JOINT PUB 3-50.1

NATIONAL SEARCH AND RESCUE MANUAL VOLUME II: PLANNING HANDBOOK

1 FEBRUARY 1991

U.S. COAST GUARD
Washington, D. C. 20593-0001

CHAIRMAN, JOINT CHIEFS OF STAFF
Washington, D. C. 20318-0200

JOINT Pub 3-50.1
COMDTINST M16120.6A
1 February 1991

MEMORANDUM FOR: Distribution List

Subject: National Search and Rescue Manual, Volume II: Planning Handbook

1. This Manual has been prepared under the direction of the Interagency Committee on Search and Rescue (ICSAR). It is intended for use as a reference book for providing specific information and instruction for search and rescue (SAR) planners and operational units during the conduct of civil SAR operations. This Manual complements the guidance provided in the National Search and Rescue System publication, Joint Pub 3-50/COMDTINST M16120.5 (series).

2. ICSAR has overall responsibility for this Manual and has assigned coordinating responsibilities for all changes to the U.S. Coast Guard. Recommendations for changes should be forwarded through appropriate channels to Commandant (G-NRS-1), U.S. Coast Guard, Washington, D.C. 20593-0001. Proposed changes will be distributed to all ICSAR member agencies for coordination within their respective agencies.

3. Military Services can obtain additional copies of this Manual through their respective servicing publication centers.

4. With this transmittal, this Manual, previously promulgated under U.S. Army FM 20-150, U.S. Navy NWP-19, and U.S. Air Force AFM 64-2, has been administratively repromulgated within the Joint Publication System. The U.S. Coast Guard directive number (COMDTINST M16120.6 series) remains unchanged due to the interagency nature of this Manual.

5. The National Search and Rescue Manual, Volume II (FM 20-150, NWP-19, AFM 64-2, and COMDTINST M16120.6) of 1 August 1986 is superseded and cancelled. Stocks of old manuals shall be destroyed without report.

6. The major changes to Volume II included in this revision are:

   a. Update of information and graph on water chill.

   b. Expansion and update of FLAR sweep width tables.

   c. Expansion and update of tables and associated information on sweep widths for visual distress signals.

7. The lead agent for this Manual is the U.S. Coast Guard.

8. The Joint Staff doctrine sponsor for this Manual is the Director, J-7, Joint Staff.

For the U.S. Coast Guard:

R. A. APPELBAUM
Rear Admiral, U. S. Coast Guard
Chief, Office of Navigation Safety and
Waterway Services
30 October 1990

For the Chairman,
Joint Chiefs of Staff:

T. R. COBERLY
Colonel, U. S. Army
Secretary, Joint Staff

08 January 1991

Distribution:

By Secretary, Joint Staff: (DO NOT INCLUDE COAST GUARD)

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Active Army: ARNG: USAR: To be distributed in accordance with DA Form 12-11A, Requirements for National Search and Rescue Manual

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U. S. Coast Guard (SDL No. 129):
A: abce(3); fghmu(2); ijklnopqrsv(1)
B: bk(3); c(25 Districts only); dmqvxyz(1); e(80); ghopr(5); j(1000); l(26); n(500); su(2)
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PREFACE
Volume II: Planning Handbook

1. **PURPOSE.** This Manual, prepared under the direction of the Interagency Committee on Search and Rescue (ICSAR), provides guidance to federal agencies concerned with the implementation of the National Search and Rescue Plan. It was intended for use as a reference book for providing specific information and instruction for search and rescue (SAR) planners and operational units during the conduct of civil SAR operations.

2. **BACKGROUND.**

a. The National Search and Rescue Plan, which is promulgated as Appendix A to the National Search and Rescue System publication, Joint Pub 3–50/COMDTINST M16120.5 (series), centers on three key concepts. First the plan implements the provisions of several conventions of the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO). These conventions require establishment of a national civil system with internationally recognized aeronautical and maritime SAR coordination responsibilities. Secondly the plan includes provisions to satisfy national SAR requirements. Finally, since no single U.S. organization has sufficient SAR resources to provide adequate SAR services, the National Search and Rescue Plan establishes the principle that Rescue Coordination Centers (RCCs) should use "all available" resources, to include federal, state, local and private, to respond to cases of persons and property in distress.

b. ICSAR, sponsored by the U.S. Coast Guard, is a federal interagency standing committee chartered to accomplish the following objectives:

(1) Oversee the National Search and Rescue Plan and coordinate development of interagency policies and positions on SAR matters;

(2) Provide an interface with other national agencies involved with emergency services; and

(3) Provide a forum for coordinated development of compatible procedures and equipment to increase the effectiveness and standardization of SAR operations.

ICSAR member agencies include: the Department of Transportation, the Department of Defense, the Department of Commerce, the Federal Emergency Management Agency, the Federal Communications Commission, the National Aeronautics and Space Administration, and the Department of Interior.

3. **SCOPE.**

a. This Manual complements the established standards and guidance concerning civil SAR operations provided in the National Search and Rescue System publication, Joint Pub 3–50/COMDTINST M16120.5 (series). It serves as a convenient search planning guide for operational units, and particularly for search planners.

b. Additional SAR planning guides unique to a single agency should be promulgated by that agency as a separate addendum, using the following assigned colored coded pages:

Salmon – U.S. Coast Guard	**Blue** – U.S. Navy
Green – U.S. Air Force	**Yellow** – U.S. Army
Red – Civil Air Patrol	**Pink** – U.S. Civil Agency or Administration

Record of Changes

Change No.	Regular or interim	Date of change	By whom entered	Date entered

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VOLUME I – NATIONAL SEARCH AND RESCUE SYSTEM[1]

VOLUME II – PLANNING HANDBOOK[1]

Notes: [1] Volumes I and II are published separately. The contents of both volumes are included here for reference.

ABBREVIATIONS/ACRONYMS

A	Search Area
A/C	Aircraft
ACP	Allied Communications Publication
ACV	Air Cushion Vehicle
ADCOM	Air (Aerospace) Defense Command
ADF	Automatic Direction Finding
AECC	Aeromedical Evacuation Control Center
AFB	Air Force Base
AFRCC	Air Force Rescue Coordination Center
AFS	Aeronautical Fixed Service
AFTN	Aeronautical Fixed Telecommunications Network
AGIL	Airborne General Illumination Lightself
AIM	Airman's Information Manual
ALERFA	Alert Phase (ICAO)
ALNOT	Alert Notic
AM	Amplitude Modulation
A_{mc}	Midpoint Compromise Search Area
AMVER	Automated Mutual–Assistance Vessel Rescue System
AOPA	Aircraft Owner's and Pilot's Association
ARC	American (National) Red Cross
ARINC	Aeronautical Radio Incorporated
ARS	Air Rescue Service
ARTCC	Air Route Traffic Control Center
ARTSIII	Automated Radar Tracking System
ASCC	Air Standardization Coordinating Committee
ASW	Anti–Submarine Warfare
ASW	Average Surface Winds
A_t	Total Attainable Search Area
ATC	Air Traffic Control
ATCC	Air Traffic Control Center
ATS	Air Traffic Service
AUTODIN	Automatic Digital Network
AUTOVON	Automatic Voice Network
AWACS	Airborne Warning and Control System
B	Cross–Over Barrier Pattern
BC	Bottom Current
BIAS	Battlefield Illumination Assistance System
C	Coverage Factor
C	Creeping Line pattern
CAP	Civil Air Patrol
CASP	Computer–Aided Search Planning
CASPER	Contact Area Summary Position Report
CCIR	International Radio Consultative Committee
C/C	Cabin Cruiser
CDR	Continuous Data Recording
CES	Coast Earth Station
CF	Drift Error Confidence Factor
CGAS	Coast Guard Air Station
CGAUX	Coast Guard Auxiliary
CHOP	Change Operational Control
CHRIS	Chemical Hazard Response Information System
CIC	Combat Information Center
CIRM	International Radio–Medical Center
Cm	Mean Coverage Factor
C_{mc}	Midpoint Compromise Coverage Factor
COMCEN	Communications Center

COSPAS	Cosmicheskaya Sistyema Poiska Avariynych Sudov – Space System for Search of Distressed Vessels (USSR Satel. Sys.)
COTP	Captain of the Port
CPA	Closest Point of Approach
CPI	Crash Position Indicator
CPR	Cardropulminary Resusitation
CRS	Coastal Radio Station
CS	Call Sign
CS	Coastal Station
CS	Creeping Line Single–Unit
CSC	Creeping Line Single–Unit Coordinated
CSP	Commence Search Point
CSS	Coordinator Surface Search
CW	Carrier Wave
D	Total Drift
d	Surface Drift
D_a	Aerospace Drift
DAN	Diver's Alert Network
DSC	Digital Selective Calling
DD	Navy Destroyer
De	Total Drift Error
d_e	Individual Drift Error
d_{ea}	Aerospace Drift Error
d_e max	Maximum Drift Error
d_e min	Minimum Drift Error
d_e minimax	Minimax Drift Error
DETRESFA	Distress Phase (ICAO)
DF	Direction Finding
DMAHT	Defense Mapping Agency Hydrographic Topographic Center
dmax	Maximum Drift Distance
DMB	Datum Marker Buoy
DME	Distance Measuring Equipment
dmin	Minimum Drift Distance
DMO	Directory Maintainance Official
DOC	Department of Commerce
DOD	Department of Defense
DOI	Department of Interior
DOT	Department of Transportation
dp	Parachute Drift
DR	Dead Reckoning
DR_e	Dead Reckoning Error
DRT	Dead Reckoning Tracer
DSC	Digital Selective Calling
DTG	Date–Time Group
E	Total Probable Error
E–ARTS	En Route Automated Radar Tracking System
ECM	Electronic Countermeasures
ELBA	Emergency Location Beacon
ELINT	Electronic Intelligence
ELR	Extra–Long–Range Aircraft
ELT	Emergency Locator Transmitter
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EOD	Explosive Ordnance Disposal
EPIRB	Emergency Position–Indicating Radio Beacon
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETI	Estimated Time of Intercept
EXCOM	Extended Communications Search
F	Flare Patterns
FACSFAC	Fleet Area Control and Surveillance Facility
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FF	Navy Fast Frigate
F^f	Fatigue Correction Factor
FGMDSS	Future Global Maritime Distress and Safety System
FIR	Flight Information Region

FIS	Flight Information Service
FIX_e	Navigational Fix Error
FLAR	Forward–Looking Airborne Radar
FLIP	Flight Information Publication
FLIR	Forward–Looking Infrared Radar
FM	Flare Multiunit
FM	Frequency Modulation
FNOC	Fleet Numerical Oceanographic Command
FOV	Field of View
FS	Flare Single–Unit
fs	Search Radius Safety Factor
FSS	Flight Service Station
FTS	Federal Telephone Service
F^v	Aircraft Speed Correction Factor
F/V	Fishing Vessel
F^w	Weather Correction Factor
GCI	Ground Control Intercept
GEOREF	Geographic Reference
GMDSS	Global Maritime Distress and Safety System
GS	Ground Speed
gt	Gross Tons
H	Homing Pattern
HEL–H	Heavy Helicopter
HEL–L	Light Helicopter
HEL–M	Medium Helicopter
HF	High Frequency
HFDF	High Frequency Direction–Finding
HQ	Headquarters
HS	Homing Single–Unit
IADB	Inter–American Defense Board
I/B	Inboard
IC	Incident Commander
ICAO	International Civil Aviation Organization
ICS	Incident Command System
ICSAR	Interagency Committee on Search and Rescue
IFF	Identification, Friend or Foe
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IMO	International Maritime Organization
IMOSAR	IMO Search and Rescue Manual
INCERFA	Uncertainty Phase (ICAO)
INMARSAT	International Maritime Satellite
INREQ	Information Request
INS	Inertial Navigation System
INTERCO	International Code of Signals
IP	Initial Position
IRC	International Red Cross
ITU	International Telecommunications Union
JANAP	Joint Army Navy Allied Publication
JASREP	Japanese Vessel Reporting System
JRCC	Joint Rescue Coordination Center
JRSC	Joint Rescue Sub–Center
kHz	Kilohertz
kt	Knot (Nautical Miles Per Hour)
L	Length
l	Search Subarea Length
LARC	Light Amphibious Resupply Cargo
LC	Lake Current
LCB	Line of Constant Bearing
LKP	Last Known Position
LOP	Line of Position
LORAN	Long–Range Aid to Navigation
LRG	Long–Range Aircraft
LUT	Local User Terminal
LW	Leeway

MAC	Military Airlift Command
MARAD	Maritime Administration, USMER vessels tracked by AMVER
MAROP	Marine Operators
MARSA	Military Assumes Responsibility for Separation of Aircraft
MAS	Military Agency for Standardization
MAST	Military Assistance to Safety and Traffic
MCC	Mission Control Center
MCW	Modulated Carrier Wave
M-DARC	Military Direct Access Radar Channel
MEDICO	International word meaning a radio medical situation
MEDEVAC	Medical Evacuation
MERSAR	Merchant Vessel Search and Rescue Manual
MF	Medium Frequency
MHz	Megahertz
MOA	Military Operating Area
MPA	Maritime Patrol Aircraft
MRA	Mountain Rescue Association
MRCI	Maximum Rescue Coverage Intercept
MRU	Mountain Rescue Unit
MSIS	Marine Safety Information System
MSO	Marine Safety Office
M/V	Merchant Vessel
N	Number of SRUs
n	Number of Required Track Spacings
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NASAR	National Association for Search and Rescue
NAS Computer	National Airspace System Computer
NATO	North Atlantic Treaty Organization
NAVSAT	Navigation Satellite
NBDP	Narrow Band Direct Printing
NCIC	National Crime Information Center
NM	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NPS	National Park Service
NSM	National SAR Manual
NSP	National Search and Rescue Plan
NTAP	National Track Analysis Program
NTSB	National Transportation Safety Board
NWS	National Weather Service
O	Contour Pattern
O/B	Outboard
OCC	Coast Guard Operations Computer Center
OCMI	Officer in Charge, Marine Inspection
ODIN	Operational Digital Network
OM	Contour Multiunit
OPCEN	Coast Guard Operations Center
OS	Contour Single-Unit
OSC	On Scene Commander
OSE	On Scene Endurance
OSV	Ocean Station Vessel
P	Parallel Pattern
PANS	Procedures for Air Navigation Services
PB	Patrol Boat
P^c	Cumulative Probability of Detection
P/C	Pleasure Craft
P_d	Drift Compensated Parallelogram Pattern
PFD	Personal Flotation Device
PIW	Person in Water
PLB	Personal Locator Beacon
PM	Parallel Track Multiunit

PMC	Parallel Multiunit Circle
PMN	Parallel Track Multiunit Non-Return
PMR	Parallel Track Multiunit Return
POB	Persons on Board
POD	Probability of Detection
POS	Probability of Success
PRECOM	Preliminary Communications Search
PRU	Pararescue Unit
PS	Parallel Track Single-Unit
PSL	Parallel Track Single-Unit Loran
PSS	Parallel Single-Unit Spiral
R	Search Radius
RADF	Radarfind
RAE	Right of Assistance Entry
RATT	Radio Teletype
RB	Short-Range Coastal or River Boat
RC	River Current
RCC	Rescue Coordination Center
RDF	Radio Direction Finder
RNAV	Area Navigation
R_o	Search Radius Rounded to Next Highest Whole Number
RSC	Rescue Sub-Center
RU	Rescue Unit
RV	Long-Range Seagoing Rescue Vessel
S	Square Pattern
S	Track Spacing
SAC	Strategic Air Command
SAR	Search and Rescue
SARMIS	Search and Rescue Management Information System
SARSAT	Search and Rescue Satellite-Aided Tracking
SARTEL	SAR Telephone (Private Hotline)
SATCOM	Satellite Communications
SC	SAR Coordinator
SC	Sea Current
SEAL	Navy Sea-Air-Land Unit
SECRA	Secondary Radar Data Only
SIF	Selective Identification Feature
SITREP	Situation Report
SL	Sea Level
SLAR	Side-Looking Airborne Radar
SM	Searchmaster (Canadian)
SMC	SAR Mission Coordinator
S_{mc}	Midpoint Compromise Track Spacing
SMIO	SAR Mission Information Officer
SOA	Speed of Advance
SOFAR	Sound Fixing and Ranging
SOLAS	Safety of Life at Sea
SPOC	Search and Rescue Points of Contact
SRG	Short-Range Aircraft
SRR	Search and Rescue Region
SRS	Search and Rescue Sector
SRU	Search and Rescue Unit
SS	Submarine
S/S	Steam Ship
SSB	Single Side Band
ST	Strike Team
SU	Search Unit
SUC	Surf Current
SURPIC	Surface Picture
S/V	Sailboat
SVR	Surface Vessel Radar
SWC	Swell/Wave Current
T	Search Time Available
T	Trackline Pattern
TACAN	Tactical Air Navigation
TAS	True Air Speed
TC	Tidal Current
TCA	Time of Closest Approach
TCA	Terminal Control Area
TD	Total Drift
TELEX	Teletype

TFR	Temporary Flight Restriction
TLX	Teletype
TMN	Trackline Multiunit Non-Return
TMR	Trackline Multiunit Return
TPL	Telephone Private Lines
TPX-42(DAIR)	TPX-42 Direct (Altitude and Identity Readout)
TRACON	Terminal Radar Approach Control Facility
TSN	Trackline Single-Unit Non-Return
TSR	Trackline Single-Unit Return
T/V	Tank Vessel
TWC	Total Water Current
TWPL	Teletypewriter Private Lines
TWX	Teletypewriter Exchange
U	Wind Speed
UDT	Underwater Demolition Team
UHF	Ultra-High Frequency
UMIB	Urgent Marine Information Broadcast
USA	United States Army
USAF	United States Air Force
USB	Upper Side Band
USC	United States Code
USCG	United States Coast Guard
USMER	U.S. Merchant Ship Vessel Locator Reporting System
USN	United States Navy
USSR	Union of Soviet Socialist Republics
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator Grid
V	Sector Pattern
V	SRU Ground Speed
v	Velocity of Target Drift
VARVAL	Vessel Arrival Data, List of vessels available to MSOs and COTPs.
VDSD	Visual Distress Signaling Device
VFR	Visual Flight Rules
VHF	Very High Frequency
VLR	Very-Long-Range Aircraft
VOR	Very High Frequency Omnidirectional Range Station
VORTAC	VHF Omnidirectional Range Station/Tactical Air Navigation
VS	Sector Single-Unit
VSR	Sector Single-Unit Radar
W	Sweep Width
w	Search Subarea Width
WC	Wind Current
WHEC	Coast Guard High-Endurance Cutter
WHO	World Health Organization
WMEC	Coast Guard Medium-Endurance Cutter
WMO	World Meteorological Organization
WPB	Coast Guard Patrol Boat
W^u	Uncorrected Sweep Width
X	Initial Position Error
XCVR	Transceiver
XSB	Barrier Single Unit
Y	SRU Error
Z	Effort
Z_t	Total Available Effort

CHAPTER 1. SAR STAGE EVALUATION

100 MASTER SAR MISSION FLOWCHART (for RCCs, RSCs, and SMCs)

A. Record data

B. Start plot of situation

C. Assign emergency phase and go to the appropriate paragraph.

1. Uncertainty phase .... paragraph 110

2. Alert phase .... paragraph 120

3. Distress phase .... paragraph 130

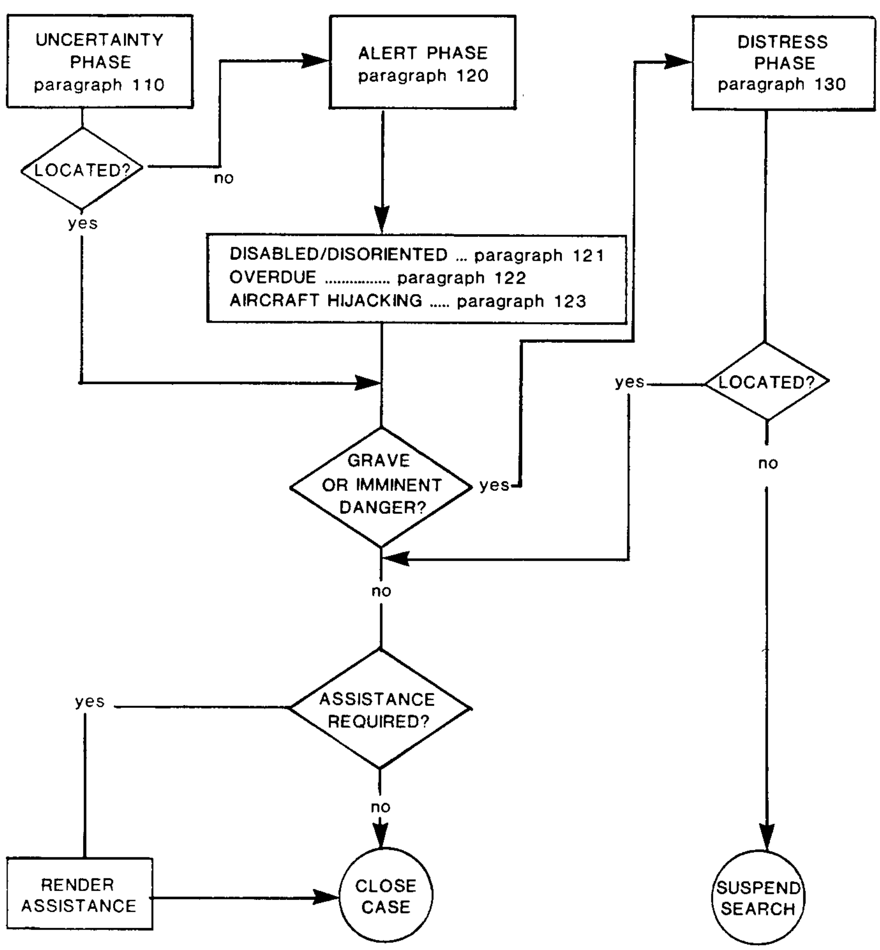


Figure 1-1. Master SAR Mission Flowchart

110 UNCERTAINTY PHASE CHECKLIST

1. Verify departure and nonarrival.
2. Assist ATC authorities with PRECOM (aircraft).
3. Conduct PRECOM (vessels).
4. Include information requests in scheduled broadcasts.
5. Provide news release to media.
6. Issue appropriate notices.
7. If located and safe:
   a. Close case.
   b. Cancel broadcasts and notices.
   c. Send required reports.
   d. Notify all concerned.
8. If not located by PRECOM, execute EXCOM, consider advancing to the Alert phase.

120 ALERT PHASE CHECKLISTS

121 Disabled or Disoriented Checklist

1. Pass control to State or local authorities, when appropriate.
2. Issue urgent broadcasts to obtain assistance.
3. Obtain information on positions of ships at sea and request assistance as necessary.
4. Dispatch SRU(s) to provide assistance.
5. Alert DF nets.
6. Request ATC authority to request assistance from en route aircraft.
7. If disabled unit regains normal operations, monitor until assured of safety.
8. When unit is no danger, cancel broadcasts and notify all concerned.
9. Close case when assistance has been completed.
10. If situation deteriorates and a unit or person is in grave and imminent danger, advance to Distress phase.

122 Overdue Checklist

A. Overdue Aircraft

1. Alert SRU(s).
2. Request ATC authorities to attempt contact.
3. Check FAA National Track Analysis Program (NTAP).
4. Alert radar and DF nets.
5. Have ATC authority alert en route aircraft.
6. Alert other agencies.
7. Alert adjacent RCCs or other SAR authorities.
8. Start search planning.
9. Dispatch SRU for initial search.
10. Designate SMC.
11. Use (as appropriate):
    a. NOTAMs.
    b. News media broadcasts.
12. If located:
    a. Close case.
    b. Cancel broadcast and notices.
    c. Notify all concerned.
13. When situation deteriorates and a unit or person is considered to be in grave and imminent danger, advance to Distress phase.

B. Overdue Vessel

1. Alert SRU(s).
2. If submersible, request Navy to declare event SUBMISS.
3. Complete PRECOM and execute EXCOM.
4. Alert other agencies.
5. Alert adjacent RCCs or other SAR authorities.
6. Start search planning.
7. Dispatch SRU for initial search.
8. Designate SMC.
9. Use (as appropriate):
   a. Urgent broadcasts.
   b. Hydros.
   c. Notice to Mariners.
   d. News media broadcasts.
10. If located:
    a. Close case.
    b. Cancel broadcast and notices.
    c. Notify all concerned.
11. If not located by completion of EXCOM, advance to Distress phase.
12. When situation deteriorates and a unit or person is considered to be in grave and imminent danger, advance to Distress phase.

123 Aircraft Hijacking

While an aircraft hyjacking is not a SAR case, it is potentially one.

1. Alert other agencies, such as the FBI or FAA.
2. Alert SRU(s).
3. Alert adjacent RCCs or other SAR authorities.
4. Alert radar and DF nets.
5. Dispatch SRU as requested by other agencies.
6. When it is probable that the aircraft is about to make a forced landing or ditch, or has done so, advance to Distress phase.

130 DISTRESS PHASE CHECKLIST

1. Pass control to appropriate authority.
2. Notify adjacent RCCs/RSCs or other SAR authorities.
3. Dispatch SRUs.
4. If submersible or underwater habitat request Navy to declare SUBSUNK.

5. Dispatch any specialized units needed.
6. Develop initial search area and track spacing.
7. Provide SRUs with mission information.
8. Identify SMC or OSC.
9. Consider use of multiple OSCs.
   a. Air OSC.
   b. Surface OSC.
   c. Geographical OSC.
10. Assign on scene frequencies.
11. Direct the use of ESCPs and DMBs.
12. Select search patterns.
13. Ensure briefing of search crews.
14. Pass instructions to OSC.
15. Request other available agencies to provide assistance.
16. Query radar and DF nets.
17. Issue distress broadcasts.
18. Request news media to include urgent requests for information.
19. Obtain SURPIC.
20. Have ATC authority alert en route aircraft.
21. Maintain communications link with distressed unit.
22. Inform distressed unit of action taken.
23. Send request for assistance to specific vessels.
24. Begin planning for extended search efforts.
25. Use computer search planning (CASP).
26. Establish contact and maintain liaison with distressed unit's operational agency.
27. Notify authorities of country of registry of distressed unit.
28. Notify accident investigation authorities.
29. Maintain records and charts of search activities and estimates of effectiveness.
30. Send required reports.
31. Ensure debriefing of SAR crews.
32. If search is successful and rescue effected, cancel broadcasts and close case.
33. If search is unsuccessful:
   a. Continue operations until all reasonable effort has been made.
   b. Obtain concurrence of SAR Coordinator and suspend search.
34. Notify all concerned of actions taken.
35. Send required final reports.

140 INCIDENT PROCESSING FORMS

Incident Processing Forms should have the following information:

A. Air or Marine Craft Incident Data

1. Nature of emergency (fire, collision, man overboard, disabled, overdue, bailout, crash, etc.).
2. Position and time of emergency (latitude/longitude or bearing/distance from known point or last reported position and next reporting position), including:
   a. Heading/speed/altitude.
   b. For boats – fathometer readings, LORAN C lines, ranges and bearing, aids to navigation, and other vessels in the area or recently seen.
3. Initial reporter (name/telephone or address if person; name/call sign if craft: ARTCC; parent agency).
4. Distressed craft name or type/call sign.
5. Persons on board (POB).
6. Sighting of survivors or parachutes.
7. Craft description (size, type, craft number, hull color, cabin color, deck color, rigging, fuselage color, tail color, wingtip color, aircraft "tail" number, vessel number, sail number, etc.).
8. Secondary targets.
9. Radio frequencies in use, monitored, or scheduled.
10. Emergency radio equipment and frequencies, including EPIRB.
11. On scene weather and sea conditions (see F. below).
12. Assistance desired, or received.
13. Fuel on board/available endurance.
14. Navigation equipment.
15. Survival equipment.
16. Food/water duration.
17. Date/time of initial report.
18. Other pertinent information.

B. Air or Marine Craft Overdue Incident Data

1. Initial reporter (name/telephone or address if person; name/call sign if craft: ARTCC; parent agency).
2. Distressed craft name or type/call sign.
3. Persons on board (POB).
4. Date, time, and point of departure, planned route, speed of advance (SOA/), ETA, and point of destination.
5. Possible route deviations.
6. Craft description (size, type, craft number, hull color, cabin color, deck color, rigging, fuselage color, tail color, wingtip color, etc.).
7. Secondary targets.
8. Radio equipment on board, frequencies available, frequencies monitored, and scheduled report times.
9. Emergency radio equipment and frequencies, including EPIRB.
10. Weather history and forecast along the proposed route (see F. below).
11. Other information sources (friends, relatives, associates, agents, agency).
12. Fuel on board/available endurance.
13. Navigation equipment.
14. Survival equipment.
15. Food/water duration.
16. Auto/boat trailer license, description, location.
17. Date/time of initial report.
18. Other pertinent information, such as a craft's

history of timely reporting and arrivals.

C. Man Overboard Incident Data

1. Craft with man overboard (name or type/call sign or number).
2. Position and time of emergency (latitude/longitude or bearing/distance from known point or last reported position and next reporting position). This includes verification information:
   a. Heading/speed.
   b. For boats, fathometer readings, LORAN C lines, ranges and bearing, aids to navigation, and other vessels in the area or recently seen.
3. Date/time of present position.
4. Craft's course/speed and destination.
5. Date/time of man overboard position.
6. Initial reporter (parent agency, radio station, name/call sign of craft).
7. Estimated water temperature.
8. Person's name, age, sex.
9. Person's physical condition and swimming capability.
10. Person's clothing amount and color, including life preserver.
11. Has craft made search?
12. Will craft remain and search and for how long?
13. Radio frequencies in use, monitored, or scheduled.
14. On scene weather and sea conditions (see F. below).
15. Assistance being received.
16. Other pertinent information.

D. MEDICO/MEDEVAC Incident Data

1. Initial reporter (parent agency, radio station, name/call sign if craft, name/telephone or address if person).
2. Craft with medico (name or type/call sign or number).
3. Craft's position (latitude/longitude or bearing/distance).
4. Date/time of position.
5. Craft's course/speed.
6. Patient name, nationality, age, sex, race.
7. Patient symptoms.
8. Medication given.
9. Standard medicine chest or other medication available.
10. Radio frequencies in use, monitored, or scheduled.
11. Craft description.
12. M/V's local agent.
13. Craft's last port of call, destination, ETA.
14. On scene weather and sea conditions (see F. below).
15. Assistance desired, if not obvious (CIRM relay or local medical advice).
16. Assistance being received.
17. Other pertinent information.

E. Lost Person Incident Data

1. Initial reporter (name/telephone or address).
2. Name of missing person.
3. Location and date/time last seen.
4. Known intentions or possible actions of missing person.
5. Age and physical description of missing person.
6. Clothing, footgear, and equipment.
7. Physical and mental condition.
8. Knowledge of area.
9. Outdoor experience.
10. Weather conditions (see F. below)
11. Action being taken.
12. Assistance desired, if not obvious.
13. Date/time of initial report.
14. Nearest relative (name/telephone or address).
15. Other pertinent information.

F. Weather Information. The individual reporting an incident should be asked about existing weather conditions when the position of a distress is in doubt.

1. Visibility and any obscurations such as fog, smoke, or haze, and the time of any recent changes.
2. Water or snow surface conditions.
3. Wind direction and velocity, and recent changes.
4. Sky condition and recent changes.
5. Temperature of water and air.
6. Barometric reading.
7. Whether rain or snow is falling or has fallen, and time of beginning and ending of fall.
8. Whether severe weather such as thunder storms, snow, hail, ice pellets, or freezing rain are occurring or have occurred, and at what times it began or ended.

150 PRECOMS AND EXCOMS

151 PRECOM for Marine Craft

A PRECOM for marine craft may include the following:

A. All Coast Guard facilities in the area should check radio log and records for any information.

B. Checks that give a thorough and rapid coverage of the area should be made, such as:

1. Bridge and lock tenders.
2. Local harbor patrols.
3. Marinas, yacht clubs, and other waterside facilities.
4. Dockmasters.
5. Harbor masters.

6. Local police (for boat launching ramps).

C. The CGAUX may be used.

D. If the missing craft is known to have a radio aboard, Coast Guard units should attempt contact. Marine operators in the search areas should be asked to check their logs for traffic to or from the craft. Public correspondence marine operators (MAROP) should be asked to attempt at least one contact.

E. If the departure point of the craft is in the search area, the actual departure and time should be confirmed. The craft's nonarrival should be confirmed and a request made that the nearest Coast Guard unit be notified immediately if it does arrive. These actions should be stated in the SITREP reporting the PRECOM results to the SMC.

F. Each facility need be contacted only once during the PRECOM.

G. A report by SITREP to the SMC should be sent when PRECOM is completed.

H. When a vessel is overdue from a long sea voyage, SAR authorities in other countries may be requested to assist through their RCCs or through naval or other military channels. The USDAO, Defense Attache Officer, at a U.S. Embassy, or consular officials, may also be contacted directly for assistance. In the latter case the U.S. Department of State should be made an information addressee on all messages.

152 EXCOM for Marine Craft

An EXCOM for marine craft may include the following:

A. During EXCOM, facilities checked during PRECOM should normally be rechecked at least every 24 hours, and preferably every 8 to 12 hours.

B. Additional facilities to be contacted during an EXCOM usually are left to the discretion of the command conducting the EXCOM. However, a listing of these facilities should be fixed with the RCC. An EXCOM should provide a thorough and blanket coverage of the area. Facilities and sources of information may include:

1. Bridge and lock tenders.
2. Vessel/boat agents.
3. Local, county, and State police.
4. Police harbor patrols.
5. Harbor masters, port authorities.
6. Marinas, docks, yacht clubs.
7. Fish companies, fisherman associations.
8. Park service, forest rangers.
9. Fuel suppliers.
10. Ice houses.
11. Ship chandlers, repair yards.
12. Customs, immigration (if applicable).
13. Major tug companies (in large ports and rivers).
14. Relatives and neighbors.

C. All facilities and persons contacted during this phase should be asked to maintain a lookout for the objective during the course of their normal operations and to notify the nearest Coast Guard unit if it is sighted. A definite time limit should be set so it will not be necessary to recontact these numerous sources to de-alert them after the vessel or boat has been located. If information is still desired after this period another EXCOM should be started.

D. Local CGAUX should be notified and asked to keep a lookout during their normal cruising.

E. If the missing craft is radio equipped, stations conducting the EXCOM should attempt contact every 4 hours for 24 hours. If it is known that the vessel has the appropriate frequencies, the marine operator should be asked to call the vessel on the same schedule, and to watch for any pertinent information received from other marine craft.

F. Local press, radio, and television coverage should be made during this phase for further dissemination of, and solicitation for, information on the missing craft.

G. Since numerous facilities must be checked during the EXCOM, it is not likely to be completed in a matter of hours, particularly if directed at night or on a weekend, as it may be necessary to wait for normal working hours to contact many sources. A listing must be maintained of the facilities contacted that will have to be rechecked. This will ensure a thorough EXCOM.

H. SAR facilities conducting an EXCOM should submit a SITREP as specified by the RCC. The SITREP should indicate the approximate percentage of EXCOM completed.

I. An EXCOM is only as good or effective as the people that are making it. Because of this human factor, the SMC should monitor the EXCOM as necessary to ensure that it is being conducted effectively.

153 PRECOM for Aircraft

A PRECOM for aircraft is usually begun by the FAA, ARTCCs for aircraft on IFR flight plans and FSSs for aircraft on VFR flight plans. When an aircraft with no flight plan is reported overdue and the time between intended arrival and the report is of concern, the RCC should begin an EXCOM immediately, at the same time requesting the appropriate flight-following facility to start a PRECOM. Aircraft PRECOM usually includes the following:

A. Contacting destination and alternate airports to confirm that aircraft has not arrived. Request physical ramp checks at all uncontrolled airports.

B. Contacting departure airport to confirm actual departure, and non-return. Verify flight plan data, weather briefing received, and any other available facts.

C. Requesting aircraft along or near route to attempt radio contact.

D. Alerting airfields, aeronautical radio stations, aeronautical aids to navigation stations, and radar and DF nets within areas through which the aircraft may have flown.

154 EXCOM for Aircraft

EXCOM for aircraft is the responsibility of the RCC, which obtains any information concerning an overdue aircraft from sources that could not be covered in the PRECOM and in areas beyond that covered in the PRECOM. The RCC should use all means of communication available and obtain assistance as necessary from ARTCCs and FSSs. The EXCOM for aircraft is normally begun after the PRECOM is complete and at when the incident has progressed to the Alert phase, but should begin sooner if the situation warrants. An EXCOM for aircraft should include:

A. Contacting all airfields, aircraft carriers and other ships as appropriate, aeronautical radio stations, operating agency's radio stations, aeronautical aids to navigation stations, radar and DF nets within 50 miles of route and not checked during PRECOM.

B. Contacting the other airfields in the general area where it is reasonably possible that aircraft may have landed.

C. Requesting aircraft along or near route of flight to attempt contact and monitor appropriate frequencies for possible distress signals.

D. Contacting other agencies, facilities, or persons capable of providing additional verifying information.

160 OTHER SOURCES OF INFORMATION

During PRECOMs and for cases involving missing persons, a number of sources of information are possible: relatives, friends, neighbors, employers, club members, departure point witnesses, technical information sources, such as Lloyd's of London and ITU, vessel agents, FCC, AMVER, U.S. Aircraft Registry (Oklahoma City, OK), airport managers, and the Naval Ocean Surveillance Information Center (NOSIC). SAR decision-makers should use their experience and good judgment to gather all useful information possible in order to form plans.

170 SURVIVAL GRAPHS

Figures 1-2 through 1-4 may be useful in estimating survival times.

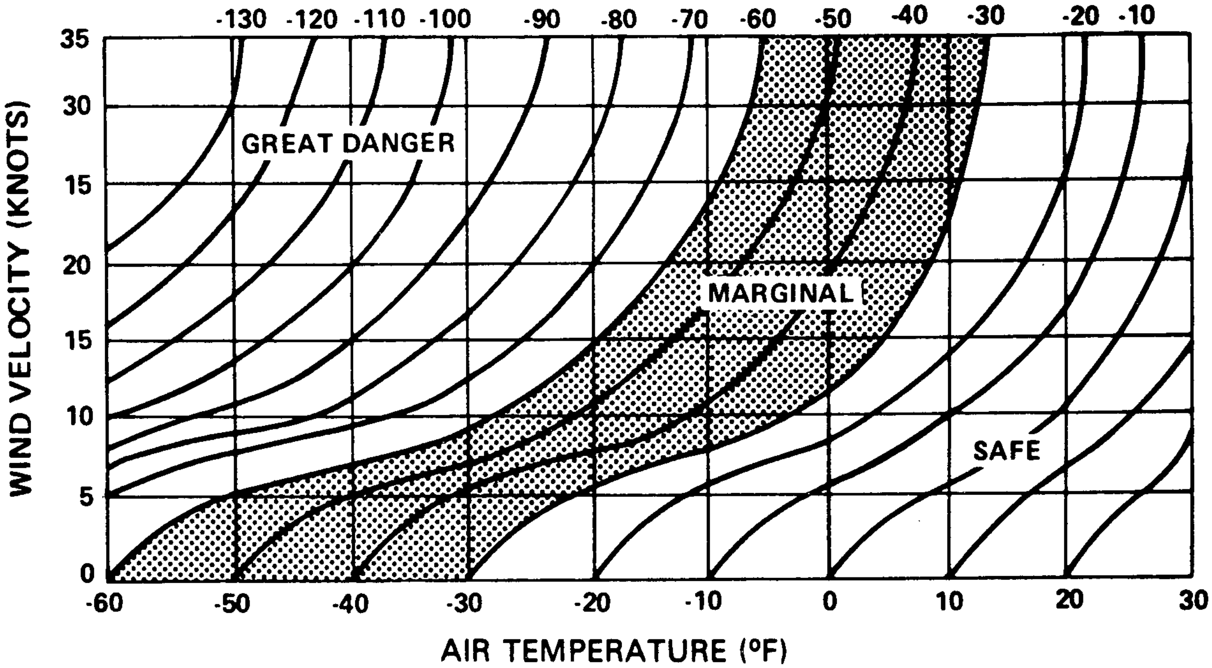


Figure 1–2. Wind Chill Graph – Equivalent Temperature Curves

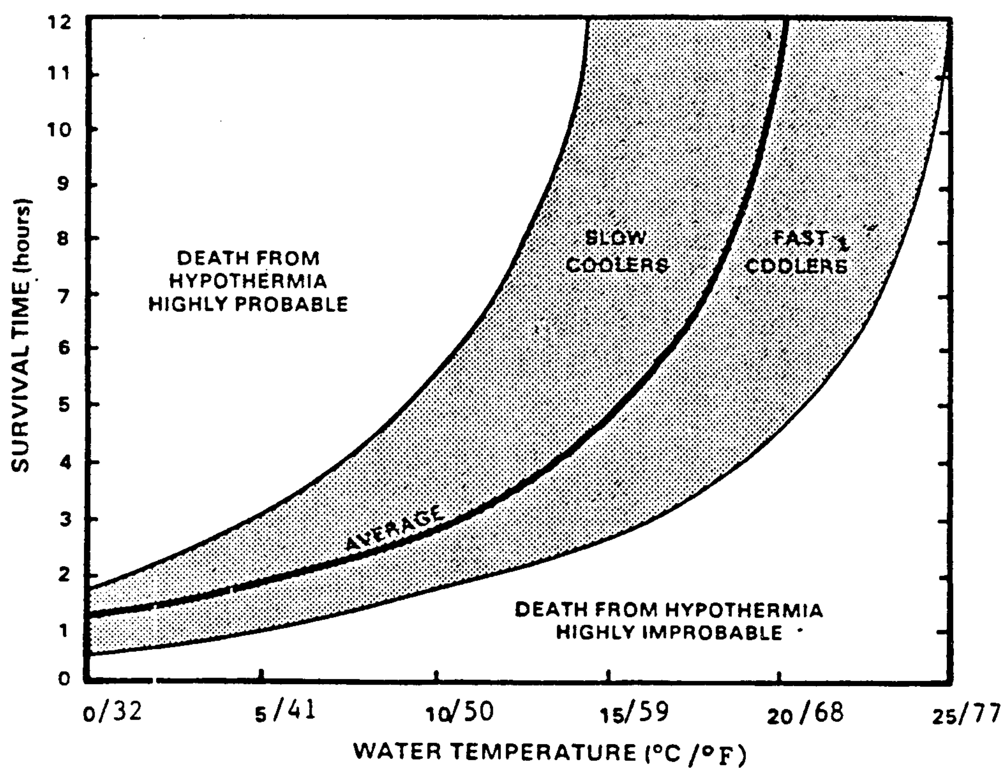


Figure 1–3. Water Chill Without Antiexposure Suit[1]

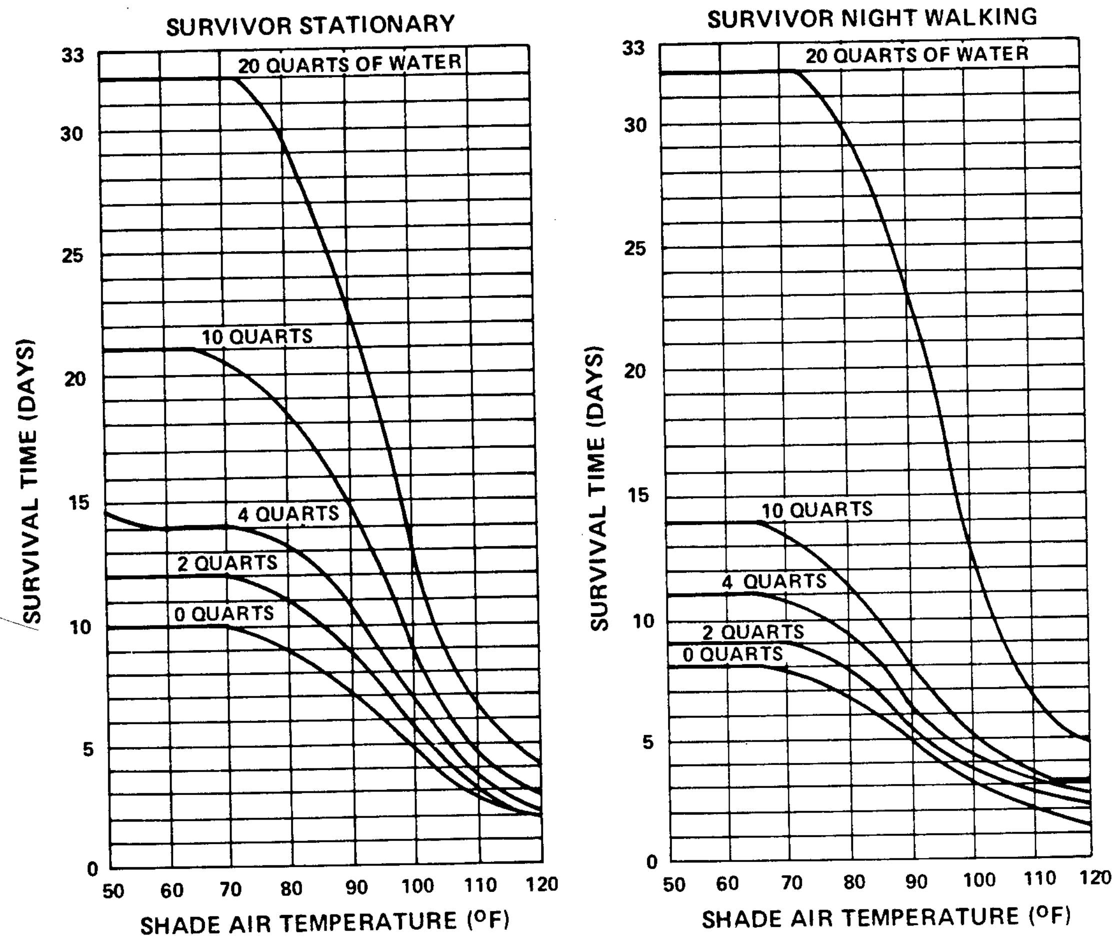


Figure 1-4. Expected Desert Survival

CHAPTER 2. DATUM CALCULATION

200 DATUM COMPUTATION WORKSHEET

Case Title ______________________ Planner's Name ____________ Date ________

A. Aerospace Drift (D_a)

N/A if there was no glide or bailout.

