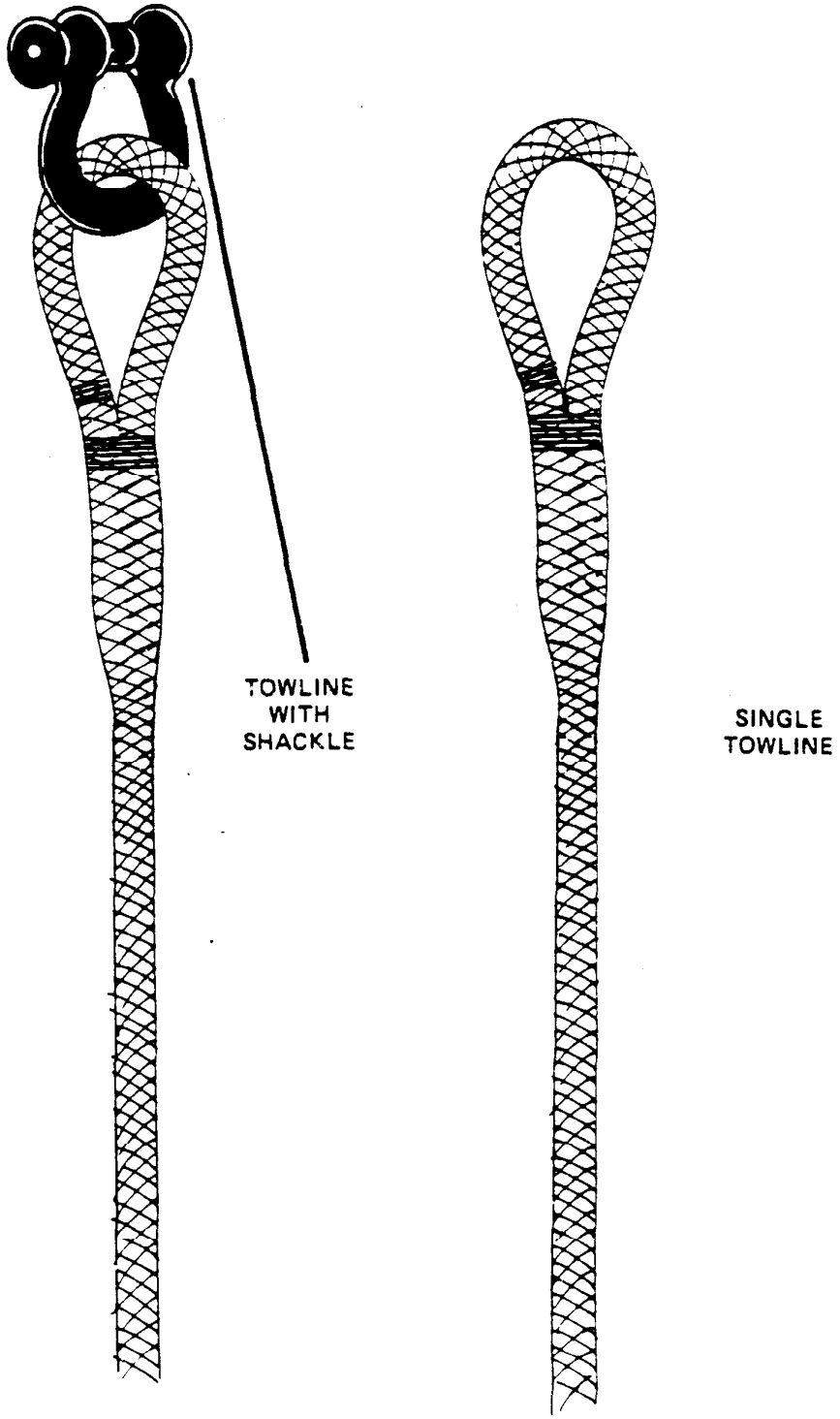

Figure 12-12 Towline With and Without Shackle

constructed of rubber or of self- inflating synthetic material. Fenders may be suspended from a line, one end of which is attached to a stanchion, cleat, bitt, or lifeline on the boat. The other end of the line, naturally, is attached to the fender. Some fenders are made with a longitudinal hole in them through which the line is run. This is convenient when the fender is used in a horizontal position along the boat's hull. Other fenders have an attached point on their tips called a grommet to which line is secured. The grommet is used when it is convenient to suspend the fender vertically. (See Figure 12-35). Movement of a boat fore and aft while lying next to a piling, however, may render vertically suspended fenders ineffective. Such is the case with the 41' UTB. A temporary solution for protecting the hull may be achieved through the use of a fender board. The fender board is approximately four to six feet in length and two inches by six inches in thickness and width respectively. Holes are drilled in the ends to which lines are attached. The board is then hung horizontally behind two or more fenders. (See Figure 12-36).

9. **The Drogue.** The correct use of the drogue significantly reduces the yawing of a tow by holding the stern of the tow to the sea, it will also slow down the rate of travel of a boat being towed through running or following seas. Since it is submerged, the drogue exerts a pull on the stern of a tow, thus allowing the tow to pivot on its stern instead of its bow. A drogue is constructed of canvas in the shape of a cone. Its forward or towing end is held open by a metal loop. It is the metal loop which also provides the negative buoyancy necessary to keep the drogue submerged. The cone end of the drogue is blunted at the tip; leaving a small hole at the point. Thus, the drogue creates a pull by allowing water into the large end of the cone and "forcing" it out through the small end. The drogue's pressure tends to keep the stern of the boat from veering off to one side or the other when it is in tow. Two lines operate the drogue. One line is called the drogue towline. One end of this line is secured on the stern of the boat. The other is secured to the large open end of the drogue with a bridle. The second, or tripping line, is secured to the small pointed end of the drogue. The other end is tended by someone on the boat. By paying out the drogue towline and securing the tripping line the drogue inverts and looses its resistance. You can then haul it aboard when it is no longer needed. In a bind you can make a jury rig drogue out of a bucket with holes, a tire (half a tire is sufficient), bait boxes, boat boxes or "stream warps" (lengths of line streamed astern which could have blankets or coats tied to them) so as to create an additional drag on the towed vessels stern. Keep in mind that drogues can exert up to (3) tons of pull. As a rule, drogues with 30 inch diameters should be used for boats 40 feet and up, while drogues with 20 inch diameters should be used for 20 to 40 feet boats. Apply the following in deciding when to use a drogue: IF YOU THINK YOU MIGHT NEED ONE, USE ONE. (See Figure 12-13).

10. **Chafing Gear.** Chafing gear is applied to protect towlines and working bridles where they are subjected to heavy wear due to rubbing or chafing on hard surfaces, i.e., lines passing over deck edges, gunwales, chocks, etc. Chafing gear consists of numerous layers of canvas (often called numbered duck) tied with marline (two-strand, left layed tarred hemp small stuff) to the lines or wire rope at points of contact; deck edges, gunwales, etc. Canvas and split rubber hose are used on light towlines, such as the 2-3/4 inch and 3 inch doublebraided nylon lines used on standard Coast Guard small boats. Canvas (numbered duck) runs from No. 1, the heaviest, to No. 12, the lightest. The weight of canvas recommended for use as chafing gear is No. 1 because of its heavy duty quality.

NOTE

Use of chafing gear should be considered a mandatory requirement.

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11. **Inspecting Shackles and Kicker Hooks.** Towing connections require that the shackles and kicker hooks posses the following characteristics: strength, ease in connecting and disconnecting, remain

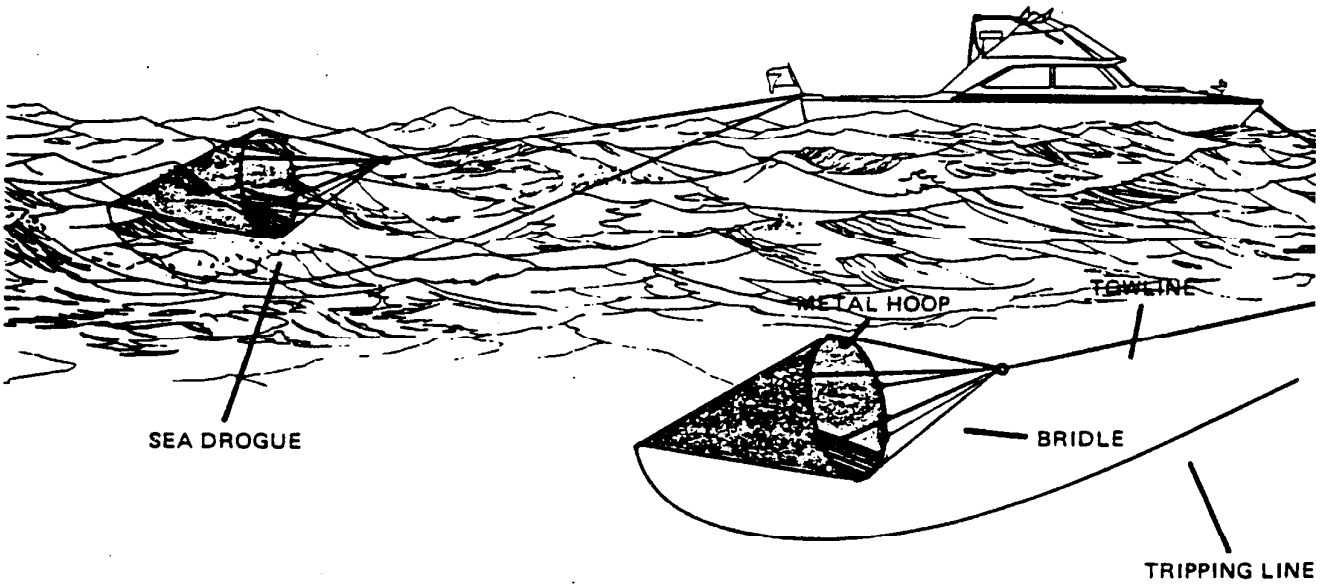

Figure 12-13 Utilizing a Drogue

connected, resist distortion, raggedness, and long exposed use with minimum of maintenance. Kicker hooks and shackles should be inspected frequently; upon completion of each towing evolution or whenever severe "shockloading" has occurred or "overloading" is suspected. Any evidence of distortion, speading, excessive wear or stripped shackle pins, is sufficient cause to require replacement.

NOTE

The double-braided line, which is part of the kicker hook assembly, MUST be inspected for the same discrepancies applicable to towlines and bridles.

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12. **Inspecting Bitts, Cleats and Chocks.** Bitts, cleats and chocks should be inspected frequently for CRACKS and FRACTURES and working surface smoothness. The working surfaces must be smooth in order for deck fittings to serve their design purposes; reduce WEAR and FRICTION on lines. In addition, the working surfaces of towing bitts must be free of paint and rust. Towline storage reels should be inspected for lubrication and freedom of rotation.

E. TOWING PROCEDURES. Towing is a very complex operation. There are procedures for towing approaches and procedures for different methods of towing. There are procedures for passing a towline, connecting a towline, and using a drogue. In short, there are procedures for virtually everything that can take place in a towing evolution. Everything that takes place in towing is inherently dangerous and unless you follow established procedures, someone might get hurt. Safety is the primary reason why so many procedures exist. Beyond this reason, though, is another. The procedures are the result of many years of Coast Guard towing experience and consequently, they provide you with the most efficient and timely ways to conduct a tow. They have been proven effective in the field. Prior to taking a vessel in tow the coxswain should thoroughly brief all crewmembers on the procedures pertaining to the towing operation. Of particular importance is the type of approach, when and from which side to pass the towline, how to pass the towline (with or without a messenger) and how much towline is to be payed out. If circumstances permit, the coxswain will make one complete circle around the disabled vessel inspecting it as closely as possible. Before starting the approach the coxswain should ensure that all crewmembers are prepared and personnel on the disabled boat are ready to receive the towline.

1. **Towing Approaches.** The coxswain will select a towing approach based upon the prevailing weather and the nature of the distress. Which approach to use is a judgement call. A coxswain must be able to do all of them for occasions will arise where only one is appropriate.
   a. Determining the Towing Approach to Use. The approach used depends on a number of considerations including the following:
      (1) The size and type of the disabled vessel.
      (2) The maneuvering characteristics of your boat.
      (3) The position of the disabled boat relative to nearby hazards and the boats' attitude to wind and sea.
      (4) The rate at which the boats are drifting.
         (a) Because of differences in drag the vessels drift at different rates, apart or together. The coxswain should set it up so that the boat drifting faster gradually overtakes the slower drifting boat, to allow more time for passing and connecting the tow line. Boats with a high superstructure forward should lay stern to the wind. The superstructure will act as a sail. Boats with a deep draft and low superstructure will generally lie broadside to the sea. The rate at which the distressed craft is drifting must be determined before you select an approach. This will enable you to select the most advantageous position from which to pass and connect the towline. To determine the rate of drift, maneuver your boat onto the same heading as the disabled boat and stop astern

of it. If the distressed craft begins to drift away, its rate of drift is faster than the rate of drift of your boat. REMEMBER, when you approach leeward (downwind) of a boat you intend to take in tow or bring alongside, the disabled vessel may block the wind, particularly if the boat is larger than yours and with a high superstructure. Thus the force of the wind that previously affected both boats, is dramatically decreased on your boat. The result is the disabled vessel will drift toward you quite rapidly. BE ALERT, for this sudden loss of wind, as you make your approach and be ready to maneuver as necessary. (See Figures 12-14 & 12-15)

CAUTION

Collision severe enough to seriously damage both vessels may result should this loss of wind factor not be taken into consideration in determining your towing approach.

b. Approaches.

(1) The Parallel Approach. The parallel approach is used in good weather conditions when the disabled boat's rate of drift is slow. The towing boat approaches from the stern on the windward side of the disabled boat. Skilled boat handling is necessary at this point because the towing boat must pass close enough to pass the towline and stop a short distance ahead of the disabled boat. (See Figure 12-16).

(2) The Crossing the "T" Approach. The crossing the "T" approach is used when there is a heavy sea or when the disabled boat's rate of drift is rapid. The towing boat crosses the bow of the disabled boat on a heading perpendicular to it. This heading should be into the sea or wind if possible. The towline is passed just before the towing boat passes the bow of the disabled boats bow. (See Figure 12-17).

(3) The 45 Degree Approach. The 45 degree approach is used when there is calm to moderate sea conditions. The towing boat approaches on a heading about 45 degrees from that of the tow's bow. The towline is passed just before the towing boat's bow crosses that of the tow. (See Figure 12-18).

(4) The Backdown Approach. The backdown approach requires you to maneuver your boat in front of the disabled vessel, passing the towline, and reverse your engines. Do not pass the towline with sternway on your boat. Any approach used improperly can ruin your day but the backdown approach may get you into trouble. The coxswain cannot see what is happening back aft to the great white sea monster (your towline) which has been known to suddenly appear in the screws from nowhere. Do not use this approach unless it is absolutely necessary to do so. (See Figure 12-19).

(5) Throughout the maneuvering associated with picking up a tow the coxswain must be particular mindful of the set and drift of his boat in relation to that of the disabled boat as well as his boats heading relative to the existing conditions. It is important that the coxswain not be placed in the situation necessiating a radical correcting maneuver during the critical towline passing process.

2. **Passing the Towline.** When the approach has been made and the boat coxswain has maneuvered the towing boat as close as safely possible to the distressed vessel, the towline must be passed to it. Where conditions permit and the towing boat can maneuver close enough to the disabled boat, the line is passed directly to one of the people on the other boat. In such cases the towline should be passed from the well deck of the Coast Guard boat. Take care not to take out excessive line. Instead, pay it out directly from the storage reel. If not kept on a reel, fake it down carefully in order to ensure that it will not kink or tangle when paid out and over the top of the towing bitt. When weather conditions, shallow water, shoals, or other conditions prevent your boat from approaching close enough to pass the line directly a messenger line must be used. The bolo, polyeth-

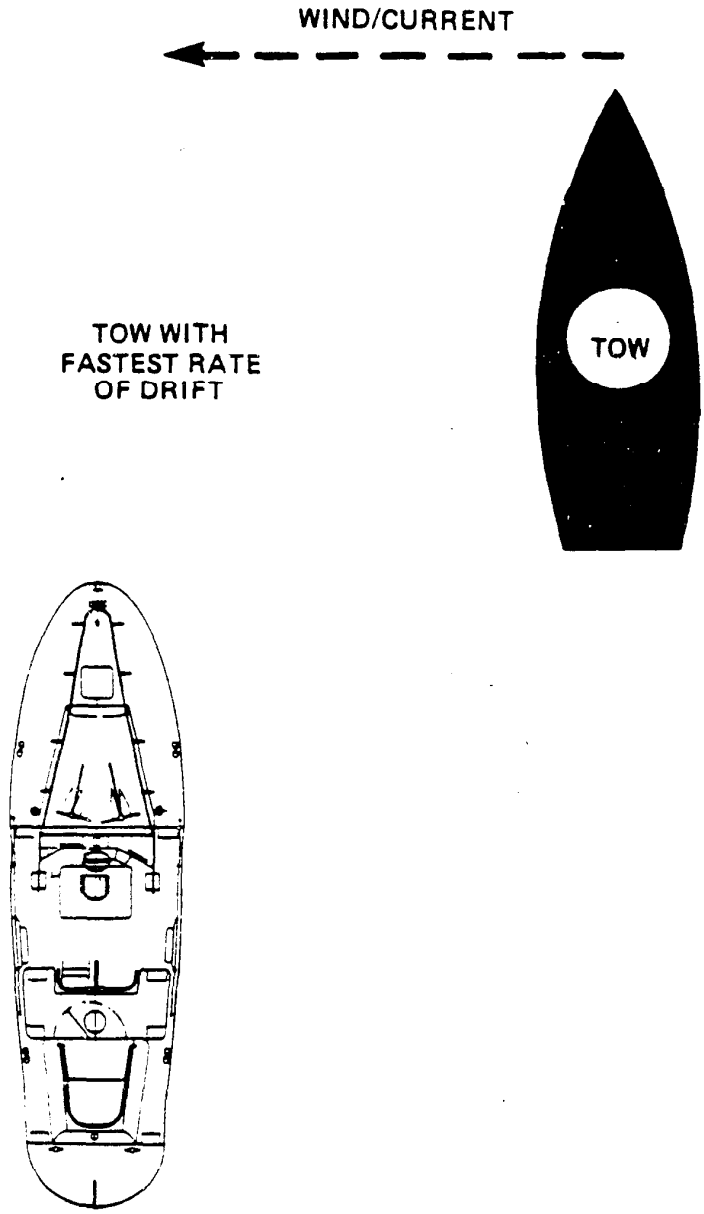
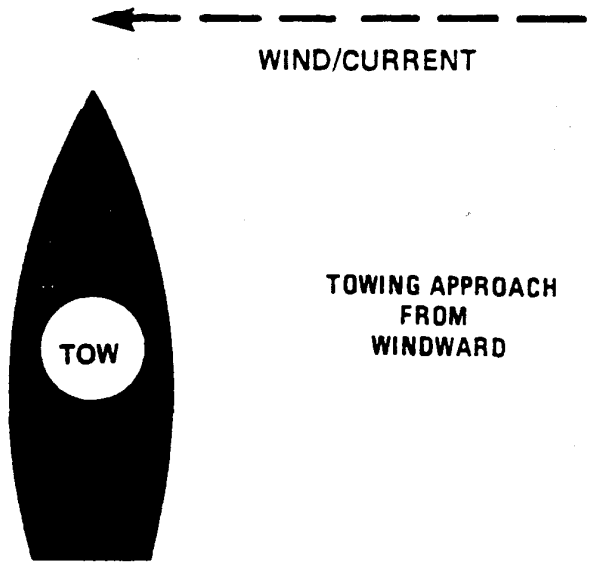


Figure 12-14 Towing Approach From Leeward



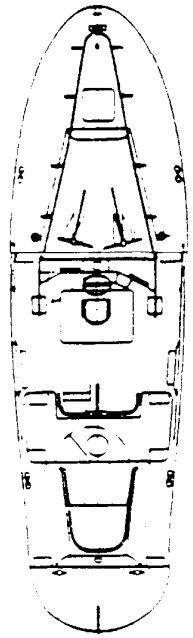


Figure 12-15 Towing Approach From Windward

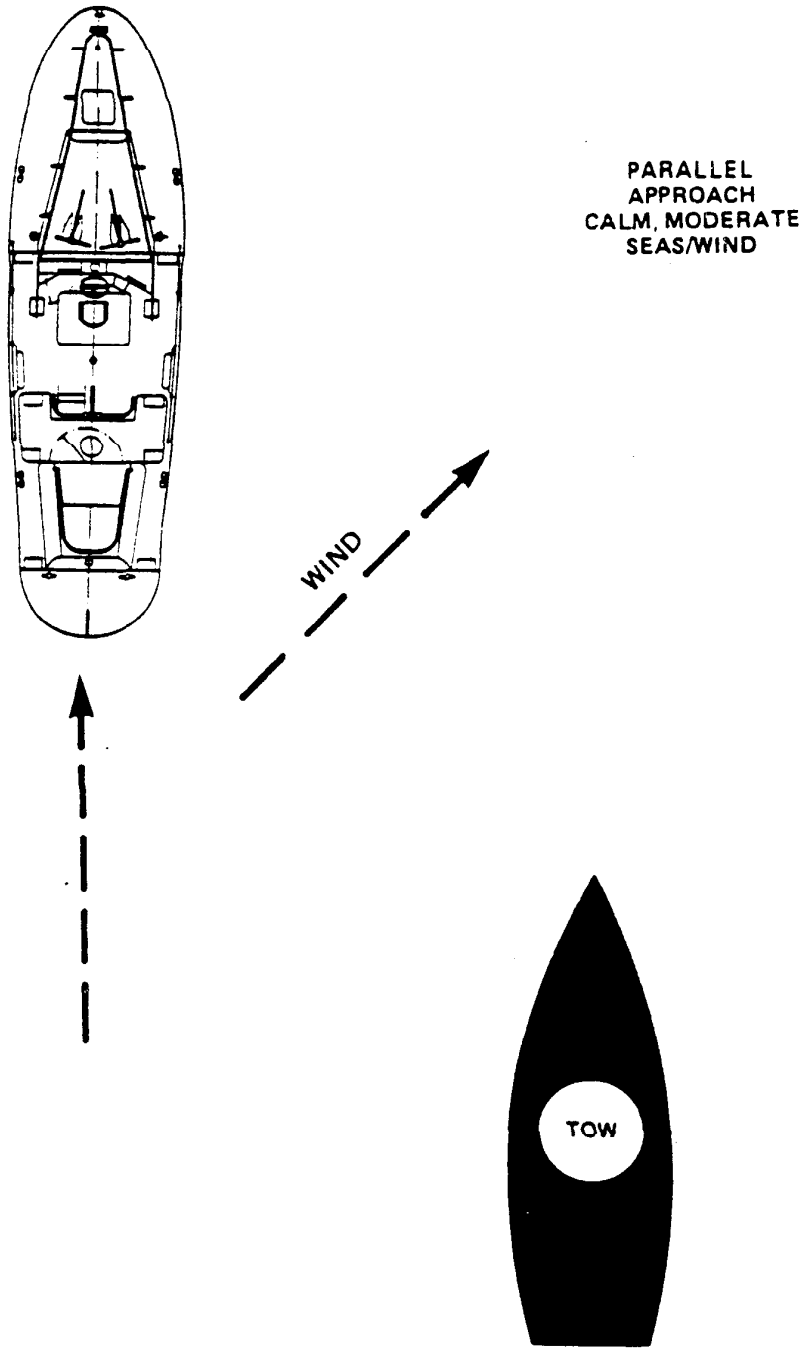


Figure 12-16 Parallel Approach

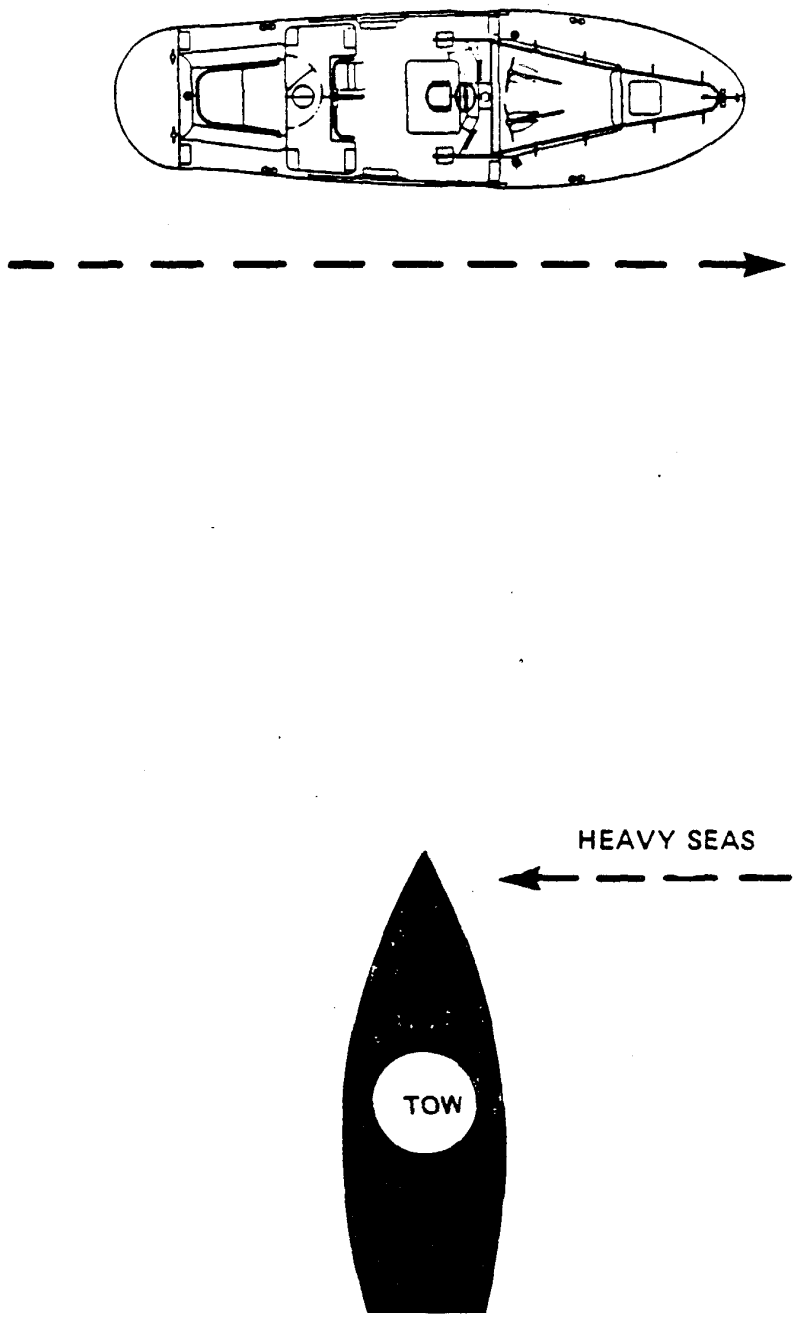


Figure 12-17 Crossing the "T" Approach

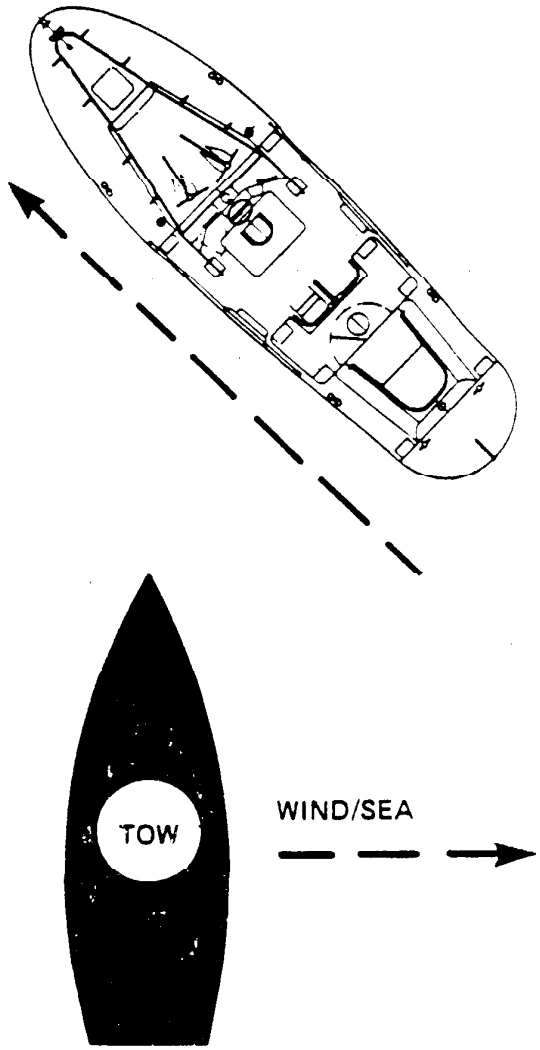


Figure 12-18 45° Approach

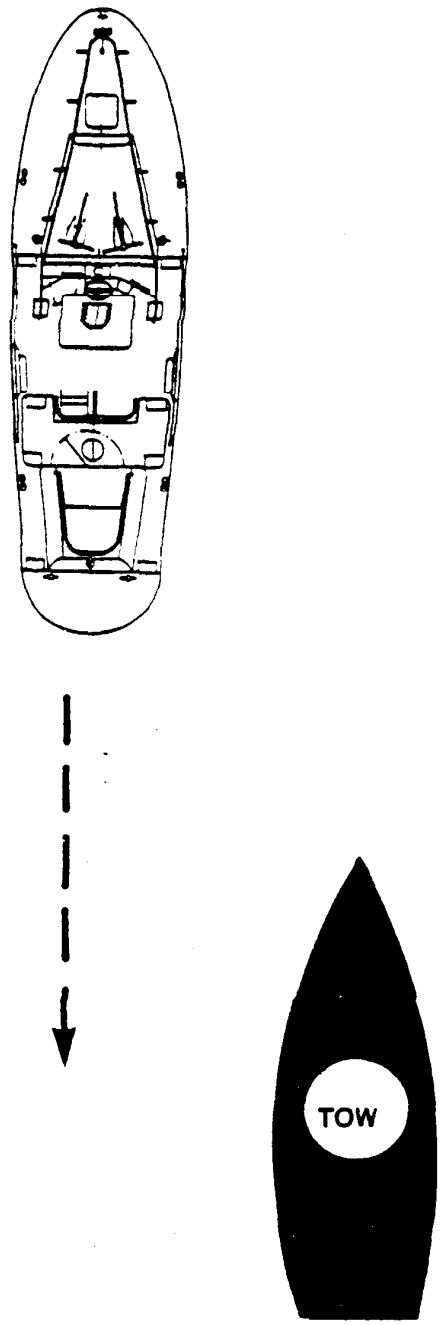


Figure 12-19 Back Down Approach

ylene float line, and the shoulder line throwing gun may serve the purpose and all have their special purpose. As previously stated, however, the heaving line with monkey fist is the preferred method of sending a messenger and should be used whenever practical. The procedure for preparing and casting this line is outlined below.

a. Wet the heaving line to make it more flexible and less susceptible to becoming tangled.
b. Bend the heaving line onto the towline, using a bowline or a clove hitch with two half hitches.
c. Coil the line clockwise in the right or casting hand with the monkey fist hanging at the outside turn of the coil and below the same turn.
d. Take two-thirds of the coil in the right or casting hand.
e. Instruct personnel on the disabled vessel to take cover ("HEADS UP").
f. Cast the heaving line using a sweeping side arm movement, (this is the preferred method), keeping the casting arm straight and using the body. This is not always possible on all boats. Be aware of all lines in the water; watch your screw(s).
g. Do not heave the line directly at the receiving boat or personnel on it. Heave the line in such a fashion that it falls across the distressed boat's deck.

3. **Connecting the Towline.** The selection of a towline attachment point or points on the disabled boat should be done with great care. The poor design characteristics of the cleats and other fittings found on many vessels make them unsuitable attachment points. They simply cannot endure the tremendous stress and strain that often occurs during towing. Some of the suggested attachment points are listed below.

CAUTION

Caution should be used in determining the best possible towing procedure and methods of attaching the towline. The stem pad-eye which is available on most trailerized small boats may be an appropriate point of attachment, however, a close inspection of the condition of the padeye, its size, the apparent condition of the stem, and the pad-eye backing plate and nut should be accomplished before selecting the stem pad-eye as the point to attach the towline. Age of fitting, size of fitting, boat loading, sea conditions, towline course relative to sea/swell may all be factors which would make the stem pad- eye a poor attachment point for the towline.

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a. The trailer eyebolt. The trailer eyebolt is generally located on the stem, at or near the waterline of a boat. (See Figure 12-20). Securing the towline to the trailer eye bolt can be dangerous both to the people on the disabled boat and to the Coast Guard personnel attempting to secure the towline from the stern of their boat. To reduce the hazard of injuries to personnel created by the individuals aboard both boats arising from their efforts to fend off and secure the towline, a kicker hook, used in conjunction with a boat hook, is employed to make the connection. The kicker hook assembly is only authorized for small trailable types of boats. Still it is an effective method for making the towline connection. It is important however, that when this method is employed that the breaking strength of the kicker hook is greater or at least equal to the breaking strength of the double braided nylon towline. A kicker hook assembly consists of a ladder hook or a stainless steel safety hook to which a six inch length of stainless steel round stock has been heliarced. Fifteen to twenty feet of two inch double braided line is then spliced to the eye of the kicker hook. Finally, the kicker hook, an eight foot boat hook with a hole drilled in the handle end of the boat hook. The hole must be large enough to allow the round stock to fit into it smoothly. (See Figures 12-21 and 12-22). The procedure for attaching the kicker hook is given below.

Attaching the Kicker Hook.

(1) Slide the kicker hook rod into the hole drilled in the end of the boat hook.
(2) Hold the kicker hook in place by pulling the two inch double braided nylon taut.

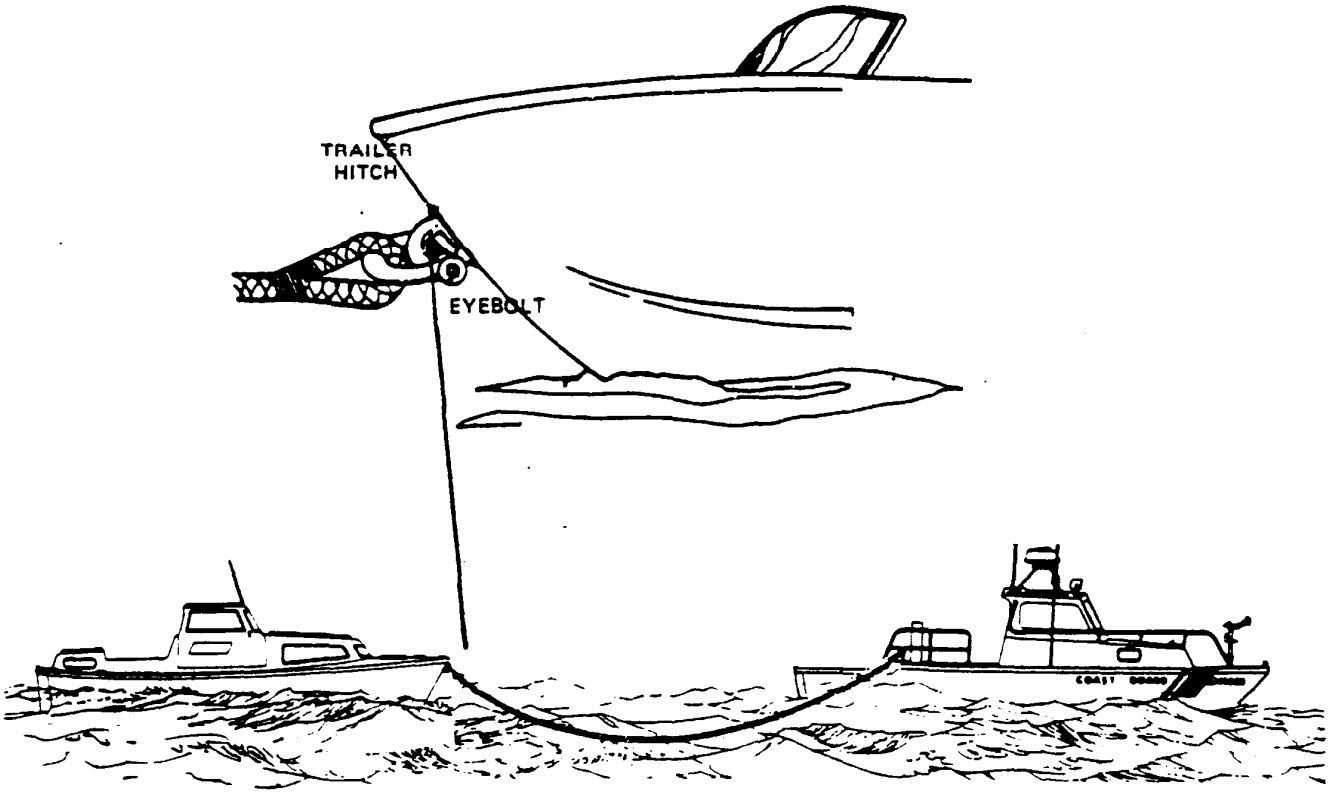

Figure 12-20 Trailer Eyebolt

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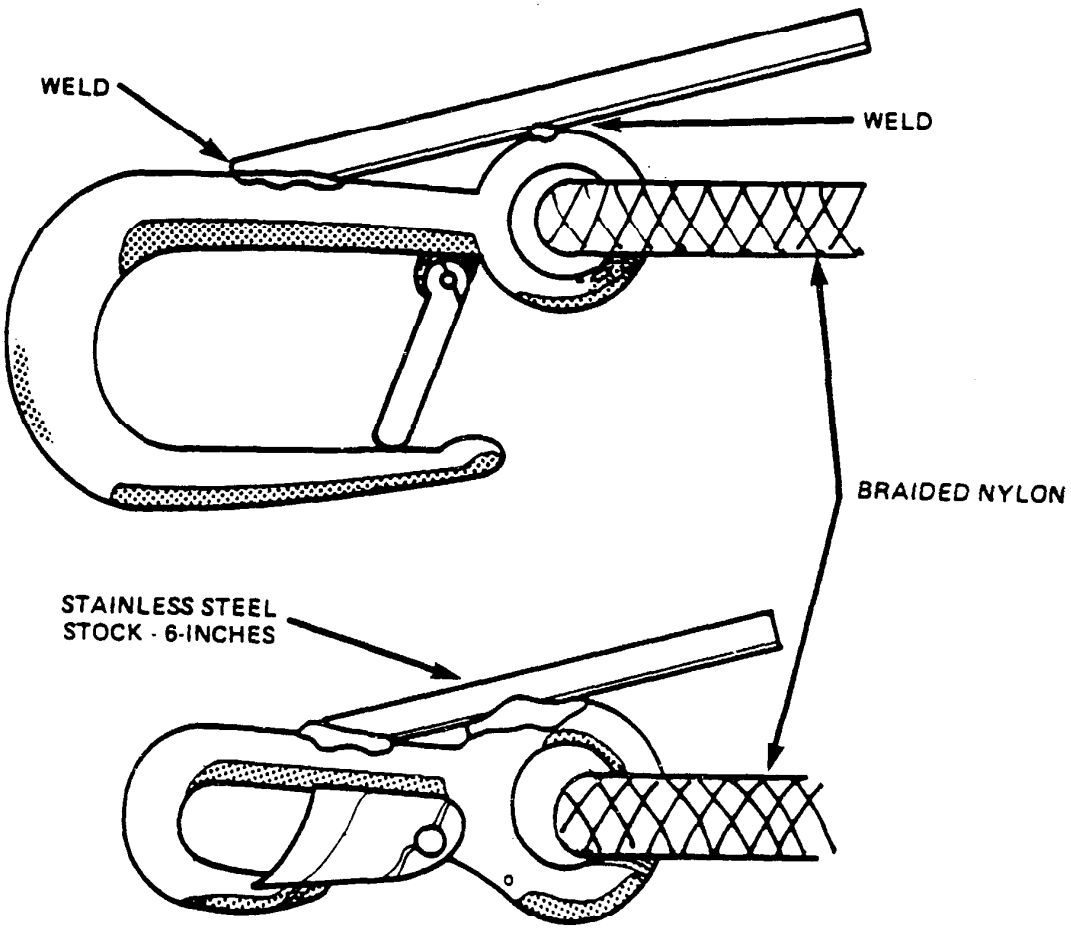

Figure 12-21 Typical Kicker Hooks

(3) Extend the boat hook and attach the kicker hook to the trailer eyebolt.
(4) Remove the boat hook. (See Figure 12-23).

Another method of connecting a towline to a trailer eyebolt is by using a shackle. However, this method must only be used in calm or moderate weather conditions because its performance requires a crewmember to physically attach the shackle. The steps below describe how to connect a towline to a trailer eyebolt using a shackle.

WARNING

Exercise EXTREME care whenever this method is employed. This procedure usually requires a crewmember to lean over the side of your boat, exposing the head and shoulders to the up and down movement to the bow of the distressed boat.

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(1) Select a shackle of appropriate size for trailer eyebolt and your towline.
(2) Keep the disabled boat alongside your boat but keep it from coming into contact with your boat by assigning a crewmember to fend the distressed boat away from your boat's hull.
(3) Remove the pin from the shackle. The pin should be attached to the shackle with a short piece of wire or marline.
(4) Place the shackle through the eye of the towline then over the trailer eyebolt on the distressed boat.
(5) Insert the shackle pin through the unthreaded side of the shackle opening and through the trailer eyebolt
(6) Tighten the shackle pin into the threaded side of the shackle opening and mouse the pin.

b. A sampson post, bow bitt, or cleats may be located on the forward deck of a boat. However before attaching the towline make certain the fittings are secured to the deck with throughbolts and backing plates. Also ensure sampson posts and bitts are secured to the deck, preferably by first being secured to the keel and then braced at deck level. If not, be aware of the potential for mishap. Advise the distressed vessel and if circumstances dictate proceed with due caution. It may be necessary to assign a crewmember to board the disabled vessel and check the serviceability of the deck fittings to be used and make the towline connections in all of the below connection procedures, as indicated by the steps for each procedure. However, this is not a standing rule or requirement.

NOTE

If there is ANY doubt in regards to the serviceability or strength of the boats deck fittings or the vessels operator capability of making proper towline connections, it would be PRUDENT to place a crewmember on the disabled vessel for the purpose of visually inspecting the fittings and making the towline connection.

---

(1) Assign a crewmember to board the disabled boat to check the serviceability of the deckfitting to be used.
(2) Pass your towline to the crewmember on the distressed vessel.
(3) The crewmember who received the line will then place the eye of the towline over the deck fitting and pass it under the fitting horns.
(4) The crewmember on the disabled boat will pull the towline snug up against the base of the fitting (where the eyesplice begins), twist the eye of the towline to the left or right, thus forming a bight, and finally drop the bight over the top of the deck fitting and under the horns.

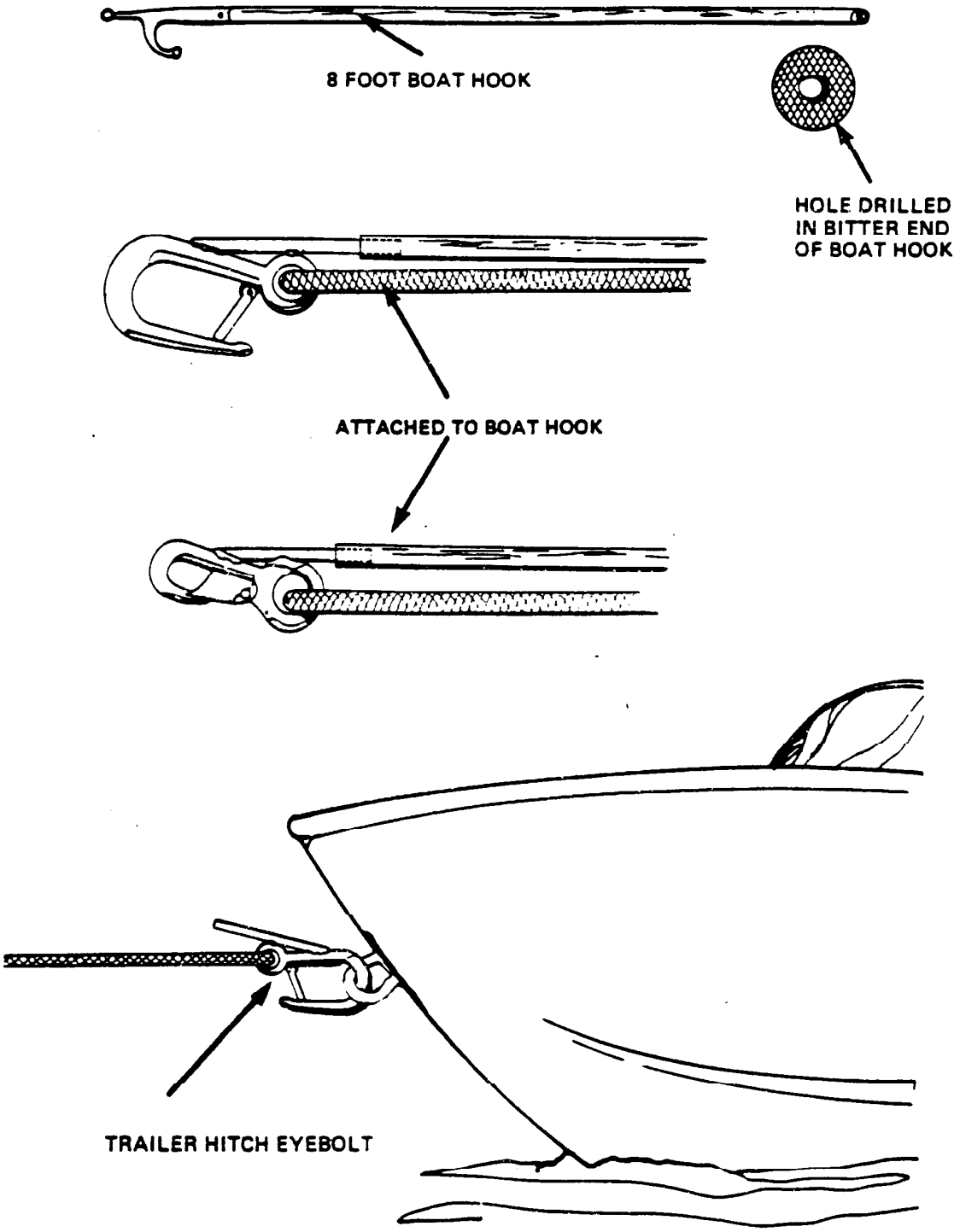

Figure 12-23 Towing With Kicker Hook

(5) If the towline connection is made by personnel other than a crewmember placed on the disabled vessel, ensure that the towline is properly secured to the appropriate fittings on the distressed boat. Remain alert to direct, if necessary, the correct way to make the towline attachment.

c. Double leg bridles, when used are attached to the two forward cleats, bitts, or to the sampson post of the distressed boat. (See Figure 12-24). The key is to make the attachment point or points so that the pull is equally distributed on the towed boat's deck fittings. Decreasing the angle formed by the towing bridle will decrease tension on the boat's deck fittings and on the towline. (See Figure 12-25). The procedure below is used to connect a towline and bridle to a boat.

(1) Assign a crewmember to board the disabled boat and perform the connection.
(2) Pass the towline and bridle to the crewmember on the disabled boat.
(3) The crewmember will secure the bridle legs to the attachment points, that is, to selected deck fittings on the distressed boat, so that the tension during the towing evolution is evenly distributed.
(4) If the towline connection is made by personnel other than a crewmember placed on the disabled vessel, ensure that the towline is properly secured to the appropriate fittings on the distressed boat. Remain alert to direct, if necessary, the correct way to make the towline attachment.
(5) Be sure that the bridle legs are of equal length and that the shackle connecting the bridle to the towline is in line with the centerline of the towed vessel.

d. Single leg bridles are generally only used in towing sailboats, and are secured to the base of sailboat's mast providing the mast is designed to withstand the stress of towing. Information concerning the mast must first be obtained from the operator of the sailboat (See Figure 12-26). The steps for connecting a towline and bridle to a sailboat mast are listed below.

CAUTION

In all instances the attachment point of single leg bridles should be aft of the disabled boats bow and fairlead through a point forward (bow chocks) so to be in line with the boats centerline. Ensure that the shackle connecting the bridle to the towline is also in line with the centerline of the towed vessel.

---

(1) Request all available information from the sailboat owner or operator concerning the condition of the mast and the amount of tension it can withstand.
(2) Assign a crewmember to board the sailboat and perform the task.
(3) The crewmember will visually inspect the mast to ensure it can withstand the stress of towing.
(4) The crewmember will advise the boat coxswain of the results of the visual inspection. If the mast is found unsafe the procedure must be halted.
(5) Pass the towline and bridle from the Coast Guard boat to the sailboat.
(6) The crewmember will take one round turn with the bridle leg around the base of the sailboat's mast and fairlead it forward through the chocks, if available.
(7) The crewmember will then secure the towline to the bridle with a bowline or shackle ensuring that the shackle is in line with the boats centerline, if used.
(8) If the towline connection is made by personnel other than a crewmember placed on the disabled vessel, ensure that the towline is properly secured to the appropriate fittings on the distressed boat. Remain alert to direct, if necessary, the correct way to make the towline attachment.

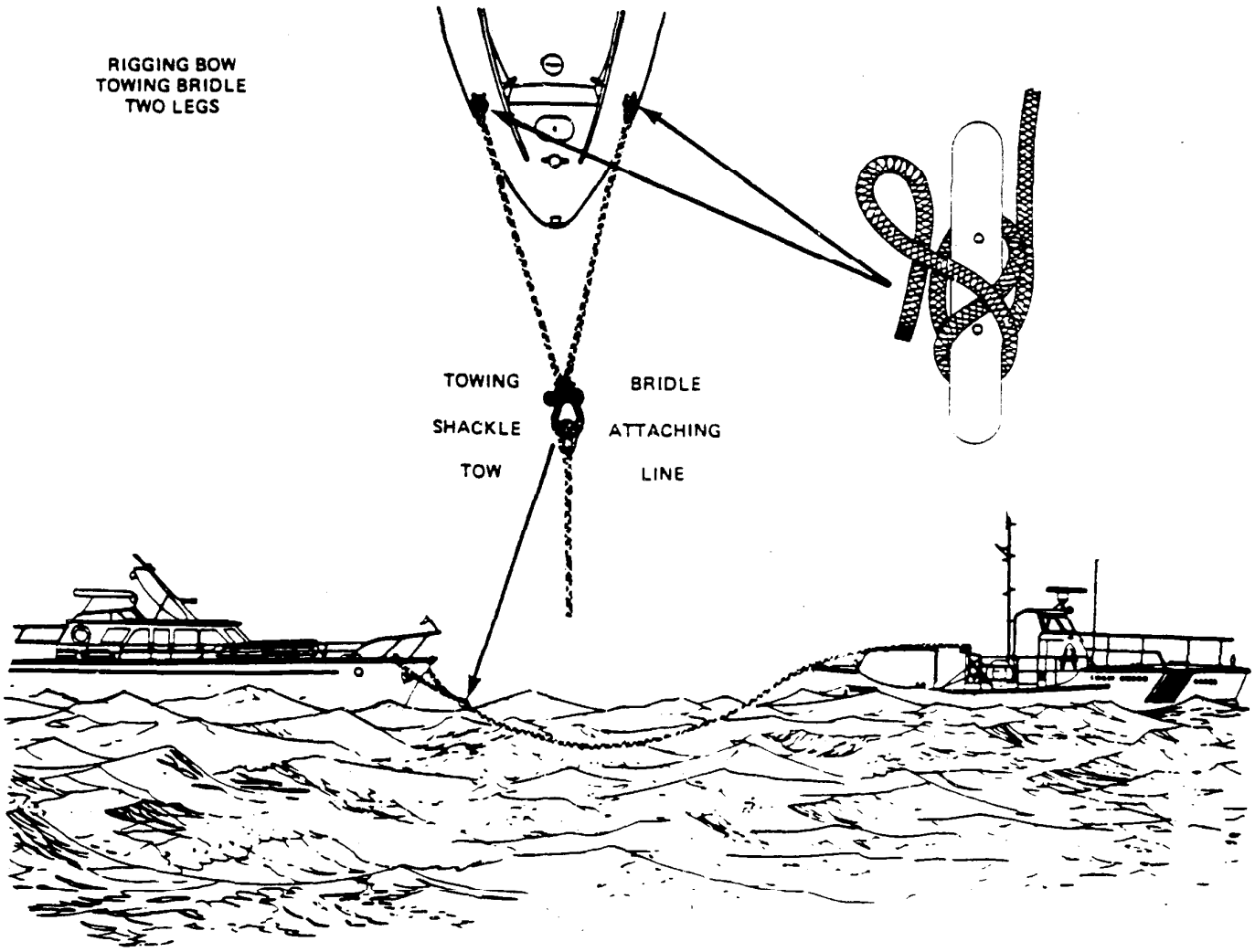

Figure 12-24 Rigging Bow Towing Bridle-Two Legs

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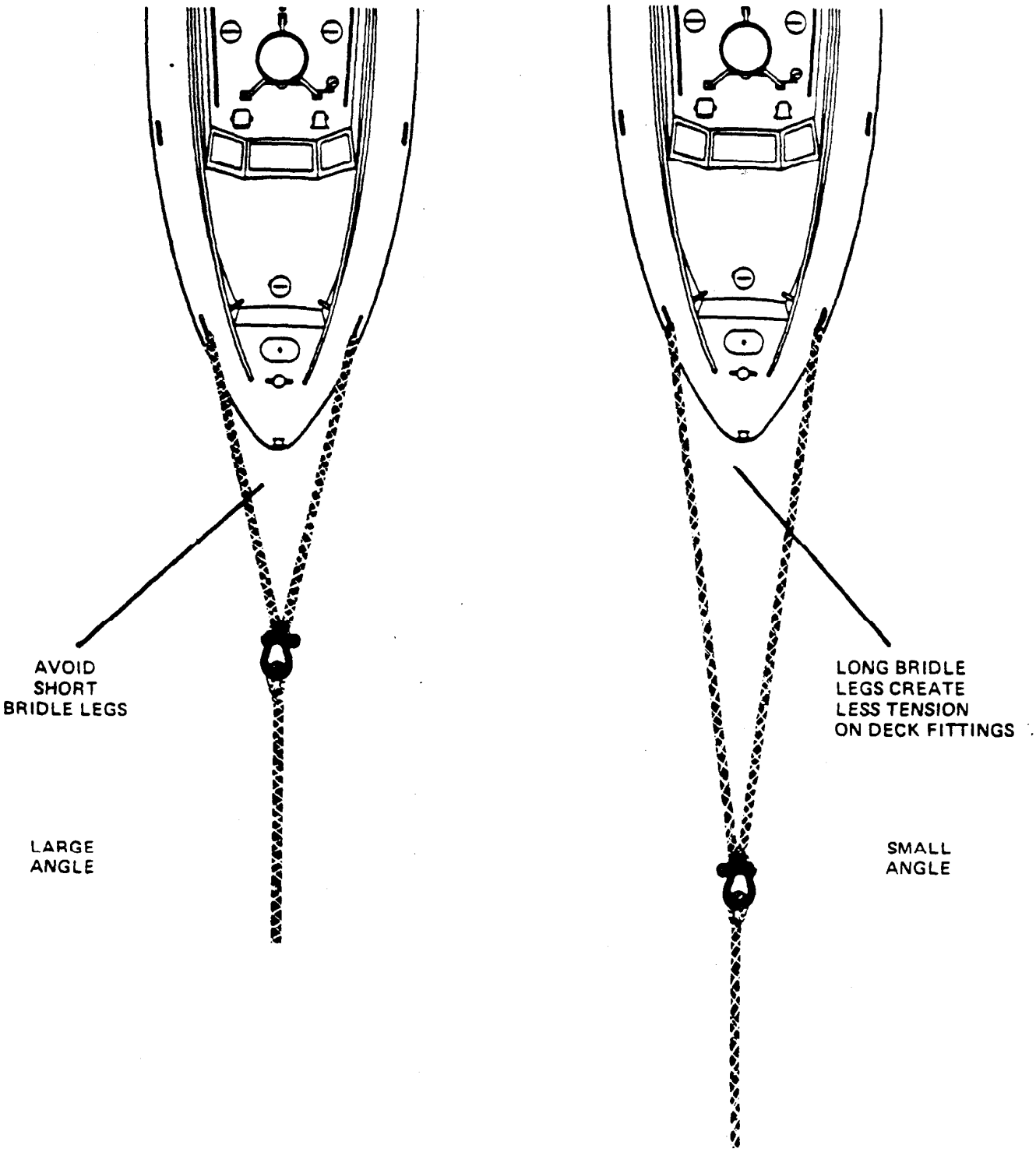

Figure 12-25 Double Leg Bridles

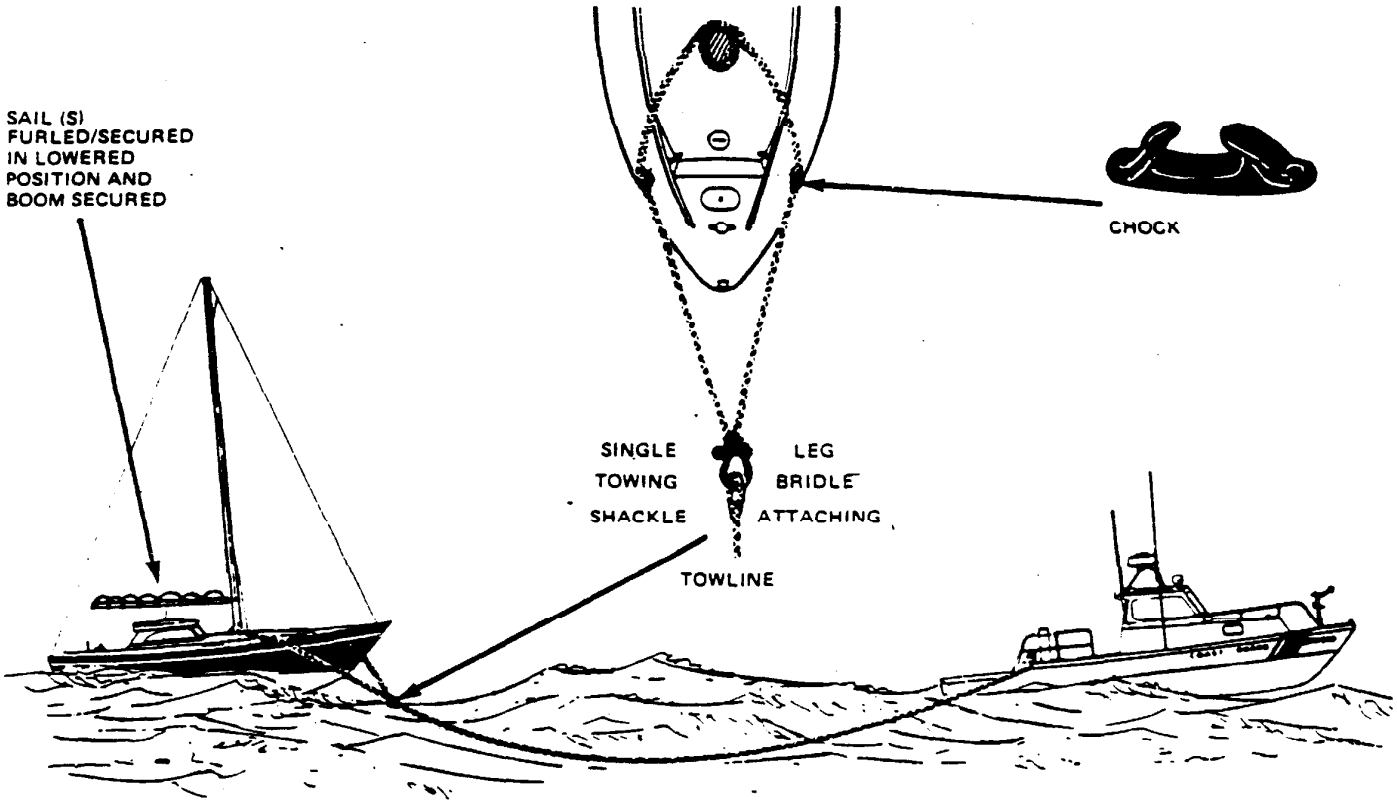

Figure 12-26 Single Leg Bridles

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4. **Determining Towing Speed.** In determining towing speed, the primary factor to be considered is the safety of the boat and its occupants. Nearly every year inexperienced personnel have damaged private boats by towing them too fast. Some incidents have resulted in sinkings and some even loss of life. The discussion below identifies how to determine a safe towing speed on the basis of a vessel's waterline length. However, it is absolutely necessary that close attention be directed to the strength of the vessel and it's fittings, and prevailing weather conditions. As weather conditions worsen, it will nearly always be necessary to decrease speed to maintain safety.
   a. **Displacement Hull.** The same principles described in Chapter 7, pertaining to displacement hull vessels, apply whether the force propelling a displacement hull is a pushing or pulling force. Naturally, if you take a displacement hull in tow the engine(s) propelling your boat becomes a "pulling force" propelling your tow. Coast Guard small boat hulls are NOT displacement hulls. Therefore, you must be careful when taking a displacement hull in tow not to tow it beyond its DESIGN or MAXIMUM TOWING speed (1.34 times the square root of the Waterline Length (FT)). TABLE 12-2, indicates various waterline lengths for displacement hull vessels and their APPROXIMATE design or MAXIMUM towing speeds whether the propelling force is a pushing or pulling force. SPEED has been taken to nearest tenth of a knot. REMEMBER, towline size and a hulls design speed are NOT the only factors to be considered in determining towing speed. The following factors MUST be taken in consideratin as well, whether the vessel is a displacement hull or planing hull.
      (1) Structural condition of a vessel.
      (2) Availability and location of adequate deck fittings.
      (3) Trim and load of a vessel.
      (4) Operational limitations of your vessel.
      (5) Existing weather conditions.
      (6) Currents and tides.
      (7) Sea conditions.