1. *Time* ________ Z ________
2. *Latitude* ____________ N/S
3. *Longitude* ____________ W/E
4. Total aerospace vector from aerospace bailout or glide worksheets ____________ °T ____________ NM

B. Position Where Surface Drift Will Start

Minimum *Maximum*

Surface position from aerospace worksheets.
Last known position/incident position.
Previous datum (non–minimax).
dmin and dmax positions.

TARGET(S) ____________________

1. *Time* ________ Z ________ ________ Z ________
   If LKP/IP, use incident time; if dmin/dmax position or previous datum, use last datum time. For most first searches you only need righthand column. However, in overdue cases, you may need minimum and maximum time of drift. If so, use column headings.
2. *Latitude* __________ N/S __________ N/S
3. *Longitude* __________ W/E __________ W/E

C. Datum Time

1. *Commence search time/mid-search time (circle).* ______Z______

2. *Drift interval* ______HRS ______HRS
   Subtract start time from datum time.

D. Sea Current (SC)

1. *Publication source* ______________

2. *Set* ______°T ______°T

3. *Drift* ______KTS ______KTS
   Use lat/long of both positions if using min and max solution.

4. *Sea current (SC) vector* ______°T ______°T
   Enter direction from above, multiply by hours of drift to calculate distance. ______NM ______NM

E. Wind Current (WC)

1. *Wind current (WC) vector* ______°T ______°T
   Attach wind current worksheets. Enter total resultant wind current vector in section D. ______NM ______NM

F. Observed Total Water Current (TWC)

To be used instead of SC and WC.

1. *Source (DMB, debris, oil)* ______________

2. *Total water current (TWC)* ______°T
   ______KTS

Enter direction from above, multiply by hours of drift to calculate distance. ______°T
______NM

G. Leeway (LW)

Leeway (LW) vector ______°T ______°T
Enter direction and distance from box on leeway worksheet. Include work sheets in case folder. ______NM ______NM

H. Total Surface Drift (Dmin & Dmax)

From chart, UPS plot, or calculator. ______°T ______°T
______NM ______NM

I. Datum Minimax ______Z______ ______N/S
Enter datum time from section C. Then enter lat/long from plot or calculator. ______W/E

(Dmin______N/S______W/E)
(Dmax______N/S______W/E) (DISTANCE BETWEEN ______)

210 AEROSPACE DATUM CALCULATION

211 Simplified MINIMAX Search Planning Worksheet – Aerospace Glide

Case Title ______________________ Planner's Name ____________ Date __________

A. Incident Position

Latitude/longitude __________N/S__________W/E

Date/time group ________Z_____

B. Average Winds–Aloft Computation

Incident altitude (start glide) ____________FT

Stop glide altitude (bailout or surface) ____________FT

Wind data source ____
(forecaster name/agency/phone/DTG of reporting)

Go down reported wind column (1) until you reach altitude nearest where incident began. In forecast wind column (2), enter wind direction/velocity from incident altitude to surface or bailout altitude. In column 3, mark exact altitudes at which glide started and stopped. In column 4, find the multiplier by subtracting interval in column 3. Sum column 4 figures to get the total number of 1000–foot. intervals aircraft will glide through, and check by subtracting stop glide altitude from incident altitude. Enter wind direction in right column and multiply wind velocity by the multiplier and enter this in the right column. Add the vectors, using a maneuvering board or hand–held calculator. *Note:* If incident is a combination glide to bailout altitude and bailout to surface, a separate average winds–aloft must be calculated for each situation.

(1) Reported Wind Levels	*(2) Forecast Wind Direction/Velocity*	*(3) Valid 1000–ft Interval*	*(4) Multiplier*	*(5) Contribution*
surface	_____/_____	0.0 – 1.0	1.0	__________
3000	_____/_____	1.0 – 4.5	3.5	__________
6000	_____/_____	4.5 – 7.5	3.0	__________
9000	_____/_____	7.5 – 10.5	3.0	__________
12000	_____/_____	10.5 – 15.0	4.5	__________
18000	_____/_____	15.0 – 21.0	6.0	__________
24000	_____/_____	21.0 – 27.0	6.0	__________
30000	_____/_____	27.0 – 32.0	5.0	__________
34000	_____/_____	32.0 – 36.5	4.5	__________
39000	_____/_____	36.5 – 42.0	5.5	__________

Total number of 1000–ft. intervals ______

Resultant wind vector direction/magnitude ________/_____KTS
From maneuvering board or calculator.

Average winds–aloft direction/magnitude ________/_____KTS
Divide resultant wind direction magnitude by number of 1000–ft intervals. Direction remains same as the resultant wind vector.

C. Aerospace Glide Vector Computation

1. *No wind glide effect vector*

Altitude loss during glide	______ FT
Glide ratio	____:____
Glide heading (if known)	______ °T
Maximum horizontal glide distance (6000 FT = 1 NM)	______ FT = ______ NM

2. *Wind effect vector*

Rate of descent	______ FT/MIN
Time of descent	______ MIN = ______ HR
Average winds–aloft direction/magnitude (hourly rate)	______ °T/ ______ kts
Reciprocal of average winds–aloft direction (+180°)	______ °T
Displacement due to average winds–aloft (effect of wind during time of descent)	______ NM

3. *Aerospace glide vector* (resultant of no wind glide effect + wind effect vector)

Add vectors on maneuvering board or calculator	______ °T ______ NM
(equal to maximum horizontal glide distance, if glide heading unknown)	______ nm Radius

D. Position of Bailout* / Surface Impact (circle)
(apply aerospace glide vector to incident position)

	______ N/S ______ W/E
If glide heading unknown	______ NM Radius

* If bailout position, go to Aerospace Bailout worksheet.

212 Simplified MINIMAX Search Planning Worksheet – Aerospace Bailout

Case Title ______________ Planner's Name ______________ Date ______

A. Bailout Position

Latitude/longitude	______ N/S ______ W/E
Date/time group	______ Z ______

B. Average Winds–Aloft Computation

Parachute opening altitude	______ FT
Terrain height	______ FT

Wind data source ______________________________
(forecaster name/agency/phone/DTG of reporting)

Go down reported wind column (1) until you reach altitude nearest where parachute opened. In forecast wind column (2), enter wind direction/velocity from this altitude to surface. In column 3, mark exact altitude of parachute opening and surface. In column 4, find the multiplier by subtracting interval in column 3. Sum column 4 figures to get the total number of 1000–foot intervals and check by subtracting terrain height from parachute opening altitude. Enter wind direction in right column and multiply wind velocity by the multiplier and enter this in the right column. Add the vectors, using a maneuvering board or hand–held calculator. Note: If incident is a combination glide to bailout altitude and bailout to surface, a separate average winds–aloft must be calculated for each situation.

(1) Reported Wind Levels	*(2) Forecast Wind Direction/Velocity*	*(3) Valid 1000–ft Interval*	*(4) Multiplier*	*(5) Contribution*
surface	______/_____	0.0 - 1.0	1.0	____________
3000	______/_____	1.0 - 4.5	3.5	____________
6000	______/_____	4.5 - 7.5	3.0	____________
9000	______/_____	7.5 - 10.5	3.0	____________
12000	______/_____	10.5 - 15.0	4.5	____________
18000	______/_____	15.0 - 21.0	6.0	____________
24000	______/_____	21.0 - 27.0	6.0	____________
30000	______/_____	27.0 - 32.0	5.0	____________
34000	______/_____	32.0 - 36.5	4.5	____________
39000	______/_____	36.5 - 42.0	5.5	____________

Total number of 1000 ft. intervals ______

Resultant wind vector direction/magnitude ______/_____KTS
From maneuvering board or calculator.

Average winds aloft direction/magnitude ______/_____KTS
Divide resultant wind direction magnitude by number of 1000–ft intervals. Direction remains same as the resultant wind vector.

C. Parachute Drift Vector

Average winds–aloft direction/magnitude ______°/_____KTS
Reciprocal of average winds–aloft direction (+ 180°) ________°T
Parachute drift table value ________NM

D. Surface Position

(apply parachute drift vector to bailout position) ________N/S
________W/E

From glide worksheet (if applicable): ___NM Radius

E. Additional Radius for Parachutes With a Known Glide Ratio

Altitude Loss: ______________FT
(Times) Glide Ratio: ______________
(Equals) Glide Distance: ______________FT = ________ NM Radius
(6000 FT = 1 NM)

220 WIND CURRENT WORKSHEET

Case Title ____________________ Planner's Name ______________ Date ____________

A. Incident Summary

1. Surface Position — Latitude ____________N/S; Longitude ____________W/E
2. Surface Position DTG ________Z______
3. Datum DTG ________Z______
4. Hours of Drift ____________HRS

B. Wind Current Vector Computations Required

WC #	*Reported Wind Dtg*	*Wind Valid Period*	*Number of Hours*
( )	0000Z	2100 – 0300	______
( )	0600Z	0300 – 0900	______
( )	1200Z	0900 – 1500	______
( )	1800Z	1500 – 2100	______
( )	0000Z	2100 – 0300	______
( )	0600Z	0300 – 0900	______
( )	1200Z	0900 – 1500	______
( )	1800Z	1500 – 2100	______
		Total hours (sum number of hours column)	______

C. Wind Current Vector Computations

Interval	*Reported Wind DTG From the National Weather Service*	*Wind (A)/(B) From NWS*	*Coefficients (C)/(D) From Coef Tables Figure 4-2*	*Contribution (A+C)/(BxD)*
1		/	/	/
2		/	/	/
3		/	/	/
4		/	/	/
5		/	/	/
6		/	/	/
7		/	/	/
8		/	/	/

Add 8 vectors in column to calculate Resultant LWC (______°T/________KTS)
times number of hours this period (________)
equals WC( ): ________°T/________NM

NOTE: Repeat calculations as necessary.

D. Total Resultant Wind Current Vector
(WC) = WC(1) + WC(2) + WC(3) + ...
[WC( ): _______/_____, WC( ):_______/_____, WC( ):_______/_____]
Total resultant wind current vector (WC) _________°T/_________NM

230 LEEWAY WORKSHEET

Case Title ____________________________ Planner's Name ________________ Date ____________

A. Incident Summary

1. Surface Position latitude ______________N/S
   longitude ______________W/E
2. Surface Position DTG _____Z______
3. Datum DTG _____Z______
4. Hours of Drift __________HRS

B. Search Object(s)_______________________________________

C. Average Surface Winds (ASW)

DTG of Reported Winds	*Wind Period*	*Number of Hours*	*Wind Direction*	*Wind Speed*	*Contribution*
0000Z	2100–0300				
0600Z	0300–0900				
1200Z	0900–1500				
1800Z	1500–2100				
0000Z	2100–0300				
0600Z	0300–0900				
1200Z	0900–1500				
1800Z	1500–2100				
0000Z	2100–0300				
0600Z	0300–0900				
1200Z	0900–1500				
1800Z	1500–2100				
0000Z	2100–0300				
	Total hours		Total wind vector		

Divide wind vector by total hours to get:
Average Surface Wind (ASW) _________°T _________KTS

Select one situation

Drift Rate Uncertainty. Leeway with minimum and maximum drift rates, e.g., drogue/no drogue or search object uncertainty. Used when there are two search objects.

	Minimum	*Maximum*
1. Average Surface Winds (ASW)		______ °T ______ KTS
2. Set (°T = reciprocal of ASW)		______ °T
3. Formula (if used)		______
4. Drift (Leeway speed graph or exponential formula)	______ KTS	______ KTS
5. Hours of Drift	______ HRS	
6. Leeway (LW) Vectors	______ °T ______ NM	______ °T ______ NM

Time Uncertainty. Used when incident time is unknown.

1. Hours of Drift	______ HRS	______ HRS
2. Average Surface Winds (ASW)(two required)	______ °T ______ KTS	______ °T ______ KTS
3. Set (°T = Reciprocal of ASW)(+180°)	______ °T	______ °T
4. Formula (if used)		______
5. Drift (Leeway speed graph or exponential formula)	______ KTS	______ KTS
6. Leeway (LW) Vectors (downwind)	______ °T ______ NM	______ °T ______ NM

Directional Uncertainty (Divergence – time and search object known). Used when there is only one object and one time.

1. Average Surface Winds (ASW)	______ °T	
2. Set (°T = reciprocal of ASW)	______ °T ______ KTS	
3. Formula (if used)		______
4. Divergence	+/– ______ °	
5. Drift(leeway speed graph or exponential formula)	______ KTS	
6. Hours of drift	______ HRS	
7. Leeway (LW) Vectors	______ °T ______ NM	______ °T ______ NM

231 Leeway Guidance Criteria

A. Leeway should normally be plotted downwind under any of the following circumstances:

1. When using Coastal Search Planning techniques.
2. When time is critical and search unit availability is limited.
3. When a MINIMAX solution using drift rate uncertainty (drogue, no drogue, or search object uncertainty) is employed.
4. When a MINIMAX solution is used because of time adrift uncertainty.

B. Leeway divergence should be considered for a MINIMAX solution in other situations.

240 COASTAL DATUM COMPUTATION

241 Coastal Search Planning Worksheet

The simplified Coastal Search Planning worksheet below may be used when it is anticipated that the search may last only one day, the incident is no more than 25 miles offshore, and the search will cover only a relatively small area.

Case Title ______________________ Planner's Name ____________ Date _________

A. **Datum**–number ____

1. *Last known position (LKP)* _________N/S_________W/E PLOT

   Enter latitude and longitude of the last reported position or incident position; this will be the first item plotted on your chart.

   a. LKP time _________

   b. Datum time _________

   c. Commence search time _________

   d. Total hours of drift _________HRS

   Subtract LKP time from Datum time, giving the answer in hours and tenths of hours.

2. *Total water current (TWC)* – attach other worksheets as necessary.

   a. Method used to determine TWC ______________________
   (local knowledge, tidal currents, etc.)

   b. Direction and velocity of TWC _______/_____KTS

   c. TWC vector ________/______NM PLOT

   Direction is the same direction as contained on line 2b. Multiply hours of drift (line 1c) by TWC (line 2b): D=VxT. This is the second item plotted.

3. *Average surface winds (ASW)*

   Perform ASW calculations in this section of the worksheet and enter direction wind is from and velocity of wind in spaces provided. Contribution is direction and hours *x* velocity, e.g. 254/24.

DATUM CALCULATION

Time of Reported Winds	*Wind Period*	*Number of Hours*	*Wind Direction*	*Wind Velocity*	*Contribution*
______	______	______	______	______	______/______
______	______	______	______	______	______/______
______	______	______	______	______	______/______
______	______	______	______	______	______/______
______	______	______	______	______	______/______
______	______	______	______	______	______/______

Total hours______ Total vector contribution ________/________

$\frac{\text{Total vector contribution}}{\text{Total hours}}$ = Average surface winds = ________°T ________KTS

4. Leeway (LW)

a. Leeway direction = Reciprocal of ASW direction ________°T

Leeway speed = ________ x ________ +/- ________ = ________KTS

ASW (KTS)

Add or subtract 180° to/from Average Surface Wind direction (line 3). Fill in the next line with the first value from Leeway Speed Formula/Leeway Speed Graph. Next enter the velocity of ASW in line 3. This equals the U in the formula. Finally, enter any additional factors from the formula. Perform functions as indicated and the result is Leeway Speed.

b. LW vector (LW) ________/________NM PLOT

Same direction as line 4a. To find distance, multiply hours of drift (line 1c) by Leeway Speed (line 4a). This is the third entry to be plotted.

5. *Total drift vector (D)* ________/______ NM

Vectorally add lines 2c and 4b. Enter direction and distance.

6. *Datum position* ________N/S ________W/E

Enter the determined position in latitude and longitude from the chart.

B. Search Area/Decisions

1. *Optimum search area:* A = L x W ________SQ NM

Once a geographic search area has been decided upon, multiply length (L) times width (W) to determine the area in square nautical miles. If the area chosen is circular, as when using a VS pattern, the square nautical miles of the area may be determined by using the formula ($3.14 \times R^2$), where R = the length of the search radius chosen, from Datum.

2. *Search Area Designation:*________ No. SRUs (N)________

Alpha-numeric code for *this* worksheet's search area. Also, the number of search units intended for *this* worksheet's search area.

3. Search pattern ____ Track spacing(S) = ____NM SRU Speed(V)____KTS

Where indicated, fill in the letter code for the search pattern chosen, track spacing in nautical miles, and the SRU's search speed in knots. If more than one SRU is to be used for this worksheet's search area, average the search speeds.

4.Commence Search Time ________ Hours Available On Scene (T)________

5. *Attainable Search Area:*

a. *Square or rectangular area:* A = VNST ________sq NM

To determine if the size of the area decided upon may actually be executed within the operational constraints of the SRUs, attainable search area is determined using the formula (A = VNST), where A = attainable area, V = velocity (SRU speed), N = number of SRUs, S = track spacing (in nautical miles), and T = time available on scene (hours and tenths).

b. *Sector Searches of Circular Areas:*

Determine total trackline miles my multiplying the length of the search Radius by 9 (R X 9). Divide the resultant distance by SRU speed (V) to obtain hours required to search. Compare hours required to hours available (T). If hours required exceed hours available, the search area is not attainable and must be reduced.

6. *Search Area Description:* ____

____

____CSP__________

Describe the search area using one of the standard methods found in Volume I, Chapter 8. Indicate the Commence Search Point (CSP).

C. Area Coverage

1. Search Objective ________________Visibility ________NM

2. Sea State ________FT Wind Velocity ________KTS

3. SRU TYPES	SRU SPEED	SRU ALTITUDE
Fixed Wing________	________KTS	________FT
Helicopter________	________KTS	________FT
Vessel________	N/A	N/A
Boat________	N/A	N/A

4. Uncorrected Sweep Width (W_u) ______

Note: For PIW with PFD, and when aircraft search altitude is 500' or less, $(W_u \times 4)$ = Total (W_u) value.

5. Weather Correction Factor (f_w) ______

6. Fatigue Correction Factor (f_f) ______

7. Aircraft Speed Correction Factor (f_v) ______

8. Corrected Sweep Width (W) ______NM

$(W) = (W_u) \times (f_w) \times (f_f) \times (f_v)$

9. Coverage Factor (C) ______

$C = \frac{W}{S}$ $\quad$ $C = \frac{W}{R}$ (circular areas)

Fill in appropriate meterological information, assigned search altitude, and speed. Obtain sweep width and correction factor information from tables, Volume II, Chapter 4. Compute coverage factor (C) for this search by dividing corrected sweep width (W) by track spacing (S), or search radius (R) for circular areas.

10. POD for *this* search: ______ percent

    Obtain probability of detection (POD) using the POD graph, Volume II, Chapter 4. Use the single search curve and coverage factor (C).

242 Tidal Current Worksheet

Information for completion of this form comes from the current edition of the National Oceanographic and Atmospheric Administration (NOAA) Tidal Current Tables for the appropriate area.

Case Title ______________________ Planner's Name ______________ Date __________

A. Reference Station ____________________ Date ____________

Substation ____________________ Reference Number ____

Locate the substation and substation reference in NOAA Table 2 which is nearest to the incident point. Table 2 will indicate the proper reference station for the particular substation.

B. Time Differences

Before Flood Hr______ Min______

Before Ebb Hr______ Min______

Maximum Flood Hr______ Min______

Maximum Ebb Hr______ Min______

This information comes from Table 2 for the particular substation.

C. Velocity Information

Flood: Speed Ratio __________ Average Direction _____°T

Ebb: Speed Ratio __________ Average Direction _____°T

This information comes from Table 2 for the particular substation.

D. Reference Station

1. *Time speed time speed(e/f)?*

____ slack ____ ________
____ slack ____ ________
____ slack ____ ________
____ slack ____ ________
____ slack ____ ________

Substation

2. *Time speed time speed(e/f)?*

____ slack ____ ________
____ slack ____ ________
____ slack ____ ________
____ slack ____ ________
____ slack ____ ________

Reference station information: The dates and times needed are listed in NOAA Table 1 under the particular reference station. Ensure that you have included an event (slack or maximum current) that will occur before the incident time and an event that will occur after the datum time. Remember to take into account the time difference from Section B when choosing the starting and ending times from the table.

Substation information: Apply the corrections from sections B and C of the worksheet to the reference station information in Section D1 above. Once this is done, it is suggested that the information in D1 be crossed out, to avoid its inadvertent use in later sections of the worksheet.

E. Tidal Current Chart

Incident Time ____________________ Datum Time ______________________

(correct for Daylight Savings Time)

The NOAA Tidal Current Table uses standard time. When using the Tidal Current Table during daylight-savings time, standard time must be converted to daylight savings time. Mark the times and velocities from section D2 on the tidal current chart. Mark and note the datum and incident times on the chart. Compute the intervals between slack and maximum current, and the intervals between maximum current and slack. Mark these times in the interval blanks.

F. Computing Average Factor of Cycle

1. Interval time from Slack water to Incident: ______ HRS ______ MIN

Interval time from Slack water to Datum: ______ HRS ______ MIN

If the incident time or datum time falls in the cycle, note the time difference between the desired time (incident or datum) and the slack in that half of the cycle.

2. Factors for the flood/ebb cycle.

______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________

Now go to NOAA Table 3. From the appropriate table (A or B), and using the first interval (the one that includes the incident time) from your current chart, find the column in the table closest to the amount of time in that interval. Do not interpolate on this table. If you are halfway between the columns, go to the next higher column.

Once in the correct column for the interval, using the time interval from section F1, find the closest value in the column at the side of the table "Interval Between Slack and Desired Time."

The intersection of these two values is the first current speed factor for section F2. Then, if your incident time is between slack and maximum current, write the remaining factors going *down* the column you are working with. If the incident time is between maximum current and slack, write the remaining factors going *up* the column.

To compute the values for the next interval: if the next interval represents the same direction as for the first interval, continue to write the factors on the same worksheet. Remember to use the "time interval from *slack* to desired time" to find the correct value along the side of the table. Also, read the factors below the cutoff point if you are concerned with the time from maximum current to datum, and the factors above the cutoff if you are concerned with the time between datum and slack water.

Each column contains a maximum current factor. When going through maximum current, remove one of these factors.

Compute factors until you reach the point where you change direction. If you change direction, stop computing factors and continue further on the worksheet.

3. Total value of factors in the cycle ________
divided by total number of factors in cycle ________
equals average factor for cycle ________

Add up all the factors and calculate a total value of factors in the cycle. The total value divided by the number of factors in the cycle equals the average factor for the cycle.

4. Maximum current speed for the cycle ______KTS
   multiplied by the average factor equals the average speed for the cycle ______KTS

The maximum current speed is listed in section D2. Find the time of maximum current for your cycle, and the speed will be listed at the time. Speed multiplied by the average factor will equal the average speed for the cycle.

G. Computing Tidal Current Vector for the Cycle

Time duration of drift through the cycle ______HRS
multiplied by the average current speed ______KTS
equals magnitude of current vector for the cycle ______NM

Calculate the time of drift through the cycle; list only the hours and tenths of hours for the cycle you are working with. This is *not* total hours of drift from incident to datum, unless it is all in the same direction.

H. Calculating the Total Tidal Current Vector

1st current vector _____°T/____NM + 2nd current vector _____°T/____NM
equals total reversing tidal current vector _____°T/____NM.

CHAPTER 3. SEARCH AREA CALCULATION

300 SEARCH AREA DETERMINATION WORKSHEET

A. Individual Drift Errors (d_e)

1. *Aerospace drift error* (d_{ea})

a. Aerospace drift distance (D_a) ________ NM

b. Drift error confidence factor (CF) **0.3**

c. Aerospace drift error (d_{ea}) (drift distance x CF) ________ NM

2. *Surface drift error*

a. *Minimax*

	Minimum		*Maximum*
(1) Sum of *all previous* drift errors (d_e min and d_e max)		________ NM	
(2) Surface drift distance (d) (dmin and dmax (distance))	________ NM		________ NM
(3) Drift error confidence factor (CF)		**0.3**	
(4) Drift error min and max (d_e min and d_e max)(dmin x CF)(dmax x CF)	________ NM		________ NM
(5) Distance between *latest* dmin and dmax positions		________ NM	

(6) Surface drift error minimax

$$d_e \text{ minimax} = \frac{(d_e \text{ min} + d_e \text{ max} + \text{distance} + \text{sum})}{2} = \_\_\_\_\_\_\_ \text{ NM}$$

b. *Non–minimax*

(1) Surface drift distance (d) ________ NM

(2) Drift error confidence factor (CF) **0.3**

(3) Individual drift error (d_e) ________ NM (d x CF)

B. Total Drift Error (D_e) ________ NM

1. Minimax ($D_e = d_{ea} + d_e$ minimax) ________ NM

2. Non–minimax ($D_e = d_{e1} + d_{e2} + d_{e3}$ + etc.) ________NM

C. **Initial position error (X)**

1. Navigational fix error (FIX_e) ________NM
2. Navigational DR error (DR_e) ________NM
3. Initial position error ($FIX_e + DR_e$) (X) ________NM

D. **SRU error (Y)**

1. Navigational fix error (FIX_e) ________NM
2. Navigational DR error (DR_e) ________NM
3. Initial position error ($FIX_e + DR_e$) (Y) ________NM

E. **Total probable error** $\sqrt{(D_e^2 + X^2 + Y^2)}$ (E) ________NM

F. **Safety factor** (circle) (f_s) 1.1 1.6 2.0 2.3 2.5

G. **Desired search radius (R)**

1. Search radius (E x f_s) (R) ________NM
2. Search radius (round up to next highest whole mile) (R_o) ________NM

H. **Desired search area (A)**

1. Square ($A = 4 \times R_o^2$) ________SQ NM
2. Circle ($A = 3.14 \times R_o^2$) ________SQ NM
3. Rectangle ($A = L \times W$) ________SQ NM
   L = length of side
   W = width of side

310 EFFORT ALLOCATION WORKSHEET

A. **Effort and search subarea computations**

1. Search subarea designation	______	______	______	______
2. Search unit assigned	______	______	______	______
3. Search craft speed (V)	______	______	______	______
4. On scene endurance	______	______	______	______
5. Daylight hours remaining	______	______	______	______
6. Search endurance (T) (T=85% of lesser of #4 or #5 above)	______	______	______	______
7. Trackline miles (VxT)	______	______	______	______
8. Search altitude	______	______	______	______

9. Uncorrected sweep width (W_u)	______	______	______	______
10. Weather correction (f_w)	______	______	______	______
11. Fatigue correction(f_f)	______	______	______	______
12. SRU speed correction (f_v)	______	______	______	______
13. Corrected sweep width (W)	______	______	______	______
14. Effort (Z_n = V x T x W)	______	______	______	______
15. Total Effort ($Z_t = Z_1 + Z_2 + Z_3 + Z_4$)	____________			
16. Optimum search area ($A = 4R_o^2$)	____________			

Note: If total effort (Zt) is greater than the optimum search area (A), go to section B, line 1. Otherwise, continue with line 17.

17. Midpoint compromise search area (A_{mc}) (optimum A + total effort Z_t)/2	____________			
18. Midpoint compromise coverage factor (C_{mc}) (total effort Z_t / A_{mc})	____________			
19. Midpoint compromise track spacing ($S_{mc} = W/C_{mc}$)	______	______	______	______
20. Track spacing (S) assignable (within usable limits of search craft navigational capability)	______	______	______	______
21. Search subarea coverage factor (C = W/S assignable)	______	______	______	______
22. Individual search subarea POD	______	______	______	______
23. Adjusted search area (A = V x S x T)	______	______	______	______
24. Total adjusted search area (A_t) ($A_t = A_1 + A_2 + A_3 + A_4$)	____________	$\sqrt{A_t}$ = ______		
25. Search coverage factor ($C = Z_t/A_t$)	____________			
26. Search POD	____________			
27. Estimated search subarea length (l'). Use $/A_t$, or following guidelines: fixed wing = V/2, helicopter = V/3	______	______	______	______
28. Estimated width of search subarea (w' = A/l')	______	______	______	______
29. Number of track spacings (n' = w'/S)	______	______	______	______
30. Round off to whole number of track spacings (n)	______	______	______	______
31. Actual subarea width (w = n x s)	______	______	______	______
32. Actual subarea length (l = A/w)	______	______	______	______

B. Excess resource planning

1. Search subarea coverage factor (C = 1.0 is recommended) _____ _____ _____ _____

2. Track spacing (S = W/C) _____ _____ _____ _____

3. Go to section A, line 20, and complete through line 32 of the worksheet.

320 DRIFT–COMPENSATED SEARCH PATTERNS WORKSHEET

A. Search planning summary

1. Target drift direction/distance _____T°_____ NM
2. Target drift rate / hour(v) __________ KTS
3. Search area length x width(l x w) _____ x _____ NM
4. SRU search speed(V) __________ KTS
5. SRU track spacing(S) __________ NM
6. Time required to complete area(T) __________ HRS

B. To determine whether drift compensation is recommended, complete the following formula:

(vl)/(VS) = (____ x ____)/(____ x ____) = (____)/(____) = ________

1. If value is less then 0.1, drift compensation is not recommended. Stop here. No further computations are necessary.

2. If value is greater then 0.1, drift compensation is recommended.
   a. Orient the search area so that the major axis is parallel to the target drift direction.

   b. Complete the following formula to see if further drift compensation is recommended:

   (vw)/(VS) = (____ x ____)/(____ x ____) = (____)/(____) = ________

   (1) If value is less then 0.1, further drift compensation is not recommended. Stop here. No further computations are necessary.

   (2) If value is greater then 0.1, further drift compensation is recommended. Go on to section C.

C. Options for further direct compensation (in descending order of preference)

1. Create a parallelogram along the major axis as follows:

   a. Select a CSP for a PS search pattern.

   b. Advance the down–creep side of the search area by the following:

   distance = (T X v) = (____) x (____) = ________

   c. Connect advanced sides to unadvanced sides. Determine new latitudes and longitudes of corners.

2. Keep major axis oriented parallel to drift direction, and conduct CS search pattern with drift–compensated headings as follows:

   a. Complete these steps to determine the heading correction:

(1) (v)/(V) = (____) x (____) = _________

(2) Heading correction = ARCTAN of above value = _______°

(3) Round off correction to nearest whole degree = _______°

b. Apply the heading correction in the direction of target drift.

c. Extend search area in the direction of target drift the following distance:
distance = (T) x (v) = (____) x (____) = _________ NM

3. If the major axis cannot be oriented parallel to the drift direction, orient the search area so that the minor axis is parallel to the drift direction, and conduct one of the following:

a. A PS search pattern with the SRU creeping in the same direction as target drift, using drift-compensated headings.

b. A PS search pattern with the SRU creeping in the opposite direction of target drift, using drift-compensated headings.

c. A CS search pattern, and construct a parallelogram.

4. If none of the above situations is feasible, conduct an XSB search (Barrier Single Unit).

330 DRIFT ERROR EXAMPLE

A. Non-minimax

1. $d_e = 0.3 \times d$

2. $D_e = d_{e1} + d_{e2} + d_{e3} + \text{etc.}$

Figure 3-1

B. D_e minimax = $d_{ea} + d_e$ minimax

1. *Downwind minimax*

Figure 3-2

$d_e \text{ min} = 0.3 \times \text{dmin} = 0.3 \times 25 = 7.5$

$d_e \text{ max} = 0.3 \times \text{dmax} = 0.3 \times 36 = 10.8$

$$d_e \text{ minimax} = \frac{d_e \text{ min} + d_e \text{ max} + \text{Dist}}{2} = \frac{7.5 + 10.8 + 11}{2} = 14.65$$

$d_e \text{ minimax} = d_{ea} + d_e \text{ minimax} = 0.0 + 14.65$

2. *Divergence minimax*

Figure 3–3

$d_e \min = 0.3 \times d\min = 0.3 \times 42 = 12.6$

$d_e \max = 0.3 \times d\max = 0.3 \times 46 = 13.8$

$$d_e \text{minimax} = \frac{d_e \min + d_e \max + \text{Dist}}{2} = \frac{12.6 + 13.8 + 16}{2} = 21.2$$

$D_e \text{minimax} = d_{ea} + d_e \text{minimax} = 0.0 + 21.2 = \underline{21.2}$

CHAPTER 4. TABLES AND GRAPHS

400 DRIFT CALCULATION TABLES AND GRAPHS

401 Parachute Drift

402 Leeway (LW)

Leeway can be estimated using the graph in Figure 4-1, which provides for wind speeds (U) up to 40 knots. For more precise values, the following formulas may be used for wind speeds up to 40 knots:

Type of Craft	*Leeway Speed*
Light displacement cabin cruisers, outboards, rubber rafts, etc. (without drogue)	0.07U + 0.04*
Large cabin cruisers	0.05U
Light displacement cabin cruisers, outboards, rubber rafts, etc. (with drogue)	0.05U − 0.12*
Medium displacement sailboats, fishing vessels such as trawlers, trollers, tuna boats, etc.	0.04U
Heavy displacement deep draft sailing vessels	0.03U
Surfboards	0.02U

***Note:** Do not use for values of U below 5 knots. Use Figure 4-1 instead, if applicable.

Figure 4-1 and the formula apply to rubber rafts with neither canopies nor ballast systems. Addition of such equipment has varying effects on leeway speeds:

TABLE 4-1. Parachute Drift Distance (Zero Glide Ratio)

(Distance in miles of landing positions downwind from position of parachute opening)

	Wind in Knots						
Parachute-Opening Height	*10*	*20*	*30*	*40*	*50*	*60*	*70*
30,000 ft. (9,000m)	3.7	7.4	11.1	14.7	18.4	22.1	25.8
20,000 ft. (6,000m)	2.7	5.3	8.0	10.7	13.3	16.0	18.7
14,000 ft. (4,300m)	1.9	3.8	5.7	7.7	9.5	11.4	13.3
10,000 ft. (3,050m)	1.4	2.8	4.2	5.7	7.0	8.3	9.7
8,000 ft. (2,400m)	1.2	2.3	3.5	4.6	5.8	6.9	8.1
6,000 ft. (1,800m)	.9	1.7	2.6	3.5	4.4	5.2	6.1
4,000 ft. (1,200m)	.6	1.2	1.8	2.4	3.0	3.5	4.1
2,000 ft. (600m)	.3	.6	.9	1.2	1.5	1.8	2.1

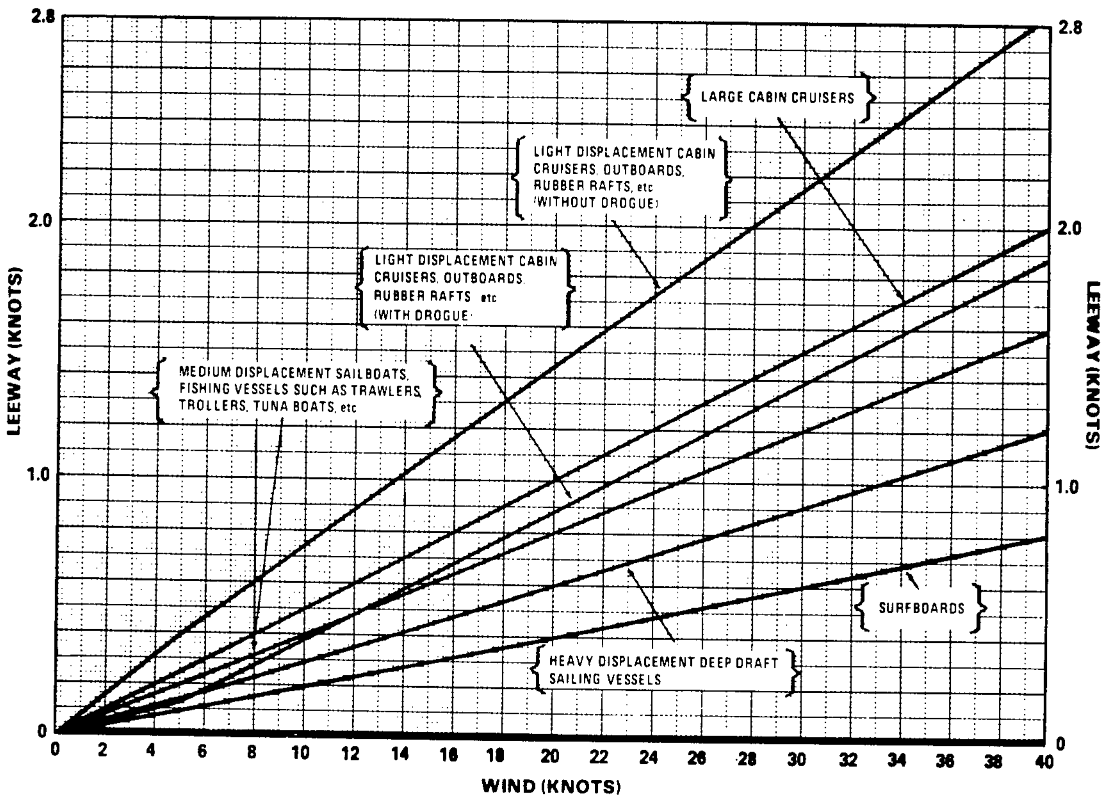


Figure 4–1. Leeway Speed

A. Rafts with canopies *and* ballast pockets have leeway speeds approximately the same as rafts without this equipment.

B. Rafts with canopies have leeway speeds approximately 20% faster than rafts without.

C. Rafts with ballast pockets have leeway speeds approximately 20% slower than rafts without.

D. Rafts with canopies and a deep ballast system have uncertain leeway speed. Speeds approximately the same as for rafts with drogue may be assumed. The minimum leeway speed is zero for winds of 5 knots or less, and 0.1 knot for winds greater than 5 knots. For a deep ballast raft where the canopy does not deploy, the leeway speed falls between 3% of the wind speed and zero.

403 Wind Current (WC)

When using Figure 4–2a or 4–2b to calculate wind current, select the column with latitude closest to the desired position. Do not interpolate.

410 ERROR ESTIMATION
411 NAVIGATIONAL FIX ERROR

A. If the means of navigation is known:

TABLE 4–2 Navigational Fix Errors

Means Of Navagation	*Fix Errors(NM)*
NAVSAT	0.5 NM
Radar	1 NM
Visual Fix (3 lines)*	1 NM
Celestial Fix (3 lines)*	2 NM
Marine Radio Beacon	4 NM (3 beacon fix)
LORAN C	1 NM
OMEGA	4 NM
INS	0.5 NM per flight hour without position update
VOR	± 3° arc and 3% of distance or 0.5 NM radius, whichever is greater
TACAN	± 3° arc and 3% of distance or 0.5 NM radius, whichever is greater

*Should be evaluated upward according to circumstances.

	NORTH LATITUDES													
Period	0°N	5°N	10°N	15°N	20°N	25°N	30°N	35°N	40°N	45°N	50°N	55°N	60°N	65°N
1	With sustained winds of 6 hours or more wind current speed will be 5% of wind speed with direction downwind.	185° 0.029	190° 0.028	196° 0.028	200° 0.027	205° 0.027	210° 0.026	214° 0.025	217° 0.024	221° 0.023	224° 0.022	226° 0.021	228° 0.020	230° 0.020
2		203° 0.012	226° 0.012	249° 0.012	271° 0.011	292° 0.011	312° 0.011	332° 0.011	350° 0.010	007° 0.010	022° 0.009	036° 0.009	049° 0.009	059° 0.008
3		219° 0.009	258° 0.009	296° 0.009	333° 0.009	009° 0.008	043° 0.008	076° 0.008	107° 0.008	136° 0.007	162° 0.007	186° 0.007	207° 0.007	224° 0.006
4		235° 0.008	289° 0.008	342° 0.008	035° 0.007	085° 0.007	134° 0.007	180° 0.007	223° 0.006	264° 0.006	301° 0.006	334° 0.006	003° 0.006	028° 0.005
5		250° 0.007	320° 0.007	029° 0.007	096° 0.006	162° 0.006	224° 0.006	283° 0.006	339° 0.006	031° 0.005	079° 0.005	121° 0.005	159° 0.005	192° 0.004
6		266° 0.006	352° 0.006	076° 0.006	158° 0.006	238° 0.006	314° 0.005	027° 0.005	095° 0.005	159° 0.004	217° 0.004	269° 0.004	315° 0.004	355° 0.004
7		282° 0.006	023° 0.006	123° 0.006	220° 0.005	314° 0.005	044° 0.005	130° 0.005	211° 0.004	286° 0.004	355° 0.004	056° 0.004	111° 0.003	158° 0.003
8		298° 0.005	054° 0.005	169° 0.005	281° 0.005	030° 0.005	134° 0.004	233° 0.004	327° 0.004	053° 0.004	132° 0.003	204° 0.003	267° 0.003	321° 0.003

Note: In each time period, the upper number shows the relationship between wind direction and current direction, and the lower number shows the relationship between wind speed and current speed.

Figure 4–2a. Wind Current – North Latitudes

	SOUTH LATITUDES													
Period	0°	5°S	10°S	15°S	20°S	25°S	30°S	35°S	40°S	45°S	50°S	55°S	60°S	65°S
1	With sustained winds of 6 hours or more wind current speed will be 5% of wind speed with direction downwind.	175° 0.029	170° 0.028	164° 0.028	160° 0.027	155° 0.027	150° 0.026	146° 0.025	143° 0.024	139° 0.023	136° 0.022	134° 0.021	132° 0.020	130° 0.020
2		157° 0.012	134° 0.012	111° 0.012	089° 0.011	068° 0.011	048° 0.011	028° 0.011	010° 0.010	353° 0.010	338° 0.009	324° 0.009	311° 0.009	301° 0.008
3		141° 0.009	102° 0.009	064° 0.009	027° 0.009	351° 0.008	317° 0.008	284° 0.008	253° 0.008	224° 0.007	198° 0.007	174° 0.007	153° 0.007	136° 0.006
4		125° 0.008	071° 0.008	018° 0.008	325° 0.007	275° 0.007	226° 0.007	180° 0.007	137° 0.006	096° 0.006	059° 0.006	026° 0.006	357° 0.006	332° 0.005
5		110° 0.007	040° 0.007	331° 0.007	264° 0.006	198° 0.006	136° 0.006	077° 0.006	021° 0.006	329° 0.005	281° 0.005	239° 0.005	201° 0.005	168° 0.004
6		094° 0.006	008° 0.006	284° 0.006	202° 0.006	122° 0.006	046° 0.005	333° 0.005	265° 0.005	201° 0.004	143° 0.004	091° 0.004	045° 0.004	005° 0.004
7		078° 0.006	337° 0.006	237° 0.006	140° 0.005	046° 0.005	316° 0.005	230° 0.005	149° 0.004	074° 0.004	005° 0.004	304° 0.004	249° 0.003	202° 0.003
8		062° 0.005	306° 0.005	191° 0.005	079° 0.005	330° 0.005	226° 0.004	127° 0.004	033° 0.004	307° 0.004	228° 0.003	156° 0.003	093° 0.003	039° 0.003

Figure 4–2b. Wind Current – South Latitudes

B. If the means of navigation is not known:

1. 5 NM for ships, military submarines, and aircraft with more than two engines.
2. 10 NM for twin-engine aircraft.

3. 15 NM for boats, submersibles, and single-engine aircraft.

C. If the position is determined from an FCC direction-finding network, the fix error corresponds to the assigned classification of the fix as follows:

Class of Fix	Fix Error
A	20 NM
B	40 NM
C	60 NM

412 Dead Reckoning Error

TABLE 4-3. Dead Reckoning Errors

Type of Craft	DRe
Ship	5% of the DR distance
Submarine (military)	5% of the DR distance
Aircraft (more than 2 engines)	5% of the DR distance
Aircraft (twin-engine)	10% of the DR distance
Aircraft (single-engine)	15% of the DR distance
Submersible	15% of the DR distance
Boat	15% of the DR distance

420 SWEEP WIDTH TABLES

421 Maritime Visual

A. Uncorrected Sweep Width. Tables 4-4 through 4-10 present uncorrected sweep width data for various types of SRUs and various altitudes and visibility conditions. Locate the table for the type of SRU (fixed-wing, helicopter, vesseL, or small boat). For aircraft, enter the column for the appropriate altitude and visibility. For surface craft enter the column for the appropriate visibility. Read down this column to the target type that most closely describes the search object. The value is the uncorrected sweep width. Interpolate as necessary.

TABLE 4-4. Uncorrected Visual Sweep Width—Fixed-Wing Aircraft Altitudes 300-750 feet

Fixed-Wing Searching For	Altitude 300 (ft) Visibility (NM)							Altitude 500 (ft) Visibility (NM)							Altitude 750 (ft) Visibility (NM)						
	1	3	5	10	15	20	30	1	3	5	10	15	20	30	1	3	5	10	15	20	30
Person in Water*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Raft 1 person	0.3	0.7	0.9	1.2	1.3	1.3	1.3	0.3	0.7	0.9	1.2	1.4	1.4	1.4	0.3	0.7	0.9	1.2	1.4	1.4	1.4
Raft 4 person	0.4	0.9	1.3	1.7	2.0	2.2	2.2	0.4	1.0	1.3	1.8	2.0	2.2	2.2	0.4	1.0	1.3	1.8	2.1	2.2	2.2
Raft 6 person	0.4	1.1	1.5	2.1	2.5	2.7	2.7	0.4	1.1	1.5	2.2	2.5	2.8	2.8	0.4	1.1	1.6	2.2	2.6	2.8	2.8
Raft 8 person	0.4	1.2	1.6	2.3	2.6	2.9	2.9	0.4	1.2	1.6	2.3	2.7	2.9	2.9	0.4	1.2	1.7	2.3	2.7	3.0	3.0
Raft 10 person	0.4	1.2	1.7	2.4	2.9	3.2	3.2	0.4	1.2	1.7	2.5	2.9	3.2	3.2	0.4	1.3	1.8	2.5	3.0	3.3	3.3
Raft 15 person	0.5	1.3	1.9	2.7	3.2	3.5	4.0	0.5	1.3	1.9	2.7	3.3	3.6	4.0	0.4	1.4	1.9	2.8	3.3	3.7	4.1
Raft 20 person	0.5	1.4	2.1	3.1	3.7	4.2	4.8	0.5	1.5	2.1	3.2	3.8	4.2	4.8	0.5	1.5	2.2	3.2	3.8	4.3	4.9
Raft 25 person	0.5	1.5	2.2	3.4	4.1	4.6	5.2	0.5	1.6	2.3	3.4	4.1	4.6	5.3	0.5	1.6	2.3	3.5	4.2	4.7	5.4
Power Boat <15 ft	0.4	0.8	1.1	1.4	1.6	1.7	1.7	0.4	0.9	1.2	1.5	1.7	1.8	1.8	0.4	0.9	1.2	1.6	1.8	1.9	1.9
Power Boat 15-25 ft	0.5	1.6	2.4	3.5	4.3	4.8	4.8	0.5	1.7	2.4	3.6	4.3	4.8	4.8	0.5	1.7	2.4	3.6	4.4	4.9	4.9
Power Boat 25-40 ft	0.6	2.1	3.3	5.3	6.6	7.6	9.1	0.6	2.1	3.3	5.3	6.7	7.7	9.1	0.6	2.1	3.3	5.3	6.7	7.7	9.2
Power Boat 40-65 ft	0.6	2.6	4.5	8.1	10.9	13.1	16.4	0.6	2.7	4.5	8.1	10.9	13.1	16.5	0.6	2.7	4.5	8.2	10.9	13.1	16.5
Power Boat 65-90 ft	0.6	2.8	5.0	9.7	13.5	16.6	21.6	0.6	2.8	5.0	9.8	13.5	16.7	21.7	0.6	2.8	5.0	9.8	13.5	16.7	21.7
Sail Boat 15 ft	0.5	1.5	2.2	3.2	3.8	4.3	4.3	0.5	1.6	2.2	3.2	3.9	4.3	4.3	0.5	1.6	2.3	3.3	3.9	4.4	4.4
Sail Boat 20 ft	0.6	1.8	2.6	4.0	4.9	5.6	5.6	0.6	1.8	2.7	4.1	5.0	5.6	5.6	0.5	1.8	2.7	4.1	5.0	5.7	5.7
Sail Boat 25 ft	0.6	2.0	3.1	4.8	6.0	6.9	6.9	0.6	2.0	3.1	4.9	6.1	7.0	7.0	0.6	2.1	3.1	5.0	6.2	7.0	7.0
Sail Boat 30 ft	0.6	2.3	3.6	5.9	7.5	8.8	10.6	0.6	2.3	3.6	5.9	7.6	8.8	10.6	0.6	2.3	3.6	6.0	7.6	8.9	10.7
Sail Boat 40 ft	0.6	2.6	4.3	7.5	10.0	11.9	14.8	0.6	2.6	4.3	7.6	10.0	11.9	14.8	0.6	2.6	4.3	7.6	10.0	11.9	14.9
Sail Boat 50 ft	0.6	2.7	4.6	8.4	11.3	13.6	17.3	0.6	2.7	4.6	8.4	11.3	13.7	17.3	0.6	2.7	4.6	8.5	11.4	13.7	17.4
Sail Boat 65-75 ft	0.6	2.8	4.9	9.3	12.7	15.5	20.0	0.6	2.8	4.9	9.3	12.7	15.5	20.0	0.6	2.8	4.9	9.3	12.7	15.6	20.0
Sail Boat 75-90 ft	0.6	2.8	5.1	9.9	13.7	16.9	22.1	0.6	2.8	5.1	9.9	13.7	17.0	22.1	0.6	2.8	5.1	9.9	13.8	17.0	22.2
Ship 90-150 ft	0.6	2.9	5.4	11.1	15.9	20.0	26.9	0.6	2.9	5.4	11.1	15.9	20.1	26.9	0.6	2.9	5.4	11.1	15.9	20.1	27.0
Ship 150-300 ft	0.6	3.0	5.7	12.5	18.8	24.7	34.8	0.6	3.0	5.7	12.5	18.9	24.7	34.8	0.6	3.0	5.7	12.5	18.9	24.7	34.9
Ship >300 ft	0.7	3.0	5.8	13.2	20.6	27.9	41.4	0.7	3.0	5.8	13.2	20.6	27.9	41.4	0.7	3.0	5.8	13.2	20.6	27.9	41.4

* For search altitudes up to 500 feet only, the values given for sweep width for a person in water may be increased by a factor of four. If it is known that the person is wearing a personal floatation device.

TABLE 4-5. Uncorrected Visual Sweep Width – Fixed-Wing Aircraft Altitudes 1000-2000 feet

Fixed-Wing Searching For	Altitude 1000 (ft) Visibility (NM)							Altitude 1500 (ft) Visibility (NM)							Altitude 2000 (ft) Visibility (NM)						
	1	3	5	10	15	20	30	1	3	5	10	15	20	30	1	3	5	10	15	20	30
Person in Water	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Raft 1 person	0.3	0.7	0.9	1.2	1.4	1.4	1.4	0.2	0.7	0.9	1.3	1.4	1.4	1.4	0.1	0.6	0.9	1.2	1.4	1.4	1.4
Raft 4 person	0.3	1.0	1.3	1.8	2.1	2.3	2.3	0.3	1.0	1.3	1.9	2.1	2.3	2.3	0.2	0.9	1.3	1.9	2.2	2.3	2.3
Raft 6 person	0.4	1.1	1.6	2.2	2.6	2.8	2.8	0.3	1.1	1.6	2.3	2.6	2.9	2.9	0.2	1.1	1.6	2.3	2.7	2.9	2.9
Raft 8 person	0.4	1.2	1.7	2.4	2.8	3.0	3.0	0.3	1.2	1.7	2.4	2.8	3.1	3.1	0.2	1.2	1.7	2.5	2.9	3.2	3.2
Raft 10 person	0.4	1.3	1.8	2.6	3.0	3.3	3.3	0.3	1.3	1.8	2.6	3.1	3.4	3.4	0.2	1.2	1.8	2.7	3.1	3.5	3.5
Raft 15 person	0.4	1.4	2.0	2.8	3.4	3.7	4.2	0.3	1.4	2.0	2.9	3.4	3.8	4.3	0.2	1.4	2.0	3.0	3.5	3.9	4.4
Raft 20 person	0.4	1.5	2.2	3.2	3.9	4.3	4.9	0.4	1.5	2.2	3.3	4.0	4.4	5.1	0.3	1.5	2.2	3.4	4.0	4.5	5.1
Raft 25 person	0.4	1.6	2.3	3.5	4.2	4.7	5.4	0.4	1.6	2.4	3.6	4.3	4.8	5.6	0.3	1.6	2.4	3.6	4.4	4.9	5.7
Power Boat <15 ft	0.4	1.0	1.3	1.7	1.8	2.0	2.0	0.3	1.0	1.3	1.7	2.0	2.1	2.1	0.2	1.0	1.3	1.8	2.0	2.2	2.2
Power Boat 15-25 ft	0.5	1.7	2.5	3.7	4.4	5.0	5.0	0.4	1.7	2.5	3.7	4.5	5.1	5.1	0.3	1.7	2.5	3.8	4.6	5.1	5.1
Power Boat 25-40 ft	0.5	2.2	3.4	5.4	6.8	7.8	9.3	0.5	2.2	3.4	5.5	6.8	7.9	9.4	0.3	2.2	3.4	5.5	6.9	8.0	9.5
Power Boat 40-65 ft	0.6	2.7	4.5	8.2	10.9	13.1	16.6	0.5	2.6	4.5	8.2	11.0	13.2	16.6	0.4	2.6	4.5	8.3	11.0	13.3	16.7
Power Boat 65-90 ft	0.6	2.8	5.1	9.8	13.6	16.7	21.7	0.5	2.8	5.1	9.8	13.6	16.7	21.8	0.4	2.8	5.0	9.8	13.6	16.8	21.8
Sail Boat 15 ft	0.5	1.6	2.3	3.3	4.0	4.4	4.4	0.4	1.6	2.3	3.4	4.1	4.5	4.5	0.3	1.6	2.3	3.5	4.1	4.6	4.6
Sail Boat 20 ft	0.5	1.8	2.7	4.2	5.1	5.7	5.7	0.4	1.8	2.8	4.2	5.2	5.8	5.8	0.3	1.8	2.8	4.3	5.2	5.9	5.9
Sail Boat 25 ft	0.5	2.1	3.2	5.0	6.2	7.1	7.1	0.5	2.1	3.2	5.1	6.3	7.2	7.2	0.3	2.1	3.3	5.2	6.4	7.3	7.3
Sail Boat 30 ft	0.6	2.3	3.6	6.0	7.6	8.9	10.7	0.5	2.3	3.7	6.1	7.7	9.0	10.8	0.3	2.3	3.7	6.1	7.8	9.1	10.9
Sail Boat 40 ft	0.6	2.6	4.3	7.6	10.9	12.0	14.9	0.5	2.6	4.3	7.6	10.1	12.0	14.9	0.4	2.5	4.3	7.7	10.1	12.1	15.0
Sail Boat 50 ft	0.6	2.7	4.6	8.5	11.4	13.7	17.4	0.5	2.7	4.6	8.5	11.4	13.8	17.5	0.4	2.7	4.6	8.6	11.5	13.9	17.5
Sail Boat 65-75 ft	0.6	2.8	4.9	9.3	12.8	15.6	20.1	0.5	2.8	4.9	9.4	12.8	15.7	20.2	0.4	2.7	4.9	9.4	12.9	15.7	20.2
Sail Boat 75-90 ft	0.6	2.8	5.1	9.9	13.8	17.0	22.2	0.5	2.8	5.1	10.0	13.8	17.1	22.3	0.4	2.8	5.1	10.0	13.9	17.1	22.3
Ship 90-150 ft	0.6	2.9	5.4	11.1	15.9	20.1	27.0	0.5	2.9	5.4	11.1	16.0	20.1	27.0	0.4	2.9	5.4	11.1	16.0	20.1	27.1
Ship 150-300 ft	0.6	3.0	5.7	12.5	18.9	24.7	34.9	0.5	3.0	5.7	12.5	18.9	24.7	34.9	0.4	2.9	5.7	12.5	18.9	24.7	34.9
Ship >300 ft	0.6	3.0	5.8	13.2	20.6	27.9	41.4	0.6	3.0	5.8	13.2	20.7	27.9	41.4	0.5	3.0	5.8	13.2	20.7	27.9	41.5

TABLE 4-6. Uncorrected Visual Sweep Width – Fixed-Wing Aircraft Altitudes 2500-3000 feet

Fixed-Wing Searching For	Altitude 2500 (ft) Visibility (NM)							Altitude 3000 (ft)* Visibility (NM)						
	1	3	5	10	15	20	30	1	3	5	10	15	20	30
Person in Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Raft 1 person	0.1	0.5	0.8	1.2	1.4	1.4	1.4	0.1	0.5	0.8	1.1	1.3	1.3	1.3
Raft 4 person	0.1	0.8	1.3	1.8	2.2	2.4	2.4	0.1	0.7	1.2	1.8	2.1	2.3	2.3
Raft 6 person	0.1	1.0	1.5	2.3	2.7	2.9	2.9	0.1	0.9	1.5	2.2	2.7	2.9	2.9
Raft 8 person	0.1	1.1	1.7	2.5	2.9	3.2	3.2	0.1	1.0	1.6	2.5	2.9	3.2	3.2
Raft 10 person	0.2	1.2	1.8	2.7	3.2	3.5	3.5	0.1	1.1	1.8	2.7	3.2	3.5	3.5
Raft 15 person	0.2	1.3	2.0	3.0	3.6	4.0	4.5	0.1	1.2	2.0	3.0	3.6	4.0	4.5
Raft 20 person	0.2	1.4	2.2	3.4	4.1	4.6	5.2	0.1	1.4	2.2	3.4	4.1	4.6	5.3
Raft 25 person	0.2	1.5	2.4	3.7	4.5	5.0	5.7	0.1	1.5	2.4	3.7	4.5	5.1	5.8
Power Boat <15 ft	0.1	0.9	1.3	1.8	2.1	2.2	2.2	0.1	0.8	1.3	1.8	2.1	2.3	2.3
Power Boat 15-25 ft	0.2	1.6	2.5	3.8	4.6	5.2	5.2	0.1	1.6	2.5	3.9	4.7	5.3	5.3
Power Boat 25-40 ft	0.2	2.1	3.4	5.6	7.0	8.1	9.6	0.2	2.1	3.4	5.6	7.1	8.1	9.7
Power Boat 40-65 ft	0.3	2.6	4.5	8.3	11.3	13.3	16.7	0.2	2.5	4.5	8.3	11.1	13.4	16.8
Power Boat 65-90 ft	0.3	2.7	5.0	9.8	13.6	16.8	21.9	0.2	2.7	5.0	9.9	13.7	16.8	21.9
Sail Boat 15 ft	0.2	1.5	2.3	3.5	4.2	4.7	4.7	0.1	1.5	2.3	3.5	4.3	4.7	4.7
Sail Boat 20 ft	0.2	1.8	2.8	4.3	5.3	6.0	6.0	0.1	1.7	2.8	4.4	5.3	6.0	6.0
Sail Boat 25 ft	0.2	2.1	3.3	5.2	6.5	7.5	7.5	0.2	2.0	3.3	5.3	6.6	7.5	7.5
Sail Boat 30 ft	0.2	2.2	3.7	6.1	7.8	9.1	11.0	0.2	2.2	3.7	6.2	7.9	9.2	11.1
Sail Boat 40 ft	0.3	2.5	4.3	7.7	10.2	12.1	15.1	0.2	2.4	4.3	7.7	10.2	12.1	15.1
Sail Boat 50 ft	0.3	2.6	4.6	8.6	11.5	13.9	17.6	0.2	2.6	4.6	8.6	11.6	14.0	17.7
Sail Boat 65-75 ft	0.3	2.7	4.9	9.4	12.9	15.8	20.3	0.2	2.6	4.9	9.4	13.0	15.8	20.3
Sail Boat 75-90 ft	0.3	2.8	5.1	10.0	13.9	17.2	22.4	0.2	2.7	5.1	10.0	14.0	17.2	22.5
Ship 90-150 ft	0.3	2.8	5.4	11.1	16.0	20.2	27.1	0.2	2.8	5.3	11.1	16.0	20.2	27.1
Ship 150-300 ft	0.3	2.9	5.6	12.5	18.9	24.8	35.0	0.2	2.8	5.6	12.5	18.9	24.8	35.0
Ship >300 ft	0.3	2.9	5.7	13.2	20.7	27.9	41.5	0.2	2.9	5.7	13.2	20.7	27.9	41.5

* Visual searches are seldom conducted from altitudes above 3000 feet; however, for altitudes up to 5000 feet where visibility exceeds 3NM and target size exceeds 25 feet, the sweep widths given for 3000 feet remain applicable.

TABLE 4–7. Uncorrected Visual Sweep Width – Helicopters Altitudes 300–750 feet

Helicopter Searching For	Altitude 300 (ft) Visibility (NM)							Altitude 500 (ft) Visibility (NM)							Altitude 750 (ft) Visibility (NM)						
	1	3	5	10	15	20	30	1	3	5	10	15	20	30	1	3	5	10	15	20	30
Person in Water*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Raft 1 person	0.4	0.9	1.2	1.5	1.7	1.7	1.7	0.4	0.9	1.2	1.6	1.8	1.8	1.8	0.4	0.9	1.2	1.6	1.8	1.8	1.8
Raft 4 person	0.5	1.2	1.6	2.2	2.5	2.7	2.7	0.5	1.2	1.6	2.2	2.6	2.8	2.8	0.5	1.2	1.7	2.3	2.6	2.8	2.8
Raft 6 person	0.5	1.4	1.9	2.7	3.1	3.4	3.4	0.5	1.4	1.9	2.7	3.2	3.5	3.5	0.5	1.4	2.0	2.7	3.2	3.5	3.5
Raft 8 person	0.6	1.4	2.0	2.8	3.3	3.6	3.6	0.6	1.5	2.0	2.8	3.3	3.7	3.7	0.5	1.5	2.1	2.9	3.4	3.7	3.7
Raft 10 person	0.6	1.5	2.1	3.0	3.6	3.9	3.9	0.6	1.6	2.2	3.1	3.6	4.0	4.0	0.6	1.6	2.2	3.1	3.7	4.0	4.0
Raft 15 person	0.6	1.6	2.3	3.3	3.9	4.3	4.9	0.6	1.7	2.3	3.3	4.0	4.4	5.0	0.6	1.7	2.4	3.4	4.0	4.5	5.0
Raft 20 person	0.6	1.8	2.6	3.8	4.5	5.1	5.8	0.6	1.8	2.6	3.8	4.6	5.1	5.9	0.6	1.8	2.6	3.9	4.6	5.2	5.9
Raft 25 person	0.6	1.9	2.7	4.1	4.9	5.5	6.3	0.6	1.9	2.7	4.1	5.0	5.6	6.4	0.6	1.9	2.8	4.2	5.0	5.6	6.5
Power Boat <15 ft	0.5	1.1	1.4	1.9	2.1	2.2	2.2	0.5	1.2	1.5	1.9	2.2	2.3	2.3	0.5	1.2	1.6	2.0	2.3	2.4	2.4
Power Boat 15-25 ft	0.7	2.0	2.9	4.3	5.2	5.8	5.8	0.7	2.0	2.9	4.3	5.2	5.8	5.8	0.7	2.0	2.9	4.4	5.3	5.9	5.9
Power Boat 25-40 ft	0.8	2.5	3.8	6.1	7.7	8.9	10.6	0.8	2.5	3.9	6.2	7.8	9.0	10.7	0.7	2.5	3.9	6.2	7.8	9.0	10.7
Power Boat 40-65 ft	0.8	3.1	5.1	9.2	12.2	14.7	18.5	0.8	3.1	5.1	9.2	12.3	14.7	18.5	0.8	3.1	5.1	9.2	12.3	14.7	18.5
Power Boat 65-90 ft	0.8	3.3	5.7	10.8	15.0	18.4	23.9	0.8	3.3	5.7	10.8	15.0	18.4	23.9	0.8	3.3	5.7	10.9	15.0	18.4	23.9
Sail Boat 15 ft	0.7	1.9	2.7	3.9	4.6	5.2	5.2	0.7	1.9	2.7	3.9	4.7	5.2	5.2	0.7	1.9	2.7	4.0	4.8	5.3	5.3
Sail Boat 20 ft	0.7	2.2	3.2	4.8	5.9	6.6	6.6	0.7	2.2	3.2	4.8	5.9	6.7	6.7	0.7	2.2	3.2	4.9	6.0	6.7	6.7
Sail Boat 25 ft	0.8	2.4	3.6	5.7	7.1	8.1	8.1	0.8	2.4	3.7	5.7	7.1	8.2	8.2	0.7	2.5	3.7	5.8	7.2	8.3	8.3
Sail Boat 30 ft	0.8	2.7	4.2	6.8	8.7	10.1	12.2	0.8	2.7	4.2	6.9	8.7	10.2	12.3	0.8	2.7	4.2	6.9	8.8	10.2	12.3
Sail Boat 40 ft	0.8	3.0	4.9	8.6	11.3	13.4	16.7	0.8	3.0	4.9	8.6	11.3	13.5	16.8	0.8	3.0	4.9	8.6	11.3	13.5	16.8
Sail Boat 50 ft	0.8	3.1	5.2	9.5	12.7	15.3	19.3	0.8	3.1	5.2	9.5	12.7	15.3	19.4	0.8	3.1	5.3	9.5	12.7	15.4	19.4
Sail Boat 65-75 ft	0.8	3.2	5.5	10.3	14.1	17.2	22.1	0.8	3.2	5.5	10.4	14.1	17.3	22.2	0.8	3.2	5.5	10.4	14.2	17.3	22.2
Sail Boat 75-90 ft	0.8	3.3	5.7	11.0	15.2	18.7	24.3	0.8	3.3	5.7	11.0	15.2	18.7	24.4	0.8	3.3	5.7	11.0	15.2	18.8	24.4
Ship 90-150 ft	0.8	3.4	6.0	12.2	17.4	21.9	29.3	0.8	3.4	6.0	12.2	17.4	21.9	29.3	0.8	3.4	6.0	12.2	17.4	21.9	29.3
Ship 150-300 ft	0.8	3.4	6.3	13.6	20.4	26.6	37.3	0.8	3.4	6.3	13.6	20.4	26.6	37.3	0.8	3.4	6.3	13.6	20.4	26.6	37.3
Ship >300 ft	0.8	3.5	6.4	14.3	22.1	29.8	43.8	0.8	3.5	6.4	14.3	22.1	29.8	43.8	0.8	3.5	6.4	14.3	22.2	29.8	43.8

* For search altitudes up to 500 feet only, the values given for sweep width for a person in water may be increased by a factor of four. If it is known that the person is wearing a personal floatation device.

TABLE 4–8. Uncorrected Visual Sweep Width – Helicopters Altitudes 1000–2000 feet

Helicopter Searching For	Altitude 1000 (ft) Visibility (NM)							Altitude 1500 (ft) Visibility (NM)							Altitude 2000 (ft) Visibility (NM)						
	1	3	5	10	15	20	30	1	3	5	10	15	20	30	1	3	5	10	15	20	30
Person in Water	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Raft 1 person	0.4	0.9	1.2	1.6	1.8	1.8	1.8	0.3	0.9	1.2	1.6	1.8	1.8	1.8	0.2	0.8	1.2	1.6	1.8	1.8	1.8
Raft 4 person	0.5	1.2	1.7	2.3	2.6	2.9	2.9	0.4	1.2	1.7	2.3	2.7	2.9	2.9	0.3	1.2	1.7	2.3	2.7	3.0	3.0
Raft 6 person	0.5	1.4	2.0	2.8	3.2	3.5	3.5	0.4	1.4	2.0	2.8	3.3	3.6	3.6	0.3	1.4	2.0	2.8	3.3	3.6	3.6
Raft 8 person	0.5	1.5	2.1	2.9	3.4	3.8	3.8	0.4	1.5	2.1	3.0	3.5	3.9	3.9	0.3	1.5	2.1	3.0	3.6	3.9	3.9
Raft 10 person	0.5	1.6	2.2	3.2	3.7	4.1	4.1	0.4	1.6	2.2	3.2	3.8	4.2	4.2	0.3	1.6	2.3	3.3	3.9	4.2	4.2
Raft 15 person	0.6	1.7	2.4	3.5	4.1	4.5	5.1	0.5	1.7	2.4	3.5	4.2	4.6	5.2	0.3	1.7	2.5	3.6	4.3	4.7	5.3
Raft 20 person	0.6	1.8	2.7	3.9	4.7	5.2	6.0	0.5	1.9	2.7	4.0	4.8	5.3	6.1	0.4	1.8	2.7	4.0	4.9	5.4	6.2
Raft 25 person	0.6	1.9	2.8	4.2	5.1	5.7	6.5	0.5	2.0	2.9	4.3	5.2	5.8	6.7	0.4	1.9	2.9	4.3	5.3	5.9	6.8
Power Boat <15 ft	0.5	1.2	1.6	2.1	2.3	2.5	2.5	0.4	1.3	1.7	2.2	2.5	2.6	2.6	0.3	1.3	1.7	2.3	2.6	2.7	2.7
Power Boat 15-25 ft	0.7	2.1	3.0	4.4	5.3	5.9	5.9	0.6	2.1	3.0	4.5	5.4	6.1	6.1	0.4	2.1	3.0	4.5	5.5	6.1	6.1
Power Boat 25-40 ft	0.7	2.6	3.9	6.3	7.9	9.1	10.8	0.6	2.6	4.0	6.3	7.9	9.2	10.9	0.5	2.6	4.0	6.4	8.0	9.3	11.0
Power Boat 40-65 ft	0.7	3.1	5.2	9.2	12.3	14.8	18.6	0.7	3.1	5.2	9.3	12.4	14.8	18.6	0.5	3.0	5.2	9.3	12.4	14.9	18.7
Power Boat 65-90 ft	0.8	3.3	5.7	10.9	15.0	18.5	23.9	0.7	3.2	5.7	10.9	15.1	18.5	24.0	0.5	3.2	5.7	10.9	15.1	18.5	24.0
Sail Boat 15 ft	0.6	1.9	2.8	4.0	4.8	5.4	5.4	0.6	2.0	2.8	4.1	4.9	5.5	5.5	0.4	1.9	2.8	4.2	5.0	5.6	5.6
Sail Boat 20 ft	0.7	2.2	3.2	4.9	6.0	6.8	6.8	0.6	2.2	3.3	5.0	6.1	6.9	6.9	0.5	2.2	3.3	5.1	6.2	7.0	7.0
Sail Boat 25 ft	0.7	2.5	3.7	5.8	7.3	8.3	8.3	0.6	2.5	3.8	5.9	7.4	8.4	8.4	0.5	2.5	3.8	6.0	7.5	8.6	8.6
Sail Boat 30 ft	0.7	2.7	4.2	6.9	8.8	10.3	12.4	0.6	2.7	4.2	7.0	8.9	10.3	12.5	0.5	2.7	4.3	7.0	9.0	10.4	12.6
Sail Boat 40 ft	0.7	3.0	4.9	8.6	11.4	13.5	16.8	0.6	3.0	4.9	8.7	11.4	13.6	16.9	0.5	3.0	4.9	8.7	11.4	13.6	17.0
Sail Boat 50 ft	0.7	3.1	5.3	9.5	12.8	15.4	19.5	0.7	3.1	5.3	9.6	12.8	15.5	19.5	0.5	3.1	5.3	9.6	12.9	15.5	19.6
Sail Boat 65-75 ft	0.8	3.2	5.6	10.4	14.2	17.3	22.2	0.7	3.2	5.6	10.4	14.3	17.4	22.3	0.5	3.2	5.6	10.5	14.3	17.4	22.4
Sail Boat 75-90 ft	0.8	3.3	5.7	11.0	15.3	18.8	24.4	0.7	3.3	5.7	11.1	15.3	18.8	24.5	0.5	3.2	5.7	11.1	15.4	18.9	24.6
Ship 90-150 ft	0.8	3.4	6.0	12.2	17.4	21.9	29.3	0.7	3.3	6.0	12.2	17.5	22.0	29.4	0.5	3.3	6.0	12.2	17.5	22.0	29.4
Ship 150-300 ft	0.8	3.4	6.3	13.6	20.4	26.6	37.3	0.7	3.4	6.3	13.6	20.4	26.6	37.3	0.5	3.4	6.3	13.6	20.4	26.6	37.4
Ship 300 ft	0.8	3.5	6.4	14.3	22.2	29.8	43.9	0.7	3.4	6.4	14.3	22.2	29.8	43.9	0.6	3.4	6.4	14.3	22.2	29.8	43.9

TABLE 4-9. Uncorrected Visual Sweep Width – Helicopters Altitudes 2500–3000 feet

Helicopter Searching For	*Altitude 2500 (ft) Visibility (NM)*							*Altitude 3000 (ft)* Visibility (NM)*						
	1	*3*	*5*	*10*	*15*	*20*	*30*	*1*	*3*	*5*	*10*	*15*	*20*	*30*
Person in Water	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Raft 1 person	0.1	0.8	1.1	1.6	1.8	1.8	1.8	0.1	0.7	1.0	1.5	1.8	1.8	1.8
Raft 4 person	0.2	1.1	1.6	2.3	2.7	3.0	3.0	0.1	1.0	1.6	2.3	2.7	3.0	3.0
Raft 6 person	0.2	1.3	1.9	2.8	3.3	3.7	3.7	0.1	1.2	1.9	2.8	3.3	3.7	3.7
Raft 8 person	0.2	1.4	2.1	3.1	3.6	4.0	4.0	0.1	1.3	2.1	3.1	3.6	4.0	4.0
Raft 10 person	0.2	1.5	2.2	3.3	3.9	4.3	4.3	0.1	1.4	2.2	3.3	3.9	4.3	4.3
Raft 15 person	0.2	1.7	2.5	3.6	4.3	4.8	5.4	0.2	1.6	2.4	3.7	4.4	4.9	5.5
Raft 20 person	0.3	1.8	2.7	4.1	4.9	5.5	6.3	0.2	1.7	2.7	4.1	5.0	5.6	6.3
Raft 25 person	0.3	1.9	2.9	4.4	5.3	6.0	6.9	0.2	1.9	2.9	4.4	5.4	6.0	6.9
Power Boat <15 ft	0.2	1.2	1.7	2.3	2.6	2.8	2.8	0.1	1.1	1.7	2.3	2.7	2.9	2.9
Power Boat 15-25 ft	0.3	2.0	3.0	4.6	5.5	6.2	6.2	0.2	2.0	3.0	4.6	5.6	6.3	6.3
Power Boat 25-40 ft	0.4	2.5	4.0	6.5	8.1	9.3	11.1	0.2	2.5	4.0	6.5	8.2	9.4	11.2
Power Boat 40-65 ft	0.4	3.0	5.2	9.3	12.4	14.9	18.8	0.3	3.0	5.2	9.3	12.5	15.0	18.8
Power Boat 65-90 ft	0.4	3.2	5.7	10.9	15.1	18.6	24.1	0.3	3.1	5.7	10.9	15.1	18.6	24.1
Sail Boat 15 ft	0.3	1.9	2.8	4.2	5.1	5.6	5.6	0.2	1.9	2.8	4.3	5.1	5.7	5.7
Sail Boat 20 ft	0.3	2.2	3.3	5.1	6.3	7.1	7.1	0.2	2.1	3.3	5.2	6.3	7.1	7.1
Sail Boat 25 ft	0.4	2.5	3.8	6.1	7.6	8.7	8.7	0.2	2.4	3.9	6.1	7.7	8.8	8.8
Sail Boat 30 ft	0.4	2.7	4.3	7.1	9.0	10.5	12.6	0.2	2.6	4.3	7.1	9.1	10.6	12.7
Sail Boat 40 ft	0.4	2.9	4.9	8.7	11.5	13.7	17.0	0.3	2.9	4.9	8.7	11.5	13.7	17.1
Sail Boat 50 ft	0.4	3.1	5.3	9.6	12.9	15.6	19.7	0.3	3.0	5.3	9.7	13.0	15.6	19.7
Sail Boat 65-75 ft	0.4	3.1	5.6	10.5	14.3	17.5	22.4	0.3	3.1	5.6	10.5	14.4	17.5	22.5
Sail Boat 75-90 ft	0.4	3.2	5.7	11.1	15.4	18.9	24.6	0.3	3.1	5.7	11.1	15.4	19.0	24.7
Ship 90-150 ft	0.4	3.3	6.0	12.2	17.5	22.0	29.4	0.3	3.2	6.0	12.2	17.5	22.0	29.5
Ship 150-300 ft	0.4	3.3	6.3	13.6	20.4	26.6	37.4	0.3	3.3	6.3	13.6	20.4	26.6	37.4
Ship >300 ft	0.5	3.4	6.4	14.3	22.2	29.8	43.9	0.3	3.3	6.4	14.3	22.2	29.8	43.9

* Visual searches are seldom conducted from altitudes above 3000 feet; however, for altitudes up to 5000 feet where visibility exceeds 3NM and target size exceeds 25 feet, the sweep widths given for 3000 feet remain applicable.

TABLE 4-10. Uncorrected Visual Sweep Width—Vessels and Small Boats

Search Object	*Vessel SRU (90' WPB) Visibility (NM)*						*Small Boat SRU (41' UTB) Visibility (NM)*					
	1	*3*	*5*	*10*	*15*	*20*	*1*	*3*	*5*	*10*	*15*	*20*
Person in Water	0.3	0.4	0.5	0.5	0.5	0.5	0.2	0.2	0.3	0.3	0.3	0.3
Raft 1 person	0.9	1.8	2.3	3.1	3.4	3.7	0.7	1.3	1.7	2.3	2.6	2.7
Raft 4 person	1.0	2.2	3.0	4.0	4.6	5.0	0.7	1.7	2.2	3.1	3.5	3.9
Raft 6 person	1.1	2.5	3.4	4.7	5.5	6.0	0.8	1.9	2.6	3.6	4.3	4.7
Raft 8 person	1.1	2.5	3.5	4.8	5.7	6.2	0.8	2.0	2.7	3.8	4.4	4.9
Raft 10 person	1.1	2.6	3.6	5.1	6.1	6.7	0.8	2.0	2.8	4.0	4.8	5.3
Raft 15 person	1.1	2.8	3.8	5.5	6.5	7.2	0.9	2.2	3.0	4.3	5.1	5.7
Raft 20 person	1.2	3.0	4.1	6.1	7.3	8.1	0.9	2.3	3.3	4.9	5.8	6.5
Raft 25 person	1.2	3.1	4.3	6.4	7.8	8.7	0.9	2.4	3.5	5.2	6.3	7.0
Power Boat <15 ft	0.5	1.1	1.4	1.9	2.1	2.3	0.4	0.8	1.1	1.5	1.6	1.8
Power Boat 15-25 ft	1.0	2.0	2.9	4.3	5.2	5.8	0.8	1.5	2.2	3.3	4.0	4.5
Power Boat 25-40 ft	1.1	2.5	3.8	6.1	7.7	8.8	0.8	1.9	2.9	4.7	5.9	6.8
Power Boat 40-65 ft	1.2	3.1	5.1	9.1	12.1	14.4	0.9	2.4	3.9	7.0	9.3	11.1
Power Boat 65-90 ft	1.2	3.2	5.6	10.7	14.7	18.1	0.9	2.5	4.3	8.3	11.4	14.0
Sail Boat 15 ft	1.0	1.9	2.7	3.9	4.7	5.2	0.8	1.5	2.1	3.0	3.6	4.0
Sail Boat 20 ft	1.0	2.2	3.2	4.8	5.9	6.6	0.8	1.7	2.5	3.7	4.6	5.1
Sail Boat 25 ft	1.1	2.4	3.6	5.7	7.0	8.1	0.9	1.9	2.8	4.4	5.4	6.3
Sail Boat 30 ft	1.1	2.7	4.1	6.8	8.6	10.0	0.9	2.1	3.2	5.3	6.6	7.7
Sail Boat 40 ft	1.2	3.0	4.9	8.5	11.2	13.3	0.9	2.3	3.8	6.6	8.6	10.3
Sail Boat 50 ft	1.2	3.1	5.2	9.4	12.5	15.0	0.9	2.4	4.0	7.3	9.7	11.6
Sail Boat 65-75 ft	1.2	3.2	5.5	10.2	13.9	16.9	0.9	2.5	4.2	7.9	10.7	13.1
Sail Boat 75-90 ft	1.2	3.3	5.7	10.8	15.0	18.4	0.9	2.5	4.4	8.3	11.6	14.2
Ship 90-150 ft	1.8	3.3	6.0	12.0	17.1	21.5	1.4	2.5	4.6	9.3	13.2	16.6
Ship 150-300 ft	1.8	3.4	6.3	13.4	20.1	26.1	1.4	2.6	4.9	10.3	15.5	20.2
Ship >300 ft	1.8	3.4	6.4	14.1	21.8	29.2	1.4	2.6	4.9	10.9	16.8	22.5

B. Correcting for Weather. Use Table 4-11 to determine the weather correction factor (if conditions of both columns apply, use correction factor in right column).

TABLE 4-11. Weather Correction Factor

Target Type	*Winds > 15 Kts Seas 2-3 ft*	*Winds > 25 Kts Seas > 4 Ft*
Person in water, or < 30-Ft Length Boat	0.5	0.25
Other Targets	0.9	0.9

C. Correcting for Fatigue. If feedback from on scene SRUs indicates search crews were excessively fatigued, reduce sweep width values by 10 percent (multiply by 0.9).

D. Correcting for Search Aircraft Speed Correction. Enter the speed correction table (Table 4-12) with aircraft type (fixed-wing or helicopter) and the speed flown. Read down the column to the search object. This value is the speed correction. Interpolate as required. There is no speed correction for surface SRUs.

422 VISUAL DETECTION AIDS

A. Daylight

TABLE 4-13. Visual Sweep Width Estimates for Daylight Detection Aids

Device	*Estimated Sweep Width (NM)*	*SRU Type*
Red/orange balloon	0.5	Air or surface
Orange flight suit	0.5	Air
Red hand flare (500 candlepower)	0.5	Air or surface
Day/night flare	0.5	Air or surface
Red pen gun flare	0.75	Air or surface
Red reflective paulin	2.0	Air or surface
Tracer bullets	2.0	Air or surface
Green dye marker*	2.0	Air
Red/orange flag(waving) (3 ft x 3 ft)	2.5	Air or surface
Sun signal mirror	5.0	Air or surface
White parachute	5.0	Air or surface
Red meteor (star) or parachute flare (10,000 candlepower)*	6.0	Air or surface

*Greatly reduced in heavy seas

TABLE 4-12. Search Aircraft Speed Correction Table

	Fixed Wing Speed (Knots)			*Helicopter Speed (Knots)*			
Search Object	*150 or less*	*180*	*210*	*60 or less*	*90*	*120*	*140*
Person in Water	1.2	1.0	0.9	1.5	1.0	0.8	0.7
Raft - 1-4 Man	1.1	1.0	0.9	1.3	1.0	0.9	0.8
Raft - 6-25 Man	1.1	1.0	0.9	1.2	1.0	0.9	0.8
Power Boat - to 25 ft	1.1	1.0	0.9	1.2	1.0	0.9	0.8
Power Boat - 25-40 ft	1.1	1.0	0.9	1.1	1.0	0.9	0.9
Power Boat - 40-65 ft	1.1	1.0	1.0	1.1	1.0	0.9	0.9
Power Boat - 65-90 ft	1.1	1.0	1.0	1.1	1.0	1.0	0.9
Sail Boat - to 26 ft	1.1	1.0	0.9	1.2	1.0	0.9	0.9
Sail Boat - 30-52 ft	1.1	1.0	1.0	1.1	1.0	0.9	0.9
Sail Boat - 65-90 ft	1.1	1.0	1.0	1.1	1.0	1.0	0.9
Ship - over 90 ft	1.0	1.0	1.0	1.1	1.0	1.0	0.9

TABLE 4–13a. Visual Sweep Width Estimates for Hand Held Orange Smoke[1]

SRU Type	*Time on Task (hr)* < 3	≥ 3
Small boat (41' UTB)	4.6	2.8
Vessel (90' WPB)	6.9	5.0
Air*	7.7	

*Sweep width based on test results involving helicopters only.

B. Night

TABLE 4–14. Visual Sweep Width Estimates for Night Detection Aids

Device	*Estimated Sweep Width (NM)*	*SRU Type*
Strobe (2,000 candlepower peak)	0.5	Air or surface
Cyalume personnel marker light	1.0	Air or surface
Electric flashing SOS lantern or hand flashlight*	3.0	Air or surface
Tracer bullets	4.0	Air or surface
Red Very signals	8.0	Air or surface
Aircraft marine markers	8.0	Air or surface
Red pen gun flare	8.0	Air or surface
Red meteor (star) or parachute flare (10,000 candlepower)	10.0 or twice limit of survivor/SRU visibility	Air or surface

*These estimates were derived from test data collected only on surface searches.

TABLE 4–14a. Visual Sweep Width Estimates for Hand Held Red Flare (500 candlepower)[1]

SRU Type	*Time on Task (hr)* < 3	≥ 3
Small boat (41' UTB)	10.7	10.2
Vessel (90' WPB)	13.0	12.6
Air*	15.4	

*Sweep width based on test results involving helicopters only.

TABLE 4–14b. Visual Sweep Width Estimates for Life ring/Life jacket White Strobe (50,000 peak candlepower)[1]

	Time on Task (hr) < 3			≥ 3		
	Wind Speed (kts)					
SRU Type	*<10*	*10–15*	*>15**	*<10*	*10–15*	*>15**
Surface	3.9	2.6	1.3	2.1	1.1	0.5

SRU Type	*Time on Task (hr)* < 1	> 1
Air**	4.4	3.9

*Values for this category were extrapolated from test data.
**Based on test results with helicopters only.

423 EPIRB/ELT

A. The following guidelines, listed in order of preference, are recommended for developing an EPIRB/ELT sweep width:

1. When minimum detection range is known: W = (1.7) x (minimum detection range).

2. When average detection range is known: W = (1.5) x (average detection range).

3. When maximum detection range is known: W = (1.0) x (maximum detection range).

4. When no detection range is known: W = (0.5) x (horizon range), using horizon range table (Table 4–27).

B. If search aircraft VHF/UHF antennas are located on top of the aircraft or in the tail, the sweep widths determined by these rules should be reduced by 25 percent.

C. If search area is in mountainous, jungle, wooded, or other vegetation areas, reduce values for W by one–half.

424 RADAR

A. Surface Vessel

TABLE 4-15. Sweep Widths for Surface Vessel Radar*(NM)

Target Type	*Douglas Sea State*	*Sweep Width (NM)) Surface Vessel Radar System* AN/SPS-64(V)	AN/SPS-66
Small (20 feet or less) fiberglass boats, without radar reflector or engine/metal equipment	0 to 1 2 to 3	1.4 1.1	0.8 0
Small (20 feet or less) fiberglass boats, with radar reflector or engine/metal equipment	0 to 1 2 to 3	5.0 1.6	2.0 0.4
Medium to large vessels (40 feet or over) with significant amounts of reflective material	0 to 2	13	9.5

*For intermediate size targets in sea states below 3, the information form the SVR table should be interpolated. For sea states greater than 3, sweep width should be estimated on the basis of sea state and target characteristics.

B. Forward-Looking Airborne Radar (FLAR)

TABLE 4-16. Sweep Widths for Forward-Looking Airborne Radar (AN/APS-133, AN/APN-215)

		Sweep Width (NM) Radar System	
Target Type	*Douglas Sea State*	*AN/APS-133 MAP-1 and MAP-2 Modes*	*AN/APN-215 SEARCH-1 and SEARCH-2 Modes*
Small (20 feet or less) fiberglass boats, without radar reflector or engine/ metal equipment	0 to 1 2	7 2	4 2
Small (20 feet or less) fiberglass boats, with radar reflector or engine/metal equipment	0 to 1 2	8 3	6 3
Medium to large (40 to 100 feet) targets with significant amounts of reflective material	0 to 1 2 to 3	40 4	40 4
Metal targets longer than 100 feet	0 to 1 2 to 3	>50 16	>50 16

TABLE 4–16a. Sweep Widths for Forward–Looking Airborne Radar (AN/APS–127)[2]

Target Type	*Range Scale (NM)*	*Search Altitudes (FT)*	*Significant Wave (FT)*	*Sweep Width (NM)*
6 to 10 person life rafts	10	500 to 4500	< 2	5.4
			2 to 5	1.8
			> 5	nil
24 to 43 foot boats	10	500 to 1000	< 2	12.8
			2 to 5	10.8
			6 to 10*	6.3
			> 10*	3.1
		1100 to 2400*	< 2	11.2
			2 to 5	9.2
			6 to 10	4.7
			> 10	2.3
		2500 to 5000	< 2	8.5
			2 to 5	7.2
			6 to 10*	3.5
			> 10*	1.5
6 to 10 person life rafts	20	500 to 4500	< 2	7.0
			2 to 5*	1.8
			> 6*	nil
24 to 30 foot boats	20	500 to 4000	< 2	14.1
			2 to 5*	7.0
			6 to 10*	4.9
			> 10*	2.4
31 to 43 foot boats	20	500 to 4000	< 2	24.9
			2 to 5*	15.3
			6 to 10*	7.0
			> 10*	3.5

*Values for this category were extrapolated from test data.

C. Side–Looking Airborne Radar (SLAR)

Sweep widths shown in Table 4–17 are based on altitudes of 2,500 to 4,000 feet for targets under 40 feet long, and 8,000 feet for targets over 40 feet long, with range scales no greater than 27 NM.

TABLE 4–17. Sweep Widths For Side–Looking Airborne Radar (NM)

Target Type	*Douglas Sea State 0 to 1*	*Douglas Sea State 2 to 3*
Fiberglass or wooden boats, 20 feet or less, without radar reflector or engine/ metal equipment	16	<6
Fiberglass or wooden boats, 20 feet or less, with radar reflector or engine/metal equipment	21	6
Life rafts, 4 to 10 persons without radar reflectors	12	<5
Targets, 40 to 100 feet, with significant metal equipment	47	24
Metal targets longer than 100 feet	57	54

425 Forward–Looking Infrared Radar (FLIR)

Sweep widths should be approximated on the basis of Table 4–18, using the operator's best estimate of effective detection ranges for other target types and field of view/scan width limits. Operators should be told the effective detection range is the range at which they believe the target will certainly be detected under prevailing conditions. Sweep width should not exceed the effective azimuthal coverage of the FLIR system in use, regardless of target size.

TABLE 4–18. Sweep Widths For Forward–Looking Infrared Radar (NM)

Target Type	*Douglas Sea State 0 TO 1*	*Douglas Sea State 2*
Persons in the water	0.3	0
Small boats and life rafts	1.5	0.5

426 Multisensor

A. SLAR/Visual. The multisensor sweep width tables assume searching at 200 knots at 2000 feet altitude. Combined sweep widths for metal–hulled targets over 40 feet long are estimated to be the same as for SLAR search alone.