WARNING

DO NOT tow displacement hulls faster than their design of maximum speed. ANY attempt to increase this speed may cause the vessel to ride up on its bow wave and become unstable. Tension on the towline and towing hardware becomes enormous. You may also pull this hull under if you exceed the design or maximum speed.

SAFE recommended towing speeds for displacement hulls is determined by **FIRST** calculating the hulls design or maximum displacement (Towing) speed. To determine maximum towing speed use the equation S = 1.34 Lw, where S = Maximum Speed (displacement mode), in knots, 1.34 = Hull Design Factor and Lw = Waterline Length, in feet. SECOND calculate SAFE towing speed by reducing the "maximum" displacement towing speed by no less than ten percent. Towing at this speed reduces frictional resistance, increases stability and safe control of the towed vessel. For example, the design or hull speed for a displacement vessel with a waterline length of 40 feet (length of the underwater portion of the hull) MAXIMUM towing speed would be 8.4 knots (a) of Table 12-2 and SAFE towing speed would be 7.6 knots (b) of Table 12-2 (See Table 12-2).

Step 1 $S = 1.34 \sqrt{Lw}$
Step 2 $S = 1.34 \sqrt{40}$
Step 3 $S = 1.34 \times 6.324$
Step 4 S = 8.4 knots MAXIMUM towing speed
Step 5 $8.4 \times .10 = .8$
Step 6 $8.4 - .8 = 7.6$ knots SAFE towing speed.

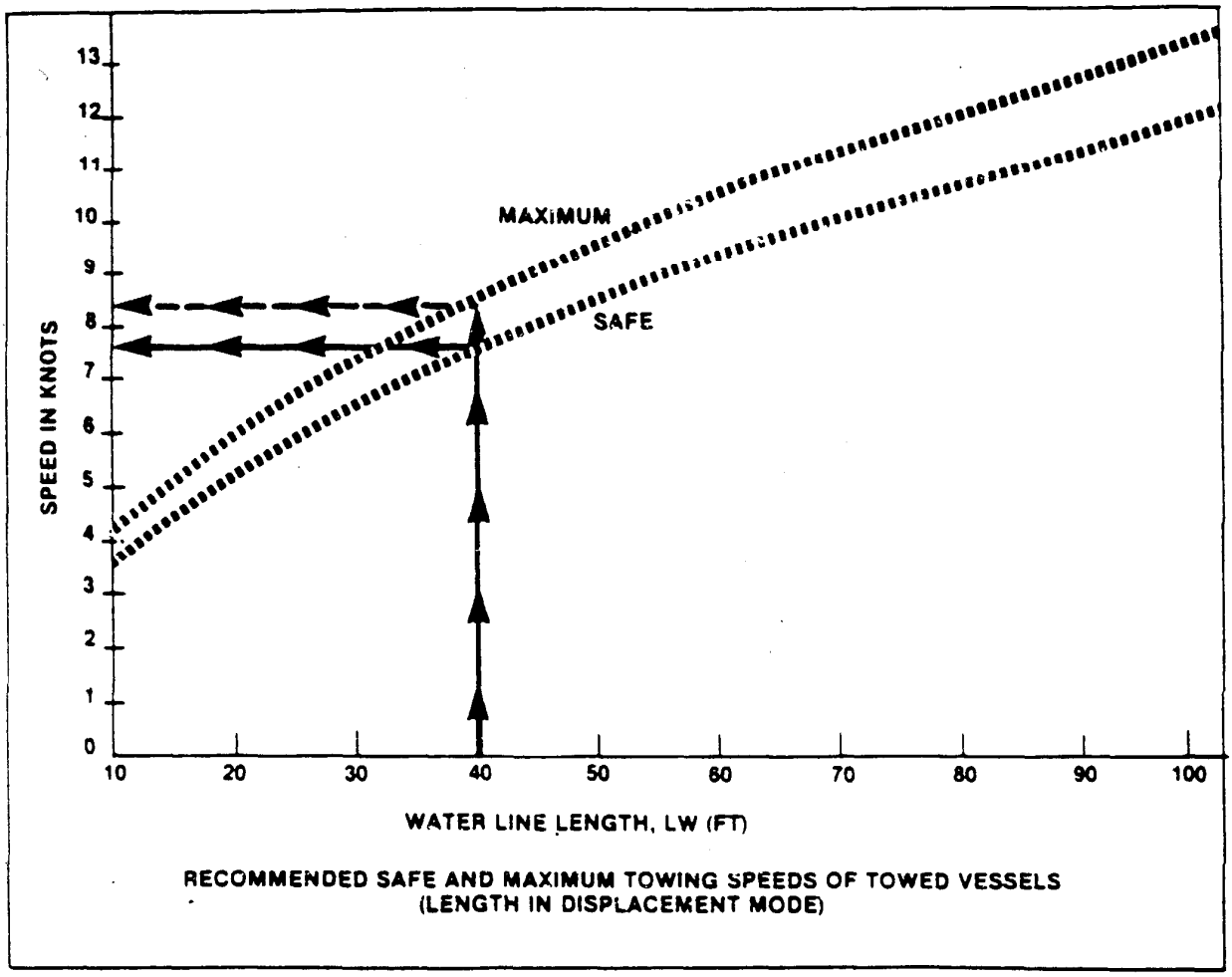

Table No. 12-2 Maximum Safe Towing Speeds

NOTE

ALWAYS take into consideration the additional factors 1 thru 7, previously discussed, when determining both maximum and safe towing speeds. Maximum towing speed should NOT be undertaken unless ideal conditions exist.

b. **Planing Hull.** A planing hull is generally a Deep V'd hull permitting a faster towing speed. The limiting factors are primarily your boats weight and engine power and the weight of the vessel being towed. If the towing attachment point (i.e., trailer eyebolt) is low and close to the center line, the planing hull can readily be placed in the planing mode permitting a greater towing speed. Towing is POTENTIALLY dangerous which is compounded by poor weather conditions, sea conditions and many unknown factors of the vessel being assisted, such as, structural conditions, strength of deck fittings and stresses being placed on these fittings. Every effort is made to ensure the SAFETY of LIFE and PROPERTY in ALL instances. Although higher towing speeds are obtainable with planing hulls, RECOMMENDED towing speeds for displacement hull vessels (Table 12-3) apply to planing hulls as well.

Table No. 12-3

MAXIMUM TOWING SPEEDS

DISPLACEMENT AND PLANING HULL VESSEL TOWING SPEEDS					
VESSELS WATERLINE LENGTH	SQUARE ROOT	MAXIMUM TOWING SPEED	VESSELS WATERLINE LENGTH	SQUARE ROOT	MAXIMUM TOWING SPEED
20	4.5	6 knots	70	8.4	11.3 knots
25	5.0	6.7	75	8.7	11.7
30	5.5	7.4	80	9.0	12.0
35	6.0	8.0	85	9.2	12.3
40	6.3	8.4	90	9.5	13.0
45	7.0	9.4	95	9.8	13.1
50	7.1	9.5	100	10.0	13.4
55	7.4	9.9	105	10.3	13.8
60	7.8	10.5	110	10.5	14.1
65	8.1	10.8	115	11.0	14.7

WARNING

HIGH SPEED TOWING is NOT recommended or authorized. Safety of Life and Property in all instances has precedence over speed and time.

5. **General procedures for Towing.** The following guidelines are applicable in most all towing evolutions. The majority of the time you will take disabled vessels in tow astern. It is the perferred method in open water.
   a. Assemble all equipment and check its useability.

b. It is important to maintain scheduled communications with the distressed vessel in order to ascertain the physical condition of the personnel involved, the material condition of the vessel and any other condition that may effect their health and safety in the conduct of the tow. If boat to boat communications cannot be established through installed radio equipment, provide a portable radio to someone on the distressed craft and give the person instructions on how to use it. Establish visual or sound signals with the other boat to be used in the event of radio failure.

c. Estimate the effects the following will have on the operation.
   (1) Existing and forecasted weather.
   (2) Currents and tides.
   (3) Sea conditions on scene and at the destination where the disabled boat will be towed.

d. Maintain a navigational plot.

e. Determine the following.
   (1) The advantages of placing a crewmember on board the disabled craft.
   (2) The need of removing the people from the disabled boat.

NOTE

When conditions warrant remove all POB from the disabled boat. The determining factor in this decision should be the overall safety of personnel and the boats involved.

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f. Direct the persons aboard the distressed craft to don PFD's.

g. Determine the rate the disabled vessel is drifting.

h. Determine the best towing approach to employ.

i. Brief the people on the other boat regarding the following.
   (1) Hook-up procedure.
   (2) Breakaway procedure.
   (3) Safety.
   (4) Line handling procedure, e.g., instruct the operator of the disabled vessel not to cast off any lines unless directed to do so by you.
   (5) Operating procedure, e.g., instruct the operator of the other boat to man its helm and ensure the operator clearly understands what you want done.
   (6) The route to be followed, sea conditions to be expected enroute, destination and estimated time of arrival.
   (7) If towing at night ensure the proper lights are displayed as required by COLREGS.
   (8) Radio frequency to be guarded and times of routine status reports (approximately every 20 minutes).

6. **Towing Astern.** The majority of the time you will take disabled vessels in tow astern. It is the preferred method employed in OPEN water. After performing the procedures indicated above, follow the guide lines indicated below after towline connections have been made.

   a. When getting underway with the tow remember the steps below.
      (1) Increase speed slowly to minimize static and dynamic forces. Change direction slowly and ONLY after headway has been gained. If possible have the towed boat assist in all heading changes by steering on your stern.
      (2) Develop and maintain a proper length in the towline. The dipping of the towline is referred to as catenary. While catenary effects provide the "elasticity" in wire rope and chain, double braided nylon rope is elastic within itself. The elasticity of the nylon increases as the load increases. The very nature of the line and its scope act as a shock absorber. (See Figure 12-27).

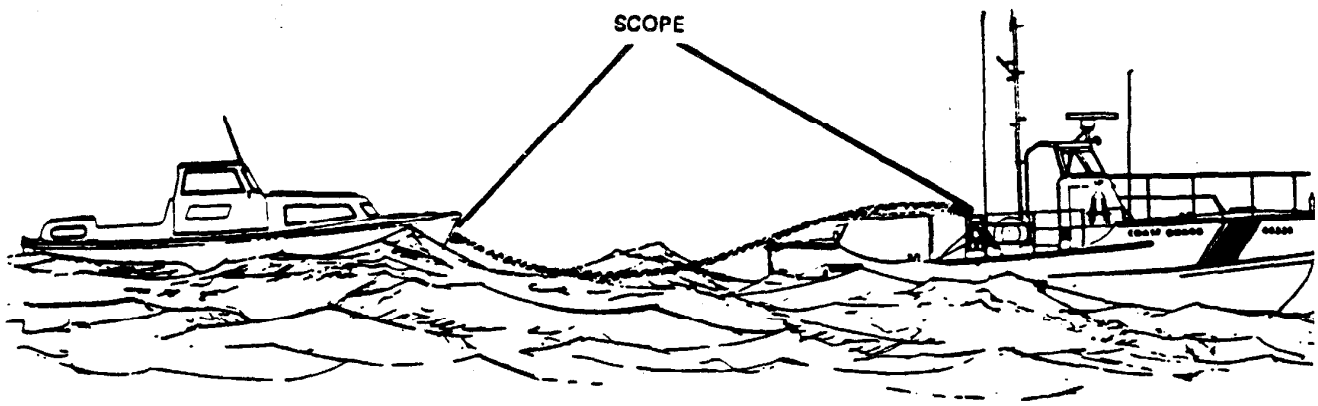

Figure 12-27 Towline Catenary

(3) Keep the towed boat in step (position). That is, a proper distance behind your boat in relation to the sea/swell patterns so that your boat and the towed boat ride over the seas in the same relative position - WAVE CREST to WAVE CREST. If one boat is in a trough while the other is on a crest, the towline will become slack and then taut as the positions of the boats alternate. The sudden jerk which results when the towline becomes taut is called "jumping the line" and can exceed the breaking strength of the line. If the towing boat is riding up a crest while the towed boat is sliding down the towline will become slack, thus exerting no control of the towed boat. A towed boat may be kept in step by providing more scope in the towline, or alternating the course so as to cross the swells diagonally (See Figures 12-28, 29 & 30).

(4) When a boat is in tow astern the possibility always exists that it may begin veering to one side of your boat or the other along the towline. This veering, called YAWING, is EXTREMELY dangerous and unless corrected may cause one or both boats to capsize. The tremendous force on deck fittings resulting from yawing may also damage deck fittings and other attachment points. Consequently, it is important to prevent or reduce yawing to the extent possible. Any one or more of the actions below will help to do so.
   (a) Decrease the towing speed.
   (b) Lengthen or shorten the scope of the towline.
   (c) Make sure the tow is trim, that is, the bow slightly higher than the stern with no list.
   (d) Rig a drogue from the stern of the towed boat.

(5) Set a towing watch and observe the action of the tow at all times.

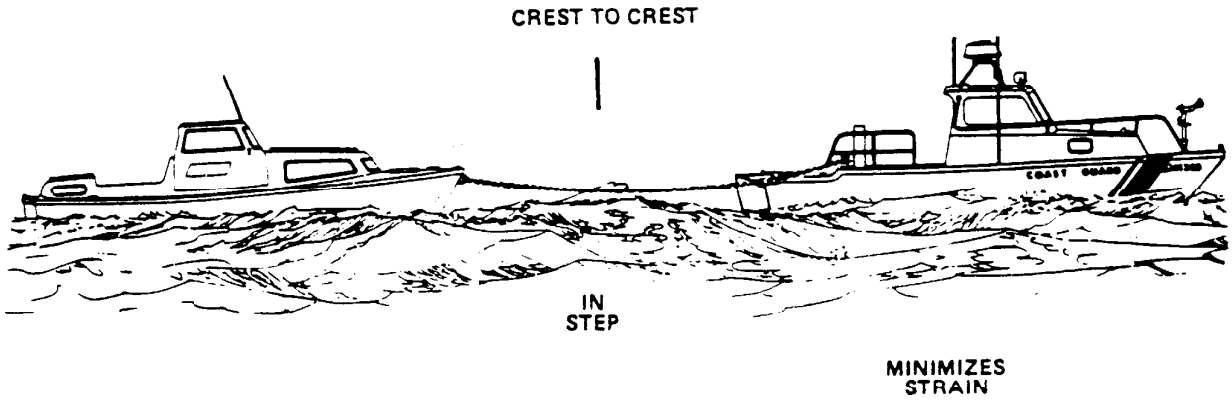

Figure 12-28 Boats in Step

7. **Positioning the Drogue.** The drogue is an effective way to reduce or prevent an astern tow from yawing. This stablizing effect at the drogue is obtained by the pull of the stern, which is normally required when a wave is approaching from the stern. For the drogue to function properly it must be submerged when the wave approaches and this will depend MAINLY on the scope of the drogue line which is payed out. The scope of the line to be payed out should normally be EQUAL to 1-1/2 wave lengths (distance from one wave crest to the next wave crest). If the waves are steep and short a scope of 2-1/2 to 3- 1/2 times the wave length is recommended.
   To position a drogue three points must be kept in mind:
   a. The drogue must be far enough behind the tow to remain submerged. It must be pulling into the base of a wave; it cannot be out of the water at the crest of a wave.
   b. There must be adequate slack in the tripping line to prevent the drogue from inverting and losing its resistance.
   c. The objective when using a drogue is to maintain a steady pull at all times.
8. **Handling a Sinking Tow.** Handling a sinking tow is tricky business. The sinking boat can pull the stern of the towing boat under unless all personnel pay close attention to what is happening during the operation. Furthermore, since the sinking boat is towed astern of the towing boat, there is the danger of the towed boat yawing, thus capsizing the towing boat by pulling it side-over by the force exerted through the towline. Few sinking tows will allow time for disconnecting the towline from the towed boat. The following procedure is recommended to overcome the dangers of a sinking tow. (See Figure 12-31).
   a. Do not cut or slip the towline until the boat is actually submerging.
   b. Slip the towline and, if necessary, cut the towline with a fireax.

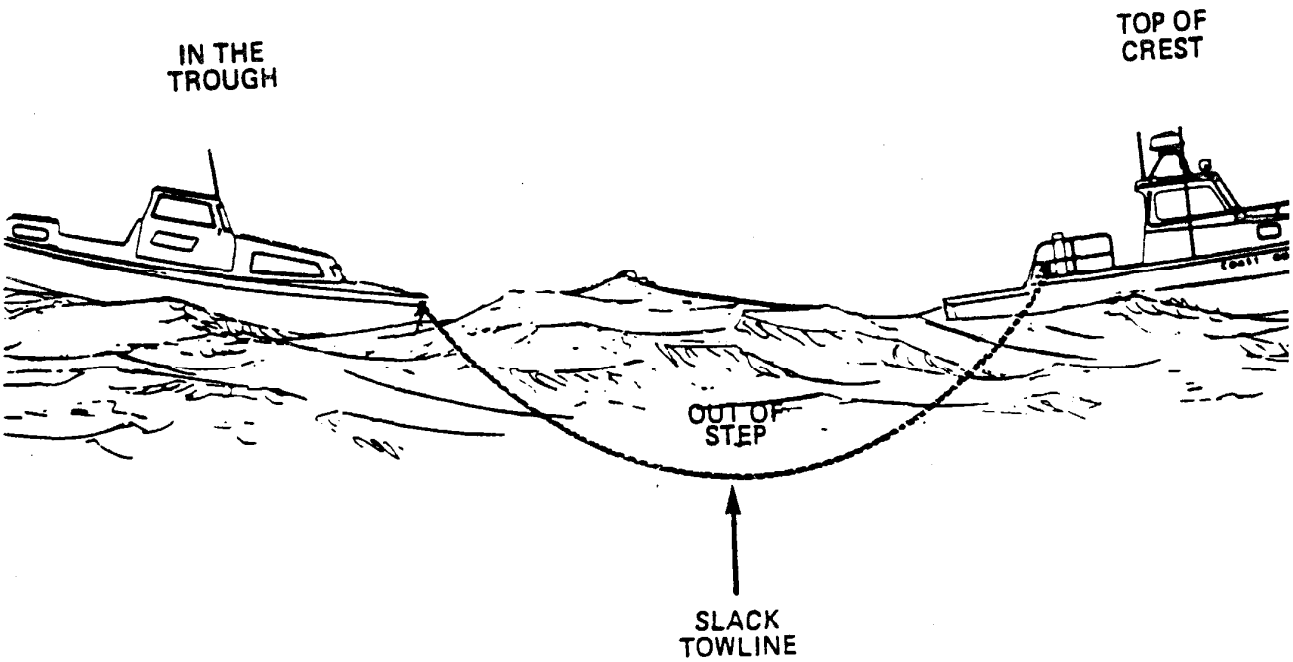

Figure 12-29 Boats Out of Step-Slack Line

c. If in shallow water and safety permits pay out the towline until the sinking tow reaches the bottom. Then do the following.
   (1) Secure a lifejacket or floatable object to the towline so that it is visible on the surface. This object will mark the location of the boat so it can salvaged by the owner later.
   (2) Cut the towline.

9. **Towing alongside.** When in confined areas shorten the tow as necessary for safe navigation, or to take the tow alongside. The alongside method of towing is used primarily when maximum control is required and perferably in protected waters. The object in alongside towing is to make both vessels act as one vessel to the extent possible. The four lines used in alongside tow are recommended to be connected as follows:
   a. The bow line is secured from your bow to the towed boats bow and serves to hold the disabled boat's bow in.
   b. The stern spring line is secured inboard of your stern to outboard of the disabled boat's stern.
   c. The tow strap is secured from your bow to the towed vessel's stern. It is this line that takes the strain resulting from forward movement.
   d. The backing line is secured from your stern to the towed vessel's bow. It is this line that takes the strain resulting from backing down. (See Figures 12-32 and 12-33).

The tow strap and backing line reduce the amount of surging which can occur between boats. Also, the nearer the lines are to a fore and aft direction, the more control you have over the tow because the angle of pull is concentrated along the keel. In general, the length of the alongside towing lines determines the amount of shock load these lines will take. Increasing the length of the lines increases the shock load absorption thus decreasing the chance of the lines parting under excessive tension. In

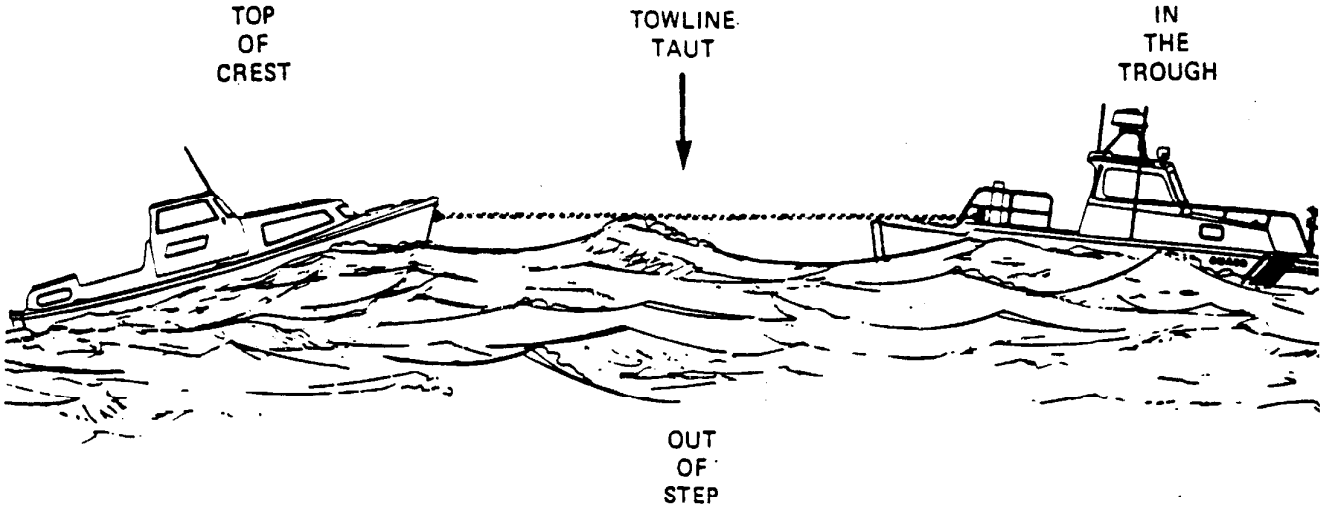

Figure 12-30 Boats Out of Step-Taut Line

many cases the placement of alongside towing lines will vary, depending on the size of the tow and the placement of attachment points of the disabled boat. However, the most common procedure for conducting an alongside tow is outlined below.

a. Brief or instruct your crew on the following:
   (1) Which side of your boat, port or starboard, the tow will be secured.
   (2) Breaking out of alongside towlines.
   (3) Rigging of fenders.
   (4) Keeping all lines clear of the water and away from the screws.
   (5) Safety.

b. Always rig fenders to prevent hull damage. The alongside tow is one case where fenders are employed to protect both boats. The following steps should be followed in positioning fenders correctly.
   (1) Note how your boat will match up with the disabled boats hull. Usually the minimum of two fenders should be secured in place prior to bringing the disabled boat alongside; one additional fender should be hand tended.
   (2) To suspend a fender, or fender board, tend it by its attachment line. Adjust the position of the fender as necessary to cushion points of contact between the two boats.
   (3) Secure the fender using a clove hitch or slip clove hitch. A slip clove hitch is used when it may be necessary to releave the fender or fender board quickly (See Figures 12-34 & 35). A fender may also be secured in the following ways:

      (a) To a stanchion or a lifeline with a half hitch.
      (b) To a stanchion or a lifeline with a clove hitch or slip clove hitch.

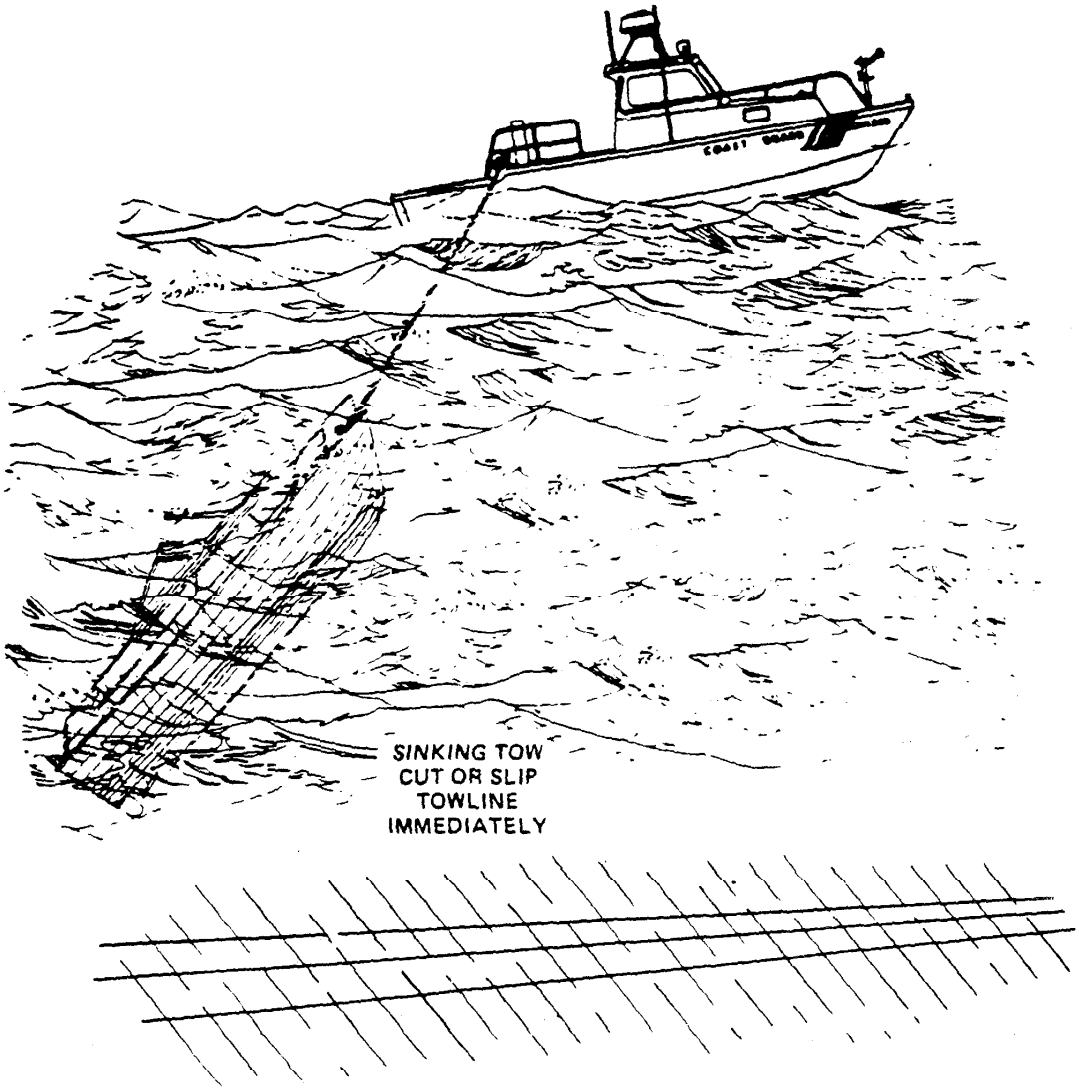

Figure 12-81 Sinking Tow

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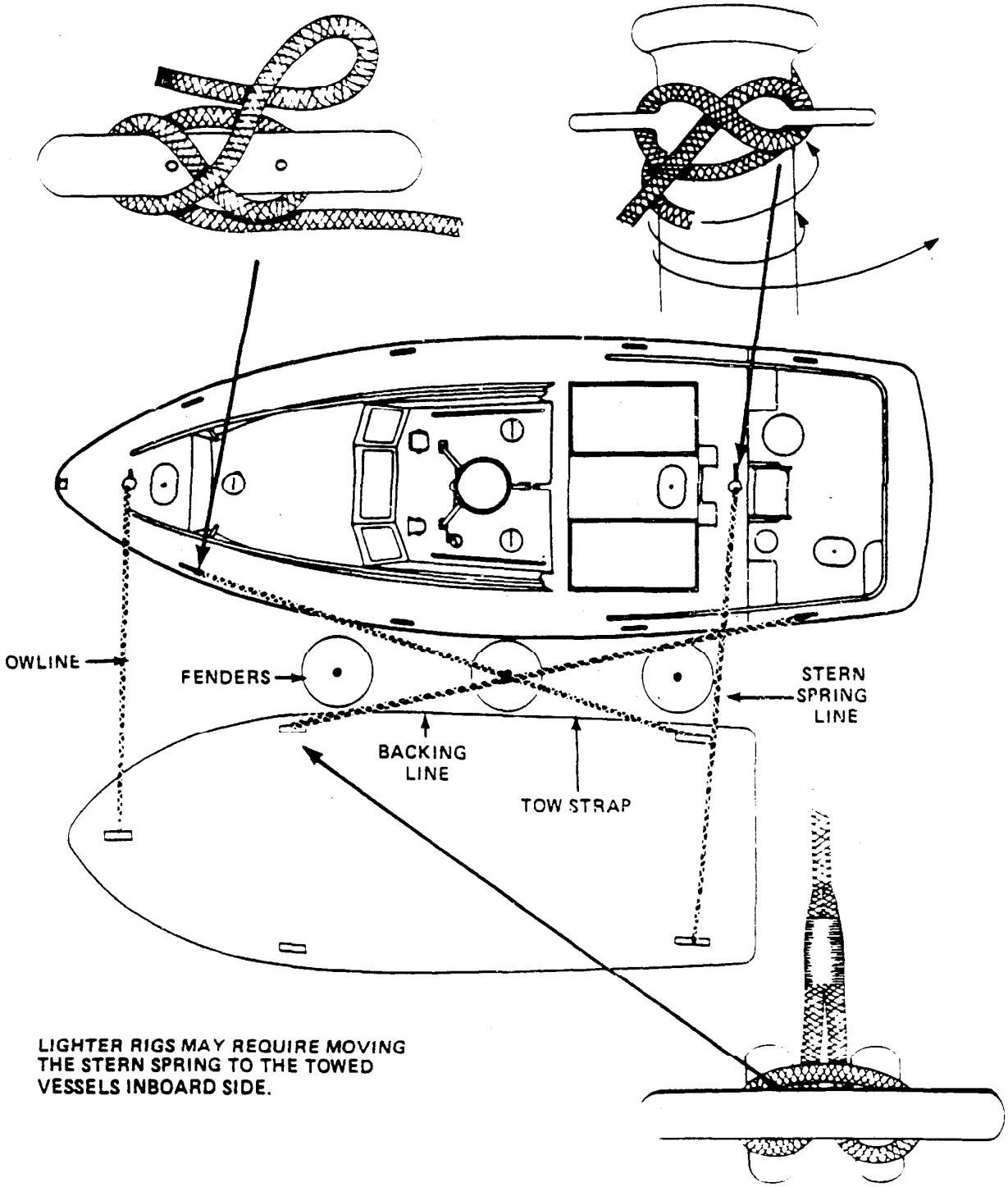

Figure 12-32 Alongside Tow-41' UTB

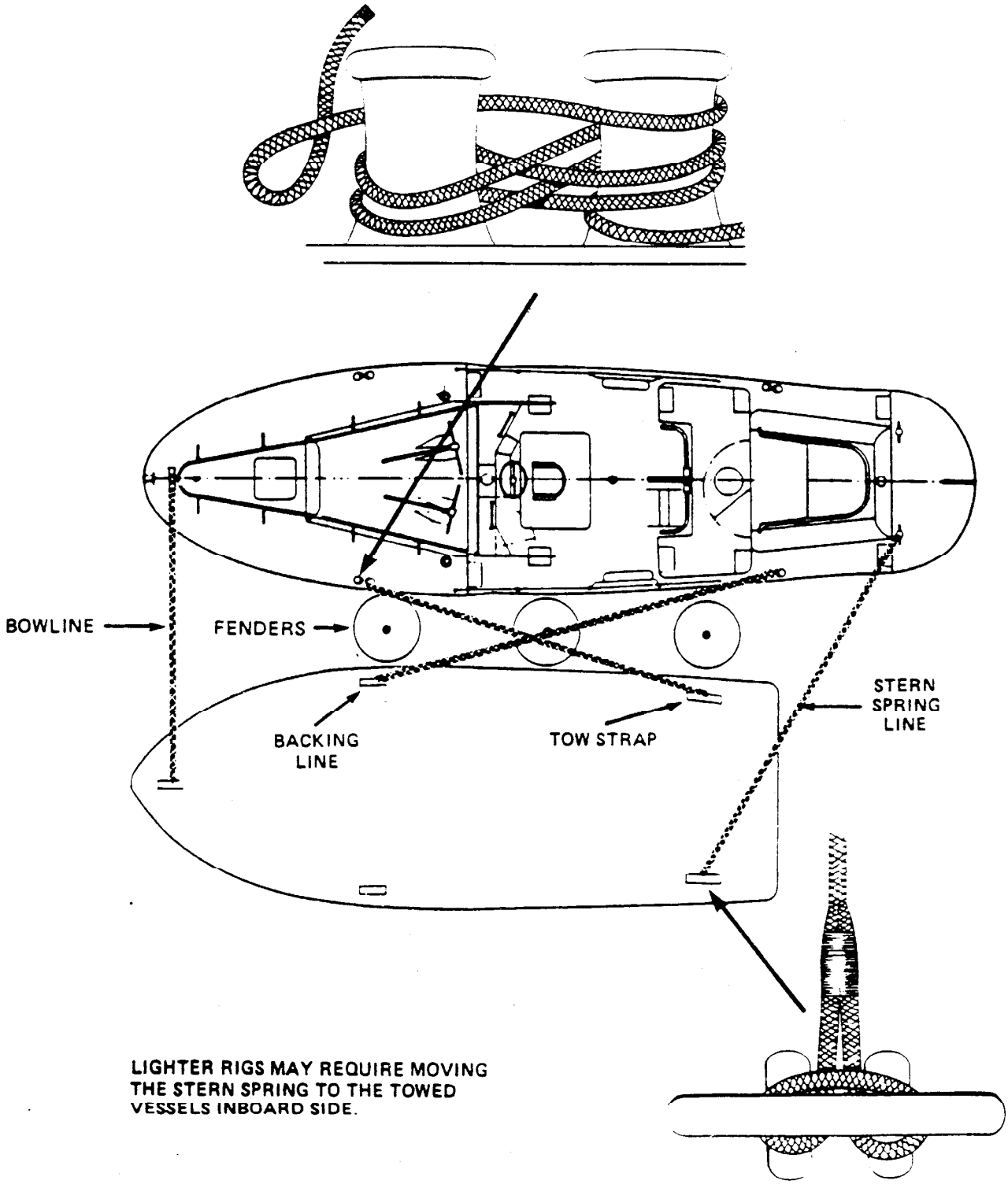

Figure 12-33 Alongside Tow-44 MLB

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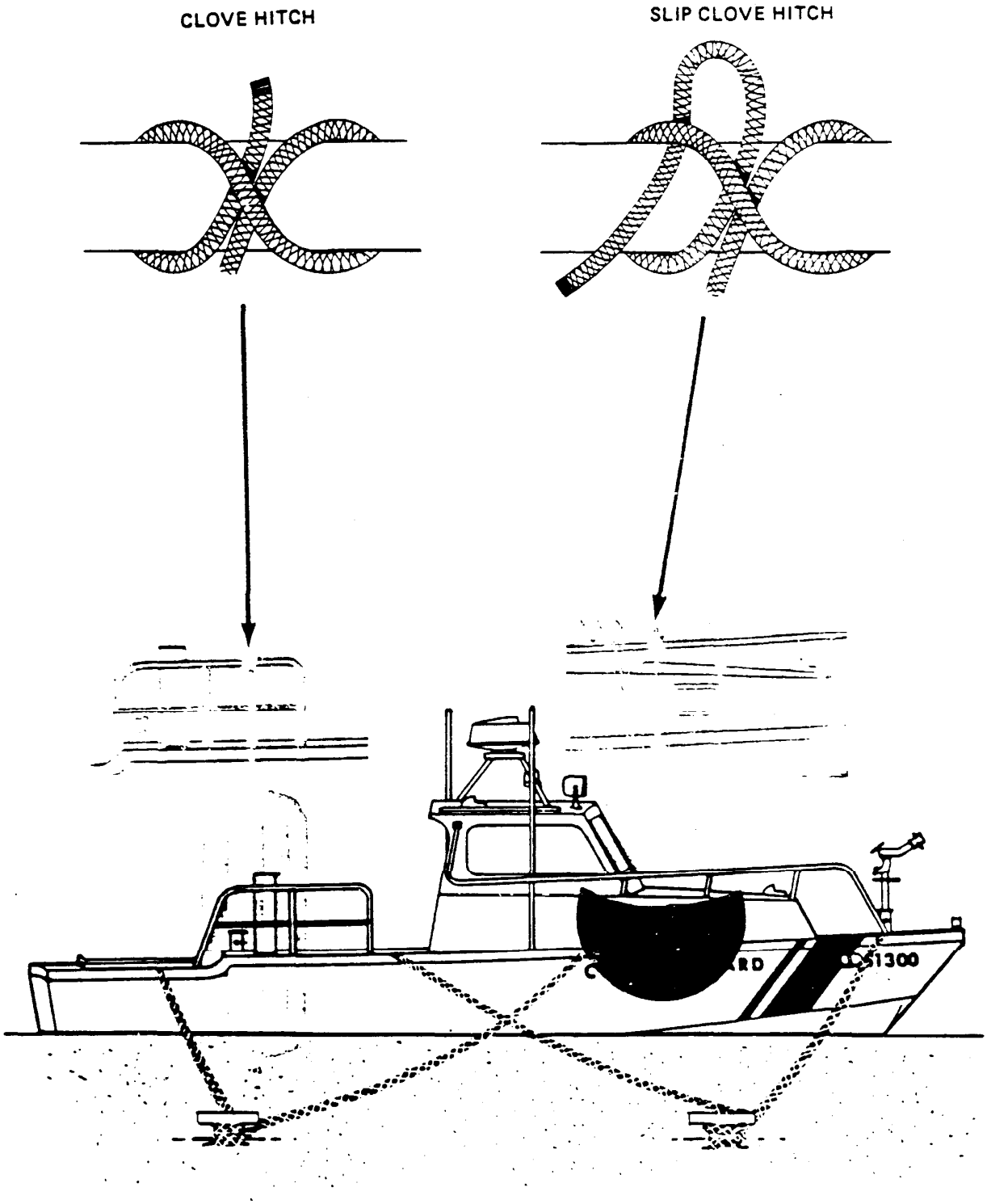

Figure 12-34 Securing Fenders

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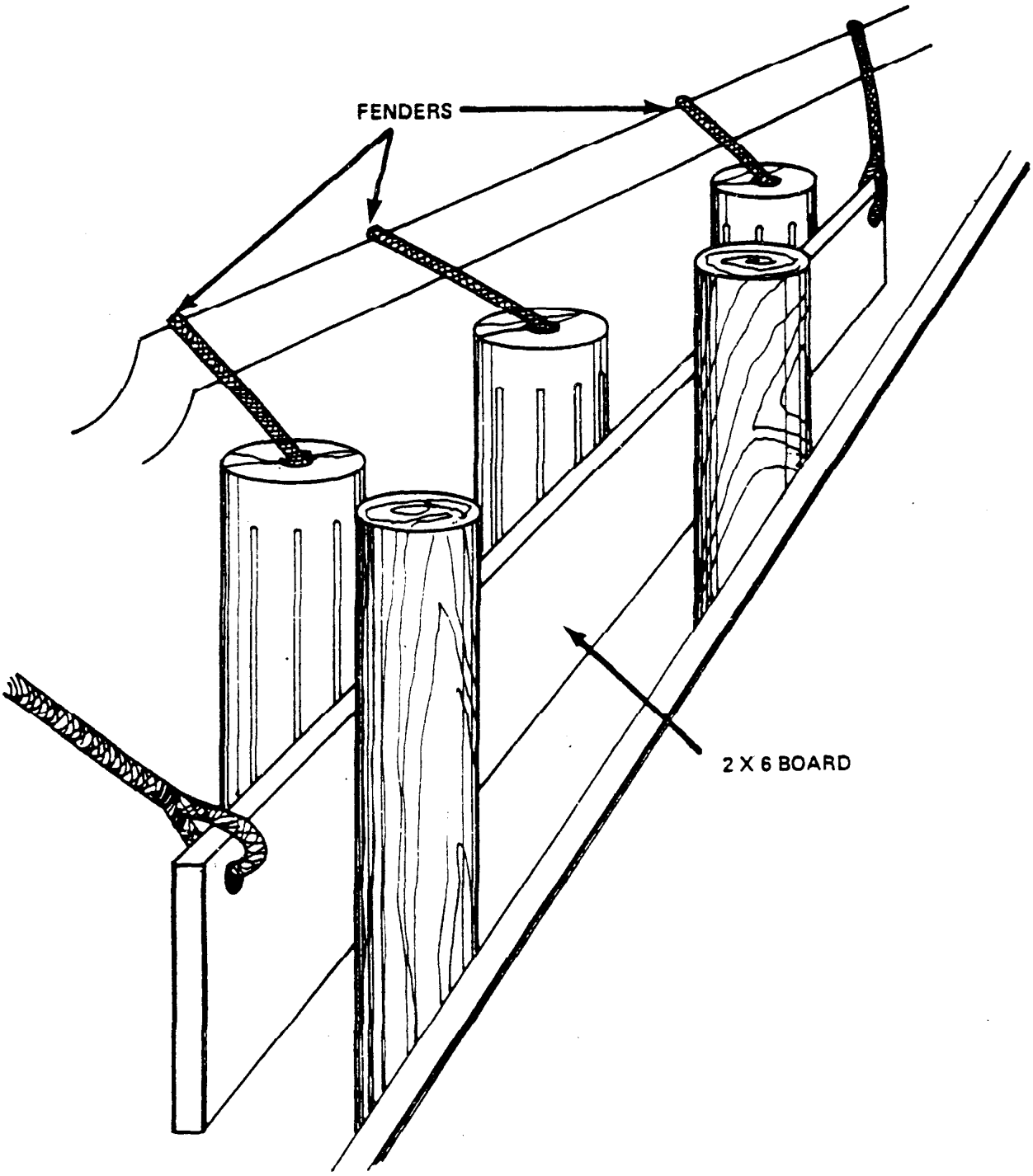

Figure 12-35 Fender Board

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(c) Belayed to a cleat with figure 8's.

c. When shortening the tow follow the steps below.
   (1) Advise the people on the disabled boat of yor intentions.
   (2) Reduce speed slowly, constantly keeping the towline in view at all times. (See Figure 12-36). Be aware of set, drift and any obstacles and obstructions. Remember, a sudden reduction in the speed of your boat has little effect on the towed boat. Thus, a rapid decrease in your speed can easily result in the towed boat closing on your boat at such a rate an overtaking or ramming situation could develop particularly if it is a displacement hull.
   (3) Heave in the slack from the towline to bring the disabled boat alongside.

d. Secure the alongside tow. To secure the alongside tow perform the steps below.
   (1) Lead the towline to your bow for the bow line. Immediately secure the backing line to get control of the vessel. (See Figure 12-32).
   (2) Secure the bow line, keeping the bow of the towed vessel slightly "toed" in towards your bow.
   (3) Secure the tow strap.
   (4) Insure that your stern is well aft of the towed vessel to maintain the effectiveness of your screw and rudder. (See Figure 12-33).
   (5) Rule of thumb. If on a 41' UTB align your towing bitt with the towed vessels stern. If on a 44' MLB align your towing bitt with the after quarter bitt on the towed vessel.
   (6) Secure the stern spring line.

NOTE

In all case secure the working ends of alongside lines to your vessel in order to adjust or relocate lines. ALWAYS pass the end of the line with the eye to the disabled boat. Direct the *placement of, including the attachment point of all lines, to the disabled boat.*

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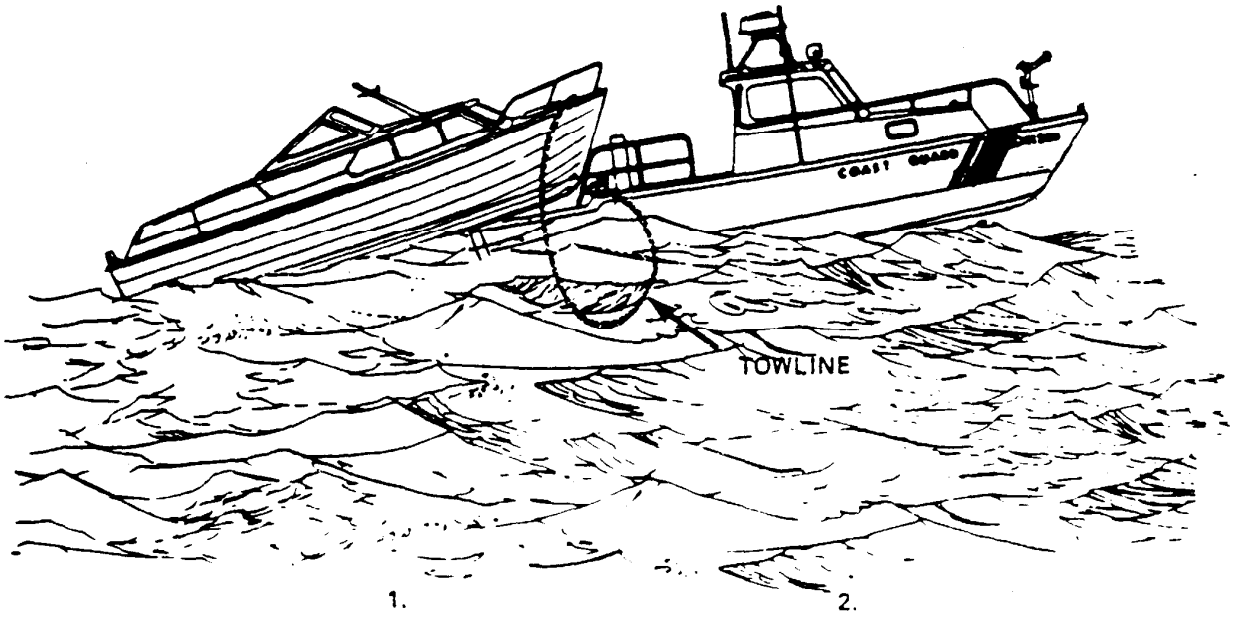
   (7) Use the following steps in making final adjustments to the tow strap and stern spring line.
      (a) Back down slowly to remove slack from the two strap. (tow strap runs from your bow to the towed boat's stern).
      (b) Go ahead slowly to remove slack from the backing line. (backing line runs from your stern to the towed boat's bow).

e. Docking an alongside tow. When docking with a vessel in alongside tow follow the steps below:
   (1) Decrease speed as slowly as possible to maintain control of the towed vessel.
   (2) *Determine the following critical factors which can effect the docking.*
      (a) Wind velocity and direction.
      (b) Current velocity and direction.
      (c) Height of tide.
      (d) Type, structure and location of mooring.
      (e) Obstacles and obstructions around the mooring/dock.
      (f) Availability and location of personnel and deck fittings.
   (3) Determine the angle of approach and the side of the boat to be moored based on the evaluation of the above factors.

NOTE

It is desirable to take advantage of wind and current when docking or mooring. Whenever possible, for control, approach against the wind and current and moor on the protected side of the mooring (leeward side).



SUDDEN REDUCTION IN SPEED

ADVERSE CURRENT FOLLOWING SEA

TOW CONTINUES FORWARD AT A FASTER RATE OF SPEED THAN YOUR VESSEL

Figure 12-36 Overtaking Tow

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10. **Towing Disabled Boats From the Surf.** Handling towing evolutions in heavy surf and is extremely hazardous. In general, vessels that have not been specifically designed for use in the surf should not conduct such operations. The rescue of boats from surf and heavy seas is a major purpose of the MLB, a fact, incidentally, which makes the operation no less dangerous. Serious injury is an everpresent possibility. So is the possibility of serious damage happening to the boat. The seriousness of surf operations limits response for the most part to cases involving risk to human life. Outboards and small open boats adrift in the surf without anyone on board do not justify risking a Coast Guard crew and boat to recover them. There is no substitute for careful planning of a towing operation to be done in the surf. You must prepare thoroughly, approach cautiously, and, once in the surf, make survival the primary rule to follow. All towing operations involving surf, such as breaking inlets, over bars during running tides, and/or in rough weather, MUST be performed with EXTREME caution. There is no substitute for experience in conducting any operation in the surf, more so in conducting towing operations. You prepare quickly, approach with confidence and once in the surf, react as you have been trained. All crewmembers MUST be in wet suits or anti-exposure coveralls crash helmets and safety harnesses. The boat must be free of loose gear, engines physically checked prior to entering the surf zone and MAXIMUM watertight integrity set. Your station should be advised of your intentions and a backup boat requested. The procedures below will help you carry out a towing evolution in surf.

WARNING

Handling towing evolutions through heavy surf is EXTREMELY hazardous. Non-surf boats are NOT designed to operate in surf environment and should NEVER cross a breaker line. Such operations are in the realm of specifically equipped boats (52' MLB, 44' MLB and 30' SRB's) and professionally trained and experienced crews.

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a. As you are approaching the surf look for the lowest part of the surf line. Observe the surf by timing each wave until the series of the breakers are determined. Then, knowing when the MAXIMUM and MINIMUM waves are expected, enter the breakers during a lull. As the waves pick up, maneuver your boat to meet them head on to avoid broaching.

b. Avoid surfing down the slope (front) of any wave. In surf, not only does this cause excessive shockloads on the towing rig, but may cause your boat to pitchpole; going end over end. In this situation, the bow buries itself in the wave and the stern pitches over the bow.

c. Determine if you can, in fact, save the boat. If not, only rescue the people on board. This decision must be made rapidly during your approach.

   (1) If the boat is towable, approach from upwind, maneuvering to the inshore side for passing the towline. If the disabled boat's proximity to the beach prevents approaching from the inshore side, you may turn your boat and back toward the other boat, but stand ready to throttle ahead into oncoming breakers.

   (2) If the boat is damaged or unsalvageable, plan your approach to arrive at the disabled vessel with your bow into the waves. Take the POB's on board your boat by either (1) coming directly alongside during lulls in the surf when both boats are in the same trough, (2) passing a floatable line to the disabled boat and pulling the people across to your boat, or (3) by placing a crewmember wearing a swimmers harness in the water; swimming between boats.

   (3) In any approach, watch your bow and stern and be ready to react to oncoming waves. NEVER allow your boat to get broadside to the surf or directly below a plunging breaker (in the curl). Lateral movement (side to side) in surf environment may be obtained by taking a breaker at a slight angle while applying power to the opposite screw. The result will be a "crabbing" motion.

d. Once within working distance of the disabled boat, turn into the waves. Ideally, you should be parallel to the other boat in the surf line if that boat is anchored. *AVOID getting directly to* landward or seaward of the disabled craft. If the disabled boat is unable to position itself into the surf line or is at the mercy of the elements you will have to maneuver with caution to get into position.

e. To take the boat in tow, throw the heaving lines or aim the line throwing gun down wind, aiming over the largest target on the disabled boat.

f. When someone on the distressed vessel has received the towline, put the towline over the side from the well deck on your boat. The crewmember tending the towline should move to a position immediately forward of the towing bitt to pay the towline out, keeping it taut and out of the screws. Hold on to your boat at all times with one hand.

NOTE

The crewmember tending the towline at the crucifix, should be aware of the direction that the line is tending and keep the coxswain informed at all times.

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g. Once the towline is secured to the disabled boat, take a turn around the right and left side of the horns of the towing bitt. The towing bitt on the MLB were specifically designed for this purpose. Control the towline payout by placing your foot on the towline reel in such a manner that it will not get entangled in the reel. DO NOT use your hands for the line will pay out very fast and will surge and stop with the surf action which may cause rope burns, dislocated shoulder(s), etc.

h. With the boat in tow proceed seaward. WATCH THE TOW AT ALL TIMES. It will at first move broadside to the surf and then turn to come in line with your boat. If the tow is a small vessel and you have left the people on board have them position themselves as far aft and as low as possible on or near the centerline of the boat taking into consideration the factors listed under paragraph B(u), except, for the helmsman who, if capable, must continue to steer. Keep the towline short to shelter the boat with your wake. If the tow is a larger boat, keep the tow 2 to 3 breakers astern. Conduct the tow as if you were operating the disabled boat as well as your own boat. Increase your power as the tow goes into a wave and decrease power when the tow is on the back side. Allow plenty of scope in the towline.

i. Once outside the surf line, shorten the tow and prepare to assist any injured personnel. Dewater the disabled boat if necessary. MAKE CERTAIN the towed vessel is seaworthy for towing.

j. Do not tow across a breaking bar. Stay outside, crossing a breaking bar is considered to be dangerous to all parties involved and will not be conducted by Coast Guard units.

11. **Towing in current.** When towing in a river or area affected by tidal currents, consideration must be made for the effect of the current on the towing and towed boats. The prudent sailor will take time to determine the predicted currents and keep alert to notice the effects of existing conditions by noticing whether a wake is trailing from objects such as buoys, dock pilings and rocks. Current of course affects both boats. A General Rule of Thumb is one knot of current produces an effect similar to 15 knots of wind. Towing in current can be viewed into three categories: towing against the current, with the current and across the current.

a. Towing against the current. When towing a vessel requiring a slow towing speed, a strong adverse current (one which is opposite your course) may prevent you from making any headway; you and the towed vessel may even be set astern. In this situation you should not increase your power to make headway as you may place excessive strain on the towing rig and associated deck fittings on both boats. The prudent action may be to anchor the vessel and wait for the current to slack.

b. Towing with the current. As indicated above, the current will influence both boats in a similar manner. As you gradually slow your speed through the water, the towed vessels speed through the water will likewise slow. However, both boats will continue to be carried in the direction of the current.

CAUTION

High speed towing should NOT be used to keep tension on the towline.

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c. Towing across the current. In rivers and narrow passages the current's speed will vary with location, running strongest in the deep waters. There may well be counter currents and eddies. As you change direction from running either against or with the current you must exercise extreme caution and plan your course changes well in advance. If conditions permit make your course alterations slowly recognizing that a following current will tend to carry the towed vessel along the current axis or direction. It may be wise to shorten your tow in advance.

12. **Tandem Towing.** Occasionally it may be necessary to tow two or more boats at the same time. The forces, principles and procedures discussed previously concerning single tows also apply to tandem tows. The potential for problems is greatly increased in proportion to the number of vessels to be towed.

CAUTION

Tandem towing should NOT be attempted by inexperienced personnel.

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a. When towing in tandem, that is, one vessel behind the other, the LARGEST and/or HEAVIEST should be FIRST in line with the smaller vessel(s) strung out astern in order of DECREASING size. The use of bridles on all vessels in tow is preferred and EXTREME care should be taken to ensure that the deck fittings, especially the stern fittings on the disabled boats to which the bridles are attached are suitable. Speeds lower than normal towing speeds should be selected.

CAUTION

Tandem towing should ONLY be attempted over short distances and under CALM sea conditions due to the unnatural stresses being placed on the first vessel(s) in the tow makeup.

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13. **Assisting a Vessel Aground.** When assisting a boat aground a careful and thorough evaluation of the situation must be made by the coxswain before attempting to assist or refloat a vessel aground. See Appendix 12-B, paragraphs 5 and 6 regarding Coast Guard policies in towing grounded vessels. Boats run aground under any number of different circumstances. In fact, no two cases are ever exactly alike. The immediate possibility of further damage, however, is present in all groundings. Pounding and broaching are two everpresent dangers.

a. Pounding. Pounding is caused by the varying degree of buoyancy of a grounded boat. The waterline changes constantly as succeeding crests and troughs of waves pass the boat. This produces an alternate increase and decrease in the boat's total buoyancy. Bottom damage occurs when this condition is great enough to lift the boat off the bottom and drop it back again. Such

damage may range from tearing a few seams open to serious holing of the grounded boat. Each wave striking against the boat tends to drive it further aground.

b. Broaching. Broaching is caused by surf hitting a boat on the side or quarter and results in the boat being thrown broadside. It is particularly dangerous for two reasons. FIRST, broaching tends to drive the boat harder aground. SECOND, currents are set up around the bow and stern of the boat. The velocity of these currents will scour sand away from the boat's hull, piling it up amid ship to leeward on the boat, thus leaving the boat supported only amidships. When this condition exists the keel of the boat may often break, rendering the boat a total loss. Refloating attempts should be avoided in these cases.

c. Refloating procedures. Regardless of the refloating method used, set will carry your boat in the direction of the current. To counter this, secure your towline forward of the stern or aft of your bow for increased maneuver ability. (See Figures 12-37 and 12-38). The various procedures for assisting a grounded vessel are outlined below:

(1) Determine set.

(2) Ensure proper steps have been taken to anchor the boat. Anchors should be layed out to seaward to prevent the boat from being driven further aground.

(3) Determine the location and extent of hull damage, if any. If the boat is beached, every attempt should be made to have a beach party from your unit visually inspect and evaluate the condition of the grounded vessel. Ensure the vessels hull is free of sand, water and leaks. If vessel is holed, effect temporary repairs to reduce leaking to a minimum. If the vessel is wooden hull, determine if any seams have worked open. Effect temporary repairs if possible.

WARNING

If there is ANY doubt as to the vessels ability to remain afloat, NO attempt to refloat the vessel should be made.

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(4) If it is determined that the vessel will remain afloat, then further action must be planned carefully to avoid unnecessary and excessive stress of the grounded vessels hull and/or towing rig. The following factors MUST be considered:

(a) Does the towing boat have enough power to do the job?

(b) Is the towing rig strong enough to take the static load?

(c) Are the fittings and hull structure of both vessels adequate? Use the strongest fittings on both vessels.

(d) What are the sea conditions?

(e) What are the tidal conditions? Unless weight is removed from the grounded vessel it should not be reflected at any less of a tidal height than that at which it went aground. Determine the vessels draft at the time of grounding as well as what time the height of the tide will be at least equal to that of when the grounding occured.

CAUTION

Any attempt to refloat a vessel prior to the height of tide being equal to the vessels draft will result in excessive strain to towing hardware and damage to the hull of the stranded vessel.

(f) What is the present and forecasted weather?