TABLE 4–19. SLAR/Visual Weather Conditions

Parameter	*Good Conditions*	*Fair Conditions*
Wind Speed	8	15
Significant Wave Height (ft)	0.5	2
Visibility (nm)	10	5
Cloud Cover (%)	50	100
Time on Task (hr)	2	2
Search Speed (knots)	200	200
Search Altitude (ft)	2000	2000

TABLE 4–20. SLAR/Visual Sweep Widths (NM)

Target Type	*Environmental Conditions** *Good*	*Fair*
High–Contrast (e.g. white), 16– to 21–ft Fiberglass or Aluminum Boat with Engine and/or Other Metal Equipment	22.0	21.8
Medium–Contrast (e.g. Blue), 16–ft Fiberglass Boat Without Engine or Other Metal Equipment	17.1	16.8
Low–Contrast (e.g. Black), Liferaft without Metal Equipment or Canopy	13.7	13.3

*"Good" and "Fair" environmental conditions from Table 4–19.

B. SVR/Visual. Combined sweep widths for targets with a radar cross section of at least 50 square meters are estimated as twice the radar horizon range in conditions up to sea state 3. For vessels with antenna heights above 30 feet, sweep widths in the tables should be considered as minimum values since the radar horizon will be longer for these SRUs.

TABLE 4–21. UTB SVR/Visual Sweep Width for Targets With Radar Reflectors

Environmental Conditions	*High–Contrast 16–Ft Boat or Liferaft w/ Canopy*	*Medium–Contrast 16–Ft Boat or Liferaft w/o Canopy*	*Low–Contrast Liferaft w/o Canopy*
Good Weather 0.5–ft Seas	3.6	3.2	3.0
Fair Weather 3–ft Seas	1.1	0.8	0.7
Light Rain (1 mm/hr) 1–ft Seas	3.0	2.6	2.5
Moderate Rain (4 mm/hr) 1–ft Seas	2.2	1.8	1.6
Heavy Rain (16 mm/hr) 2–ft Seas	0.8	0.7	0.6
Moderately Heavy Snow (4 mm/hr of water) 2–ft Seas	0.7	0.6	0.6
Dense Fog (100–ft visibility) 0.5–ft Seas	1.9	1.9	1.9

Note: Sweep widths are rounded to nearest 0.1 nautical mile.

TABLE 4–22. UTB SVR/Visual Sweep Width for Targets Without Radar Reflectors

Environmental Conditions	*High–Contrast 16–Ft Boat or Liferaft w/ Canopy*	*Medium–Contrast 16–Ft Boat or Liferaft w/o Canopy*	*Low–Contrast Liferaft w/o Canopy*
Good Weather 0.5–ft Seas	3.5	3.0	2.9
Fair Weather 3–ft Seas	—*	—*	—*
Light Rain (1 mm/hr) 1–ft Seas	2.7	2.3	2.1

Moderate Rain (4 mm/hr) 1-ft Seas	2.1	1.6	1.4
Heavy Rain (16 mm/hr) 2-ft Seas	0.4	0.3	0.3
Moderately Heavy Snow (4 mm/hr of water) 2-ft Seas	0.2	0.2	0.1
Dense Fog (100-ft visibility) 0.5-ft Seas	0.4	0.4	0.4

Note: Sweep widths are rounded to nearest 0.1 nautical mile.
*The AN/SPS-66 radar was unable to detect targets without radar reflectors in these conditions. Visual sweep width alone applies.

TABLE 4-23. WPB SVR/Visual Sweep Width for Targets With Radar Reflectors

Environmental Conditions	*High-Contrast 16-Ft Boat or Liferaft w/ Canopy*	*Medium-Contrast 16-Ft Boat or Liferaft w/o Canopy*	*Low-Contrast Liferaft w/o Canopy*
Good Weather 0.5-ft Seas	5.5	5.1	5.1
Fair Weather 3-ft Seas	1.7	1.6	1.6
Light Rain (1 mm/hr) 1-ft Seas	4.3	4.1	3.9
Moderate Rain (4 mm/hr) 1-ft Seas	2.5	2.2	2.2
Heavy Rain (16 mm/hr) 2-ft Seas	0.8	0.7	0.7
Moderately Heavy Snow (4 mm/hr of water) 2-ft Seas	1.7	1.7	1.7
Dense Fog (100-ft visibility) 0.5-ft Seas	3.6	3.6	3.6

Note: Sweep widths are rounded to nearest 0.1 nautical mile.

TABLE 4-24. WPB SVR/Visual Sweep Width for Targets Without Radar Reflectors

Environmental Conditions	*High-Contrast 16-Ft Boat or Liferaft w/ Canopy*	*Medium-Contrast 16-Ft Boat or Liferaft w/o Canopy*	*Low-Contrast Liferaft w/o Canopy*
Good Weather 0.5-ft Seas	4.9	4.3	4.1
Fair Weather 3-ft Seas	1.3	1.2	1.2
Light Rain (1 mm/hr) 1-ft Seas	3.3	2.7	2.6
Moderate Rain (4 mm/hr) 1-ft Seas	2.1	1.6	1.4
Heavy Rain (16 mm/hr) 2-ft Seas	0.4	0.3	0.3
Moderately Heavy Snow (4 mm/hr of water) 2-ft Seas	0.3	0.2	0.2
Dense Fog (100-ft visibility) 0.5-ft Seas	0.8	0.8	0.8

Note: Sweep widths are rounded to nearest 0.1 nautical mile.

430 PROBABILITY OF DETECTION (POD)

431 Maritime

432 Inland

A. Single Search POD. Horizontal axis values in Table 4-25 represent effective search visibility (NM), and vertical axis values represent search altitude and track spacing. PODs should be adjusted for each search object and for conditions encountered in each individual search area.

B. Cumulative POD. Table 4-26 is entered with cumulative POD to date and the POD of the latest search. The intersection of two PODs is the new cumulative POD.

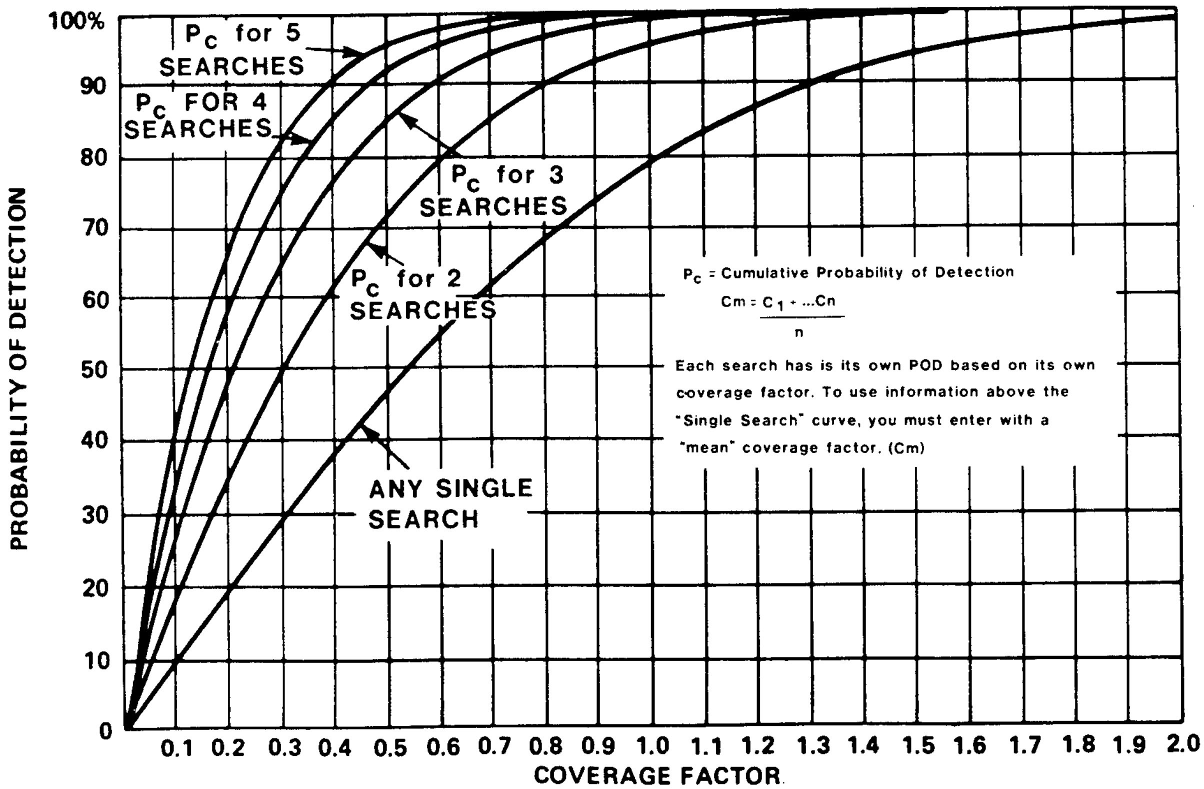


Figure 4–3. Maritime Probability of Detection

TABLE 4-25. Inland Probability of Detection: Single Search

OPEN, FLAT TERRAIN

Search Alt. / *Track Spacing*	*Search Visibility* 1 mi	2 mi	3 mi	4 mi
500 ft				
.5 mi	35%	60%	75%	75%
1.0 mi	20	35	50	50
1.5 mi	15	25	35	40
2.0 mi	10	20	30	30
700 ft				
.5 mi	40%	60%	75%	80%
1.0 mi	20	35	50	55
1.5 mi	15	25	40	40
2.0 mi	10	20	30	35
1000 ft				
.5 mi	40%	65%	80%	85%
1.0 mi	25	40	55	60
1.5 mi	15	30	40	45
2.0 mi	15	20	30	35

MODERATE TREE COVER (or HILLY)

Search Alt. / *Track Spacing*	*Search Visibility* 1 mi	2 mi	3 mi	4 mi
500 ft				
.5 mi	20%	35%	50%	50%
1.0 mi	10	20	30	30
1.5 mi	5	15	20	20
2.0 mi	5	10	15	15
700 ft				
.5 mi	20%	35%	50%	55%
1.0 mi	10	20	30	35
1.5 mi	10	15	20	25
2.0 mi	0	10	15	20
1000 ft				
.5 mi	25%	40%	55%	60%
1.0 mi	15	20	30	35
1.5 mi	10	15	20	25
2.0 mi	5	10	15	20

HEAVY TREE COVER (or VERY HILLY)

Search Alt. / *Track Spacing*	*Seach Visibility* 1 mi	2 mi	3 mi	4 mi
500 ft				
.5 mi	10%	20%	30%	30%
1.0 mi	5	10	15	15
1.5 mi	5	5	10	10
2.0 mi	5	5	10	10
700 ft				
.5 mi	10%	20%	30%	35%
1.0 mi	5	10	15	20
1.5 mi	5	5	10	15
2.0 mi	5	5	10	10
1000 ft				
.5 mi	15%	20%	30%	35%
1.0 mi	5	10	15	20
1.5 mi	5	10	10	15
2.0 mi	5	5	10	10

TABLE 4-26. Inland Probability of Detection: Cumulative

Previous or Cumulative POD	*Cumulative POD Chart*								
5-10%	15								
11-20%	20	25							
21-30%	30	35	45						
31-40%	40	45	50	60					
41-50%	50	55	60	65	70				
51-60%	60	65	65	70	75	80			
61-70%	70	70	75	80	80	85	90		
71-80%	80	80	80	85	85	90	90	95	
over 80%	85	85	90	90	90	95	95	95	95 +
	5-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	80% +
	POD This Search								

440 MISCELLANEOUS

441 Height Of Eye Vs. Horizon Range

442 Douglas Sea State

TABLE 4-28. Douglas Sea State Scale

Douglas Sea State	*Description*	*Wave Height*
0	Calm	--------
1	Smooth	0 - 1 foot
2	Slight	1 - 3 feet
3	Moderate	3 - 5 feet
4	Rough	5 - 8 feet
5	Very Rough	8 - 12 feet
6	High	12 - 20 feet
7	Very High	20 - 40 feet
8	Precipitous	over 40 feet
9	Confused	--------

TABLE 4–27. Height of Eye vs. Horizon Range

Height feet	Nautical miles	Statute miles	Height feet	Nautical miles	Statute miles	Height feet	Nautical miles	Statute miles
1	1.1	1.3	120	12.5	14.4	940	35.1	40.4
2	1.6	1.9	125	12.8	14.7	960	35.4	40.8
3	2.0	2.3	130	13.0	15.0	980	35.8	41.2
4	2.3	2.6	135	13.3	15.3	1,000	36.2	41.6
5	2.6	2.9	140	13.5	15.6	1,100	37.9	43.7
6	2.8	3.2	145	13.8	15.9	1,200	39.6	45.6
7	3.0	3.5	150	14.0	16.1	1,300	41.2	47.5
8	3.2	3.7	160	14.5	16.7	1,400	42.8	49.3
9	3.4	4.0	170	14.9	17.2	1,500	44.3	51.0
10	3.6	4.2	180	15.3	17.7	1,600	45.8	52.7
11	3.8	4.4	190	15.8	18.2	1,700	47.2	54.3
12	4.0	4.6	200	16.2	18.6	1,800	48.5	55.9
13	4.1	4.7	210	16.6	19.1	1,900	49.9	57.4
14	4.3	4.9	220	17.0	19.5	2,000	51.2	58.9
15	4.4	5.1	230	17.3	20.0	2,100	52.4	60.4
16	4.6	5.3	240	17.7	20.4	2,200	53.7	61.8
17	4.7	5.4	250	18.1	20.8	2,300	54.9	63.2
18	4.9	5.6	260	18.4	21.2	2,400	56.0	64.5
19	5.0	5.7	270	18.8	21.6	2,500	57.2	65.8
20	5.1	5.9	280	19.1	22.0	2,600	58.3	67.2
21	5.2	6.0	290	19.5	22.4	2,700	59.4	68.4
22	5.4	6.2	300	19.8	22.8	2,800	60.5	69.7
23	5.5	6.3	310	20.1	23.2	2,900	61.6	70.9
24	5.6	6.5	320	20.5	23.6	3,000	62.7	72.1
25	5.7	6.6	330	20.8	23.9	3,100	63.7	73.3
26	5.8	6.7	340	21.1	24.3	3,200	64.7	74.5
27	5.9	6.8	350	21.4	24.6	3,300	65.7	75.7
28	6.1	7.0	360	21.7	25.0	3,400	66.7	76.8
29	6.2	7.1	370	22.0	25.3	3,500	67.7	77.9
30	6.3	7.2	380	22.3	25.7	3,600	68.6	79.0
31	6.4	7.3	390	22.6	26.0	3,700	69.6	80.1
32	6.5	7.5	400	22.9	26.3	3,800	70.5	81.2
33	6.6	7.6	410	23.2	26.7	3,900	71.4	82.2
34	6.7	7.7	420	23.4	27.0	4,000	72.4	83.3
35	6.8	7.8	430	23.7	27.3	4,100	73.3	84.3
36	6.9	7.9	440	24.0	27.6	4,200	74.1	85.4
37	7.0	8.0	450	24.3	27.9	4,300	75.0	86.4
38	7.1	8.1	460	24.5	28.2	4,400	75.9	87.4
39	7.1	8.2	470	24.8	28.6	4,500	76.7	88.3
40	7.2	8.3	480	25.1	28.9	4,600	77.6	89.3
41	7.3	8.4	490	25.3	29.2	4,700	78.4	90.3
42	7.4	8.5	500	25.6	29.4	4,800	79.3	91.2
43	7.5	8.6	520	26.1	30.0	4,900	80.1	92.2
44	7.6	8.7	540	26.6	30.6	5,000	80.9	93.1
45	7.7	8.8	560	27.1	31.2	6,000	88.6	102.0
46	7.8	8.9	580	27.6	31.7	7,000	95.7	110.2
47	7.8	9.0	600	28.0	32.3	8,000	102.3	117.8
48	7.9	9.1	620	28.5	32.8	9,000	108.5	124.9
49	8.0	9.2	640	28.9	33.3	10,000	114.4	131.7
50	8.1	9.3	660	29.4	33.8	15,000	140.1	161.3
55	8.5	9.8	680	29.8	34.3	20,000	161.8	186.3
60	8.9	10.2	700	30.3	34.8	25,000	180.9	208.2
65	9.2	10.6	720	30.7	35.3	30,000	198.1	228.1
70	9.6	11.0	740	31.1	35.8	35,000	214.0	246.4
75	9.9	11.4	760	31.5	36.3	40,000	228.8	263.4
80	10.2	11.8	780	31.9	36.8	45,000	242.7	279.4
85	10.5	12.1	800	32.4	37.3	50,000	255.8	294.5
90	10.9	12.5	820	32.8	37.7	60,000	280.2	322.6
95	11.2	12.8	840	33.2	38.2	70,000	302.7	348.4
100	11.4	13.2	860	33.5	38.6	80,000	323.6	372.5
105	11.7	13.5	880	33.9	39.1	90,000	343.2	395.1
110	12.0	13.8	900	34.3	39.5	100,000	361.8	416.5
115	12.3	14.1	920	34.7	39.9	200,000	511.6	589.0

443 Search Pattern Summary

Pattern	*Name*	*SRU required*	*Remarks*
TSR	Trackline single–unit return	1	For search of a trackline or line of position when unit must break off search at same end of track as search oringinated.
TMR	Trackline multiunit return	2 or more	Same AS TSR except that 2 or more SRUs are used cruising abeam of each other.
TSN	Trackline single–unit nonreturn	1	Same as TSR except that search terminates at opposite end of track from commence search point.
TMN	Trackline multiunit nonreturn	2 or more	Same as TMR except that search terminates at opposite end of track from commence search point.
PS	Parallel track single–unit	1	Search of a large area when position of distress is unknown.
PM	Parallel track multiunit	2 or more	Same as PS except two or more SRUs search abeam of each other a distance S apart.
PMR	Parallel track multiunit return	2 or more	Used for search of long rectangular area where only one track out and back is possible.
PMN	Parallel track multiunit nonreturn	2 or more	Only enroute SRUs or transient craft available for one track through search area.
PSL	Parallel track single–unit Loran line	1	Same as PS except SRU uses Loran lines for greater navigational accuracy on tracks.
PMC	Parallel multiunit circle	2 or more	Underwater pattern only.
PSS	Parallel single–unit spiral	1	Underwater pattern only.
P_d	Parallel drift compensated	1 or more	Used when target motion requires drift compensation
CS	Creeping line single–unit	1	Distress generally known to be between two points. Wider than trackline patterns.
CSC	Creeping line single–unit coordinated	1 acft + 1 ship	Same as PS except coordinated ship movement used to obtain greater navigational accuracy.
SS	Square single–unit	1	Distress Position known within close limits and search area not extensive.
SM	Square multiunit	2 acft	Same as SS except two SRUs fly at different altitudes on tracks which differ by 45°.
VS	Sector single–unit	1	Distress position known within close limits and search area not extensive.
VSR	Sector single–unit radar	1 acft + 1 ship	Same as VS except ship controls aircraft by radar.
OS	Contour single–unit	1	Search of mountainous/hilly terrain.
OM	Contour multiunit	2 or more	Search of mountainous/hilly terrain by land search teams.
FS	Flare single–unit	1 acft + 1 ship or 2 acft.	Night visual search only.
FM	Flare multiunit	1 acft + ships	Night visual search only.
HSA	Homing single–unit aural	1	Electronic homing–in use.
HSM	Homing single–unit meter	1	Electronic homing–in use.
HMN	Homing multiunit nonreturn	2 or more	Electronic positioning use.
B	Cross–over Barrier	1 or more	Used when target motion requires drift compensation.

Figure 4–4. Search Pattern Summary

CHAPTER 5. MESSAGES

500 SAR MISSION MESSAGES

SAR mission messages include situation reports (SITREPs), search action plans, rescue action plans, all ships broadcasts, aircraft alerting messages, and miscellaneous SAR messages. RCCs should establish a preformatted message file to aid in quickly drafting and releasing often-used messages. This chapter includes a code of standard phrases for use between RCCs and RSCs.

510 SITUATION REPORTS (SITREPs)

SITREPS are used by the OSC to keep the SMC aware of mission events, and by the SMC to keep agencies informed of mission progress. The OSC addresses SITREPs only to the SMC unless otherwise directed. The SMC may address SITREPs to as many agencies as necessary, including other RCCs and RSCs, to keep them informed. SITREPs prepared by an SMC usually include a summary of information received from OSCs. Often a short SITREP is used to provide the earliest notice of a casualty or to pass urgent details when requesting assistance. A more complete SITREP is used to pass amplifying information during SAR operations, or to pass information to agency SAR authorities of the craft in distress. Initial SITREPs should be transmitted as soon as details of an incident become clear to indicate SAR system involvement, and should not be delayed unnecessarily for confirmation of all details.

511. SITREP Content

A. SITREP format is usually established by agency directives. Whatever the format, SITREPs normally provide the following information:

1. *Identification*–Usually in subject line, the SITREP number, identification of the unit, and a one- or two-word description of the emergency. The perceived phase of the emergency should be indicated. SITREPs should be numbered sequentially throughout the entire case. When an OSC is relieved on scene, the new OSC continues the SITREP numbering sequence.

2. *Situation*–A description of the case, the conditions that affect the case, and any amplifying information that will clarify the problem. After the first SITREP, only changes to the original reported situation need be included.

3. *Action Taken*–A report of all action taken since the last report, including results of such action. When an unsuccessful search has been conducted, the report includes the areas searched, a measure of effort such as sorties flown or hours searched, and the coverage factor or POD.

4. *Future Plans*–A description of actions planned for future execution including any recommendations and, if necessary, a request for additional assistance.

5. *Status of Case*–This is used only on a possible final SITREP to indicate that the case is closed or that search is suspended pending further developments.

B. Initial SITREPs are released by the SMC as soon as possible after the first information is received. Subsequent SITREPs are released when important new developments occur during a mission, and at least once daily by a maritime SMC. For inland SAR cases, the AFRCC normally transmits information via teletype in a Mission Summary, issued at the end of each day. For all missions involving Navy or Marine Corps units in distress, the Naval Safety Center, NAS Norfolk, VA should be an information addressee on all SITREPs originated by the SMC.

C. For missions where pollution or threat of pollution exists as a result of a casualty, the appropriate agency tasked with environmental protection should be an information addressee on all SITREPs.

512 International SITREPS

A. A **standard SITREP format** has been adopted internationally which should be used, along with the standard codes, for international communications between RCCs.

B. Short form–To pass urgent essential details when requesting assistance, or to provide the earliest notice of casualty, the following information should be provided:

TRANSMISSION	(Distress/urgency etc.)
FROM:	(Originating RCC)
TO:	
SAR SITREP (NUMBER)	(To indicate nature of message and completeness of sequence of SITREPs concerning the casualty)
A IDENTITY OF CASUALTY	(Name, call sign, flag state)
B POSITION	(Latitude/longitude)
C SITUATION	(Type of message–e.g., distress/urgency; date/time; nature of distress/urgency–e.g., fire, collision, medico)
D NUMBER OF PERSONS	
E ASSISTANCE REQUIRED	
F COORDINATING RCC	

C. Full form–To pass amplifying or updating information during SAR operations, the following additional sections should be used as necessary:

G DESCRIPTION OF CASUALTY	(Physical description, owner/charterer, cargo carried, passage from/to, life saving equipment carried, etc.)
H WEATHER ON SCENE	(Wind, sea/swell state, air/sea temperature visibility, cloud cover/ceiling, barometric pressure)
J INITIAL ACTIONS TAKEN	(By casualty and RCC)
K SEARCH AREA	(As planned by RCC)
L COORDINATING INSTRUCTIONS	(OSC/CSS designated, units participating, communications, etc.)
M FUTURE PLANS	
N ADDITIONAL INFORMATION	(Include time SAR operation terminated)

Notes:

1. Each SITREP concerning the same casualty should be numbered sequentially.

2. If help is required from the addressee, the first SITREP should be issued in short form if remaining information is not readily available.

3. When time permits, the full form may be used for the first SITREP or to amplify it.

4. Further SITREPs should be issued as soon as other relevant information has been obtained. Information already passed should not be repeated.

5. During prolonged operation, "no change" SITREPs, when appropriate, should be issued at intervals of about 3 hours to reassure recipients that nothing has been missed.

6. When the incident is concluded, a final SITREP should be issued as confirmation.

513 COSPAS–SARSAT RCC–MCC Messages[1]

Standard international formats have been developed for communicating with any COSPAS-SARSAT MCC, and typically would be used when needed for the following purposes:

A. Acknowledgement that an alert is received and understood (normally not necessary).

FM: RCC
TO: MCC

DISTRESS ALERT REPORT (NUMBER)

1. MESSAGE RECEIVED.

B. Request to repeat an unsuccessfully transmitted message.

FM: RCC

TO: MCC

DISTRESS ALERT REPORT (NUMBER)

1. REPEAT REQUESTED.

C. Advise the MCC that the SAR operation is complete, and relay of further alerts unnecessary.

FM: RCC
TO: MCC

DISTRESS ALERT REPORT (NUMBER)

1. CASE CLOSED (SUSPENDED).
2. BEACON TURNED OFF.

D. Request an MCC to "listen to" a particular geographic area in which the RCC suspects an incident has occurred.

FM: RCC
TO: MCC

REQUEST FOR ALERT DATA
1. GEOGRAPHIC LOCATION.
2. FREQUENCY.
3. CANCELLATION DATE/TIME.

E. Request for SAR-related data which may be stored at or available to the MCC in association with registration of emergency beacons.

FM: RCC
TO: MCC

REQUEST FOR ADDITIONAL INFORMATION FROM DATABASE

1. BEACON ID CODE.

520 SEARCH ACTION PLAN

The Search Action Plan, a message adaptation of the standard operation organization plan, is used to formally pass actions required of participating SRUs and agencies. Search action plans should be developed by the SMC, or by the OSC if the SMC does not do so. It is preferable to release the search action plan early; it should arrive, if possible, at all parent agencies providing SRUs at least 6 hours prior to their required departure time, or earlier for SRU crews that may need to begin planning before resting for a "first light" search. If debriefing reveals some additional factor that was previously not considered, the SMC can always modify the original plan.

521 Elements of a Search Action Plan

A. The search action plan may be abbreviated depending on mission size, but usually has the following:

1. *Situation*

   a. Brief description of incident, position, and time.

   b. Number of persons on board (POB).

   c. Primary/secondary search targets, including amount and type of survival equipment.

   d. Weather forecast and period for forecast.

   e. SRUs on scene.

2. *Search Area,* by columns: Area, Size, Corner Points, Other.

3. *Execution,* by columns: Area, SRU, Parent Agency, Pattern, Creep Direction, CSP, Altitude.

4. *Coordination.*

   a. SMC designation

   b. OSC designation

   c. On scene time for SRUs

   d. Track spacing/coverage factor desired

   e. OSC instructions (include DMB instructions)

   f. Airspace reservations

   g. Aircraft safety comments

   h. SRU CHOP instructions

   i. Parent agency relief instructions

   j. Authorization for non-SAR aircraft in the area

5. *Communications*

   a. Control channels, primary and secondary.

   b. On scene channels, primary and secondary.

   c. Monitor channels.

   d. SAR vessel aerobeacon and IFF identification.

e. Press channels.

6. *Reports*

a. OSC collects on scene weather reports from SRUs, collates information, and resolves discrepancies prior to report to SMC.

b. OSC reports to SMC.

c. Parent activities report to SMC at end of daily operations: sorties, hours flown, area(s) searched, and coverage factor(s).

B. Special Passing Instructions may be desired by the SMC to ensure that proper personnel receive the search action plan. Such instructions are inserted immediately before the message subject line. For example:

ATTN: Command Post Duty Officer 55th ARS. Pass to Aircraft Commander Coast Guard

522. Search Action Plan Example

UNCLAS

ATTN: COMMAND POST DUTY OFFICER 55th ARRS

DISTRESS MAC 17341 DITCHED SEARCH PLAN 172300Z

1. SITUATION

A. C-141 MAC 17341 REPORTED DITCHING DUE FLAMEOUT OF 3 ENGINES AT 162300Z. LAST REPORTED POSITION 38-40N 65-10W at 162200Z.

B. POB: 135

C. SEARCH TARGETS. PRIMARY: EIGHT 20-MAN RAFTS (WITH STANDARD SURVIVAL EQUIPMENT OF PYRO, SEA DYE, AND MIRRORS). SECONDARY: POSSIBLE SURVIVORS IN WATER, WRECKAGE/DEBRIS, CRASH POSITION INDICATOR BEACON.

D. WX FCST PERIOD 171200Z TO 172400Z: CEILING 8000 BROKEN, VIS 16, WIND 190/30, SEAS 210/2-3 FT.

E. CG-1385, CG-1390, CGC DALLAS CONDUCTING NIGHT SEARCH IN AREA. ACFT DIRECTED TO DEPART AREA PRIOR 1700Z.

2. SEARCH AREA (READ IN FOUR COLUMNS)

AREA	CORNER POINTS	IFF	TACAN
BRAVO-1	38-42N 66-20W, 39-21N 65-20W,39-02N 64-58W, 38-22N 65-57W.	___	NONE
BRAVO-2	38-04N 66-00W, 38-42N 65-02W,38-23N 64-42W, 37-45N 65-40W.	___	10
BRAVO-3	37-43N 65-39W, 38-22N 64-41W,38-03N 64-22W, 37-24N 65-19W.	___	73

3. EXECUTION (READ IN SIX COLUMNS)

AREA	SAR UNIT	PARENT ACT	PATT	CREEP	CSP	ALT
BRAVO-1	HC-130	55th ARRS	PS	320T	NE CN	1000
BRAVO-2	P3A	VP-49 BDA	PS	320T	NE CN	1000
BRAVO-3	HC-130	CGAS ECITY	CS	050T	NE CN	500
BRAVO-4	DALLAS	NONE	SS	N/A	DATUM	N/A

4. COORDINATING INSTRUCTIONS

A. ATLANTIC SAR COORDINATOR REMAINS SMC.

B. CGC DALLAS DESIG OSC.

C. ALL UNITS ON SCENE 171100Z.

D. TRACK SPACING 2 NM DESIRED.

E. OSC AUTHORIZED ALTER SEARCH PLAN AS SITUATION DICTATES. PROVIDE ALTITUDE SEPARATION FOR ALL ACFT. OSC SEL SUITABLE SRU TO DEPLOY DMB IN POSN ______ LAT ______ LONG AT EARLIEST OPPORTUNITY. ENSURE DMB FREQ SEPARATION FROM ANY PREV DEPLOYED DMBS. ALSO 1275.ENSURE DMB OPERATING PROPERLY. RELOCATE ALL DEPLOYED DMBS WHEN ENTERING AND DEPARTING SEARCH AREAS. OSC PASS EXACT TIME OF INSERTION/RELOCATION AND POSN TO SMC VIA FASTEST MEANS.

F. NYK OAC APPROVED SAR OPERATIONS WARNING AREA SFC TO 6000 FT FROM 37-00N TO 38-00N BETWEEN 64-30W AND 66-00W.

G. ACFT CHOP OSC UPON ARR SEARCH AREA, CHOP OAC UPON DEPT SEARCH AREA.

H. ONE ACFT DESIRED EACH AREA CONTINUOUSLY 1100Z TO 1700Z. PARENT ACTIVITIES PROVIDE RELIEF ACFT IF REQUIRED.

I. ONE ACFT CARRYING PRESS AUTHORIZED IN WARNING AREA. IDENT N-1768-C DIRECTED CONTACT OSC PRIOR TO ENTERING SAR AIRSPACE.

5. COMMUNICATIONS

A. CONTROL CHANNEL PRI 5680 KHZ USB. SEC 8984 KHZ USB.

B. ON SCENE CHANNEL PRI 123.1 MHZ. SEC 282.8 MHZ. TER 5680 KHZ.

C. MONITOR CHANNEL 243.0 MHZ. 121.5 MHZ.

D. CGC DALLAS BEACON 522 KHZ, IDENT NRDC, IFF.

E. PRESS CHANNEL.

6. REPORTS

A. OSC SEND SITREPS TO SMC WITH WX AND RAFT COVERAGE FACTOR ATTAINED EVERY 4 HOURS.

B. END OF DAYS OPERATIONS, PARENT ACTIVITY RPT SORTIES, TIME OF DEPARTURE AND ARRIVAL, HRS FLOWN, AREA(S) SEARCHED TO SMC.

C. ALL PARTICIPATING SRUS PASS ON SCENE WX TO OSC. OSC COLLATE WX INFO AND RESOLVE ANY DISCREPANCIES IN OBSERVATIONS PRIOR TO RPTNG TO SMC.

BT

530 RESCUE ACTION PLAN

The Rescue Action Plan uses the same general format as the search action plan and formally details actions required of SRUs and agencies to carry out an effective, efficient, and safe rescue. A rescue action plan is not required for most SAR missions, since either it is combined with the search action plan or rescue may logically follow a successful search action plan.

531. Elements of a Rescue Action Plan

The basic rescue action plan, as shown in Vol. 1, Chapter 7, is self-explanatory and usually has the following:

1. *Situation*
    a. Brief description of incident
    b. Number of persons requiring rescue
    c. Extent of injuries of persons involved
    d. Amount and type of survival equipment
    e. Weather forecast and period for forecast
    f. SRUs on scene
2. *Rescue Area*

a. Position of the incident described by proper name and latitude/longitude, or by bearing and distance from a well-known geographical point.

b. Detailed description of access route to be followed by SRUs, including beaching sites and overland routes, in relation to well-known and easily identifiable geographical features, such as roads, rivers, and highway mileage markers.

3. *Execution*

a. SRUs assigned, including unit call sign and parent agency providing the SRU.

b. Rescue method to be attempted by SRU.

c. Aerial delivery of supplies and other supporting equipment to SRU.

d. SMC supportive arrangements.

4. *Coordination*

a. SMC designation

b. OSC designation

c. On scene/rendezvous time for SRU

d. SRU CHOP instruction

e. Parent agency relief instructions

f. Temporary flight restrictions

g. Authorization for non-SAR aircraft in area

5. *Communications.*

a. Control channels, primary and secondary.

b. On scene channels, primary and secondary.

c. Call signs of aircraft assigned high altitude communications relay duties.

d. Other information.

6. *Reports*

a. OSC reports to SMC.

b. Parent activity reports to SMC at end of daily operations: sorties, hours flown, and further recommendations.

532. Rescue Action Plan Example

UNCLAS

DISTRESS PAW PAW VILLAGE EXPLOSION RESCUE PLAN 17 JAN.

1. SITUATION

A. THE MAIN POWER PLANT OF PAW PAW VILLAGE EXPLODED 162300Z AND RESULTANT FIRE HAS CONSUMED MOST OF THE VILLAGE.

B. TOTAL VILLAGE POPULATION 17 PERSONS (10 ADULTS, 7 CHILDREN).

C. 16 VILLAGERS RECEIVED MAJOR BURNS AND ALL IN STATE OF SHOCK. VILLAGE MAYOR RECOMMENDS TOTAL EVACUATION AND TREATMENT OF VILLAGERS.

D. FCST 171200Z to 172400Z: CEILING 8000 SCATTERED, VISIBILITY 16, WIND 190/10 KTS.

E. HC-130 AF-17333 CONDUCTED NIGHT RECONNAISSANCE IN AREA AND REPORTED 90% OF VILLAGE IN FLAMES. AIR DROPPED EMERGENCY RADIO AND ESTABLISHED CONTACT WITH VILLAGE MAYOR. WILL REMAIN ON SCENE UNTIL 171500Z.

2. RESCUE AREA

A. PAW PAW VILLAGE, SOUTHEASTERN TIP OF CADILLAC ISLAND, LATITUDE 60.00N 166.00W.

B. VILLAGE ACCESSIBLE BY LAND SRU FROM BEACHING SITE APPROXIMATELY 3 MILES NORTHWEST OF VILLAGE. SMALL, 1 LANE ROAD CONNECTS VILLAGE AND BEACHING SITE. NO FIXED-WING AIRCRAFT LANDING SITE AVAILABLE. SUITABLE HELICOPTER LANDING SITE AVAILABLE AT NORTH END OF VILLAGE.

3. EXECUTION

A. CGC CONFIDENCE DIVERTING FROM PATROL AT 162350Z TO PROCEED TO PAW PAW VILLAGE. DOCTOR, MEDICAL SUPPLIES, AND HH-52/CG-1311 ABOARD CONFIDENCE.

B. CONFIDENCE LAUNCH HELICOPTER WITH DOCTOR AND SUPPLIES WHEN 100 MILES FROM PAW PAW IF WEATHER CONDITIONS SUITABLE.

C. AIRSTA KODIAK PROVIDE HC-130 TO ESCORT CG1311 AND PROVIDE COMMS PLATFORM.

D. AF-17333 DEPLOY ARRS PARARESCUEMEN TEAM AT SUNRISE IF WEATHER, VISIBILITY, AND WIND CONDITIONS SUITABLE. PARARESCUEMEN AND DOCTOR TO PROVIDE EMERGENCY MEDICAL CARE UNTIL CONFIDENCE WITHIN 50 MILES VILLAGE AT WHICH TIME HELO EVAC OF VILLAGERS TO CONFIDENCE WILL COMMENCE.

E. EVACUATED VILLAGERS WILL BE TRANSPORTED TO ALACAN HARBOR FOR TRANSFER TO FIXED-WING MEDICAL EVACUATION AIRCRAFT, THEN TRANSPORTED TO ELMENDORF AFB FOR FURTHER TRANSFER TO ALASKAN NATIVE HEALTH SERVICE HOSPITAL.

4. COORDINATION

A. JUNEAU SAR COORDINATOR REMAINS SMC.

B. AF-17333 DESIGNATED OSC UNTIL 171500Z. CGC CONFIDENCE DESIGNATED OSC UPON DEPARTURE OF AF-17333.

C. CG HC-130 WILL AIRDROP ADDITIONAL MEDICAL SUPPLIES AFTER ARRIVAL OF PARARESCUEMEN OR DOCTOR ON SCENE. MEDICAL SUPPLIES INCLUDE TEN GALLONS OF WHOLE BLOOD AND ASSORTED BURN MEDICATIONS. PRESENT ETA OF CG C-130 OVER PAW PAW VILLAGE IS 171300Z.

D. AIRCRAFT CHOP OSC UPON ARRIVAL RESCUE AREA, CHOP ARTCC UPON DEPARTURE RESCUE AREA.

E. AIRSTA KODIAK PROVIDE RELIEF HC-130 WHEN REQUIRED.

F. ANCHORAGE ARTCC HAS ESTABLISHED TEMPORARY FLIGHT RESTRICTIONS SURFACE TO 2000 FEET, 5 MILE RADIUS OF PAW PAW VILLAGE.

G. ONE AIRCRAFT CARRYING PRESS AUTHORIZED IN AREA OF TEMPORARY FLIGHT RESTRICTION. IDENT N1777C. DIRECTED CONTACT ON SCENE AIRCRAFT 123.1 PRIOR TO ENTRY.

5. COMMUNICATIONS

A. CONTROL CHANNEL PRI 5680 KHZ USB. SEC 8984 KHZ USB.

B. ON SCENE CHANNEL PRI 282.8 MHZ. SEC 123.1 MHZ.

C. COMMUNICATIONS RELAY TO BE COORDINATED BY OSC.

D. GROUND SRU CALL SIGN RESCUE ONE RESCUE TWO.

6. REPORTS

A. OSC SEND SITREPS TO SMC WITH WEATHER EVERY FOUR HOURS AND UPON ARRIVAL OF EACH SRU.

B. PARENT ACTIVITIES SEND END OF DAY OPERATIONS REPORT OF SORTIES, HOURS FLOWN, AND ANY RECOMMENDATIONS TO SMC.

BT

540 CODE OF STANDARD PHRASES

The following codes represent standard SAR phrases and are established for use between RCCs and RSCs of different countries to overcome language difficulties for coordinating international SAR operations. When using these codes, identify the IMO SAR Manual as a source reference since some countries may be unfamiliar with IMO's adoption of these codes. Additional codes are given in the IMO Standard Marine Navigational Vocabulary, 1985, designed to standardize language used for navigation at sea.

Code of Standard Phrases

RJA Confirm you are controlling SAR action.

RJB I am controlling SAR action.

RJC Casualty reported to me:
1. Overdue. 4. Aground.
2. Sinking. 5. Taking water.
3. On fire. 6. Requiring tow.

RJD Cargo is:
1. Dangerous.
2. Not dangerous.
3. Oil.

RJE Casualty carries (... Number of persons on board):
1. (... Number) lifeboats.
2. (... Number) liferafts.

RJF Casualty name, call sign (CS), and flag state as indicated.
1. Owners/agents as indicated.

RJG MAYDAY/or PAN PAN broadcast initiated by ...(Call sign of CRS).

RJH Following rescue/search craft are/have been launched.
1. Surface vessel (CS) ETA on scene ...
2. SAR helicopter (CS) ETA on scene ...
3. SAR aircraft (CS) ETA on scene ...

RJI SAR craft (as indicated) can be made available from (... location) at ... (time).

RJJ SAR craft (as indicated) cannot be made available until ... (time).

RJK Number of SAR craft available at this time.

RJL Can you make SAR craft (as indicated) available now or in the near future.

RJM Request details of SAR craft that can be made available including ETA on scene.

RJN SAR craft (CS) is returning to base.
1. Will be replaced by (CS) (ETA ...).
2. Will not be replaced.

RJO Designated CSS is (CS).

RJP Designated OSC is (CS).

RJQ Following vessels are in area search ing/standing by casualty ... (CS).

RJR Search datum is (...Lat ...Long).
1. New search datum is (...Lat ...Long).

RJS Search area is bounded by (...Lats ...Longs).
1. New search area bounded by (...).

RJT SAR aircraft is/was over casualty and indicates no sign life.

RJU SAR aircraft is/was over casualty and indicates (Number ...) survivors sighted.

RJV Survivors have taken to (Number ...) liferaft(s).

RJW At what time will (CS) be on scene?

RKA SAR helicopter (CS) will be in position to attempt rescue at ... (time).

RKB Rescue attempt successful. (Number ...) survivors up-lifted and being taken to (... location).

RKC Rescue attempt unsuccessful. Will make further attempt shortly.

RKD Rescue attempt unsuccessful. (CS) does not intend to make further attempt at this time because of conditions, endurance, other reasons not known.

RKE Further rescue attempt will be made when conditions improve or at ... (time).

RKF How many survivors are there?
1. Number of survivors recovered is (Number ...).

RKG How many missing persons?
1. Number of missing persons is (Number ...).

RKH (Number ...) bodies located in position...

RKI (Number ...) liferafts located in position ...

RKJ (Number ...) survivors located in position ...

RKK (Number ...) survival craft located with no sign of life has/have been sunk to avoid confusion.

RKL (Number ...) survival craft located by (CS) has/have been sunk after recovery of (Number ...) survivors.

RKM All survival craft located and (Number ...) survivors recovered.

RKN All survival craft located. No survivors.

RKO For how long do you intend to continue search?

RKP Consider search should continue for...
1. Survivors.
2. Bodies.
3. Wreckage.
4. Survival craft.

RKR Do not consider further search can be of any benefit.

RKS Intend continuing search.

RKT Do not expect search to continue after ... (time).

RKU Incident is now closed.

RKV Cancel MAYDAY or PAN PAN message.

RKW Intend transferring control of incident to (CS).

CHAPTER 6. BRIEFINGS

600 SEARCH BRIEFINGS

A. Situation Briefing. It should include:

1. The circumstances of the distress.

2. The number of POB, including the color of clothing, and any medical problems.

3. Survival equipment.

4. A description of search target(s) and any possible secondary targets, including visual or electronic distress signals.

5. The last known position of the search object.

6. All participating SAR agencies.

7. SMC plans should target be located.

B. Weather Briefing. A knowledge of the weather, from the time of distress to the present, helps the search crew appreciate how the search plan was formulated and any degradation of search effectiveness due to poor weather in the search area. It should include:

1. The weather previous to operations.

2. The expected on scene weather.

3. The weather forecast for the area.

4. Special meteorological information that might affect operations or safety.

Because the SMC has used forecast weather to develop the search plan, if the actual weather encountered is not as forecast, the SRU should report that to the OSC, for relay to the SMC, to allow revisions to the search plan. Search crews should be warned of forecast weather hazards.

C. Search Area Briefing. It should include:

1. Search area designations and geographical coordinates.

2. Adjacent search areas.

3. Known terrain hazards and the probability of unknown hazards, such as towers, power/telephone lines across valleys, high bridges in river/harbor areas, high masted ships in oceanic/coastal areas, or coastal oil towers.

4. SAR airspace reservation, and the limitations of that protection.

5. Areas previously searched, as well as the current search area, including the rationale for selection and size.

6. En route search requirements.

7. En route and search area navigational charts, as necessary.

D. Search Pattern Briefing. It should include:

1. The search pattern designation, the CSP, track spacing, and search altitudes.

2. Navigation aids/system in the search area, if other than as charted.

E. Communication Briefing. It should include:

1. Primary, secondary, and tertiary frequencies, assigned by the SMC, on scene and control channels.

2. En route frequencies assigned by parent agencies.

3. Monitor channels, depending on type of emergency radios or EPIRBS/ELTs available to the survivors.

4. Press channels, if heavy news media coverage is expected.

5. Air-to-air TACAN channels.

6. Radio call signs. SRUs may use plain language radio call signs. Exceptions are:

a. The use of the search area designator (Alfa-1, Bravo-2) as a call sign for on scene identification of the SRU searching within that area.

b. A collective call sign for on scene identification of the OSC.