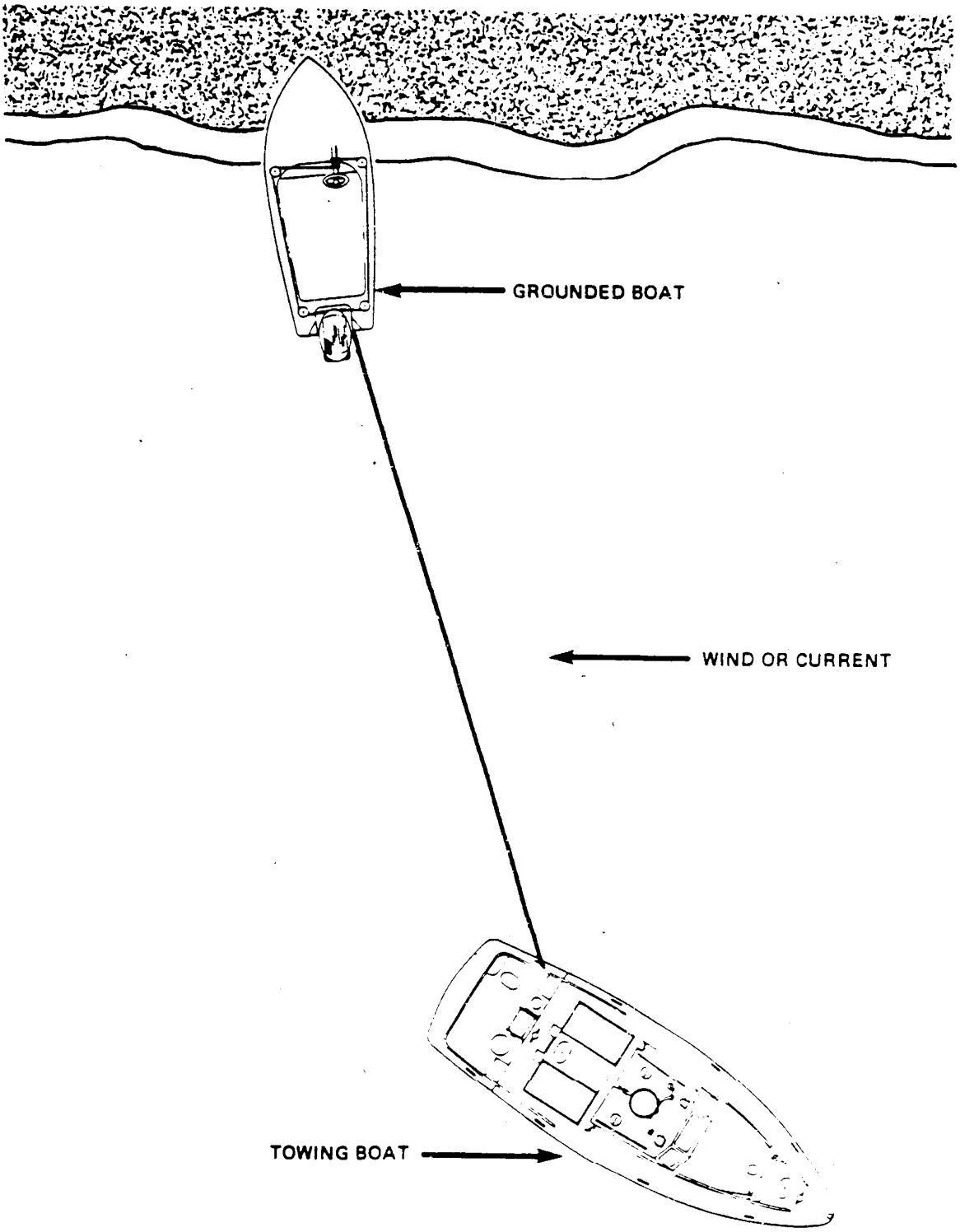

Figure 12-37 Wind or Current

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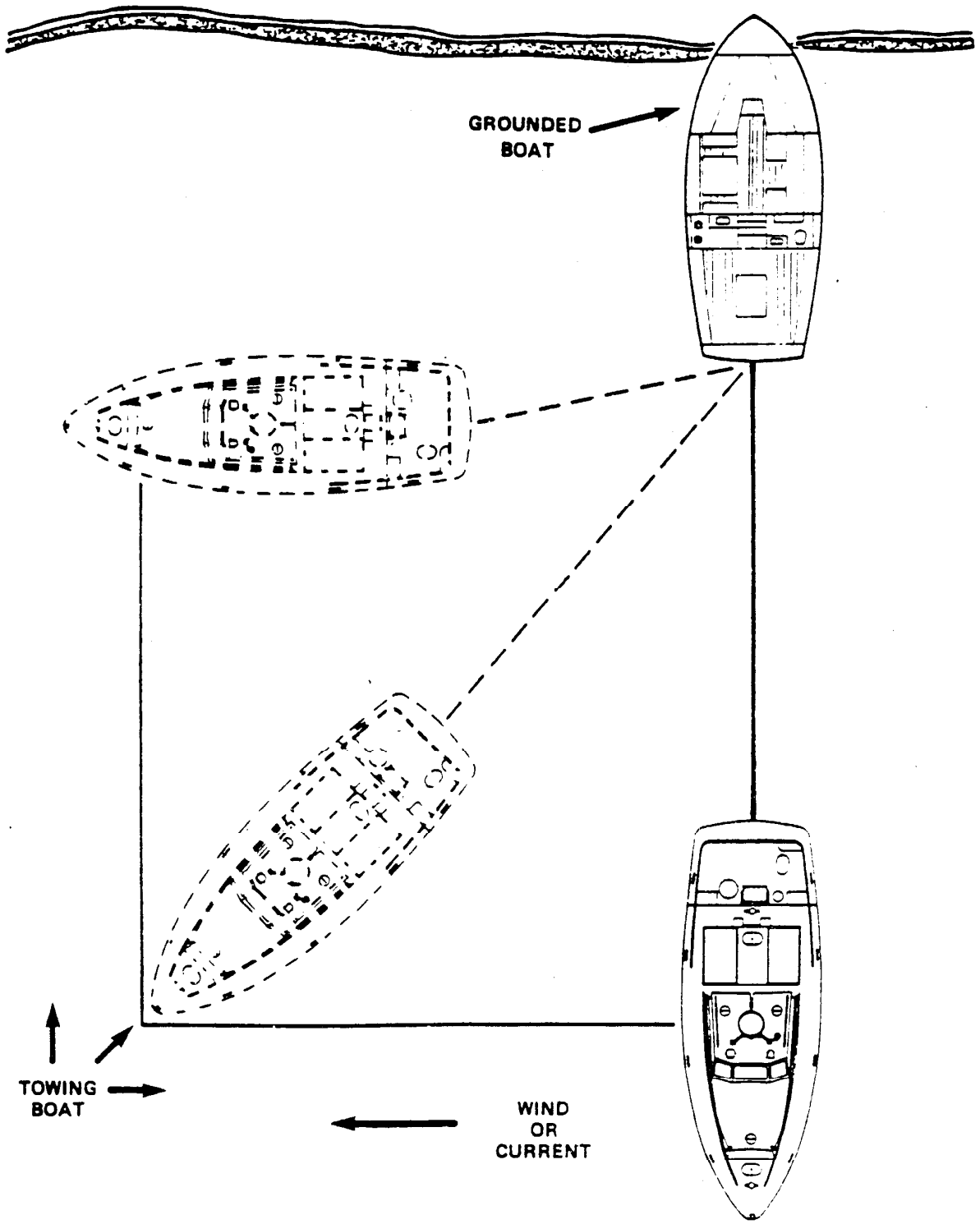

Figure 12-38 Restricted Maneuverability With Towline Directly Astern

(5) Take soundings along the sides and the stern of the grounded boat and throughout the area of the grounding. The soundings will help determine the direction of pull to use for refloating the boat.

(6) Carefully decide on the refloating procedures to use. DO NOT attempt refloating during low water.

(a) One of the greatest aids in refloating a stranded boat is using the effect of scouring current from your boat's screw. This method of scouring a channel for the distressed boat can only be employed when the endangered vessel is grounded in sand, mud, or gravel bottom and only when water depth permits your boat to work alongside the other boat. Scouring a channel is performed in the following way.

(1) Moor alongside the stranded boat amidship so that your boat's screw current will be directed diagonally down and under the grounded boat.

(2) Commence scouring amidships and as the operation progresses, shift your boat aft or forward as necessary.

(b) If the boat is only lightly aground, bow into the bottom with the stern afloat; a straight pull off is the simplest and most direct method of assistance. (See Figure 12-39). To conduct a straight pull follow the steps below.

(1) Determine the direction of current

(2) Consider anchoring your boat at a safe distance and back down toward the stranded boat paying out slack in your anchor line.

(3) Pass a messenger line to the boat. The messenger can be buoyed and floated to the stranded boat. (See Figure 12-40). Your boat's screws can become fouled however, unless you do this carefully, resulting in your boat running aground. Do not attempt to float the end straight down to the boat; pay it out approximately parallel to the shore and follow the steps below.

(a) Position your boat up current from the grounded boat and pay out the messenger until the end is near the shore.

(b) Bring your boat about and run past the stranded boat, paying out the messenger as you go.

(4) Ensure the disabled boat is ready to secure the towline and let the anchor go after it clears the beach or shoal.

(5) Once the towline is secured on the grounded boat, go ahead slowly, weighing anchor and paying out the towline to provide a good catenary.

(6) Commence pulling or heaving so that maximum force can be applied at a maximum high water. The stranded boat can best be pulled off in the direction opposite to the course it held when it first ran aground.

(c) Wrenching and pulling is another aid in refloating operations. As often happens, the stranded boat may be resting on a bottom type unfavorable for scouring action or the water may be too shallow to permit working alongside the disabled boat. The object of this method is to pull the grounded boat from side to side (wrenching). By rotating a stranded boat it breaks the grip of bottom of the hull. Procedures for this method are basically the same as mentioned above for the straight pull method. That is, with one exception–the pull is applied alternately from side to side on the grounded boat. (See Figure 12-41).

(d) A bow on pull is another refloating method which is employed when the wind and current is offshore or from inland and no heavy surf conditions are present. Follow the steps below in using the bow on method. (See Figures 12-42 and 12-43).

(1) Approach bow on from windward or up current. Drift toward the stern of the stranded boat.

(2) Pass the messenger and towline from the bow of your boat.

(3) Secure the towline aft of your boat's bow. Boat pivoting capability will be lost if the towline is secured directly at the bow.

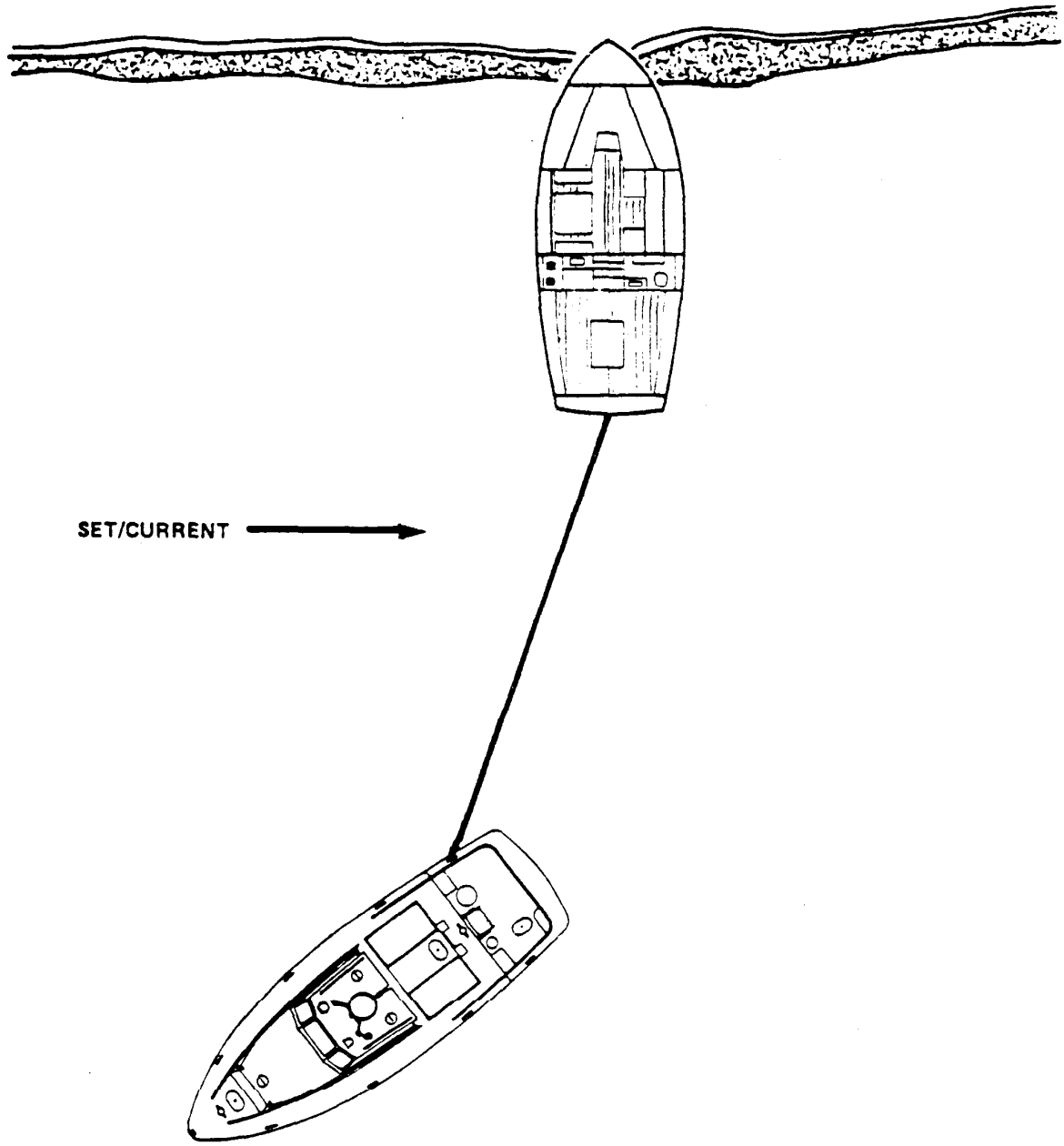

Figure 12-39 Straight Pulling Operation

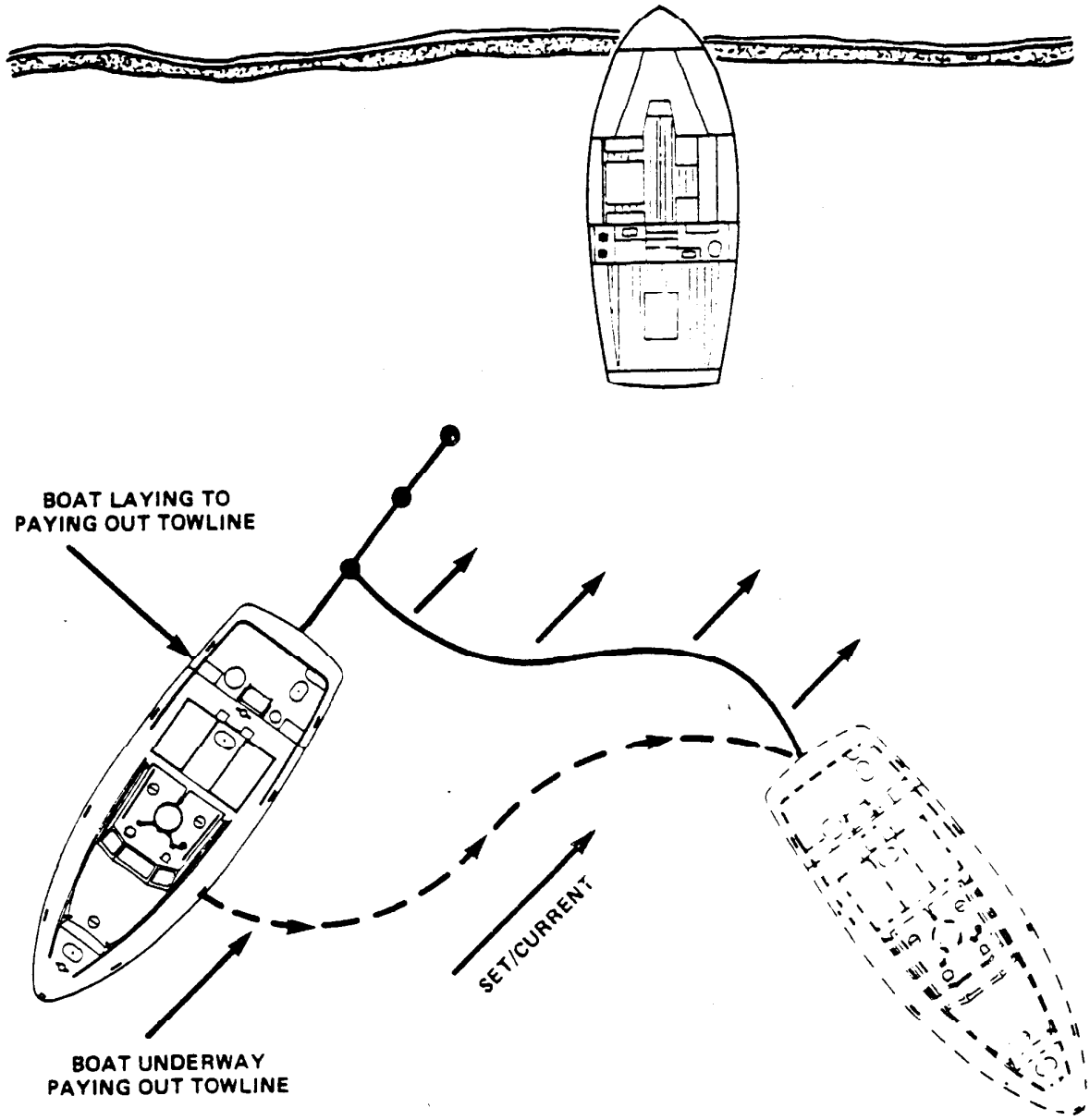

Figure 12-40 Floating the Messenger/Towline

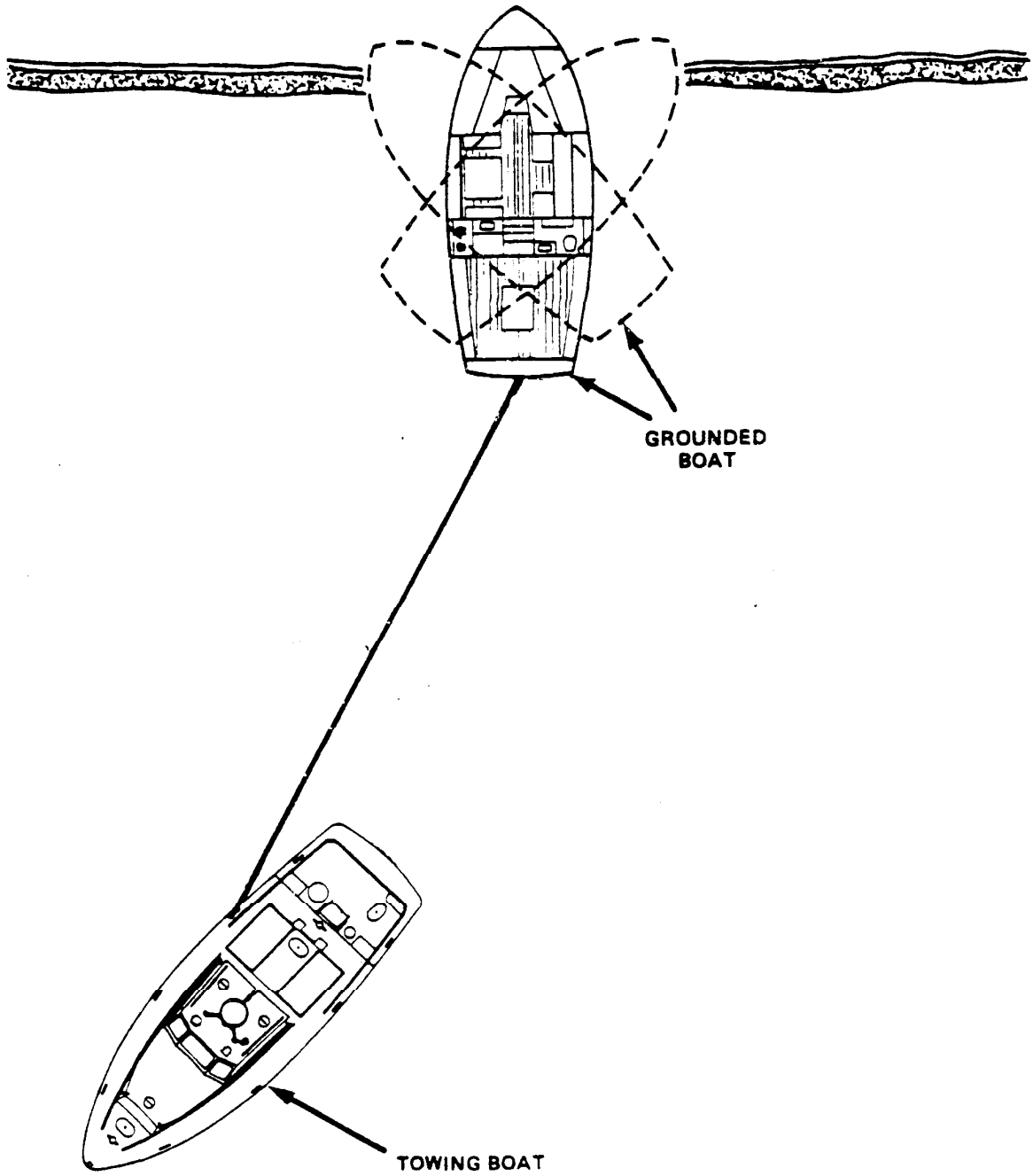

Figure 12-41 Wrenching Operation

(7) Backdown slowly on your engines. Apply power gradually.

14. **Assisting a Grounded Coast Guard Boat.** Should a Coast Guard boat run aground the coxswain must evaluate the situation immediately. The following procedure should be followed.
    a. Secure the stranded boat's engines immediately to prevent engine damage caused by sucking sand into the cooling system.
    b. Notify the station immediately so assistance can be sent. Resist the impulse to attempt to back off simply by backing down full as, if the bottom is sand, mud or gravel, you may succeed in doing nothing more than directing more bottom substance forward your bow with the prop wash, resulting in becoming harder aground.
    c. Maintain communication with the station. Keeping the station updated regarding your intentions and the situation.
    d. Lay out anchors to seaward to prevent being driven further aground.
    e. Inspect bilges to ascertain the extent of water being taken on from hull damage sustained during the initial impact with the bottom.
    f. Insure watertight integrity is set.
    g. Inspect the hull to determine the extent of damage.
    h. Take soundings around the entire boat to determine the depth of water and the characteristics of the bottom.
    i. Determine whether backing the boat off would be advantageous or cause further damage. Also determine if the pumps could control flooding if you were to back the boat off.
    j. Stay with your boat until assistance arrives or you are otherwise advised.

F. DAMAGE CONTROL. A very real problem at sea in rough weather or after experiencing a grounding is failure in a boat's hull, which allows water to enter the hull and/or bilge flooding. When any sort of hull failure occurs you are faced with two problems, FIRST to stop water from entering the hull, and SECOND to remove the water which is in the hull. Both are equally important, as the water in the hull affects the boat's stability or the water may find its way to the engines or batteries causing failures which can further complicate the situation. It is exceedingly important, therefore, that crewmembers know how to stop flooding and make emergency repairs. Any emergency at sea, especially in rough weather can be very frightening, but with fore-thought the effects can be minimized. You should be as self-sufficient as possible as there is always the possibility of help not being immediately available.

1. **Suggested Damage Control Kit (DC):** Every boat should have its own DC Kit. As a minimum, carry enough tools and spare parts to make jury repairs that will enable you to return the boat to its mooring, where further repairs can be affected. Suggested contents of a DC Kit are listed below:
    a. RTV (silicone rubber) for plugging holes and seams. It sticks to wet surfaces and will set up under water.
    b. Scotch Brank NO. 33 Plastic Tape. It can be applied under water and never slips, unless exposed to oil or gasoline.
    c. Replacement hoses; stock of every size employed on board, and a box of suitable clamps.
    d. Soft Wooden Plugs (unpainted) for every through-hull fitting.
    e. Soft Wooden Wedges or equivalent (shingles) 15" x 20" (unpainted).
    f. Canvas, size approximately 4' x 4'
    g. Rubber Sheet, size approximately 4' x 4' x 1/8".
    h. Blankets
    i. Rags
    j. Tarred marlin, approximately 250'.
    k. DC Mallet.
2. **Bilge Flooding:** The bilge is a void space where considerable water can collect seriously affecting a boat's operation (stability). Water accumulation may be the result of the normal slow accumulation of leakage from shaft packing glands, sea cocks, and the like, or massive amounts of water,

such as might occur very suddenly in heavy weather by flooding through an open hatch, engine vents, or hull failure as a result of grounding or collision.

3. 44' MLB:
   a. Bilge drain is accomplished by the use of the fire pump discharge water and water jet eductor, which are connected to a portable suction hose. The suction hose is led around the engines in the engine room bilge and controlled by a gate valve placed between the hose and eductor. Additional lengths of hose should be aboard. They can be connected to the engine room hose and used to pump the bilges in the litter, messing, and passenger spaces.
   b. To drain the forepeak, use the sluice valve located in Bulkhead 1. This valve is operated by a "T"-handle that leads through the passenger space deck and is accessible inside the forward transom locker. The water will drain into the passenger space bilge and can be pumped from the deck scuttle.
   c. The mess deck compartment bilges have no sluice valves and would have to be pumped from the deck scuttle.
   d. Water in the void between Bulkheads 15 and 17 can be sluiced at Bulkhead 15 into the engine room, from where it can be pumped.
   e. Water in the aft steering space can be sluiced into the aft compartment by a valve located at Bulkhead 21. The aft compartment can then be pumped from the engine room with the eductor hose. The water is discharged overboard on the starboard side, aft of frame 10.

WARNING

Operating of the bilge eductor system requires a crewmember in the engine room at all times while in operation. The reason for this is that you can flood the engine room with this system if not done in the proper sequence. The following steps shall be followed to the letter:

(1) Check bilge suction hose to assure that it is connected to the suction side on the eductor.
(2) Be sure gate valves in fire station supply, eductor supply, and suction lines are CLOSED.
(3) Open sea chest gate valve to fire pump.
(4) Engage fire pump.
(5) When 100 lb psi is reached on fire main gage, slowly open gate valve in EDUCTOR supply line and OVERBOARD discharge valve.
(6) Slowly open gate valve in EDUCTOR SUCTION line, and pump bilges as necessary.
(7) When pumping is complete, reverse the procedure.

NOTE

After the 44' MLB has experienced a grounding, heavy sea, and/or surf, check all bilges. If any amount of water exists, investigate source. Take corrective action as necessary.

4. 41' UTB:
   a. The bilge alarms provide an early warning system to advise you of flooding problems at the earliest stage. Always check all bilges before securing, and regularly when underway, especially in heavy weather. Pay particular attention to the well deck bilge; watch for the presence of fuel here, which could indicate a fuel tank overflow or rupture, leading to fuel contamination or a possible explosion.
   b. If a grounding has been felt or suspected, check the skeg sounding tube, which is located in the engine compartment just aft of the engines, to starboard of the centerline. If water is present in the tube, the keel is damaged.

c. Be sure the bilge alarm system is activated at all times. When the alarm sounds, check all bilges for signs of flooding and check to be sure each pump is working, if needed.
d. Each of the four compartments below the main deck is provided with a 24-Volt direct current bilge pump. These pumps are located forward of Bulkheads 2, 6, and 10, and aft of the fuel tanks. Bilge water is drawn through the bilge pumps, passes through a 1" ID hose, a stop check valve and overboard. These overboard discharge hull connections are located so that the outlets are one inch below the top edge of the black bottom paint. The pumps operate manually and are activated by switches located on the coxswain console. A 12-Volt float switch is wired to the loud-hailer, which sounds if a flooding conditon exists.

5. Obviously, it is important to empty the bilge of water as soon as possible. When this cannot be accomplished with pumps the engine WATER INTAKE LINE may be used following the procedures below:

CAUTION

Care must be taken, to be sure that the bilge is free of any floating debris that could clog up the engine water pump. After the bilge has been pumped, the engine must be secured or the intake hose reconnected to its fitting to avoid overheating the engine.

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a. Secure the water intake line seacock.
b. Disconnect and remove the engine water intake line from its through-hull fitting.
c. Place the intake hose in the bilge so that it will suck up the bilge water and remove it through the exhaust; watch for floating debris that could clog up the engine water pump.
d. After the bilge has been pumped, secure the engine or reconnect the intake hose to its fitting (open seacock) to avoid over-heating engine.

6. **Holes in the Hull:** The difficulties in making ju-y (temporary) repairs to a hull is that patches cannot be nailed on steel or fiberglass hulls ano the curved surfaces on which you are working make seating of patches difficult. One of the first steps after dealing with the immediate problem is to notify your unit so assistance can be sent.
a. Small Holes: Temporary repairs can be made by driving unpainted, soft wooden plugs or wedges into small holes. Bare, soft wood soaks up water and swells, holding the plugs or wedges firmly in place. PAINTED or HARD WOOD WILL NOT SOAK UP WATER. If you wrap the plugs with cloth (rags), you will get an additional seal. RTV (silicone rubber) may also be used as it sticks to wet surfaces and will set up under water.

CAUTION

Wedges should not be driven into a crack, because they will cause the crack to enlarge and expand.

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b. Cracks: To fill a crack, use RTV and lay a flat piece or rubber and/or canvas over the crack, back it up with a board and hold the patch in place with Scotch Brand NO. 33 plastic tap and shoring.

CAUTION

This type of patch must be inspected frequently because it tends to shift and slip with the movement of the boat.

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c. Large Holes: Large holes through which water is pouring are difficult to control. The only control possible may be to establish Watertight Integrity to isolate the damage and confine it to as small an area as possible.

d. Holes Above The Waterline: These may be more dangerous than they appear. When the boat rolls, these holes may admit water into spaces above the center of gravity and REDUCE STABILITY of the boat. These holes are given high priority but they are not too difficult to patch. You can use either inside or outside patches on them. Inside patches may be made with pillows, seat cushions, blankets, etc. backed up with boards and shoring.

   (1) A good patch can be made with a pillow or cushion which has a hole punched in the center. The backup board also must have a hole in the center. Line or marline is passed through the padding and board and tied securely behind the board. Then the entire patch is placed on the outside of the hull. The line is passed through the hole and secured to a firmly structure inside the boat.

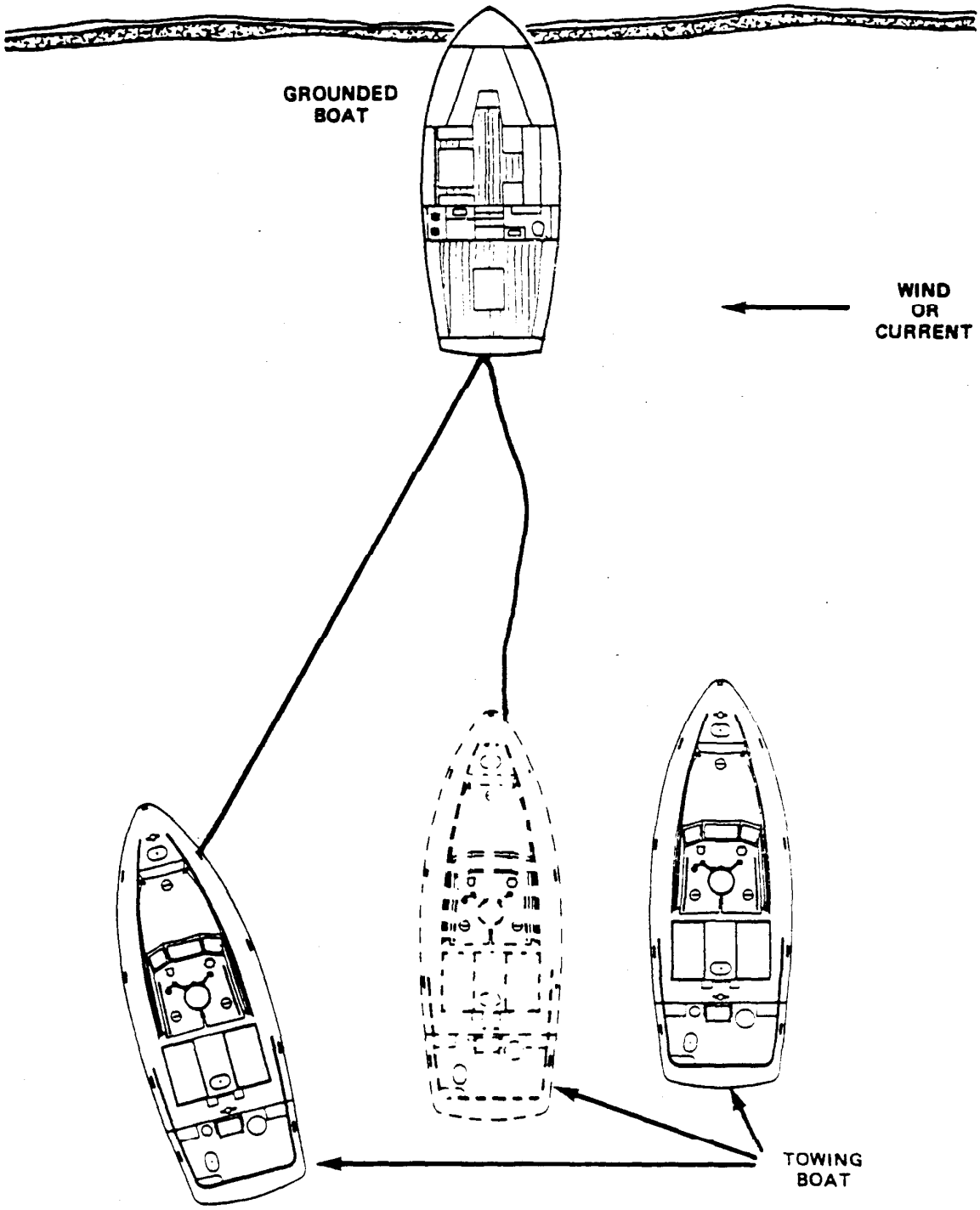

Figure 12-42 Towing Boat Approaching Bow on Position Windward

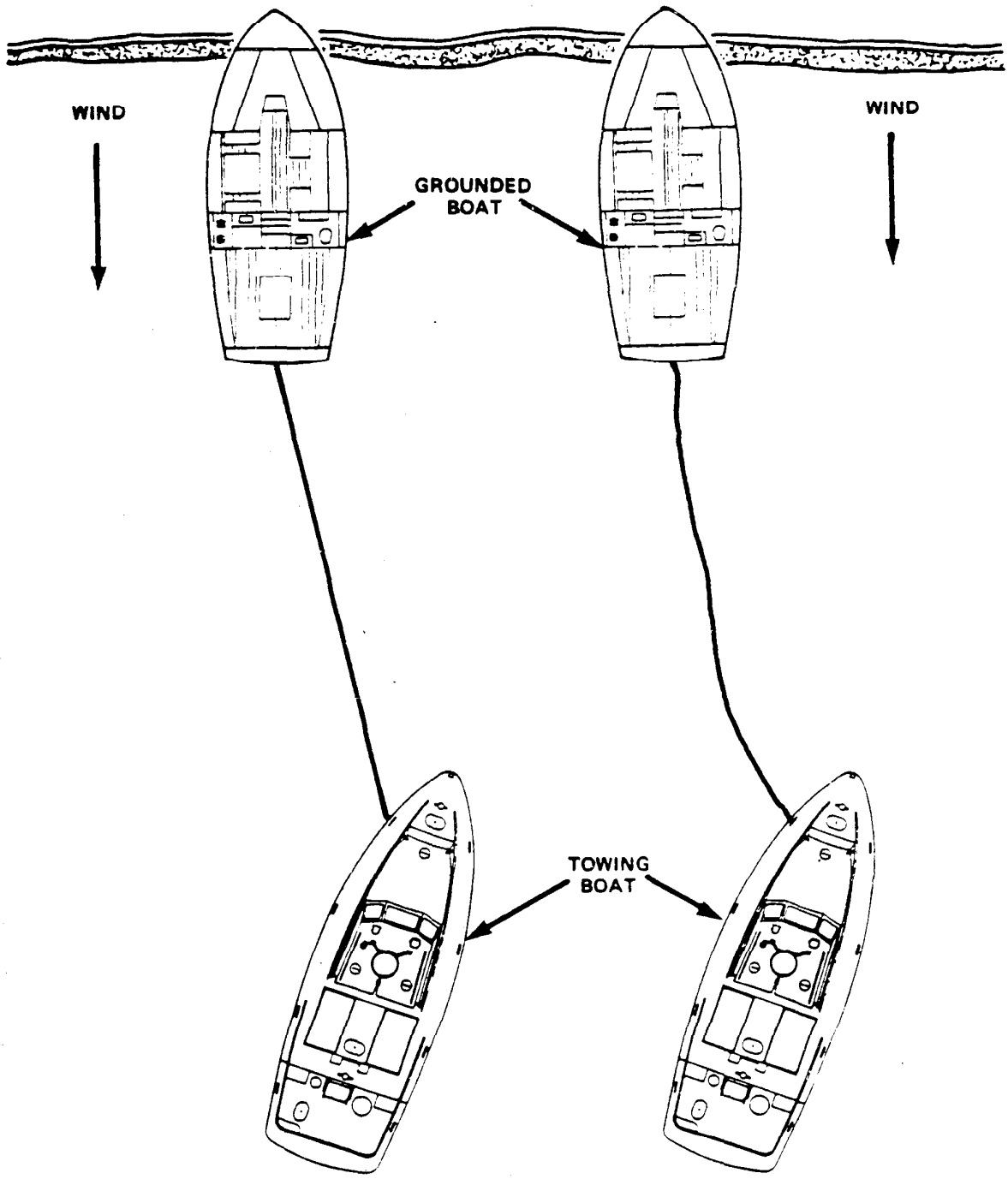

Figure 12-43 Towing Boat Approaching Bow on Receiving Towline Forward

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APPENDIX 12-A. TOWING WITH NON-STANDARD BOATS

A. INTRODUCTION: Non-standard boats are special use boats designed to operate in sheltered and semi-sheltered water where speed and shallow draft boats are required. Due to the many variations of design, construction, and handling characteristics of these boats currently employed at operational units throughout the Coast Guard, is it impossible to single out any one single boat of this class for discussion. Thus, it becomes obvious as to where the term non-standard is derived from. These boats may be powered strictly by an Outboard Motor or the propulsion unit may be inboard/outboard. Much of the preceding chapters of this manual such as Boat Handling, Navigation, Safety, Seamanship, Towing, etc., are applicable to the non-standard boat class. These boats are highly serviceable operating under the conditions mentioned above and with proper training will conduct a large percentage of a Unit's operational missions.

B. GENERAL EQUIPMENT: As with any boat class, if you are to safely and successfully assist and rescue distressed personnel you must know each piece of equipment on the boat and where it is located. Table 12-A-1 outlines the recommended equipment for the non-standard small boat class:

Table No. 12-A-1

GENERAL EQUIPMENT

ITEM	QUANTITY
ANCHOR, 16 LB.	1 EA.
ANCHOR LINE, ½"	150 FT.
TOWLINE AND SHACKLE, DOUBLE BRAIDED NYLON 2"	**
MOORING LINES, NYLON 20 FT.	4 EA.
HEAVING LINE, MONKEY FIST W/75 FT. COTTON LINE	2 EA.
HEAVING LINE, KAPOK, W/75 FT. ¼" POLY. PROP.	2 EA.
SWIMMING HARNESS W/TENDING LINE, 50-75 FT., ¼" POLY. PROP.	1 EA.
FENDERS, MARINE	3 EA.
BOAT HOOK, 8 FT.	1 EA.
PADDLE OR OAR, 5-8 FT.	2 EA.
LIFE RING, 20" W/75 FT. POLY. PROP. ¼" LINE AND ATTACHED FLOATLIGHT	1 EA.
LIFEJACKETS, WORK VEST**	2 EA.
SURVIVAL KITS, PERSONNEL**	2 EA.
FIRST AID KIT, 10 MAN	1 KT.
FIRE EXTINGUISHER, DRY CHEMICAL 5 LB.	1 EA.
FLASHLIGHT, D-CELL (WATERPROOF)	1 EA.
MOUTH HORN, REED FOG	1 EA.
TOOL KIT	1 KT.
SPARE PARTS	AS RQRD.
COMPASS	1 EA.
NAVIGATION KIT (COMPLETE)	1 KT.
RADIO (INSTALLED)**	1 EA.
RADIO, PORTABLE**	1 EA.

** The described equipment outlined above will vary with the size, number of crewmembers, and design characteristics of the boat being employed. However, regardless of the characteristics of the boat, Double Braided Nylon is the ONLY authorized line for towing, including the towing bridle line.

** The described equipment outlined above will vary with the size, number of crewmembers, and design characteristics of the boat being employed. However, regardless of the characteristics of the boat, Double Braided Nylon is the ONLY authorized line for towing, including the towing bridle line.

C. TOWING. Small boats of the non-standard class should be retained at a high state of readiness for use when quick response and shallow water are major conditions. These boats are not designed for heavy breaking seas. Nor should they be towing boats appreciably heavier than their own weight. Towing procedures previously discussed in Chapter 12 apply also to this class of small boat.

1. **Towing Astern.** When towing astern, care should be taken not to let the boat in tow fall too far to Port/Starboard of your boat, especially if your boat is equipped with a high towing bitt. If the tow falls too far to one quarter or the other it can cause your boat to capsize or swamp astern. Towing stranded or grounded boats presents much the same problem and the towline can "rubber band" with a sling shot effect, pulling your boat backwards swamping it astern. This also applies with a sudden reduction in power. The selection of the towing arrangement depends mainly upon the design characteristics of the boat, availability and location of the deck fittings which applies to all boats.
2. **Towing Without a Bridle.** Larger small boats of the non-standard class may have a towing bitt or sampson post aft. If these deck fittings are available the towing procedures should be accomplished as previously discussed in the basic chapter (Chapter 12). (See Figure 12-A-1).
3. **Towing With Bridle.** Bridles are used in conjunction with the towline in the same manner as discussed in Chapter 12 with one exception. If the towing boat does not have a towing bitt or sampson post aft it becomes necessary to rig the bridle to quarter cleats, bitts or transom eyebolts of the towing boat. These fittings must be through-bolted with backing plates to the deck in order to withstand the stresses of towing. Remember, it is important that the bridle legs be equal in length so that the towing stresses will be distributed equally on deck fittings; breaking strength of the bridle must be equal to or greater than that of the towline. Long bridle legs create less tension on deck fittings. Note that the angle of the bridle legs must permit adequate clearance for operation of the outboard engine(s); if the boat being employed is so equipped. There is one very important drawback to using a bridle rigged astern of your boat. Tending the towline is very difficult (paying out or taking in slack) as the line is well aft of your boat secured to the bridle. (See Figures 12-A-2 and 12-A-3.)

CAUTION

When reducing speed, EXTREME CAUTION must be exercised to prevent the bridle and/or towline from becoming fouled in the screw(s). Outboard and inboard/outboard screw(s) are highly vulnerable to becoming fouled.

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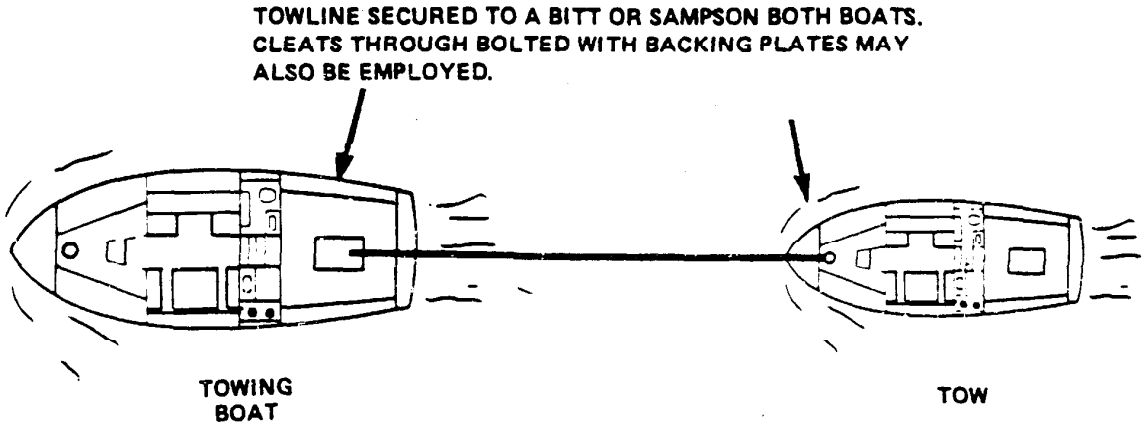

Figure 12-A-1 Typical Non-Standard Boat Towing Arrangement; Towing Only

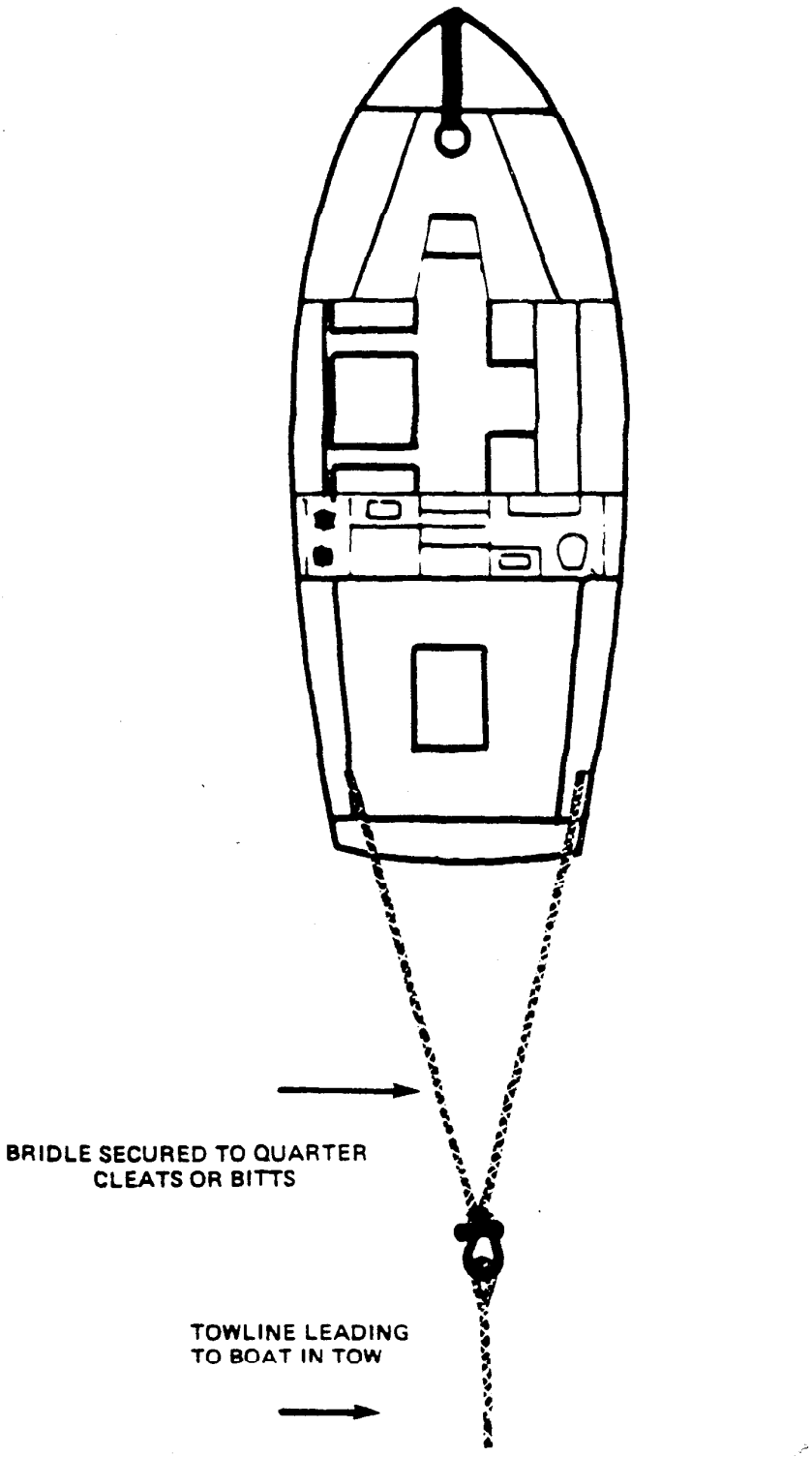

Figure 12-A-2 Non-Standard Boat Towing Arrangement, Employing a Bridle Secured to Quarter Cleats or Bitts

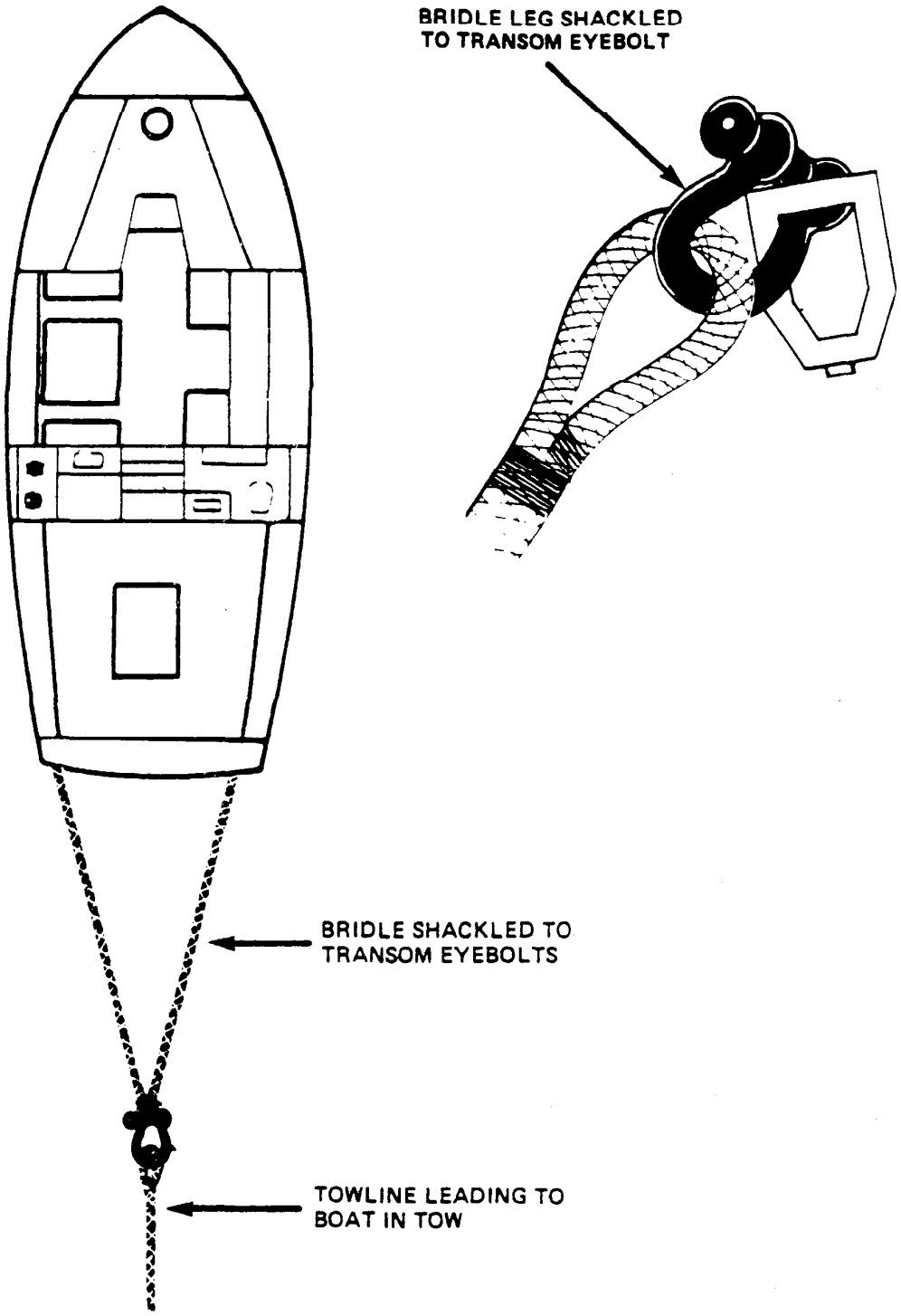

Figure 12-A-3 Non-Standard Boat Arrangement, Employing a Bridle Secured to Transom Eyebolts

APPENDIX 12-B. TOWING AND SALVAGE POLICIES

(Extracted from the Coast Guard Addendum to the National SAR Manual).

1. **General Towing Policies:** The area commander or the district commander, upon receipt of information that a vessel or person is disabled or in potential distress, should send a Coast Guard vessel or aircraft, as appropriate, to the scene. Upon arrival at the scene, assistance rendered may include, but is not limited to, the following:
   a. Technical assistance furnished on the spot.
   b. Miscellaneous supplies and equipment furnished for the purpose of effecting temporary repair on the spot.
   c. Towage to the nearest port in which EMERGENCY rapairs can be made.
      (1) Towing to the nearest port where emergency repairs can be effected DOES NOT imply that the port must have complete facilities to perform permanent repair work. Nor does it imply that the Coast Guard should tow the vessel to the repair yard itself. Normally, in a port where commercial towing is available, the Coast Guard will have discharged its responsibility when the distressed vessel is brought to a safe harborage.

NOTE

If a vessel is loaded with perishable cargo, a tow to the nearest port where the cargo may be discharged will normally be provided, if the operational situation permits.

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2. **Vessel out of Fuel:** Many cases arise where the vessel is disabled because of lack of fuel. The cause of the fuel shortage is immaterial, although in most cases it is poor judgement. In all such cases, a check should be made on arrival at the scene to determine if the vessel does in fact require fuel to reach the NEAREST PORT WHERE FUEL MAY BE OBTAINED. If a shortage exists, sufficient fuel to reach the nearest port may be invoiced to the vessel following procedures in the Comptroller Manual (VOL 3 and 4). The above procedure will also be followed by Lightvessels.

CAUTION

Due regard for weather conditions existing or expected should be exercised.

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   a. If the Coast Guard vessel does not have the proper fuel, then towage to the nearest fueling port is indicated as outlined below.
3. **Commercial Enterprise:** Although the Coast Guard will not compete or interfere with private towing activities or other commercial enterprise, it cannot rely upon private enterprise to render assistance in minor cases and itself act only when extreme jeopardy exists. Even though reliable information is received that a tug or other private assistance is proceeding to the scene, there is no assurance that it will complete the mission until it is on scene and has the situation in hand. Until then the Coast Guard units should proceed toward the scene.
   a. If, upon arrival at the scene, private enterprise is already there and is rendering assistance, or is willing to render assistance, the Coast Guard SHALL NOT interfere with the private activity unless IT BECOMES APPARENT THAT PRIVATE ENTERPRISE CAN NOT COPE WITH

THE SITUATION and that action by the Coast Guard is necessary to prevent LOSS OF LIFE or PROPERTY. The private salvor's ability to carry out the operation is best determined by the Coast Guard ON-SCENE COMMANDER, but if doubt exists, the matter may be referred to the district commander.

NOTE

In all doubtful cases, however, the Coast Guard unit shall stand by and be prepared to render assistance until it is apparent that no further assistance is required.

b. When the Coast Guard unit is already rendering assistance and private assistance arrives on-scene, the Coast Guard vessel shall turn the case over to the private operator if:
   (1) He desires to accept it.
   (2) The character of the assistance he can render is adequate.
   (3) The operator of the assisted vessel agrees.
   (4) The shift of responsibility can be accomplished without further endangering the craft in trouble.

NOTE

Actual refusal to release the disabled vessel to a private operator whose facilities are deemed inadequate will only be done after careful consideration.

c. Should the operator of this disabled vessel, or the owner of an unmanned vessel, refuse to accept commercial assistance, or remain silent the Coast Guard will discontinue towing and stand by.

CAUTION

This step will only be taken if the disabled vessel is not further endangered. Otherwise the tow shall be continued until it can be discontinued without danger. (Check District Op Order for further possible information)

d. If towed to the vicinity of a harbor entrance or safe anchorage under these circumstances, the possibility of the towed vessel creating a hazard should be carefully considered. The length of time that a Coast Guard vessel is required to stand by while the commercial salvor and disabled vessel are negotiating will depend on the circumstances. Should a more urgent case arise, the Coast Guard is free to depart and undertake the more urgent case.
e. If no other cases are pending, the Coast Guard should stand by until negotiations are concluded, and the commercial salvor has taken the disabled vessel in tow. Should a Coast Guard vessel arrive at the scene before a commercial salvage vessel, the Coast Guard vessel may take the vessel in tow pending arrival of the salvage vessel, if such action will contribute to the safety of the distressed vessel or reduce the time in which the Coast Guard vessel is required to stand by.

4. **General Salvage Policy (other than towing):** Coast Guard units should engage in salvage other than towing only when no commercial salvage facilities are on scene performing salvage, and limited salvage operations (e.g. ungrounding, pumping, damage control measures, etc.) by the Coast

Guard can prevent a worsening situation or complete loss of the vessel. When commercial salvors are on scene performing salvage, Coast Guard units may assist them within the unit's capabilities, if the salvor requests. Coast Guard units and personnel shall not be unduly hazarded in performing salvage UNDER THE AUTHORITY OF THIS SECTION.

5. **Towing and Salvage of Small Craft:** Conflicts relative to towing and salvage of large vessels seldom arise since arrangements are usually made between the owners or agents and private salvage companies. With smaller boats and vessels, the value of property is such that private towing is often unprofitable. In such cases the Coast Guard unit may be the only one in position to render assistance. Even should private towing assistance be offered, the operator of a small craft is under no obligation to accept it. Should he refuse, a Coast Guard unit is not obliged to assist as long as the private vessel is standing by. If it departs or if the situation worsens to the extent that LIFE or PROPERTY are in danger, the Coast Guard unit then should render assistance.
   a. SECTION B (5) applies to small craft which need salvage other than towing. However, when no commercial salvage companies are available with a reasonable time or distance, the district commander may modify the policy of SECTION B (5) to provide for refloating a grounded boat which is not in peril of further damage or loss providing:
      (1) The Coast Guard units are capable of rendering assistance.
      (2) The owner requests the assistance and agrees to the specific effort to be made.
      (3) Coast Guard units and personnel are not unduly hazarded by the operation.

WARNING

Occasionally an operator will insist that the Coast Guard take action, such as pulling a vessel from a reef, that the Coast Guard personnel on scene consider unwise. The Coast Guard is under no obligation to agree to any such request or demand. If a decision to comply with such a request is made, it should be made clear to the operator that he/she is assuming the risk of the operation and the fact that the action is undertaken at his/her request against our advise should be logged.

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6. **General Procedures When Towing Vessels Under 65 Feet in Length:**
   a. Wearing of personal flotation devices (PFD): Towing is a potentially dangerous evolution, which is often compounded by poor weather conditions and the crossing of breaking bars or inlets. While every effort is made to insure the safety of LIFE and PROPERTY in all instances, the fact remains that a number of boats each year SINK or CAPSIZE while under tow by the Coast Guard. Occasionally, loss of life has resulted from these mishaps. Since the wearing of personal flotation devices would reduce the possibility of loss of life during towing operations, vessels under sixty-five (65) feet should normally not be taken in tow until all persons on board the towed vessel are wearing approved personal flotation devices. While it is recognized that every towing situation does not warrant the wearing of PFD's, it must be remembered that the safety of the POB and the vessel being towed is in part the responsibility of the boat coxswain and the Coast Guard; therefore, the wearing of PFD's must at least be considered in every towing evolution. In cases where insufficient personal flotation devices are available, Coast Guard personal flotation devices, in excess of crew requirements on the assisting unit, should be furnished for those persons in need of them.

CAUTION

At no time should the stricken vessel be left in immediate danger while waiting for personnel aboard to don their personal flotation devices.

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b. If there are insufficient personal flotation devices to go around, do not wait for more to arrive before rendering assistance. Priority consideration upon arriving at the distress scene is:
   (1) Removing the vessel and occupants from immediate danger.
   (2) Getting all personnel into personal flotation devices as soon as possible.

CAUTION

It is stressed that only wearable types of personal flotation devices fully meeting safety requirements are used; however, other types may be used if not enough wearable PFD's are available.

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c. Removal of Personnel: When conditions warrant and the opportunity is presented it is desireable to remove all civilians from a disabled craft, and place a Coast Guardman aboard. This decision should be made only with the concurrance of the people involved. The determining factor should be the safety of the people and the boat involved, considering the hazards of going alongside. Prudence should be exercised to avoid making a bad situation worse. Consideration should be given to the weather conditions and the design of vessel, as well as the physical and psychological state of the POB's.

d. Deck Fittings: Another hazard in towing small craft involves the poor strength characteristics of cleats and fittings aboard many of today's pleasure craft.

CAUTION

EXTREME caution should be used in determining the best possible towing procedure and methods of attaching the towline. The stem pad-eye which is available on most trailerized small boats may be an appropriate point of attachment, however, a close inspection of the condition of the pad-eye, the apparent condition of the stem, and the pad-eye backing plate and nut should be accomplished before selecting the stem pad-eye as the point to attach the towline. Age of fitting, size of fitting, boat loading, sea conditions, towing course relative to sea/swell may all be factors which would make the stem pad-eye a poor attachment point for the towline.

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e. Communications: Under certain operating conditions involving the towing evolution, it is essential that a system of communication with the towed vessel be established. The coxswain of the towing boat must insure that those he is assisting understand and agree on a signal to indicate trouble. Ideally, stationing a Coast Guardman on board wtih a portable communication rig would insure quick response to urgent situations. As an alternative, most units have portable radios that could be carried on board Coast Guard boats when underway, thereby providing a ready communication resource which could be transferred to the disabled vessel utilizing some type of watertight enclosure. Directions for use of the radio are on the back of the set. However, the radio could be switched on and preset for working frequency, prior to transfer to the disabled vessel in order to insure immediate operation. This procedure would be of particular value during night-time operations. Other methods such as flashing lights, warning flag or rag, hand signals, etc., may also be utilized by the coxswain, depending on the on-scene conditons.

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NOTE

It must be remembered that it is incumbent on Coast Guard personnel to learn as much as possible about the conditions on the towed vessel, and this information must be continuously updated. Regular checks utilizing the radio or other means of communication are essential elements which will assist in insuring a safe evolution.

f. Tidal Considerations: Many of the incidents which resulted in damage to grounded small craft could have been avoided by waiting for a rising tide before attempting to refloat, and by inspecting the hull in some manner to determine if it is water-tight. The fact that certain small craft are left high and dry by receding tide may not cause damage, if suitable preventer lines are rigged to prevent capsizing, or to maintain it upright on the incoming tide.

g. Unit Training: All units operating SAR boats must have a SAR Boat Training Program pursuant to COMDTINST M16114.6 (Old CG-313). Note that part of this training program is devoted to Seamanship and Safety, **and includes towing methods, care, techniques and dangers associated with this operation.** A complete program will cover detailed procedures for the towing of vessels or small craft and sailboats, including righting small craft and sailboats.

h. Liability Releases: The question has often been raised as to the need for Coast Guard units to obtain a liability release prior to rendering aid. Court decisions do not generally favor the use of releases to avoid liability for future negligence, especially in situations where the person giving the release is in an emergency situation and has little choice in the matter.

NOTE

Coast Guard personnel should concentrate on the primary task of assisting persons and property in danger to the best of their ability, realizing that the best defense against any allegation of negligence is to be able to show that a high standard of care was exercised when rendering assistance. LIABILITY RELEASES SHALL NOT BE USED IN ASSISTANCE CASES.

0322 Selecting Course And Speed

1. The OTC is responsible for selecting and promulgating replenishment course and speed. He should obtain recommendations from replenishment force commanders. The replenishment course and speed should permit ships to maintain station with a minimum of stress on intership rigs.

2. Course Selection.

a. Sea State. The direction and height of swell are the principal considerations in selecting the replenishment course (Figures 3-2 and 3-3). Heavy seas adversely affect the replenishment operation. Increased rolling and pitching, with high waves breaking over low freeboard ships, add to the difficulties of station keeping and line handling and may cause excessive strain on intership rigs.

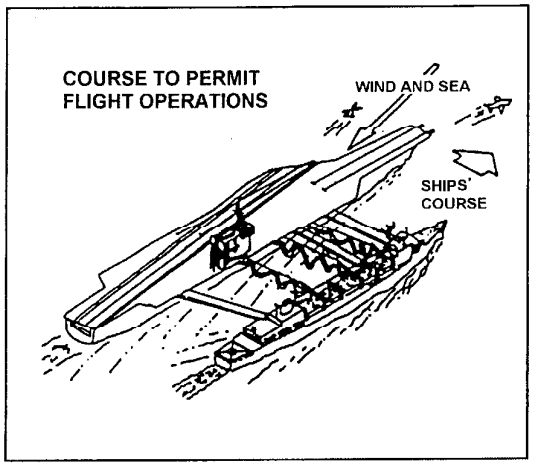


Figure 3-2. Replenishment Course to Permit Flight Operations

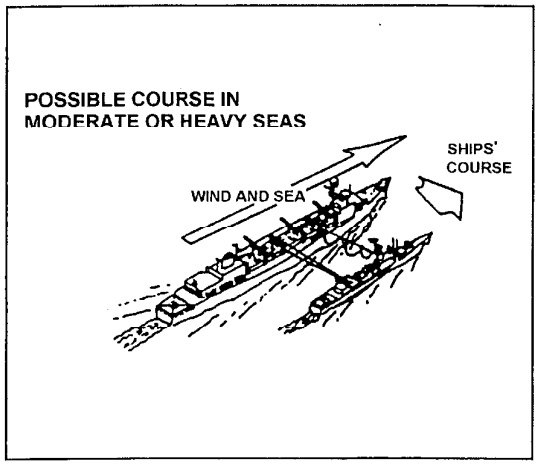


Figure 3-3. Possible Replenishment Course in Moderate or Heavy Seas

(1) During heavy weather, a course with the sea will moderate these adverse effects and may permit replenishment when it otherwise would be impossible.

b. Wind Conditions. Although not as significant as sea state, wind conditions must be considered when selecting replenishment course.

(1) Relative wind velocity should be as low as the tactical situation permits. High relative winds, especially in cold and rainy weather, will quickly fatigue exposed personnel and increase replenishment time. Therefore, a downwind heading may be preferable.

(2) Under other conditions, heading into the wind may be more desirable. It may permit carriers to conduct flight operations at replenishment course and speed (Figure 3-2). Also, steaming with the wind one or two points on the port bow provides a lee for destroyer-type ships replenishing to starboard of larger ships. Figure 3-3 indicates the alternate method of steaming down seas.

(3) Certain destroyer-type ships with large deck houses aft tend to yaw badly with high winds (above 30 knots) from abaft the beam.

c. Special Considerations for the LST.

(1) Replenishment course with the sea rather than into the sea is usually best for the LST. Such a course:

(a) Affords better ship control.

(b) Keeps yaw and pounding to a minimum.

(c) Permits increased speed for maintaining station.

(2) A replenishment course into seas above state 2 requires reduced speed to avoid severe pounding caused by the blunt bow.

(3) The sail effect of the high freeboard on the LST produces rapid leeway but does not appreciably affect maintaining an ordered course.

(4) During replenishment operations involving LSTs and ships with similar maneuvering characteristics (i.e., position of conning station, shallow draft, etc.), two distance lines may be employed. The lines will be located on those ships as follows:

(a) As far forward as possible to allow an unobstructed view by the conning officer.

(b) In the vicinity of the bridge in view of the conning officer.

(5) The ***delivering*** ship will provide all rigs required, station-to-station phone line, and ***forward*** distance line. The ***receiving*** ship will provide the ***after*** bridge-to-bridge phone and distance line following the procedure outlined in Article 0314. Both distance lines must be passed in such manner as to allow the zero end to be secured to the outermost rail of the ***delivering ship*** and must be tended on the ***receiving ship***.

3. Speed Selection. A replenishment speed between 10 and 16 knots is usually advisable. However, weather conditions influence the selection of replenishment speed just as they do the selection of replenishment course. Under all conditions, a ship must make sufficient speed to maintain steering control. Speeds of less than 8 knots are not advisable because of reduced rudder effect.

a. Sea State and Wind. The speed of the waves on a downwind course must be carefully considered in choosing the replenishment speed. If the replenishment speed is equal to or close to the speed of the waves, shallow draft ships will "surf," that is, slide down the waves making station keeping erratic; while all ships will experience some difficulty in maintaining course due to yawing. To preclude these two problems, a speed must be chosen that is 3 or 4 knots greater or less than the speed of the waves, bearing in mind that a minimum of 8 knots must be maintained for steerageway. Often a change of as little as 1 knot in replenishment speed can overcome these problems.

b. Pressure Effect. The interaction because of the proximity of other ships is greatly increased in shallow water. (See Figure 3-4.)

c. Station Keeping. To allow a margin for station keeping, speed should not exceed 1 knot less than the maximum speed available under replenishment conditions for the delivering ship, nor 2 knots less than the receiving ship's maximum speed, whichever is the lesser.

d. Shear Current. A shear current is a line of water with a small boundary layer between differing sets/drifts, similar to a tidal rip. The north wall of the Gulf Stream is a good example of a location where shear currents can be found. If a shear current is encountered suddenly from still

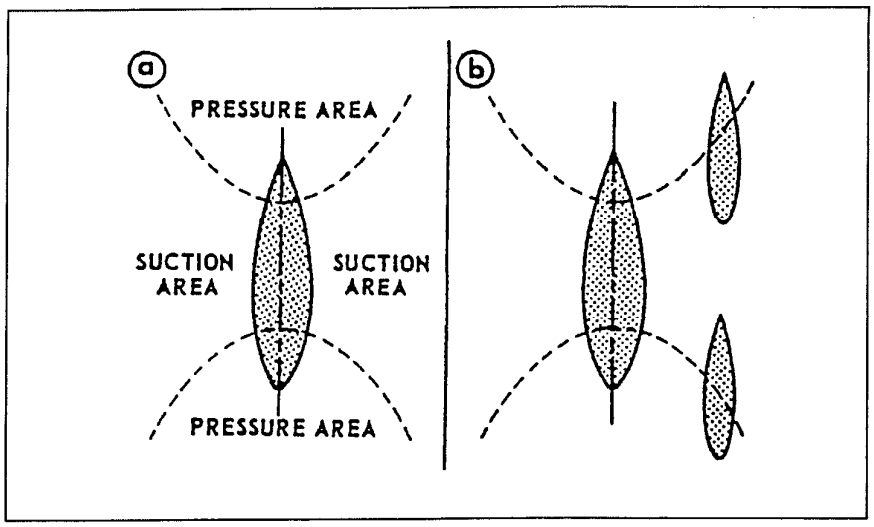


Figure 3-4. Dangers of Hull Wash

water, it can produce a heading change of 10° in ships as large as CVs in a short period of time. Ship handlers should be aware of shear currents and take special precautions to avoid them during underway replenishment, as they may cause ship handling difficulties while alongside.

0323 Approaching and Maintaining Station

1. Distance Between Ships.

a. Sufficient distance between ships must be maintained to ensure that replenishment can be accomplished with safety and efficiency. The proper distance depends on:

(1) Wind and sea conditions.

(2) Size and type of ships.

(3) Ability of ships to maneuver while abeam.

(4) Type of transfer rig.

(5) Depth of water.

(6) Replenishment speed.

b. The distances for the various types of rigs are given in Table 3-1. In addition to the normal working distances, the maximum ship separation for the type of rig is given. On ships that have protrusions extending outward from the hull, the distance is measured from the outermost protrusion, perpendicular to the centerline. Whenever tensioned and nontensioned rigs are used together in a RAS operation, the distance between ships should not exceed that specified for the nontensioned rig.

Table 3-1. Typical Distances Between Ships for Fueling and Storing Rigs

	TYPE OF REPLENISHMENT RIG					
	MISSILE/ CARGO STREAM (1) (2) (3)	MANILA/ SYNTHETIC SUPPORT LINE (4) (5)	FUEL STREAM (6)	NONTEN-SIONED SPANWIRE FUELING	DERRICK RIG	
SHIP TYPE	Meters	Meters	Meters	Meters	Meters	Meters
Destroyers and Smaller	24 to 61 Normal 91 Maximum	24 to 30 Normal 55 Maximum	24 to 55 Normal 61 Maximum	24 to 30 Normal 55 Maximum	37 to 43 Normal 61 Maximum	18 to 24 Normal 30 Maximum
Cruisers and Larger	24 to 61 Normal 91 Maximum	24 to 37 Normal 61 Maximum	24 to 55 Normal 61 Maximum	24 to 37 Normal 61 Maximum	37 to 43 Normal 61 Maximum	
Aircraft Carriers	30 to 61 Normal 91 Maximum	30 to 43 Normal 61 Maximum	24 to 55 Normal 61 Maximum	30 to 43 Normal 61 Maximum	37 to 43 Normal 61 Maximum	

Notes:
(1) Minimum separation of 43 meters required during tensioning.
(2) STREAM: Standard Tensioned Replenishment Alongside Method.
(3) Includes all UK heavy jackstay rigs.
(4) Includes UK light jackstay rigs.
(5) Includes US Burton rig.
(6) Includes all UK jackstay fueling rigs.
(7) Includes UK crane rig.

2. Depth and Speed Considerations.

a. In those instances wherein operational considerations require replenishment in water less than 64 meters (35 fathoms), the distance between ships should be increased as the water becomes more shallow.

b. Distance between ships should be increased as speed increases; at speeds above 15 knots, distance should be near the maximum.

3. Sea State. When ships are yawing excessively, the distance between ships should be near the maximum allowable distance shown in Table 3-1.

4. Location of Transfer Station. If all transfer stations are located on the quarter of a large ship, the distance between ships conducting replenishment should be maintained near the upper recommended limit because of the forces that tend to draw ships together. This is particularly important when the ship abeam is a destroyer or other small ship.

5. Approach.

a. Adequate lateral separation must be ensured during the approach, particularly when the bow of the receiving ship passes the stern of the delivering ship. If the separation is not adequate at this stage, there is a risk of collision since the water pressure differential causes the bow of the receiving ship to veer in toward the delivering ship. In addition, when in shallow water, the relative speed should be reduced since shallow water increases the water pressure differential effect.

b. Normally the median ship separation should be used for the approach. Adequate ship separation is even more vital at night and when reduced visibility impairs accurate judgment of distance. When steering by magnetic compass, the approach must be wider than would normally be required using a gyrocompass. Conning officers and helmsmen must be alert for the magnetic compass swing toward the other ship that occurs when coming into station abeam.

c. Approach procedures are:

(1) Delivering ship signals when ready to receive a ship abeam (Figure 3-1).

(2) Approach ship, when ready for RAS at designated stations, commences approach and hoists Romeo close-up.

(3) Approach ship slows so as to be moving at replenishment speed when in position abeam. (Use of high approach speeds and/or backing bells/astern power should only be used if weather conditions are favorable and personnel are proficient.) If a waiting station on the beam of the delivering ship has been ordered, the approach ship steers slowly inwards to close the distance. Radical course changes should not be made.

(4) The delivering ship sends over the messengers and station-to-station telephone lines with attached phone as soon as practicable. The delivering ship also passes the bridge-to-bridge combined phone/distance line with phone.

(5) When ships are in proper relative position, transfer rigs are passed and hooked up. During this operation, the approach ship may be closer in than the optimum distance to speed the hooking up.

(6) If the delivering ship has to steer by magnetic compass, it is advisable to station a ship ahead for her to steer on.

6. Maintaining Station. Maintaining station abeam of the delivering ship requires precise maneuvering on the part of the receiving ship. Steaming too close restricts maneuverability, and steaming too far apart puts an undue strain on the rigs. Steaming too close also increases the turbulence between the ships. In the case of loaded oilers, this can throw seas onto the tank deck and endanger personnel who must work there.

a. Pressure Effects.

(1) When underway, there are areas of increased water pressure at the bow and stern of a ship and decreased pressure (suction) amidships as the result of the differences in velocity of the flow of water around the hull.

(2) When ships are abeam of each other underway, this venturi effect is increased and becomes further complicated because of the intermingling of the pressure areas. These effects vary with the distance between ships, size and configuration of ships, speed, and depth of water.

(3) When ships of the same size are abeam, the best position is exactly at 90°. If the approach ship is considerably smaller than the delivering ship, the former should remain between the bow and stern pressure areas.

(4) Figure 3-4b shows ships that are in dangerous positions because they are being acted on by radically different pressures. Changes in relative positions will impose rapid changes in the pressure effects on their hulls. Either ship position may require quick rudder action by the smaller ship. The hazard is increased if speed is reduced. Radical speed changes will further aggravate the situation.

(5) Replenishment operations are usually conducted in relatively deep water. In shallow water, pressure effects are more pronounced and extra care is required in maneuvering.

b. Steering Control.

(1) To maintain station while abeam, a small amount of rudder is usually necessary. However, the amount of rudder required will vary with the size and load of both ships, sea and wind conditions, speed, and ship separation and types of rigs used.

(2) When receiving a constant tension rig, all receiving ship conning officers (and especially conning officers of destroyers and shallow draft ships such as LST and MSO types) must be constantly alert to avoid being drawn in toward the control ship while maintaining station abeam. Additionally, the conning officers of both the control and approach ship(s) must be constantly alert to the relatively instantaneous impact on ships' heading when tension is initially applied and after completion, when tension is released. After all rigs are tensioned, the control ship's conning officer may need to carry some amount of relatively steady rudder angle to maintain the prescribed course. Likewise the conning officer of the ship(s) maintaining station abeam the control ship may find it necessary to carry some amount of rudder and, in many instances, may need to steer a slightly different heading from the prescribed course to maintain proper distance abeam.

(3) The need for and degree of rudder angle the receiving ship will carry will depend, principally, on the location(s) of the constant tension rig reception station(s) relative to the receiving ship's center of rotation (pivot point). However, once tension has been applied on all constant tension rigs, station keeping abeam usually will require fewer rudder angle and engine order changes to maintain proper position than is required when receiving by nontensioned rigs with their attendant transient force applications. An exception to this statement is the "tension/detension" method where the sudden and repetitive application and release of side force will require prompt and frequent rudder changes.

(4) A control ship with receiving ships hooked up on both sides will probably carry a different amount of rudder angle than with only one ship abeam. Consequently, the control ship's conning officer and helmsman must be prepared for rudder angle changes occasioned by initial tensioning and eventual detensioning on one side while replenishing continues on the other side. The control ship's conning officer, additionally, must alert the conning officer of the ship continuing abeam to be prepared for a possible change in the amount of rudder angle carried when rigs to a ship at the other beam are tensioned or detensioned.

(5) When constant tension rigs are used, the control ship should recommend a minimum distance for ship separation considered safe for the receiving ship when tension is first applied, considering wind, sea, and location of the rigs, and should notify the receiving ship's bridge and station personnel via sound-powered phones when tension is to be applied. In no case should the ship be closer than 30 meters when tensioning. When tension is to be released, the conning officers should again agree on a desired ship separation.

(6) A greater amount of rudder usually is required when ships ride closer together than 24 meters. As a result of such increased rudder, speed is reduced. This complicates the problem of maintaining station. Should a steering casualty occur at such a time, the possibility of being "drawn in" by the combination of screw suctions, the pull of tensioned lines, and excessive use of rudder will increase the probability of collision.

c. Coordination Between Ships.

(1) It is imperative that communications and liaison be maintained between respective conning officers. Bridge-to-bridge phones are essential for this purpose. If the control ship changes course or speed or encounters difficulty in steering, the approach ship must be notified immediately. The conning officer can best maintain proper distance between ships and adjust his relative fore and aft station if he takes up a position where he can observe his own ship's heading, the gyro compass, the rudder angle indicator, and the relative motion of the two ships. Radical changes in course or speed should be avoided. Refer to ATP 1/MTP 1, Vol. I, paragraphs 2242 and 2243, for course and speed signals during RAS operations.

(2) A large combatant ship coming abeam of a delivering ship may cause a change of speed by as much as 1 knot and will also, unless compensated for, affect the delivering ship's head. The replenishment ship must be alert for this effect so that proper ship's head may be maintained. No compensation will be made by the delivering ship for this effect on speed, but it must be compensated for by the ships abeam of the delivering ship.

0324 Departure from Station

1. On completion of replenishment (Figure 3-l) the receiving ship:

a. Directs course outboard in small steps in 2° or 3° increments.

b. Increases speed moderately (3 to 5 knots) and clears ahead.

2. Radical changes in speed and course must be avoided since the propeller wash can adversely affect the steering of the control ship and may cause a dangerous situation to develop if another ship is abeam.

3. When a large ship departs, the conning officer of the control ship and the ship abeam should be prepared for an increase in speed of own ship as it is freed from the dragging influence of the other ship and also to compensate for the effect on ship's head. (See paragraph 0323.6a.) Ships departing from abeam should avoid passing close to another replenishing unit, particularly at high speed or with maneuvers that could embarrass the replenishment unit.

0330 Maneuvering for Astern Methods

The transfer of liquids can also be done by astern methods. These are the float method and the gunline method.

0331 Float Method

1. Approach.

a. When the tanker (the delivering ship) is steady on the replenishment course and speed, she will hoist Romeo at the dip on the side the hose will be streamed.

b. The receiving ship takes station about 450 meters astern of the delivering ship.

c. When ready to close she will hoist Romeo at the dip.

d. When the delivering ship is rigged and ready, she will hoist Romeo close up.

e. The receiving ship hoists Romeo close up and then starts the approach. She increases speed 3 to 5 knots and moves up to the hose line float. She grapples the hose line and brings the hose on deck.

2. Station-Keeping Speed.

a. Station is kept with the bridge near the marker buoy. The bight in the hose should be neither too short nor too long to prevent excessive strain on the hose. When approaching, care should be taken not to hit the hose with the ship's bow, as this will almost certainly damage the hose.

b. The replenishment speed must generally not exceed 12 knots, as higher speeds will constrict the passage of the fluid and can damage the hose.

3. Factors to be Considered. The following factors should be considered for choosing the astern method for fueling:

a. It gives an extra fueling capability to the tanker.

b. Specially equipped merchant ships can stream the astern rig only.

c. It is less critical as far as station keeping is concerned and may at times be the best method for unwieldy or small ships.

d. In situations of increased threat it leaves the combat ship less restricted in the use of sensors and weapons.

e. In very shallow water, astern replenishment may be the only safe method of obtaining fuel.

0332 Gunline Method

1. When a tanker (the delivering ship) is steady on the replenishment course and speed, she will hoist Romeo at the dip on the side from which the hose will be streamed.

2. The receiving ship takes station about 450 meters on the delivering ship's quarter and makes ready to close and come to the tanker's quarter in order to receive the gunline and attached messenger.

3. When the delivering ship is ready and rigged, she will hoist Romeo close up.

4. The receiving ship hoists Romeo close up when she starts the approach. She increases speed 3 to 5 knots and moves to a station about 45 meters on the delivering ship's quarter.

5. The gunline is fired in accordance with Article 0315 and the receiving ship hauls in the gunline and messenger. Then she drops back to station and hauls in the hose line and the hose.

6. On disengaging, care must be taken to tie the hose line to the recovery line.

0333 Altering Course and Speed when Fueling Astern

1. Course. Alterations of course during astern fueling operations are sometimes difficult; however, it may become tactically necessary to alter course during such an operation.

a. It is the responsibility of the tanker to keep the escort informed of any alterations in course and speed. In the event of a major course change, the entire force should change course in 20° steps, with each fueling unit (tanker and astern replenishing ship) accomplishing each step in 5°

increments. The tanker is the controlling ship for this maneuver. When the OTC signals to alter course 20°, the master of the tanker will do the following:

(1) Indicate commencement of each 5° increment by waving a flag (red for port turns, green for starboard turns) in a circular motion above his head.

(2) Hold the flag steady while the ship is swinging to the new course.

(3) Wave the flag up and down when steady on each new 5° increment.

(4) Hold the flag in the horizontal position, arm outstretched, on completion of the last 5° increment.

b. The escort commander will execute similar signals to indicate the movements of his ship. During the course change, the escort will maintain her relative position astern by careful use of engine and rudder. The escort commander should not order any subsequent alteration of 20° until he is satisfied that all units have steadied on the previously signaled course.

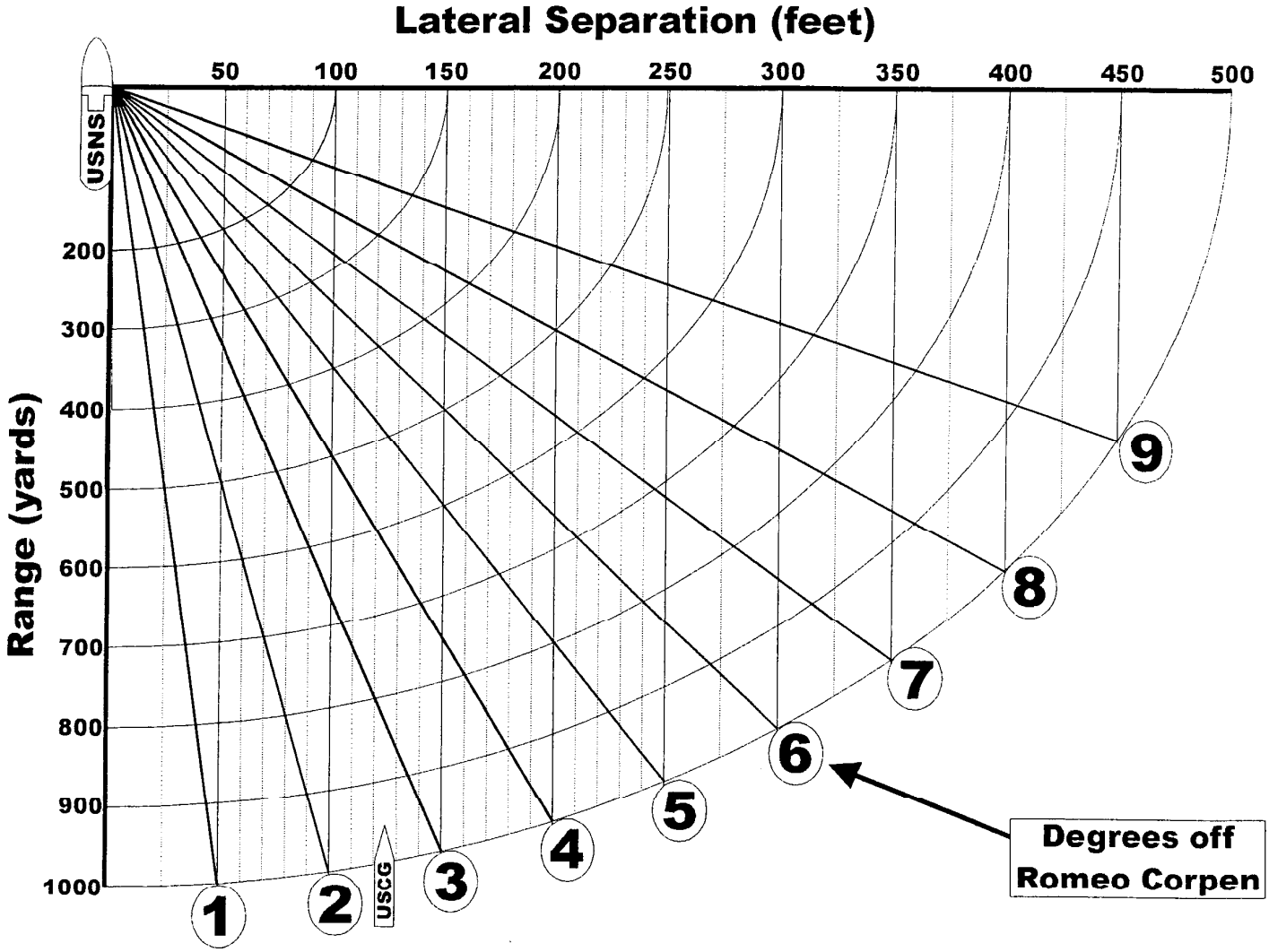
2. Speed. Alterations in speed by the tanker should be made in increments of one knot. The escort keeps very accurate station on the quarter of the tanker by keeping her bridge abreast a marker buoy towed by the tanker, and by staying about 12 meters clear of the tanker's wake. While picking up the hose, speed should be not more than 10 knots.

0340 Replenishment of Towed Array Ships

1. The towed array (TA) ship normally operates at a distance from other ships and it would be detrimental to its mission if it were to depart its patrol area for replenishment. If support ship numbers allow, the delivery boy procedure for replenishment is an option. In this case, the supplying ship joins the TA ship. The TA ship becomes guide and the supplying ship closes from forward of the beam, taking station two cables on the beam of the TA ship. When in station, the supplying ship assumes guide and the TA ship makes a slow approach either to the abeam or stern station. Minimum alterations of course and speed will be made if the TA ship is in contact.

2. Variations to this procedure can be agreed by the participants. The guiding principle is the need to maintain a TA contact or achieve an effective search.

Underway Replenishment Approach Aid



Step 1: Get a stadimeter range from your bridge wing to the delivery ship.
Step 2: Shoot a bearing to the starboard side of the delivery ship.
Step 3: Subtract that bearing from the Romeo Corpen to get the offset bearing.
Step 4: Find the intersection of the range and bearing offset on the nomogram.
Step 5: The vertical line (interpolate if necessary) is your projected lateral separation.

LESSONS LEARNED HANDOUT

SUBJ: REPLENISHMENT AT SEA (RAS); AN OPERATIONS OFFICER'S PERSPECTIVE FOR A HIGH ENDURANCE CUTTER (HAMILTON CLASS)

RAS CONNING/COACHING EXPERIENCE:

- 1989& 90 GALLATIN (PRE-FRAM); CTG 4.1 CD OPS, SOLID SHIELD-89 & REFTRA-89
- 1990 & 91 DALLAS (POST-FRAM); CTG 4.1 CD OPS, REFTRA-91, & MARCOT-90 & 91
- 1994 & 95 HAMILTON (POST-FRAM); SUPPORT DEMOCRACY-94, ABLE MANNER-94, & TSTA-95

REPLENISHMENT EXPERIENCE:

- Caloosahatchee
- Savannah (AOR 4), Kalamazoo (AOR 6) & Roanoke (AOR 7)
- Henry Kaiser (T-AO 187), John Lenthall (T-AO 190), Walter S. Diehl (T-AO 193), Kanawha (T-AO 196), Pecos (T-AO 197), Big Horn (T-AO 198), & Rappahannock (T-AO 204)
- Brambleleaf (A81) (UK)

A. Discussion.

Preparation is the key to any successful operation/mission. As the Operations Officer, and senior watchstander, you "own" the bridge. Aside from the obvious fact that the Commanding Officer "sets the course," the bridge is your responsibility. CG Regulations dictate that *you* are directly responsible to the Commanding Officer for the safe operation of the ship's movement. Conducting an underway replenishment at sea (UNREP), or refueling at sea (RAS) requires that you operate alongside a replenishment vessel (oiler) at extremis, 80-140 feet of separation, depending on the sea-state and weather. In this respect, one could argue that an underway replenishment (UNREP) evolution is probably one of the most stressful and difficult evolutions that you may encounter as an Operations Officer.

Why is this so? UNREP/RAS, commands your leadership skills and organizational ability to orchestrate many segments of the ship's crew to safely come alongside an oiler, remain on station at an uncomfortable distance, and safely transfer valuable amounts of fuel/cargo to your ship. In some circumstances, the environment may not be favorable, but the evolution is necessary for your ship to sustain its ability to survive. It can be stressful because in the Coast Guard your opportunities to practice this type of evolution are limited. On the other hand, you may be fortunate to gather the necessary experience from previous afloat tours, but then you must deal with an inexperienced crew. You could be the only experienced conning officer to work this hazardous evolution. Consequently, your *preparation* and attention to the smallest details will set you up for a successful UNREP/RAS evolution.

B. Preparation Phase.

1. NAVSURFLANT/PAC INST C9010.1 (series), FLEET UNREP GUIDE, delineates USNS oiler characteristics. This guide contains critical information necessary for your planning (i.e., the oiler's height of mast to waterline for your stadimeter, fueling/unrep station locations/distances, oiler LOA, fuel pumping capabilities, etc.).

2. NWP 4-01.4 (the former NWP 14), Underway Replenishment, is the preferred reference for UNREP/RAS deck evolutions and procedures. Most of your questions can be answered from this Naval publication. As the Operations Officer you must thoroughly understand Chapter Two. In all Coast Guard replenishment evolutions from an oiler, you will always be the "approach" ship and the "receiving" ship. The US Navy is very proficient at RAS, it is their "bread and butter." If you must replenish from a US Navy combatant, refer to NWP 11 for their characteristics.

3. Since this evolution is an operations evolution, you (the Operations Officer) should take the lead and hold a UNREP/RAS briefing the day before the scheduled evolution. Participants should include the First Lieutenant, BMC, EO, MPA, DCA, Conning Officers, XO, and CO. At a minimum, go over: (1) manning positions (in accordance with your WQSB), (2) casualty procedures (Plan of Action (POA) for loss of steering and engineering plant), (3) diagram the approach phase using the radian rule, and (4) emergency break-away. The EO should do a separate briefing for his fuel/oil people and go over operating and fueling procedures (it is not unusual to be on station for a long time because your fuel/oil people did not align the valves correctly or overfilled the tanks). The First Lieutenant should do a similar briefing for his deck people to cover the deck seamanship portion of the hook-up and release.

4. After your briefing, conduct a dry-run, well before the evolution so that you can lay out your gear and fix problems. Normally, time will be available to run through your emergency procedures such as the "what-if" emergency/casualty drills. "War game" worst case scenarios with your key players during your rehearsal. If advance time is not available, at a minimum, before getting on-station, run through two significant drills: loss of inboard shaft (transition to single shaft operations alongside) and loss of steering (transition to after-steering and effectively steering the ship from there). During your dry run, station team leaders should review procedures and safety issues on-station with respective players (crew members). It is imperative that all players know their roles. There is no such thing as being over-prepared for this evolution.

5. You should gather your conning officers and discuss with the EO/MPA the pitch/rpm settings for various speeds. Make out a handout with your POA for each critical phase and casualty. The conning officers need to copy on an index card the "approach speed" (SRPM/PITCH), "stationing" (Romeo) speed (SRPM/PITCH) (normally set by the oiler, depending on what you request in your RASREQ and weather/sea-state), and planned "break away" speeds. The approach speed is normally five knots over the stationing speed. The break away speed is usually done in increments of 3-5 knots/5-10 degrees rudder depending on weather conditions and current situation (i.e., gear and personnel are still all over the place so taking off at Flank Bell on both MGTs w/ greater than 15 degrees rudder is not prudent). Initial break-away should be done gradually; avoid aggressive and drastic maneuvers (to avoid suction from oiler). The EO/MPA should have the same POA for his engineer watchstanders in the control booth as you do on the bridge for your DWOs. Basically, the bridge DWOs and engine room key players should be operating from the same "sheet of music." During the dry-run the EO/MPA should work out these speeds with the OPS/conning officers. You can either use your doppler speed log or GPS to accomplish this task. This will help reduce your time trying to get on station and better prepare yourself for any engine plant casualties. When you are taking station 1000 yards astern of the

oiler you can verify your speed tables using your radar to maintain his speed and fine tune your RPMs/PITCH. In most cases an oiler will be at Romeo speed waiting for you so this is a good opportunity to match the oiler's Romeo speed while you wait to get manned and ready. Naturally, once you are alongside stationing speed is relative...just fine tune your SRPM/PITCH to match the oiler's replenishment speed, but because of your preparations it should not vary much.

6. Turbines or diesels? What are ***you*** and your ***Commanding Officer*** most comfortable with? Which engine plant configuration is more reliable? Basically, it really doesn't matter which plant configuration you choose because you will be successful either way. Either plant configuration will get the job done. It comes down to a personal preference unless you are operating in a war/exercise environment where SOA is critical. Than you will need to operate on turbines. Never run a mixed plant--one turbine/one diesel (unless you have no choice)--keep it simple. Bottom line:

Turbines:

(+) more power, easier to keep on station--very responsive, can get you out of trouble, higher sustained speeds, oiler may want you to operate at higher speeds due to environment/security (war time?);

(-) can be loud for fueling team and line handlers on the flight deck, suck up a lot of fuel during the evolution (who cares...next to an oiler), if you have a history of turbine problems (i.e., SRPM hunting, can't keep speed constant) pucker factor goes up--not reliable. If you don't normally run your turbines than operating them solely for a RAS can increase your anxiety level and reduce your confidence.

Diesels:

(+) quiet, reliable (?), slower speeds--things happen slower;

(-) less control, stationing ability--less responsive, oilers normally operate at stationing speeds of 12-13 kts (but will operate for training purposes at whatever speed you want, normally 10 kts on diesels).

7. Be on time to your station. *Time is money* and oilers normally have other thirsty customers waiting to take station. They have a schedule to keep and places to go (unless its TSTA). There is nothing more embarrassing then to be on station 1000 yard astern of the oiler and not be ready to make your approach) because you're still "farting" around with manned and ready reports. The oiler will start flashing light (Navy loves to flash light) or after a while she will call you on the VHF-FM radio to ask you whether there is a problem (for the whole Fleet to listen). Your Commanding Officer (and especially the Executive Officer) will eventually get impatient and get on your case. The best advice I have in order to avoid this situation is to have the previous watch do all the preparations (bridge type stuff) and make sure the ship's close to the oiler so you can slide into position quickly. Positioning is critical. If you have a scheduled RAS at 0800 than make sure the 0400-0800 deck watch does all the preparations and that you are on the bridge well before 0600 to check on progress. Murphy's Law always kicks in when you thought that you gave specific instructions to the OOD (poor Ensign) to be "there" and you are over "here." You have to be on your toes and constantly check on the bridge watch to make sure preps are getting done properly.

8. When should you set the UNREP Bill? Base your decision on how your dry-runs went. It is best to set it early and then stand down and let the crew relax. RAS for Coast Guard cutters can become an all day evolution or at least taxing on the stress curve so people need to be rested. Most cutters set the bill at least an hour prior to hooking up. Remember that when you tell the oiler that you want to RAS at 0800, that means you are hooked up at 0800. Work backwards from that time. If you start at 1000 yards astern of the oiler and your approach speed is 5 knots over the Romeo speed than it will take you close to six minutes to get alongside. Throw in 3-5 minutes jockeying to line up the fueling probe. That is roughly 11+ minutes already so plan to start your approach 15 minutes before you say you will hook-up. Of course you must wait for the oiler to "close-up" the Romeo flag before you start your approach. Trust me, oilers will always be ready (unless they have another combatant alongside or in front of you and they have to shift tanks/hoses).

C. Approach Phase.

1. Set the UNREP Bill and be at 1000 yards astern of the oiler. Once you get experienced and this becomes old hat, you may want to start your approach from 500+ yards. Both turbines (or diesels) should be on line with the OOD working with the EOW to get the romeo speed down by using your radar to maintain distance/speed. During this time you should also run through after-steering drills (shift cables then shift steering to after-steering...let them steer for a while) and practice punching out a turbine (or dropping a diesel) to test your emergency along-side procedures. The Conning Officer making the approach should relieve the OOD well before the approach so that he/she is comfortable with all the preparations and the environment. Follow your UNREP check-off sheet and make sure you get the Commanding Officer to sign it when you are manned and ready (no different than your u/w check-off sheet).

2. The approach is done by one officer who has the "conn" but once you are alongside, the "conn" can be given to two officers, "conn-speed" and "conn-helm." Some ships prefer to keep "conn" with one officer throughout the whole evolution for simplicity. Several ships beak up the evolution so that more Junior Officers can get the opportunity to experience the conning evolutions. In addition, it is less stressful when you have one officer concentrating on speed and another on the steered course. If you decide to break the "conn" up, make sure to designate one officer as "in charge" in case of emergencies. It is easier to designate the "conn-helm" as the primary conning officer since most ships designate that person to make the approach. "Conn-helm" will make the approach. After the order to slow down to Romeo speed is given and the ship has steadied alongside, does the "conn-helm" pass the speed commands to "conn-speed." Most ships designate the XO as the overall bridge safety supervisor (see your WQSB).

3. Weather and sea-state normally dictate your distance alongside. All HEC (378) cutters take tension when refueling so a safe distance from the oiler should fall between 80-140 feet. In my experience, I am most comfortable with staying between 100-120 feet. Weather conditions and your comfort level should dictate your separation but stay within 160-180 feet. Once you start flirting outside of 160-180 feet the oiler's rig (lines/hoses) get tight and the oiler gets nervous

(oiler's normally space at 200 feet for carriers but they plan their rig for it; "small boys" rig for less than 160 feet).

4. Unless otherwise directed by your CO, shoot for 120 feet separation when making your approach. Use your engaged side bridge wing alidade to take a bearing off a tangent of the oiler's hull/side you will engage. Compare this LOB to your ship's present heading to determine the separation angle. Use the same index card that you have marked with speeds to mark the radian rule with distances/separation angles. This way you have a quick gauge on any corrections you need to make to be at 120 feet separation (or whatever distance you choose). All course (helm) corrections on your approach need to be subtle, less than 1/2 degrees (no more than 1 degree increments). Make sure both bridge wing alidades have been calibrated and gyro errors posted. When figuring out distance to the oiler, have a person each on the stadimeter and radar. Compare the two and choose which of the two you feel most accurate (you will be surprised how the drum on a stadimeter likes to slide/roll so that the distances don't make much sense). (On the radar don't forget that your antenna is not exactly where you are standing; calculate the differences as necessary.)

Your index card should have the following distance/angles:

1000 yards	2.3+degrees	1.5-2.0 degrees
900 yards	2.5 degrees	
600 yards	4.0 degrees	3.0-3.5 degrees
500 yards	5.0 degrees	
300 yards	8.0 degrees	6-7 degrees
	120 feet	90-100 feet

5. When you have permission to make your approach from the CO, make sure you are at 2+ degree separation for 1000 yards before you increase your speed to 5 knots over Romeo speed. Remember that the oiler will close-up his Romeo when he is ready to receive you. Keep your Romeo at the dip until you have closed to 500 yards. Once you are between 500 and 300 yards than close-up your Romeo. Double check your position at 900, 600, 500 and 300 yards. Make sure your separation is at the angles you have marked on your index card. Make subtle course changes to correct. Also, you can verify your separation by looking at the oiler's stern wake; it should be 5-10 yards from your wake. At 300 yards pass the command to "stand-by to enter the prop wash/danger area." The oiler's stern wake/prop wash will push your bow away from the stern of the oiler (as much as 2-3 degrees). Don't panic on this. As you go through the danger area, your bow will then get sucked back into the oiler. Be sure that your helmsman is prepared for this "effect" otherwise they will use too much rudder to correct and it could throw you way off your approach.

6. Once you are through the prop wash/danger area, the helmsman should try and maintain the last course you ordered. Your helmsman is a key position. They will experience stress throughout the evolution so it is advisable to have a JO behind the helmsman to acknowledge steering commands. It is not uncommon for the helmsman to lose concentration and rely on the JO for help. I have seen the helmsman drift off course by as much as 2 degrees after an hour of

the exercise. It is very important for the "conn-helm" to concentrate and watch the messenger line markers for distance between bridges. Once alongside helm commands should only change by 1/2 degrees and no more than 1 degrees.

7. For a post-FRAM HEC, we determined that the slow-down rate of speed was 10-15 yards per knot of speed. Therefore, if you are using a 5kt plus approach speed factor in a 50-75 yard (or 150-225 feet) slow-down rate from the time you give the order to slow to Romeo speed. You can figure out what point you should slow down by knowing that your refueling probe is 176 feet aft of your bow and your king post is 248 feet aft of your bow. Once you are alongside and you have given the order to slow to Romeo speed it is easier to move up than drift back so caution on the greater slow down rate of 15 yards per knot. It usually works out that you want to give the order to slow to Romeo speed about 50 feet before your bow goes through their refueling station that you intend to hook-up. Basically, all oilers are larger than 600 feet so you end up moving your bow through their stern before you slow down to Romeo speed.

D. Alongside Phase.

1. Once you are comfortably alongside pick a range marker on the oiler so that you can keep station. It is easy to pick up a king post or two antennas to use as a range. The oiler has a station keeping day board but sometimes it is more difficult to stay focused on that. Pass the "conn-speed" to the second conning officer. The "conn-helm" should focus solely on the course headings and the "conn-speed" on speed commands. Your 1JV talker should have a clip board with a line drawn down the center of the legal pad so that one side has course commands and the other side has speed commands. Some ships elect to go with a grease board but sometimes it helps to know what your last commands were so that you can see a trend developing (closing; up or down). Obviously the "conn-helm" will use the distance phone line with the distance markers to determine separation but make sure that the line remains perpendicular to the ship and the line handlers keep it taut. Otherwise your distances will be distorted. "Conn-speed" will rely more on the natural ranges from the oiler to determine whether he is moving ahead or falling behind station on the oiler. Naturally speed commands will effect helm commands so work together. It is a lot easier then you think.

2. When the first line is over, strike Romeo.

3. When the tension line (span wire) is ready to take tension it is very important to pass "standby, wire taking strain" over the 1MC and to your helmsman. This will effect your steering and can alter your ability to maintain station. If you are taking tension aft on the King Post on the flight deck, it could pull your stern in closer to the oiler. It could have the same affect if you are taking tension at the fueling station. If you are below 70% liquid load, the affect will be noticeable as your ship will heel over initially. The conning officer needs to pay attention and correct with course corrections, gradually, to maintain station.

4. Speed changes alongside should be given in RPMs. For example, "speed 186." Course changes alongside should be given as "steer 205.5." Use the word "speed" for speed changes and "steer" for course changes. Avoids confusion.

5. Fifteen minutes prior to ending the exercise close-up your "Prep" flag. When the last line is let go, strike the prep flag.

E. Breakaway Phase.

1. Emergency breakaway should be executed in the same manner as the normal breakaway--from the conning position. The whole evolution is in a controlled manner. Read the sign on the oiler. He has the whole procedure written down in bold letters. You will normally be asked to do at least one emergency breakaway for practice.

2. When breaking away, avoid dramatic course or speed changes. Make sure you have all lines clear before you depart (not funny...we had a USN combatant take off before all the lines were clear and they took some of our equipment with them). Initially use 3-5 degree course changes and 5 knot speed changes. Be aware of the fact that you have people on deck and lines out. When operating on turbines, be careful not to "show off" and use more than 10 degrees of rudder at greater than 25 knots.

OTHER FACTORS:

1. Recommend that your Romeo course be at least 10-30 degrees off head seas and wind direction (if possible) as per ATP I, volume I. Avoid quartering seas off your stern, if possible (square sterns (i.e., HEC 378s) do not ride well in following quarter seas.

2. Day shapes are required...you are restricted in your maneuverability due to the nature of your work. Some ships do not heed, regardless how angry you get with them on the radio. Be prepared for you and the oiler to change course. Let the oiler dictate to you how this will be done. The master of the oiler will discuss the procedure with you over the phone line (or radio). Normally, the oiler will change course first by 3+ degrees and you will execute a helm command when he tells you. Naturally, the oiler will turn at a different rate so follow him by watching the distance messenger line. It is not as hard as it sounds...I have done it a few times (if I can do it then you can do it).

3. Make sure the oiler "blows down" before disconnecting. Otherwise you will have a lot of fuel on your decks.

4. A normal gas turbine engineering plant configuration for a HEC 378, operating for a Romeo speed of 13 knots is 185 SRPM with .5 pitch on BMGT. With this configuration, your approach speed should be 18 knots at 185 SRPM with .75 pitch on BMGT. (For 13 knots I have seen 163 SRPM with .55 pitch for both MGT. It varies with the comfort level of the engineers.) Be aware that your speed 13 is not the oiler's speed 13. Once you are alongside you will have to adjust so that you are on station. That means you may have to turn for 13.3 knots to make the "oiler's 13 knots."

5. A normal diesel engineering plant configuration for a HEC 378, operating for a Romeo speed of 12 knots is 95-100 SRPM with full pitch on BMDE. With this configuration, your approach

speed should be 17 knots at 140 SPRM with full pitch on BMDE. Slow down rate on diesels has been measured at about 10 yards (30 feet) per knot.

6. In the event of an engineering casualty which requires shutting down either MGT, the Throttleman will immediately declutch the affected shaft and advance the pitch on that shaft to full ahead pitch. Pitch on the unaffected shaft will immediately be advanced to .70 pitch ahead. Conn will be notified of the casualty and will direct Main Control to modify SRPM as appropriate to maintain stationing speed. (Your EO and MPA will set their own procedures.)

7. For a steering casualty, don't screw around; shift steering to after-steering. Pass them the course headings to steer. This is an evolution that you have practiced many times so it should not be difficult. Naturally, if you have either a steering or engineering casualty, you ***will*** execute an emergency breakaway. (Make sure that your after-steering people have the trick wheel engaged before beginning the evolution.)

Hope this info sheet helps...Good Luck, this evolution is not difficult. Keep it simple and have fun.

Naturally, each of us have developed different methods in approaching the same problem. Our goal is to achieve the same result--**success**. If you found through your own experience that some points in this handout need to be changed or addressed differently, please feel free to contact me. We are eager to help other Coast Guard sailors perfect the skill of operating a cutter safely alongside an oiler.

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(Revision Jan 99)

R 031508Z APR 00
FM USCGC TAMPA
TO ZEN/COMLANTAREA COGARD PORTSMOUTH VA//AOFC//
INFO ZEN/USCGC DALLAS
ZEN/USCGC GALLATIN
ZEN/USCGC BEAR
ZEN/USCGC HARRIET LANE
ZEN/USCGC NORTHLAND
ZEN/USCGC SPENCER
ZEN/USCGC SENECA
ZEN/USCGC ESCANABA
ZEN/USCGC TAHOMA
ZEN/USCGC CAMPBELL
ZEN/USCGC THETIS
ZEN/USCGC FORWARD
ZEN/USCGC LEGARD
ZEN/USCGC MOHAWK
Y9/COGARD ACADEMY NEW LONDON CT//LCO//
BT
UNCLAS //N04020//
SUBJ: LESSONS LEARNED - FAS - CANADIAN OILER
A. NWP 4-01.4, UNDERWAY REPLENISHMENT
B. EXTAC 1003, UNDERWAY REPLENISHMENT
1. ON 30MAR00, DURING UNITAS DEPLOYMENT, TAMPA CONDUCTED FAS WITH HMCS PRESERVER (AOR 510), RECEIVING 19,001 GALLONS OF F-76. FOUND THE CREW OF PRESERVER TO BE EXTREMELY PROFESSIONAL AND PATIENT, ALLOWING FOR A SMOOTH AND SAFE EVOLUTION DESPITE LESS THAN IDEAL CONDITIONS (6-8 FOOT SEAS; 20 KT HEAD WINDS). FOLLOWING ARE LESSONS LEARNED.

A. ORIG HAD NOT CONDUCTED FAS FOR NEARLY TWO YEARS, AND PRIOR TO DEPLOYMENT TOOK ADVANTAGE OF THE STREAM RIG TRAINER (COURSE NR J-060-0026) AT EXPEDITIONARY WARFARE TRAINING GROUP, ATLANTIC, LOCATED AT NAB LITTLE CREEK, VA. WE SENT OUR ENTIRE DECK FORCE AND A FEW KEY ENGINEERS, WHO FOUND THE ONE-DAY COURSE ENORMOUSLY BENEFICIAL. CLASS SIZE IS 25; ALLOW APPROX TWO MONTHS FOR SCHEDULING.

B. REF A IS STANDARD DOCTRINE FOR U.S. FAS EVOLUTIONS. HOWEVER, REF B CONTAINS OUTSTANDING INFORMATION REGARDING CANADIAN AND OTHER ALLIED OILERS THAT SHOULD BE REVIEWED THOROUGHLY. ELECTRONIC COPIES OF BOTH REFS ARE AVAILABLE ON THE QUARTERLY NTIC B DOCTRINE CD-ROMS SUPPLIED BY NAVY WARFARE DEVELOPMENT COMMAND. ALSO, HIGHLY RECOMMEND THAT IF OPERATIONS ALLOW THE APPROACH SHIP EMBARK AN OFFICER FROM THE CANADIAN AOR PRIOR TO FAS TO EXPLAIN IN DETAIL THEIR PROCEDURES, WHICH HAVE SOME DIFFERENCES FROM STANDARD U.S. FAS DOCTRINE.

C. TAMPA FUELED FROM STATION 3 (AFT STATION, STARBOARD SIDE), WHICH IS 292 FEET AFT OF PRESERVERS BOW. THIS LOCATION IS IDEAL, AS THE APPROACH SHIP IS NOT AFFECTED BY THE HIGH PRESSURE AREA ON THE AORS BOW.

D. PRESERVER USED A TENSIONED SPAN WIRE AND PUMPED AT 40 PSI THROUGH A 2.5 INCH J.C. CARTER NOZZLE (D-2 FITTING). BE SURE TO NOTIFY THE CANADIAN SHIP IN ADVANCE SO THEY CAN RIG THIS FITTING, AS IT IS NOT THEIR USUAL CONFIGURATION.

E. TO PASS LINES, PRESERVER DIRECTED TAMPA TO FIRE A SINGLE SHOT LINE FROM OUR FLIGHT DECK, TO WHICH THEY ATTACHED THE MESSENGER FOR THE SPAN WIRE AS WELL AS THE BRIDGE-TO-BRIDGE T/D LINE AND THE FUELING STATION PHONE LINE. SEPARATING THE TWO PHONE LINES WAS DIFFICULT, SLOWING THE INITIAL SET UP PRIOR TO TENSIONING. ALSO IN THIS MASS OF LINES WAS AN INHAUL LINE USED TO RETRIEVE PRESERVERS LIGHT AND HEAVY MESSENGERS.

F. PRESERVERS T/D LINE WAS MARKED IN METERS VICE FEET; BE READY TO CONVERT. TAMPA MAINTAINED STATION BETWEEN 42 AND 48 METERS (136-156 FEET) FOR MOST OF THE EVOLUTION, AT TIMES CLOSING TO ABOUT 36 METERS (117 FEET).

G. TO GUARD AGAINST OVERTENSIONING, TAMPA REQUESTED THAT PRESERVER USE THEIR MINIMUM AVAILABLE SETTING, 9000 LBS. TENSIONING TOOK APPROXIMATELY FIVE SECONDS AND CAUSED ONLY A TWO-DEGREE LIST TO PORT. THE HELMSMAN NEEDED ABOUT FIVE DEGREES LEFT RUDDER TO KEEP TAMPA ON COURSE WHILE UNDER TENSION. DETENSIONING WAS EQUALLY SMOOTH. 9000 LBS WAS AN IDEAL TENSION AS IT KEPT THE SPAN WIRE TAUT WHILE NOT ADVERSELY AFFECTING MANEUVERABLITY.

H. THE CANADIANS DO NOT USE SNAP CLIPS ON THEIR MESSENGERS, REQUIRING THAT EACH LINE BE BENT SECURELY TO ANOTHER AND NECESSITATING AT TIMES AN ADDITIONAL RIGGER ON STATION. AS THE FAS STATION ABOARD A 270 IS ALREADY CRAMPED, THIS BECAME A LESS THAN DESIRABLE SITUATION. THE USE OF AUTO-INFLATOR PFDS IN LIEU OF KAPOK LIFE VESTS, AS RECENTLY SANCTIONED BY THE USN, WOULD HELP, ALBEIT SLIGHTLY, TO REDUCE THE CROWDING ON STATION.

I. WHEN PRESERVER LOWERED THE FUELING RIG TO TAMPA ALONG THE SPAN WIRE, THEY ALLOWED IT TO MOVE AT A FAIRLY BRISK SPEED, CAUSING THE FIRST BIGHT OF HOSE TO SLAP INTO THE FUELING STATION WITH SIGNIFICANT FORCE. IT IS ESSENTIAL TO REMOVE ALL PERSONNEL FROM THE FAS STATION AS THE FUEL HOSE IS LOWERED TO PREVENT POTENTIAL INJURY.

J. BE PREPARED TO BE SERENADED WITH A "GREATEST HITS" LIST OF CANADIAN SEA CHANTIES AND POPULAR MUSIC DURING THE COURSE OF THE EVOLUTION. WE ALSO RECEIVED A SOLO BY PRESERVERS BAGPIPER, WHO EARNED HIMSELF A ROUSING CHEER AFTER HIS STIRRING PERFORMANCE. THE CANADIANS CHERISH THEIR NAVAL TRADITIONS AND HERITAGE AS SHOWN IN THEIR GENEROSITY IN THE CUSTOMARY GIFT EXCHANGE: FUEL WAS NOT THE ONLY HIGH-OCTANE LIQUID TRANSFERRED BETWEEN OUR SHIPS.

2. THIS WAS A UNIQUE AND REWARDING EXPERIENCE. IT WAS A PLEASURE TO FAS ALONGSIDE THE DEDICATED PROFESSIONALS OF THE CANADIAN NAVY. FAS POC IS LTJG HAHN OR BMC GEPHART, (757)483-8710. DIGITAL PHOTOS AND 8MM VIDEO OF THE EVOLUTION ARE AVAILABLE UPON REQUEST; POC ENS COST, PAO.

"SECOND TO NONE!"

BT

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R 112125Z SEP 00
FM USCGC TAMPA
TO ZEN/COMLANTAREA COGARD PORTSMOUTH VA//AOFC//
INFO ZEN/COMPACAREA COGARD ALAMEDA CA//POF//
ZEN/COMAFLOATRAGRU ATLANTIC NORFOLK VA//00CG//
MECLANT
ZEN/USCGC GALLATIN
ZEN/USCGC DALLAS
Y9/COGARD ACADEMY NEW LONDON CT//LCO//
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REF/B/DOC/NWP 4-01.4, UNDERWAY REPLENISHMENT//
NARR/REFS A AND B ARE INTERNATIONAL AND U.S. UNDERWAY
REPLENISHMENT DOCTRINE//
POC/COST/ENS/FIRST LT/-/(757)483-8710//
RMKS/1. ON 06SEP00, DURING UNITAS DEPLOYMENT, CONDUCTED
FUELING AT SEA WITH THE CHILEAN OILER ARAUCANO (AOR-53).
THE CHILEANS SIMULTANEOUSLY CONDUCTED FAS OFF THEIR
PORT SIDE WITH USS HAYLER. FOLLOWING ARE LESSONS LEARNED.
A. OVERALL THIS EVOLUTION WAS MORE CHALLENGING THAN THE
TYPICAL UNREP. RECENT FAS EXPERIENCE IN MARCH (CANADIAN
OILER; CARIBBEAN PHASE OF UNITAS) AND JULY (USNS BIG HORN;
TSTA) WAS A GREAT HELP IN MAKING THE EVOLUTION RUN
SMOOTHLY. FOR ANY CUTTER ANTICIPATING UNREP WITH A CHILEAN
OILER, STRONGLY RECOMMEND CONDUCTING FAS WITH A U.S. OILER
IN THE PRECEEDING FEW MONTHS FOR CREW PROFICIENCY.
B. REF (A) PROVIDES EXCELLENT INFO ON MANY ALLIED OILERS,
BUT DOES NOT INCLUDE INFO FOR SOUTH AMERICAN NAVIES. AS A
RESULT, TAMPA WAS UNABLE TO OBTAIN ARAUCANO S LAYOUT/
OVERVIEW UNTIL ON SCENE. WE USED JANE S TO GIVE US A ROUGH
PICTURE OF THEIR DECK ARRANGEMENT.
C. ARAUCANO IS 498 FEET LONG (COMPARED TO 650-700 FEET FOR
TYPICAL U.S. OILERS), AND SITS VERY LOW IN THE WATER. BETWEEN
THEIR FORWARD AND AFT SUPERSTRUCTURES THE VESSEL HAS ONLY
ABOUT TEN FEET OF FREEBOARD. BE PREPARED FOR THE UNIQUE
EXPERIENCE OF LOOKING DOWN AT THE OILER FROM WHICH YOU ARE
FUELING. THEY HAVE TWO FUELING STATIONS ON EACH SIDE AND
DIRECTED TAMPA AND THE THREE USN VESSELS TO USE THE FORWARD
STATIONS. THIS PLACED OUR BOW ROUGHLY IN LINE WITH ARAUCANOS
DURING THE FAS.
D. ORIG TRANSMITTED A RASREQ TO THE CHILEANS THREE DAYS PRIOR
TO THE EVENT, BUT ARAUCANO DID NOT RECEIVE IT. WE ARRIVED ON
SCENE WITH THE OILER TWO HOURS EARLY, AHEAD OF THE THREE USN
SHIPS THAT ALSO WERE SCHEDULED TO FAS, ALLOWING TIME TO WORK
OUT MOST DETAILS FOR THE EVOLUTION AND TO CONDUCT ONE LEAP
FROG AND ON-STATION TRAINING. ALSO CONDUCTED AN ALL HANDS
UNREP WALK THROUGH THE AFTERNOON PRIOR TO THE FAS.
E. THE LANGUAGE BARRIER WAS SIGNIFICANT. ARAUCANO HAD A FEW
OUTSTANDING ENGLISH SPEAKERS BUT THEY WERE NOT EMPLOYED
DURING MANY RADIO COMMS, FORCING MINOR DELAYS AND SOME
TEMPORARY MISUNDERSTANDINGS. IN RESPONSE, WE PLACED OUR
THREE SPANISH-SPEAKERS AT KEY COMMS STATIONS: BRIDGE VHF;
FLIGHT DECK STATION-TO-STATION SPP; AND BRIDGE-TO-BRIDGE
T/D LINE SPP. THIS GREATLY IMPROVED COMMS ALTHOUGH THEY WERE

SLOWER THAN NORMAL DUE TO THE TIME NEEDED FOR TRANSLATION. IT IS IMPORTANT TO ENSURE SPANISH LINGUISTS ARE FULLY FAMILIAR WITH UNREP PROCEDURES AND TERMINOLOGY SO THAT THEY ARE ABLE TO ACCURATELY TRANSLATE.

F. DUE TO INCOMPATIBLE FITTINGS WE CONDUCTED A DRY HOOK UP VICE ACCEPTING FUEL. THE CHILEANS USE A 7-INCH PROBE WITHOUT THE 2.5-INCH ADAPTER NEEDED TO FUEL A 270 WMEC. UNFORTUNATELY, WE DID NOT HAVE TIME ON SCENE TO RIG A TEMPORARY ADAPTER. FOR FUTURE UNITAS CUTTERS, RECOMMEND COORDINATING WITH THE CHILEANS SEVERAL MONTHS IN ADVANCE TO RESOLVE THIS ISSUE. IDEALLY, THIS WOULD BE AN AGENDA ITEM AT THE UNITAS CHILEAN PHASE FINAL PLANNING CONFERENCE, HELD PRIOR TO THE DEPLOYMENT.

G. THE CHILEANS CAN PUMP FUEL SELECTIVELY BETWEEN 20-100 PSI, AND ARE ABLE TO ACCOMMODATE THE 270 WMEC MAX PUMP PRESSURE OF 40 PSI.

H. ARAUCANO HELD ON BOARD AN OLDER VERSION OF REF (B) BUT FOLLOWED U.S. PROCEDURES CLOSELY. WHILE ALONGSIDE THERE WERE NO MAJOR DIFFICULTIES AND NO CONFUSION. THEY RAN THE FAS IN A VERY PROFESSIONAL AND CRISP MANNER. ONE NOTABLE DEVIATION FROM U.S. DOCTRINE: EMERGENCY BREAKAWAY TRAINING (SEE BELOW).

I. THE CHILEANS PASSED ONE SHOT LINE FROM THEIR VESSEL TO OUR FLIGHT DECK, WITH SEPARATE MESSENGERS ATTACHED FOR THE TWO SOUND POWERED PHONE LINES AND THE SPAN WIRE. WE PRE-STAGED A CHEATER LINE FROM THE FLIGHT DECK TO THE O-3 LEVEL TO ALLOW EASE OF RIGGING THE BRIDGE-TO-BRIDGE T/D LINE; THIS WORKED EXTREMELY WELL.

J. ACAUCANO USES MANUAL VICE MACHINE TENSIONING, WITH A MAX TENSION OF 8000 LBS. THIS SMALL AMOUNT OF PULL HAD NO VISIBLE EFFECT ON STEERING AND WE WERE HARD PRESSED TO TELL EXACTLY WHEN THEY PUT US UNDER TENSION.

K. ARAUCANO EMPLOYED THE STATION KEEPING AID DESCRIBED IN APPENDIX K TO REF (B). ALTHOUGH THEY DID NOT PLACE IT IN AN IDEAL LOCATION IT DID PROVIDE A SOMEWHAT USEFUL REFERENCE.

L. TAMPA MAINTAINED STATION BETWEEN 140-160 FEET, SLIGHTLY FURTHER OFF THE OILER THAN USUAL BUT NECESSARY DUE TO THE ADDED COMPLEXITIES OF THE MULTI-UNIT UNREP. AT THIS DISTANCE WE OBSERVED NO EFFECTS FROM THE HIGH PRESSURE AREAS AT THE BOW AND STERN OF THE OILER.

M. WEATHER CONDITIONS WERE ALMOST IDEAL, WITH LESS THAN 15 KNOTS OF WINDS AND 2-4 FOOT HEAD SEAS. HOWEVER, A VERY LONG PERIOD PACIFIC SWELL CAUSED BOTH SHIPS TO SLOW ON OCCASION AS WE PLOWED INTO A WAVE, REQUIRING CLOSE ATTENTION ON OUR PART TO MATCH STATIONING SPEED.