7. Tactical call signs are not normally used in SAR missions occurring outside a war zone.

F. Coordination Briefing. Every SRU must have at least a rudimentary knowledge of SAR mission organization and its effect on SRU task and search area procedures. The SRU crew should be aware of the following:

1. SMC assignment
2. OSC assignment
3. OSC CHOP
4. OPS normal reports
5. Position report
6. Sighting reports
7. Marking sightings
8. Flight plan remarks
9. Flight hazards

G. Lookout/Scanner Briefing. In addition to the general briefing, the lookouts and scanners should receive a separate, supplementary briefing, covering:

1. A review of scanning techniques.
2. Descriptions and drawings of the distressed craft and survival rafts or boats.
3. Proper methods for reporting sightings.
4. Instructional and motivational handouts, if appropriate and available.
5. Maximum detection range for primary target.

H. Navigator Postbriefing Check. The navigator of an aircraft SRU should check:

1. Regular binoculars for checking visual sightings.
2. Gyrostabilized binoculars for searching, if available.
3. Operable UHF/VHF homers or signal strength meters.
4. Spare navigation equipment.

I. SAR Mission Briefing Folders will help ensure necessary information is passed and that crew has a written record of instructions.

610 SHIPBOARD SCANNER BRIEFING

A. Lookout Procedures

1. Sweep the horizon slowly.
2. Examine the field 5° at a time.
3. Cover assigned sector completely.
4. Return to starting point and begin sweep again.

B. Reporting of Sightings

1. Report objects immediately, whether identified or not.
2. Keep objects in sight after reporting them.
3. Ensure officer of deck acknowledges report.
4. Keep object in sight by pointing to it, if necessary.

C. Location of Sightings

1. Name object (if known).
2. State direction in relative bearings to bow of ship.
3. State range.

   a. Estimated range in yards (2000 yards = 1 mile).

   b. Use word "range", then give distance ("range 3000 yards").

4. Reporting format: "liferaft, bearing 050°, range 1000 yards."
5. Give other details, e.g. color, POB.

620 AIRCRAFT SCANNER BRIEFING

A. Motivation

1. Purpose of search
2. Importance of duty
3. Requirement for prolonged search operations
4. Developments in search

B. Mission briefing

1. Targets

a. Distinctive markings and color

b. Number of personnel involved

c. Emergency equipment carried

d. Flight information

(1) Time en route to search area

(2) Time on scene

(3) Search altitude and speed

(4) Weather

2. Assigned search areas and pattern

C. Sighting characteristics (cover applicable portions)

1. Surface craft afloat

a. Size and distinctive markings

b. Location at night

2. Foundered vessels

a. Objects of search

(1) Lifeboats

(2) Rafts

(3) Debris

(4) Oil slicks

(5) Personnel in water

b. Scene of disaster – large vessel

(1) Large amount of debris

(2) Oil slick

(3) Survivors in lifeboats, rafts, or water

(4) Visual signals

c. Scene of disaster – small vessel

(1) Survivors in rafts

(2) Survivors in water

(3) Limited emergency signaling equipment

3. Overland search objects

a. Look for --

(1) Variations in contrast

(2) Odd angles of light

(3) Differences in texture

(4) Discontinuity

(5) Movement

b. Specifically --

(1) Broken or scarred trees

(2) Bits of shiny metal beneath trees

(3) Fresh burned-out areas

(4) Parachutes

(5) Visual signals by survivors

4. Survival signals

a. Pyrotechnic signals (smoke or flare)

b. Signal mirror flashes

c. Sea dye marker

d. Lights

e. Tracer ammo

D. Scanning procedures

1. Sighting ranges

2. Eye movement patterns

a. Follow fixed pattern to avoid missing areas.

b. For side position --

(1) Start under aircraft.

(2) Move out to effective field of vision.

(3) Return to starting point at same rate.

(4) Repeat.

c. For forward position --

(1) Move right to effective field of vision.

(2) Move back to left to effective field of vision.

(3) Repeat.

3. Rate of eye movement (normal speed SRU aircraft) of 10° eye movement per second

4. Methods of preventing fatigue and prolonging scanner endurance

a. Movement of head with eyes to prevent eyestrain

b. Areas of "no contrast"

(1) May cause severe eyestrain problem.

(2) Prevent eyestrain by periodic focusing of eyes on nearby object.

(3) Use sunglasses.

c. Comfortable scanner position

d. Cleanliness of windows

e. 30-minute rotation of positions

f. Relief at periodic intervals (maximum 2-3 hours endurance)

g. Use of light snacks and coffee

h. Intercommunication between scanners

i. Comfortable cabin temperatures

j. Correct use of visual aids

k. Night techniques

(1) Lights

(2) Dark adaption period

E. Sighting procedures

1. Reporting sightings to pilot: clock position and estimated distance

2. Marking sighting locations

3. Procedure turn technique (90° - 270° method)

4. Visual return to target

a. Scanner calls out clock position and estimated distance.

b. Pilot turns aircraft in direction of sighting.

c. Scanner continues to call out position and distance.

d. Pilot (copilot) states when target in sight.

e. Do not take eyes off of the target.

630 LAND SRU/INTERROGATION TEAM CHECKLIST

A. Briefing. Obtain all possible information before departure.

B. Preparations

1. If possible, use a mobile radio.

2. Have a definite plan for transmitting of reports of position or information.

3. Determine frequency of position reports prior to team deployment.

4. Check vehicle for fuel, extra fuel, flashlights, spare tire, extra water.

5. Obtain telephone numbers of command post, local police, and other agencies.

6. Obtain assistance of a local guide.

7. Obtain necessary road and county maps.

8. Check weather conditions and dress accordingly.

C. Precautions

1. Observe State highway traffic laws.

2. When approaching homes in isolated areas at night:

a. Be alert for dogs.

b. Identify yourself by shining light on your person or vehicle.

3. Keep an accurate account of area searched.

D. Possible leads

1. Minute bits of wreckage

2. Smoke

3. Unusual sounds

4. Broken or disturbed trees or underbrush

5. Presence of scavengers

6. Drops of oil or fuel

7. Decomposition odors

8. Signs of human passage or occupancy of an area

9. Landslide

10. Horsetails (caused by wind blowing loose snow over an obstruction)

11. Unexplained break in terrain contour

E. Interrogation of individuals

1. Question individuals who might have seen or heard the target.

a. Details of time

b. Direction of target

c. Sound of an engine

d. Other information

Note: Attempt to have the individual volunteer information. Evaluate leads as to relative merit. When information gathered does not ring true, ask verification questions.

2. Develop leads requiring ground interrogation or investigation.

a. Individuals who may have heard or seen flashes or explosion.

b. Objects reported by search aircraft.

631 Lost Person Briefing Checklist

A. Brief all information about the subject to help the searcher recognize subject, detect clues and determine behavior.

1. Physical description.

2. Clothing and equipment.

3. Physical condition.

4. Mental condition.

5. Behavioral traits.

B. Vital concerns – subject may need medicine, etc.

C. Subject's trip plans.

D. Any terrain, hazards, etc. in assigned search area.

E. Weather in assigned search area.

F. Equipment needed by searchers.

1. Clothing.

2. Safety, food and water.

3. Recording equipment.

4. Specialized equipment.

5. Other.

G. Communications details – call numbers, use of codes, etc.

H. Transportation details.

I. How long the teams will be out.

J. Overview of search progress to date.

1. The "Big Picture".

2. Explanation of what has happened and why.

K. Who the relatives or close associates are and where they are located.

L. Media procedures.

1. Where located.

2. Who liaison/spokesman is.

3. What searchers should do if contacted by media.

M. Explicit instructions for team.

1. Area, commence search point.

2. Search pattern, track spacing, etc.

3. Marking procedures.

4. Adjacent teams, etc.

5. Commence search time, when to stop.

6. What to do if subject is found – alive, injured, dead.

7. Instructions for protecting the scene.

N. Debriefing instructions.

O. Safety instructions – helicopters, terrain hazards, snakes, etc.

640 MERCHANT VESSEL IDENTIFICATION BRIEFING FORM

DESCRIPTIVE DATA: (Source: Register, AMVER, ONI, DIA.)

Name ______________. Call sign __________.

Vessel type ____________________________.

LOA ________. Beam ______. Draft ________.

Number of decks _______.

Deadweight tonnage ___________________.

Special features and alterations ___________

____.

Superstructure type ____________________.

Stern type ____________________________.

Hull raises (in thirds) __________________.

Sequence of uprights ___________________.

Hull color _____________. Superstructure color

___________ Stack color ________________.

Ship loaded or in ballast? Deck cargo _________.

Dangerous cargo _______________

POSITION/MOVEMENT DATA: (Source: AMVER, INDEX)

Last position ___________ lat., ___________

long., at ___________ GMT.

Course ______°True, speed __________ knots.

Departed ______________ on date ________

for ________________.

Last port of call was ____________________

on date ______________.

SHIP EQUIPMENT: (Source: Register, AMVER, H.O.-100)

Direction finder: Yes No Unknown

Fathometer: Yes No Unknown

Gyro compass: Yes No Unknown

LORAN/DECCA/SATNAV Yes No Unknown

Surface radar: Yes No Unknown

Medical doctor on board: Yes No Unknown

Standard medical chest on board: Yes No Unknown

FM radio telephone, 156.8 MHz: Yes No Unknown

AM radio telephone, 2182 KHz: Yes No Unknown

CW radio telegraphy, high freq: Yes No Unknown

Radio watch, ITU schedule: H24 H16 H8

Calling freq. _________ Working freq. _________

Homing freq. ___________.

OWNERSHIP/MACHINERY DATA: (Source: Register, Index)

Owner ______________________________.

Manager _____________________________.

Flag of registry ________________________.

Home port ___________________________.

Previous names _________________________

____________________________________.

Built in year 19 __ by ___________________

____________________________________.

Engine size __________________________.

Boilers ______________________.

Propulsion type ________________________.

Number of screws _________.

CHAPTER 7. AIRCRAFT INTERCEPTS

700 AIRCRAFT INTERCEPTS

Aircraft intercepts are based on the capability of SAR aircraft to establish visual/electronic contact with an aircraft in distress, provide in flight assistance, and escort it to a safe landing. Escort service will normally be provided to the nearest adequate airport. Should the escorted aircraft continue on to another destination after reaching a safe airport, or decide not to divert to the nearest safe airport, further escort is discretionary.

710 WHEN TO INTERCEPT

A. The SAR coordinator may intercept and escort an aircraft when an Alert phase exists and should intercept and escort when a Distress phase exists or when a pilot requests an intercept. Local liaison should eliminate unnecessary duplication of escort services.

B. The following incidents often require intercept:

1. An aircraft is unable to maintain altitude.

2. An aircraft has suffered structural damage.

3. Pilot control of an aircraft is impaired.

4. Uncertainty exists as to the position of the aircraft.

5. Uncertainty exists as to whether the aircraft has enough fuel to reach a safe airport.

6. Fewer than 3/4 of the engines are operating normally or, for a three-engine aircraft, fewer than 2/3 of the engines are operating normally.

7. An aircraft is in other grave and imminent danger.

720 TYPES OF INTERCEPTS

If radar vectors to the intercept are not available, intercept should be accomplished using a direct, offset, or maximum rescue coverage procedure. Maximum rescue coverage intercepts are modified forms of direct intercepts. The method selected will be determined by the nature of the emergency, the track of the distressed aircraft, and the relative position of the SAR aircraft.

721 Direct Intercept

The direct or head-on intercept is used when the distressed aircraft is inbound to the SAR aircraft base. A distressed aircraft should not be asked to change its heading for a direct intercept unless the aircraft is lost, requires minor heading changes to correct for navigation error, or is in imminent danger and cannot reach safety. In the direct intercept solution:

A. The simultaneous positions of SAR and distressed aircraft are plotted.

B. The SAR aircraft flies a reciprocal track to that being flown by the distressed aircraft.

C. The distance between the simultaneous position plots is determined and the rate of closure computed.

D. Time of interception is computed by dividing the distance separating the two aircraft by the rate of closure.

722 Offset Intercept: Method 1

The offset intercept is used when the distressed aircraft is making good a track to a landing area and the SAR aircraft is to one side of the track. The SAR aircraft intercepts the track of the distressed aircraft. When the distressed aircraft has the greater groundspeed, the SAR aircraft will have to be closest to the point of intended landing to make the offset interception possible. To perform an offset intercept (see Figure 7-1):

A. The simultaneous positions of the distressed aircraft (A) and the SAR aircraft (B) are plotted, and a 10-minute lead to the position of the distressed aircraft is added to allow for navigational errors (C).

B. A line of constant bearing (LCB) is drawn between these positions (BC).

C. A parallel LCB (DE)is projected from the position of the distressed aircraft (with lead) one hour ahead on its proposed true course.

D. A wind vector downwind from the original position of the SAR aircraft (BF) is drawn.

E. An arc equal to the SAR aircraft TAS is swung through the projected LCB using the end of the wind vector as the center or origin. A line then drawn between the origin (F) and the point (G) where the TAS arc crosses the projected LCB represents the intercept true track.

F. The point where the TAS arc crosses the projected LCB is also a point on the interception true course of the SAR aircraft. The bearing and distance of the line drawn from the original position of the SAR aircraft to this point (G) represent interception true course and ground speed. If necessary, this line is extended until it crosses the projected true course of the distressed aircraft (H).

G. The distance to intercept the intended track of the distressed aircraft is measured between the original position of the SAR aircraft (B) and the point at which the interception true course crosses the projected true course of the distressed aircraft (H). The en route time for this distance and closure time for the lead distance are computed and added to determine total time required for collision point intercept with the distressed aircraft.

H. Depending on the speed differential, the SAR aircraft may execute a turn to the reciprocal of the track of the distressed aircraft when the course of the distressed aircraft has been intercepted. Interception of the course of the distressed aircraft can be confirmed by DF from the distressed aircraft.

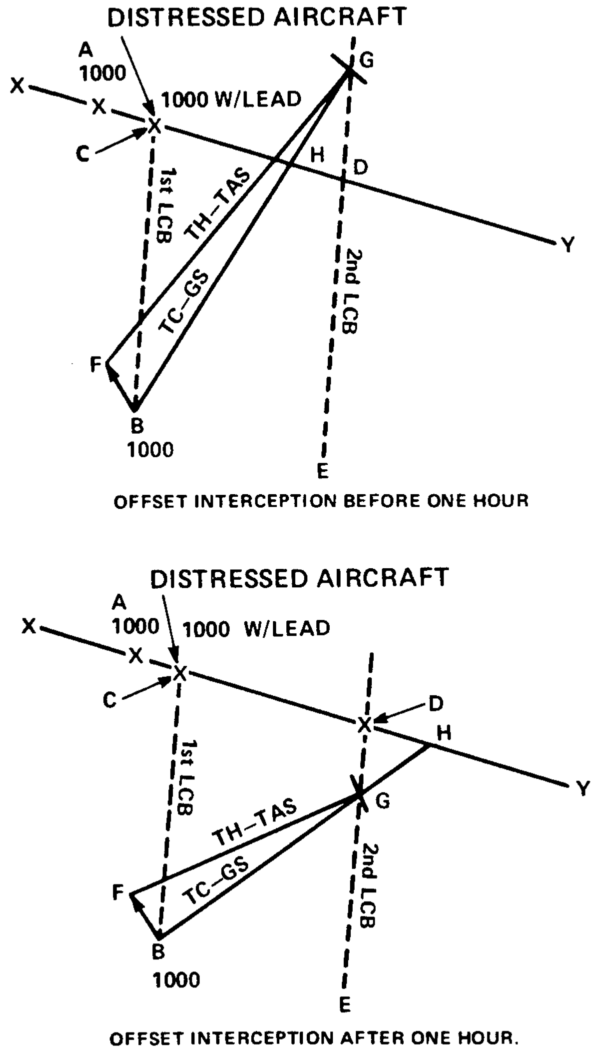


Figure 7-1. Offset Intercept Problem

723 Offset Intercept: Method 2

The method 1 procedure will end with an approximate 10-minute direct intercept. However, it is not always feasible to allow for the 10-minute leadtime and final turn into a direct intercept situation. In this case, the 10-minute leadtime is disregarded and greater reliance is placed on maintaining a line of constant bearing to the distressed aircraft. This procedure (see Figure 7-2) is executed as follows:

A. After the bearing to the distressed aircraft has been determined, the SAR aircraft is turned to a heading 45° from this bearing in the direction the distressed aircraft is flying.

B. A relative bearing of 45° is maintained by checking DF bearings.

C. If the DF check reveals that the bearing from the SAR aircraft has increased, the interception course should be increased twice the amount of change between the last two bearings.

D. If the check reveals that the bearing from the SAR aircraft has decreased, the interception course should be decreased twice the amount of change between the last two bearings.

E. By bracketing the bearings as described above, an interception course is determined maintaining a line of constant bearing.

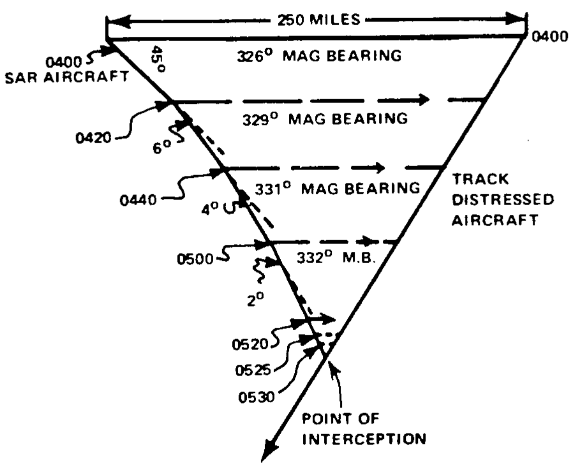


Figure 7-2. Offset Intercept Homing

724 Maximum Rescue Coverage Intercept (MRCI)

A. This procedure was developed to intercept and escort high-speed aircraft with low-speed SAR aircraft. Because of speed differential, it may be necessary for the SAR aircraft to turn short of the interception point on the distressed aircraft track to provide maximum rescue coverage over the remaining distance to be flown. This is accomplished by computing a turn-around point for the SAR aircraft ahead of the distressed aircraft and allowing the distressed aircraft to overtake the SAR aircraft. The distance from the turn-around point to the distressed aircraft should be equal to the distance of the SAR aircraft from the distressed aircraft at the time the distressed aircraft lands. During the MRCI, the distressed aircraft should be constantly informed of the type of interception being performed and the status.

B. The MRCI should be used when all of the following conditions exist:

1. The distressed aircraft is not, and is not expected to be, in immediate danger of ditching, crash landing, or bailout before it overtakes the SAR aircraft.

2. The distressed aircraft TAS/GS is at least 50 knots faster than the SAR aircraft.

3. The time to interception is 30 minutes or more.

4. The position of the distressed aircraft is accurately known.

C. The MRCI procedure is as follows:

1. The estimated time of intercept (ETI) for a normal, direct intercept (ETI is always stated as clock time, either local or Greenwich time) is computed.

2. The minutes to turn early before intercept (Z) are calculated by using the formula or the table shown in Table 7-1.

   a. Subtract Z from ETI to obtain the clock time of the time to turn (TTT).

   b. The formula for MRCI solutions is:

$$Z = \frac{60DV_{a1}(V_b - V_{a2})}{(V_{a1}+V_b)(V_b)(V_{a2}+2V_{a1}+V_b)}$$

and $$TTT = ETI - Z$$

where:
Z = Minutes to turn early before intercept
D = Total distance of intercept (distance between SAR aircraft and distressed aircraft at flight altitude)
V_{a1} = Groundspeed of SAR aircraft, outbound to intercept
V_{a2} = Groundspeed of SAR aircraft, inbound after TTT
V_b = Groundspeed of distressed aircraft
TTT = Time to turn for SAR aircraft
ETI = Estimated time of intercept – if no early turn made by SAR aircraf

TABLE 7-1. Maximum Rescue Coverage Intercept Factors

GS distress aircraft	*TAS 150 Knots, factors*	*TAS 175 knots, factors*	*TAS 210 knots, factors*	*TAS 290 knots factors*
Knots:				
200	0.010	–	–	–
300	0.013	0.011	0.008	–
400	0.012	0.011	0.010	0.005
500	0.010	0.010	0.009	0.007
600	0.009	0.009	0.008	0.007
700	0.007	0.007	0.007	0.007
800	0.006	0.006	0.006	0.006
900	0.005	0.006	0.006	0.006

Solutions: 1. Find GS of distressed aircraft. 2. Using the GS of distressed aircraft, go to the right and find the factor under appropriate TAS column. 3. Factor multiplied by distance distressed aircraft is from base = minutes to subtract from Estimated Time of Interception (ETI).

3. When time or other circumstances prevent the use of the Z formula, the factor table, Table 7-1 may be used. It requires less time, but is less accurate when great distances and speed differentials exist. However, the results are acceptable for most MRCI missions.

730 SAR AIRCREW DUTIES

Providing the maximum service to the distressed aircraft requires SAR aircraft crew coordination and close coordination between the distressed aircraft, the SAR aircraft, and assisting air/ground facilities. Duties of the SAR aircraft crew to ensure this coordination are as follows:

A. The pilots normally maintain VHF/UHF communications with the distressed aircraft and assisting facilities.

B. The radio operator keeps the pilot, copilot, and navigator informed of all pertinent HF communications. Whenever possible, voice transmissions should be used to expedite procedures and permit the pilots and navigator to monitor the exchange of information.

C. The navigator should plot the progress of both aircraft. The accuracy of position reports received from the distressed aircraft should be carefully evaluated and verified by other checks as soon as possible. The system of navigation being used, such as LORAN, celestial, radar, or dead reckoning, may provide a clue to the navigational accuracy of the distressed aircraft. The navigator should compute an intercept as soon as possible after receiving data from RCC. If the calculation is not completed prior to takeoff, the pilot should be given the initial heading, approximate distance, and estimated time of intercept. The navigator should direct the intercept until homing establishes reliable bearings on the distressed aircraft, keeping the pilot advised of heading, estimated time of intercept, and relative position of the distressed aircraft. The navigator should be prepared to complete a navigational/visual intercept if communications or electronic contact with the distressed aircraft is lost.

740 ACTIONS DURING INTERCEPT

741 Intercept Altitudes

The SAR aircraft should choose an altitude that maximizes the capability of the primary method of interception, whether visual or electronic. Except for high-altitude emergencies, the SAR aircraft should be flown at 1,000 feet below or above the distressed aircraft, using these guidelines:

A. Visual. The SAR aircraft will normally be flown 1,000 feet below the distressed aircraft to silhouette the latter against the sky and achieve maximum sighting distance. On a clear night the SAR aircraft may be flown 1,000 feet above the distressed aircraft to eliminate possible confusion between stars and the lights of the distressed aircraft. Where lights from cities could cause confusion, flying 1,000 feet below the distressed aircraft may be the best choice.

B. Instrument Conditions. The SAR aircraft should be flown 1,000 feet above the distressed aircraft for best utilization of radar and to clear lower altitudes in the event the distressed aircraft is unable to hold its assigned altitude. Where ground clutter is excessive, best radar may be obtained by flying 1,000 feet below the distressed aircraft; this should be done only when the distressed aircraft is maintaining assigned altitude. To ensure safe vertical separation, it is imperative that the altimeter settings of the two aircraft be compared and coordinated prior to intercept.

742 Intercept Communications

A. Communications Procedures. Establishing visual/electronic contact with a distressed aircraft and providing assistance are dependent on communications by the SAR aircraft. Communications between aircraft should instill confidence in the crew of the unit in distress. The SAR aircraft should establish direct communications on the en route frequency, emergency VHF/UHF frequency, or any other frequency with the distressed aircraft as soon as possible. Procedures should be as follows:

1. Assume that communications will be lost or the distressed crew may be forced to bail out, crash land, or ditch at any moment. Coordinate immediate action items first and supplemental items as the mission progresses.

2. Avoid long transmissions. Provide information at periodic intervals to assure the distressed crew that contact is being maintained.

3. Keep messages clear and concise. Know what to say and use a confident tone.

4. Avoid burdening the distressed crew with unnecessary information or instructions.

5. If direct communications are delayed or fail, relay data and instructions through an air/ground station in contact with both aircraft.

6. If efforts to contact the distressed aircraft fail or communications are lost, transmit information and instructions "in the blind," under the assumption that the distressed aircraft is receiving but is not able to acknowledge.

B. HF Communications Procedures. The high frequency (HF) en route channel used by the distressed aircraft to alert air/ground stations and to request interception should be used as the primary HF frequency. Changing from a primary to a secondary frequency should not be attempted unless absolutely necessary, and then only after instructions have been acknowledged by the distressed aircraft. The radio operator in the SAR aircraft should establish contact with the distressed aircraft on HF before takeoff or as soon as possible thereafter. Upon establishing contact, the radio operator should do the following:

1. Give identity and advise that a SAR aircraft is en route.

2. Instruct the distressed aircraft to stay on the present frequency, if possible.

3. Instruct the distressed aircraft to standby on the emergency VHF/UHF frequency for voice contact.

4. Instruct the distressed aircraft to turn IFF to 7700, unless the aircraft is under the control of, and assigned a transponder code by ATC.

5. Notify the SAR pilot and navigator when contact has been established. Transmit supplemental data such as altimeter setting, weather, ETI, or minimum safe altitude.

6. Provide homing instructions for the distressed aircraft, if required.

C. VHF/UHF Communications Procedures

1. The intercept should be conducted using the frequencies in use at the time the emergency was declared, unless ATC directs otherwise. If no frequency is assigned or if the distressed aircraft reported the distress on HF, emergency VHF/UHF frequencies 121.5 MHz and 243.0 MHz, are suitable for intercept. Use of either frequency has the following advantages:

   a. Immediate contact on a clear channel with all aircraft, military or civilian, United States or foreign. These aircraft should have one of these frequencies.

   b. Simultaneous contact with assisting air/ground facilities on one frequency. These facilities are familiar with SAR procedures and may provide valuable assistance during precautionary or emergency intercepts.

   c. Suitable operation of VHF/UHF direction-finding and homing procedures. While, during VHF homing, the "on course" beam may be wider when using 121.5 MHz, an accurate bearing and center of the beam may be determined by beam bracketing.

2. When using VHF, the operating range of 120–140 MHz is most desirable. If contact cannot be established, or if homing signals are not received from the distressed aircraft "in the blind," contact on a secondary VHF/UHF frequency may be arranged through HF communications.

3. The pilot should attempt VHF/UHF contact with the distressed aircraft as soon as possible and complete the following:

a. Identify, and advise that the SAR aircraft is en route.

b. Instruct the distressed aircraft that the present frequency will be used as the primary frequency and not to change frequency.

c. Assign a secondary VHF/UHF frequency to be used if contact is lost for any 3-minute period.

d. Instruct the distressed aircraft to monitor its HF en route frequency for further instructions if all contact is lost on VHF/UHF.

e. Instruct the distressed aircraft to turn its IFF to the emergency mode/code, unless it is being positively controlled by ARTCC.

f. Notify the radio operator that VHF/UHF contact has been established with the distressed aircraft, to end further instructions to the distressed aircraft on HF, and to set up the liaison transmitter for MF homing signals if needed.

g. Obtain/verify the distressed aircraft emergency and intentions.

h. Obtain and evaluate the latest position, time, true course, ground speed, altitude, and flight condition of the distressed aircraft, if required.

D. Blind Communication Procedures. If contact cannot be established with the distressed aircraft, complete the following on VHF/UHF:

1. Monitor the emergency VHF/UHF frequency for homing signals transmitted by the distressed aircraft "in the blind," as instructed by the RCC or other authority.
2. If the above proves unsuccessful, issue instructions "in the blind" for the distressed aircraft to change to another frequency and, if no contact is made within 30 seconds, to return and monitor the emergency VHF/UHF frequency.
3. Instruct the distressed aircraft to monitor a suitable HF en route frequency for CW or voice contact.
4. Issue instructions "in the blind" for the distressed aircraft to transmit a continuous 30-second signal automatically every other minute for homing.
5. If the distressed aircraft acknowledges the above instructions by transmission of the requested signals, complete VHF/UHF homing procedures and issue pertinent information between signals.

743 Supplemental Intercept Procedures

The pilot of the SAR aircraft can provide in flight data to the distressed crew to permit them to devote full attention to the emergency and to increase their confidence. The pilot should also:

A. Request immediate notification of any appreciable change in flight progress of the distressed aircraft, nature of emergency, intentions, weather conditions, and destination weather.

B. Determine the navigation aids used by the distressed aircraft and crosscheck positions with electronic bearings or fixes as soon as practical. Approximate position may be determined or verified by proximity to outstanding surface objects, landmarks, or conspicuous cloud formations.

C. Advise the distressed aircraft of estimated time of intercept (ETI).

D. Advise the distressed aircraft of the closest suitable airport, location, elevation, type and length of landing surface, landing aids, the correct altimeter setting, minimum safe altitude en route, weather information, and other data.

E. Contact available ground radar or DF facilities and obtain position, track, ground speed, altitude, and intercept course to the distressed aircraft, as applicable.

744 Close-In Procedures

A. Many actions occur just prior to intercept. The SAR crew should monitor the close-in approach of the distressed aircraft to guard against a missed intercept. The following additional procedures should be completed when close in:

1. If available, monitor IFF interrogator.
2. Begin radar search approximately 10 minutes

prior to intercept. The navigator notifies the pilot when the target is found, giving range, bearing, and course correction.

3. Five minutes prior to ETI, alert the distressed aircraft, issuing instructions to keep a sharp lookout and report sightings, and stating SAR aircraft altitude.

4. Issue instructions for signaling with landing lights, collision lights, or pyrotechnics by either crew.

5. Request longer and more frequent VHF/UHF homing signals from the distressed aircraft to preclude undetected passage.

6. Request the distressed aircraft to advise when the radio compass needle indicates "station passage" on the SAR aircraft homing signal.

B. The IFF interrogator is usually the most effective and dependable electronic aid, and requires little cooperation from the distressed aircraft once its IFF transponder has been turned on and is within range of the SAR aircraft interrogator. The ATC should be advised of the IFF codes being used.

C. Airborne air search radar provides a positive method of intercept and escort where restricted visibility (weather, night, etc.) precludes visual sighting. Airborne radar capability is normally limited to short ranges. Radar search for a distressed aircraft should begin at least 10 minutes before ETI. Once the distressed aircraft has been identified on the scope, the navigator gives directions to the pilot for intercept and escort. Caution should be exercised to ensure that the target is actually the distressed aircraft.

D. Bearings and position fixes from ground DF stations may be used as a primary aid for intercept when other aids are unsuccessful, or may be used to check the navigation accuracy of either aircraft. VHF/UHF DF is limited to line-of-sight operations, with altitude the main factor affecting range. Average range at 8,000 feet is approximately 110 nm. HF/DF may be used up to 1,000 miles. However, short-range operation may be unreliable.

E. Radio beacons may be used to obtain bearings, relative positions, and groundspeeds of both aircraft. If the distressed aircraft is close to a radio beacon, it can be instructed to fly a bearing inbound to the station. The SAR aircraft can complete the intercept at the station or by flying outbound on the appropriate bearing.

750 LOST AIRCRAFT PROCEDURES

A. If an aircraft declares that its position is unknown or uncertain, the entire communications system should be used to locate its approximate position. Radar or DF stations can establish a bearing indicating the general intercept direction. The following procedures have proven effective:

1. SAR aircraft should attempt to contact the lost aircraft by climbing to the highest practical altitude to increase communications range.

2. If the lost aircraft is in contact with an air/ground station, the SAR aircraft should orbit above the station until the lost aircraft is contacted or until some clue indicates the general direction of the lost aircraft.

3. If communications prove unsuccessful, the SAR aircraft should proceed in the most logical direction to the lost aircraft.

4. A second SAR aircraft may be launched and directed to proceed on a course 90° different than that of the first SAR aircraft. This aircraft could be used to obtain a second bearing line on the distressed aircraft if communications can be established.

5. The distressed aircraft is instructed to maintain radio contact at all costs, orbit its present position to keep from flying beyond communications range, and maintain the highest altitude practical.

6. Fuel, endurance, and POB of the distressed aircraft, are determined.

7. Communications with air/ground stations capable of providing bearings, fixes, and other assistance are maintained.

8. The electronic aid that can provide the quickest and most reliable bearing or fix of the lost aircraft is used first. Other aids should be used as the mission progresses.

9. As soon as the first reliable bearing or fix is established for the lost aircraft, the pilot is instructed to leave his orbit position and take up a heading to the SAR aircraft or to the closest suitable landing area.

10. If voice contact with the lost aircraft can be maintained but a bearing or fix cannot be

established, approximate position may be determined from a surface object, landmark, or peculiar cloud formation the pilot can identify and report to the SAR aircraft. Landing lights and pyrotechnic flares may be used at night to improve detection capabilities.

B. If the lost aircraft must land as soon as possible, and only one SAR aircraft is available, the following procedure may be used to fix aircraft position prior to vectoring it to a suitable field (see Figure 7–3):

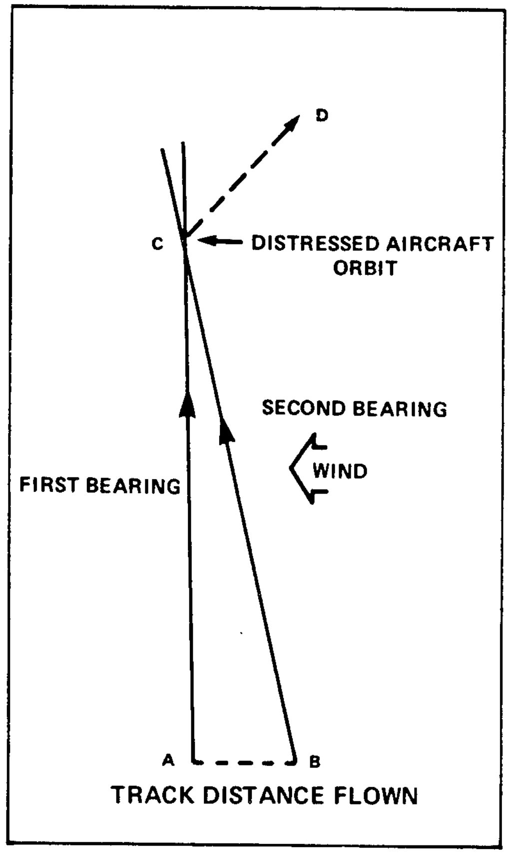
1. With lost aircraft (C) orbiting a fixed unknown position and the SAR aircraft (A) at a known position, a bearing is taken.
2. The SAR aircraft is then flown on a heading perpendicular to the bearing obtained for a period of 5 minutes, and a second bearing is taken on the lost aircraft from the new position (B).
3. Distance to the lost aircraft may be computed with the formula:

$$\text{Distance} = \frac{\text{TAS x minutes flown}}{\text{Bearing change}}$$

4. The bearings from the appropriate known positions of the SAR aircraft are plotted.
5. The point where the two bearings cross is the approximate position of the lost aircraft. The bearing and distance to the closest suitable airfield (D) are then relayed to the lost aircraft.

C. The above procedure may be worked in reverse, that is, the SAR aircraft orbits and takes bearings as the lost aircraft flies directed headings. This procedure should be used only if the SAR aircraft cannot complete the normal lost aircraft fixing procedure.

D. In either case, before a course is recommended to a distressed aircraft, a reasonably accurate position should be obtained. The course provided must ensure adequate terrain clearance for the altitude of the lost aircraft.



A. POSITION OF SAR AIRCRAFT TAKING 1ST BEARING.
B. POSITION OF SAR AIRCRAFT TAKING 2ND BEARING.
C. POSITION OF LOST AIRCRAFT.

A-B TRACK OF SAR AIRCRAFT AND DISTANCE FLOWN.
C-D BEARING TO BASE OF NEAREST SAFE LANDING.

Figure 7–3. Lost Aircraft Fixing Procedure

760 BAILOUT OR DITCHING PRIOR TO INTERCEPT

If it appears that the distressed aircraft may ditch or crash land, or the crew bail out before the SAR aircraft arrives, the following actions should be taken by the SAR aircraft:

A. Advise the distressed crew to delay bailout, crash landing, or ditching until it is absolutely necessary for safety of personnel. This delay gives the SAR crew time to alert air/ground stations and request their assistance. It also precludes a distressed crew taking emergency actions prematurely because of erroneous analysis of the fuel reserve, navigation, or the degree of emergency. Many times a distressed aircraft has been escorted to a safe landing even though the distressed crew had given up all hope.

B. Use the electronic aids and begin homing procedures immediately to close the distance between the two aircraft.

C. Alert air/ground stations of the following:

1. The emergency and intentions, anticipated or

actual incident site, and frequency used to maintain contact with the distressed aircraft.

2. The need to maintain continuous bearings and fixes on the distressed aircraft. Aircraft, surface vessels, rescue teams, or other SAR resources need to be dispatched to the scene and should contact the SAR aircraft for further instructions.

D. Determine the time the aircraft can remain airborne and the number of POB.

E. Provide the location and heading to the best area or the closest facility for bailout, crash landing, or ditching. If over land, advise the pilot of the least hazardous land area for bailout or crash landing. If over water, recommend bailout or ditching as follows:

1. Alongside a Coast Guard or Navy vessel or any other surface vessel in the area. Coast Guard personnel are equipped and trained to assist distressed aircraft and to rescue personnel immediately after ditching. AMVER may be of assistance in locating the closest merchant vessels. The RCC will provide AMVER information as well as nearby Navy or Coast Guard ships. Other ships can give complete weather including the length, height, speed, and direction from which waves and swells are moving. They may also provide other assistance, such as night illumination.

2. On the lee side of an island or in a lagoon.

3. Under the visual/electronic guidance of the SAR aircraft.

F. Assist the distressed crew with advice to continue flight or prepare for emergency action, such as:

1. Jettisoning cargo, equipment, and/or fuel.

2. Using maximum range power settings and altitudes.

Proper altimeter settings, minimum safe altitude, and other pertinent flight data should be provided.

G. If over water, evaluate sea surface conditions and provide the distressed pilot with ditching information (see Vol. II, Appendix A, Ditching Procedures), as follows:

1. If it is obvious that intercept cannot be completed prior to ditching, descend on course and make a low-level observation of sea surface conditions.

2. If time does not permit a low-level observation of sea surface conditions, make an estimate from the best information available.

H. Instruct the distressed aircraft crew to lock their CW transmitter key in the closed position just prior to bailout, crash landing, or ditching, and to place their EPIRB/ELT in operation as soon as possible after abandoning their aircraft. Request actual heading, altitude, and notification just prior to bailout, crash landing, or ditching, and plot the estimated position of the incident site. Log the time of the ditching and monitor emergency frequencies for transmission from emergency radio devices.

I. Maintain altitude while proceeding to the incident site to increase the receiving range of transmissions from the emergency radios and to conserve fuel.

J. If over water, drop sea dye and/or pyrotechnic markers over the estimated position of the incident site to be used as a reference point for search. If available, drop a DMB (Datum Marker Buoy) for on scene drift information.

770 INTERCEPT CHECKLIST

A. Take initial aircrew actions:

1. Brief aircrew.

2. Perform scramble preflight duties.

3. Obtain intercept course, distance, and ETI.

4. Turn on all electronic aids.

5. Contact appropriate ATC, GCI, etc., for supplemental briefing.

6. Cruise at best power and altitude.

B. Establish communications:

1. Establish HF contact direct or through relay.

2. Attempt VHF/UHF contact as soon as possible.

3. If no contact, monitor emergency VHF/UHF frequency for homing signals.

4. If still no contact, transmit essential data and instructions "in the blind."

C. Provide initial data and instructions:

1. State identity and mission of SAR aircraft.
2. Maintain contact on present frequency – designate primary.
3. Designate a secondary frequency.
4. Stand by on emergency VHF/UHF – or HF if initial contact is on VHF/UHF.

D. Obtain/verify essential data:

1. Nature of emergency and intentions.
2. Position.
3. Time.
4. True course.
5. Altitude.
6. Ground speed.
7. Flight conditions.

E. Begin electronic DF and homing:

1. IFF.
2. Medium frequency (MF).
3. VHF/UHF.
4. GCI, ACW, DEW.
5. LORAN, radio beacon, OMEGA, RNAV, INS.
6. Airborne radar.

F. Exchange supplemental data prior to interception:

1. Advise the distressed pilot of closest suitable airfield for precautionary landing. Provide location, type and length of landing surface, elevation, landing aids, weather, etc.
2. Determine the number of POB and the airborne time remaining.
3. Request notification of any change in plans of distressed aircraft.
4. Determine the method of navigation and evaluate accuracy of position.
5. Provide altimeter setting and minimum safe altitude en route.
6. Keep distressed aircraft advised of distance and ETI.

G. Follow close–in procedure:

1. Monitor IFF interrogator.
2. Initiate radar search 10 minutes prior to ETI.
3. Alert SAR and distressed aircraft crews 5 minutes prior to ETI.
4. Issue instructions for signaling with landing lights, Aldis lamp, or flares.
5. Request longer and more frequent VHF/UHF homing signals.
6. Request notification of "station passage" on radio compass of distressed aircraft.

H. Follow escort procedures:

1. Take up the proper escort position and maintain visual/electronic contact. The best escort position IFR or night is 1,000 feet above the distressed aircraft and behind. If day VFR conditions exist, the best escort position is slightly below and to the rear of the distressed right wing. If the distressed aircraft is going to jettison fuel, the escort must move to a position well clear of the dangerous fuel–air mixture formed behind the aircraft jettisoning the fuel.
2. Provide position, heading, and ETA to destination.
3. Notify home base of position and time of intercept. Request the latest weather, field conditions, and services of crash facilities at destination.
4. Advise distressed aircraft of weather and field conditions at destination.
5. Obtain instrument letdown clearance and request radar surveillance.
6. Obtain landing instructions and remain overhead while the distressed aircraft lands.

I. Provide emergency assistance:

1. Instruct distressed aircraft to delay bailout, crash landing, or ditching until necessary, but prior to fuel exhaustion.
2. Provide the location and heading to closest facility or best area for bailout, crash landing, or ditching.

3. Alert ground stations and request bearings, fixes, and dispatch of assistance.

4. Advise on jettisoning cargo, equipment, and fuel.

5. Advise on use of maximum range power settings.

6. Advise on sea surface conditions, best heading, and technique for ditching.

7. Guide distressed aircraft to VFR area, if practicable.

8. Advise distressed crew to place emergency radio devices in operation as soon as possible after abandoning aircraft.

9. Drop illuminating flares to assist in bailout, crash landing, or ditching, if necessary.

10. If interception cannot be completed:

a. Request heading, altitude, and notification just prior to emergency actions.

b. Advise distressed crew to lock CW key in closed position and then home on signal.

c. Monitor emergency frequencies for emergency radio transmissions.

d. If over water, drop sea dye and pyrotechnic over position of incident site.

J. Follow lost aircraft communications procedures:

1. Climb to altitude and proceed in best direction to improve communications.

2. Consider instructing lost aircraft to orbit until bearing or clue to position is received.

3. Establish bearing and provide heading to home on SAR aircraft.

4. If on-course interception is impractical, complete lost aircraft fixing procedures and vector to closest suitable airfield.

5. If all electronic aids fail, estimate approximate position from landmarks, surface objects, or unusual cloud formations in sight of lost aircraft.

APPENDIX A. AIRCRAFT DITCHING PROCEDURES

A. SELECTION OF DITCHING HEADING

Selecting the heading for aircraft ditching depends on basic knowledge of sea conditions. An optimal ditch heading minimizes rapid deceleration, the greatest danger in ditching. While the suggested procedures and information in this Appendix are correct in most ditching situations, the primary source of information for ditching of a specific aircraft is normally the aircraft flight manual.

1. Definitions

Fetch. The distance the waves have been driven by a wind blowing in a constant direction, without obstruction.

Sea. Condition of the surface -- the result of both waves and swells.

Swell. Condition of the surface caused by a distant wind system. The individual swell appears to be regular and smooth, with considerable distance between rounded crests.

Swell Direction. The direction from which a swell is moving. This direction is not the result of the wind present at the scene. Swells, once set in motion, tend to maintain their original direction for as long as they continue in deep water. The direction toward which a swell is moving is called the down swell.

Swell Face. The side of the swell toward the observer. The backside is the side away from the observer. These definitions apply regardless of the direction of swell movement.

Swell Height. The height between crest and trough, measured in feet.

a. Swell height is proportional to the strength of the wind of origin, the length of time the wind has been blowing, the steadiness of direction, and the fetch. High swells are not generated instantaneously, nor are there high swells in the lee of an obstruction, no matter how long the wind has blown.

b. The vast majority of ocean swells are less than 15 feet. Swells over 25 feet are rare.

c. Due to interference, which is the overrunning of one swell system by another, successive swells may differ considerably in height.

Swell Length. The horizontal distance between successive crests, measured in feet.

Swell Period. The time interval between the passage of two successive crests.

Swell, Primary. The swell system having the greatest height from trough to crest.

Swells, Secondary. Swell systems of less height than the primary swell.

Swell Velocity. The velocity with which the swells advance with relation to a fixed reference point, measured in knots. There is little horizontal movement of water. Each water particle transmits energy to the next, resulting primarily in a vertical motion, similar to the motion observed when shaking out a carpet.

Wave (or Chop). The condition of the surface caused by local wind. Characterized by irregularity, short distance between crests, whitecaps, and breaking motion.

2. Choosing a Heading

a. *Effect of Swells.* It is extremely dangerous to land into the wind without considering sea conditions. There are two formulas for determining the length and velocity of swells:

Length (ft) = 5 x period^2 (sec)

Velocity (kts) = 3 x period (sec)

Assuming a 10–second swell period, by substitution in the formulas the swell length is found to be 500 feet with a velocity of 30 knots.

(1) Figure A–1 illustrates an aircraft landing into the swell. If it is assumed that the aircraft takes 450 feet and 7 seconds to come to rest, during the 7 seconds of runout the swell moves toward the aircraft a distance of about 300 feet, thereby shortening effective swell length to about 200 feet. Since the aircraft takes 450 feet to come to rest, it would meet an oncoming swell about halfway through its runout and possibly be swamped, or thrown into the air out of control. Therefore, this ditching heading should be avoided.