N. THE EMERGENCY BREAKAWAY DRILL SEEMED TO CATCH THE OILER BY SURPRISE, EVEN THOUGH WE HAD PRE-BRIEFED IT ON VHF AND BY SPP. IT TOOK SEVERAL MINUTES OF GESTURING TO GET ARAUCANOS BRIDGE-TO-BRIDGE T/D LINE TENDERS TO DISCONNECT AND FEED THE LINE BACK TO US. RECOMMEND DURING MULTI-UNIT EVOLUTIONS SUCH AS THIS GIVING ALL INVOLVED UNITS A CALL ON VHF IMMEDIATELY PRIOR TO COMMENCING THE EMERGENCY BREAKAWAY. POST-FAS DISCUSSIONS FOUND THE CHILEANS DO NOT ROUTINELY PERFORM EMERGENCY BREAKAWAY DRILLS AFTER FAS.

O. FOLLOWING OUR BREAKAWAY USS LA MOURE COUNTY AND USS KLAKRING CONDUCTED FAS WITH ARAUCANO. KLAKRING DID NOT MAKE ITS APPROACH UNTIL AFTER SUNSET. INTERESTINGLY, AND IN CONTRAST TO U.S. PROCEDURES, THE CHILEANS RUN ALMOST COMPLETELY DARK DURING NIGHT FAS. FEEDBACK FROM KLAKRING

INDICATES THIS MADE JUDGING DISTANCES DIFFICULT AND THEY
ADAPTED BY MAKING A WIDER THAN NORMAL APPROACH.
2. THROUGHOUT OUR TIME ALONGSIDE, ARAUCANOS CREW WAS
EXTREMELY COMPETENT, SAFETY CONSCIOUS, AND ACCOMMODATING.
BEING PART OF A DOUBLE FAS WITH A FOREIGN OILER AND A U.S.
DESTROYER WAS A RARE AND REWARDING EXPERIENCE. IT WAS A
PLEASURE WORKING WITH THE PROFESSIONALS OF THE CHILEAN AND
U.S. NAVIES.
3. ADDITIONAL INFORMATION, DIGITAL PHOTOS, AND VIDEO OF
THE EVOLUTION ARE AVAILABLE UPON REQUEST. TAMPA P.O.C. IS ENS
COST, FIRST LIEUTENANT,(757)483-8710 OR DCOST(AT)CGCTAMPA.USCG.MIL
(AFTER 15 OCTOBER). UNDERWAY EMAIL: CGCTAMPA(AT)BIGFOOT.COM;
PLACE RECIPIENT S NAME IN SUBJ LINE.
SECOND TO NONE!//
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CHAPTER 6: ICE OPERATIONS

A. General.

1. References. There are several standard texts on icebreaking that provide guidance and should be reviewed prior to working in ice. *Polar Operations Manual* (USN) is devoted entirely to ice operations. *Knight's Modern Seamanship* and *Naval Shiphandling* both devote chapters to the subject. American Practical Navigator (Bowditch, Vol. I) is anther good source. These texts deal mostly with polar operations and buoy tenders rarely work in polar regions. The differences between polar and domestic ice breaking are substantial and tenders will find themselves working in ice of various types and thicknesses. A large portion of the assistance provided occurs in wind-driven ice, restricted river channels, or refrozen brash. The vessels will also be relieving buoys in ice and performing ice-related flood relief. A good source of information on domestic icebreaking is *A Handbook of Ice Operations for the U.S. Coast Guard's WTGB Class Cutter*, by CDR Lawson Brigham. His research paper is a compilation of information about WTGB methods and contains some valuable analysis on several ice-related accidents involving Coast Guard cutters. CDR Brigham's *USCG 43 Meter Icebreaker Operational Performance and Techniques on the Great Lakes* is another possible reference.

2. Planning and Importance. Icebreaking and its associated activities **are not** "seat of the pants" operations. Any evolution in ice should be approached only after careful analysis of the prevailing weather, sea room, and ice conditions. Whenever possible, use the elements and sea conditions to assist with ice operations.

3. Overview. The methods suggested in this chapter are techniques that have been employed successfully by others. Tenders without experience may find that these methods will help them to operate safely until some experience is gained. However, not every situation can be covered in this text and thoughtful innovation is encouraged.

B. Domestic Ice Breaking Definitions.

1. Definitions. The following definitions are associated with ice in the Great Lakes and coastal waters.

AGE - The length of time since ice formed.

ANCHOR ICE - Ice attached to the bottom.

BALL ICE - Formed when small ice chunks of any type are trapped in extremely turbulent water which is at the freezing point throughout its depth. The particles grow by coalescence or accretion to form soft, spongy spheres up to three feet in diameter.

BARE ICE - Ice without snow cover.

BRASH - Conglomerations of small ice cakes and chunks which have been broken off from other ice formations. These conglomerations coalesce and refreeze into irregularly

shaped masses, one to six feet in diameter, usually with sharp projections. Brash ice can extend all the way to the bottom of an ice-congested waterway.

CAKES - Detached segments of ice sheets. The following shows the recognized categories of Cakes/Floe measurement:

Cake - Less than 20 meters (22 yds) across

Small Floe - 20 - 100 meters (22 - 109 yds) across

Medium Floe - 100 - 500 meters (109 - 545 yds) across

Big Floe - 500 - 2000 meters (545 yds - 1.1 NM) across

Vast Floe - 2 - 10 Kilometers (1.1 - 5.5 NM) across

Giant Floe - More than 10 Kilometers (5.5 NM) across

COVERAGE - The ratio of water surface covered by ice to the total surface area at a specific location or over a defined area. Ice coverage is always reported in tenths.

CRACK - An opening in the ice sheet or floe that is not navigable by a ship. (A good rule of thumb is: If you can jump across it, it's a crack. If you can't, it's a small lead.) See LEADS.

DRIFT ICE - Any unattached ice formation. Any area of ice other than fast ice.

FAST ICE - Immobilized ice formations. Ice so firmly frozen into place (along the shore or held by islands) that winds and water currents cannot dislodge the formation.

FAST SHEET ICE - An ice field.

FLOES - Detached segments of floating ice sheets. See CAKES.

FRAZIL - Fine spicules or ice crystals that float freely and individually in the water.

GREASE ICE - Where the water surface is completely covered by frazil but the crystals have not yet begun to freeze together. The surface has a greasy, matte appearance and may look like an oil slick.

ICE EDGE - The boundary, at any given time, between the open sea or lake and ice of any kind, whether drifting or fast.

ICE JAM - Formed when drifting masses of floes and cakes are forced into convergent motion by the configuration of shorelines and/or fast ice formations.

LAKE ICE - Ice formed on a lake, regardless of observed location. Nearly all ice on lakes can be classified as either "blue" or "white." Blue ice consists of closely packed water crystals with relatively few impurities. White ice incorporates large quantities of air.

LEAD - Any opening or passageway through sea ice that is navigable by a ship. Different variations:

Blind Lead - A lead blocked at one end (dead end).

Shore Lead - A lead between the pack ice and the shore.

Flaw Lead - A lead between pack ice and fast ice.

PLATE ICE - Flat ice with approximately uniform thickness and without ridges/windrows.

PANCAKE ICE - Predominantly circular pieces of ice. Pieces are one to eight feet across with raised rims resulting from the pieces striking against one another.

POLYNYA (Pronounced "Pul en ya") - A water area enclosed in ice, usually fast or any non-linear opening in the ice cover. This water area remains constant in size and usually has an oblong shape. Some of these are recurring, due to the natural upwelling of warmer water currents.

POOL - A small body of water (usually fresh melt water) in a depression or hollow in ice. Also known as a MELT POND.

PRESSURE RIDGE - A line or wall of broken ice forced upward and downward by pressure. This is usually formed when two floes collide with each other.

RAFTED ICE - A type of ice formed by one floe overriding another. Some parts of the overlap will trap water which may freeze and cement the two floes together. Other parts will trap air and take on the characteristic white appearance.

RIND ICE - A brittle, shiny crust of ice usually less than three inches thick. It is formed on a quiet surface by direct freezing or from grease ice. Ice rind is easily broken by wind or swell and usually breaks into rectangular pieces.

RIVER ICE - Ice formed in or carried by a river, regardless of observed location.

ROTTEN ICE - Ice that has become honeycombed because of melting and is in an advanced state of disintegration. Rotten ice may appear transparent (dark) when saturated with water.

SEA ICE - Any form of ice found at sea which has originated from the freezing of sea water.

SEA SMOKE - Fog formed when water vapor is added to air which is much colder than the vapor's source. This most commonly occurs when very cold air drifts across relatively warm water

SHORE ICE - A basic form of fast ice that is attached to the shore or grounded in shallow water.

SKIM ICE - Where frazil crystals have frozen together, but do not yet exhibit tensile strength. Ripples may move through skim ice.

SLUSH - Snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

WHITEOUT - An atmospheric optical phenomenon in which the observer appears to be engulfed in a uniformly white glow. Shadows, horizon, and clouds are not discernible; sense of depth and orientation is lost. Only very dark, nearby objects can be seen. On the Great Lakes a uniformly overcast sky, blowing snow and an unbroken ice cover can contribute to a whiteout.

WINDROW - Rows of ice piles formed by drifting masses of floes and cakes being pushed against the shore or against fast ice by the wind. Windrows continue to grow as long as the wind persists.

C. Open Water Transits.

1. General. There are several situations faced by an unescorted vessel in severe winter conditions that can place the vessel and crew in great danger. These include being beset in the ice (and possibly having the vessel pinched out of the ice) and ice accretion (icing of the superstructure and decks). Icing, which poses the worst threat, occurs only in open water areas. A vessel caught in heavy seas can actually find relief from icing and the rough seas by entering an ice field.

2. Icing. Icing can occur very rapidly and can significantly reduce the vessel's stability (by raising the vessel's center of gravity). Because icing normally occurs when the wind and seas are running, this loss of stability can result in broken masts, booms, davits, and lost boats. Extreme icing in heavy seas can cause capsizing and loss of the vessel. Use your vessel stability program to compute your maximum icing capability when icing occurs.

3. Fresh vs. Salt Water. Vessels operating in fresh water are more prone to icing than those in salt water. This is because fresh water freezes at a higher temperature than salt water. The Great Lakes pose particular problems because of the shorter wave period vessels encounter there. Severe icing can occur in relatively small seas as the bow breaks each succeeding wave and throws spray into the cold air.

4. Tactics. Because of the speed with which icing can imperil a vessel, the Commanding Officer should always consider alternatives when conditions are favorable for icing. Consider a sheltered route, if available, and slower transit speed to lessen the amount of spray sent up by the bow. Tack off the wind and seas. If the ship is not responding to an emergency, it may be prudent to seek shelter in a safe harbor, and delay sailing until conditions improve.

5. Dealing with Topside Icing. If icing is encountered and a safe refuge is not available, it may be necessary for the vessel to come about periodically and run with the seas so ice can be removed by the crew. A transit under these conditions is very tiring for the crew, and should be avoided. Ice should be removed with wooden baseball bats or ax handles. Metal malls and hammers should never be used because they may damage the deck or superstructure.

D. Transiting in Ice.

1. General. The best advice for a vessel transiting an area covered by ice is to go around if possible. If you can't go around, look for the easiest route to transit.

2. Night Transits. Transits of ice fields at night are not recommended. The ability to judge ice thickness and to distinguish pressure ridges at night is greatly reduced. At night, vessels have entered into heavy ice and become beset. Others have tried to force a route, spending hours backing and ramming with little headway, only to find a very easy transit in the morning because they were able to avoid the windrows and

pressure ridges in the daylight. Most vessels that routinely operate in ice have ice lights (mounted on the bow). They use these in combination with their searchlights when they must transit ice at night. Even with this artificial lighting it is still very difficult to avoid all of the obstacles in an ice field.

3. Ice Damage. Ice is capable of causing serious damage to propellers, rudders, and hull plating. Vessels should always place the rudder amidships before backing down in ice. This prevents ice from becoming jammed between the propeller and rudder and to keep from bending the rudder stock. Bow thrusters should not be used in ice. Thrusters are useless in ice and may be damaged by ice ingested into the tunnel.

4. Ice Dangers and Responses. The greatest danger in transiting an ice field is loss of propulsion or maneuverability. This can result in a vessel becoming trapped, especially in a moving ice field, and either driven aground or forced out of the ice and stranded. If the vessel is forced out of the water there is very little chance to maintain any equipment unless it has keel coolers. In several vessel classes, ice has a tendency to clog sea strainers and block cooling water to the main engines, ship service generators and main motors. This problem occurs most frequently in brash ice. Even if a beset vessel is not pinched out of the ice, there are other potential dangers. If a vessel is caught beam to a moving ice field, ice may start to drive up and over the deck, forcing the vessel to heel over be or pushed under the ice. Keeping the doors in the buoy ports when transiting ice fields is recommended. The doors will help keep ice off the buoy deck should the vessel be disabled. If it becomes necessary to secure propulsion in moving ice, maneuver the bow into the oncoming ice first. This will allow more time for repairs before the ice forces the situation.

5. Obstacles. In domestic icebreaking, it is usually not necessary to follow leads in ice (because of the reduced thickness compared to arctic ice). The greatest obstacles are windrows and pressure ridges. Skirting these, and transiting through unbroken plate will allow for the safe passage of most large tenders. If a vessel must back and ram to force a passage, great care must be taken to keep the vessel from being driven into several succeeding windrows whose separation is less than twice the length of the vessel. The tremendous pressure ice exerts is readily apparent when a vessel cannot maneuver because of a windrow at the bow and stern or even worse at the bow and amidships. It is best to chip away at windrows until the opening in the windrow is large enough to allow the vessel's passage.

6. Backing and Ramming. When backing and ramming, the vessel need not back more than two ship lengths from the ice edge. Backing further will result in too much momentum. The vessel may be carried so far up on the ice that it cannot back off. Remember the bow shape allows the vessel to ride up the ice and it is the weight of the vessel that breaks the ice, not the bow as bludgeon or speed. Breaking ice often requires a great deal of patience to accomplish an evolution safely. Cycle the rudder prior to starting a back and ram evolution to wash away ice from the stern. Ensure the rudder is amidships while backing.

7. Method. A ship breaks fast ice by riding up on the ice and breaking it as the weight becomes greater than the ice can support. This effect is assisted by the buoyancy of

the stern of the vessel. The bow rides up on the ice, and consequently the stern is driven down into the water. However, because the water pressure is greater than that exerted by the stern, the stern will be forced up again exerting downward force on the bow. This additional force gives the bow added breaking action. Vessels moving well in ice will demonstrate this "hinge" characteristic.

8 Utilizing Sinkers. Vessels making unescorted transits are recommended to carry a sinker large enough to roll the vessel from side to side when moved from port to starboard; a sort of "heeling system." This will assist the vessel in extracting itself should it become beset.

9. Sallying. "Sallying the Rudder" has long been recognized as an effective method for forcing a passage through ice. This is a procedure in which the helmsman shifts the rudder from left to right in nearly equal increments of ten or more degrees while maintaining a general heading. The rudder is shifted by the feel of the vessel. As the vessel starts to answer the rudder in one direction the helmsman then shifts the rudder, so the effect of the constantly shifting rudder imparts a roll to the ship. This technique will often prevent the vessel from becoming beset once it starts to slow, but is of limited use if the vessel has already come to a stop. Additionally, the screw turning and moving the rudder prevents ice damage. Use extreme caution when sallying the rudder near shoals, in restricted waterways, or near other vessels.

10. Fixing Position. Since a vessel transiting an ice field cannot always follow a set course it is critical that the position of the vessel be fixed accurately and often to prevent a mishap.

E. Escorting and Assisting Vessels Beset in Ice.

1. General. Buoy tenders often assist other vessels through ice. Some of the same shiphandling rules that apply for working buoys apply when assisting beset vessels. However, as with most rules there are exceptions and times to depart from them, use common sense.

   a. One primary rule for any operation in ice is to always use the ice and wind conditions to your advantage.

   b. A long held rule for icebreaking with single screw ships is, whenever possible, to make a starboard side approach to the vessel being assisted. This is to prevent the escort from backing into the beset vessel should her progress be stopped. However, some forces that apply to single screw vessels in open water, like backing to port, do not necessarily apply when operating in ice. For example, any ship operating in ice will tend to follow the path of least resistance. This means a single screw vessel may back straight out the same track it made instead of backing to port.

   c. The general rule is that the assisting vessel should never break ice on the leeward side of a vessel. This is to keep the assisting vessel from becoming beset, and having the assisted vessel blow down on the assisting vessel. However, if there is a heavy wind the beset vessel will have ice piling up on the windward side. It will also have ice packed against the leeward side as the wind pushes the vessel onto

the ice. If ample sea room exists to break the restricting plate on the leeward side, your efforts may be better rewarded there. The beset vessel may be set into the open tracks on the leeward side faster than the moving ice can fill them in, allowing it to fall in behind the escort. Efforts on the windward side may only break free more ice to pile against the vessel as the wind pushes the plate into the track behind you.

d. While these maneuvers work well in plate, where ample sea room exists, they are not recommended in narrow brash-filled channels because vessels operating in brash ice react more closely to their open water handling characteristics.

2. Expanding Margin of Safety. Never restrict yourself to a close maneuver if ample sea room exists to give you a safer margin for error. As explained above, you can sometimes deviate from the accepted approach by taking advantage of the elements and your maneuvering area without placing your vessel at risk. There are times when working very close to a vessel in restricted waters dictates that you follow procedural theory. When sea room exists, however, utilize it to provide a greater margin of safety while completing the vessel extraction. While ample power must be applied to break an ice jam, be aware when working in close quarters, that your vessel heading may fall off into the assisted vessel. Also be aware that your wake is effective in breaking ice when adequate speed is possible. Use extreme caution using high speed near other vessels.

3. Primary Tasks. Your main task when assisting a beset vessel is relieving pressure, reducing friction and providing a less restricted path for the vessel. You want to complete this as efficiently and safely as possible, with safety being the paramount concern. In ice, a vessel will always seek the path of least resistance. This law of physics should be exploited to the maximum extent possible. This same law is the quickest way for a vessel to get in trouble when working close to another vessel in ice.

4. First Passes. The first passes down the side of a beset vessel should be made at a distance equal to the length of the assisting vessel, if possible. This is often sufficient to relieve the pressure around the beset vessel. It also will allow you to judge the thickness of the ice and identify any weak areas along the vessel if closer passes are needed. The reason such a distance from the beset vessel is recommended is to allow sufficient room to swing the stern should a low pressure area draw the assisting vessel toward the beset vessel. Most collisions that occur are the result of the stern striking the beset vessel as the assisting vessel attempts to maneuver out of a sheer.

5. Areas for Concern. The areas around the bow and stern of the beset vessel are where low pressure areas are most likely to occur. This is a result of the prop wash and backing of the beset vessel weakening the ice as it attempts to free itself (See **Figure 6-1**.) As the assisting vessel approaches either end of the beset vessel it should begin to open the distance between the vessels and be prepared to maneuver to avoid a collision.

F. Vessel Types.

1. General. Each of the many varied types of vessels you may have to assist has its own personality. Each has its own unique combination of hull form, horsepower, and handling characteristics.

2. Wood or Fiberglass. Exercise care when maneuvering in the vicinity of wood or fiberglass vessels, as excessive ice movement could damage their hulls.

3. Large Vessels. Large vessels and tugs pushing a tow will require assistance at turns. Obviously, the vessel's stern swings in the opposite from which direction the vessel is turning. To facilitate this motion, you will have to break ice ahead of the vessel in the direction of the turn and aft of the pivot point on the opposite side.

4. Ice Dumping. These vessels will also require places to dump ice from the bow at periodic intervals, especially in refrozen brash, or several parallel tracks so ice displaced by the vessel's passage has somewhere to go (See **Figure 6-2**.)

5. Vessels with Large Sail Area. When there are high winds, light tows and bulk carriers have difficulty maneuvering in the ice because of their large sail area. Also their lack of ballast often results in the screw and rudder being partially out of the water, further reducing usable horsepower and limiting maneuverability. Vessels being assisted in the ice should be asked to ballast down to as near a normal trim as possible. This will increase their efficiency in the ice. The added ballast will also help them to transit short stretches of ice of varying thicknesses. When escorting a vessel through wind-driven ice you may have to make several parallel tracks leeward of the main ice sheet. The ice from the windward track, which should blow faster than the main ice sheet, has somewhere to go. This will relieve the pressure for the escorted vessel (See **Figure 6-3**.)

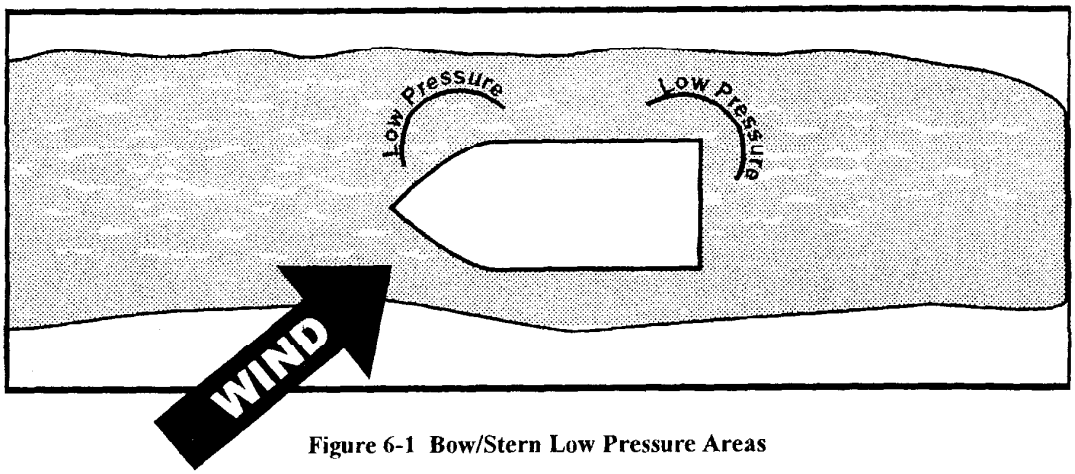

Figure 6-1 Bow/Stern Low Pressure Areas

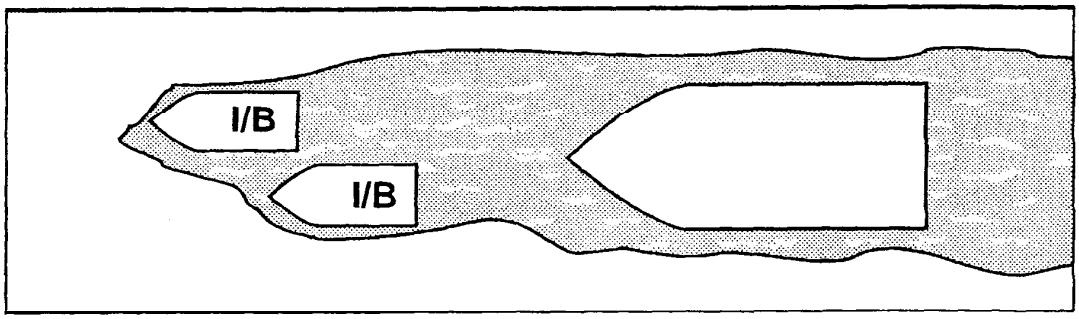

Figure 6-2 Parallel Tracks

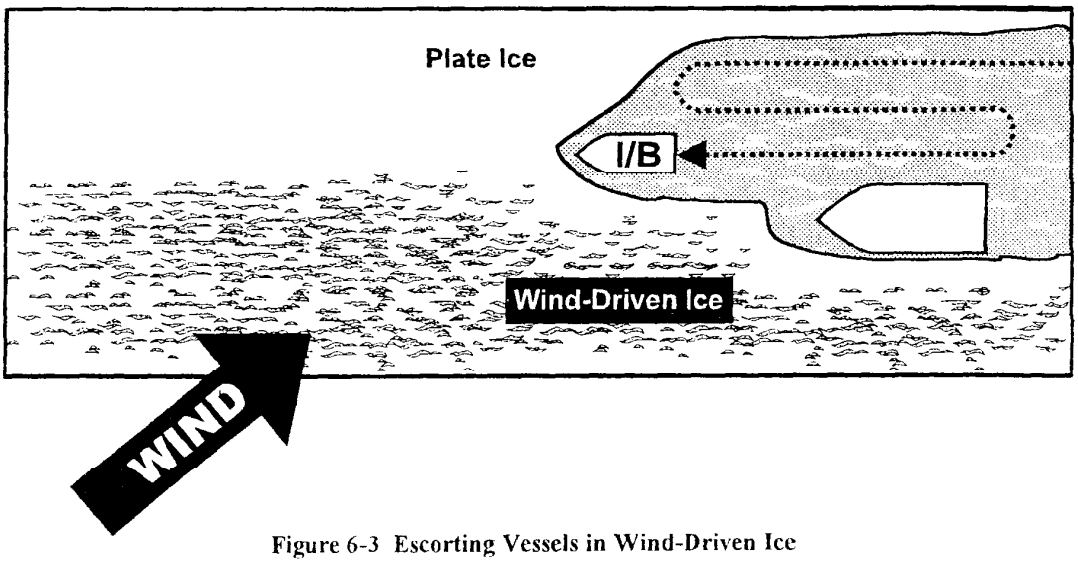

Figure 6-3 Escorting Vessels in Wind-Driven Ice

6. Getting a Light Vessel Started. To get an otherwise unimpeded light vessel started you may have to back down on the bow of the beset vessel and then come ahead with full power. This will push ice away from the bow and lubricate the beset vessel's hull with water. Light vessels, once started, can usually follow in a well prepared track. They just require a fairly clear stretch to build momentum.

7. Draft. When escorting a vessel through an ice field you must know their draft. You are assuming a degree of responsibility for the safety of the vessel you are escorting. You must maintain a constant plot so you do not inadvertently lead the vessel into waters you can safely navigate but which exceed the draft of the escorted vessel. Remember you are in charge of the operation.

G. Convoy Techniques.

1. General. Often the only efficient way move many vessels through wind driven ice or brash-filled rivers is in a convoy. However, the safe completion of a convoy requires a knowledge of the vessels involved. You need to know their horsepower, length, and draft. You also will have to come to an agreement among the vessels as to minimum following distance, general communications procedures and radio frequencies. You must keep in mind that your cutter is more powerful, for its size, and much more maneuverable than the vessels you are assisting. Therefore, you must make all turns and set safe following distances from the perspective of the vessels you are escorting.

2. Ability. The vessel with the highest horsepower to length ratio should be placed at the head of the convoy (measure of ice-breaking ability). Vessels with lesser ratios of horsepower to length should then be lined up in descending order. This will help to alleviate the problem of vessels with lesser ratio of horsepower to length becoming beset and halting the progress of the convoy.

3. Methods. There are several ways for the escorting vessel to handle a convoy. One way is to break track ahead of the lead vessel and allow the rest of the convoy to follow without further assistance (See **Figure 6-4**). Another way is for the escorting vessel to break track ahead of the convoy. Then break a parallel track back to the convoy. This works well if the escort can maintain a high enough speed to keep a track broken a safe distance ahead of the lead ship (See **Figure 6-5**.)

4. Drawbacks. The drawback to single ship operations is that the escort may have to fall back to assist a straggler and may not be able to keep the convoy moving with any regularity. In the past, cutters have left stragglers (in no danger) and assisted the bulk of the convoy, then returned to assist the straggler directly.

5. Multiple Escorts. Often several ships will be assigned the convoy escort task. This greatly simplifies the operation. One vessel can break track leaving the other vessel to break a parallel track or assist vessels in the convoy as necessary (See **Figure 6-6**).

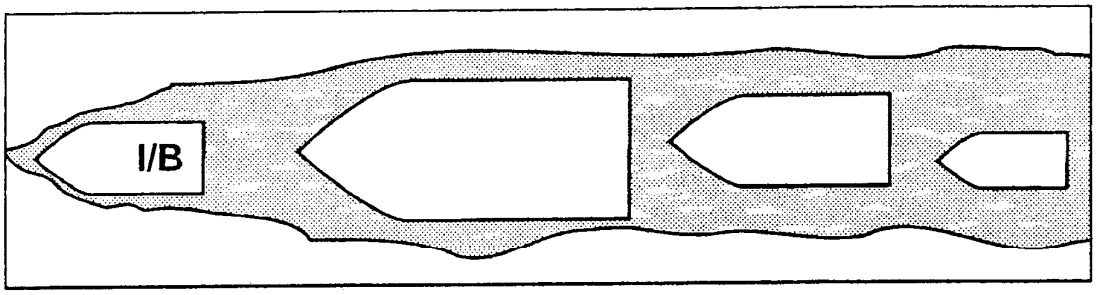

Figure 6-4 Breaking Track Ahead of Lead Vessel

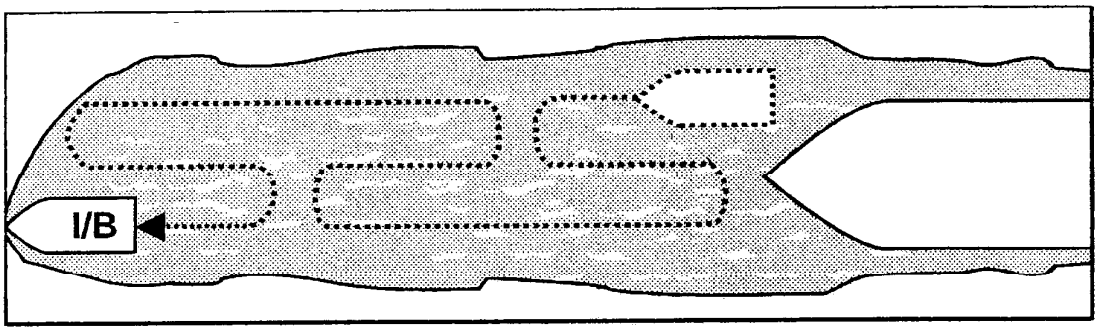

Figure 6-5 Breaking Track Ahead - Parallel Track Back

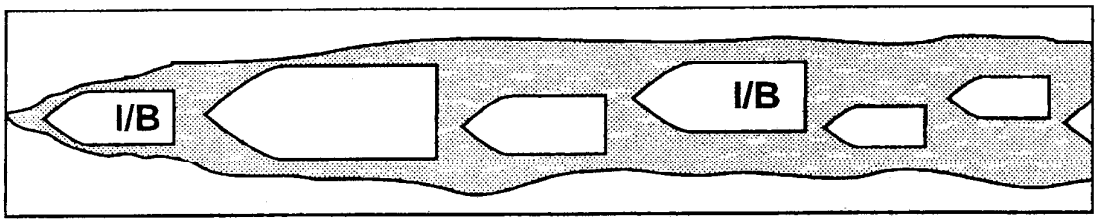

Figure 6-6 Several Ships Escorting Convoy

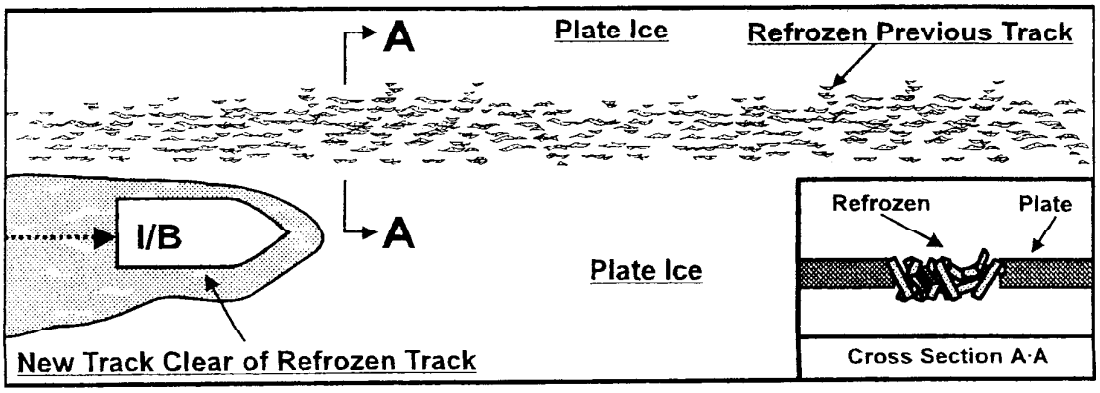

Figure 6-7 Old and New Tracks

H. Towing in Ice.

1. General. The hull form, horsepower and fiber towlines used by buoy tenders are not conducive to towing of vessels in ice. Therefore, buoy tenders should not tow in ice except as a last resort to prevent loss of life or property.

I. Communications Safety.

1. General. Communication between the vessel assisting and the vessel being assisted have to be established before any action is taken. This is the key to preventing collisions in the ice.

2. Inter-vessel Communication. Make sure the master of the vessel you are assisting understands exactly how you are going to approach, when to use and not use his engines, and what following distance to maintain. Immediately inform the escorted vessel of any ridge or condition that could slow your progress to prevent a collision.

3. Ensure Compliance. Never assume that the master of the vessel is going to do as you have requested. In the past, masters of vessels have put turns on, when for safety reasons, they have been asked to wait until the assisting vessel was clear. At other times they have run so close on the stern of the escort that collision could not be avoided when the escort became beset. It may take frequent reminders to the master to gain compliance with your wishes. Remember, you are in charge of the operation, but you may find yourself frustrated by a halfhearted effort on the part of the beset vessel to free itself.

4. Constant Contact is Essential. There should always be a visual or sound backup system used with the radio to communicate with the master of the vessel being assisted. This can be used to alert the master that he needs to act to avoid collision with the assisting vessel should it become beset or slowed. Some vessels have yellow or red warning lights aft. Others vessels have blue law-enforcement lights. These should be controlled from the bridge. If lights are not available, a system of whistle signals or signal flags can be used. It is important to use the signal each and every time there is a problem, even if the radio is working. This serves to familiarize the personnel on the assisted vessel with the signal system should the radio fail.

J. Flood Relief Operations.

1. General. Flood relief operations are common during the spring of the year. The Coast Guard assists in these operations when requested by the Army Corps of Engineers or local authorities.

2. Background. Flood relief operations are necessitated by ice jams forming in rivers, stopping or restricting the flow and causing the water to rise above flood stage.

3. Cause of Jams. Jams may be formed when plate ice at the mouth of a river prevents the flushing of broken ice from upstream. Jams can also be caused when the ice on a large body of water breaks up. Then if it is forced, by wind or current, into a constricted waterway, the ice moving under pressure will ground on islands, at bends in the waterway and on shoals. Ice can completely fill a channel from top to bottom, end to end, and render all but the most powerful vessels useless.

4. Debris. When a vessel is involved in flood relief, watch for debris (trees, buoys, refrigerators and even cars) floating on or just under the surface, to avoid damage to the propeller and rudder.

5. Method. Always attack an ice jam from downstream if possible. Ice in a river should be broken sufficiently to allow water pressure to move the ice out of the channel. Working from upstream only adds material to the jam. If a vessel must approach from upstream, the vessel can usually force a passage from upstream to the downstream side without causing a drastic deterioration of the situation. Then the vessel can attack the jam from downstream. Know where the current runs the strongest and concentrate in that area to leverage your efforts. In tidal areas, break on the ebb to increase your effectiveness.

6. Types. Some ice jams can be easily cleared by first breaking the restricting plate below the jam. Then attack the plug directly. Other ice jams are more extensive and will require a concerted effort and several days to remove, especially by tenders.

7. Utilizing Old Track. In some channels with a heavy current large pieces of plate ice can be piled up with the edges up on the downriver side (See **Figure 6-7**). Once a track has been broken it is advisable to make all subsequent transits upriver in a broken track and break new ice headed downstream. Using this method will significantly reduce the amount of backing and ramming required.

8. Procedure. When loosening ice, break from the river's edge to the center, since the outside edges have been grounded on the shoals. This pressure has to be released before the center ice will move. Once the ice starts moving it will be necessary to "groom" the ice edge so new growth does not occur. Without the grooming, ice will ground, starting from shore at each new constriction or bend and work toward the center of the channel, forming a new ice jam. It is best to attack the moving ice edge at a shallow angle from upstream. If not, the vessel may cause an ice stoppage as it turns by forcing the ice toward the edge of the channel.

9. Maneuvering. When an ice jam breaks it is sometimes impossible for a vessel to even maintain station against the mass of moving ice. The best advice is to maneuver the vessel with all power to the center of the channel, with the bow headed upstream. This will give the vessel the best chance to prevent damage until further maneuvers can be executed to extract the vessel from this precarious situation.

10. Transiting. When transiting restricted waterways try not to disturb fast ice, which could drift down current and cause an ice jam. Keep in mind that your wake may break fast ice.

K. AtoN Operations in Ice - General Safety Considerations.

1. General. Some buoy tenders will be required to service buoys in ice conditions.

2. Overview. The manner in which the buoy is worked will depend on variables such as type and thickness of the ice, nearness of shoal water, and speed and direction of ice movement.

3. Conditions. Always try to use ice and wind conditions to your advantage. Never

approach a buoy in ice without maintaining a good plot of the location of both the tender and the buoy. Reference points are often obscured or unreliable because of poor visibility. Distance and speed of advance are more difficult to determine in moving ice.

4. Patience. Never rush an evolution; there are too many accidents that can happen when people are working on a cold slippery buoy deck. If one plan isn't working, it is advisable to stop, allow the crew to warm up, and develop a new plan.

5. Precautions. Precautions should be taken to minimize danger to the crew. Ensure that personnel on deck are adequately clothed and equipped with safety glasses, hard hats, safety shoes and life vests. Sending a person out on the ice should be only a last resort. If you must send someone out, ensure that the person is wearing a survival suit or exposure coveralls, is attached to a life line and carrying a boat hook. The boat hook is used to probe the ice for weak spots, or is carried horizontally to break a fall should the person go through the ice.

6. Remove the Ice. When working a buoy with significant ice growth, always remove as much ice as possible from the buoy before bringing it on deck. Often a buoy in otherwise open water will have a collar of ice at the waterline. Removing this ice while the buoy is outboard of the buoy port allows you to maintain better control of the buoy. It also prevents damage to the main purchase from exceeding the weight limit and reduces the chance of a crewman being injured by falling ice or by slipping on deck.

7. Methods of Ice Removal. Several methods have been tried over the years to remove ice from buoys. Generally any method that causes the buoy hull to vibrate without damaging the buoy or endangering personnel will be effective. The vibration of the metal breaks the ice away from the buoy hull. Blacksmith hammers, sledge hammers, pry bars, and air hammers have all been used effectively. Shotguns with 00 buck shot work well for clearing lifting eyes.

8. Warning. Do not attempt to lift a buoy by the cage. Buoy cages were never designed for lifting a buoy. Keep in mind that there may be several tons of accumulated ice on the buoy. It is not unusual for ice-covered buoys to hang horizontal when lifted out of the water.

L. Working a Buoy in Fast Ice.

1. General. Buoy tending in pancake, skim, or fast ice, less than four inches thick, is the same as buoy tending in open water since buoys in ice of this type are usually visible.

2. Approaching a Buoy in Fast Ice. When working a buoy in fast ice, in excess of four inches, approach the buoy as close as possible. This will prevent ice from getting between the vessel and the buoy and forcing the buoy too far away to be hooked. This may mean setting almost a collision course for the buoy. Use only enough power to bring the buoy abeam the ship at the buoy port. This way you can use the ice to stop your forward movement and maintain station while working the buoy. The buoy may be on its side but still visible above the surface. If the buoy is heavily iced it may be necessary to clear the lifting eye with a shotgun.

3. Locating a Buoy Under the Ice. A buoy that has been forced under the ice can be located by relieving the pressure around the buoy, allowing the buoy to surface. In fast ice it may be necessary to determine what the wind direction was several days before. This will give you an indication of which direction the buoy and chain are led. This minimizes the chance of wrapping a buoy in the screw. Always keep the stern of the vessel well clear of the estimated watch circle. Buoys often leave a trail of broken ice as they force their way to the surface. This trail is very useful in finding buoys that have been dragged from AP. If unable to cut relief tracks due to shoaling, station a person on the forecastle with a marker. If the buoy is driven under during the approach, toss the marker over at the bow. This will give the conning officer an idea of his speed in relation to the ice and help prevent overriding the buoy. Once a buoy has been brought alongside, maneuver the vessel so moving ice is forced around the bow and just clears the buoy. Take care to not get canted so far that the ice sets the ship onto the buoy and mooring. The unequal pressures present in ice make it nearly impossible to keep station with anything other than the bow facing into a moving ice field. A pass by the buoy position may also crack the ice and allow the buoy to surface.

M. Working a Buoy in Moving Ice.

1. General. Because of the deceptive nature of a moving ice field it can present one of the most challenging buoy evolutions. The ice is usually of varying thicknesses and consistencies, which will introduce variable forces to your station keeping problem in the same manner as a gusting wind. The tender can actually be set away, onto, or worse, overshoot the approach on a buoy that has gone under the ice. Since the ice and the tender are constantly moving, if the buoy is forced under the ice it will be almost impossible to gauge the tender's movement or location in relation to the buoy. A natural range works well but may not be available. The best way to approach this situation is to determine the direction the flow is coming from. If there is sufficient sea room for maneuvering, break a track from the buoy into the flow. This way the buoy will surface in a broken track and will be visible during the approach. You will find it necessary to maintain turns in a moving ice field in the same manner as stemming a current. The critical part of the evolution is to lift the buoy hull clear of the ice before the unbroken ice field reaches the buoy. Depending on the ice field's speed of advance and the icing on the lifting eyes, this evolution may have to be repeated several times.

2. Clearing the Lifting Bail and Hoisting the Buoy. Sometimes a boat hook or shotgun with 00 buck will clear the lifting eye. It may even be necessary to swing a small sinker from the main to knock ice loose. In the worst cases it may be necessary to ram the buoy to clear enough ice so you can hook the buoy. This procedure is described in detail later. After the buoy is hooked get the chain into the stopper as fast as possible. Moving ice will break around the chain and you can effectively stem a flow while lifting the sinker. Again, you should always maintain a constant plot of your position in moving ice.

N. Clearing Ice from a Buoy by Ramming.

Heavy ice accumulation may force the tender to remove ice by ramming the buoy with the bow. During the execution of this evolution, use only enough speed to make contact with the buoy. At the time of impact the tender should be backing to prevent overriding or striking the buoy so hard as to cause damage to the cage. Under no circumstances should so much speed be used that the buoy advances past the buoy port. It will be necessary to place a person on the fo'c'sle to call distances and directions for the conning officer. Buoys have a tendency to "walk" away from the bow of a cutter, and course corrections may be necessary. Ramming should be used only to remove ice in excess of 24 inches, because of potential for serious damage to the buoy hull.

O. Towing Buoys in Ice.

It may be necessary to drag the buoy to safer water before attempting further retrieval efforts. Towing a buoy in ice is very dangerous and should be executed only after everyone involved understands the evolution. Towing a buoy away from a shoal because of prevailing ice movement may be necessary to prevent hazard to the vessel. Because of the dangerous nature of this evolution it should be considered only when faced with the possible loss of the buoy hull. It is much cheaper to replace a lost buoy than to replace hull plate.

1. Procedure. Buoys should be towed by a line attached through a lifting eye. The buoy should never be towed while hooked into the main purchase. Instead the line should be passed through the chock forward of the chain stop and attached to the cleat above it. Enough slack should be left in the towline so the buoy can slip into the track left by the vessel as it backs away from the shoal. There may be an initial hesitation if the sinker is well mudded in.

2. Safety. There is great potential for parting the towline on a stubborn mooring. All personnel must be kept well clear of the towline when towing a buoy in ice.

P. Mooring/Unmooring a Vessel in Ice.

1. General. Vessels operating in an ice environment will often have to moor or get away from a slip or dock that is clogged with ice.

2. Getting Underway. Even thin plate ice can prevent a vessel from springing. If so, use a large sinker suspended by the main over the side to break the ice. If there is sufficient room ahead or astern the vessel can be moved forward or aft in the slip so the sinker can be used to break ice the full length of the slip. This will improve the chances of the vessel getting away from the pier easily. In heavier ice moving a sinker from side to side can heel the ship, breaking the ice grip on the ship at the waterline. In a more restricted mooring, alternating turns ahead and astern while shifting the rudder may weaken the ice sufficiently to allow the vessel to get away from the slip. Vessels operating in ice should use the largest size mooring line that can be handled by the ship's personnel for lines 2 and 3.

3. Mooring. When mooring in ice keep in mind how you intend to depart and plan accordingly. You may want to leave a piece of fast ice between the ship and pier to assist you in getting away, or you may want to clear a slip of enough ice to allow you room to maneuver when you depart. Mooring a vessel to a solid pier clogged with ice

can be very frustrating if approached with insufficient speed and angle of approach.

a. One mooring technique in heavy ice is to leave an "ice fender" between the ship and the pier. To accomplish this, make a standard approach but aim the bow at the pier short of the stern's final position. When the vessel is close enough to the pier leave roughly three feet of ice between the vessel and the pier face. Maneuver the vessel parallel to the pier, maintaining the bow angled toward the pier. This can be accomplished with 5 - 10 degrees of rudder. If the bow is allowed to fall off, the size of the ice fender will increase and force the vessel away from the pier. Maintain speed or the ship's head will seek the low pressure area away from the pier allowing the "ice fender's" size to increase. However, there is the possibility of a low pressure area next to the pier that could veer the ship's head toward the pier. The conning officer has to keep this in mind so action can be taken to prevent damage to the vessel. Taking turns off will generally allow the ice to stop the vessel immediately. Since a vessel will always seek the path of least resistance in ice, a vessel getting underway, having approached in the above manner, can merely back out the same track it entered. The ice fender will prevent contact with the pier and the vessel can simply take in all lines and back with the rudder amidships.

b. When mooring in shifting ice, always moor with the bow upstream and canted toward the pier. This will prevent ice from getting between the pier and the vessel.

U.S. Department of Transportation
United States Coast Guard

Commander
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Atlantic Area

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Portsmouth, Va. 23704-5004
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LANTAREAINST 3173.1
13 APRIL 2000

ATLANTIC AREA INSTRUCTION 3173.1

Subj: 87 FOOT COASTAL PATROL BOAT - SMALL BOAT STERN LAUNCH AND RECOVERY PROCEDURES STANDARD DOCTRINE

Ref: (a) Rescue and Survival Manual, COMDTINST M10470.10(Series)
(b) Boat Crew Seamanship Manual, COMDTINST M16114.5 (Series)
(c) Naval Ships Technical Manual 613
(d) Naval Engineering Manual COMDTINST M9000.6 (Series)

1. PURPOSE: This instruction promulgates the "best practices" for the launch and recovery procedures of the small boat for the 87 foot coastal patrol boat. The instruction provides guidelines and specifications of the equipment associated with launch and recovery of the small boat. Procedures for launch and recovery listed in enclosure (1) are considered optimal procedures to use under ideal sea conditions (0-3 feet).

2. ACTION: Commanding Officers and Officers in Charge shall utilize the procedures contained in this instruction as a guideline for the launch and recovery evolution. Commanding Officers and Officers in Charge may deviate from these procedures if conditions are less than optimal. Commanding Officers and Officers in Charge shall ensure that all equipment is aligned with the specifications defined in enclosure (1).

2. DISCUSSION: Enclosure (1) to LANTAREAINST 3173.1 provides a class specific doctrine which defines equipment, manning, embarking and disembarking the small boat and procedures for launch and recovery. The launch and recovery procedures listed in enclosure (1) represent the "best practices" as shared from 87' patrol boats currently operating in Atlantic and Pacific Area.

//s//
T.E.BERNARD
Chief of Staff

Enclosure (1): 87 foot Coast Patrol Boat - Small Boat Stern Launch and Recovery Doctrine

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87' COASTAL PATROL BOAT

BEST PRACTICES FOR

LAUNCH AND RECOVERY OF SMALL BOAT

ENCLOSURE (1) TO

LANTAREAINST 3173.1

COMMANDER (AOFT), USCG ATLANTIC AREA
431 CRAWFORD STREET, PORTSMOUTH, VA 23704
(757)398-6573

INTRODUCTION

1. The following doctrine has been developed to assist the Commanding Officer and Officers in Charge in the safe launch and recovery of the small boat for the 87' coastal patrol boat. This doctrine will also serve as a tool for group ready for operations inspections and for cutter training. It is not the intent of this instruction to dictate the procedures for the launch and recovery of the small boat under all conditions. It is the intent of the proceeding document to accomplish the following:

   - *Establish standards for all equipment* associated with the launch and recovery of the small boat.
   - Establish procedures for the launch and recovery of the small boat under optimal conditions.
   - Establish general safety guidelines for the launch and recovery of the small boat under optimal conditions.
   - Provide a list of factors to consider when assessing and managing risk.

2. The following is an overview of the document.

SECTION	DESCRIPTION	PAGE NO.
I	RIB Specifications	4
II	Standard Equipment	6
III	Launch and Recovery Procedures	13
IV	Safety Precautions	18

SECTION I - RIB SPECIFICATIONS

Purpose

The following specifications are provided for the information of the 87' coastal patrol boat crew.

Manufacturer

Ambar Marine Corporation, Metairie, LA

Specifications

MODEL	AM 550
OVERALL LENGTH	17' 6"
BEAM (MAX)	7'
DRAFT	13"
DISPLACEMENT	Dry – 2400 lbs. Full – 3500 lbs.
PROPULSION	Yanmar Model # 4JH2, I/B Diesel, 100 HP
DRIVE SYSTEM	North American Marine Jet, Model N12Y
MAX CAPACITY	6 Personnel fully outfitted (including coxswain)
SPEED	Max – 28 KTS (3 POB) Cruise – 22 KTS (3 POB)
FREEBOARD HEIGHT	16"
DESIGN SPECIFICATION FOR MAX SEA STATE	5 Feet (See Note)

Note: The design specifications for maximum sea state were loosely defined. Although the boat is designed to operate in a sea state of 5 Feet that does not necessarily mean that it can not operate in seas slightly greater than 5 feet. Even in seas less than 5 feet the CO/OinC must consider all risk factors when deciding whether to launch the small boat. For more discussion on risk assessment and management turn to page 14 of this guide.

SECTION II - STANDARD EQUIPMENT

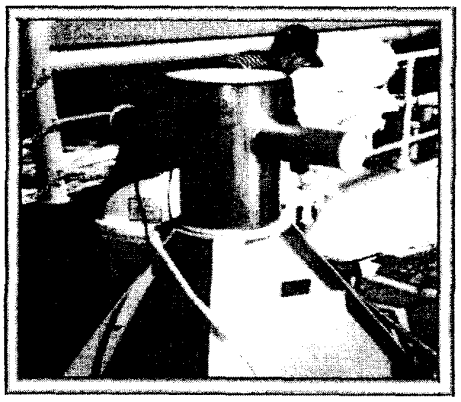
Purpose

The purpose of this section is to define the standard equipment used during the launch and recovery of the RIB. The specifications for the equipment described in this section are the result of lessons learned and shared best practices in the fleet. Cutters should follow the standards set forth in this doctrine to ensure standardization of equipment throughout the fleet.

Deck Equipment

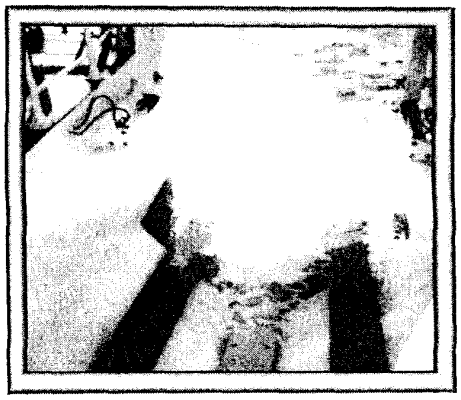
Towing Bit

Located just forward of the notch; can be used to secure the mooring catch line. However, later in this doctrine, best practices suggest that the towing bit should not be used normally for the mooring catch line. The winch control box is located on the starboard side of the towing bit base.



RIB Cradle

The RIB cradle and ramp are built directly into the cutter. The ramp is equipped with ultra-poly skids which reduce friction between the CPB and the RIB during launch and recovery. As the cutter moves through the water, the ramp extends below the waterline to create a seawater pool.



Deck Equipment

Mooring Catch Line

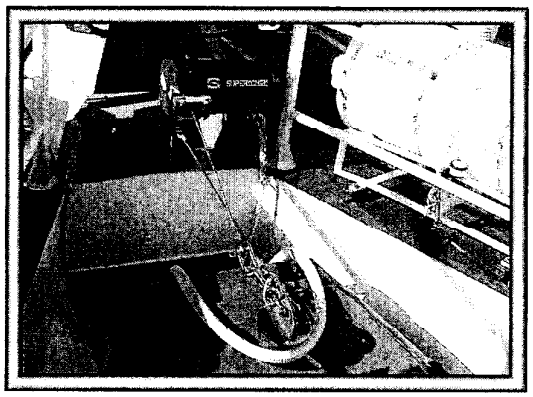
The mooring catch line is used to catch the RIB during the recovery process. Once the small boat has been fully cradled using the winch, and the safety line is secured, the catch line may be removed.

Mooring Catch Line Configuration

Best practices and lessons learned show that the mooring catch line should be secured permanently by mounting two stainless steel pad eyes on either side of the winch base. The mooring catch line can then be shackled to the pad eyes by splicing an eye on each end of the line and running the shackles through that eye and onto the pad eyes. This configuration has two important advantages.

- By not attaching the line to the towing bit the deck personnel do not have to make up the line each time the boat is recovered.
- By mounting and securing the line from a lower starting point the line height is closer to height of the forward bit on the RIB, which minimizes the line bounce during recovery.

Mooring Catch Line Configuration Picture



Mooring Catch Line Size and Type Advantages

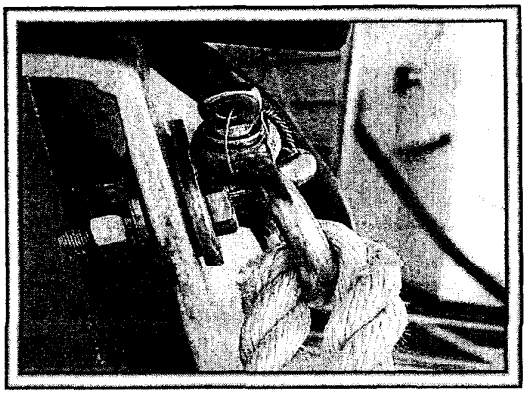
The mooring Catch line should be 12 foot 2 ½" polypropylene line. This line was chosen because it holds several advantages over Nylon three strand or double braided. These advantages are:

- The line is U/V resistant
- Breaking Strength is 8900 lbs. less 10% for splices, SWL is 4000 lbs. which is still twice the required 2000lbs holding strength.
- Easier to replace
- Less expensive
- Resistant to mold and mildew
- Industry standard

Mooring Catch Line Assembly Specifications

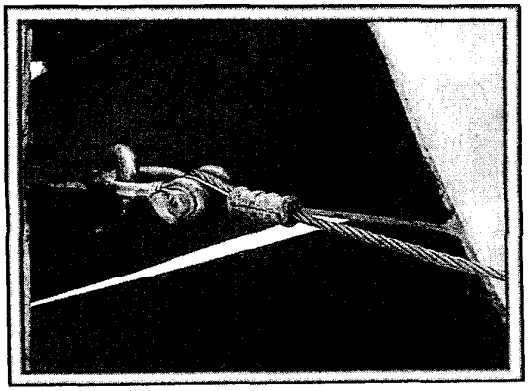
The picture below illustrates how the installed configuration should look with the exception of the line type. The line should be the polypropylene as specified (not the nylon line pictured below).

- Two pad eyes 1 1/8" inside diameter ¾" Thick
- Shackle (attaches to the D-Ring 5/8" inside diameter (ID) 3/8" Thick
- 12 Foot 2 ½" polypropylene line eye spliced at each end with chafing gear (hose) added prior to splicing.



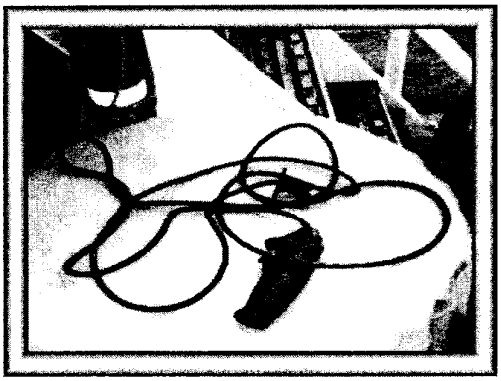
Safety Line

The safety line should be stainless steel cable. The cable should be 1/4" IWRC 6x9 2 ½ feet in length. This provides more than adequate strength at 14,720 lbs. direct pull. The swage fittings must be tested to 40% of the breaking strength of the wire for a duration of 10 minutes before being used. The safety line must be inspected quarterly and visually before each use. The safety line should not be covered in plastic since this will prevent proper care and maintenance and will prevent visual inspection over a period of time.



Winch and Controls

The winch has a 2000 lb. towing capacity and is powered by a ½ HP motor that operates on 12 volts of direct current. The winch is operated by using a hand control (pictured below) that plugs into the winch motor. The winch motor is located directly aft of the towing bit.



Safety Precautions

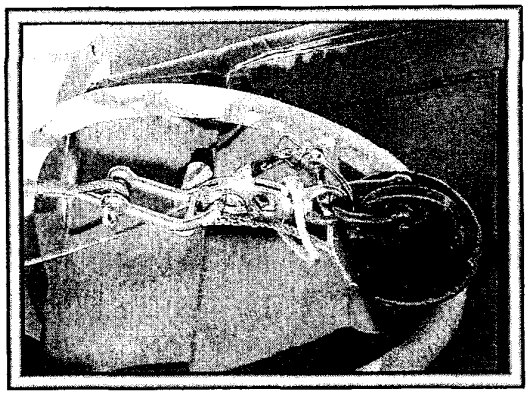
Use the following precautions when operating the winch.

1. Ensure the winch hook is securely fastened on the small boat.
2. Ensure personnel are clear of the winch hook, small boat and forward cradle area as the RIB is brought into position.

Boat Equipment

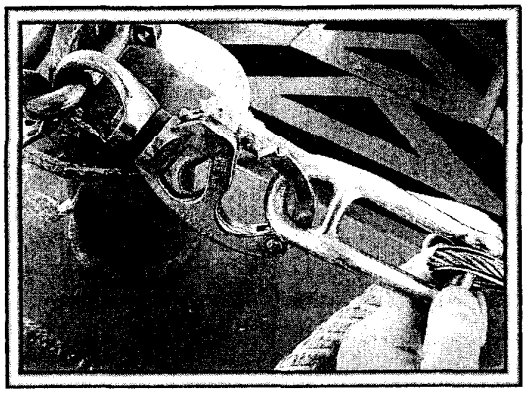
Forward Bit

The securing bit is located on the forward part of the small boat. The safety line and release hook are attached to a stainless steel screw pin shackle which is attached to the top of the bit. The mooring catch line is dropped over this bit during recovery operations.



Release Hook

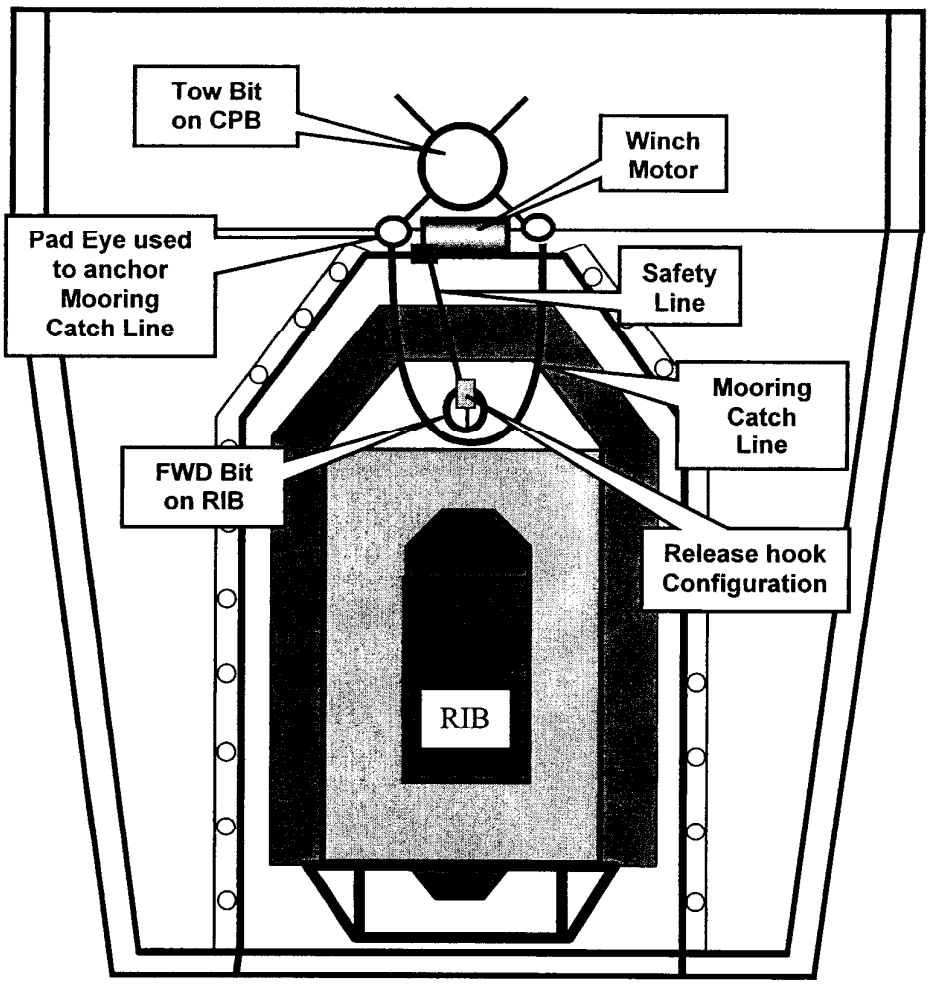
The boat release hook attaches to the stainless steel screw pin shackle attached to the pad eye on top of forward bit. A crew member is able release the boat by pulling on the lanyard attached to the release hook and thus disengaging the hook and the small boat.



Personal Protection Equipment Boat Crew & Deck Crew

The CO/OinC's should refer to references (a) and (b) and existing shipboard policy as to the proper safety and floatation equipment that should be used during launch and recovery operations.

OVERVIEW OF DECK CONFIGURATION AND PRIMARY EQUIPMENT FOR STERN LAUNCH AND RECOVERY SYSTEM



COMPLETE DECK AND BOAT EQUIPMENT SPECIFICATIONS LISTING

CONFIGURATION	EQUIPMENT ITEM DESCRIPTION	SPECIFICATIONS
Mooring Catch Line	Catch Line	12 feet in length, 2 ½" Polypropylene Line eye spliced at both ends fitted with chaffing gear prior to splicing
	Pad Eyes (2)	1 1/8" ID 3/4" Thick, (Bolted to the base of winch).
	Shackles	5/8" ID 3/8" Thick, (Attaches to the D-ring)
Winch Cable Array	Super Snap Shackle	5 ½" Total Length, 1 1/16" ID, 3/8" Thick Bail
	Head Board Shackle	4 ½" Total Length, 15/16" ID, ½" Thick, (remains attached to the winch cable at all times.)
Safety Line	Snap Shackle	4 ½" Total Length1 1/16" ID, ¼" Bail Thickness, ¼" Stainless Steel Cable 2 ½ feet in length, (remains attached to the safety line at all times, and locks into main shackle on forward post).
	Shackle on Tow Bit	3/8" Thick, 5/8" ID
RIB Forward Bit	Shackle on Forward bit	1 1/16" ID, ½" Thick

SECTION III - LAUNCH & RECOVERY PROCEDURES

Overview

These launch and recovery procedures are guidelines for operating under optimal conditions. We recognize that the CO/OinC's may deviate from these procedures given less than optimal conditions. A complete risk assessment must be made prior to every launch and recovery of the 87' small boat. Based on that risk assessment, steps should be taken to manage and minimize the risk that is present. During the operation, it is imperative that CO/OinC's maintain situational awareness and continually reassess the conditions as they may change rapidly.

Cutter Maneuvering

The best course under optimal conditions for launching and recovering the small boat is into swell at 30 - 40 degrees port or starboard of the seas. The cutter should maintain a speed of 3-6 knots in order to maintain a seawater pool in the RIB cradle which is critical for recovery.

Communications

As with any shipboard evolution communications are key to a safe and successful mission. During the pre-mission brief, primary and secondary means of communications must be defined by the command.

Radio Communications

The primary means of radio communications should be a VHF/FM "protected" frequency designated and agreed to between the bridge and coxswain.

Hand Signals

Hand signals should be used to verify the readiness of personnel on the RIB and onboard the cutter to recover the small boat. The use of hand signals may be preferred as a primary or secondary means of communications.

Door Operation

The transom of the cutter is fitted with an aluminum door. When closed, the door protects the RIB and crew from waves. The door is connected to a hydraulic power system which raises and lowers the door. The controls for the door are located on the bridge and on the port rail near the towing bit. The door is normally closed unless the cutter is conducting launch and recovery procedures.

Risk Assessment & Risk Management

The CO/OinC must weigh numerous factors when assessing and managing risk. Each situation is different and specific factors for every possible scenario can not be listed. The following is a listing of some of the factors that CO/OinC and boat personnel should consider. The list below is not all inclusive.

- Sea height and direction
- Wind direction and strength
- Number of POB
- Time of Day
- AOR
- Type of evolution or mission
- Options available other than launching the RIB
- Crew fatigue and stress level
- Crew experience level and qualification status
- Small boat capabilities

Each factor as well as others should be weighed and steps should be taken to manage and minimize risk. The Coast Guard does work in an environment that has a certain amount of inherent risk. Team Coordination principles, when applied, help to reduce the risk that is present, but in most cases will never completely eliminate it. CO/OinC's are encouraged to regularly discuss possible launch and recovery scenarios with key personnel and develop contingency plans accordingly. The consistent use of pre-mission briefings and post-mission debriefings are key to continually improving safety and procedures. Documenting best practices and lessons learned and sharing that information through the chain of command will enable the Coast Guard to continue to improve this doctrine.

Launch Procedures

The following table describes the basic steps for launching the 87' RIB under optimal conditions.

STEP	ACTION
1	Break out and Hook-up Winch Controls
2	Ensure all deck and boat crew personnel are present and wearing proper personal protection (note 1).
3	Brief boat crew, deck personnel and personnel being transported on evolution and mission, answer all questions and solicit input, make risk assessment, take steps to manage and minimize risk, and establish primary and secondary means of communications.
4	Coxswain – requests permission to enter boat
5	Coxswain inspects boat release for safety
6	Boat crew and passengers enter boat.
7	Boat crew conducts final checks with safety observer (note 2)
8	Cutter maneuvers to optimal course for launch.
9	Coxswain – Requests for door to be opened and permission to launch.
10	Cutter grants permission to open the door and release small boat.
11	As door opens and seawater fills the notch, coxswain starts engine (note 3).
12	Designated crewmember pulls lanyard on release hook on command from the coxswain to release the small boat (note 4)

Note 1: Units should refer to the Boat Crew Seamanship manual for a list of proper safety equipment for the boat crew.

Note 2: A deck safety observer should be designated by the command. The deck safety observer is responsible for maintaining situational awareness (big picture) during launch and recovery operations.

Note 3: The amount of water in the notch is not sufficient to cool the engine on the RIB for an extended period of time. The engine should be started as soon as water fills the notch. It will take several seconds for the door to be completely opened, which will allow enough time for the coxswain to ensure the engine is working properly prior to launch.

Note 4: The lanyard on the release hook may be pulled by a person on deck or by a boat crewman. Designating who will pull the lanyard is at the command's discretion. Who ever is responsible for releasing the boat, must not do so until the coxswain has given the command.

Recovery Procedures

The following table describes the basic procedures for recovering the 87' RIB under optimal conditions.

STEP	ACTION
1	Cutter maneuvers to a optimal riding course and a speed of 3 - 6 knots.
2	Recovery crew requests permission from CO/OinC to raise stern door.
3	OOD ensures cutter is on optimal heading and speed and deck crew is ready for recovery
4	Coxswain requests permission to approach the cutter.
5	Cutter opens door and confirms ready to recover the small boat.
6	RIB accelerates into notch.
7	Deck crew drops mooring catch line onto forward bit of RIB.
8	Coxswain secures RIB engine
9	Deck crew hands winch hook to boat crewman
10	Boat crewman attaches winch hook to shackle on forward bit
11	Boat crew and passengers exit RIB.
12	Deck crew winches small boat all the way into notch and attaches safety line.
13	Door is closed
14	Deck crew attaches safety line.
15	Deck crew slacks winch cable
16	Small boat made ready for sea.

Recovery Of a Disabled RIB

This recovery method can only be used in calm water. If weather conditions are not favorable on scene, then the best option is to tow the small boat to sheltered waters prior to recovery.

The basic premise is to work the small boat to the opening of the notch so that you can hand them the winch cable and winch the RIB into the notch. Two ways this may be accomplished are:

- Prepare the deck by running enough winch cable out to reach the opening of the boat well. Have two crew members standing by with 2" alongside lines and make a parallel approach to the small boat. Ensure that the small boats' bow is pointed towards the cutter's stern as you make your approach alongside. Once alongside, pass the two lines down to the small boat and make them up off the stern cleat and the base of the bow post. You can then walk the small boat around the stern to the notch opening. The boat crewman can then retrieve the winch hook and secure it to the forward bit. As the small boat is winched into place, the crew will have to help to continue to line the RIB up with the notch. Once in place, the safety line can be attached and the winch cable slacked.

- The second possible method is to make up a 100 foot polypropylene line with an orange ball (same as a rescue heaving line) at the end. The winch cable is set up as above and the polypropylene line is made up on the tow bit. As the cutter makes a slow 45° approach to the RIB the polypropylene line is fed out the open well and around the stern to either the port or starboard quarter. As the cutter maneuvers to the RIB the OOD brings the cutter to all stop and drifts just forward of the RIB bow. The deck crew throws the line to the boat crew and the boat crew pulls the RIB to the notch. The deck crew then passes the winch cable to the boat crew.

- Units are encouraged to experiment with these two methods and plan for this contingency. The time to try these recovery methods is not when an actual casualty occurs.

Winch Failure

If the cutter experiences a failure of the winch that does not allow the crew to power the boat back up into the well, the use of a 1 ton chain fall has proven successful to get the boat up the notch to attach the safety line. Attach the block to the shackle holding the safety line then work the chain fall from the small boat. This system can also work in a failure of the hydraulics to raise the door.

SECTION IV - SAFETY PRECAUTIONS

General

The following safety precautions should be followed at all times.

1. When embarking and disembarking the small boat, ensure only one person at a time moves forward.
2. While maneuvering the small boat along side another vessel request that the vessel maintains at least five knots forward speed for better steerage. This is done to compensate for the poor slow speed thrust of the jet drive design.
3. Approach for recovery should commence no less that 100 yards behind the cutter.
4. Prior to entry into the notch, the coxswain shall ensure that there is water in the well.
5. Consider the necessity of mission sortie for launching in sea conditions greater than 5 – 6 feet.
6. When evaluating sea state during launch and recovery of the RIB consider the differences between ground swell height and sea wave height. Proper risk assessment must take into account the unique differences associated with swells and waves.

P R 082000Z JUN 01
FM CCGDFIVE PORTSMOUTH VA//A//
TO ALLCOGARDFIVE
INFO COMLANTAREA COGARD PORTSMOUTH VA//AOD/AO/AOLE/AOF/AOSR/ACC//
CCGDONE BOSTON MA//O//
CCGDSEVEN MIAMI FL//O//
CCGDEIGHT NEW ORLEANS LA//O//
CCGDNINE CLEVELAND OH//O//
COMDT COGARD WASHINGTON DC//G-OCU/G-OCS/G-AWP/G-A/G-WKS//
COMCOGARD MLC LANT NORFOLK VA//M/V//
BT
UNCLAS //N03080//
SUBJ: 87 FOOT CUTTER RIB LIMITING RESTRICTIONS IN D5 AOR
1. SITUATION. THERE IS A GROWING BODY OF EVIDENCE THAT THE 87 FOOT CUTTER RIB POSSESSES DESIGN LIMITATIONS THAT MARKEDLY INCREASE RISK FACTORS FOR SAFE OPERATION IN SEAS OVER 4 FEET. WHEN SEA CONDITIONS ARE GREATER THAN 4 FEET, THE RIB IS DIFFICULT TO MANEUVER AT SLOW SPEEDS, VULNERABLE TO CAPSIZING WHEN PASSENGERS SHIFT POSITION AND CHALLENGING TO CONTROL WHILE COMING ALONGSIDE OTHER VESSELS DURING BOARDINGS (ESPECIALLY FISHING VESSELS WITH GEAR DEPLOYED). THE RISK OF CAPSIZING IN THESE SEA CONDITIONS CONCERNS ME MOST.
2. ACTION. UNTIL FURTHER NOTICE, FIFTH DISTRICT 87 FOOT CUTTERS SHALL NOT DEPLOY THEIR RIBS FOR ROUTINE OPERATIONS IN SEAS GREATER THAN 4 FEET. CUTTER CO/OINC'S SHALL CONTINUE TO USE THEIR JUDGMENT FOR RIB DEPLOYMENT DURING SAR. ANY DEVIATION FROM THIS POLICY MUST BE APPROVED BY THE COGNIZANT GROUP COMMANDER AFTER CAREFUL ASSESSMENT OF SEA CONDITIONS, URGENCY OF THE MISSION, COXSWAIN EXPERIENCE/TRAINING AND ANY OTHER RISK FACTORS APPROPRIATE TO THE CIRCUMSTANCES. HOWEVER, UNDER NO CIRCUMSTANCES SHALL THE BOAT BE OPERATED IN CONDITIONS THAT EXCEED SEA STATE 4 (8 FOOT SEAS). CUTTER CO/OINC'S SHALL TRAIN THEIR COXSWAINS AND CREWS TO SAFELY OPERATE THE RIB AT OR NEAR THE ROUTINE LIMITS (4 FOOT SEAS). PROSPECTIVE COXSWAINS SHALL DEMONSTRATE THE ABILITY TO MANEUVER THE RIB AT ALL SPEEDS, MANAGE PASSENGER LOADING AND RECOGNIZE RISK FACTORS WHILE APPROACHING VESSELS FOR BOARDINGS IN ADDITION TO ALL OTHER COXSWAIN QUALIFICATION REQUIREMENTS.
3. QUESTIONS MAY BE ADDRESSED TO LCDR MIKE GERMINARIO AT (757) 398-6266.
BT
NNNN

Craig, Thomas PO

From: Kondratowicz, John LCDR
Sent: Wednesday, October 10, 2001 7:41 PM
To: Backholm, Scott CPO; Beeman, Karl; Craig, Thomas; DeJager, Eric SCPO; DeOliveira, David; Kahle, Michael; Kolstedt, David PO; Labine, Michael; Ryan, Jooyi; Downey, John E. MCPO; McCarthy, David PO; Mills, Edward PO; Pfeifer, Laura PO; Ney, Peter CWO
Subject: FW: R 102330Z OCT 01 COMCOGARDGRU WOODS HOLE MA

ACTION - SDO'S BECOME FAMILIAR W/GROUP POLICY - POST

R 102330Z OCT 01
FM COMCOGARDGRU WOODS HOLE MA
TO USCGC HAMMERHEAD
INFO COMCOGARDGRU SOUTHWEST HARBOR ME
COMCOGARDGRU PORTLAND SOUTH PORTLAND ME
COMCOGARDGRU BOSTON MA
COMCOGARDGRU LONG ISLAND SOUND NEW HAVEN CT
COMCOGARDGRU MORICHES NY
COMCOGARDACT NEW YORK NY
ALGRUWOODSHOLE
CCGDONE BOSTON MA//O/OSR/DCS/CC/OPR/IMT//
COMLANTAREA COGARD PORTSMOUTH VA//AOD/AOFC//
COMDT COGARD WASHINGTON DC//G-OCU/G-OCS/G-AWP/G-WKS//
COMCOGARD MLC LANT NORFOLK VA//M/V//
USCGC CHINOOK
USCGC RIDLEY
USCGC MORAY
BT
UNCLAS E F T O FOUO //N03120//
SUBJ: 87' COASTAL PATROL BOAT(CPB) SMALL BOAT RESTRICTIONS
A. 87' CPB - SMALL BOAT STERN LAUNCH AND RECOVERY PROCEDURES STANDARD DOCTRINE - LANTAREAINST 3173.1 OF 13APR00
B. CCGDONE SAR PLAN - CCGDONEINST M16101.1D OF 24JUL00
C. CG SAR ADDENDUM TO THE NATIONAL SAR MANUAL COMDTINST M16130.2B
D. OPERATIONAL RISK MANAGEMENT COMDTINST M3500.3
1. BACKGROUND.
REF A PROVIDES A GUIDELINE RECOMMENDING THE MAX SEA STATE TO OPERATE THE CPB'S SMALL BOAT IS IN SEAS NOT GREATER THAN 5FT. REF B DOES NOT SPECIFICALLY IDENTIFY THE LIMITATIONS OF THE CPB'S SMALL BOAT, HOWEVER ANNEX A, FIGURE A-10 OUTLINES THE MAX SEAS/WINDS TO OPERATE A 16-22FT RIBM IS 8FT/20KTS. PARA 4.C.2 TABLE 4-2 OF REF C STATES THAT THE CPB'S CAN LAUNCH THE SMALL BOAT IN SEAS UP TO 8FT.
2. SITUATION.
GROUP WOODS HOLE HAS EXPERIENCE TWO CPB SMALL BOAT CAPSIZINGS; DEC 98 AND SEP 01. THERE IS A GROWING BODY OF EVIDENCE THAT THE CPB'S 5.4 METER SMALL BOAT POSSESSES DESIGN LIMITATIONS THAT INCREASE THE RISK FACTORS FOR SAFE OPERATIONS. THE CPB'S SMALL BOAT IS DIFFICULT TO MANEUVER AT SLOW SPEEDS AND VULNERABLE TO CAPSIZING WHEN CREW/PAX SHIFT POSITIONS OR WHILE ALONG SIDE OTHER VSLS.
3. ACTION.
A. UNTIL FURTHER NOTICE, ALL 87' CPB'S UNDER MY OPCON SHALL NOT DEPLOY THEIR SMALL BOATS FOR ROUTINE OPERATIONS IN SEAS GREATER THAN FOUR FT OR WINDS IN EXCESS OF TWENTY KTS. UNDER NO CIRCUMSTANCES SHALL CPB SMALL BOATS BE OPERATED IN SEAS GREATER THAN EIGHT FEET AND WINDS IN EXCESS OF TWENTY KTS. CPB SMALL BOATS SHALL NOT BE LAUNCHED IN SEAS GREATER THAN FOUR FT EXCEPT FOR CASES INVOLVING PROBABLE LOSS OF LIFE, IN WHICH CASE PRIOR GROUP COMMANDER APPROVAL IS REQUIRED. IN THE EVENT COMMUNICATIONS AND/OR EMERGENT SITUATION PRECLUDES PRIOR GROUP COMMANDER APPROVAL, I EXPECT CO'S/OIC'S TO USE THEIR JUDGEMENT AND NOTIFY GROUP OPCEN AT EARLIEST OPPORTUNITY.
B. AS A SAFETY MEASURE, A FENDER SHALL BE CARRIED AT ALL TIMES IN THE SMALL BOAT. THIS WILL BE USED AS ON SCENE CONDITIONS WARRANT DURING EVOLUTIONS WHICH REQUIRE COMING ALONGSIDE ANOTHER VSL.
C. CO'S/OIC'S SHALL TRAIN THEIR COXSWAINS AND CREWS TO SAFELY OPERATE THE SMALL BOAT AT OR NEAR THE ROUTINE OPERATIONAL LIMITS (FOUR FT SEAS AND WINDS LESS THAN TWENTY KTS).

D. THE EVOLUTIONS OF LAUNCH AND RECOVERY OF A SMALL BOAT AND BOARDING FROM A SMALL BOAT AT SEA HAVE SIGNIFICANT ASSOCIATED RISKS. THIS IS NO MORE EVIDENT THAN ON OUR MINIMALLY CREWED PATROL BOATS WHERE MOST EVOLUTIONS REQUIRE ALL HANDS AND EVERY POSITION IS CRITICAL. IT IS REQUIRED AND IMPERATIVE THAT CO'S/OIC'S THOROUGHLY APPLY THE PRINCIPLES OF TEAM COORD TRNG (TCT) TO INCLUDE MISSION ANALYSIS, RISK ASSESSMENT, AND EFFECTIVE COMMUNICATIONS TO HELP ENSURE SAFE AND EFFECTIVE MISSION ACCOMPLISHMENT. CO'S/OIC'S SHALL CONDUCT A COMPREHENSIVE RISK ASSESSMENT IAW REF D OF THE SEA CONDITIONS/WX, URGENCY OF THE MISSION, RISK VS GAIN, COXSWAIN EXPERIENCE/TRAINING, CREW FATIGUE, TIME OF DAY/VISIBILITY AND ANY OTHER RISK FACTORS APPROPRIATE TO THE CIRCUMSTANCES.
E. ANY DEVIATION FROM THIS POLICY MUST BE APPROVED BY THE GROUP COMMANDER.
4. CAPT J. F. MURRAY SENDS
BT
NNNN

ATLANTIC AREA FORCE TRAINING SECTION (AOFT)

REV: 11/01

SUBJECT

Special and Emergency Operations and Procedures (SEOPS) Training

EXECUTIVE SUMMARY

SEOPS is the Commandant approved and required training and qualification system for all cutters 175' and below. Change 4 to the Cutter Training and Qualification Manual COMDTINST M3502.4E recognizes SEOPS as the equivalent to Navy DC PQS for sections 301 - 307. The SEOPS Training manual LANT/PACAREAINST 3502.1(Series) explains the program requirements in detail. The SEOPS Training teams visit cutters every 18-24 months for Atlantic Area cutters and every 12-18 months for PACAREA cutters. Training requests are submitted by the Districts to Aoft. The SEOPS Training Team visit is five days in length with two of those days underway.

PROGRAM OVERVIEW

SEOPS consists of three primary parts:

- Standard Doctrine
- Training and Qualification System
- SEOPS Training Team Visit

STANDARD DOCTRINE

There are currently standard machinery space firefighting doctrines (MSFD) available for all classes of cutter with the exception of WLR and WLIC. Aoft is currently drafting doctrine for the two remaining classes and a copy of these drafts are available upon request. Cutters are required to comply with their standard MSFD. Individual unit MSFDs will be reviewed during the SEOPS Training team visit.

Standard Navigation practices doctrine LANTAREAINST 3530.2 (Series), is published and provides the minimum navigational practices for each class of cutter. PACAREA is awaiting approval of COMDT's revised navigation standards.

Standard Drill Performance Check Sheets are available for most required drills. SEOPS cutters are required to use these sheets when conducting shipboard drills.

TRAINING AND QUALIFICATION SYSTEM

The SEOPS Training and Qualification System consists of 10 Learning Reference Guides (LRG's) and a Student Guide (LANT/PACAREAINST 3502.2(Series)). The cutter Training Officer/Petty Officer is required to enroll each crewmember in the SEOPS program upon their arrival to the cutter. Incoming crewmembers who are already Navy DC PQS qualified must also enroll and complete all NON-DC/FF sections. Enrolled crewmembers should qualify completely within 6 months. SEOPS is a self-paced study system but does require the practice of certain tasks under qualified supervision.

SEOPS TRAINING TEAM VISIT

Nominations for training are submitted to Aoft by each cutter's District approximately 4 months prior to the scheduled quarter. Procedures for receiving a nomination within each district vary. Four to six weeks prior to the training team visit the cutter will receive a pre-arrival letter explaining the visit, classroom requirements, and a standard schedule. One to two weeks prior to the visit, the Team Leader will contact the cutter to discuss the visit and address any concerns the cutter may have.

TRAINING TEAM PHILOSOPHY

The SEOPS Training Teams strive to provide the cutter with the best possible training. Our philosophy is to mentor the cutter OBTT, provide classroom instruction, practical exercises and provide expert feedback on drill performance that will assist the cutter in improving their training and qualification program. We are not an inspection team, but because cutter performance can be tied to doctrine compliance and how well the SEOPS training system is implemented we do provide feedback on both. The SEOPS Training Team will be open, flexible and objective. We welcome recommendations for program improvements and implore the field to provide detailed feedback.

SEOPS SUPPLIES

Supplies of SEOPS instructions and materials can be requested by phone or e-mail directly from our office. Some materials are also available currently on our web site listed below.

LANTAREA SEOPS POINTS OF CONTACT

Questions of comments can be directed to any of the following:

- CDR M. E. Mooney, Section Chief, (757)398-6649
- LT K. M. Niles, Assistant Section Chief, (757)398-6491
- Mr. G. H. Brooks, Training Specialist, (757)398-6573

Visit our Web Site at: http://cgweb.lant.uscg.mil/lantarea/aoft

SEOPS DISTRICT POC'S		
DISTRICT	**NAME**	**PHONE NO.**
1st District (opr)	LTJG Fredrick DeTar	(617) 223-8150
5th District (ole)	LT Willie Carmichael	(757) 398-6662
7th District (ole)	LTJG Chad Cooper	(305) 415-6784
8th District (osr)	CWO Tom Chenoweth	(504) 589-6228
9th District (oan)	LTJG Teresa Wall	(216) 902-6066
PACAREA TRATEAM	LCDR Dave Crowley	(510) 437-3295

Pacific Area Training Team

S.E.O.P.S.

Topic Syllabus

1. **Rescue Survival Systems (3.0 hours)**
   Overview: A familiarization with the personal flotation devices, hypothermia protective clothing, survival gear, pyrotechnics and liferafts in use on CG cutters. Liferaft launching, abandon ship procedures and psychological factors are also discussed. In water exercises are conducted using an 8 person liferaft supplied by the Training Team.
   Designed for: All hands
2. **CPR Familiarization (4.0 hours)**
   Overview: Students discuss the basic physiology of breathing and circulation, cause of absent breathing/ circulation, obstructed airway management, initial response and adult CPR. Students practice on various CPR mannequins. **This class does not result in student CPR certification.**
   Designed for: All hands
3. **First Aid (6.0 - 8.0 hours)**
   Overview: This class is an overview of basic "first responder" first aid techniques for non-EMT personnel. Decision making, initial and secondary surveys (Patient Assessment), familiarity with the cutter's supplies and equipment and victim transportation are stressed. Multiple casualty drill will be introduced to address various injuries. **The unit is to provide expendable first aid equipment.**
   Designed for: All hands
4. **Casualty Control for Engineers (4.0 hours)**
   Overview: This class covers symptoms, causes and immediate corrective actions for operational engine room casualties.
   Designed for: FNs, MK3s, MK2s
5. **Casualty Control for Non-Engineers (4.0 hours)**
   Overview: This class covers engine room familiarization and emphasizes generator casualties and immediate corrective action. When requested, students will practice lighting off and securing the generators.
   Designed for: Non-rated engineers, deck and operations division
6. **Fire Fighting - Shipboard (4.0 hours)**
   Overview: A classroom discussion of fire science, extinguishing agents and firefighting equipment is followed by a practical exercise in extinguishing a class "B" with fire extinguishers and a walk-through drill in a smoke filled compartment using live OBA canisters. **The unit is to provide OBA canisters.**
   Designed for: All hands
7. **Shoring (4.0 hours)**
   Overview: Students in this class will discuss tools and equipment used for shoring, shoring terms, and the different types of shoring structures. Practical application will consist of constructing any one of the different types of shoring or combining 2 or more types together. The latter method enhances training by avoiding complacency students could exhibit due to space familiarity. **The unit is to provide shoring materials.**
   Designed for: All hands
8. **Vessel Dewatering (4.0 hours)**
   Overview: This class covers investigation of a vessel taking on water, patching and plugging techniques, along with proper pump operations. Students will discuss and demonstrate the use of plugs, wedges, and various pipe patches. In the pump section of the class, students learn safety procedures, proper storage, and operation of the P-250 MOD 1 pump along with either the CGP-1B or the CGP-5 pump (whichever one the unit has aboard), the PERI-JET, NAVY 4" EDUCTORS, AKRON BRASS MOD 521 WATER SIPHON, and associated equipment. In the practical portion of this class, students will use equipment and techniques previously discussed to dewater a training drill boat which is taking on water (supplied either by the cutter's fire main,
   P-250, or from a source located at the mooring facility). **The unit is to provide plugging and patching materials.**
   Designed for: All hands

9. **Main Space Fire (4.0 hours)**
   Overview: This exercise tests the unit's fire fighting capabilities with a simulated main space casualty. During a "fast cruise" conducted pierside, the engine room will be filled with "smoke" at the command's request and personnel will respond with live OBA canisters. **The unit is to provide OBA canisters.**
   Designed for: All hands
10. **Rescue and Assistance Drill (2.0-3.0 hours)**
   Overview: This drill will utilize the Trateam Drill Boat in an underway SAR case scenario. This unit will respond to the emergency which could entail fire, flooding, and rendering first aid to the victim(s). Unit will be required to tow the drill boat to the exercise area. Proper notification will need to be made to the local Police and Fire Departments as well as the Group or District OpCen.
   Designed for: All hands
11. **Navigation (4.0 hours)**
   Overview: This course is designed with the navigation detail personnel in mind. Instruction includes chart symbology interpretation, computing set and drift, and corrections needed to regain an intended track.
   Designed for: OODs, QMs, BMs
12. **Coastal Search and Rescue (4.0 hours)**
   Overview: This course is tailored for the SRU level. It includes fundamentals such as determining total drift vector, initial search patterns and reporting procedures. It also includes executing a Search Action Plan (SAP). This course involves a practical exercise.
   Designed for: OODs, QMs, BMs
13. **Rules of the Road (3.0 hours)**
   Overview: A basic and broad overview of the rules of the road in plain language covering both Inland and International rules.
   Designed for: OODs, QMs, BMs
14. **Rapid Radar Plotting (4.0 hours)**
   Overview: An explanation of plotting principles and tools. Included are classroom exercises in CPA, course and speed, intercept, and avoidance. Rules of the road decision making will come into play during the course of instruction.
   Designed for: OODs, QMs, BMs

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FM COMPACAREA COGARD ALAMEDA CA//PO//
TO CCGDELEVEN ALAMEDA CA//O/OLE//
CCGDFOURTEEN HONOLULU HI//O/OSR//
CCGDTHIRTEEN SEATTLE WA//O/OLE//
CCGDSEVENTEEN JUNEAU AK//O/OLE//
COGARD TRATEAM PAC ALAMEDA CA
INFO PACISLCLASS
USCGC DORADO
USCGC BLACKFIN
USCGC BARRACUDA
USCGC BLACKTIP
USCGC HAWKSBILL
USCGC LONG ISLAND
USCGC TYBEE
USCGC EDISTO
USCGC NARWHAL
USCGC CUTTYHUNK
USCGC ORCAS
USCGC OSPREY
USCGC ADELIE
USCGC GALVESTON ISLAND
USCGC KISKA
USCGC ASSATEAGUE
USCGC WASHINGTON
USCGC KITTIWAKE
USCGC LIBERTY
USCGC ANACAPA
USCGC MUSTANG
USCGC ROANOKE ISLAND
USCGC NAUSHON
COMLANTAREA COGARD PORTSMOUTH VA//AO/AOFT//
COMDT COGARD WASHINGTON DC//G-OCU/G-OCS//
BT
UNCLAS //N03501//
SUBJ: READY FOR OPERATIONS (RFO) ASSESSMENTS FOR 110' AND 87' PATROL BOATS IN PACIFIC AREA
A. PACIFIC AREA INSTRUCTION 3501
1. FULLY MISSION CAPABLE PATROL BOATS AND FULLY QUALIFIED CREWS ARE AT THE FOUNDATION OF OUR ABILITY TO SAFELY CONDUCT CORE COAST GUARD MISSIONS, AND THE SUPERVISORY RESPONSIBILITY FOR OUR 110' & 87' PATROL BOATS IS CLEARLY ESTABLISHED AT THE GRU/ACT/DISTRICT LEVEL. HOWEVER, DIRECTIVES REGARDING PATROL BOAT READINESS ARE EITHER NON-EXISTENT OR ARE GREATLY DISPERSED THROUGH A NUMBER OF DOCUMENTS, RESULTING IN DUPLICATION OF EFFORT AND INCONSISTENCY THROUGHOUT PAC AREA.
2. A WORKGROUP WAS FORMED IN SPRING 2001 TO DEVELOP A STANDARDIZED PATROL BOAT RFO PROGRAM FOR PACAREA. THE WORKGROUP CONSISTED OF MEMBERS REPRESENTING ALL PACAREA DISTRICTS, SEVERAL OPERATIONAL COMMANDERS, AND REPS FROM 110' AND 87' PB'S. THE WORKGROUP'S EFFORTS RESULTED IN REFERENCE (A), WHICH OUTLINES RFO ASSESSMENT PRACTICES AND REQUIREMENTS THROUGHOUT AREA. THE PRIMARY FOCUS OF THIS DOCUMENT IS TO IMPROVE THE CONSISTENCY AND OBJECTIVITY OF THESE EVENTS, AND TO ELIMINATE REDUNDANT DEVELOPMENT OF ASSESSMENTS BY EACH OPERATIONAL COMMANDER.
3. REFERENCE (A) CAN BE DOWNLOADED FROM THE PACAREA TRATEAM INTRANET WEBSITE:http://cgweb.pacarea.uscg.mil/PACAREATRATEAM/documents/pacarea INST 3501.pdf. UNITS UNABLE TO DOWNLOAD DUE TO CONNECTIVITY PROBLEMS

SHOULD CONTACT THEIR OPERATIONAL COMMANDER OR PACAREA TRAINING TEAM FOR A PAPER COPY.

4. DISTRICT COMMANDERS, GROUP AND ACTIVITY COMMANDERS, AND PATROL BOAT COMMANDING OFFICERS AND OFFICERS IN CHARGE SHALL REVIEW AND ENSURE COMPLIANCE WITH REF (A).

5. POC'S: TRATEAM- LCDR D. CROWLEY, 510-437-3295, AREA (POFT)- CDR J. BILLY, 510-437-3505.

BT

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APPENDIX C

AN/SPS-73 QUICK REFERENCE GUIDE

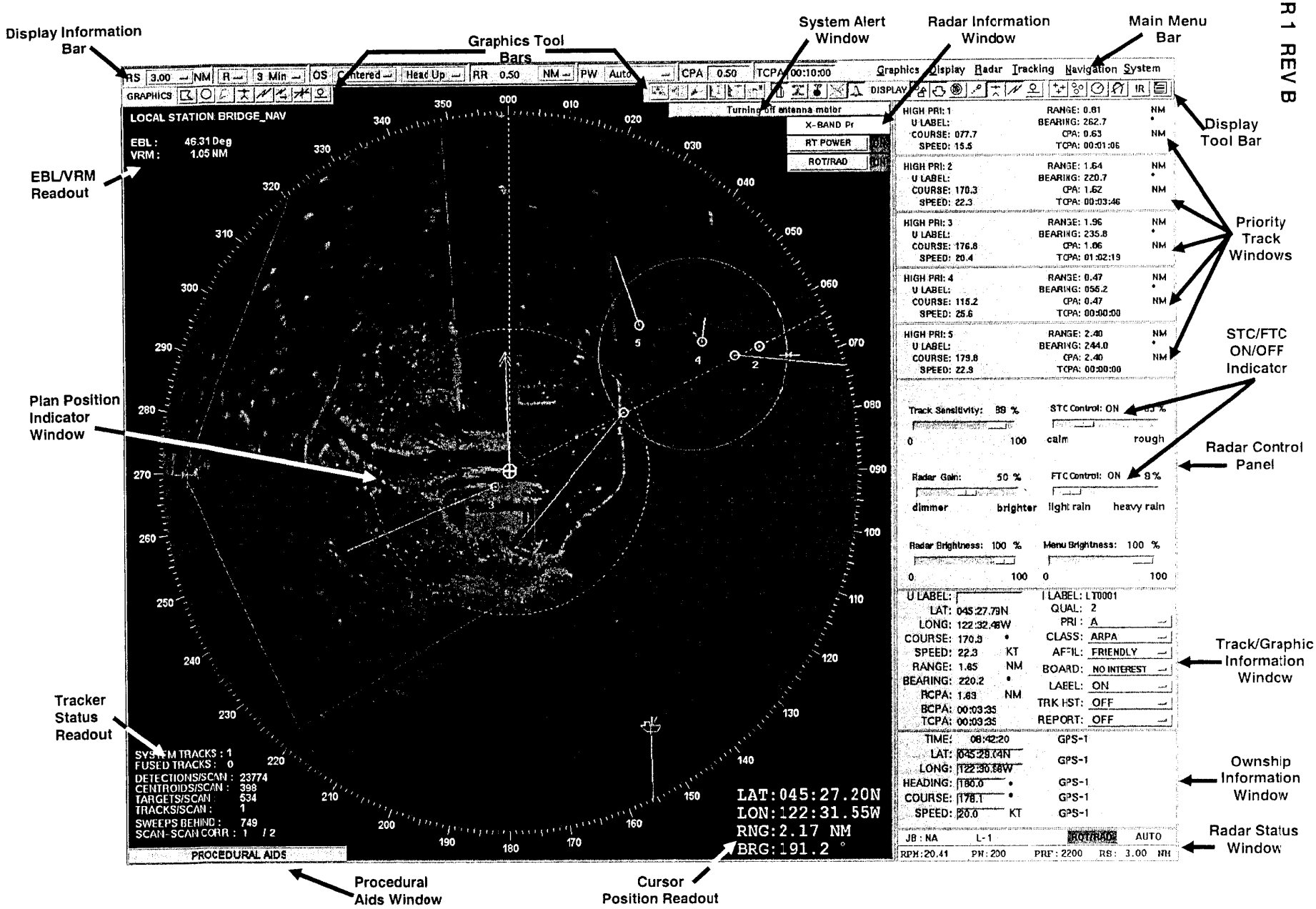
AN/SPS-73 KEYS	OPERATION
HOT KEYS	
Ctrl A	Acquire track
Ctrl D	Drop Object (e.g., Acquisition Area or Track)
Ctrl P	POSCOR Track
Ctrl R	Reposition Object
Ctrl B	Silence Alarm
Up Arrow	Transitions up in scale when cursor is over video area
Down Arrow	Transitions down in scale when cursor is over video area
H	Turns off Heading Marker while pressed
FUNCTION KEYS	
F1	CRT contrast down
F2	CRT contrast up
F3	CRT brightness down
F4	CRT brightness up
F5	Radar area brightness down
F6	Radar area brightness up
F7	Menu brightness down
F8	Menu brightness up
F9	Decrements through six color schemes
F10	Increments through six color schemes
WINDOW NAVIGATION	
Alt Tab	Navigates to the next window family
Alt Shift Tab	Navigates to the previous window family
NAVIGATION AND SELECTION IN MENUS	
Space	Displays an option menu
Up Arrow	Navigates up within a menu
Down Arrow	Navigates down within a menu
Left Arrow	Navigates left within a menu bar or menu
Right Arrow	Navigates right within a menu bar or menu
Enter or Space	Selects a menu title or menu option
NAVIGATION WITHIN WINDOWS	
Ctrl Tab	Navigates to the next tab group
Tab	Navigates to the next tab group except in multiline text
Ctrl Shift Tab	Navigates to the previous tab group
Shift Tab	Navigates to the previous tab group except in multiline text
Up Arrow	Navigates up one increment (e.g. one line)
Down Arrow	Navigates down one increment
Left Arrow	Navigates left one increment
Right Arrow	Navigates right one increment
Page Up	Navigates up one page in the Note Pad
Page Down	Navigates down one page in the Note Pad
SELECTION	
Alt Underlined letter	Selects menu of underlined letter (e.g. Radar)
Enter or Space	Selects an element in a collection except in text
TEXT ENTRY	
Delete	Deletes one character to the right
Backspace	Deletes one character to the left

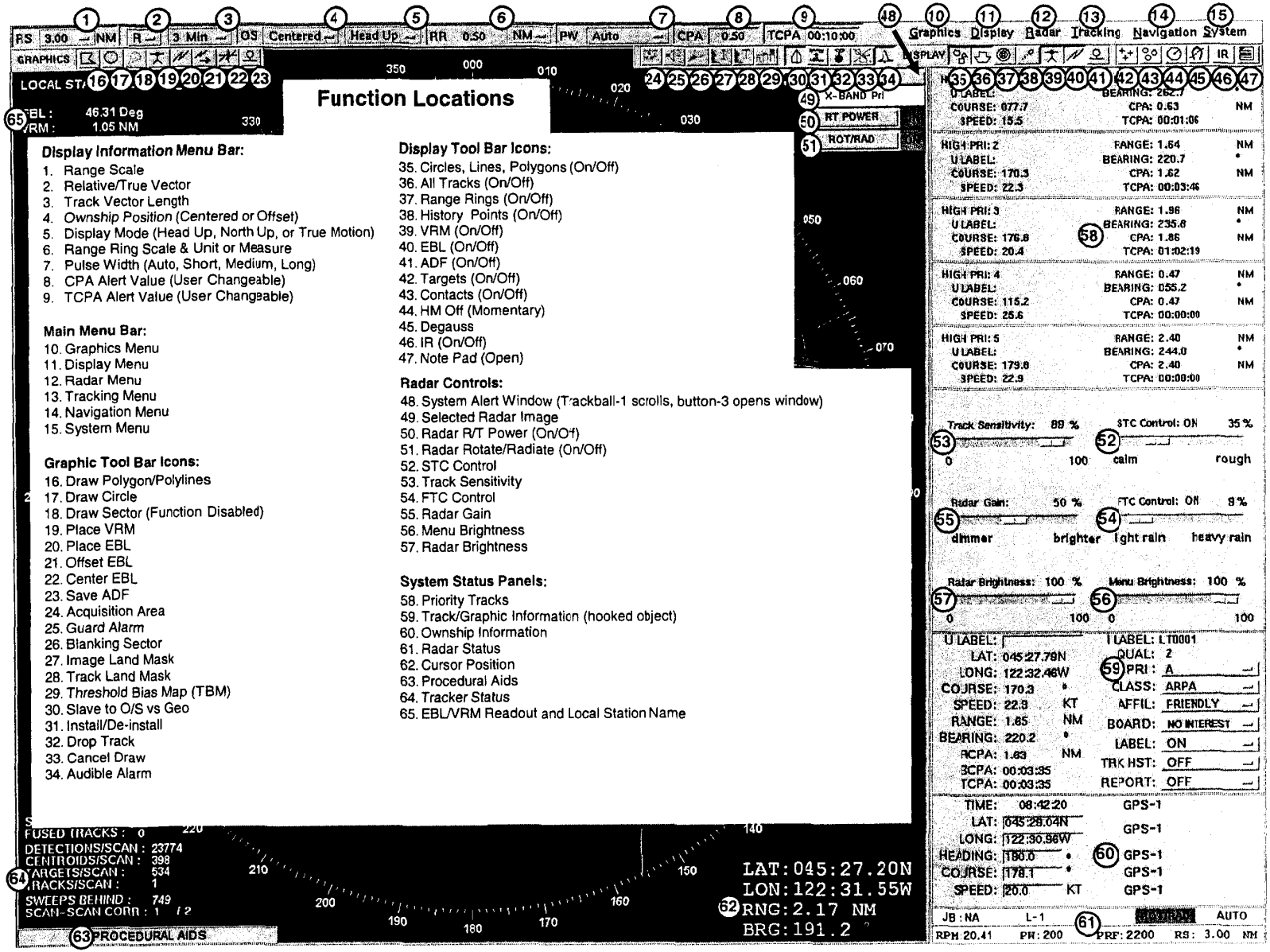
AN/SPS-73 KEYS	OPERATION
Space	Inserts a space
Enter	In multiline text, inserts a new line
Tab	In multiline text, inserts a tab or moves to the next tab stop
Insert	Toggles between replace and insert mode

SHIP SPECIFIC SYSTEM CONFIGURATION	
FIELD	**VALUE**
Fore-Aft Position	Meters
Athwartship Position	Meters
Antenna Height	Meters
Azimuth Reference Pulse (ARP) Adjust	Degrees
Azimuth Bias	Degrees
Blank 1 Start	Degrees
Blank 1 End	Degrees
Blank 2 Start	Degrees
Blank 2 End	Degrees
Trigger Delay	nsec

AN/SPS-73

QUICK REFERENCE GUIDE




Function Locations
Display Information Menu Bar:
1. Range Scale
2. Relative/True Vector
3. Track Vector Length
4. Ownship Position (Centered or Offset)
5. Display Mode (Head Up, North Up, or True Motion)
6. Range Ring Scale & Unit or Measure
7. Pulse Width (Auto, Short, Medium, Long)
8. CPA Alert Value (User Changeable)
9. TCPA Alert Value (User Changeable)
Main Menu Bar:
10. Graphics Menu
11. Display Menu
12. Radar Menu
13. Tracking Menu
14. Navigation Menu
15. System Menu
Graphic Tool Bar Icons:
16. Draw Polygon/Polylines
17. Draw Circle
18. Draw Sector (Function Disabled)
19. Place VRM
20. Place EBL
21. Offset EBL
22. Center EBL
23. Save ADF
24. Acquisition Area
25. Guard Alarm
26. Blanking Sector
27. Image Land Mask
28. Track Land Mask
29. Threshold Bias Map (TBM)
30. Slave to O/S vs Geo
31. Install/De-install
32. Drop Track
33. Cancel Draw
34. Audible Alarm
Display Tool Bar Icons:
35. Circles, Lines, Polygons (On/Off)
36. All Tracks (On/Off)
37. Range Rings (On/Off)
38. History Points (On/Off)
39. VRM (On/Off)
40. EBL (On/Off)
41. ADF (On/Off)
42. Targets (On/Off)
43. Contacts (On/Off)
44. HM Off (Momentary)
45. Degauss
46. IR (On/Off)
47. Note Pad (Open)
Radar Controls:
48. System Alert Window (Trackball-1 scrolls, button-3 opens window)
49. Selected Radar Image
50. Radar R/T Power (On/Off)
51. Radar Rotate/Radiate (On/Off)
52. STC Control
53. Track Sensitivity
54. FTC Control
55. Radar Gain
56. Menu Brightness
57. Radar Brightness
System Status Panels:
58. Priority Tracks
59. Track/Graphic Information (hooked object)
60. Ownship Information
61. Radar Status
62. Cursor Position
63. Procedural Aids
64. Tracker Status
65. EBL/VRM Readout and Local Station Name
Graphics
Display
Radar
Tracking
Navigation
System
LAT:045:27.20N
LON:122:31.55W
RNG:2.17 NM
BRG:191.2
PROCEDURAL AIDS

AN/SPS-73

QUICK REFERENCE GUIDE

DRAWING GRAPHICS

1. **Draw Polygon.**
   a. Click trackball button-3.
   b. Click Draw Polygon/Polyline icon.
   c. Roll the trackball to position the pointer at the desired origin (first point) of the polygon/polyline.
   d. Click trackball button-1
   e. Roll the trackball to position the pointer at the desired location of the next polygon/polyline point.
   f. Click trackball button-1.
   g. Repeat steps e and f until the polygon/polyline is completely drawn.

2. **Draw Circle.**
   a. Click trackball button-3.
   b. Click Draw Circle icon.
   c. Roll the trackball to the desired position of center of circle.
   d. Click trackball button-1.
   e. Use trackball to expand/contract the radius of the circle.
   f. When the circle is the desired size, click trackball button-1.

3. **Place Variable Range Marker (VRM)**
   a. Click trackball button-3.
   b. Click Place VRM icon.
   c. Roll the trackball to position the pointer at the point where the VRM will be drawn.
   d. Click trackball button-1.

4. **Place Electronic Bearing Line (EBL)**
   a. Click trackball button-3.
   b. Click Place EBL icon.
   c. Roll the trackball to position the pointer at the point through which the EBL will be drawn. Centered EBL is the default.
   d. Click trackball button-1.

5. **Move Graphic**
   a. Hook Graphic Object to be moved.
   b. Position pointer to desired position.
   c. Click trackball button-2.

TRACKING FUNCTIONS

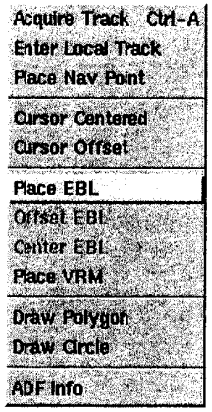
1. **Manually Acquire Track**
   a. Click trackball button-3.
   b. Click Acquire Track (Ctrl-A).
   c. Position pointer over target video.
   d. Click trackball button-1.

2. **Dropping a Track**
   a. To drop a single track:
   b. Hook desired track by clicking trackball button-1.
   c. Click trackball button-3.
   d. Click Drop Object (Ctrl-D).

<u>To drop all tracks:</u>

   a. In the Main Menu bar, click Tracking.
   b. Click Drop All Tracks.
   c. A confirmation Dropping All Tracks pop-up window is displayed.
   d. Click OK.

3. **Making an Auto Acquisition Area**
   a. Click Slave to O/S vs. Geo button to desired position.
   b. Click trackball button-3 (with nothing hooked).
   c. Draw Circle or Draw Polygon (refer to procedures under DRAWING GRAPHICS).
   d. Click Acquisition Area icon to activate.



Trackball Button-3 Non-Hooked Pop-Up Menu

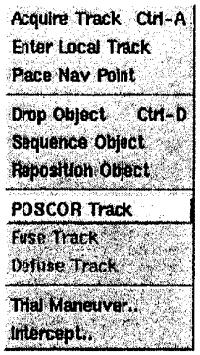
4. **Making a Guard Zone**
   a. Click Slave to O/S vs. Geo button to desired position.
   b. Click trackball button-3 (with nothing hooked).
   c. Draw Circle or Draw Polygon (refer to procedures under DRAWING GRAPHICS).
   d. Click Guard Alarm icon to activate.

5. **Repositioning a Track**
   a. Hook desired track by clicking trackball button-1.
   b. Position pointer to desired position.
   c. Enter hot keys Ctrl-R.

NOTE: Repositioning a Track may also be accomplished using the trackball button-3 Hooked Pop-up Menu.

6. **Correlate a Track Position (POSCOR)**
   a. Hook desired track by clicking trackball button-1.
   b. Position pointer to desired position.
   c. Enter hot keys Ctrl-P.

NOTE: Correlating a Track Position may also be accomplished using trackball button-3 Hooked Pop-up Menu.



Trackball Button-3 Hooked Pop-Up Menu

NAVIGATION FUNCTIONS

1. **Calculate a Trial Maneuver**
   a. Hook desired track by clicking trackball bu 1.
   b. Click trackball button-3.
   c. Click Trial Maneuver.
   d. Enter Course and Speed in window.
   e. Read results in window.
   f. See results on PPI.

2. **Calculate a Projected Intercept**
   a. Hook desired track by clicking trackball bu 1.
   b. Click trackball button-3.
   c. Click Intercept Track.
   d. Select either Speed or Time in window.
   e. Enter Standoff Distance and Speedtime in window.
   f. Read results in window.
   g. See results on PPI.

3. **Place a Navpoint**
   a. Click trackball button-3.
   b. Click Place Nav Point.
   c. Roll the trackball to position where Nav Point is to be placed.
   d. Click trackball button-1. Observe circled orange triangle with dot in middle appears (circle indicates item is hooked).

POWER UP

1. On the front of the SAOP console, turn the following switches to ON:

   POWER

   RADAR POWER ENABLE

   ANTENNA ROTATE ENABLE

   NOTE

   After power is applied, it takes approximately 80 seconds for the power-up to be completed and the operational display to become visible on the monitor. DO NOT perform any actions until the operational display appears on the CRT. Disregard any "no signal" message appearing on the CRT unless it persists for more than 80 seconds.

2. After the operational display appears (approx. 70-90 seconds), complete the following steps:

   a. At the end of the 180-second timeout, click ROT/RAD button.

      1) Verify an image (radar return) is visible on the Operational Display. On the Radar Control Panel, adjust for optimum display.

3. When power is removed from the SAOP, heading reference is lost. To enter initial heading, complete the following steps:

   a. In the Main Menu bar, click Navigation.
   b. Click Heading Init.
   c. Enter Initial Heading in Heading Initialization pop-up window.
   d. Click OK.

SHUTDOWN AND POWER OFF

1. Click ROT/RAD to OFF position and RT POWER OFF. An RT Power pop-up window is displayed.
2. Click OK.
3. In the Main Menu bar, click System.
4. Click Shutdown. A Shutdown confirmation window is displayed.
5. Click OK. The operational display is blanked and the shutdown message is displayed.
6. When shutdown message screen disappears, turn the following switches to OFF:

   RADAR POWER ENABLE

   ANTENNA ROTATE ENABLE

   POWER

FILE RETRIEVAL/STORAGE

1. **Opening Graphics Files.**
   a. In the Main Menu bar, click Graphics.
   b. Click Open. A Select A File pop-up window is displayed.
   c. Select the desired file and click OK.
2. **Saving Graphics Files.**
   a. In the Main Menu bar, click Graphics.
   b. Click Save.

   Or

   a. In the Main Menu bar, click Graphics.
   b. Click Save As. A Select A File pop-up window is displayed.
   c. Enter a file name in the Files text field with a file type of .grp and click OK.

OPERATOR ALERTS

Alert Indication	Type*	Description	Corrective Action
AGC ADJUST RVF SCALER	P	AGC processing is not receiving any centroids (a possible lockup condition).	Notify maintenance (password protected).
Antenna motor failed	S	Antenna motor enabled, but no ACP/ARP (rotation) detected within last 20 seconds.	Notify maintenance.
Antenna motor power not sensed	S	Rotate enabled but no antenna power output signal detected.	Notify maintenance.
Antenna Rotate control failure	S	No motor power output detected for the last 30 seconds.	Notify maintenance.
Autotune could not find peak	S	Autotune not working properly.	Toggle ROT/RAD. If persistent, notify maintenance.
Cannot fuse parked track: Pri = <track ID> Sec = <track ID>	I	Parked tracks cannot be fused.	
Cannot fuse tracks: Pri = <track ID> Sec = <track ID>	P	Tracks labels, classifications, or affiliations are different	Re-label fused track.
Cannot Open NSIU Port /tyCo/<port>	S	Unable to open specified serial port for reading data. Loss of ownship Gyro and Speed log data.	Notify maintenance.
Course data restored	I	Course data restored.	
Drop system track <track ID>	I	Track outside maximum range of 96 nm.	
Dropping system track, bad time	S	Dropping system track, time delta is too big. Time does not agree on all OPs.	Notify maintenance (password protected).
ERROR magnetron not warmed up!	S	Radiating before magnetron warmed up. This can be caused by software or hardware error.	Reboot SAOP. If persistent, notify maintenance.
Heading data restored	I	Heading data restored.	
Interlock open / Radar Power switch	S	No 115 VAC input to power supply. An interlock switch was activated or there is a SAOP control signal failure.	Notify maintenance.
Lost course data	S	NSIU has lost interface to course data.	Check input Gyro sensor is turned on and no barrel switches are off external to equipment. If persistent, notify maintenance.
Lost heading data	S	NSIU has lost interface to heading data.	Check input heading sensor is turned on and no barrel switches are off external to equipment. If persistent, notify maintenance.
Lost positional data	S	NSIU has lost interface to positional data.	Check input positional sensor is turned on and no barrel switches are off external to equipment. If persistent, notify maintenance.
Lost speed data	S	NSIU has lost interface to speed data.	Check input speed sensor is turned on and no barrel switches are off external to equipment. If persistent, notify maintenance.
Lost time data	S	Primary time source has been lost. Automatically goes to secondary selection.	Notify maintenance.
Lost water speed data	S	NSIU has lost interface to water speed data.	Check input speed log sensor is turned on and no barrel switches are off external to equipment. If persistent, notify maintenance.
Magnetron heater outputs not active	S	Magnetron heater outputs not active after R/T Power enabled for 10 seconds.	Check RADAR POWER ENABLE switch on Power Control Panel. If persistent, notify maintenance.
Navigation Point <track label> Dropped	P	Navigation point is greater than 25000 NM from ownship.	Either a GPS input error or operator entered data error.
NMEA Output Exceeds Limit	I	NMEA Output Exceeds Limit (20 Tracks).	
No +/-12 Volts output to radar	S	RT power enabled but □12 volts output to radar not present.	Check RADAR POWER ENABLE switch on Power Control Panel. If persistent, notify maintenance.
No MagHtr output to radar	S	115VAC into power supply but no MagHtr out.	Notify maintenance.
No TxHv being output to radar	S	No TxHv being output to radar. 115 VAC into power supply, but no TxHV out.	Notify maintenance.
NSIU device <device name> (/tyCo/<port>) is back on-line	I	Detected data again from the NSIU device.	

Alert Indication	Type*	Description	Corrective Action
NSIU device <device name> (/tyCo/<port>) is down	S	Timed-out on receiving data from the NSIU device. Serial port failure.	Check input sensor is turned on and no barrel switches are off external to equipment. If persistent, notify maintenance.
NSIU device <device name> (/tyCo/<port>) is UP	I	Detected first-time data from the NSIU device. Input sensor has been turned on for the first time.	
OP (Station Name) has gone down	S	Sensed a console failure. Its OP heartbeats are no longer detected.	Reboot lost CPU. If persistent, notify maintenance.
OP (Station Name) is up	I	OP is up.	
OP Radar Controller timeout	S	No 1-HZ ICC comm heartbeats for 3 minutes.	Reboot lost CPU. If persistent, notify maintenance.
Parked track <track ID>	I	Track is parked (diamond-shaped symbol).	POSCOR, reposition, or drop track.
Positional data restored	I	Positional data restored.	
Radar duty cycle error	P	Under manual mode of operation, operator entered a combination of pulse width and PRF that is not allowed due to possible damage to radar equipment.	Notify maintenance (password protected).
Radar Safety Switch activated	S	Radar safety switch activated.	Notify maintenance.
RDE Initialization Failed – Reboot SAOP	S	RDE Initialization failed.	Reboot. If persistent, notify maintenance.
Reached Maximum ID Links	I	Auto or manual fusion cannot be performed.Max no. of links exceeded.	
RP (Station Name) has gone down	S	Sensed a console failure. RP heartbeats are no longer detected.	Reboot lost SAOP. If persistent, notify maintenance.
RP (Station Name) is up	I	RP is up.	
RT Power enabled but no RT Power	S	RT power enabled but no R/T power.	Notify maintenance.
SAOP failure to apply magnetron power	S	SAOP failure to apply magnetron power to MagHtr output(s) after 2 minutes.	Notify maintenance.
Sensor Track Capacity Exceeded!	P	Number of detected sensor tracks has exceeded radar processor tracker capacity.	Delete tracks and possibly lower track sensitivity control.
Set Antenna Rotate Enable switch to OFF	I	Set the ANTENNA ROTATE ENABLE switch to OFF.	
Speed data restored	I	Speed data restored.	
System Track <track ID>	I	Sensor source has lost track and ceased reporting.	Try to manually acquire missing radar's sensor track and manually fuse. If cannot manually re-acquire, no operator action req'd.
System track capacity exceeded	P	Maximum system track capacity has been exceeded.	Recommend manual drop of non-important tracks. If persistent, notify maintenance.
SysTrk=<track ID>, SensTrk=<track ID>	P	Fusion metric exceeds threshold.	Recommend defuse.
THERE ARE NO ALERTS	I	Displayed when there are no alerts to view.	
Time data restored	I	Time data restored.	
TRK <track label> APPROACHING CPA/TCPA	P	A track is approaching the CPA/TCPA settings.	Check track course to avoid possible collision with ownship.
TRK <track label> HAS ENTERED THE GUARD ZONE	P	A track has been detected entering a guard zone.	
TRK <track label> HAS LEFT THE GUARD ZONE	P	A track has been detected leaving a guard zone.	
Turning off antenna motor	I	No ACP/ARP for 30 seconds.	

TYPE*

I – indicates informational type alert.
P - indicates potential problem, operator action required.
S – indicates serious problem, possible maintenance action required.

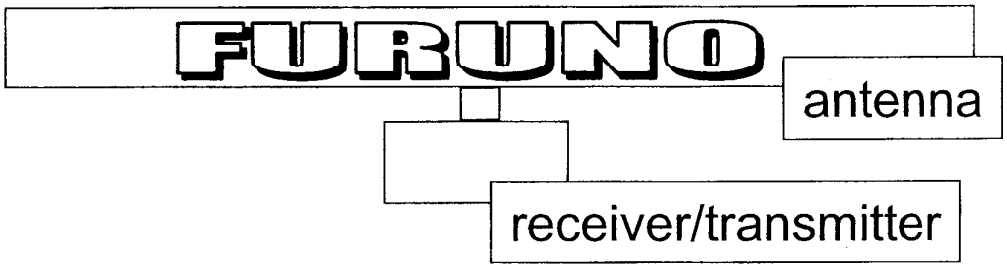
INTRODUCTION

The Hardware & Configuration

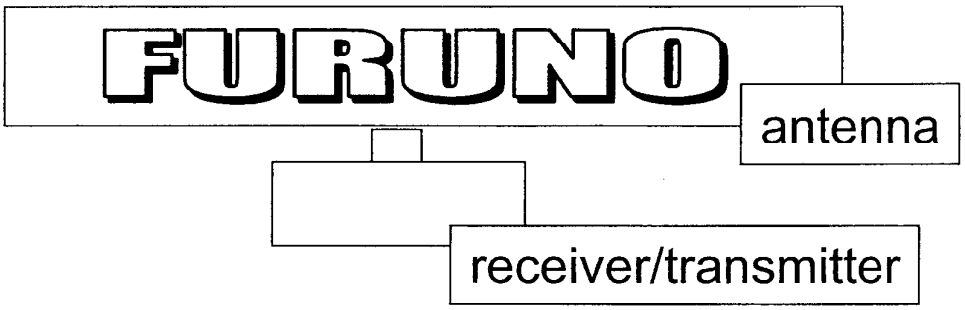
- Components and their functions
- Cutter configuration
- Primary, Secondary, and Tertiary radar control
- Selecting a radar input

ANTENNA

X-BAND RADAR
Requires 115VAC



S-BAND RADAR
Requires 440VAC and 115VAC



210' Configuration includes 2 X-band antennas

270' and 378' Configurations include 1 X-band and 1 S-band antenna

RECEIVER/ TRANSMITTER (RT)

The receiver/transmitter has three basic functions.

First it creates a pulse fitting the characteristics assigned by the primary operator.