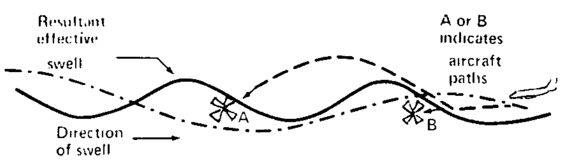


Figure A–1. Landing into the Swell

(2) Figure A–2 illustrates an aircraft landing with a swell. The swell is moving with the aircraft, increasing the effective swell length to about 800 feet. The aircraft, if touched down just beyond the crest, will come to rest short of the next crest. In the long swells of the Pacific, this can be an easy landing. Shorter swell lengths ordinarily prevent this heading except when landing down a secondary swell system. Selection of a ditching heading to parallel a primary swell system may require landing down swell on a secondary system.

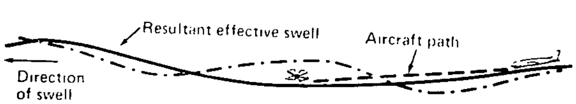


Figure A–2. Landing with the Swell

(3) Figure A–3 shows a landing parallel with the swell. This is the best ditching heading. Landing on the top or back side of the swell is preferable.

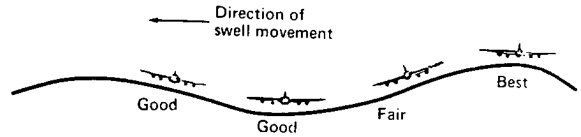


Figure A–3. Landing Parrallel with the Swell

(4) If only one swell system exists, the problem is relatively simple, even with a high, fast system. Unfortunately, most cases involve two or more systems running in different directions. With several systems, the sea presents a confused appearance. One of the most difficult situations occurs when two swell systems are at right angles. If the pilot parallels one, landing should be into, or down, the second. A landing parallel to the primary system, and down swell on the secondary system is indicated. If both systems are of equal height, a compromise may be advisable –– selecting an intermediate heading at 45° down swell to both systems. When landing down a secondary swell, touchdown should be on the back side, not on the face, as shown in Figure A–4. Avoid the face of a swell.

Figure A–4. Landing on the Back Side of a Swell

b. *Effect of Chop.* Local winds create chop which acts much the same as a swell system. When winds are over 14 knots, chop rides on top of the resultant uneven surface and, if severe, may serve to hide the underlying swell system. Moderate chop, alone, can be discounted as a danger to ditching.

c. *Effect of Surface Wind.* The best condition is one that permits landing parallel to a single swell system and into the wind, but this situation seldom exists. Some crosswind is usually present, and should be accepted in order to parallel the major swell. The recommended procedures in the manufacturer's flight handbook should be used. The following general rules apply:

(1) *Winds from 0–25 knots.* The crosswind component is ignored and landing is made parallel to the major swell. The heading that has the greatest headwind component is selected. If a pronounced secondary swell exists, it may be desirable to land down the secondary system and accept some tailwind component.

(2) *Winds from 25–35 knots.* It may be necessary to select an intermediate heading, neither parallel to the swell (since the crosswind component may prove too much to handle) nor into the wind (because the ground speed reduction due to headwind will not compensate for the disadvantage of landing into the swell). A heading at an angle into the wind and swell may be indicated. If the swell is high, a greater crosswind component should be accepted in order to more closely parallel the swell.

(3) *Winds over 35 knots.* Generally, with winds of this force, landing should be made into the wind regardless of the swell, because ground speed is significantly reduced. If the swell is so formidable as to make a successful landing into it doubtful, it may be advisable to land at an angle to, or parallel to, the swell, accepting large crosswinds.

(4) In general, low–wing land aircraft can accept a much higher crosswind component than seaplanes. If the swell system is formidable, landplanes should accept more crosswind in order to avoid landing directly into the swell.

(5) When the secondary swell system is from the same direction as the wind, the landing may be made parallel to the primary system, with the wind and secondary system at an angle. There is a choice of two headings paralleling the primary system. One heading is downwind and down the secondary swell; the other is into the wind and into the secondary swell. The choice is based on the velocity of the wind versus the velocity and height of the secondary swell.

3. Surface Wind Evaluation

The simplest method of estimating wind direction and velocity is to examine wind streaks on the water. These appear as long streaks up and down wind. Whitecaps fall forward with the wind, but are overrun by waves, thus producing the illusion that the foam is sliding backward. Knowing this, and by observing the direction of the streaks, the pilot can easily determine wind direction. Wind velocity can be accurately estimated by noting the appearance of the whitecaps, foam, and wind streaks. The Beaufort scale in Table A–1 may prove useful.

4. Sea Evaluation

a. The primary or basic swell can readily be distinguished from high altitude (above 2000 feet) and should be seen first. It appears as a definite pattern or differences in light intensity on the surface. By watching the pattern for a few seconds, the direction of motion of the system can easily be determined. Once the primary system is found, observers should look in different directions for other systems.

b. Once the aircraft is below 1500 feet, the basic system may disappear from view, hidden by the secondary system and local chop. Thus it is essential to plot the direction of various systems as they are recognized. The secondary system may not be visible until under 800 feet. The wind–driven sea current, if any, will be easily recognized by the appearance of whitecaps.

c. Once primary and secondary systems are recognized, the analysis may be easily checked by flying on various headings just above the water. When flying into any system, the sea appears to be steep, fast, and rough. When flying down or parallel to the systems, the surface appears more calm.

d. If the surface is not visible from altitude, the speed and direction of the seas underlying the local chop may be approximated with a ceiling as low as 75 to 100 feet by dropping a smoke float, dye marker, or other floating object:

(1) Swell direction can be determined as crests pass under the float.

(2) Swell period can be found by timing the interval between passage of successive

crests under the float.

(3) The primary swell length and velocity are computed by use of the formulas in paragraph 2.a.

(4) Length and velocity of the secondary swell are computed.

(5) Direction and velocity of the surface wind are estimated.

e. Pilots flying over water should make a habit of evaluating the sea. This ensures a tentative ditching heading at all times and provides practice in identifying swell systems. In some ocean areas there are prevailing swells from a fairly constant direction. These conditions should be recognized by pilots regularly flying certain routes.

5. Assistance in Ditching Heading Determination

A pilot with an emergency may obtain a recommended ditch heading in a number of ways. If escorted, the pilot of the escort aircraft may make the sea evaluation and recommend a ditch heading, particularly if the escort is a SAR aircraft. If the ditching is alongside a ship, the wind and sea state can be obtained from the ship if communication has been established. A Navy or Coast Guard ship may also be able to recommend a ditch heading. An RCC may provide an estimated ditch heading based on weather and sea state reports if on scene evaluation cannot be made.

6. Ditch Heading Summary

Major considerations in selecting a ditch heading are summarized below. Various ditching situations are illustrated in Figure A-5.

TABLE A-1. Beaufort Scale

Beaufort Number	*Wind Velocity (Knots)*	*Sea Indications*	*Height of Waves (Feet)*
0		Like a mirror.	0
1	1-3	Ripples with the appearance of scales.	1/2
2	4-6	Small wavelets; crests have a glassy appearance and do not break.	1
3	7-10	Large wavelets; crests begin to break. Foam of glassy appearance; few very scattered whitecaps.	2
4	11-16	Small waves, becoming larger. Fairly frequent whitecaps.	5
5	17-21	Moderate waves, taking a pronounced long form, many whitecaps.	10
6	22-27	Large waves begin to form; white foam crests are more extensive; some spray.	15
7	28-33	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of waves.	20
8	34-40	Moderately high waves of greater length; edges of crests break into spindrift; foam blown in well-marked streaks in the direction of the wind.	25
9	41-47	High waves. Dense streaks of foam; sea begins to roll; spray affects visibility.	30
10	48-55	Very high waves with overhanging crests; foam in great patches blown in dense white streaks. Whole surface of sea takes on white appearance. Visibility is affected.	35

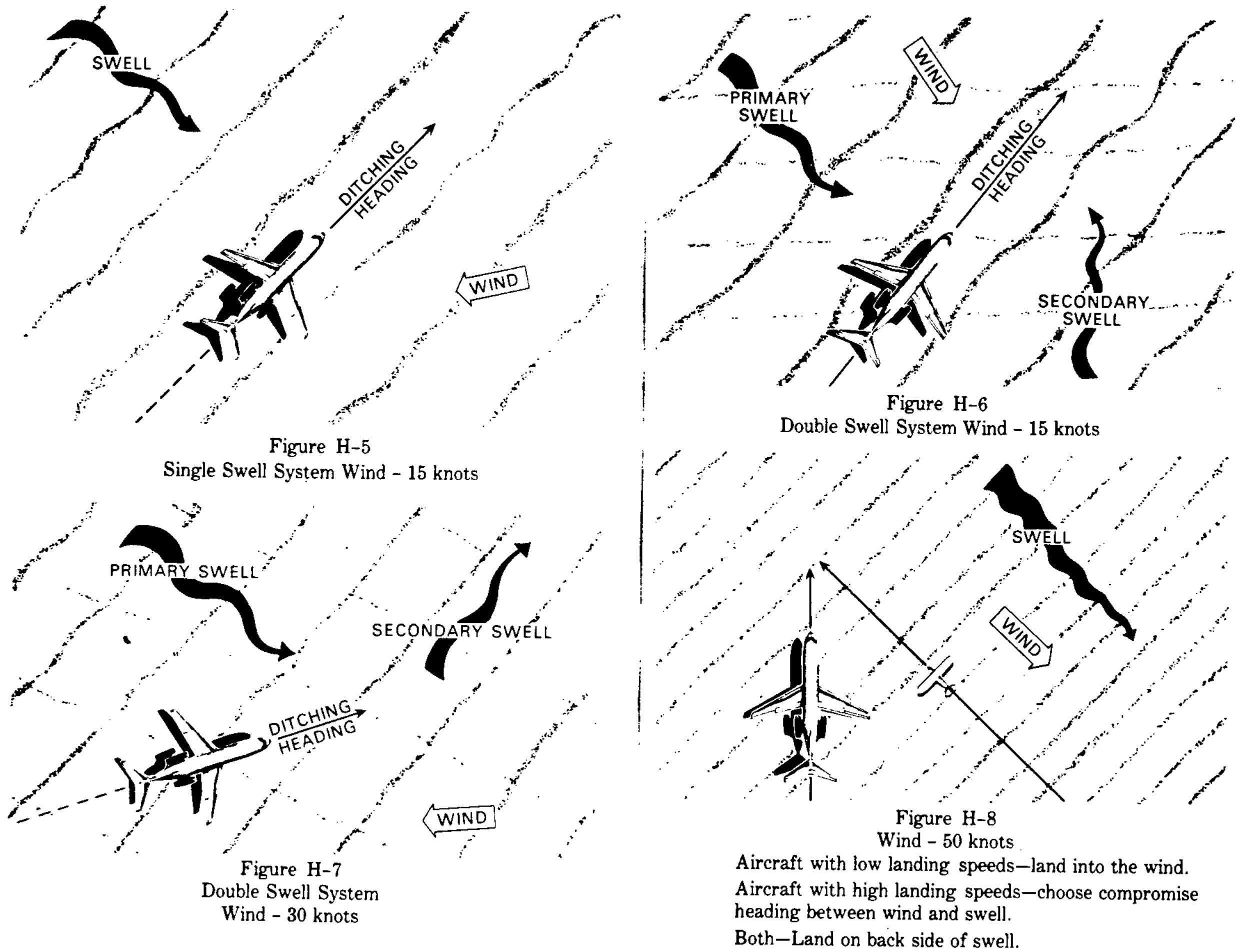


Figure H-5
Single Swell System Wind - 15 knots

Figure H-6
Double Swell System Wind - 15 knots

Figure H-7
Double Swell System
Wind - 30 knots

Figure H-8
Wind - 50 knots
Aircraft with low landing speeds—land into the wind.
Aircraft with high landing speeds—choose compromise heading between wind and swell.
Both—Land on back side of swell.

Figure A-5. Some Wind-Swell-Ditching Heading Situations

a. Never land into the face of a primary swell system (or within 30° to 35°) unless winds are extremely high.

b. The best ditch heading usually is parallel to the major swell system and down the secondary swell system.

c. The next best choice is parallel to the minor swell system and down the major swell system.

d. The choice between 2 and 3, above, will be determined by which heading gives the greatest headwind component.

e. In moderately strong winds it may be desirable to compromise the above rules by landing more into the wind and slightly across the swell system.

f. If the pilot is unable to evaluate various headings, the one that appears to be the smoothest and that does not run into the face of a primary swell is usually the best.

B. AIRCRAFT TYPE

By knowing the characteristics of an aircraft, and its expected behavior on the water, the pilot can take certain steps to ensure best ditching performance. The general ditching performance of several types of aircraft is discussed below.

1. Other factors being equal, larger aircraft have better ditching characteristics. Fighter aircraft, due to their high landing speeds and smaller size, often react violently to ditching. Standard

procedure in fighter type aircraft is to eject and descend by parachute rather than ditch. This is true also of most modern bomber aircraft.

2. Transport aircraft are generally better in a ditching situation than combat aircraft. Aircraft bottoms, where most failures occur during ditching, are stronger in transports than in bombers (which are greatly weakened by large bomb bay doors). In most aircraft, bottom damage may be expected, primarily in the midsection, and nose windows will probably collapse. The behavior of the aircraft on runout depends on the damage suffered, and is more violent if the fuselage is damaged on first impact. Double deck aircraft may suffer rapid flooding of the lower deck, but the upper deck may be relatively safe. Aircraft equipped with cabin pressurization have good water–tight integrity and, if the fuselage is intact, afford good protection against rapid flooding. In all cases, however, the aircraft must be depressurized before ditching.

3. Aircraft with long afterbodies may break forward of the tail, especially when ditching in a fully stalled attitude into the face of a swell. In several military patrol aircraft ditchings, the afterbody of the aircraft separated entirely.

4. Low–wing aircraft, due to wing flotation support, are safer for ditching than high–wing types. High–wing aircraft tend to sink rapidly after impact until the wings settle in the water, so most of the fuselage is under water soon after the aircraft comes to rest. However, high–wing C–130 aircraft have been successfully ditched.

5. External appendages affect ditching characteristics. Landing gear must be retracted. Low–wing aircraft with large underslung engines, if landed wing low, may dig one nacelle first, causing a waterloop. This rotation around the vertical axis may also cause structural failure to the fuselage afterbody. Although flaps may break away on initial impact, the importance of flaps in slowing down the aircraft on approach makes their use mandatory. Generally, auxiliary fuel tanks and ordnance located beneath the wing or fuselage should be jettisoned prior to touchdown. Wingtip tanks have no marked adverse effect, and if empty provide additional flotation.

6. Jet–engined aircraft have higher landing speeds, large jet intakes, and, in most cases, underslung engines. The increased landing speed of jets will increase deceleration forces of ditching. However, this may be offset by the strengthened fuselage. Some underslung engines will break away under water loads, or cause a diving moment.

C. PILOT SKILL AND TECHNIQUE

The recommended procedures for ditching techniques published in the manufacturer's flight handbook should normally be followed. In the absence of these procedures or as general guidelines, the following techniques may be used.

1. An understanding of the technical aspects of the deceleration forces is necessary in applying the recommended techniques. Kinetic energy must be fully expended before the aircraft can come to rest. This energy is determined by the formula:

$$E = \tfrac{1}{2} MV^2$$

where: E = energy
M = the mass of the aircraft
V = velocity

2. To reduce the energy to be expended, and thereby reduce damage to the aircraft, it must be made as light as possible, and landing speed must be as slow as possible consistent with good control. This factor emphasizes the need for a power approach, if power is available, since this will appreciably lower the touchdown speed.

3. When ditching in rough water or into the face of a swell, much greater forces are to be expected. The length of runout will depend on whether the aircraft is swamped or thrown back into the air by contact with a swell. Landings parallel to a major swell system more nearly approximate those on calm water.

4. Seaplanes and landplanes differ considerably in ditching characteristics. Seaplanes are conducive to fairly smooth deceleration, even in rough water. A landplane, due to its shape and probable impact damage, may be subjected to irregular deceleration. Vertical forces are also severe if the aircraft is stalled from too high an altitude or thrown back into the air with insufficient airspeed. In a landplane ditching, the pilot should set down on a proper heading in the right spot at the best combination of attitude and speed. Touchdown should be at the lowest

speed and rate of descent which permit safe handling and optimum nose-up attitude on impact. Once first impact has been made, there is often little the pilot can do-- especially if the control surfaces are broken away. In a seaplane, the pilot is normally able to control the aircraft through the runout. Maximum deflection of controls will normally be required to maintain heading and attitude.

5. Once preditching preparations are completed, the pilot should turn to the ditching heading and begin letdown. The pilot should observe the sea surface ahead. Shadows and whitecaps close together indicate that the seas are short and rough; touchdown in these areas should be avoided. Touchdown should be in an area (only about 500 feet is needed) where the shadows and whitecaps are not so numerous. These areas are usually caused by swell systems being in opposition to one another, which tends to cancel out the effect of each. The aircraft should be flown low over the water and slowed to approximately 10 knots above stall. At this point, additional power should be used to overcome the increased drag caused by the nose-up attitude. When a smooth stretch of water appears ahead, the pilot should cut power and touchdown at the best recommended speed or 5 to 10 knots above stall speed. Donot stall the aircraft prior to touch down. By cutting power when approaching a relatively smooth area, the pilot will prevent overshooting and will touch down with less chance of becoming airborne a second time.

6. Most experienced seaplane pilots prefer to make contact with the water in a semi-stalled attitude, cutting power as the tail makes contact. This technique eliminates the chance of misjudging altitude with a resultant heavy drop in a fully stalled condition. Care must be taken not to drop the aircraft from too high an altitude or to balloon due to excessive speed.

a. Over glassy smooth water, or at night with insufficient light, it is easy to misjudge altitude by 50 feet or more. Under such conditions, enough power should be carried to maintain 9° to 12° nose-up attitude and 10 to 20 percent over stall speed until contact is made in the water.

b. The proper use of power on the approach is of great importance. If power is available on one side only, a little power should be used to flatten the approach; however, the engine should not be used to such an extent that the aircraft cannot be turned against the good engines, right down to the stall with a margin of rudder movement available. When near the stall, sudden application of excessive unbalanced power may result in loss of directional control. If power is available on one side only, a slightly higher than normal glide approach speed should be used. This ensures good control, and some margin of speed after leveling off, without excessive use of power.

c. The use of power in ditching is so important that the pilot should, if possible, ditch before fuel is exhausted. The use of power in a night or instrument ditching is far more essential than during daylight. If no power is available, a greater than normal approach speed should be used down to the flare-out to allow the glide to be broken early and more gradually.

7. When landing parallel to a swell system, there is little difference between landing on a crest or in the trough. The wings of the aircraft should be trimmed to the surface of the sea rather than the horizon. If forced to land into a swell, touchdown should be made just after passage of the crest. The forces acting on the aircraft after touchdown are of such magnitude that crosswind drift will be only a secondary consideration. If the aircraft is under good control, the "crab" may be kicked out with rudder just prior to touchdown. This is more important with high-wing aircraft, which are laterally unstable on the water in a crosswind, and may roll to the side in ditching.

8. Ditching a helicopter can be done with little or no groundspeed which should decrease the resultant decelerative violence. However, without built-in flotation, the helicopter will sink so rapidly that timely evacuation becomes a major problem. This danger is compounded by the fact that evacuation cannot be started until rotating components have come to a stop, by which time the cabin spaces are filling or filled with water. The following generalizations are based on actual ditching experience in single rotor helicopters without built-in flotation:

a. If possible, prior to water contact, jettison doors that open outward. Cabin doors that slide should be opened or windows removed. Care must be taken when jettisoning doors to preclude damage to the main or tail rotor blades.

b. A normal landing should be made at zero ground speed into the wind and minimum rate of sink. Excessive tail flare should be avoided; premature water contact of the tail rotor may result in loss of antitorque control before the main fuselage settles in the water. In the event of ditching due to anticipated fuel starvation or for any reason where ditching is imminent but not immediate, much can be done to protect personnel and survival gear if planned ditching procedures are established and followed. In a planned ditching, the helicopter should be hover taxied approximately 50 yards downwind after the crew and equipment have been evacuated. A hovering autorotation should then be accomplished to attain minimum rotor speed upon contact with the water. Under any ditching conditions, water spray may reduce visibility.

c. Main rotor brake (when available) should be applied and the aircraft kept level while rotor RPM decays. As the fuselage settles in the water, pitch should be pulled until the aircraft tends to roll. At that time, cyclic should be applied in the same direction so water contact will stop the main rotor without violent reactions or flipping the aircraft in the opposite direction. If one side of the aircraft provides better exits the helicopter should be rolled in the opposite direction before effective rotor control is completely lost.

d. It is important that all occupants remain strapped in their seats until the cabin spaces have filled with water. This prevents being swept around inside the cabin with inrushing water. Each occupant must identify and hold onto a reference until the aircraft has submerged. This minimizes disorientation with respect to the nearest exit, regardless of aircraft attitude after submersion. Life preserver units should not be inflated until positively clear of the aircraft.

D. SURFACE CRAFT ASSISTANCE

If an aircraft has to ditch, or the crew bail out over water, the most advantageous place is near a surface craft.

E. COMMUNICATIONS

1. Radio

The different maritime and aeronautical radio bands make direct communications between vessel (especially merchant vessel) and aircraft difficult.

a. Most civil aircraft flying over ocean areas are equipped with VHF radios (118–136 MHz) and HF/SSB radios (3–20 MHz). Military aircraft normally have UHF radios (225–399.9 MHz) and HF/SSB radios (3–30 MHz). Both military and civil aircraft maintain contact with ATC facilities on HF while over ocean areas. In emergencies, the pilot normally advises ATC of the situation and intentions. If not able to continue toward an airport, the pilot usually asks the ATC agency to advise of any ships in the area and ask them to establish a voice watch on 4125 kHz to assist in ditching and rescue.

b. Merchant ships are ordinarily informed of aircraft distress situations by broadcast messages from Coastal Radio Stations on the international distress frequencies of 500 kHz, 2182 kHz, or 156.8 MHz (VHF channel 16). Few aircraft can operate on these frequencies.

c. Emergency communications are usually established with aircraft on 4125 kHz.

d. Communication between an aircraft and a merchant vessel often may have to be relayed via a SAR aircraft, military vessel, or ground station.

2. Visual

While there is no standard emergency signal to indicate ditching, an aircraft in distress can use any means to attract attention, make its position known and obtain help. Lowering landing gear and flashing landing lights on and off may be used to signal ditching intentions.

F. ASSISTANCE FROM SHIPS

1. Navy and Coast Guard Ships

Ditching assistance can be provided by Navy and Coast Guard ships. The extent of their capability will vary according to the type and size of the ship. Navy combat ships of destroyer size and above and WHECs may be able to provide the full range of assistance -- including aircraft radio frequencies. Other ships are more limited in assisting with the approach and ditching phase, but they have excellent capability to rescue survivors. Assistance that might be provided in a ditching situation includes:

a. Establishing and maintaining communications with the aircraft. Every effort will be made to establish immediate direct voice communication between the ship and distressed aircraft. When contact is made, a lost- contact procedure should be arranged with the ship for use in the event that contact is lost.

b. Locating the aircraft. The ship may locate the aircraft by:

(1) *Radar.* Identification of the distressed aircraft will probably be made by IFF interrogation. Standard procedure is for the distressed aircraft to put its transponder beacon on Code 7700. If this is not possible, the pilot may be able to make a 90° identification turn. The pilot should hold the new course for 3 minutes and then return to base course.

(2) *Radio direction finder.*

(3) *Homing signals.* If the ship can send homing signals on a frequency compatible with the aircraft's direction finder, the pilot may be able to provide a reciprocal bearing.

(4) *Shore-based assistance.* Authorities may be able to provide a position on the aircraft from DF nets or other available information.

(5) *Aircraft's navigational data.* The pilot may be able to give a position from navigational data.

(6) *Weather data.* Unusual weather conditions reported by the pilot may give clues about the aircraft's position.

c. Vectoring or assisting in homing the Aircraft to the ship. A ship may assist an aircraft by providing homing signal or steers based on radar or DF bearings from the ship. During daylight, a ship may make black smoke, cruise at high speeds to form a wake, or use other means to attract attention visually. At night, star shells, searchlights, pyrotechnics, deck lights, or water lights may be used.

d. Furnishing weather, sea information, and recommended ditching heading. Final determination of the ditching heading is the responsibility of the pilot, who should inform the ship of the selected ditching heading as soon as possible.

e. Marking the sea lane along the selected ditching heading. During daylight, with relatively calm sea conditions, a ship may mark the sea lane with fire extinguisher foam. At night, or during a low-visibility daytime ditching, a ship may lay a series of floating lights along the selected ditching heading.

f. Providing approach assistance. Approach may be made visually, by ADF using the homing signals from the ship, by radar assistance from the ship, or by a combination of these. The ship will normally be to one side of the sea lane.

(1) *Visual approach.* Under visual conditions, day or night, the aircraft should make a visual approach.

(2) *Instrument approach.* During low ceiling or poor visibility, a ship may provide continuous homing signals through the final approach stage. It may also operate air navigation aids to allow an instrument approach. The pilot should be aware of the height of the masts on the ship and must allow some deviation on final approach in order not to collide with the ship. If the pilot desires, and radar contact is held by the ship, it may give radar ranges. Full radar-controlled approach should not be attempted unless the ship is qualified in such approaches.

g. Providing illumination. Ships with flare or star shell capability can provide illumination at night for a visual approach. Illumination may be placed over the expected ditching location and over-shoot area, approximately 1200 yards past the end of the sea lane. The ship may also fire an orientation flare when the pilot begins the final approach.

h. Rescuing and Caring for Survivors. Rescue may be by small boats or the ship itself. Survivors in the water or aircraft should usually be rescued first and those safe in rafts last. If there are serious injuries, the SMC can make medical arrangements.

2. Merchant Ships

a. The nearest ship to a distressed aircraft will probably be a merchant ship. The traditions of the sea and the general agreement among nations as expressed in international conventions call for these ships to assist anyone in distress. Since merchant ships provide a source of rescue capability at sea, SAR authorities have developed methods, procedures, and guidance material for rescue by merchant ships in the international Merchant Ship Search and Rescue Manual (MERSAR) issued by IMO. One chapter of MERSAR is devoted to assisting aircraft in distress at sea.

b. Rendezvous procedure with merchant ship

(1) *Alerting the ship.* Aircraft normally transmit a distress or urgency message on their air-ground frequency. This is relayed to the RCC via Air Traffic Control. For aircraft incidents over water, steps are taken to obtain the positions of ships near the projected aircraft trackline. The ships in best position to assist in a ditching are alerted by the RCC. When a ship is selected, the RCC passes instruction for aiding in rendezvous, approach, and rescue.

(2) Providing the ship with an estimated ditching location. Information on the projected track will enable the ship to alter course to reduce time to rendezvous.

(3) *Communicating.* Direct communications between aircraft and ship is normally possible only on HF frequency 4125 kHz. Where direct communication cannot be established, relay through a SAR aircraft or a ground station should be set up.

(4) *Homing signals by the ship.* Homing is the most positive method of effecting rendezvous. Most merchant ships will have the ability to provide homing signals on a frequency in the 400 kHz band. For standardization, the frequency advised for rendezvous is 410 kHz. When advised that the ship has started homing signals the pilot should use an ADF to home on the ship. The RCC verifies to the aircraft the frequency to be used. The usual homing signal is the call sign of the ship, followed by two 10-second dashes, and then repeated.

(5) *Visual aids by the ship.* At night the ship should turn on as many deck lights as possible and use searchlights directed upward or sweeping the horizon. During the daytime the ship may make black smoke. The sea level altimeter setting should be transmitted to the aircraft.

c. A merchant ship can provide only a limited amount of assistance during ditching. The pilot can use information on weather and sea conditions to select a ditch heading, and should inform the ship of this as soon as possible. The ship will probably set course parallel to the ditching heading. If the pilot wants to use the ship for an ADF approach, the pilot should ask the ship for continuous transmissions. This is the only instrument approach practicable with merchant ships.

d. Rescue and care of survivors is dictated by sea and weather conditions, and medical facilities aboard the ship, which may range from a medicine chest to full hospital facilities. If sea conditions prohibit the use of lifeboats, the ship is maneuvered to the survivors. They are brought aboard by ladders, cargo nets, or in slings hoisted by ship's cargo booms. If they need care beyond the ship's capabilities, the SMC may arrange a MEDEVAC.

APPENDIX B. OCEANIC PROBLEM SAMPLE

100 The following Oceanic SAR Planning Example is provided as a guide to assist inexperienced SAR planners in completing a manual solution using the forms contained in this volume (the outline numbers indicate the chapter origin of the various forms used).

A. Scenario

1. *Situation:* At 1000Z, 29 April 1985 a MAYDAY was received from NAVY "FOXTROT TWO FOUR" indicating that the pilot and copilot had just ejected from their aircraft at 10,000 feet in position 39-15.0N 64-30.0W. According to the parent command, both ejection seats are equipped with self-deploying single-man rafts with built-in drogues.

2. The first available SAR unit, a Coast Guard C-130, will arrive on scene at 291800Z. The C-130 has an on scene endurance of 5 hours and will search at a speed of 150 knots. A Navy P-3 is scheduled to arrive on scene at approximately 291830Z to assist in the search. The P-3 has an on scene endurance of 5 hours and will search at a speed of 170 knots. Also proceeding to the area is a Navy destroyer, whose ETA is 300600Z.

B. Meteorological Data has been obtained for the vicinity of 39-15N 64-30W:

1. 2500 feet broken with 90% cloud cover, meteorological visibility 20 nm, surface winds 070/20 kts, seas 8 feet from the north.

2. 291000Z Upper Winds Forecast from WSFO, JFK, New York:

Surface	070/15	18000	210/25
3000	120/30	24000	210/20
6000	130/25	30000	210/30
9000	170/48	34000	215/65
12000	165/52	39000	218/83

Variation in position 39-15N 64-30W is 12° West.

Sunset on 29 April 1985 is 2000Z.

C. Surface Wind History/Forecast has been obtained from Fleet Numerical Oceanographic Center, Monterey, CA:

270000Z	100/15	290000Z	040/25
0600Z	070/18	0600Z	065/20
1200Z	065/10	1200Z	074/20
1800Z	080/20	1800Z	077/18
280000Z	040/30	300000Z	090/10
0600Z	035/40	0600Z	090/20
1200Z	040/40	1200Z	065/15
1800Z	045/20	1800Z	050/20

D. The C-130 search aircraft will insert a Datum Marker Buoy (DMB) upon arrival on scene. An Urgent Marine Information Broadcast (UMIB) has been issued, an AMVER SURPIC has been requested, and a HYDROLANT has been issued. No other search craft are immediately available.

E. Search Planning Decisions

1. Use 1400-NA6 for Sea Current computations.

2. A coverage factor (C) of 1.0 is desired in all initial search planning efforts.

F. Assumptions

1. The downed pilots possess and know how to use daylight and darkness detection aids and an ELT/EPIRB device (detection range unknown at this time).

2. Possible daylight detection aid and visual sweep widths:

Parachute	W = 5NM
Sun Signal Mirror	W = 5NM
Orange Smoke	W = 6NM
Green Dye Marker	W = 2NM
Reflective Paulin	W = 2NM
Orange Flight Suit	W = 0.5NM
Pen Gun Flares	W = 0.75NM

3. Leeway divergence is occurring between 0 and 35 degrees either side of downwind.

4. Each pilot is using some form of protective clothing. Water temperature is 43°F, air temperature 47°F.

200 DATUM COMPUTATION WORKSHEET

Case Title **BAILOUT–NAVY FOXTROT 24** Planner's Name **LT. J. JONES** Date **29 APR 85**

A. Aerospace Drift (D_a)
N/A if there was no glide or bailout.

1. *Time* — **291000** Z **APR 85**
2. *Latitude* — **39–15.0** N/S
3. *Longitude* — **64–30.0** W/E
4. *Total* aerospace vector from aerospace bailout or glide search planning worksheets — **319** °T, **3.9** NM

B. Position Where Surface Drift Will Start

Surface position from aerospace worksheets.
Last known position/incident position.
Previous datum (non–minimax).
dmin and dmax positions.

TARGET(S) **2 RAFTS WITH DROGUES**

	Minimum	*Maximum*
1. *Time* — If LKP/IP, use incident time; if dmin/dmax position or previous datum, use last datum time. For most first searches you only need right– hand column. However, in overdue cases, you may need minimum and maximum time of drift. If so, use column headings.	____ Z ____	**291000** Z **APR 85**
2. *Latitude*	____ N/S	**39–17.7** N/S
3. *Longitude*	____ W/E	**64–33.0** W/E

C. Datum Time

1. Commence search time/mid–search time (circle). — **291800** Z **APR 85**
2. *Drift interval* — ____ HRS — **8** HRS
   Subtract start time from datum time.

D. Sea Current (SC)

1. *Publication source* ______ 1400 NA6

2. *Set* ______ °T ___071___ °T

3. *Drift* ______ KTS ___1.1___ KTS
   Use lat/long of both positions if using min and max solution.

4. *Sea current (SC) vector* ______ °T ___071___ °T
   Enter direction from above, multiply by hours of drift to calculate distance. ______ NM ___8.8___ NM

E. Wind Current (WC)

1. *Wind current (WC) vector* ______ °T ___316___ °T
   Attach wind current worksheets. Enter total resultant wind current vector in section D. ______ NM ___2.1___ NM

F. Observed Total Water Current (TWC)
To be used instead of SC and WC.

1. *Source* (DMB, debris, oil) ______ N/A ______.
2. *Total water current (TWC)* ___N/A___ °T
   ___N/A___ KTS

   Enter direction from above, multiply by hours of drift to calculate distance. ___N/A___ °T
   ___N/A___ NM

G. Leeway (LW)

Leeway (LW) vector ___220___ °T ___290___ °T
Enter direction and distance from box on leeway worksheet. Include work sheets in case folder. ___6.7___ NM ___6.7___ NM

H. Total Surface Drift (Dmin & Dmax)
From chart, UPS plot, or calculator. ___105___ °T ___005___ °T
___2.7___ NM ___6.8___ NM

I. Datum Minimax 291800 Z APR 85 ___39-21.0___ N/S
Enter datum time from section C. Then enter lat/long from plot or calculator. ___64-31.2___ W/E
(Dmin ___39-16.9___ N/S ___64-29.7___ W/E)
(Dmax ___39-24.4___ N/S ___64-32.3___ W/E) (DISTANCE BETWEEN ___7.8___)

212 Simplified MINIMAX Search Planning Worksheet – Aerospace Bailout

Case Title BAILOUT–NAVY FOXTROT 24 Planner's Name LT. J. JONES Date 29 APR 85

A. Bailout Position
Latitude/longitude ___39-15___ N/S ___64-30___ W/E

Date/time group 291000 Z APR 85

B. Average Winds Aloft Computation

Parachute opening altitude ___10,000___ FT

Terrain height ___SL___ FT

OCEANIC PROBLEM SAMPLE

Wind data source **WSFO, JFK, NEW YORK** .
(forecaster name/agency/phone/DTG of reporting)

Go down reported wind column (1) until you reach altitude nearest where parachute opened. In forecast wind column (2), enter wind direction/velocity from this altitude to surface. In column 3, mark exact altitude of parachute opening and surface. In column 4, find the multiplier by subtracting interval in column 3. Sum column 4 figures to get the total number of 1000 foot. intervals and check by subtracting terrain height from parachute opening altitude. Enter wind direction in right column and multiply wind velocity by the multiplier and enter this in the right column. Add the vectors, using a maneuvering board or hand–held calculator. *Note:* If incident is a combination glide to bailout altitude and bailout to surface, a separate average winds–aloft must be calculated for each situation.

MANEUVERING BOARD AVERAGE WINDS ALOFT

(1) *Reported Wind Levels*	*(2)* *Forecast Wind Direction/Velocity*	*(3)* *Valid 1000–ft Interval*	*(4)* *Multiplier*	*(5)* *Contribution*
surface	**070 /15**	0.0 – 1.0	1.0	**070 / 15**
3000	**120 /30**	1.0 – 4.5	3.5	**120 / 105**
6000	**130 /25**	4.5 – 7.5	3.0	**130 / 75**
9000	**170 /48**	7.5 – **10.0** ~~10.5~~	**2.5** ~~3.0~~	**170 / 120**
12000	/	10.5 – 15.0	4.5	
18000	/	15.0 – 21.0	6.0	
24000	/	21.0 – 27.0	6.0	
30000	/	27.0 – 32.0	5.0	
34000	/	32.0 – 36.5	4.5	
39000	/	36.5 – 42.0	5.5	

Total number of 1000–ft. intervals **10**

Resultant wind vector direction/magnitude
From maneuvering board or calculator. **139** /**282.5** KTS

Average winds aloft direction/magnitude **139** /**28** KTS
Divide resultant wind direction magnitude by number of 1000 ft intervals. Direction remains same as the resultant wind vector.

C. Parachute Drift Vector

Average winds aloft direction/magnitude **139** °/ **28** KTS
Reciprocal of average winds–aloft direction (+ 180°) **319** °T
Parachute drift table value **3.9** NM

D. Surface Position
(apply parachute drift vector to bailout position) **39–17.7** N/S
64–33.0 W/E
From glide worksheet (if applicable): **N/A** NM Radius

220 WIND CURRENT WORKSHEET

Case Title **BAILOUT–NAVY FOXTROT 24** Planner's Name **LT. J. JONES** Date **29 APR 85**

A. Incident Summary

1. *Surface Position*	Latitude	**39–17.7** N/S
	Longitude	**64–33.0** W/E
2. *Surface Position DTG*		**291000 Z APR 85**
3. *Datum DTG*		**291800 Z APR 85**
4. *Hours of drift*		**8** HRS

B. Wind Current Vector Computations Required

WC #	*Reported Wind Dtg*	*Wind Valid Period*	*Number of Hours*
( )	0000Z	2100–0300	
( )	0600Z	0300–0900	
(**1**)	1200Z	**1000** ~~0900~~–1500	**5**
(**2**)	1800Z	1500–**1800** ~~2100~~	**3**
( )	0000Z	2100–0300	
( )	0600Z	0300–0900	
( )	1200Z	0900–1500	
( )	1800Z	1500–2100	

Total hours (sum number of hours column) **8**

C. Wind Current Vector Computations

Interval	*Reported Wind DTG From the National Weather Service*	*Wind (A)/(B) From NWS*	*Coefficients(C)/(D) From Coef Tables(d) Figure 4–2*	*Contribution (A+C)/(BxD)*
1	**291200Z**	**074/20**	**217/0.024**	**291/0.48**
2	**290600Z**	**065/20**	**350/0.010**	**055/0.20**
3	**290000Z**	**040/25**	**107/0.008**	**147/0.20**
4	**281800Z**	**045/20**	**223/0.006**	**268/0.12**
5	**281200Z**	**040/40**	**339/0.006**	**019/0.24**
6	**280600Z**	**035/40**	**095/0.005**	**130/0.20**
7	**280000Z**	**040/30**	**211/0.004**	**251/0.12**
8	**271800Z**	**080/20**	**327/0.004**	**047/0.08**

Add 8 vectors in column to calculate Resultant LWC (**333** °T/ **0.26** kts)
times number of hours this period (**5**)
equals WC(**1**): **333** °T/ **1.3** NM

Note: Repeat calculations as necessary.

MANEUVERING BOARD WIND CURRENT (1)

C. Wind Current Vector Computations

Interval	*Reported Wind DTG From the National Weather Service*	*Wind (A)/(B) From NWS*	*Coefficients (C)/(D) From Coef Tables(d) Figure 4-2*	*Contribution (A+C) / (BxD)*
1	**291800Z**	**077/18**	**217/0.024**	**294/0.43**
2	**291200Z**	**074/20**	**350/0.010**	**064/0.20**
3	**290600Z**	**065/20**	**107/0.008**	**172/0.16**
4	**290000Z**	**040/25**	**223/0.006**	**263/0.15**
5	**281800Z**	**045/20**	**339/0.006**	**024/0.12**
6	**281200Z**	**040/40**	**095/0.005**	**135/0.20**
7	**280600Z**	**035/40**	**211/0.004**	**246/0.16**
8	**280000Z**	**040/30**	**327/0.004**	**007/0.12**

Add 8 vectors in column to calculate Resultant LWC (**291** °T/ **0.30** kts)
times number of hours this period (**3**)
equals WC(**2**): **291** °T/ **0.9** NM

Note: Repeat calculations as necessary.

D. Total Resultant Wind Current Vector
(WC) = WC(1) + WC(2) + WC(3) + ...

[WC(1): **333 / 1.3**, WC(2): **291 / 0.9**, WC( ): ____ / ____]

Total resultant wind current vector (WC): **316** °T/ **2.1** NM

MANEUVERING BOARD WIND CURRENT (2)

MANEUVERING BOARD TOTAL WIND CURRENT (WC)

230 LEEWAY WORKSHEET

Case Title **BAILOUT–NAVY FOXTROT 24** Planner's Name **LT. J. JONES** Date **29 APR 85**

A. Incident Summary

1. *Surface Position* — Latitude **39–17.7** N/S; Longitude **64–33.0** W/E
2. *Surface Position DTG* — **291000 Z APR 85**
3. *Datum DTG* — **291800 Z APR 85**
4. *Hours of Drift* — **8** HRS

B. Search Object(s) **2 RAFTS "WITH" DROGUES**

C. Average Surface Winds (ASW)

DTG of Reported Winds	*Wind Period*	*Number of Hours*	*Wind Direction*	*Wind Speed*	*Contribution*
0000Z	2100–0300				
0600Z	0300–0900				
1200Z	**1000** ~~0900~~–1500	**5**	**074**	**20KTS**	**074/100**
1800Z	1500–**1800** ~~2100~~	**3**	**077**	**18KTS**	**077/54**

0000Z	2100–0300	______	______	____	______
0600Z	0300–0900	______	______	____	______
1200Z	0900–1500	______	______	____	______
1800Z	1500–2100	______	______	____	______
0000Z	2100–0300	______	______	____	______
0600Z	0300–0900	______	______	____	______
1200Z	0900–1500	______	______	____	______
1800Z	1500–2100	______	______	____	______
0000Z	2100–0300	______	______	____	______

Total hours **8** Total wind vector **075/154**

Divide wind vector by total hours to get:
Average Surface Wind (ASW) **075** °T **19.2** KTS

MANEUVERING BOARD AVERAGE SURFACE WINDS (ASW)

Case Title **BAILOUT–NAVY FOXTROT 24** Planner's Name **LT. J. JONES** Date **29 APR 85**

Select one situation

Drift Rate Uncertainty. Leeway with minimum and maximum drift rates, e.g., drogue/no drogue or search object uncertainty. Used when there are two search objects.

	Minimum	*Maximum*
1. *Average Surface Winds (ASW)*	______ °T ______ KTS	
2. *Set* (°T = reciprocal of ASW)	______ °T	
3. *Formula* (if used)	______________	
4. *Drift* (Leeway speed graph or exponential formula)	______ KTS	______ KTS
5. *Hours of Drift*		______ HRS
6. *Leeway (LW) Vectors*	______ °T ______ NM	______ °T ______ NM

Time Uncertainty. Used when incident time is unknown.

1. *Hours of Drift*	______ HRS	______ HRS
2. *Average Surface Winds (ASW)* (two required)	______ °T ______ KTS	______ °T ______ KTS
3. *Set* (°T = Reciprocal of ASW) (+180°)	______ °T	______ °T
4. *Formula* (if used)	______________	
5. *Drift* (Leeway speed graph or exponential formula)	______ KTS	______ KTS
6. *Leeway (LW) Vectors* (downwind)	______ °T ______ NM	______ °T ______ NM

Directional Uncertainty (Divergence–time and search object known). Used when there is only one object and one time.