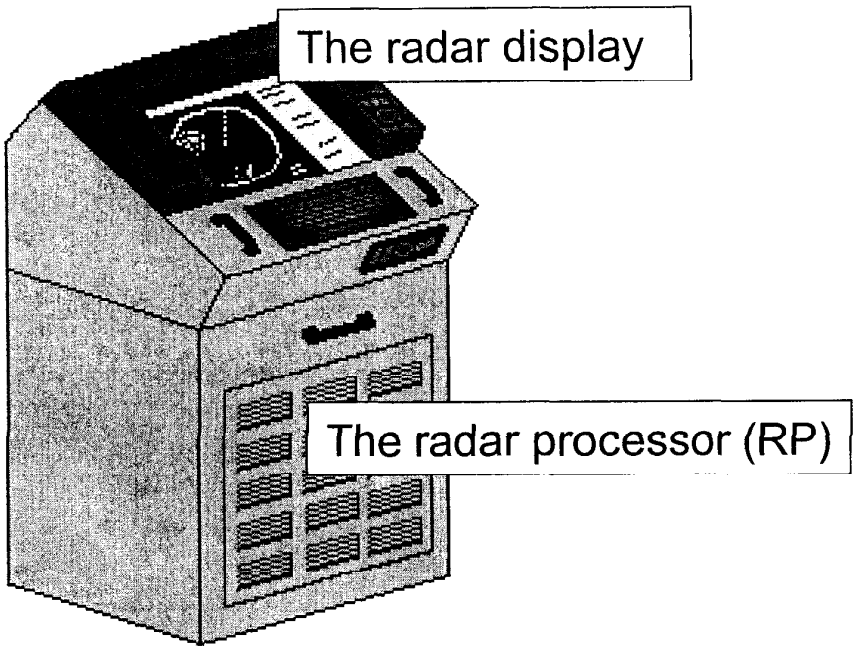
Second it transmits that pulse through the antenna.

Last it receives the pulse that has been reflected back and sends that signal to the Radar Processor (RP).

THE SAOP

Stand **A**lone **O**perator **P**osition

The SAOP is made up of two parts.



RADAR PROCESSOR (RP)

The radar processor takes the information from the receiver (RT) and turns it into video for the display.

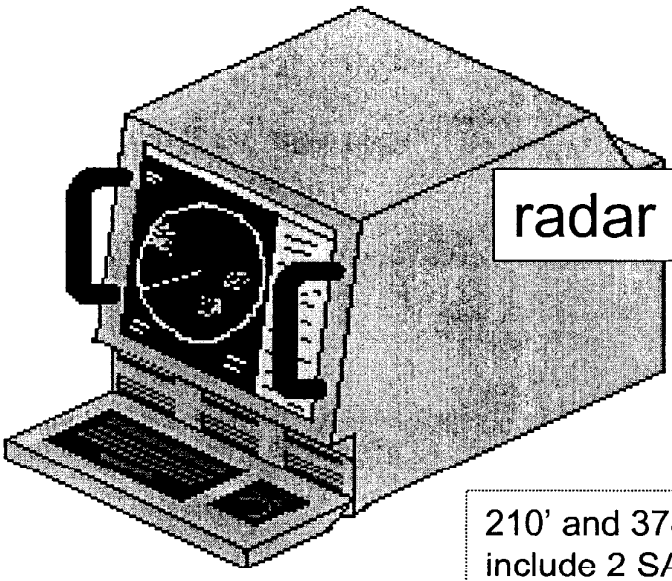
The processor can be assigned to process information from any receiver (RT)., if your configuration has more than one.

TBOPs do not have radar processors.

Even though the radar processor is physically located in this SAOP it can be controlled through the network by any other SAOP or TBOP.

THE TBOP

Tabletop **O**perator **P**osition



radar display only

210' and 378' Configurations include 2 SAOP's and 1 TBOP

270' Configuration includes 2 SAOP's

DISPLAY

The display takes information from the radar processor and presents it for the operator on the monitor.

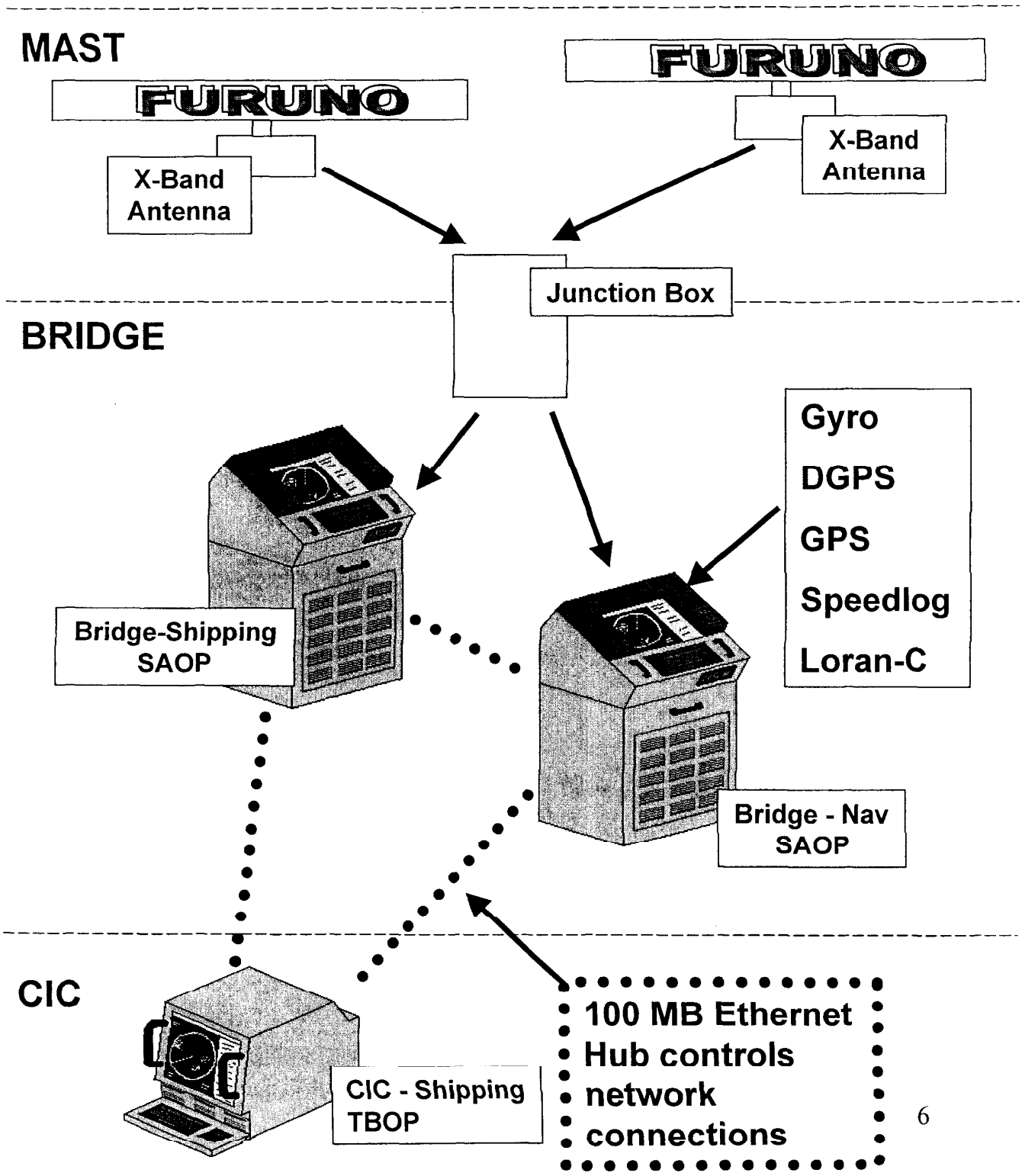
Both SAOP and TBOP have displays.

Display can present any video selected by the operator.

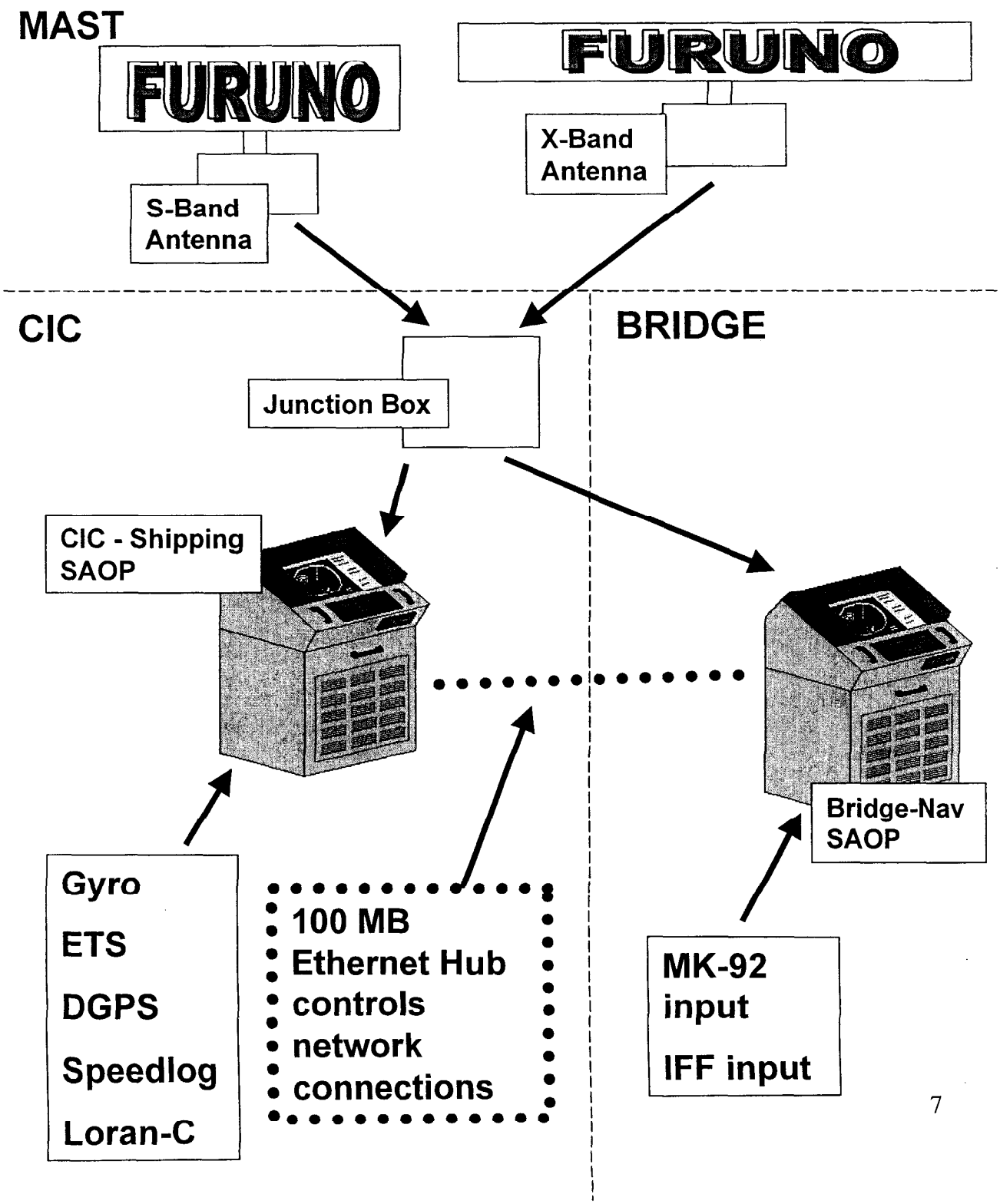
THE RADAR NETWORK

- This radar connects all SAOP's and TBOP's using a 100 MB network. The radar network also connects all radars to the SCCS network.
- The network hub is located in CIC.
- All the consoles share information through the network on system tracks.
- The network allows the radars to be set up in many different configurations. For example the TBOP has no Radar Processor (RP), however, through the network the TBOP can take control of an RP physically located inside a SAOP on the bridge.
- The MASTER console can exist at any console. Master indicates the master of the network. This console controls which operator positions will have which capabilities. (see pg. 9-11 for more on Primary, Secondary, and Tertiary controls)

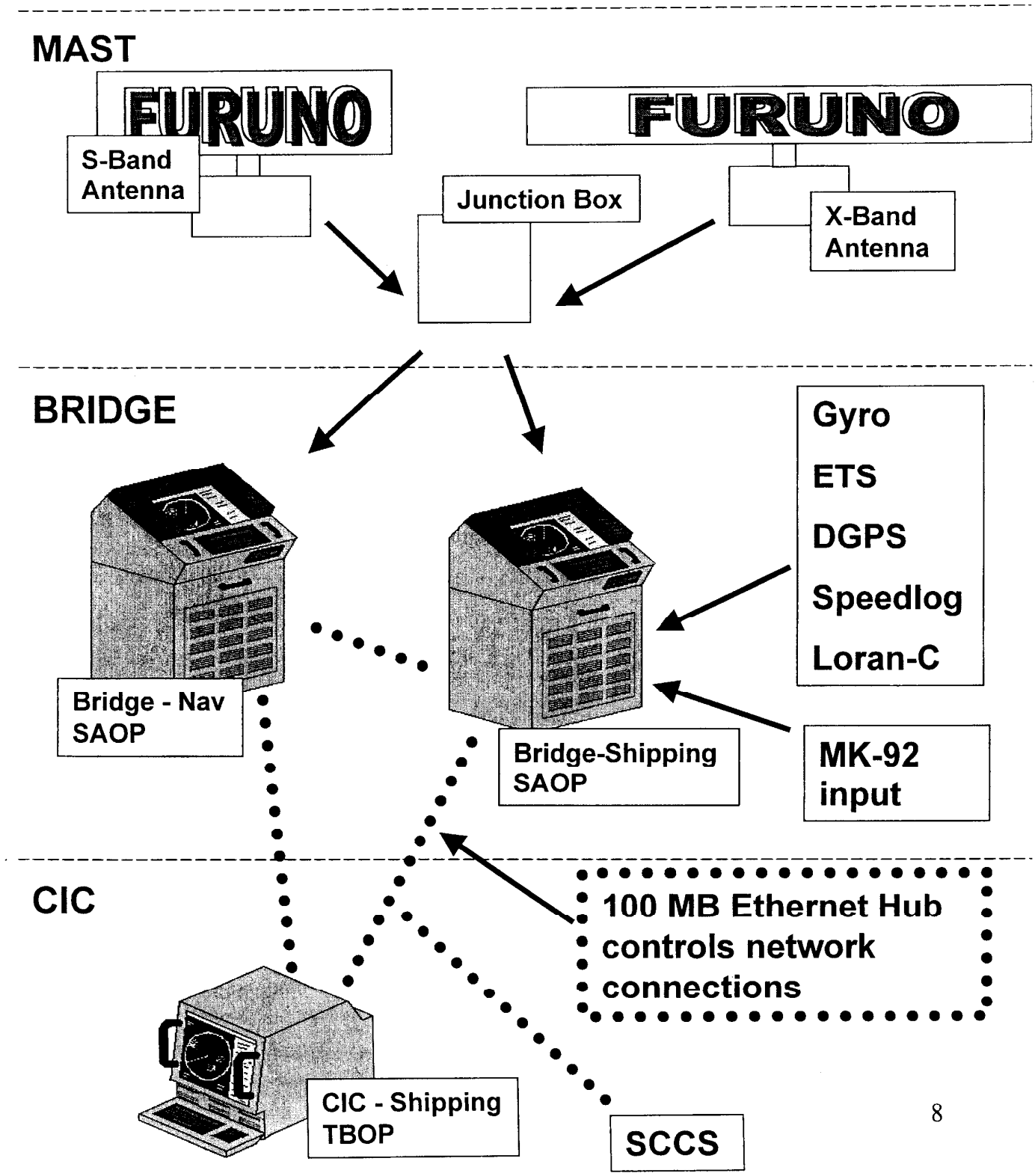
210' CONFIGURATION



270' RADAR CONFIGURATION



378' CONFIGURATION

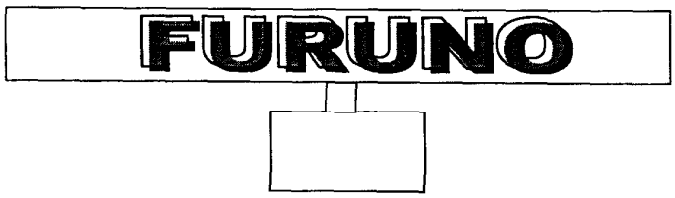


PRIMARY, SECONDARY, & TERTIARY

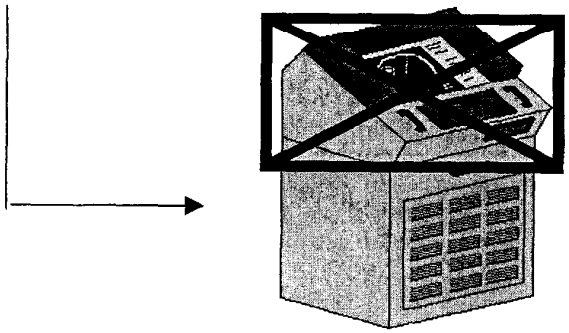
Primary, Secondary, and Tertiary are terms used to indicate the console's level of access to radar functions. Each radar antenna can have only one Primary console and one Secondary console, these responsibilities are assigned by the Master console. All consoles can use tertiary video.

PRIMARY CONSOLE (L1)

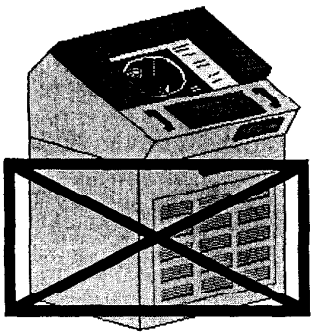
The primary console is the only console that can control the Receiver/Transmitter (RT) or the antenna.

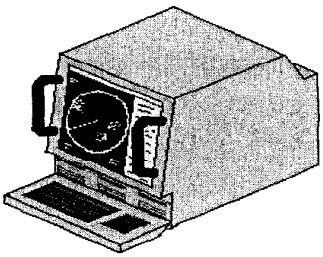


The primary console shares control of the Radar Processor (RP).



Primary has full control over its display

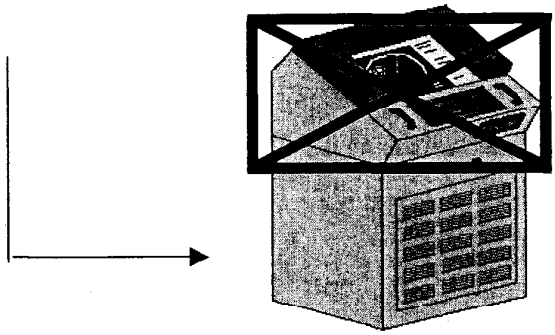




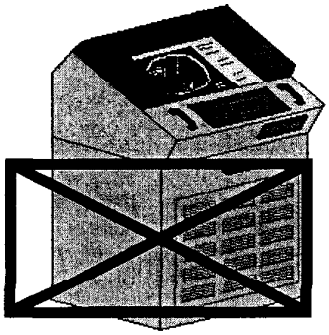
SECONDARY CONSOLE (L2)

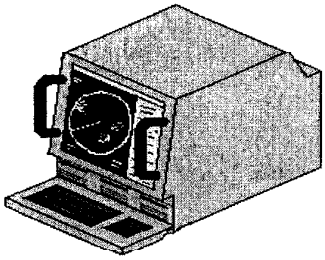
The secondary console can NOT control the Receiver/Transmitter (RT) or the antenna.

The secondary console shares control of the Radar Processor (RP).



Secondary has full control over its display





The console assigned as Secondary will not be able to adjust…

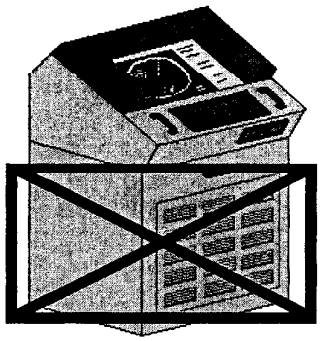
- Pulse Width/PRF
- Track Sensitivity
- Anti-Clutter Sea (STC)
- Anti-Clutter Rain (FTC)

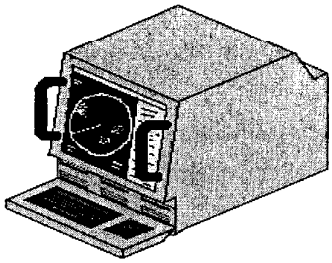
TERTIARY CONSOLE (L3)

The tertiary console can NOT control the Receiver/Transmitter (RT) or the antenna.

The tertiary console can NOT control the Radar Processor (RP).

Tertiary has full control over its display only.

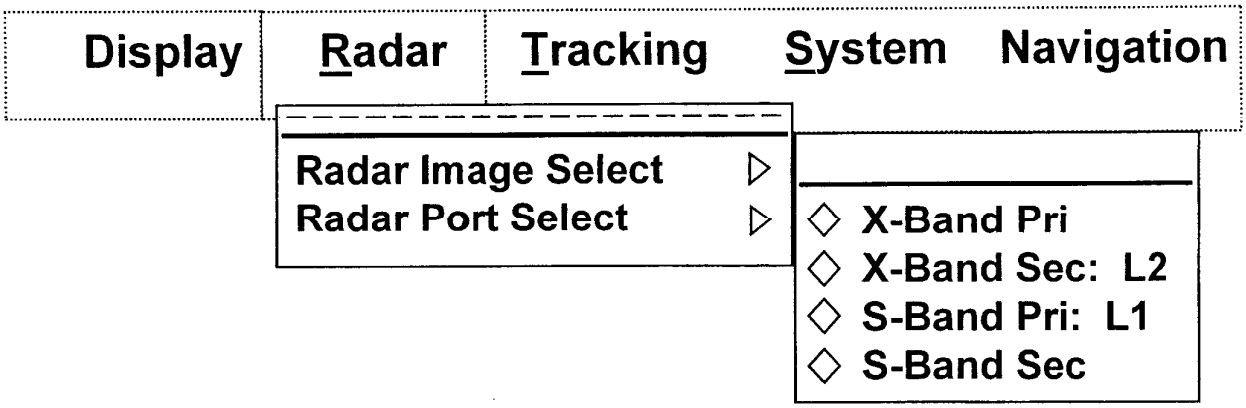




The console assigned as Tertiary will not be able to adjust...

- Pulse Width/PRF
- Track Sensitivity
- Anti-Clutter Sea (STC)
- Anti-Clutter Rain (FTC)
- Image Gain
- Range Scale
- Orientation
- Offset

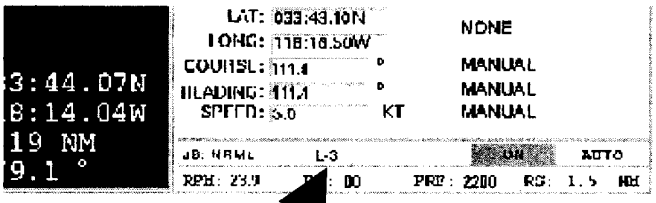
SELECTING A RADAR INPUT



To select a radar input select **RADAR** pull down menu and **RADAR IMAGE SELECT** cascade menu. The options available will be displayed in black text. Select an image.

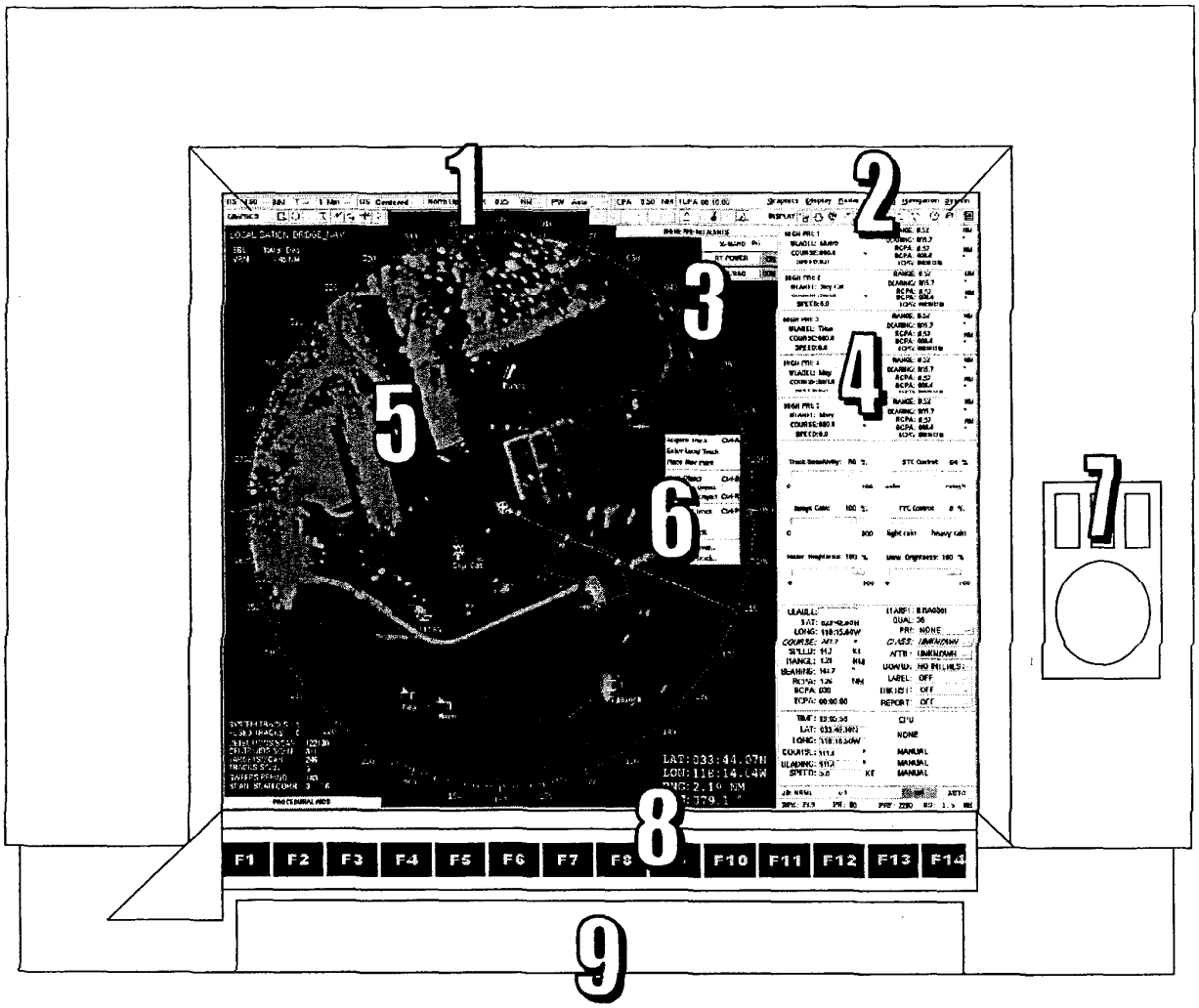
REMEMBER: All radars installed on your vessel will be available on the menu in both Primary and Secondary modes. A console with primary control will have L1 written after the name of the radar, if the console has secondary control L2 will be written there. If the operator selects a radar, primary or secondary, that has not been assigned to their console, the operator will be looking at tertiary video. The Image Select menu pictured above will indicate the operator is viewing the video normally but the status window shown below will reflect the actual radar type being viewed.

See pg 9-11 for more information on the capabilities of Primary, Secondary, and Tertiary video



L-3 (Level Three) indicates Tertiary Video is currently displayed even though the image select window above shows X-band Primary is selected.

MENU LOCATIONS



1. Top Menu Bar
2. Pull down Menus
3. Radar Status Window
4. Radar Menu
5. Radar Screen
6. Right Pop-up Menu
7. Trackball
8. Function Keys
9. Keyboard

SECTION ONE

Radar Control

- Energize the radar
- Adjust display for various sea, weather, and tactical conditions

TURN ON PROCEDURES

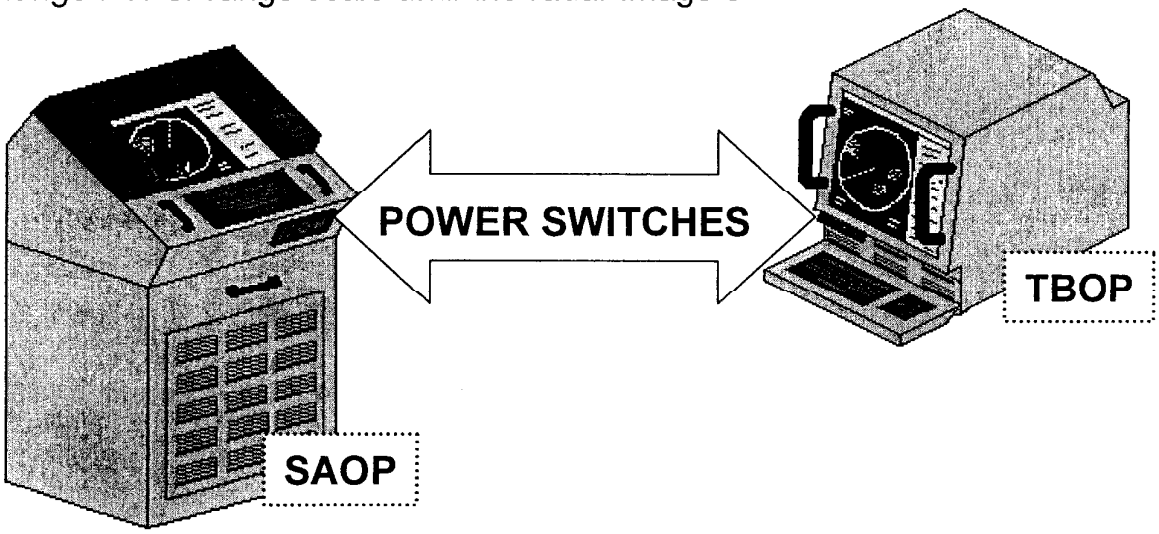
Turn on the three power switches on the front of the SAOP or single power switch on TBOP. This will activate the automatic start-up procedure. When start-up is complete, approximately 5 minutes, the radar will be in the Standby condition.

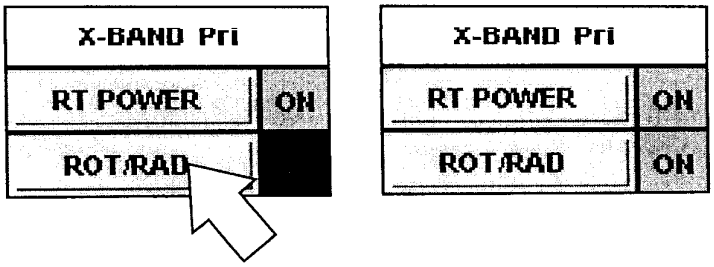
In the Standby condition the radar antenna is not spinning and there is no electronic pulse being sent out. There will be no radar video displayed on the radar screen.

Place the cursor over the words ROT/RAD in the radar status menu and press the left trackball button.

Now the radar antennas will begin spinning and the radar will transmit pulses. There will be a radar image displayed on the screen.

The radar requires 30 seconds to 1 minute to perform an auto-tune. During the auto-tune the radar picture will be unstable. For best auto-tune DO NOT change PW or range scale until the radar image stabilizes.





RADAR GAIN

Effects the overall strength of the radar video displayed.

TRACK SENSITIVITY

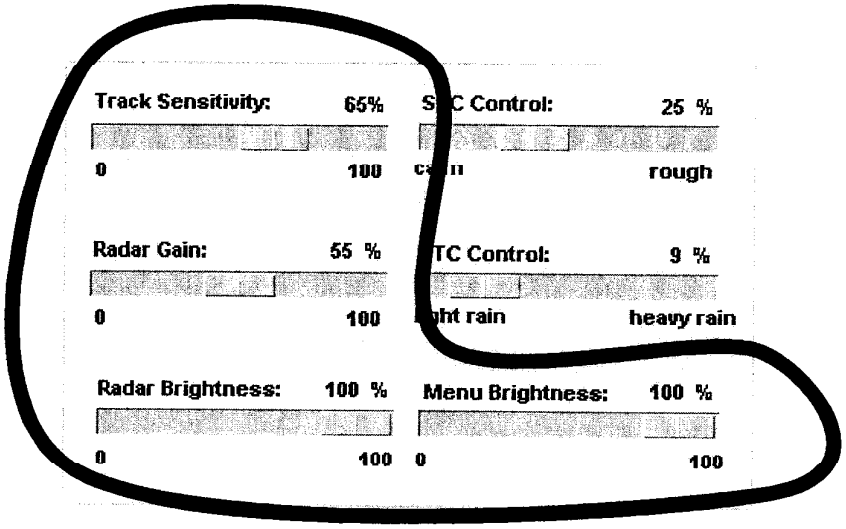
Effects the amount of return seen by the tracker. (see pg.29 for more on the tracker) Make this adjustment slowly to prevent overloading the tracker.

RADAR BRIGHTNESS

Effects the brightness of the radar area.

MENU BRIGHTNESS

Effects the brightness of the radar menu.



NOTE: Brightness controls can be accessed using functions keys F5 - F8. (see pg. 25)

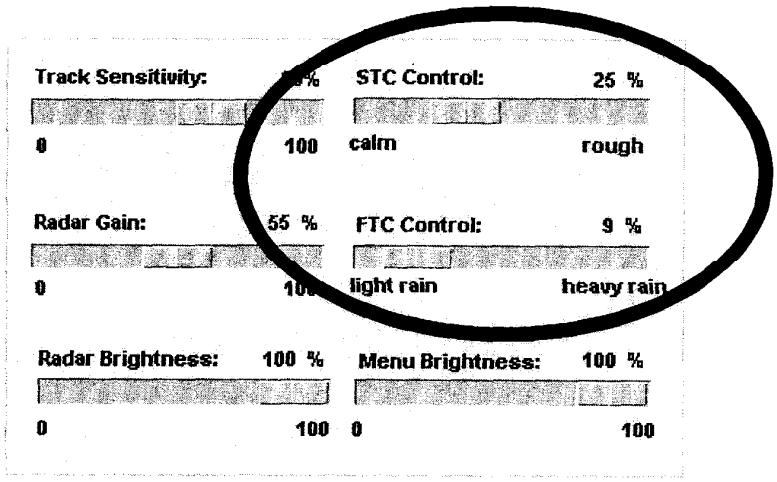
ANTI-CLUTTER SEA (STC)

When the radar sends out a pulse it is very strong. If the pulse bounces off something close by the signal will still be very strong when it returns to the receiver.

When the radar pulse is reflected by sea swells the strong return causes Sea Clutter, the ring of video usually present around own ship.

Anti-Clutter Sea or STC controls this phenomenon by reducing the radar's sensitivity to close contacts.

Use this feature when tracking a contact close to own ship. The contact's return will be stronger than the sea swells.



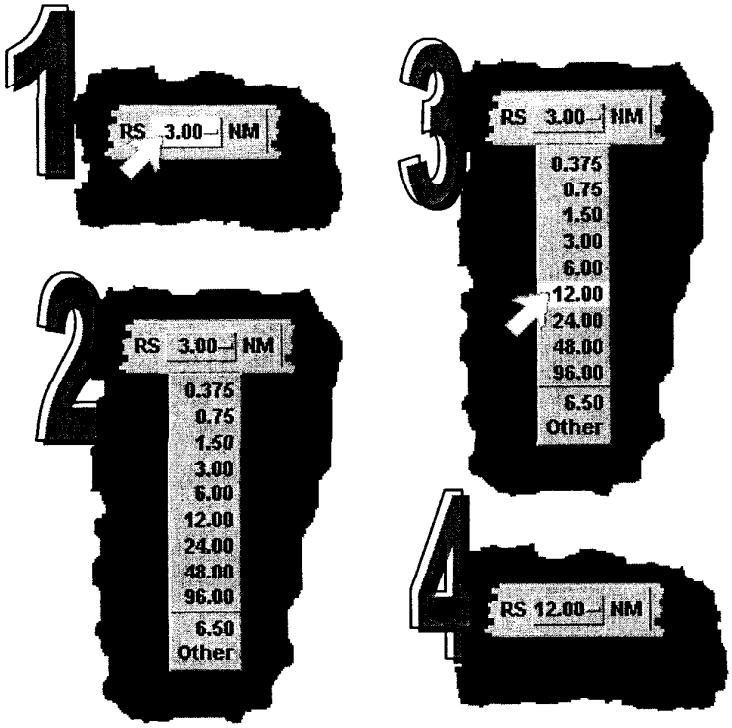
ANTI-CLUTTER RAIN (FTC)

Sometimes Clouds will give strong return. This return can cover the return of contacts beneath the cloud.

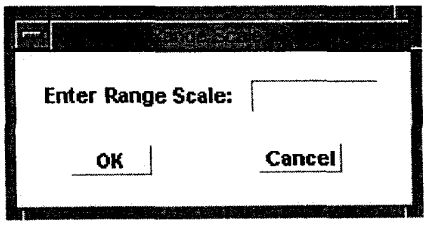
The operator should use Anti-Clutter Rain or FTC to limit the weather displayed on the radar picture.

RANGE SCALE

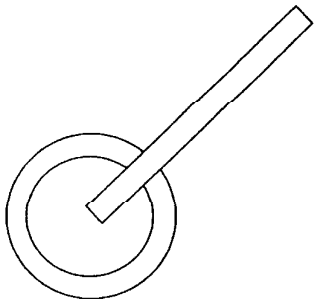
Range Scale changes the distance the operator can see. With a range scale of 12 NM the operator will be able to see 12 NM from own ship (the center of the radar screen) in all directions. Once the operator has selected the new range scale it will take about 5-10 seconds for the radar to adjust the picture.



If the operator selects OTHER from the range scale selection menu the window show below will be displayed. Type any increment between 0.01 and 96.00 and the radar screen will display that range scale. The most recent custom range entered will be displayed above the word OTHER in the radar selection menu.

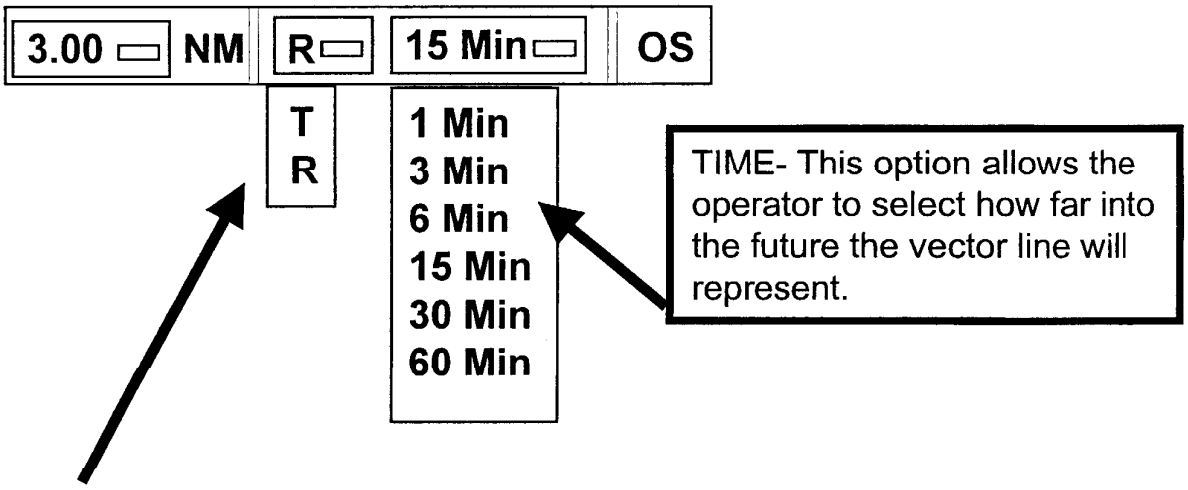


VECTORS



The line extending from the center of the contact is called a vector.

The end of the line represents where the contact will be in the future based on its current course and speed.

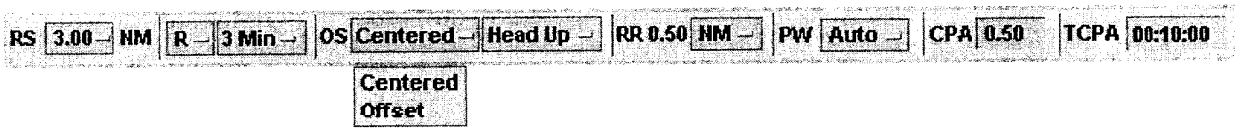


VECTOR ORIENTATION- This option allows the operator to select the orientation of every vector on the radar screen. It will not effect the orientation of the radar image.

TRUE- The radar is using only the contact's course and speed to plot its future position. The **latitude** and **longitude** at the end of the vector line will be accurate provided the contact does not alter course or speed.

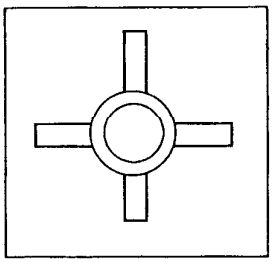
RELATIVE- The radar is using own ship course and speed in relationship to the contact's course and speed to plot the contact's future position. The **range** and **bearing** at the end of the vector line will be accurate provided the contact does not alter course or speed.

OFFSET



OFFSET- Offset allows the operator to change the center reference of the radar screen to any position selected by the operator's cursor.

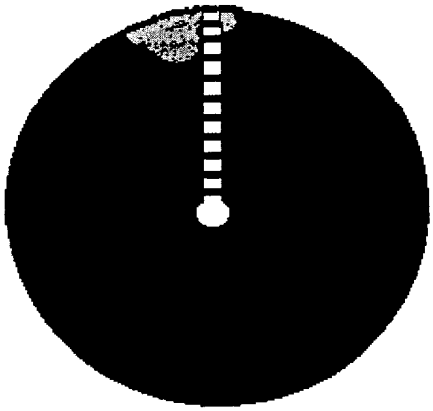
Select **OFFSET** from the selection menu.
The cursor will change to an active cursor.

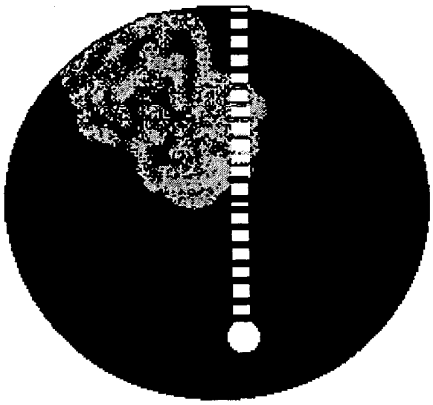


Place the cursor over the position that will become the new center point and press the left trackball button. In 5-10 seconds the video will shift to reflect the new center point.

To return own ship to center select **CENTERED** from the selection window under the word OFFSET on the top menu bar.

CENTERED **OFFSET**



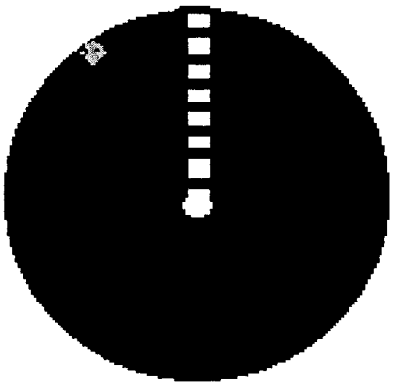


OFFSET (CONT.)

Offset can be used to "zoom in on a contact. This feature is used when an operator is unsure if a contact is valid. (Is it a cloud or a boat?)

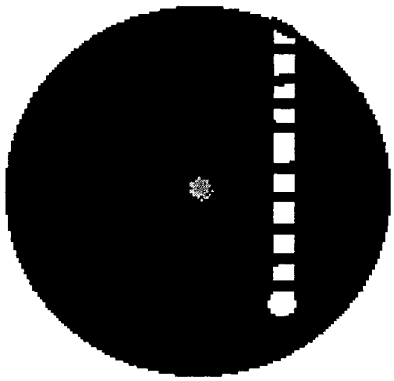
---

1 The radar range is at 24.00 NM. A contact is detected but the operator is unsure it is a viable surface contact.



---

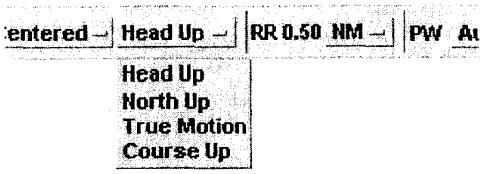
2 Use offset to center the suspect video.



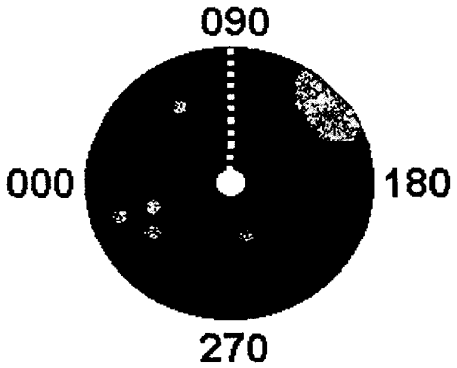
---

3 Select a small range scale (< 3NM) to view the suspect video.

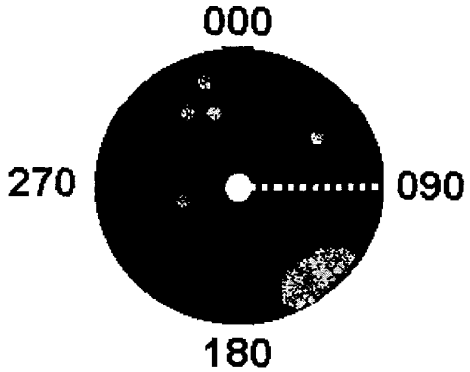
ORIENTATION



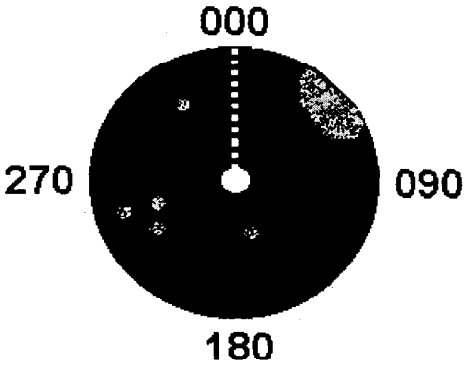
The orientation can be selected by the operator to change the way video is displayed.



Head-Up will orient the radar picture to the ship's current course. The heading marker will always be at the top of the screen and the video will move around own ship.



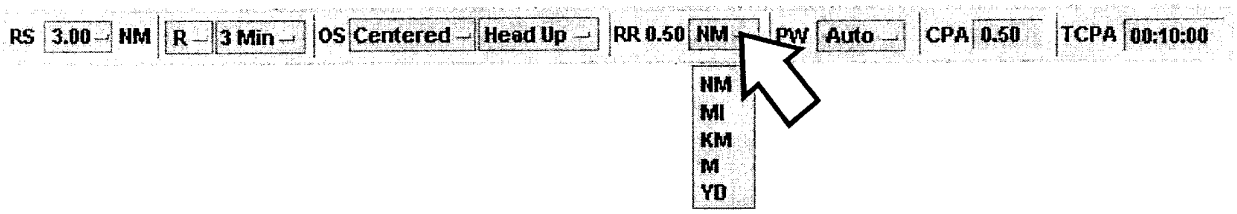
North-Up will use 000 degrees true to orient the picture. The heading marker will change as the ship heading changes. Own ship will remain at the center of the display and the radar video will remain stable



True motion uses the same orientation as North Up. However, in True Motion own ship will NOT remain in the center of the display. Own ship will move through the radar video.

The Course Up function has not yet been installed.

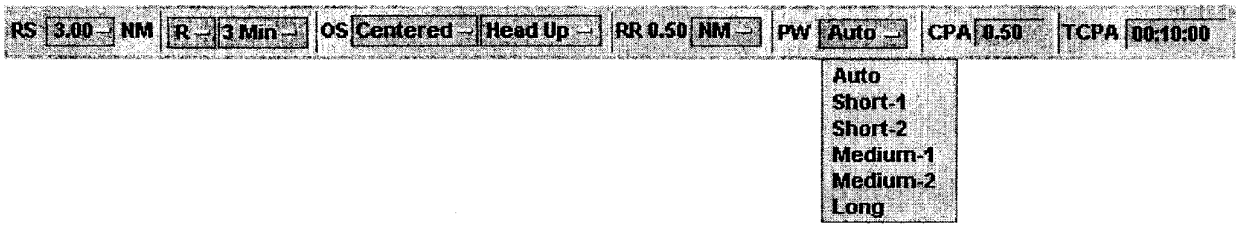
UNITS OF MEASURE



Changing this setting will convert all calculations into the new unit of measure.

It will effect the cursor readout, track summaries, trial maneuvers, intercept solutions, CPA/TCPA, range rings...

PULSE WIDTH (PW) & PULSE REPETITION FREQUENCY (PRF)



This adjustment is made to improve the radar picture and/or tracking. Changes are made to compensate for variations in sea condition, weather, and mission.

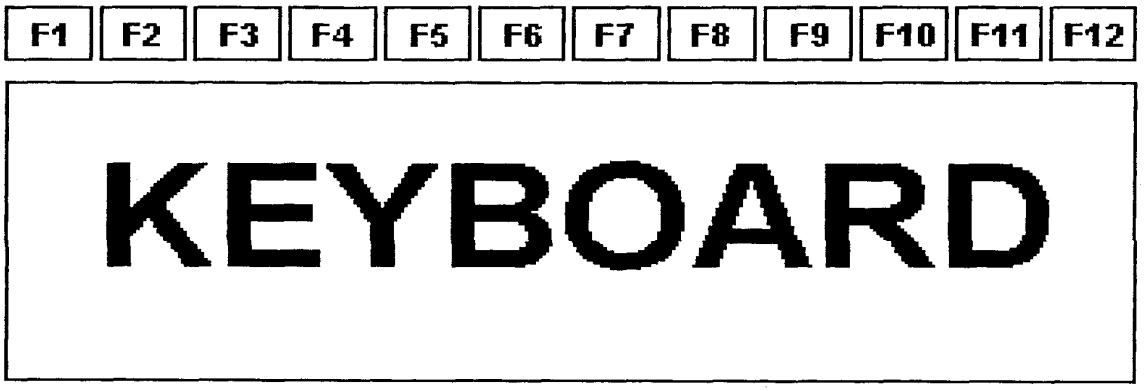
In AUTO the radar will automatically select a Pulse Width (PW) and Pule Repetition Frequency (PRF) depending on the range scale selected by the operator.

The rest of the options are organized from the shortest pulse width (PW) SHORT-1 to the longest pulse width (PW) LONG.

The shorter the PW selected by the operator the more target definition will be displayed on screen. This makes **shorter** PW's preferred for **tracking small targets** or during **Special Sea Detail** when detailed video is required to track buoys and other navigation aids. The detail provided by shorter PW's may cause weather to be displayed on screen blocking out potential targets. The operator should use a **longer** PW when in **heavy weather** conditions. **Longer** PW's also provide more range and should be used for **long range tracking**.

FUNCTION KEYS

Function Keys are used to adjust the radar display. The picture below represents the operator's function keys and keyboard.



• F1	• Decrease Contrast (monitor)
• F2	• Increase Contrast (monitor)
• F3	• Decrease Brightness (monitor)
• F4	• Increase Brightness (monitor)
• F5	• Decrease Radar Area Brightness
• F6	• Increase Radar Area Brightness
• F7	• Decrease Menu Brightness
• F8	• Increase Menu Brightness
• F9	• Select increasingly darker Color Schemes
• F10	• Select increasingly brighter Color Schemes

• Alt-A	• Acquire Contact
• Alt-D	• Drop Object
• Alt-P	• POSCOR (Position Correction)
• Alt-R	• Reposition Object

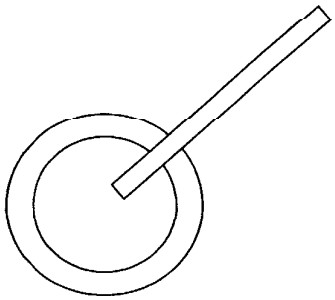
SECTION TWO
Tracking

- Track targets using system track
- Track targets using local track
- Drop targets from the screen
- Other important operator functions

TRACKING

The SPS-73 radar uses two methods to track contacts, System Tracking and Local Tracking. The next few pages will illustrate how to use both features and the differences between the two.

CHARACTERISTICS OF A SYSTEM TRACK



1. System tracks are the most used function on the SPS-73 radar.

2. A system track acquired on one radar console will be displayed on all radar consoles and SCCS screens automatically.

3. Any amplifying information entered about a system track will update the track's display on all consoles.

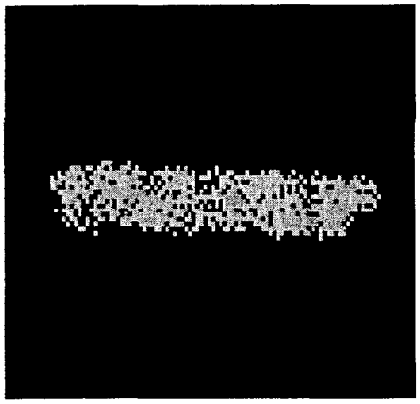
4. A system track's course and speed will be automatically updated by the radar on all displays without operator intervention.

5. A good system track will have a track quality of 120 or higher.

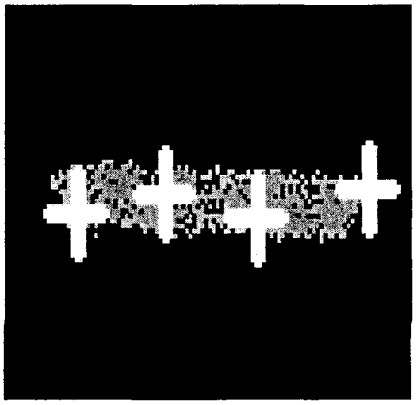
6. The illustration above shows the default state of a system track, a yellow circle (Unknown / Default). The operator, however, can add amplifying information on the track that will change its appearance. (see pg. 61-64 for more information on changing track characteristics)

THE TRACKER

This radar uses the Tracker to automatically update course and speed information on a system track.



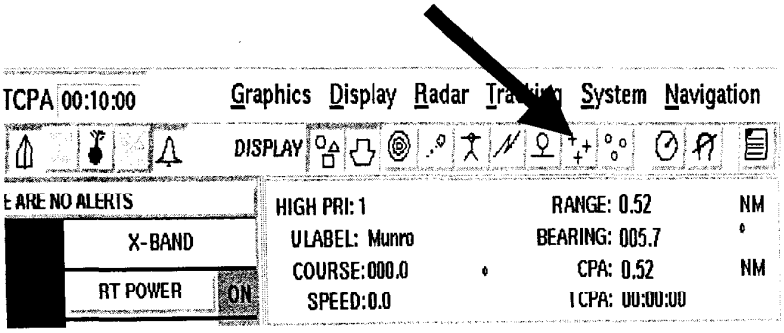
The video displayed for the operator is green.



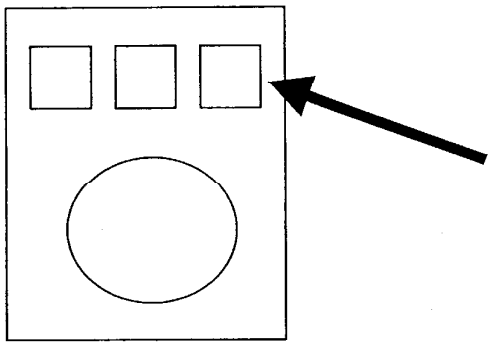
The tracker uses a different picture which can be displayed for the operator as yellow plus signs. The plus signs indicate where the tracker "sees" potential contacts.

If the radar is properly tuned there will be plus signs over all the radar video on the display indicating the operator may acquire a system track.

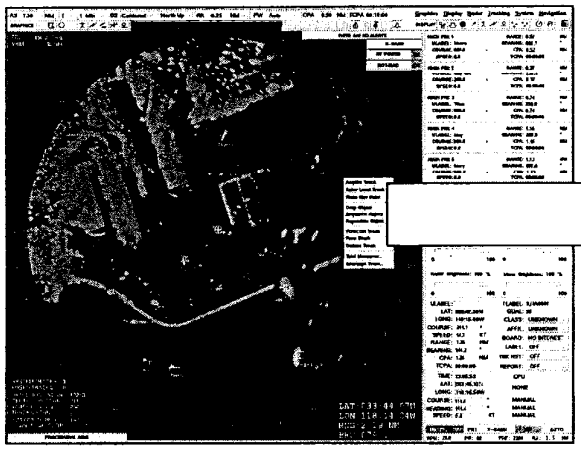
These yellow plus signs can be turned displayed or hidden by changing the condition of the Contacts icon located below the pull down menus.



RIGHT POP-UP MENU



Press the right trackball button anywhere on the radar screen to access the right pop-up menu.



Acquire Track Ctrl-A
Enter Local Track
Place Nav Point

Cursor Centered
Cursor Offset

Place EBL
Offset EBL
Center EBL
Place VRM

Draw Polygon
Draw Circle

ADF Info

The right pop-up menu will be displayed on the radar screen as shown above.

Acquire Track Ctrl-A
Enter Local Track
Place Nav Point

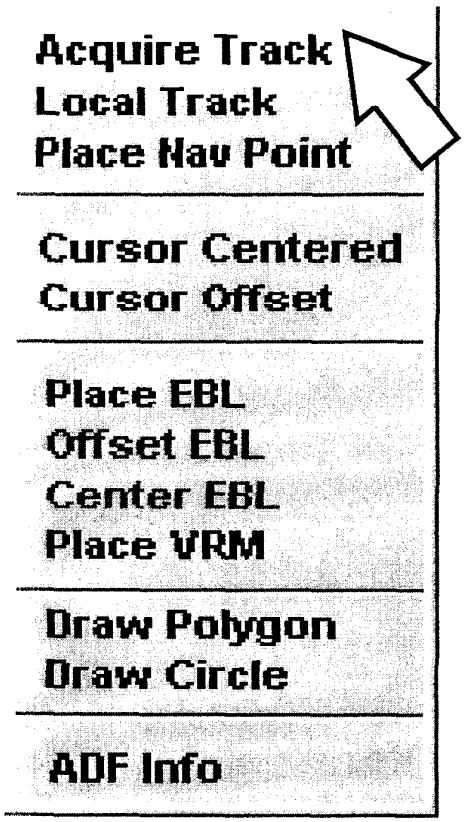
Drop Object Ctrl-D
Sequence Object
Reposition Object Ctrl-R

POSCOR Track Ctrl-P
Fuse Track
Defuse Track

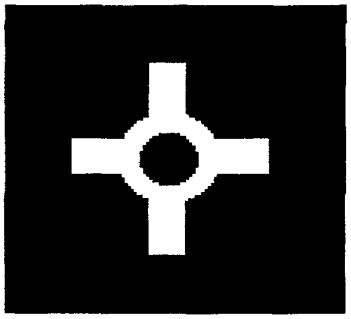
Trial Maneuver...
Intercept Track...

NOTE: This slightly different menu will appear if a track, nav point, or graphic are hooked when the right pop-up menu is activated.

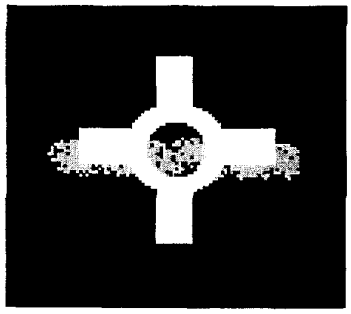
ACQUIRE TRACK



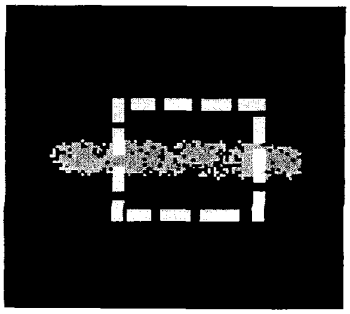
When the operator selects acquire track by placing the cursor over the words Acquire Track and pressing the left trackball button the cursor will become a bullseye.



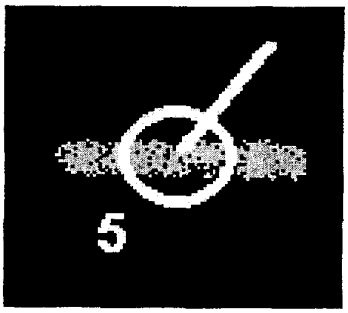
Place the bullseye over the video you wish to track and press the left trackball button.



A yellow square will be displayed over the target video indicating the radar is searching for something to track in that area.



*In a few seconds the radar will begin to auto-*track. A track symbol will appear on top of the desired video. It will be a yellow circle indicating it is a default/unknown contact.



If the contact is a high priority track the track information will be displayed *in the high priority track window on the radar menu. The* track shown is a high priority track. The number 5 displayed to the lower left of the track symbol indicates the radar has calculated the contact has the fifth closest CPA of all contacts acquired on the radar screen. *For more information on high priority tracks see pg. 38.*

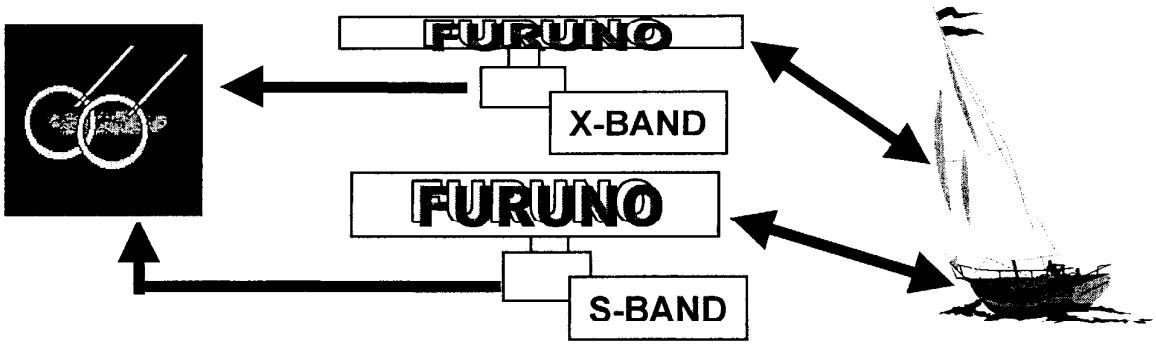
AUTOMATIC FUSION

Fusion merges the two or more tracks into one. Fusion is used only with system tracks and provides the operator with more stable tracking.

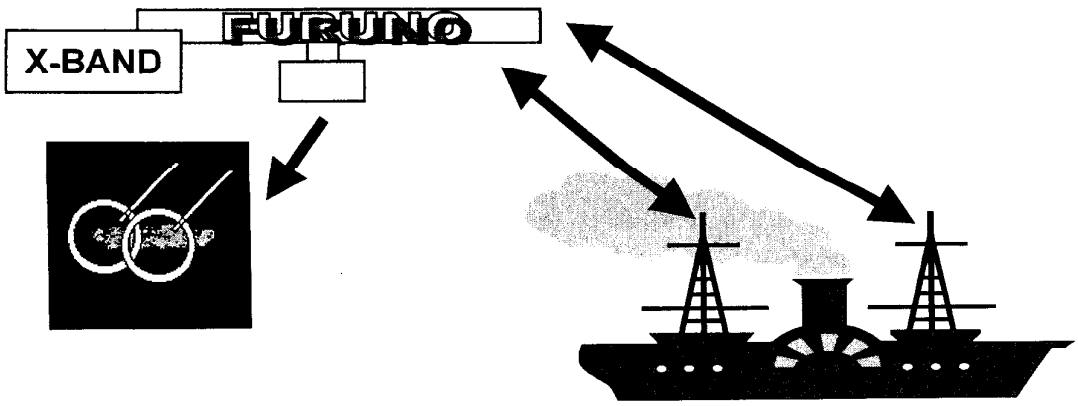
Automatic fusion is generally selected by the system administrator. In this mode tracks within a preset range to each other will fuse (merge).

Below are two scenarios which require fusion.

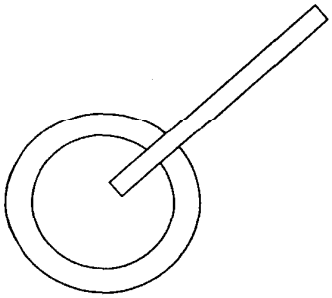
1 When both radars "see" one contact causing the radar screen to display two track symbols.



2 When the radar sees two small contacts instead of one large contact causing two tracks to be displayed where there is only one contact.



CHARACTERISTICS OF A LOCAL TRACK



1. Local Tracks are only seen on the console where they are acquired.

2. Local Tracks are not "seen" by the tracker. Neither video or tracker plus signs are required to place a Local Track.

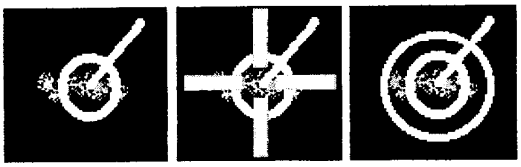
3. They will not automatically update course and speed without operator intervention. (see pg. 35 for information on POSCOR)

4. When a local track is initially acquired the symbol will be blue circle indicating a Friendly / Default track. The operator, however, can add amplifying information on the track that will change its appearance. (see pg.61-64 for more information on changing track characteristics)

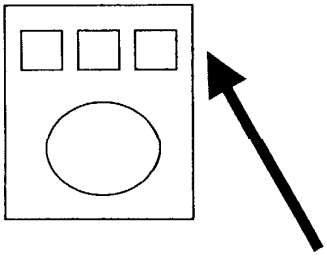
5. Local Tracks are acquired using the right pop-up menu and selecting LOCAL TRACK. The cursor will become a bullseye. Place this cursor in the position of the desired track and press the left trackball button.

DROP TRACK

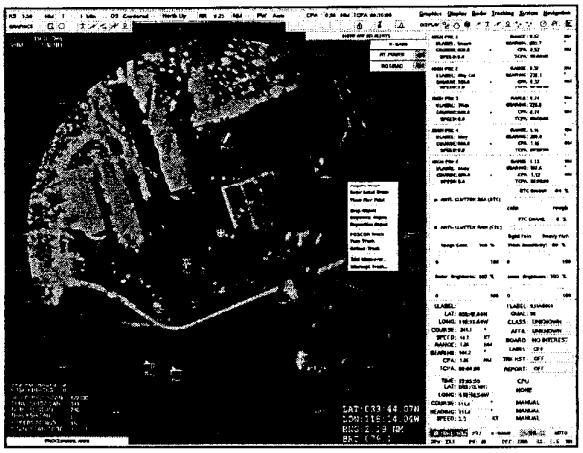
1 To drop a track the operator must first hook the track. To hook a track place the cursor over the track symbol and press the left trackball button. A circle will appear around the track symbol. Once the desired track is hooked continue with step two.



2

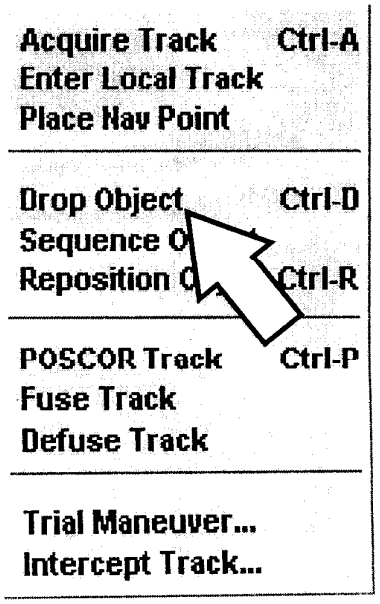


Press the right trackball button anywhere on the radar screen to access the right pop-up menu.



The right pop-up menu will be displayed on the radar screen as shown above.

3



Select DROP OBJECT by placing the cursor over those words and pressing the left trackball button. The hooked track symbol will disappear from the screen.

MOVING TRACK SYMBOLS

If a system or local track symbol is not over the desired video the operator can intervene using Reposition Object or Position Correction (POSCOR).

- REPOSITION OBJECT
  - Used to change the location of a *hooked track or nav point symbol*. This function will not effect course and speed. Use this feature when the video drifts out from under symbol or when a symbol is placed incorrectly.

- POSCOR (Position Correction)
  - The radar uses the current position of the track symbol and the position inputted by the operator to calculate a new course and speed for a local or system track. This function will move the track symbol and change its course, speed, and CPA information.

    POSCOR is the only way to get course and/or speed information on Local Tracks

SECTION THREE
Collision Avoidance

- Track information displays
- Closest Point of Approach (CPA), Time to CPA (TCPA), and Bearing to CPA (BCPA)
- Trial Maneuver
- Intercept Solution

RADAR DESIGNATED HIGH PRIORITY TRACKS

The priority of a track is determined automatically by the radar and prioritized one through five.

The radar uses CPA to determine a tracks priority. The five closest CPA's become high priority tracks

The operator uses the radar's high priority tracks to quickly identify hazards to navigation.

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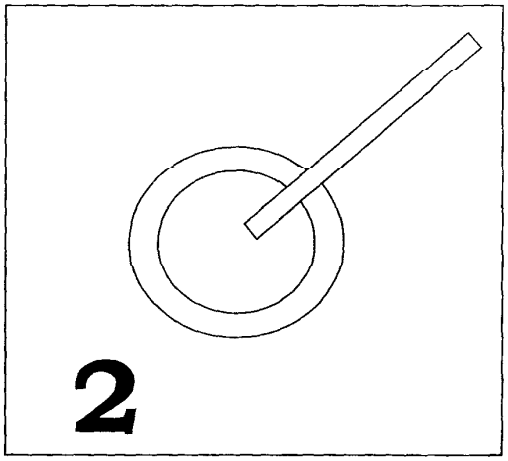
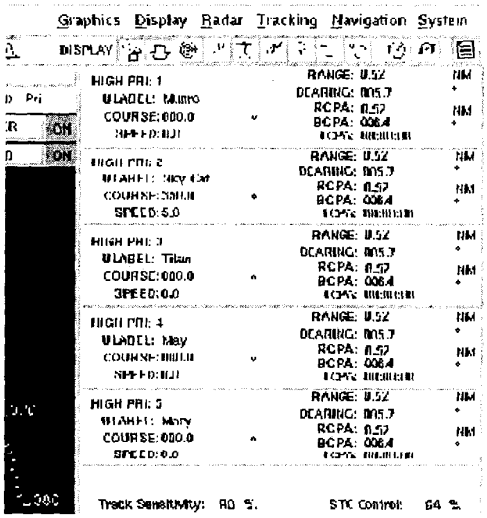


Information on the top five tracks will be displayed on the right side of the screen.

A number 1-5 is displayed next to the high priority track symbol on the radar screen. These numbers can not be turned off.



IMPORTANT: The radar designated high priority track number will change as the CPA of the track changes. This constant changing may become confusing if no U Labels or operator designated priorities are assigned to the contact. (see pg. 39 for more on operator designated priority tracks and U Label)

HOOKED TRACK WINDOW

To hook a track place the cursor over the track symbol and press the left trackball button. A circle will appear around the track symbol. Once the desired track is hooked the information will be displayed in the hooked track window shown below. (If the operator hooks a graphic or nav point that information will also be displayed in this window.)

The operator assigns the U Label

Place the cursor in the text box and press the left trackball button.

Use the keyboard to enter the name of the contact and press ENTER. The label will be displayed on the radar screen.

Quality of 36 is the highest a system track can achieve. As this number decreased the reliability of track information also decreases.

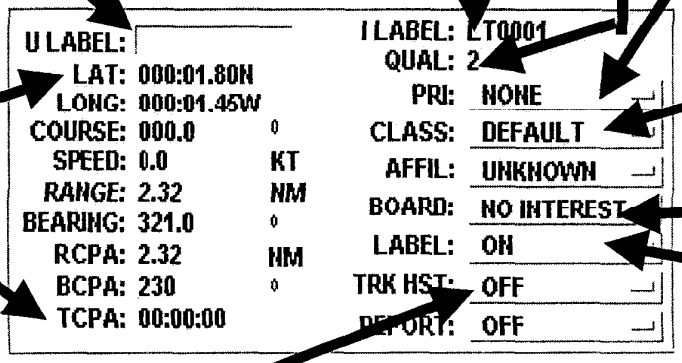
Normal Quality for a Local Track or Nav Point is 2 and it will not change.

The operator can designate up to five high priority tracks.

The letter, A - E selected by the operator will be displayed on the radar screen to the right of the radar designated high priority track.

The radar automatically assigns the I Label

This label is not seen on the radar screen.



Track information on hooked contact

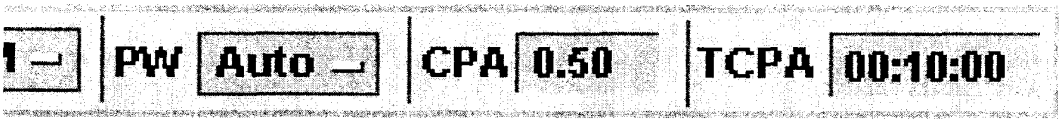
Track Characteristics *See pg 61-64*

Turns U Label displayed on the radar screen ON or OFF

Turns Track History points on or off for the hooked contact.

This function will shown a trail behind the contact showing where it has been.

CPA/TCPA



Located on the top menu bar. These settings are applied to all system and local tracks.

CPA - **C**losest **P**oint of **A**pproach

TCPA - **T**ime to **C**losest **P**oint of **A**pproach

If a track will enter CPA in the time allotted by TCPA an alarm will sound and an alert will be displayed in the alert window shown below.

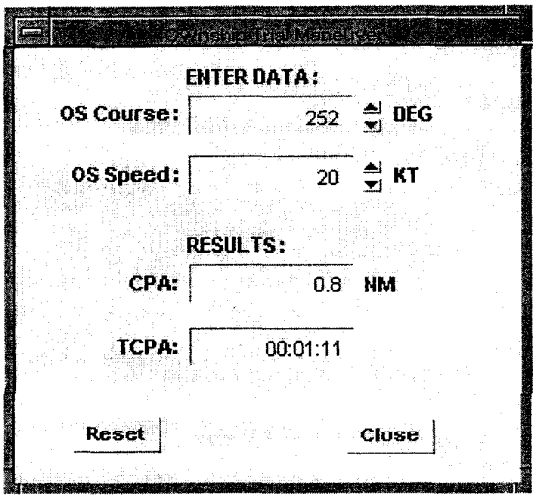
Track 1U1A00001 is approaching CPA/TCPA

To change CPA or TCPA place the cursor in the text box displaying the current setting and press the left trackball button. Use the keyboard to enter the new settings and press ENTER on the keyboard.

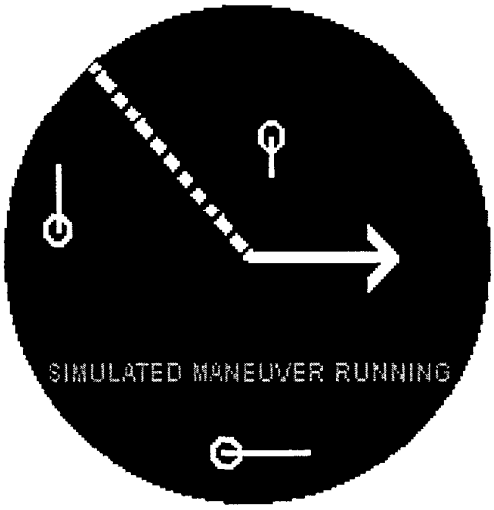
TRIAL MANEUVER

The operator must hook a contact before activating the trial maneuver. Once a contact is hooked activate the right pop-up menu and select TRIAL MANEUVER.

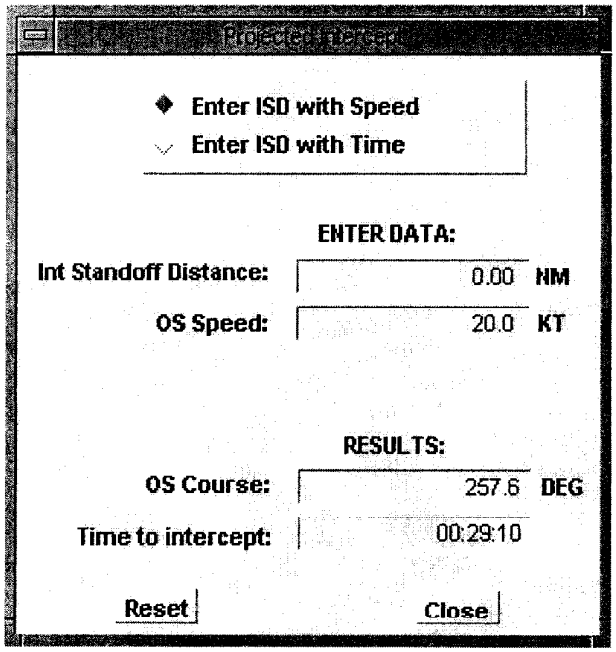
This menu will appear. Use the spin buttons or text box to enter new course and/or speed information. The CPA/TCPA information will change as own ship's course and speed changes.

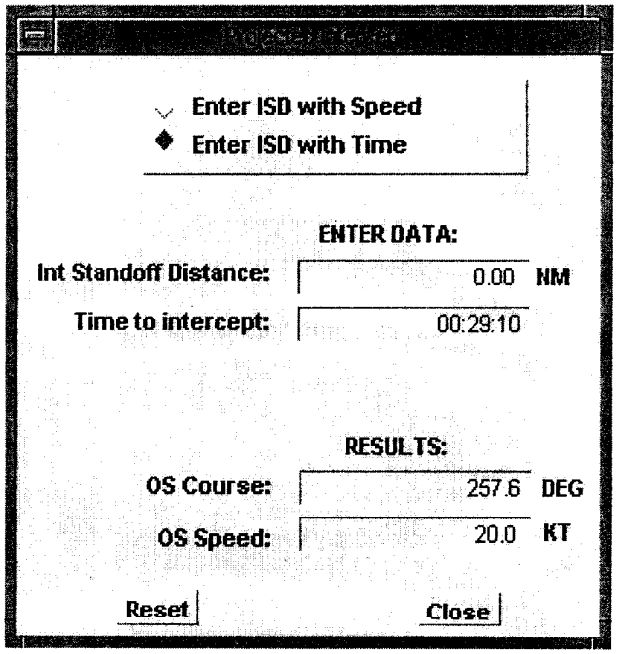


Watch the radar screen to see all vectors, including own ship's vector recalculate to reflect trial information. A warning is displayed at the bottom of the radar screen to indicate vectors are not real world.



INTERCEPT SOLUTION





The operator must hook a contact before activating intercept solution. Once a contact is hooked activate the right pop-up menu and select INTERCEPT TRACK. One of the windows above will appear.

Intercept can be found in two ways. By entering trial speed or entering the time the operator wishes the intercept to take place. To select the type of intercept use the radio buttons at the top of the intercept window.

Watch the radar screen to see all vectors, including own ship's vector recalculate to reflect intercept information. A warning is displayed at the bottom of the radar screen to indicate vectors are not real world.

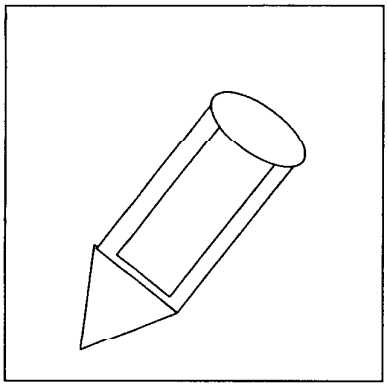
SECTION FOUR
Graphics

- Draw a graphic
- Associate a graphic to a function
- Save graphic files

DRAWING A GRAPHIC

Once you select draw circle or draw polygon your cursor will look like a pencil.

Use the pencil to draw your graphic.



DRAW A CIRCLE

To begin a circle place the pencil where the center of the circle will be and press the left trackball button. Roll the cursor out to until the circle is the correct size and press the left trackball button again complete the circle.

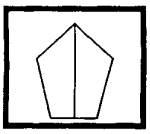
DRAW A POLYGON

To draw a polygon use the pencil cursor and press the left trackball button every time to make a corner.

When you have finished drawing you can associate and install the graphic.

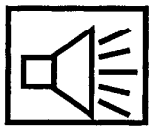
In other words make it DO SOMETHING.

WHAT GRAPHICS DO



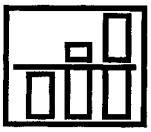
O/S or GEO

Before a graphic is drawn the operator must decide if the graphic will be slave to own ship or geo-stabilized. Slave to own ship (button pushed in) means the graphic will move with the ship. Geo-stabilized means the graphic will remain at the latitude and longitude where it is placed.



Guard Alarm

The Guard Alarm will sound an audible alarm if a track enters or leaves the area designated by the graphic.



Threshold Bias Map

The Threshold Bias Map eliminates video from the associated graphic using figures entered in the Radar All Current Parameters Menu.

Track Land Mask

Track Land Mask prevents the tracker from seeing targets in the area of the associated graphic.
NOTE: It is impossible to use a system track inside a Track Land Mask.

Auto-Acquisition Area

The Auto-Acquisition Area will place a system track on every potential contact inside the associated graphic.
NOTE: This feature will track everything including land, buoys, and clouds

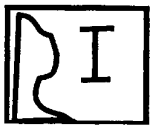
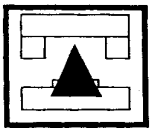


Image Land Mask

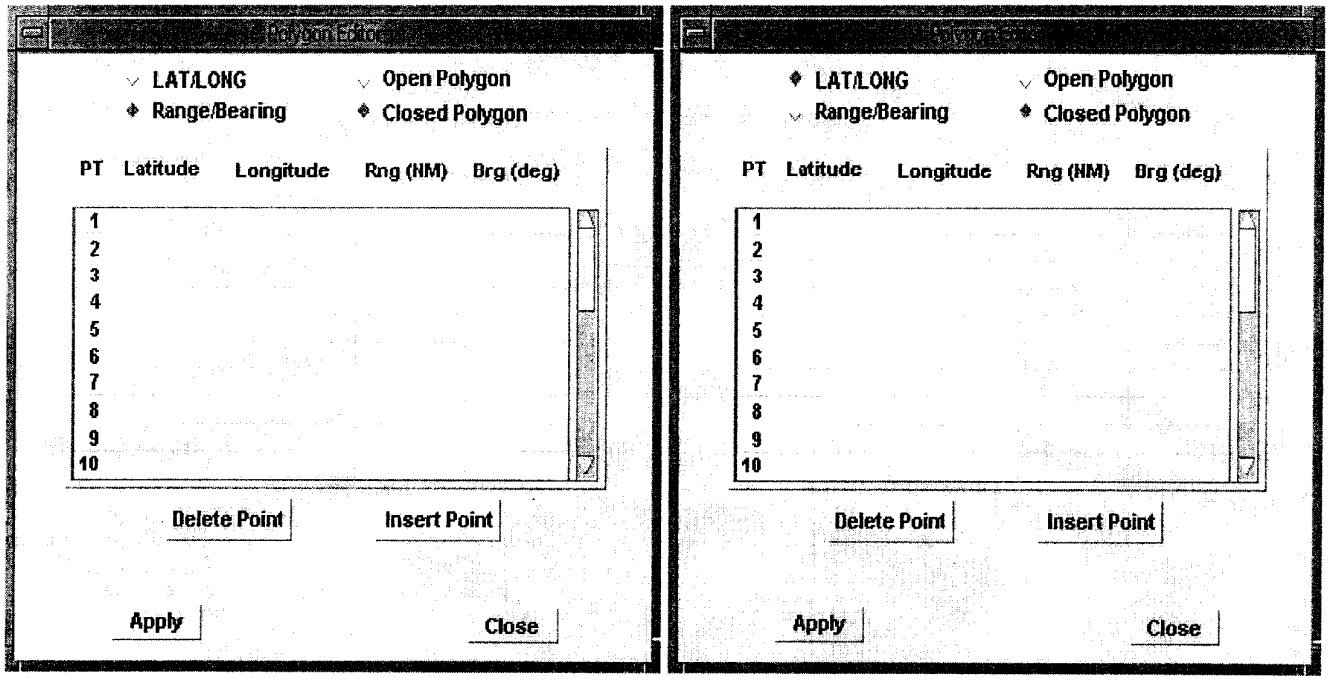
Image Land Mask is used to eliminate radar video from the area designated by the associated graphic.



Install

The Install function must be used to activate any of the above functions. Press this button to activate the function associated to the graphic.

DRAWING A GRAPHIC BY RANGE AND BEARING OR LAT/LONG



Before accessing the polygon editor pictured above the operator must choose between slave to own ship or geo-stabilized. (see the previous page)

Choose the graphics pull down menu and select edit polygon.

Enter information by either course and speed (right) or latitude and longitude (left).

Press APPLY at the bottom of the graphics editor to display the graphic on screen.

To save a graphic choose the graphics pull down menu and select SAVE AS.

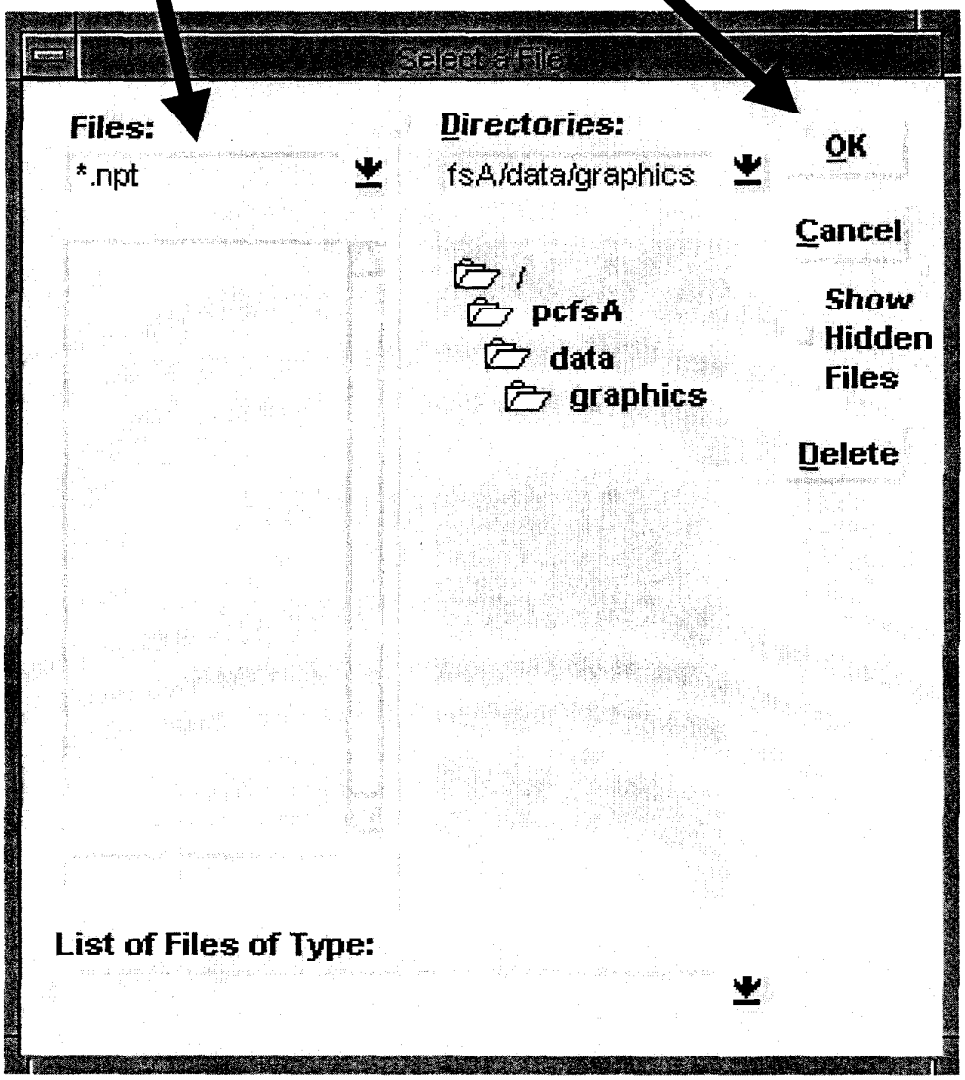
For more information on saving graphics turn to the next page.

GRAPHICS FILES

SAVE A FILE

To save to a file select SAVE AS from the graphics pull down menu. The window below will become active.

Type in the ONE WORD file name. Choose OK.



OPEN A FILE

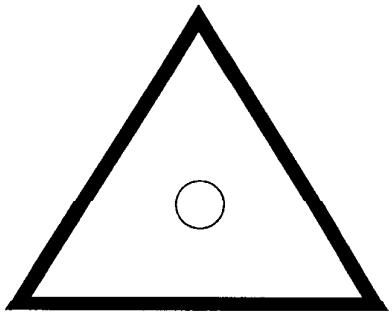
To recall a file select OPEN from the graphics pull down menu. The window shown here will open. Highlight the desired file and choose OK.

SECTION FIVE

Navigation Points

- Using Navigation (Nav) Points
- Save Nav Point files

CHARACTERISTICS OF A NAVIGATION POINT



1. Nav Points are only displayed on the console where they are acquired.

2. They are not "seen" by the Tracker. Neither video or tracker plus signs are required to place a Local Track.

3. Nav Points are fixed points, they have no course or speed.

4. A maximum of 30 Nav Points can be displayed at one time.

5. They can be saved in lists of up to 30 points to be displayed on demand.

6. The illustration above shows a Nav Point. They are displayed as orange triangles.

7. Nav Points are acquired using the right pop-up menu and selecting PLACE NAV POINT. The cursor will become a bullseye. Place this cursor in the position of the desired navigation point and press the left trackball button.

NAV POINT LISTS

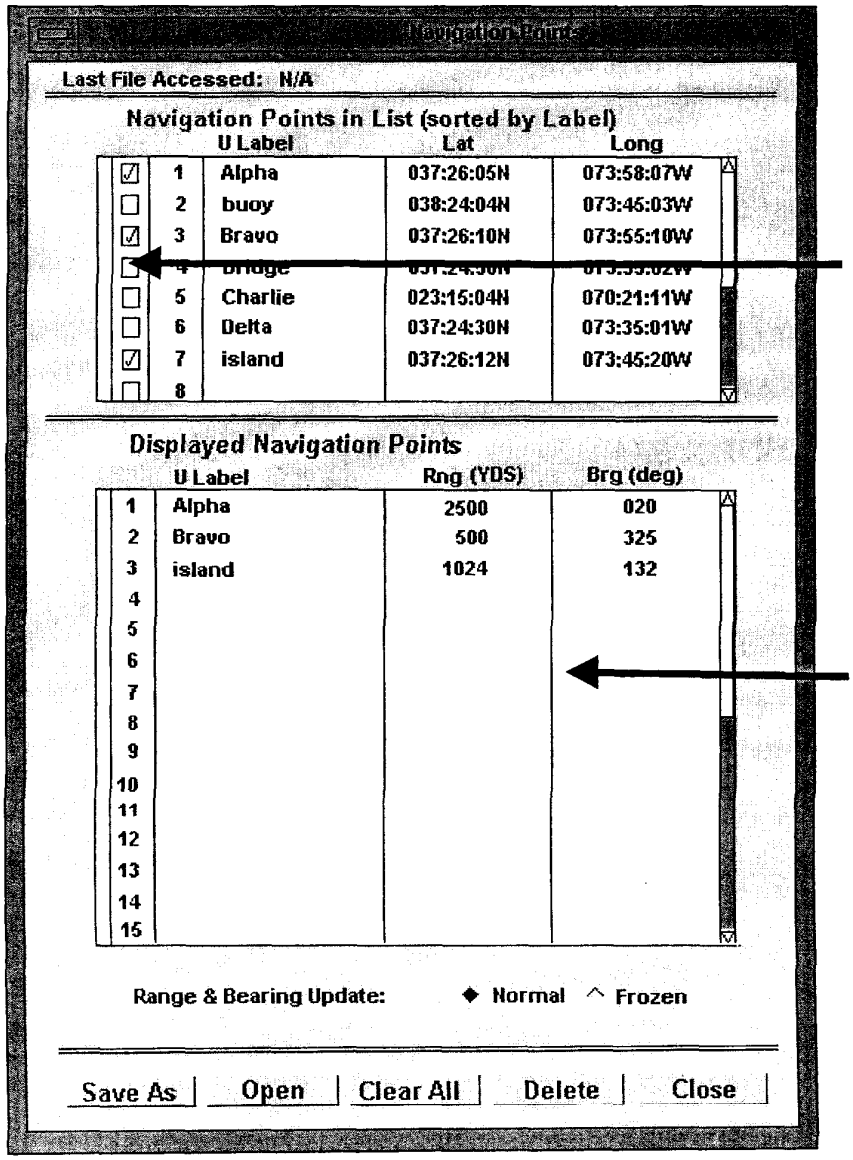
Nav points can be saved to a list.

Each list can store up to 30 points.

Nav Points will be saved alphabetically.

The points can be entered on screen with the PLACE NAV POINT option available on the right pop-up menu or entered manually with latitude and longitude on the list itself.

To access the list select the NAVIGATION pull down menu and then select EDIT NAV POINTS from the pull-down menu.



To activate a Nav point place the cursor in the box to the left of the Nav point and press the left trackball button. The box will have a check mark in it and the Nav Point will be displayed on the radar screen.

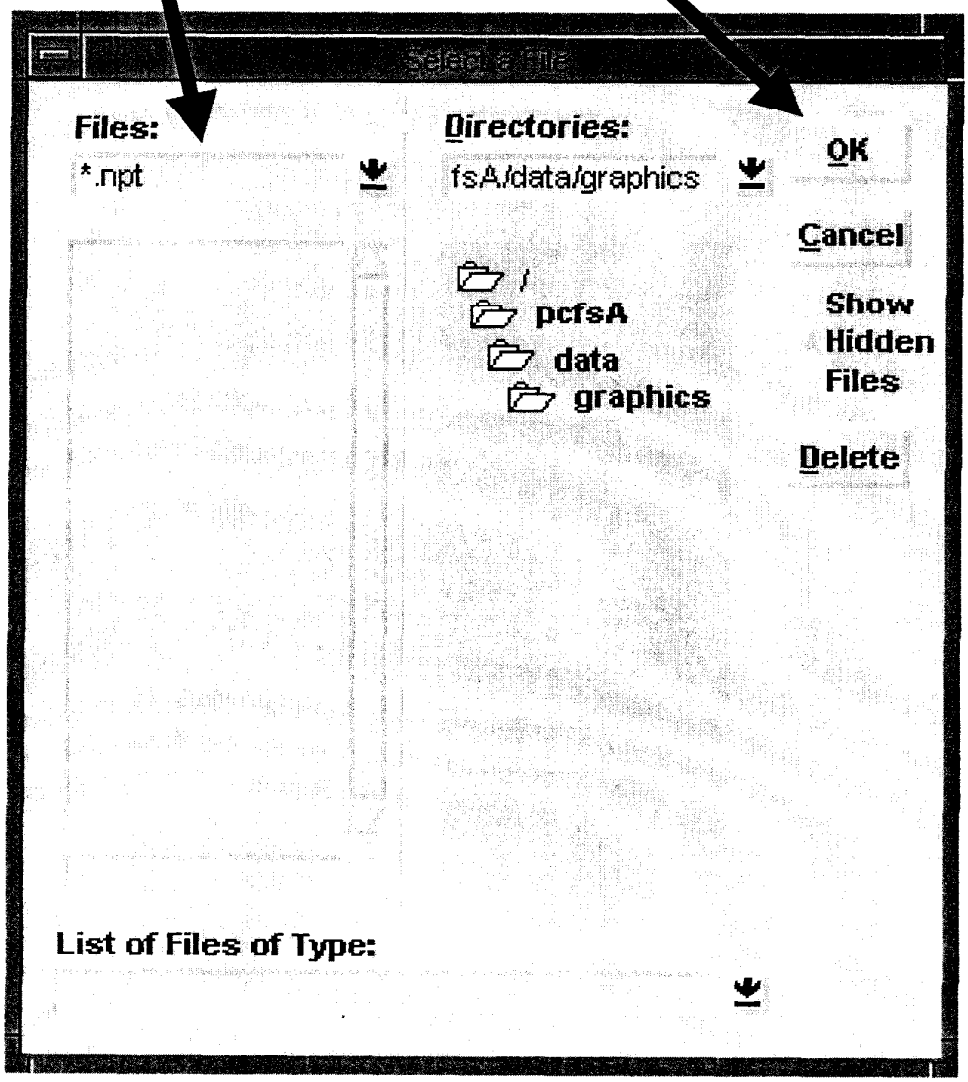
The bearing and range information on the checked Nav point will be displayed in the box at the bottom of the Nav point list. To deactivate a point reverse the process.

NAV POINT FILES

SAVE A FILE

To save to a file select SAVE AS from the bottom of the Nav Point list window. The window below will become active.

Type in the ONE WORD file name. Choose OK.



OPEN A FILE

To recall a file open the Nav point list outlined on pg. 51. Then select OPEN from the bottom of the Nav point list window. The window shown here will open. Highlight the desired file and choose OK.

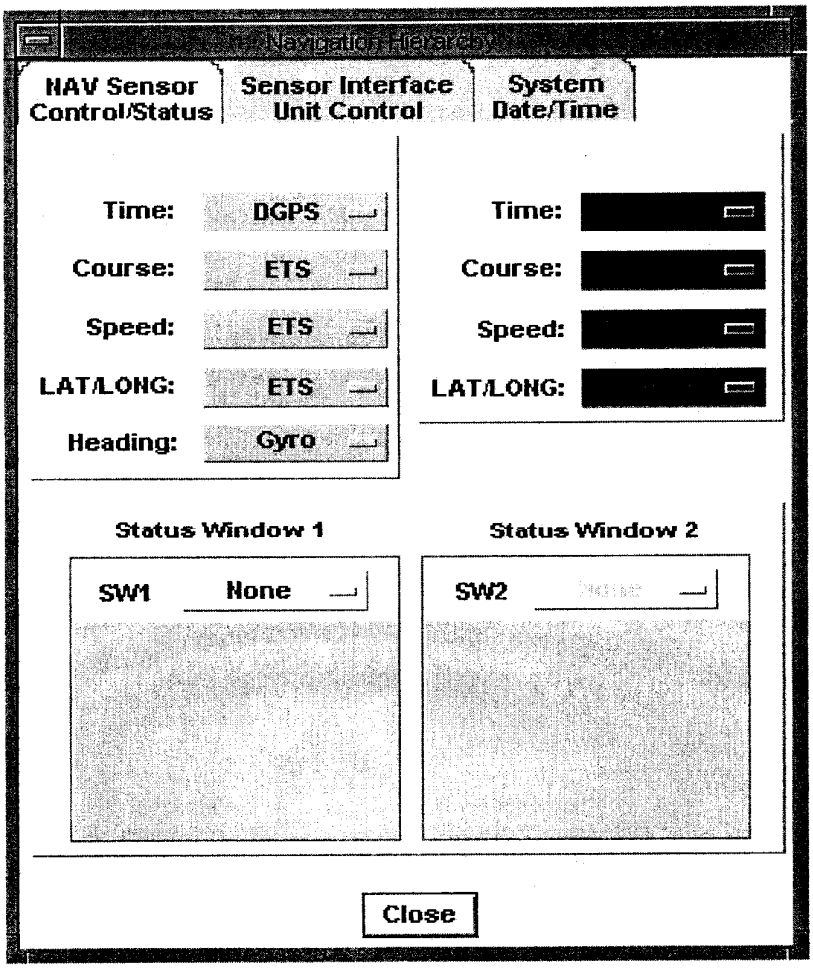
SECTION SIX
Casualties

- Possible work-arounds for common problems
- Alternate Navigational Data
- Reboot
- Initialization

Work-Arounds

• 440 VAC fails (270' & 378')	• Use X-band only, [switch J-box]
• Gyro failure	• Use Head Up to view relative video
• GPS fails	• Use Loran-C
• Speedlog fails	• Switch to GPS, don't forget to change course to GPS.
• Part fails on one SAOP	• Cannibalize parts from second SAOP for best OPS.
• Part fails on TBOP	• Some parts can be shared with SAOP.
• MK-92 fails to transmit (270')	• If there is still rotation IFF will be available.
• 73 tracks fail to transmit to JMCIS (378')	• Use SPA-25G to track contacts in CIC.

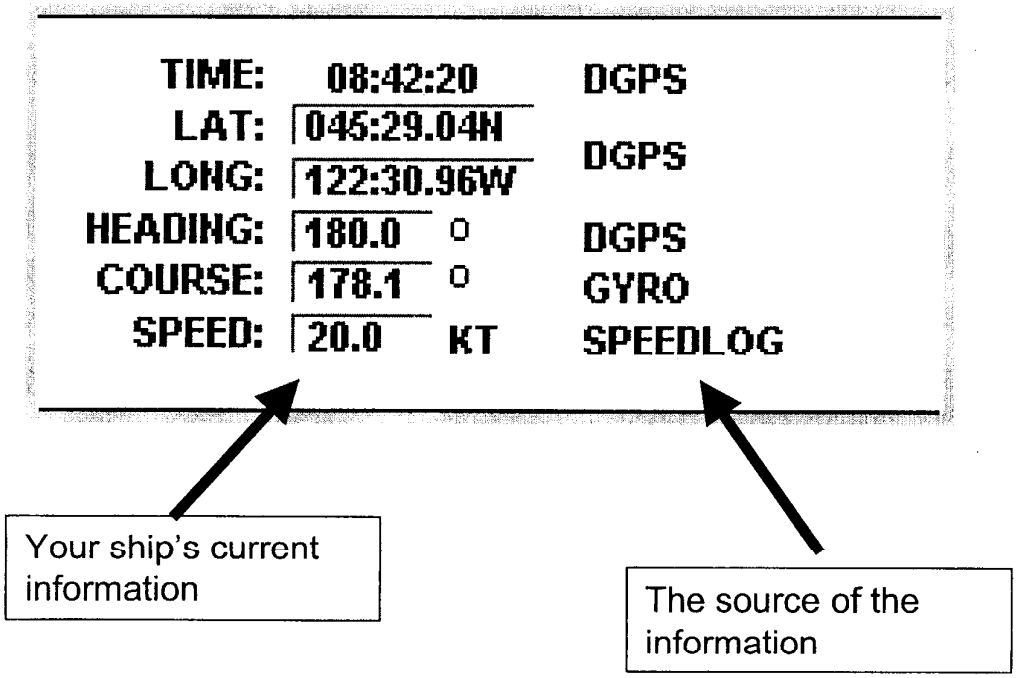
Navigation Hierarchy



This menu is a password protected system administration window used to assign navigation inputs to specific functions. If the radar input is being actively used by the radar it will be displayed in a green window. If the input is inactive or unavailable it will be displayed in a red window. The secondary inputs, displayed on the right side of the window, will take over if the primary inputs, displayed on the left side of the window, cannot be accessed by the radar. See the next page for more information.

OWN SHIP INFORMATION

Own ship information is determined by the settings in the Navigation Hierarchy menu. If this information is incorrect the radar will be wrong on all calculations.

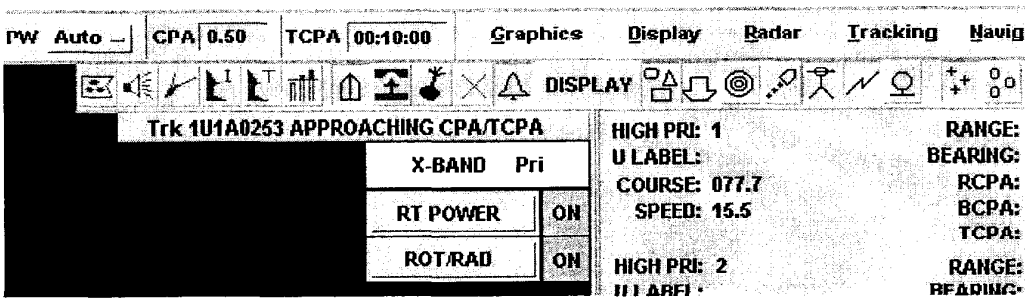


WARNING: If course is calculated **course over ground (COG)** than speed must also be calculated **over ground**. For example if DGPS is selected to input course information it should also be selected to input speed information. If course is calculated **through the water** than speed must also be calculated **through the water**. For example if Gyro is selected to input course information Speedlog should be selected to input speed information.

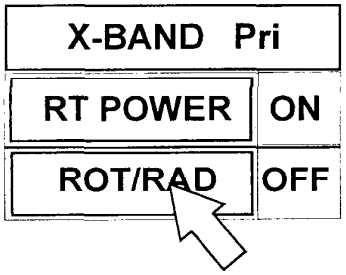
WARNING: Failure to assign proper inputs may cause serious errors in radar calculations and can pose a threat to safe navigation.

PLACING THE RADAR IN STAND-BY

This picture shows the radar status window in normal operating condition.



To place radar to stand-by press the ROT/RAD button. ROT/RAD will change form the color green and the word ON to the the color red and the word OFF.



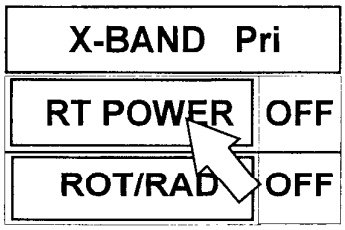
In this condition the radar antenna is not spinning and there are no pulses being sent out. There will be no radar image displayed on the screen.

The radar can be turned on immediately from this condition by placing the cursor over the words ROT/RAD and pressing the left trackball button.

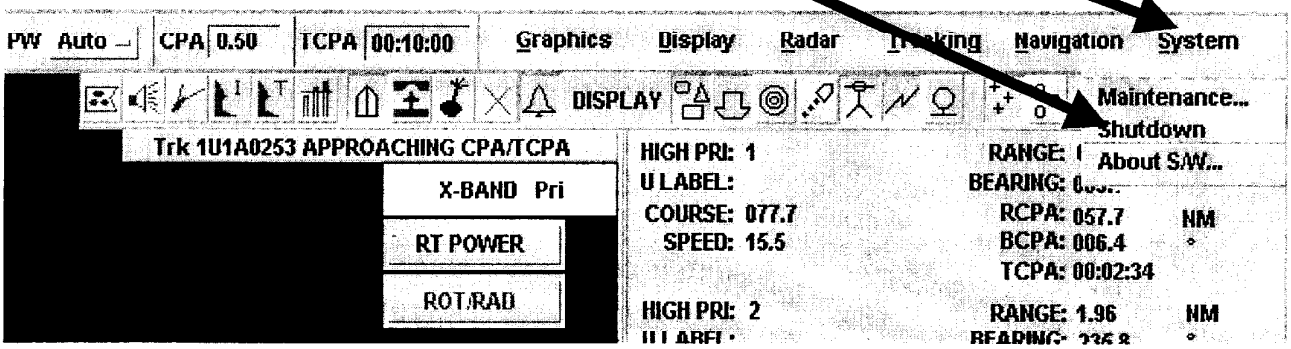
REBOOT

Begin with the radar in stand-by. (see pg. 57 for more on stand-by)

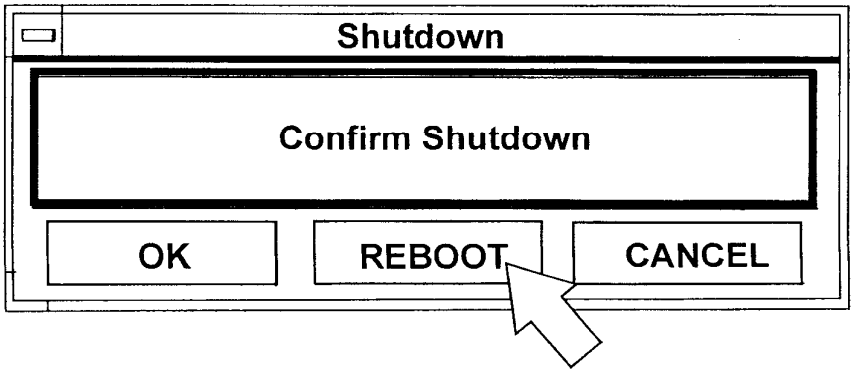
Turn the radar off by pressing the RT POWER button. A warning window will be displayed. Select OK. From this condition it will take 3 minutes to restart the radar.



Once the radar is turned off select the SYSTEM pull down menu. Select **SHUTDOWN.**



A warning window will be displayed select **REBOOT.**

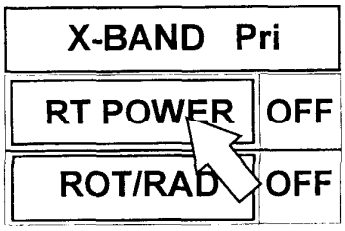


The radar will begin the reboot cycle. This process will take about 6 minutes.

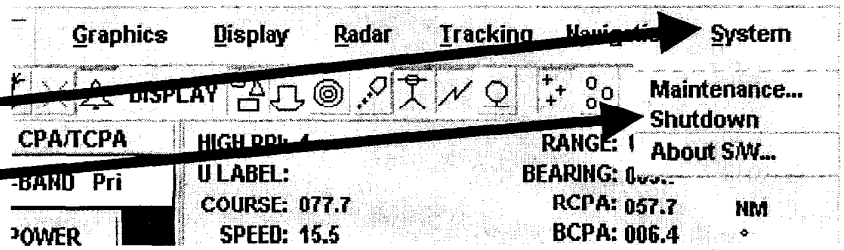
SHUTDOWN THE CONSOLE

Begin with the radar in stand-by. (see pg. 57 for more on stand-by)

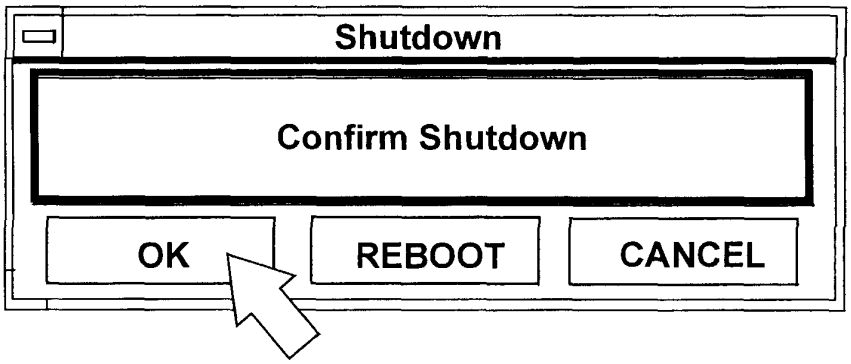
Turn the radar off by pressing the RT POWER button. A warning window will be displayed. Select OK. From this condition it will take 3 minutes to restart the radar.



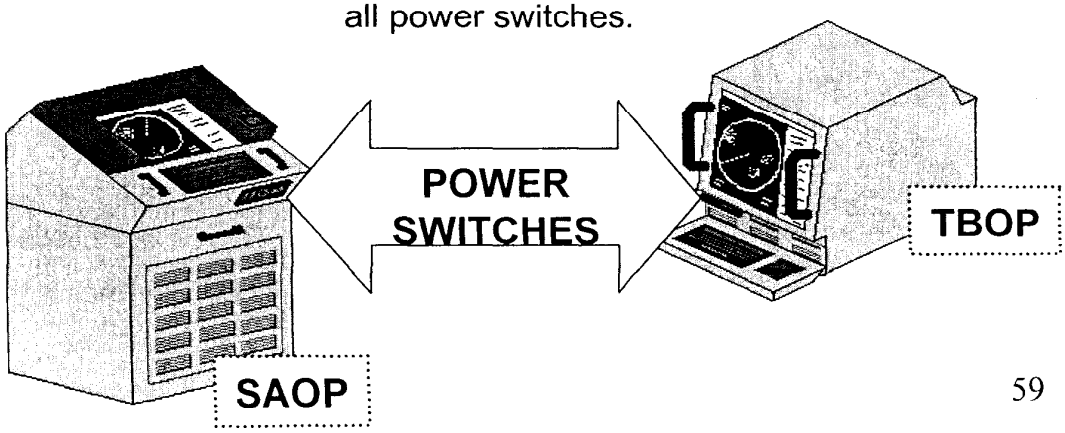
Once the radar is turned off select the SYSTEM pull down menu. Select **SHUTDOWN.**



A warning window will be displayed select OK. **Once the shutdown is complete it will take 6 minutes to start the radar.**



Wait for warning, ***IT WILL BE SAFE TO TURN OFF SAOP/TBOP WHEN THIS SCREEN DISAPPEARS,*** to disappear. Then secure all power switches.



EMERGENCY SHUTDOWN

Only used if the system does **NOT** have an interruptible power supply (UPS).

Emergency shutdown is used when the radar loses power unexpectedly.

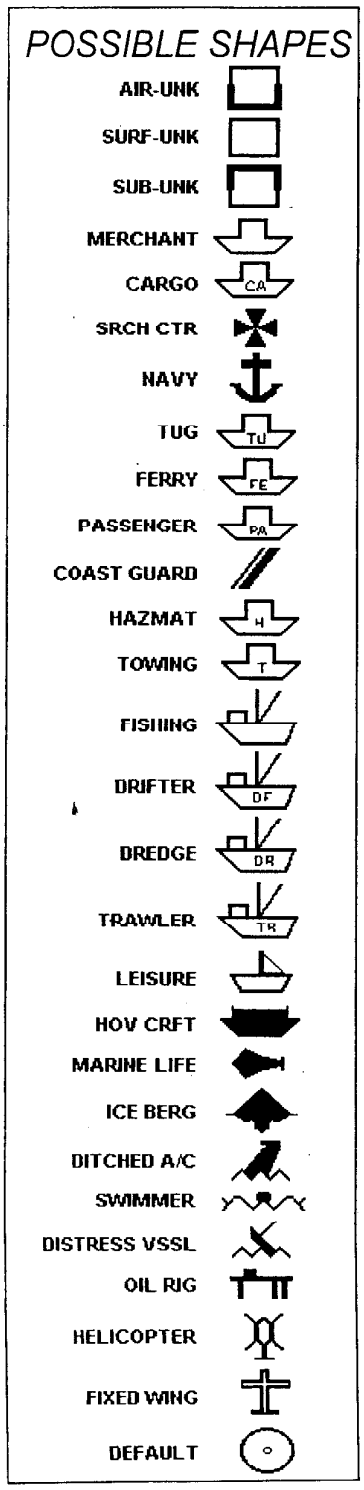
IMPORTANT: FAILURE TO SECURE POWER SWITCH DURING A POWER OUTAGE, BEFORE POWER IS REAPPLIED, MAY RESULT IN DAMAGE TO THE RADAR.

To shutdown the radar when power is lost to the console secure all three power switches on SAOP or the single power switch on TBOP.

SECTION SEVEN
Track Characteristics

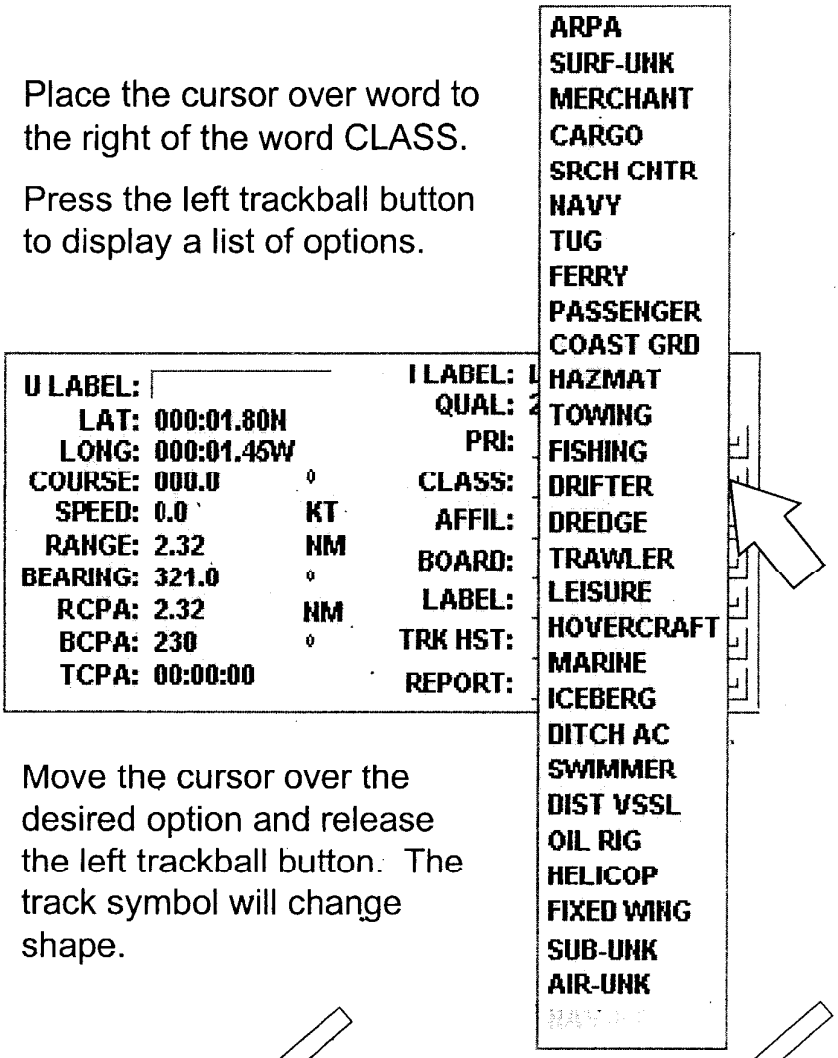
- Class
- Threat
- Boarding Status

Changing the **CLASS** will change the **SHAPE** of the track symbol.

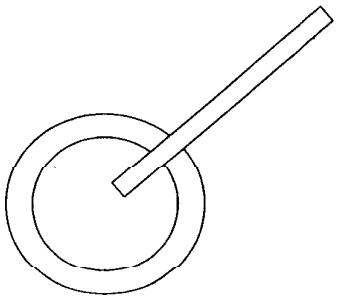


Place the cursor over word to the right of the word CLASS.

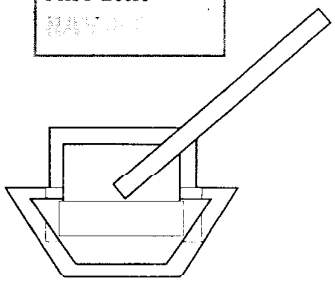
Press the left trackball button to display a list of options.



Move the cursor over the desired option and release the left trackball button. The track symbol will change shape.

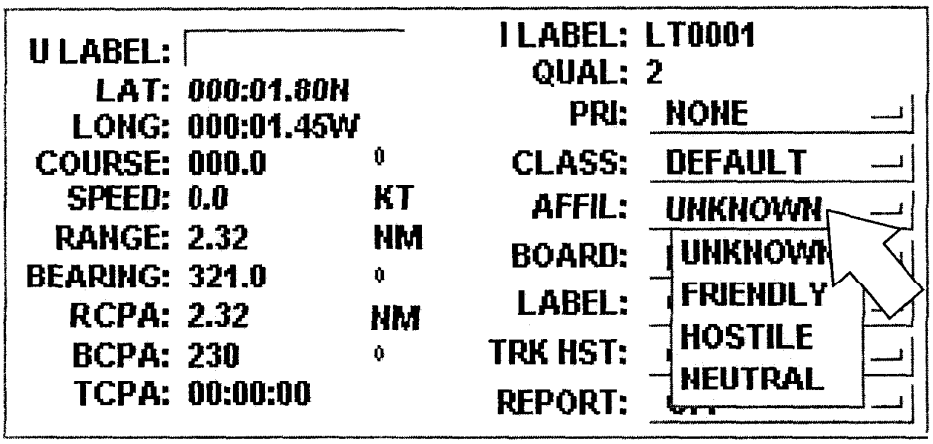


DEFAULT



MERCHANT

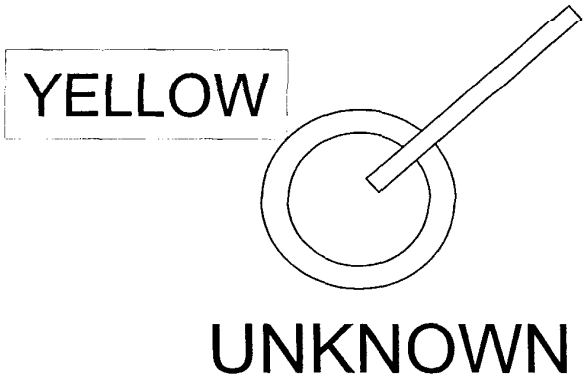
Changing the **AFFILIATION** will change the **COLOR** of the track symbol.

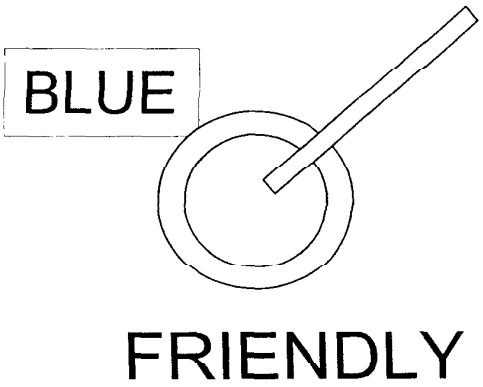


Place the cursor over word to the right of the word AFFIL.

Press and hold the left trackball button to display a list of options.

Move the cursor over the desired option and release the left trackball button. The track symbol will change color.





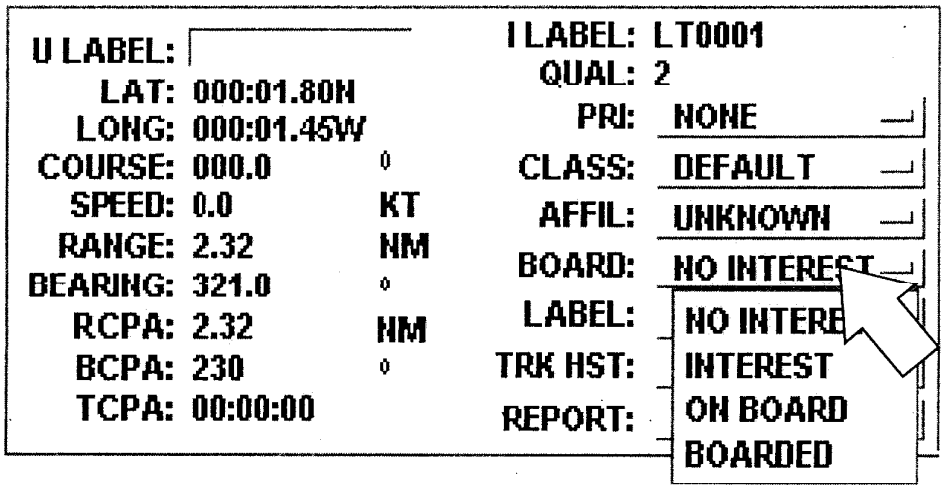
YELLOW: Unknown

BLUE: Friendly

RED: Hostile

GREEN: Neutral

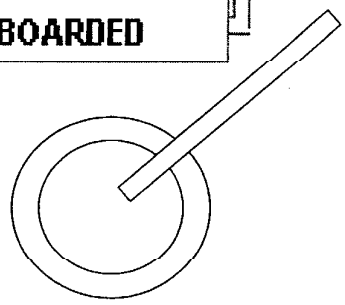
Changing the **BOARD** feature will put an **orange ring** around the track.



Place the cursor over word to the right of the word BOARD.

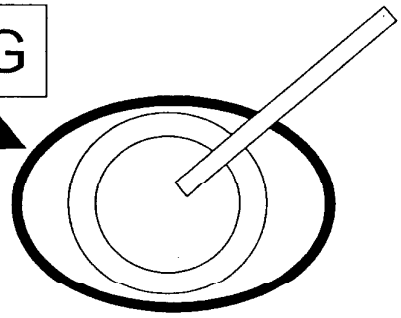
Press and hold the left trackball button to display a list of options.

Move the cursor over the desired option and release the left trackball button.



NO INTEREST

ORANGE RING



INTEREST

No Circle: No Interest

Orange circle: Interest

Flashing Orange Circle: On Board

Dashed Orange Circle: Boarded