1. *Average Surface Winds* (ASW) — **075** °T
2. *Set* (°T = reciprocal of ASW) — **255** °T; **19.2** KTS
3. *Formula* (if used) — **0.05U – 0.12**
4. *Divergence* — **+/– 35°**
5. *Drift* (Leeway speed graph or exponential formula) — **0.84** KTS
6. *Hours of Drift* — **8** HRS
7. *Leeway (LW) Vectors* — **220** °T, **6.7** NM; **290** °T, **6.7** NM

300 SEARCH AREA DETERMINATION WORKSHEET

A. Individual drift errors (d_e)

1. *Aerospace drift error* (d_{ea})

   a. Aerospace drift distance (D_a) — **3.9** NM
   b. Drift error confidence factor (CF) — 0.3 .
   c. Aerospace drift error (d_{ea}) (drift distance x CF) — **1.17** NM

2. *Surface drift error*

   a. Minimax

	Minimum	*Maximum*
(1) Sum of *all previous* drift errors (d_e min and d_e max)	N/A NM	
(2) Surface drift distance (d) (dmin and dmax (distance))	**2.7** NM	**6.8** NM
(3) Drift error confidence factor (CF)	0.3 .	
(4) Drift error min and max (d_e min and d_e max)(dmin x CF)(dmax x CF)	**0.81** NM	**2.04** NM
(5) Distance between *latest* dmin and dmax positions	**7.8** NM	
(6) Surface drift error minimax		

$$d_e \text{ minimax} = \frac{(d_e \text{ min} + d_e \text{ max} + \text{distance} + \text{sum})}{2} = \underline{5.325} \text{ NM}$$

   b. Non–minimax
   (1) Surface drift distance (d) — ______ NM
   (2) Drift error confidence factor (CF) — 0.3 .
   (3) Individual drift error (d_e) — ______ NM (d x CF)

B. Total drift error (D_e) — ______ NM

1. Minimax ($D_e = d_{ea} + d_e$ minimax) — **6.495** NM
2. Non–minimax ($D_e = d_{e1} + d_{e2} + d_{e3}$ + etc.) — ______ NM

C. Initial position error (X)

1. Navigational fix error	(FIX_e)	10 NM
2. Navigational DR error	(DR_e)	N/A NM
3. Initial position error ($FIX_e + DR_e$)	(X)	10 NM

D. SRU error (Y)

1. Navigational fix error	(FIX_e)	5 NM
2. Navigational DR error	(DR_e)	N/A NM
3. Initial position error ($FIX_e + DR_e$)	(X)	5 NM

E. Total probable error $\sqrt{(D_e^2 + x^2 + y^2)}$	(E)	12.93 NM
F. Safety factor (circle) (f_s)		1.1 1.6 2.0 2.3 2.5

G. Search radius (R)

1. Search radius ($E \times f_s$)	(R)	14.22 NM
2. Search radius (round up to next highest whole mile)	(R_o)	15 NM

H. Desired search area (A)

1. Square ($A = 4 \times R_o^2$)	900 SQNM
2. Circle ($A = 3.14 \times R_o^2$)	______ SQNM
3. Rectangle ($A = L \times W$) L = length of side W = width of side	______ SQNM

DATUM SEARCH AREA

310 EFFORT ALLOCATION WORKSHEEET

A. Effort and search subarea computations

1. Search subarea designation		A-1	A-2	
2. Search unit assigned		C-130	P-3	
3. Search craft speed (V)		150	170	
4. On scene endurance		5	5	
5. Daylight hours remaining		2	1.5	
6. Search endurance (T) (T=85% of lesser of #4 or #5 above)		1.7	1.27	
7. Trackline miles (VxT)		255	215.9	
8. Search altitude		500	1000	
9. Uncorrected sweep width (W_u)		1.4	1.4	
10. Weather correction (f_w)		0.25	0.25	
11. Fatigue correction (f_f)		1	1	
12. Speed correction (f_v)		1.1	1.03	
13. Corrected sweep width (W)		0.38	0.36	

14. Effort ($Z_n = V \times T \times W$)		96.9	77.7	
15. Total Effort ($Z_t = Z_1 + Z_2 + Z_3 + Z_4$)		174.6		
16. Optimum search area ($A = 4R_o^2$)		900		
Note: If total effort (Z_t) is greater than the optimum search area (A), go to section B, line 1. Otherwise, continue with line 17.				
17. Midpoint compromise search area (A_{mc}) (optimum A + total effort Z_t) / 2		537.3		
18. Midpoint compromise coverage factor (C_{mc}) (total effort Z_t / A_{mc})		0.32		
19. Midpoint compromise track spacing ($S_{mc} = W/C_{mc}$)		1.19	1.13	
20. Track spacing (S) assignable (within usable limits of search craft navigational capability)		1.1	1.1	
21. Search subarea coverage factor (C = W/S assignable)		0.35	0.33	
22. Individual search subarea POD		34	32	
23. Adjusted search area ($A = V \times S \times T$)		280.5	237.5	
24. Total adjusted search area (A_t) ($A_t = A_1 + A_2 + A_3 + A_4$)	518	$\sqrt{A_t}$ =	22.8 .	
25. Search coverage factor ($C = Z_t/A_t$)		0.34		
26. Search POD		33		
27. Estimated search subarea length (l'). Use $\sqrt{A_t}$ or following guidelines: fixed wing = V/2, helicopter = V/3		22.8	22.8	
28. Estimated width of search subarea (w' = A/l')		12.3	10.4	
29. Number of track spacings (n' = w'/S)		11.2	9.5	
30. Round off to whole number of track spacings (n)		11	10	
31. Actual subarea width (w = n x S)		12.1	11.0	
32. Actual subarea length (l = A/w)		23.2	21.6	

B. Excess resource planning

1. Search subarea coverage factor (C = 1.0 is recommended)	______	______	______	______
2. Track spacing (S = W/C)	______	______	______	______

3. Go to section A, line 20, and complete through line 32 of the worksheet.

320 DRIFT–COMPENSATED SEARCH PATTERNS WORKSHEET

A. Search planning summary **C–130**

1. Target drift direction/distance		029 °T 3.6 NM
2. Target drift rate / hour	(v)	0.45 KTS
3. Search area length x width	(l x w)	23.2 x 12.1 NM
4. SRU search speed	(V)	150 KTS
5. SRU track spacing	(S)	1.1 NM
6. Time required to complete area	(T)	1.7 HRS

B. To determine whether compensation is recommended, complete the following formula:

(vl)/(VS) = (0.45 x 23.2)/(150 x 1.1) = (10.44)/(165) = 0.063

1. If value is less then 0.1, drift compensation is not recommended. Stop here. No further computations are necessary.

2. If value is greater then 0.1, drift compensation is recommended.

   a. Orient the search area so that the major axis is parallel to the target drift direction.
   b. Complete the following formula to see if further drift compensation is recommended:

   (vw)/(VS) = (___ x ___)/(___ x ___) = (___/(___) =

   (1) If value is less then 0.1, further drift compensation is not recommended. Stop here. No further computations are necessary.
   (2) If value is greater then 0.1, further drift compensation is recommended. Go on to section C.

C. Options for further direct compensation (in descending order of preference)

1. Create a parallelogram along the major axis as follows:

   a. Select a CSP for a PS search pattern.
   b. Advance the down-creep side of the search area by the following:

   distance = (T X v) = (___) x (___) =

   c. Connect advanced sides to unadvanced sides. Determine new latitudes and longitudes of corners.

320 DRIFT COMPENSATED SEARH PATTERNS WORKSHEET

A. Search planning summary P-3

1. Target drift direction/distance		029 °T 3.6 NM
2. Target drift rate / hour	(v)	0.45 KTS
3. Search area length x width	(l x w)	21.6 x 11.0 NM
4. SRU search speed	(V)	170 KTS
5. SRU track spacing	(S)	1.1 NM
6. Time required to complete area	(T)	1.27 HRS

B. To determine whether drift compensation is recommended, complete the following formula:

(vl)/(VS) = (0.45 x 21.6)/(170 x 1.1) = (9.72)/(187) = 0.052

1. If value is less then 0.1, drift compensation is not recommended. Stop here. No further computations are necessary.

2. If value is greater then 0.1, drift compensation is recommended.

   a. Orient the search area so that the major axis is parallel to the target drift direction.
   b. Complete the following formula to see if further drift compensation is recommended:

   (vw)/(VS) = (___ x ___)/(___ x ___) = (___)/(___) =

(1) If value is less then 0.1, further drift compensation is not recommended. Stop here. No further computations are necessary.
(2) If value is greater then 0.1, further drift compensation is recommended. Go on to section C.

C. Options for further direct compensation (in descending order of preference)

1. Create a parallelogram along the major axis as follows:

a. Select a CSP for a PS search pattern.
b. Advance the down–creep side of the search area by the following:

distance = (T X v) = (__) x (__) =

c. Connect advanced sides to unadvanced sides. Determine new latitudes and longitudes of corners.

APPENDIX C. COASTAL PROBLEM SAMPLE

100 The following Coastal SAR Planning Example is furnished as a guide to assist inexperienced search and rescue planners in completing a manual solution using the forms contained in this volume.

A. Scenario At 1300Q on 5 May 1985, a white 21-foot open boat with an outboard motor and one POB is reported by a passing commercial vessel to be adrift in position 36-54N 75-55W. This reported position puts the drifting boat within the influence of the tidal substation at Cape Henry Light, 2.2 miles southeast of reference #4621. The only resource available for the first search effort is a 44' MLB, which will not be on scene until 1600Q.

B. Weather Conditions

1. Sunset will occur at 2030Q.

2. Seas 3 FT.

3. Visibility 10 NM.

4. The NWS observed/forecast wind information for 5 May:

1300Q	280/18 KTS	1600Q	210/20 KTS
1400Q	250/20 KTS	1800Q	200/10 KTS

C. Assumptions. The drifting boat will not use a drogue, nor will it be able to anchor.

240 COASTAL DATUM COMPUTATION

241 Coastal Search Planning Worksheet

The simplified Coastal Search Planning worksheet below may be used when it is anticipated that the search may last only one day, the incident is no more than 25 miles offshore, and the search will cover only a relatively small area.

Case Title **21' OUTBOARD ADRIFT** Planner's Name **BITLER, QMC** Date **5 MAY 85**

A. Datum - number **1**

1. *Last known position (LKP)* **36-54** N/S **75-55** W/E PLOT

Enter latitude and longitude of the last reported position or incident position; this will be the first item plotted on your chart.

a. LKP time **1300**

b. Datum time **1600**

c. Commence search time **1600**

d. Total hours of drift **3** HRS

Subtract LKP time from Datum time, giving the answer in hours and tenths of hours.

2. *Total water current (TWC)* - attach other worksheets as necessary.

a. Method used to determine TWC **ATLANTIC TIDAL CURRENT TABLE**
(local knowledge, tidal currents, etc.)

b. Direction and velocity of TWC __165 / 1.0__ KTS

c. TWC vector __165 / 3.0__ NM PLOT

Direction is the same direction as contained on line 2b. Multiply hours of drift (line 1c) by TWC (line 2b): D = V x T. This is the second item plotted.

3. *Average surface winds (ASW)*

Perform ASW calculations in this section of the worksheet and enter direction wind is from and velocity of wind in spaces provided. Contribution is direction and hours x velocity, e.g. 254/24.

Time of Reported Winds	Wind Period	Number of Hours	Wind Direction	Wind Velocity	Contribution
1300	1300–1330	0.5	280	18	280 / 9
1400	1330–1500	1.5	250	20	250 / 30
1600	1500–1600	1	210	20	210 / 20
					/
					/
					/

Total hours __3__ Total vector contribution __241__ / __54__

$$\frac{\text{Total vector contribution}}{\text{Total hours}} = \text{Average surface winds} = \underline{241}\ ^\circ\text{T}\ \ \underline{18}\ \text{KTS}$$

4. *Leeway (LW)*

a. Leeway direction = Reciprocal of ASW direction __061__ °T

Leeway speed = __0.07__ x __18__ (ASW (kts)) +/− __0.04__ = __1.3__ KTS

Add or subtract 180° to/from Average Surface Wind direction (line 3). Fill in the next line with the first value from Leeway Speed Formula/Leeway Speed Graph. Next enter the velocity of ASW in line 3. This equals the U in the formula. Finally, enter any additional factors from the formula. Perform functions as indicated and the result is Leeway Speed.

b. LW vector (LW) __061 / 3.9__ NM PLOT

Same direction as line 4a. To find distance, multiply hours of drift (line 1c) by Leeway Speed (line 4a). This is the third entry to be plotted.

5. *Total drift vector (D)* __103 / 4.3__ NM

Vectorally add lines 2c and 4b. Enter direction and distance.

6. *Datum position* __36–53__ N/S __75–49.8__ W/E

Enter the determined position in latitude and longitude from the chart.

B. Search Area/Decisions

1. *Optimum Search Area:* A = L x W __144__ SQNM

Once a geographic search area has been decided upon, multiply length (L) times width (W) to determine the area in square nautical miles. If the area chosen is circular, as when using a VS pattern, the square nautical miles of the area may be determined by using the formula ($3.14 \times R^2$), where R = the length of the search radius chosen, from Datum.

2. *Search Area Designation:* __A–1__ No. SRUs (N) __1__

Alpha–numeric code for *this* worksheet's search area. Also, the number of search units intended for *this* worksheet's search area.

3. Search Pattern __PS__ Track spacing (S) __3__ NM SRU Speed (V) __8__ KTS

Where indicated, fill in the letter code for the search pattern chosen, track spacing in nautical miles, and the SRU's search speed in knots. If more than one SRU is to be used for this worksheet's search area, average the search speeds.

4. Commence Search Time __1600Q__ Hours Available On Scene (T) __4.5__

5. *Attainable Search Area:*

a. Square or Rectangular Areas: A = VNST __108__ SQ NM

To determine if the size of the area decided upon may actually be executed within the operational constraints of the SRUs, attainable search area is determined using the formula (A = VNST), where A = attainable area, V = velocity (SRU speed), N = number of SRUs, S = track spacing (in nautical miles), and T = time available on scene (hours and tenths).

b. Sector Searches of Circular Areas:

Determine total trackline miles by multiplying the length of the search radius by 9 (R x 9). Divide the resultant distance by SRU speed (V) to obtain hours required to search. Compare hours required to hours available (T). If hours required exceeds hours available, the search area is not attainable and must be reduced.

6. *Search Area Description:* **CORNERS: 37–00.2N 75–55.0W TO 36–57.5N 75–40.9W TO 36–45.0N 75–44.2W TO 36–48.5N 75–58.8W TO ORIGIN**

CSP __NW CORNER__

Describe the search area using one of the standard methods found in Volume I, Chapter 8. Indicate the Commence Search Point (CSP).

C. Area Coverage

1. Search Objective __21' OUTBOARD__ Visibility __10__ NM

2. Sea State __3__ FT Wind Velocity __10__ KTS

3. SRU TYPE	SRU SPEED	SRU ALTITUDE
Fixed Wing ________	________KTS	________FT
Helicopter ________	________KTS	________FT
Vessel ________	N/A	N/A
Boat 44' MLB	N/A	N/A

4. Uncorrected Sweep Width (W_u) 4.3 NM

Note: For PIW with PFD, and when aircraft search altitude is 500' or less, (W_u x 5) = Total (W_u) value.

5. Weather Correction Factor (f_w) 0.5
6. Fatigue Correction Factor (f_f) N/A
7. Aircraft Speed Correction Factor (f_v) N/A
8. Corrected Sweep Width (W) 2.15 NM

$(W) = (W_u) \times (f_w) \times (f_f) \times (f_v)$

9. Coverage Factor (C) 0.72

$C = \frac{W}{S}$ $C = \frac{W}{R}$ (circular areas)

Fill in appropriate meteorological information, assigned search altitude, and speed. Obtain sweep width and correction factor information from tables, Volume II, Chapter 4. Compute coverage factor (C) for this search by dividing corrected sweep width (W) by track spacing (S), or search radius (R) for circular areas.

10. POD for *this* search: 62 %

Obtain probability of detection (POD) using the POD graph, Volume II, Chapter 4. Use the single search curve and coverage factor (C).

242 Tidal Current Worksheet

Information for completion of this form comes from the current edition of the National Oceanographic and Atmospheric Administration (NOAA) Tidal Current Tables for the appropriate area.

Case Title 21' OUTBOARD ADRIFT Planner's Name QMC BITLER Date 5 MAY 85

A. Reference Station CHESAPEAKE BAY ENTRANCE Date 5 MAY 85

Substation CAPE HENRY LT, 2.2 MI SE OF Reference Number 4621

Locate the substation and substation reference in NOAA Table 2 which is nearest to the incident point. Table 2 will indicate the proper reference station for the particular substation.

B. Time Differences

Before Flood	HR -1	MIN 54	Before Ebb	HR -0	MIN 39
Maximum Flood	HR -1	MIN 18	Maximum Ebb	HR -1	MIN 41

This information comes from Table 2 for the particular substation.

C. Velocity Information

Flood: Speed Ratio **1.0** Average Direction **346** °T

Ebb: Speed Ratio **0.6** Average Direction **165** °T

This information comes from Table 2 for the particular substation.

D. Reference Station **Substation**

1. *Time*	*speed*	*time*	*speed(e/f)?*	2. *Time*	*speed*	*time*	*speed(e/f)?*
___	slack	**0411**	**1.8E**	___	slack	**0230**	**1.08E**
0731	slack	**0957**	**1.1F**	**0537**	slack	**0839**	**1.1F**
1232	slack	**1616**	**2.0E**	**1153**	slack	**1435**	**1.2E**
1934	slack	**2230**	**1.7F**	**1740**	slack	**2112**	**1.7F**
___	slack	___	___	___	slack	___	___

Reference station information: The dates and times needed are listed in NOAA Table 1 under the particular reference station. Ensure that you have included an event (slack or maximum current) that will occur before the incident time and an event that will occur after the datum time. Remember to take into account the time difference from Section B when choosing the starting and ending times from the table.

Substation information: Apply the corrections from sections B and C of the worksheet to the reference station information in Section D1 above. Once this is done, it is suggested that the information in D1 be crossed out, to avoid its inadvertent use in later sections of the worksheet.

E. Tidal Current Chart

Incident Time **1300 DST** Datum Time **1600 DST**
(correct for Daylight Savings Time)

The NOAA Tidal Current Table uses standard time. When using the Tidal Current Table during daylight savings time, standard time should be converted to daylight savings time. Mark the times and velocities from section D2 on the tidal current chart. Mark and note the datum and incident times on the chart. Compute the intervals between slack and maximum current, and the intervals between maximum current and slack. Mark these times in the interval blanks.

F. Computing Average Factor of Cycle

1. Interval time from Slack water to Incident: **1** HRS **07** MIN

   Interval time from Slack water to Datum: **1** HRS **40** MIN

   If the incident time or datum time falls in the cycle, note the time difference between the desired time (incident or datum) and the slack in that half of the cycle.

2. Factors for the flood/ebb cycle.

   0.6 (INCIDENT) ________

   0.7 ________

0.8	
0.9	
1.0	
1.0 (MAX)	
1.0	
0.9	
0.9	
0.8 (DATUM)	

Now go to NOAA Table 3. From the appropriate table (A or B), and using the first interval (the one that includes the incident time) from your current chart, find the column in the table closest to the amount of time in that interval. Do not interpolate on this table. If you are halfway between the columns, go to the next higher column.

Once in the correct column for the interval, using the time interval from section F1, find the closest value in the column at the side of the table "Interval Between Slack and Desired Time."

The intersection of these two values is the first current speed factor for section F2. Then, if your incident time is between slack and maximum current, write the remaining factors going *down* the column you are working with. If the incident time is between maximum current and slack, write the remaining factors going *up* the column.

To compute the values for the next interval: if the next interval represents the same direction as for the first interval, continue to write the factors on the same worksheet. Remember to use the "time interval from *slack* to desired time" to find the correct value along the side of the table. Also, read the factors below the cutoff point if you are concerned with the time from maximum current to datum, and the factors above the cutoff if you are concerned with the time between datum and slack water.

Each column contains a maximum current factor. When going through maximum current, remove one of these factors.

Compute factors until you reach the point where you change direction. If you change direction, stop computing factors and continue further on the worksheet.

3. Total value of factors in the cycle — **8.6**

divided by total number of factors in cycle — **10**

equals average factor for cycle — **0.86**

Add up all the factors and calculate a total value of factors in the cycle. The total value divided by the number of factors in the cycle equals the average factor for the cycle.

4. Maximum current speed for the cycle — **1.2** KTS
multiplied by the average factor equals the average speed for the cycle — **1.0** KTS

The maximum current speed is listed in section D2. Find the time of maximum current for your cycle, and the speed will be listed at the time. Speed multiplied by the average factor will equal the average speed for the cycle.

G. Computing Tidal Current Vector for the Cycle

Time duration of drift through the cycle	**3** HRS
multiplied by the average current speed	**1.0** KTS
equals magnitude of current vector for the cycle	**3.0** NM

Calculate the time of drift through the cycle; list only the hours and tenths of hours for the cycle you are working with. This is *not* total hours of drift from incident to datum, unless it is all in the same direction.

H. Calculating the Total Tidal Current Vector

1st current vector **165** °T/ **3** NM + 2nd current vector ____ °T/ ____ NM

equals total reversing tidal current vector **165** °T/ **3** NM .

Table C-1. Cape Henry Light Current Differences

CURRENT DIFFERENCES AND OTHER CONSTANTS, 1985

NO.	PLACE	METER DEPTH	POSITION Lat.	POSITION Long.	TIME DIFFERENCES Min. before Flood	TIME DIFFERENCES Flood	TIME DIFFERENCES Min. before Ebb	TIME DIFFERENCES Ebb	SPEED RATIOS Flood	SPEED RATIOS Ebb	AVERAGE SPEEDS AND DIRECTIONS Minimum before Flood	AVERAGE SPEEDS AND DIRECTIONS Maximum Flood	AVERAGE SPEEDS AND DIRECTIONS Minimum before Ebb	AVERAGE SPEEDS AND DIRECTIONS Maximum Ebb
		ft	° ' N	° ' W	h. m.	h. m.	h. m.	h. m.			knots deg.	knots deg.	knots deg.	knots deg.
	DELAWARE BAY and RIVER Time meridian, 75°W				on DELAWARE BAY ENTRANCE, p.58									
4481	Penns Neck, 0.3 mile west of...........		39 37.07	75 34.58	+3 22	+3 07	+3 08	+3 37	1.0	0.9	0.0 - -	1.8 339	0.0 - -	1.7 152
4486	New Castle, channel abreast of..........		39 39.1	75 33.2	+4 04	+3 21	+3 34	+4 01	1.1	1.3	0.0 - -	1.9 051	0.0 - -	2.4 230
4491	Kelly Point, 0.2 mile northwest of......		39 38.9	75 32.8	+3 43	+3 55	+3 24	+3 31	0.9	0.8	0.0 - -	1.6 049	0.0 - -	1.5 230
4496	Deepwater Point, channel northwest of...		39 42.1	75 30.6	+3 44	+3 54	+3 45	+3 55	1.7	1.4	0.0 - -	3.0 029	0.0 - -	2.6 215
4501	Christina River, 1 mile above entrance..		39 43	75 32	+3 16	+3 01	+2 58	+2 44	0.4	0.5	0.0 - -	0.7 300	0.0 - -	0.9 050
4506	Cherry Island Flats, channel east of....		39 44.3	75 29.1	+4 09	+4 08	+4 02	+3 57	0.9	0.7	0.0 - -	1.6 027	0.0 - -	1.4 207
4511	Oldsmans Point..........................		39 45.9	75 28.4	+4 28	+3 42	+4 03	+4 40	0.9	0.8	0.0 - -	1.6 027	0.0 - -	1.5 210
4516	Marcus Hook.............................		39 48.2	75 24.6	+4 58	+4 19	+4 02	+4 51	0.9	0.8	0.0 - -	1.7 061	0.0 - -	1.6 232
4521	Eddystone...............................		39 50.8	75 20.5	+5 25	+4 41	+4 31	+4 55	0.9	1.2	0.0 - -	1.7 058	0.0 - -	2.2 242
4526	Essington Harbor........................		39 51.5	75 18.3	+4 09	+3 54	+4 04	+3 56	0.8	0.6	0.0 - -	1.4 096	0.0 - -	1.2 274
4531	Crab Point, 0.5 mile east of............		39 50.8	75 17.0	+4 48	+4 44	+4 44	+4 58	1.2	1.0	0.0 - -	2.1 094	0.0 - -	1.9 268
4536	Hog Island, channel southeast of........		39 52.0	75 12.9	+4 53	+4 53	+4 42	+4 52	1.1	1.2	0.0 - -	1.9 054	0.0 - -	2.2 231
4541	Schuylkill River entrance <1>..........		39 53.2	75 11.7	- - -	+3 20	- - -	+4 08	0.3	0.2	0.0 - -	0.5 356	0.0 - -	0.4 178
4546	Gloucester..............................		39 53.4	75 08.1	+5 13	+5 02	+4 53	+5 00	1.2	1.1	0.0 - -	2.2 020	0.0 - -	2.0 210
4551	Greenwich Point, northeast of...........		39 54.5	75 07.6	+5 18	+4 53	+4 54	+5 01	0.9	0.8	0.0 - -	1.6 002	0.0 - -	1.6 188
4556	Camden Marine Terminals, E of Chan. <29>		39 56.4	75 08.2	+5 52	+5 13	+5 16	+5 07	0.7	0.6	0.0 - -	1.3 005	0.0 - -	1.1 174
4561	Fisher Point............................		39 58.9	75 04.2	+6 07	+5 46	+5 23	+5 06	0.8	0.9	0.0 - -	1.4 041	0.0 - -	1.7 223
4566	Torresdale, west of channel.............		40 02.4	74 59.4	+6 54	+5 56	+4 59	+5 46	0.5	0.8	0.0 - -	0.9 044	0.0 - -	1.6 223
4571	Rancocas Creek, off Delanco.............		40 02.6	74 57.6	+6 36	+6 25	+5 51	+6 08	0.6	0.5	0.0 - -	1.0 090	0.0 - -	0.9 272
4576	Bristol, south of.......................	8	40 05.3	74 51.6	+6 55	+5 31	+4 57	+6 10	0.7	0.8	0.0 - -	1.3 024	0.0 - -	1.6 200
4581	Burlington Island, channel east of......		40 05.7	74 50.2	+7 32	+5 46	+4 16	+6 46	0.5	0.9	0.0 - -	0.9 018	0.0 - -	1.8 204
4586	Whitehill <30>..........................		40 08.2	74 44.2	- - -	- - -	- - -	+7 07	- -	0.7	0.0 - -	- - - -	0.0 - -	1.4 233
	DEL., MD. and VA. COAST													
4591	Indian River Inlet (bridge).............		38 37	75 04	- - -	+0 05	- - -	+0 10	1.0	1.1	0.0 - -	1.8 265	0.0 - -	2.1 085
4596	Fenwick Shoal Lighted Whistle Buoy 2....		38 25	74 46	See table 5.									
4601	Winter-Quarter Shoal Buoy 6WQS <31>.....		37 55	74 56	See table 5.									
					on CHESAPEAKE BAY ENTRANCE, p.64									
4606	Cape Charles, 70 miles east of..........		37 05	74 51	See table 5.									
4611	Smith Island Shoal, southeast of........	7	37 05.3	75 43.5	-2 14	-2 12	-2 04	-2 05	0.3	0.3	0.0 - -	0.3 298	0.0 - -	0.4 068
4616	Chesapeake Light, 4.4 miles northeast of		36 59	75 42	See table 5.									
4621	Cape Henry Light, 2.2 miles southeast of		36 53.9	75 58.7	-1 54	-1 18	-0 39	-1 41	1.0	0.6	0.0 - -	1.0 346	0.0 - -	0.9 165
	CHESAPEAKE BAY													
4626	Cape Henry Light, 1 mile north of.......		36 56.4	76 00.5	+0 04	-0 25	-0 08	-0 25	1.1	1.3	0.0 - -	1.1 280	0.0 - -	2.0 090
4631	Cape Henry Light, 1.8 miles north of....		36 57.4	76 00.1	-0 23	-0 11	+0 10	-0 17	1.2	1.0	0.0 - -	1.2 292	0.0 - -	1.5 099
4634	Cape Henry Light, 3.4 n.mi. NNE of......	15d	36 58.80	76 00.00	-0 28	-0 55	-0 20	-0 13	0.9	0.9	0.1 218	0.9 301	0.0 - -	1.3 128
4636	CHESAPEAKE BAY ENTRANCE.................	7	36 58.8	76 00.4	Daily predictions						0.0 - -	1.0 306	0.0 - -	1.5 126
4641	Cape Henry Light, 4.6 miles north of....		37 00.1	75 59.3	-1 05	-0 46	-0 10	-0 54	1.3	0.9	0.0 - -	1.3 294	0.0 - -	1.3 104
4646	Cape Charles Light, 9.5 mi. WSW of......	6	37 03.7	76 05.4	-0 12	+0 08	+0 32	-0 05	1.5	0.9	0.0 - -	1.5 319	0.0 - -	1.4 126
4651	Cape Henry Light, 8.3 mi. northwest of..		37 02.2	76 06.6	-0 22	-0 12	+0 16	-0 05	1.0	0.7	0.0 - -	1.0 329	0.0 - -	1.1 133
4656	Lynnhaven Roads.........................		36 55.1	76 04.9	-0 58	-0 37	-0 14	-0 41	0.8	0.6	0.0 - -	0.8 280	0.0 - -	0.9 070
4661	Lynnhaven Inlet bridge..................		36 54.4	76 05.6	-1 56	-2 05	-2 12	-3 01	0.6	0.9	0.0 - -	0.6 180	0.0 - -	1.4 000

Endnotes can be found at the end of Table 2.

Table C-2. Chesapeake Bay Entrance

CHESAPEAKE BAY ENTRANCE, VIRGINIA, 1985

F-Flood, Dir. 305° True E-Ebb, Dir. 125° True

MAY

Day	Slack Water Time h.m.	Maximum Current Time h.m.	Vel. knots
1 W	0300 0837 1529 2056	0540 1212 1806	1.1F 1.5E 1.1F
2 Th	0356 0924 1614 2157	0035 0635 1300 1859	1.7E 1.2F 1.7E 1.3F
3 F	0448 1008 1700 2255	0128 0723 1344 1951	1.8E 1.2F 1.9E 1.5F
4 Sa	0540 1051 1746 2350	0219 0811 1430 2041	1.8E 1.2F 2.0E 1.6F
5 Su	0631 1132 1834	0311 0857 1516 2130	1.8E 1.1F 2.0E 1.7F
6 M	0044 0723 1214 1923	0402 0944 1603 2219	1.7E 1.0F 1.9E 1.6F
7 Tu	0137 0817 1257 2015	0456 1033 1651 2313	1.6E 0.8F 1.8E 1.5F
8 W	0232 0915 1342 2111	0551 1125 1747	1.4E 0.7F 1.7E
9 Th	0329 1017 1432 2212	0007 0648 1219 1846	1.3F 1.3E 0.5F 1.5E
10 F	0428 1125 1530 2318	0105 0751 1321 1950	1.1F 1.2E 0.4F 1.3E
11 Sa	0528 1233 1641	0211 0857 1432 2058	0.9F 1.1E 0.4F 1.2E
12 Su	0027 0626 1334 1800	0315 0956 1542 2207	0.8F 1.1E 0.4F 1.2E
13 M	0134 0719 1426 1915	0420 1051 1644 2305	0.7F 1.1E 0.5F 1.2E
14 Tu	0235 0805 1508 2018	0513 1140 1739	0.7F 1.2E 0.6F
15 W	0327 0844 1546 2110	0002 0558 1222 1822	1.2E 0.7F 1.3E 0.7F

Day	Slack Water Time h.m.	Maximum Current Time h.m.	Vel. knots
16 Th	0413 0918 1621 2156	0047 0640 1300 1903	1.3E 0.7F 1.3E 0.8F
17 F	0455 0948 1654 2237	0128 0716 1336 1936	1.3E 0.6F 1.4E 0.9F
18 Sa	0534 1016 1726 2315	0207 0748 1407 2011	1.3E 0.6F 1.4E 1.0F
19 Su	0611 1042 1759 2353	0246 0820 1439 2046	1.3E 0.6F 1.4E 1.1F
20 M	0648 1108 1833	0323 0855 1510 2122	1.3E 0.6F 1.4E 1.1F
21 Tu	0030 0727 1135 1910	0359 0928 1543 2200	1.2E 0.5F 1.4E 1.1F
22 W	0109 0806 1207 1949	0437 1005 1618 2241	1.2E 0.5F 1.4E 1.1F
23 Th	0151 0850 1244 2034	0518 1046 1657 2324	1.1E 0.5F 1.4E 1.1F
24 F	0235 0937 1329 2125	0603 1131 1746	1.1E 0.4F 1.3E
25 Sa	0324 1029 1425 2222	0015 0658 1224 1845	1.0F 1.0E 0.4F 1.3E
26 Su	0417 1125 1534 2324	0110 0753 1327 1951	1.0F 1.1E 0.5F 1.3E
27 M	0513 1221 1654	0210 0855 1433 2102	0.9F 1.1E 0.6F 1.3E
28 Tu	0029 0608 1316 1817	0309 0951 1541 2211	0.9F 1.3E 0.7F 1.4E
29 W	0134 0702 1408 1935	0410 1047 1645 2317	0.9F 1.4E 1.0F 1.5E
30 Th	0236 0754 1459 2045	0509 1139 1743	1.0F 1.6E 1.2F
31 F	0335 0843 1549 2149	0015 0605 1230 1841	1.6E 1.0F 1.8E 1.4F

JUNE

Day	Slack Water Time h.m.	Maximum Current Time h.m.	Vel. knots
1 Sa	0431 0931 1638 2247	0112 0657 1319 1934	1.6E 1.0F 1.9E 1.5F
2 Su	0525 1017 1727 2343	0205 0748 1408 2027	1.7E 1.0F 1.9E 1.6F
3 M	0618 1103 1817	025° 0836 1455 2117	1.6E 0.9F 1.9E 1.6F
4 Tu	0036 0711 1148 1908	0350 0927 1546 2208	1.6E 0.8F 1.9E 1.5F
5 W	0128 0804 1234 2000	0443 1016 1637 2259	1.5E 0.7F 1.8E 1.4F
6 Th	0218 0858 1323 2054	0534 1104 1729 2348	1.4E 0.6F 1.6E 1.2F
7 F	0308 0954 1415 2150	0629 1200 1823	1.3E 0.5F 1.5E
8 Sa	0356 1051 1512 2249	0039 0723 1254 1924	1.1F 1.2E 0.5F 1.3E
9 Su	0444 1148 1616 2351	0133 0818 1353 2023	0.9F 1.1E 0.5F 1.2E
10 M	0531 1243 1726	0228 0911 1456 2123	0.7F 1.1E 0.5F 1.1E
11 Tu	0052 0616 1334 1835	0325 1002 1555 2224	0.6F 1.1E 0.5F 1.1E
12 W	0152 0700 1420 1939	0419 1051 1652 2321	0.6F 1.2E 0.6F 1.1E
13 Th	0247 0740 1502 2036	0508 1137 1740	0.5F 1.2E 0.7F
14 F	0338 0818 1542 2126	0012 0553 1218 1822	1.1E 0.5F 1.3E 0.8F
15 Sa	0424 0854 1620 2212	0057 0634 1257 1906	1.2E 0.5F 1.3E 0.9F

Day	Slack Water Time h.m.	Maximum Current Time h.m.	Vel. knots
16 Su	0507 0928 1656 2255	0141 0713 1335 1945	1.2E 0.5F 1.4E 1.0F
17 M	0548 1001 1733 2337	0224 0751 1411 2024	1.2E 0.5F 1.4E 1.1F
18 Tu	0627 1034 1811	0301 0830 1449 2103	1.2E 0.5F 1.4E 1.1F
19 W	0017 0706 1110 1850	0342 0905 1522 2143	1.2E 0.5F 1.5E 1.2F
20 Th	0057 0746 1151 1932	0421 0946 1603 2224	1.2E 0.5F 1.5E 1.2F
21 F	0138 0827 1236 2018	0502 1030 1646 2309	1.2E 0.6F 1.5E 1.2F
22 Sa	0220 0910 1328 2108	0548 1115 1738 2356	1.2E 0.6F 1.5E 1.1F
23 Su	0304 0958 1427 2202	0633 1210 1829	1.2E 0.6F 1.4E
24 M	0350 1050 1534 2302	0048 0725 1307 1930	1.1F 1.3E 0.7F 1.4E
25 Tu	0438 1145 1649	0143 0818 1409 2039	1.0F 1.3E 0.8F 1.3E
26 W	0005 0528 1242 1807	0242 0917 1518 2150	0.9F 1.4E 0.9F 1.3E
27 Th	0111 0621 1339 1925	0339 1013 1621 2255	0.8F 1.5E 1.1F 1.4E
28 F	0217 0714 1435 2037	0441 1110 1724	0.8F 1.6E 1.2F
29 Sa	0321 0807 1530 2143	0002 0542 1206 1825	1.4E 0.8F 1.7E 1.4F
30 Su	0420 0900 1623 2242	0100 0638 1300 1922	1.4E 0.8F 1.8E 1.5F

Time meridian 75° W. 0000 is midnight. 1200 is noon.

Table C-3. Speed of Current at Any Time

TABLE A

Interval between slack and desired time	Interval between slack and maximum current													
h. m.	*h. m.* 1 20	*h. m.* 1 40	*h. m.* 2 00	*h. m.* 2 20	*h. m.* 2 40	*h. m.* 3 00	*h. m.* 3 20	*h. m.* 3 40	*h. m.* 4 00	*h. m.* 4 20	*h. m.* 4 40	*h. m.* 5 00	*h. m.* 5 20	*h. m.* 5 40
	f.	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*
0 20	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0 40	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
1 00	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3
1 20	1.0	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4
1 40	......	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4
2 00	......	......	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5
2 20	......	......	......	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6
2 40	......	......	......	......	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7
3 00	......	......	......	......	......	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.7
3 20	......	......	......	......	......	......	1.0	1.0	1.0	0.9	0.9	0.9	0.8	0.8
3 40	......	......	......	......	......	......	......	1.0	1.0	1.0	0.9	0.9	0.9	0.9
4 00	......	......	......	......	......	......	......	......	1.0	1.0	1.0	1.0	0.9	0.9
4 20	......	......	......	......	......	......	......	......	......	1.0	1.0	1.0	1.0	0.9
4 40	......	......	......	......	......	......	......	......	......	......	1.0	1.0	1.0	1.0
5 00	......	......	......	......	......	......	......	......	......	......	......	1.0	1.0	1.0
5 20	......	......	......	......	......	......	......	......	......	......	......	......	1.0	1.0
5 40	......	......	......	......	......	......	......	......	......	......	......	......	......	1.0

TABLE B

Interval between slack and desired time	Interval between slack and maximum current													
h. m.	*h. m.* 1 20	*h. m.* 1 40	*h. m.* 2 00	*h. m.* 2 20	*h. m.* 2 40	*h. m.* 3 00	*h. m.* 3 20	*h. m.* 3 40	*h. m.* 4 00	*h. m.* 4 20	*h. m.* 4 40	*h. m.* 5 00	*h. m.* 5 20	*h. m.* 5 40
	f.	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*	*f.*
0 20	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
0 40	0.8	0.7	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
1 00	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4
1 20	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5
1 40	......	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6
2 00	......	......	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.6
2 20	......	......	......	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7
2 40	......	......	......	......	1.0	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.7
3 00	......	......	......	......	......	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.8	0.8
3 20	......	......	......	......	......	......	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.8
3 40	......	......	......	......	......	......	......	1.0	1.0	1.0	1.0	0.9	0.9	0.9
4 00	......	......	......	......	......	......	......	......	1.0	1.0	1.0	1.0	0.9	0.9
4 20	......	......	......	......	......	......	......	......	......	1.0	1.0	1.0	1.0	0.9
4 40	......	......	......	......	......	......	......	......	......	......	1.0	1.0	1.0	1.0
5 00	......	......	......	......	......	......	......	......	......	......	......	1.0	1.0	1.0
5 20	......	......	......	......	......	......	......	......	......	......	......	......	1.0	1.0
5 40	......	......	......	......	......	......	......	......	......	......	......	......	......	1.0

Use table A for all places except those listed below for table B.
Use table B for Cape Cod Canal, Hell Gate, Chesapeake and Delaware Canal and all stations in table 2 which are referred to them.

1. From predictions find the time of slack water and the time and velocity of maximum current (flood or ebb), one of which is immediately before and the other after the time for which the velocity is desired.
2. Find the interval of time between the above slack and maximum current, and enter the top of table A or B with the interval which most nearly agrees with this value.
3. Find the interval of time between the above slack and the time desired, and enter the side of table A or B with the interval which most nearly agrees with this value.
4. Find, in the table, the factor corresponding to the above two intervals, and multiply the maximum velocity by this factor. The result will be the approximate velocity at the time desired.

APPENDIX D. GRIDDING[1]

A. The standard sectional aeronautical chart and the following grid identifications system is used by CAP when coordinating missions with the AFRCC and other agencies. CAP does not preclude the use of local procedures where they are deemed necessary or more practicable. Many missions are "local" in nature, and local procedures may be highly efficient and effective in the management of SAR resources within a defined geographical boundary.

B. Standardized Sectional Aeronautical Chart Grid and Identification System

1. The Sectional Aeronautical Chart (scale: 1-500,000) is divided into 30 minute intervals. Consider both the north and south sides of a sectional chart as one unit. Identify the northern and southern most latitude limits, and the western and eastern most longitude limits from Table D-1. The rectangular area thus formed is the area to be gridded. Line off each 15 minutes of latitude and longitude within this area. Start with the first full 15 minute quadrangle in the northwest corner of the chart as number one (1) and number in sequence from west to east. Continue in this manner until reaching the southeast corner of the gridded area which serves as the last full 15 minute quadrangle. The number of quadrangles in each respective chart is scheduled in column 7, Table D-1.

2. The basic 15 minute quadrangle (grid) is further broken down into quarter sections. The northwest quarter is labeled "A"; the northeast "B"; the southwest "C"; and the southeast "D". This breakdown is used when concentrated search is required and as a means of identifying 7 ½ minute quadrangles, they need not be annotated on the charts but should be understood to exist and used in mission assignment and reporting.

3. Where charts overlap (the same grid is located on two or more charts) the grids on all charts will be assigned the number and identifier of the primary chart (the most westerly chart will be designated as the primary chart). Consider the Kansas City and St. Louis charts as an example. The Kansas City chart will be numbered in accordance with paragraph B.1. above; that portion of the St. Louis that is overlapped by the Kansas City chart will be labeled with the number identical to the same grid on the Kansas City chart preceded by the letters "MKC" to identify the origin of the grid numbers. (See Table D-1) The normal sequential numbers on the overlap area that are displaced by the primary chart will simply be ommitted for use.

   a. The Los Angeles chart has a 15 minute latitude overlap on the Las Vegas chart within the area defined by 36-00N to 35-45N, and 118-00W. (Total of 12 grids)

   b. The Los Angeles chart has one(1) degree longitude overlap on the Phoenix chart within the area defined by 35-45N to 32-00N, and 116-00W to 115-00W. (Total of 60 grids)

   c. The Denver chart has a 15 minute latitude overlap on the Albuquerque chart within the area defined by 36-00N to 35-45N, and 109-00W to 104-00W. (Total of 12 grids)

   d. The Kansas City chart has one(1) degree longitude overlap on the St. Louis chart within the area defined by 40-00N to 36-00N, and 91-00W. (Total of 64 grids)

   e. The St. Louis chart has one(1) degree longitude overlap on the Cincinnati chart within the areaa defined by 40-00N to 36-00N, and 85-00W to 84-00W. (Total of 64 grids)

   f. The Cincinnati chart has one(1) degree longitude overlap on the Washington chart within the area defined by 40-00N to 36-00N, and 79-00W to 78-00W. (Total of 64 grids)

4. Chart identifiers are listed in Table D-1.

5. On charts with inserts over oceanic areas, number consecutively through the insert just as would be accomplished were the insert not published.

C. Grids and numbering for the Sectional Aeronautical Charts listed in Table D-1 are depicted in Figures D-1 thru D-37.

Table D–1. Sectional Aeronautical Chart Grids

Chart	*Identifier*	*North Grid Limit*	*South Grid Limit*	*West Grid Limit*	*East Grid Limit*	*Total Grids*
Seattle	SEA	49–00N	44–30N	125–00W	117–00W	576
Great Falls	GTF	49–00N	44–30N	117–00W	109–00W	576
Billings	BIL	49–00N	44–30N	109–00W	101–00W	576
Twin Cities	MSP	49–00N	44–30N	101–00W	93–00W	576
Green Bay	GRB	48–15N	44–00N	93–00W	85–00W	544
Lake Huron	LHN	48–00N	44–00N	85–00W	77–00W	512
Montreal	MON	48–00N	44–00N	77–00W	69–00W	512
Halifax	HFX	48–00N	44–00N	69–00W	61–00W	512
Klamath Falls	LMT	44–30N	40–00N	125–00W	117–00W	576
Salt Lake City	SLC	44–30N	40–00N	117–00W	109–00W	576
Cheyenne	CYS	44–30N	40–00N	109–00W	101–00W	576
Omaha	OMA	44–30N	40–00N	101–00W	93–00W	576
Chicago	ORD	44–00N	40–00N	93–00W	85–00W	512
Detroit	DET	44–00N	40–00N	85–00W	77–00W	512
New York	NYC	44–00N	40–00N	77–00W	69–00W	512
San Francisco	SFO	40–00N	36–00N	125–00W	118–00W	448
Las Vegas	LAS	40–00N	35–45N	118–00W	111–00W	476
Denver	DEN	40–00N	35–45N	111–00W	104–00W	476
Wichita	ICT	40–00N	36–00N	104–00W	97–00W	448
Kansas City	MKC	40–00N	36–00N	97–00W	90–00W	448
St. Louis	STL	40–00N	36–00N	91–00W	84–00W	448
Cincinnati	LUK	40–00N	36–00N	85–00W	78–00W	448
Washington	DCA	40–00N	36–00N	79–00W	72–00W	448
Los Angeles	LAX	36–00N	32–00N	121–30W	115–00W	416
Phoenix	PHX	35–45N	31–15N	116–00W	109–00W	504
Albuquerque	ABQ	36–00N	32–00N	109–00W	102–00W	448
Dallas – Ft. Worth	GSW	36–00N	32–00N	102–00W	95–00W	448
Memphis	MEM	36–00N	32–00N	95–00W	88–00W	448
Atlanta	ATL	36–00N	32–00N	88–00W	81–00W	448
Charlotte	CLT	36–00N	32–00N	81–00W	75–00W	384
El Paso	ELP	32–00N	28–00N	109–00W	103–00W	384
San Antonio	SAT	32–00N	28–00N	103–00W	97–00W	384
Houston	HOU	32–00N	28–00N	97–00W	91–00W	384
New Orleans	MSY	32–00N	28–00N	91–00W	85–00W	384
Jacksonville	JAX	32–00N	28–00N	85–00W	79–00W	384
Brownsville	BRO	28–00N	24–00N	103–00W	97–00W	384
Miami	MIA	28–00N	24–00N	83–00W	77–00W	384

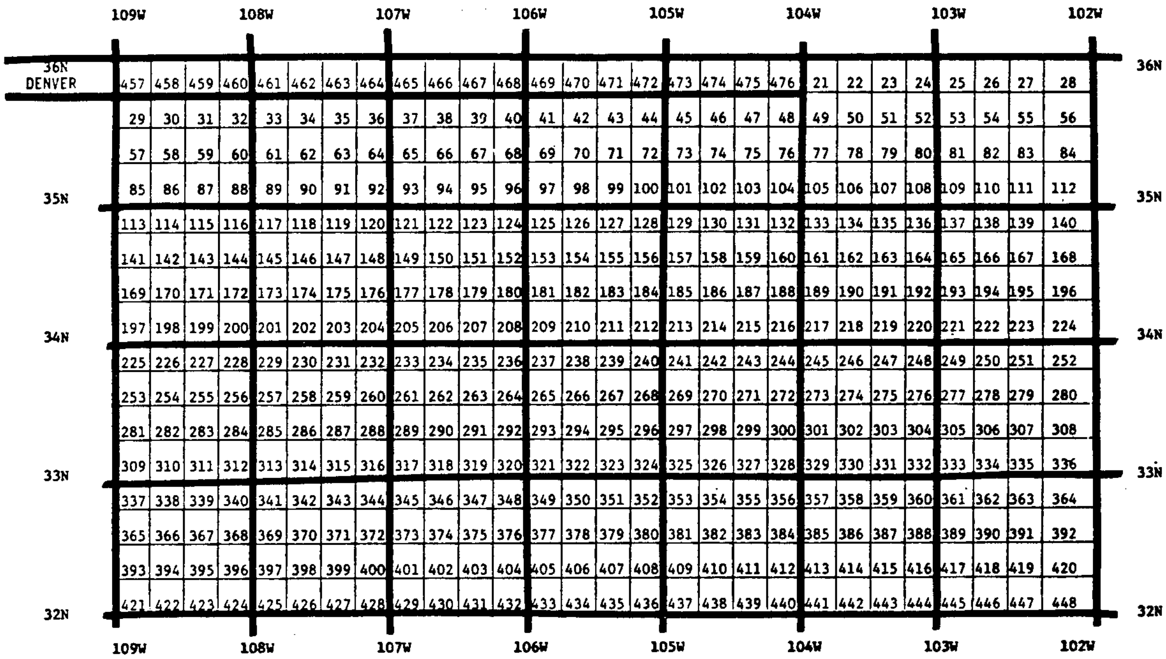


Figure D-1. Albuquerque Chart Grid

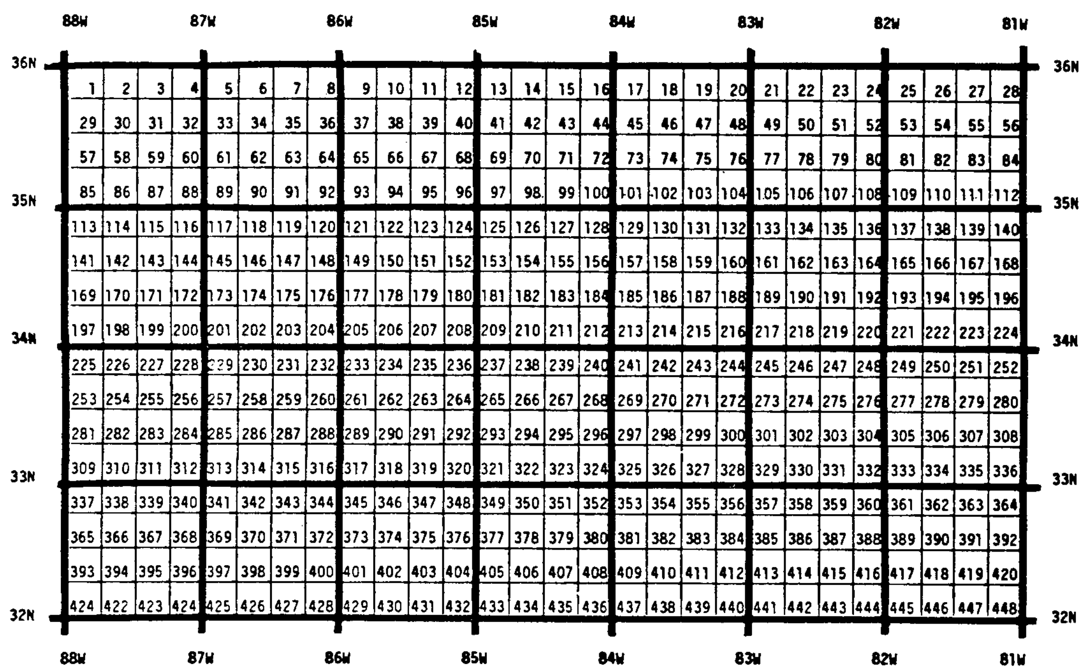


Figure D-2. Atlanta Chart Grid

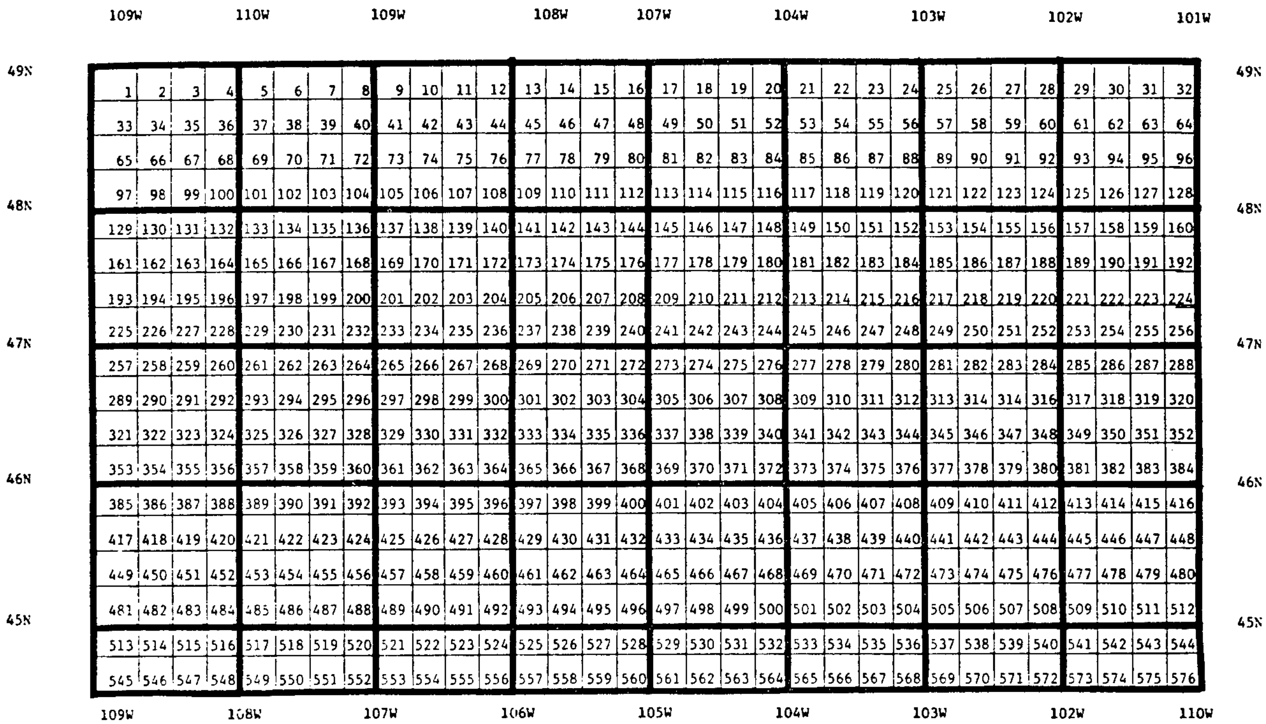


Figure D–3. Billings Chart Grid

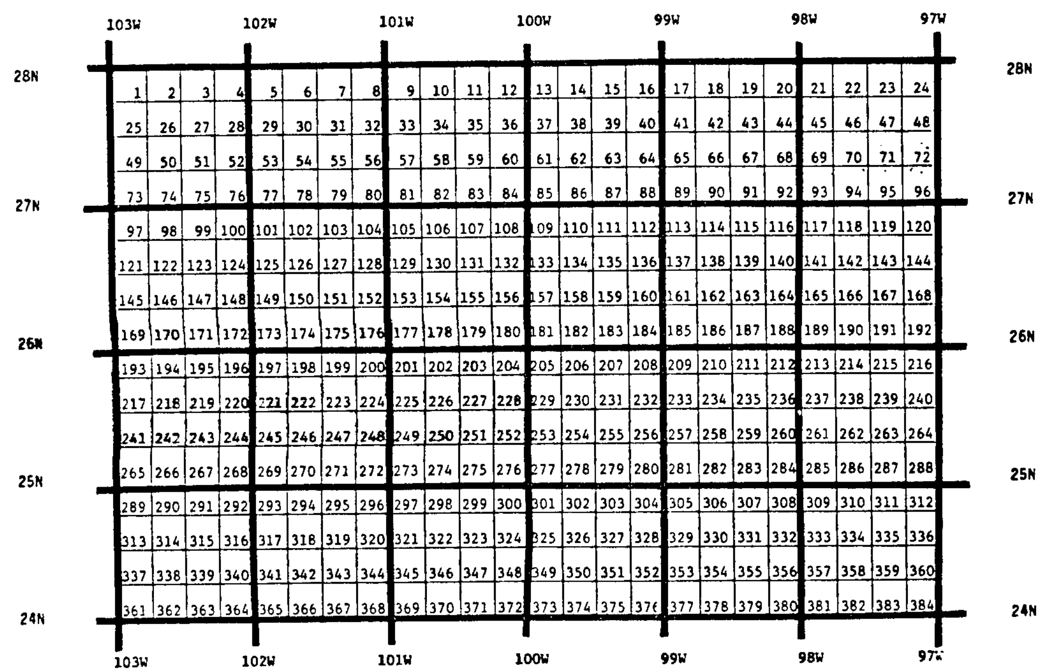


Figure D–4. Brownsville Chart Grid

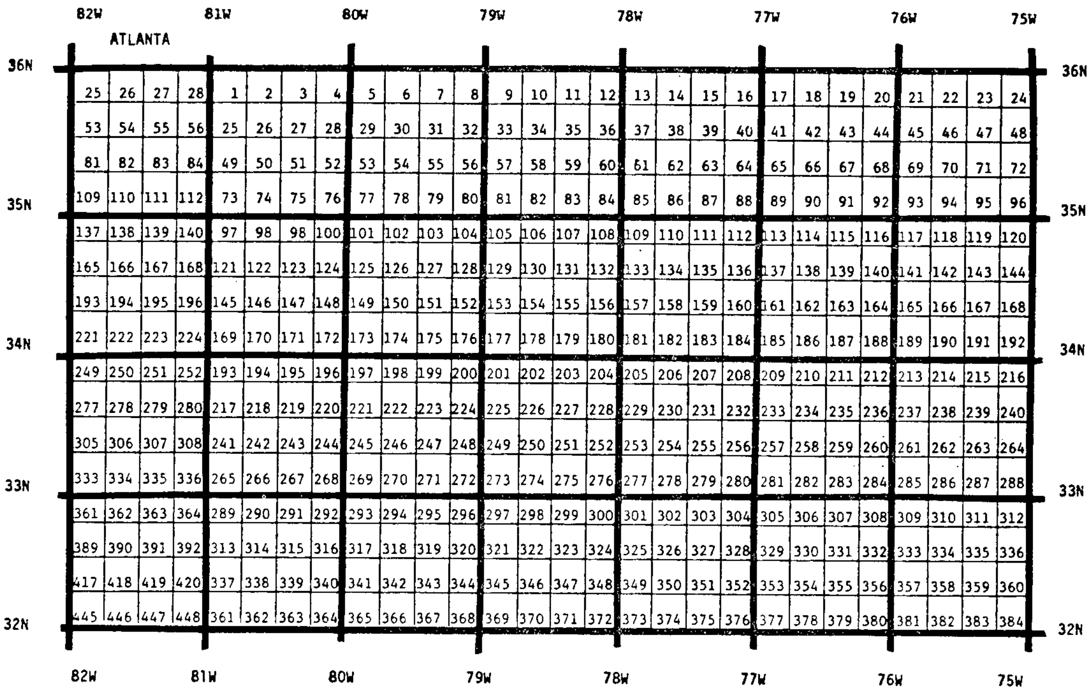


Figure D–5. Charlotte Chart Grid

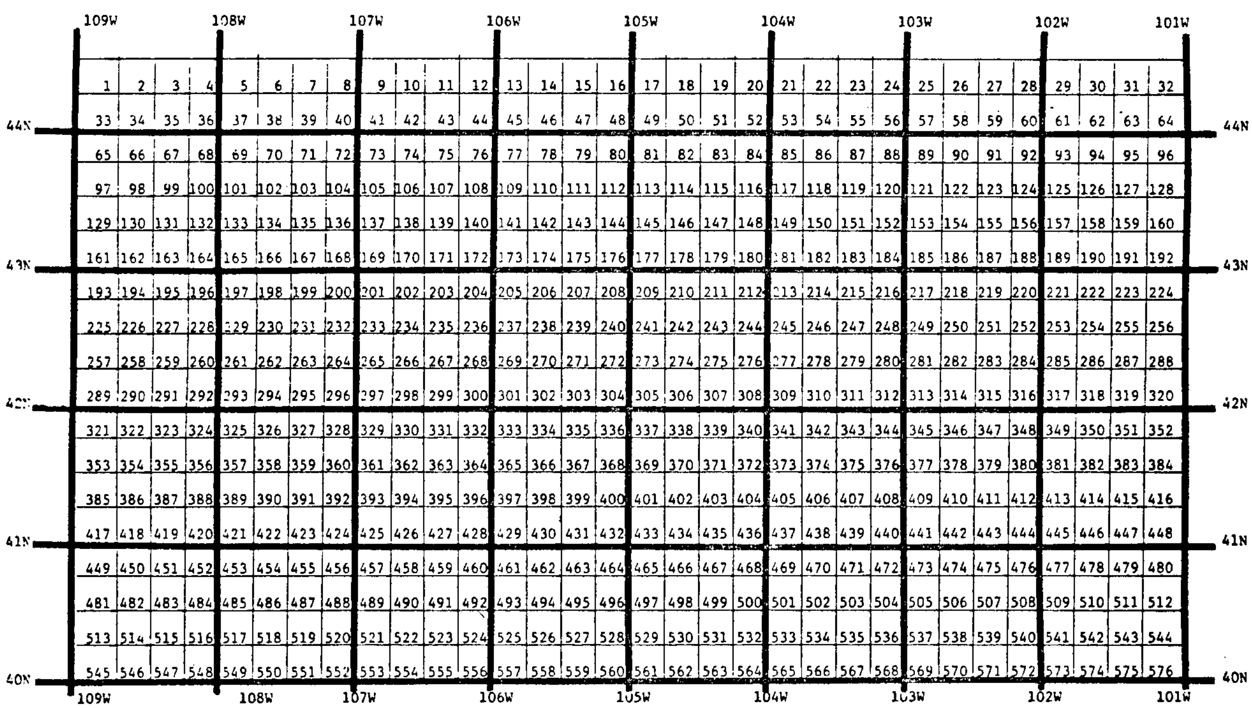


Figure D–6. Cheyenne Chart Grid

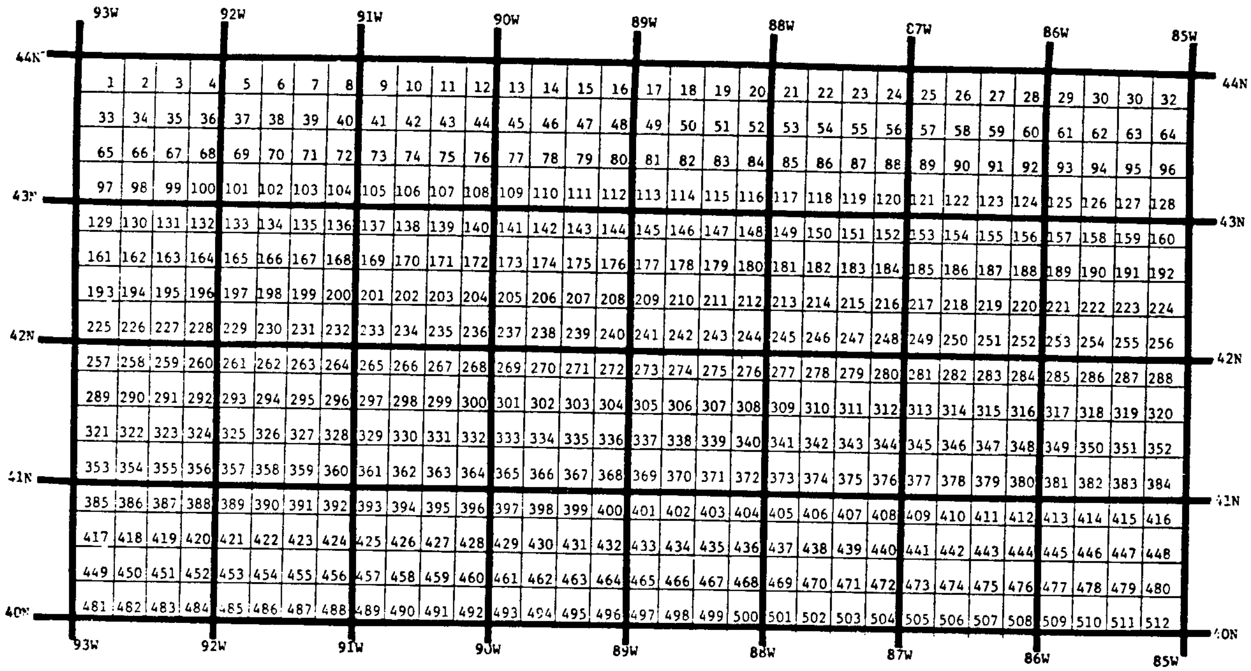


Figure D–7. Chicago Chart Grid

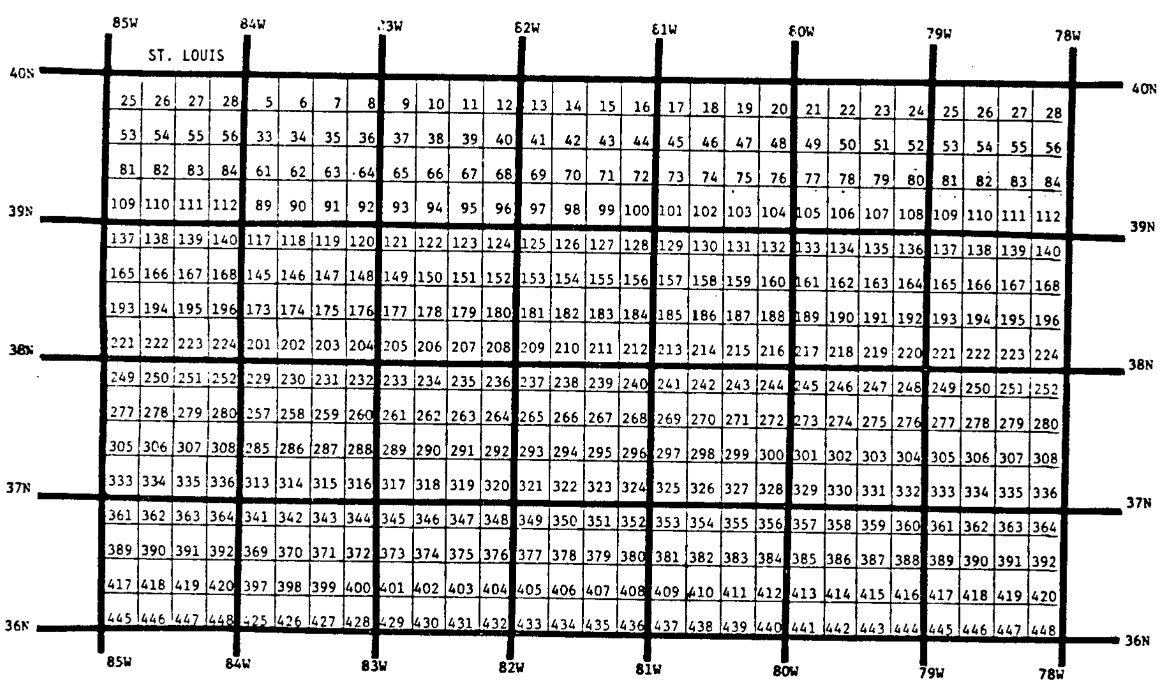


Figure D–8. Cincinnati Chart Grid

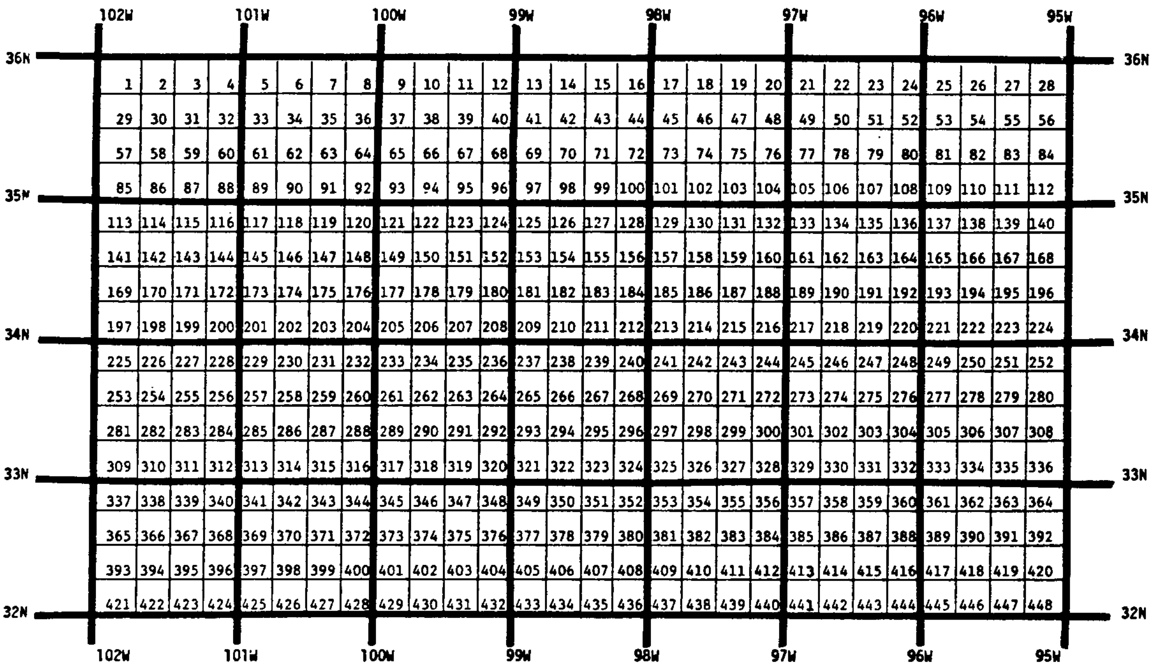


Figure D-9. Dallas – Fort Worth Chart Grid

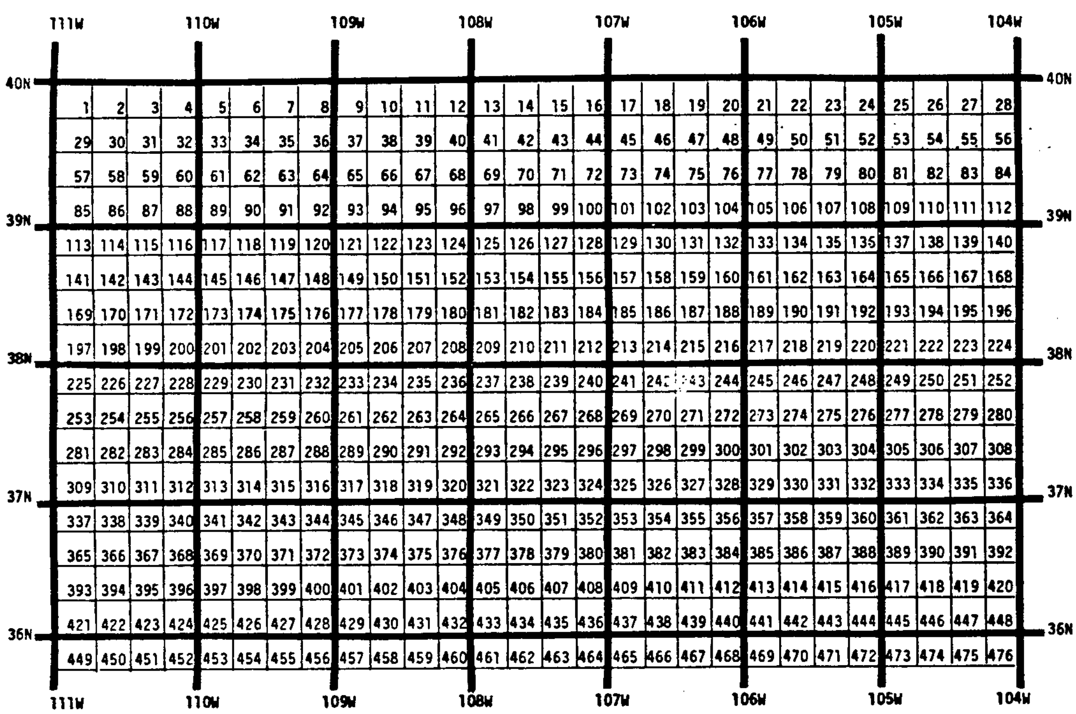


Figure D-10. Denver Chart Grid

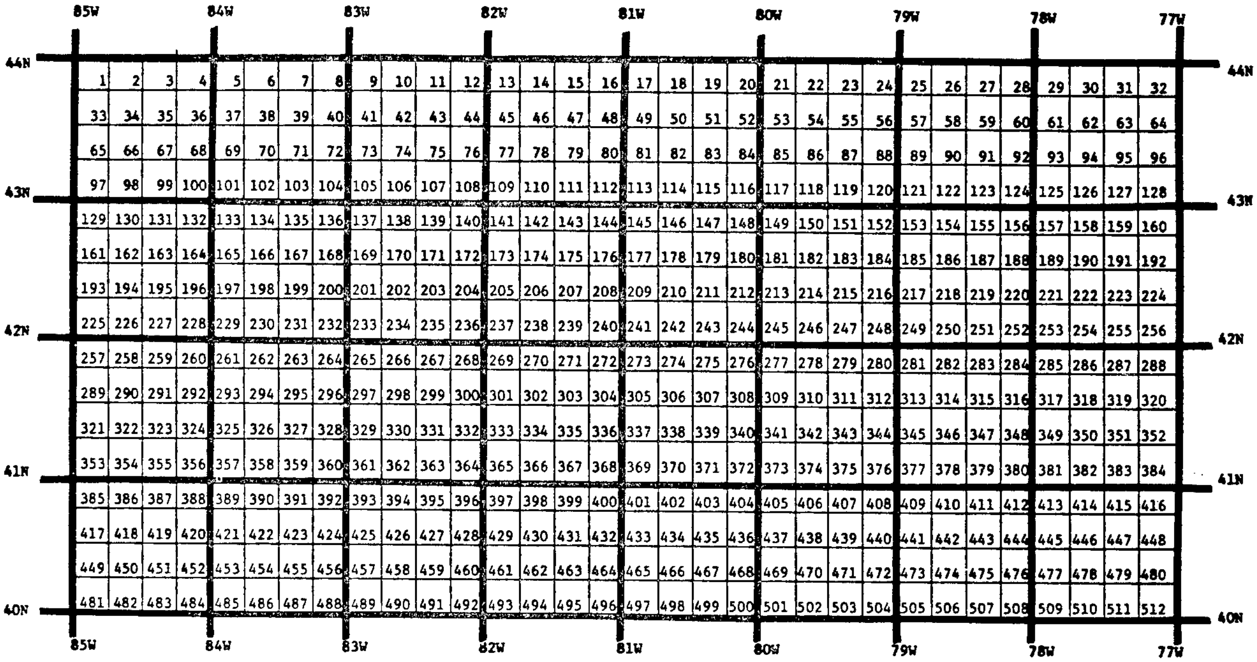


Figure D-11. Detroit Chart Grid

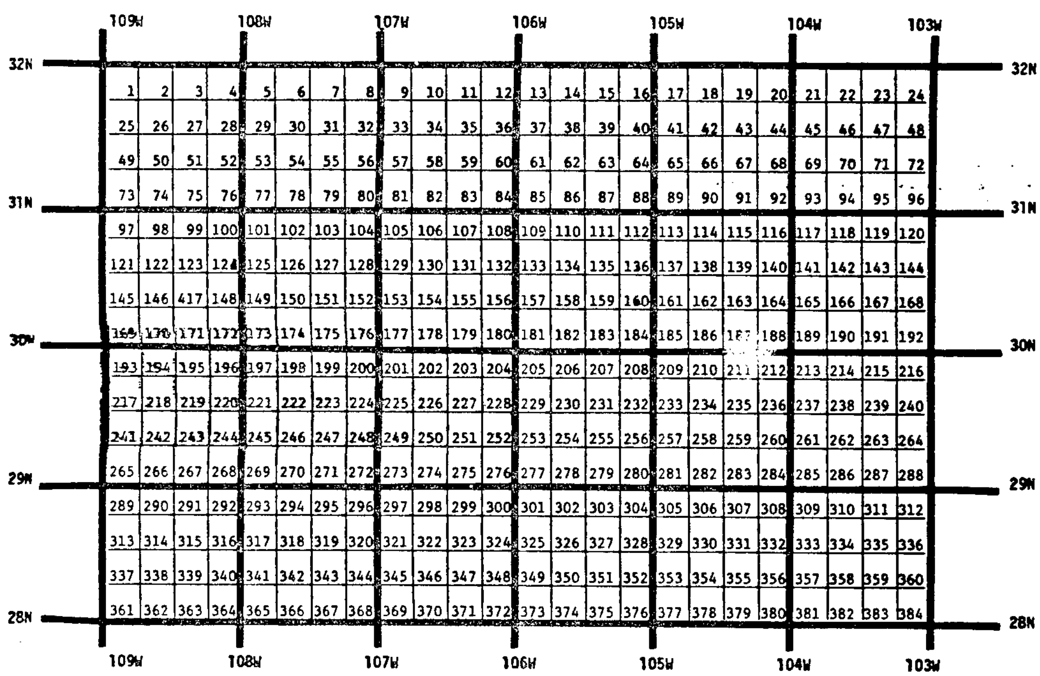


Figure D-12. El Paso Chart Grid

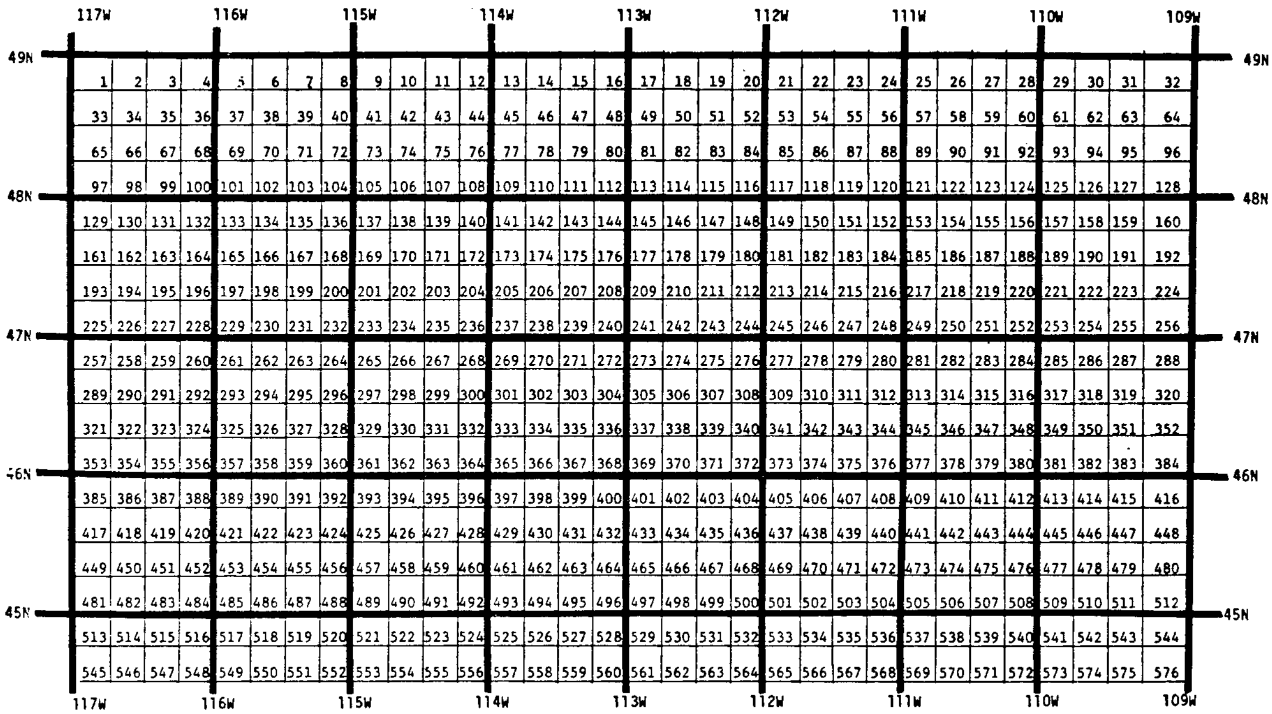


Figure D–13. Great Falls Chart Grid

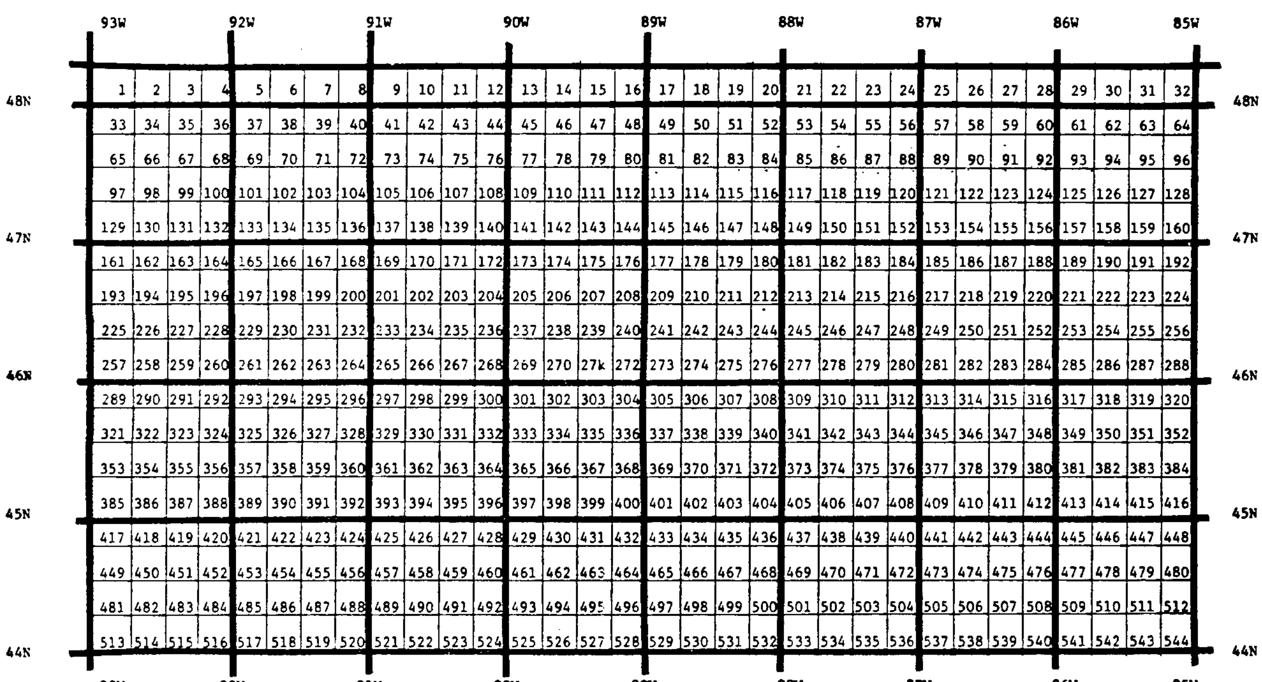


Figure D–14. Green Bay Chart Grid

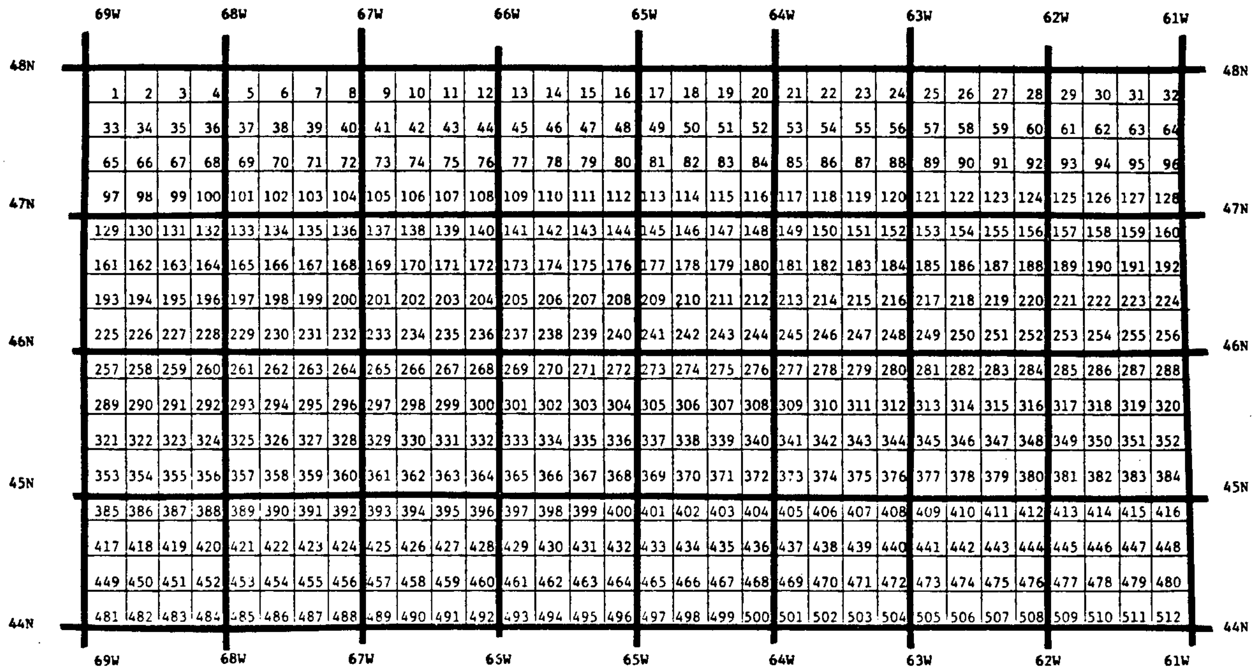


Figure D–15. Halifax Chart Grid

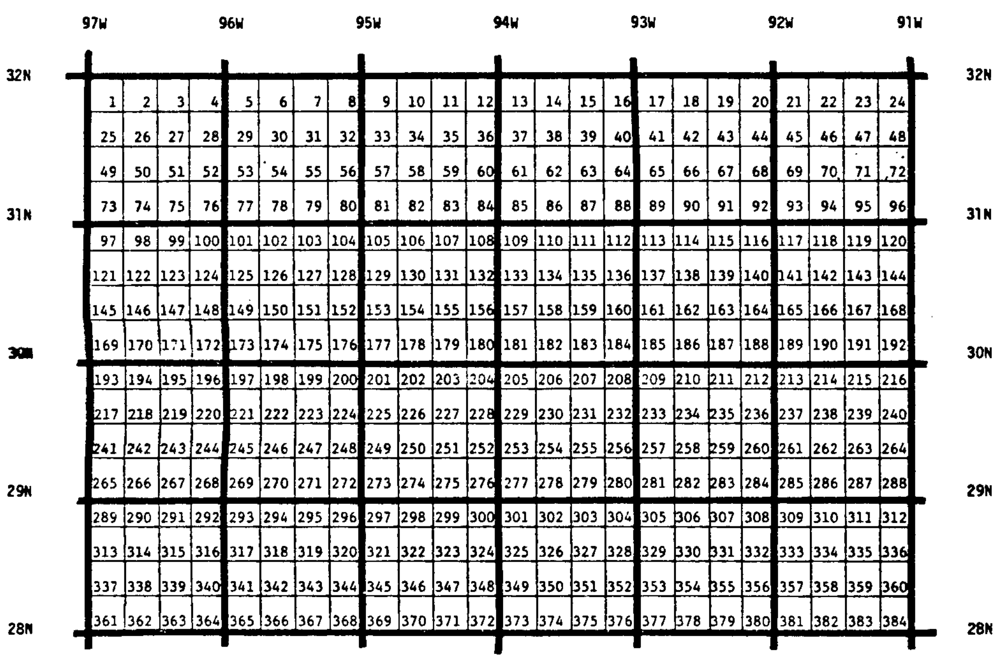


Figure D–16. Houston Chart Grid

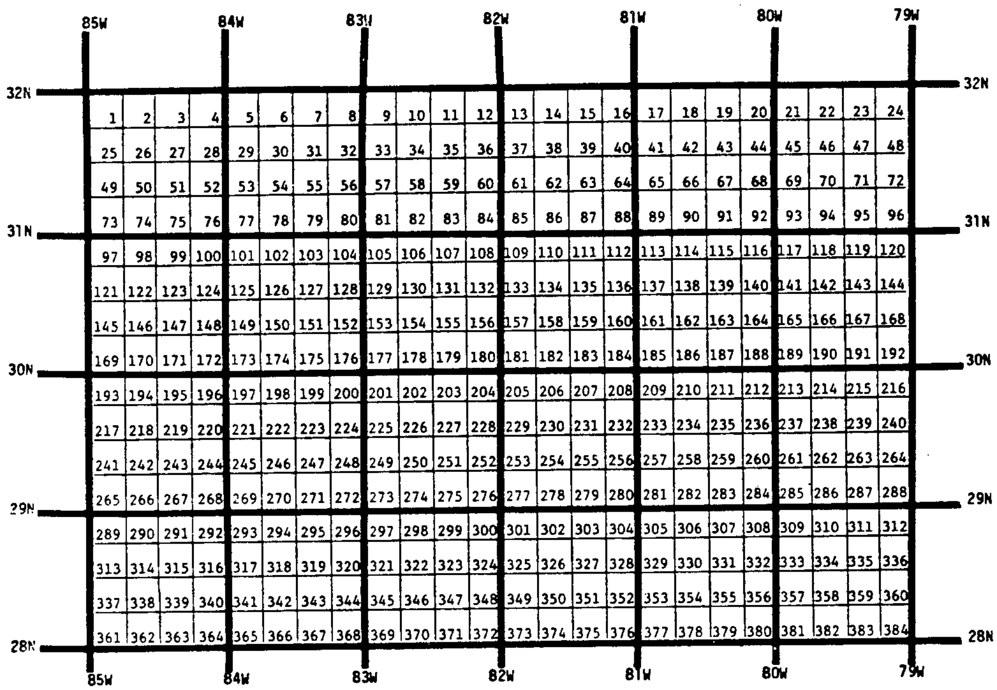


Figure D-17. Jacksonville Chart Grid

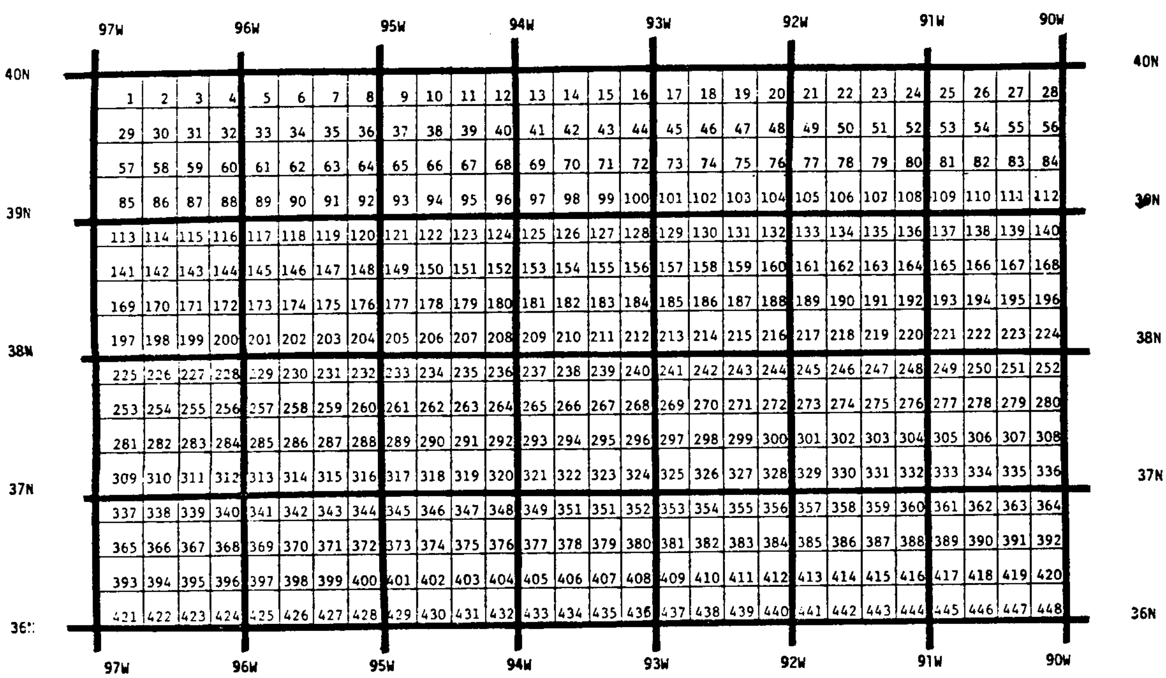


Figure D-18. Kansas City Chart Grid

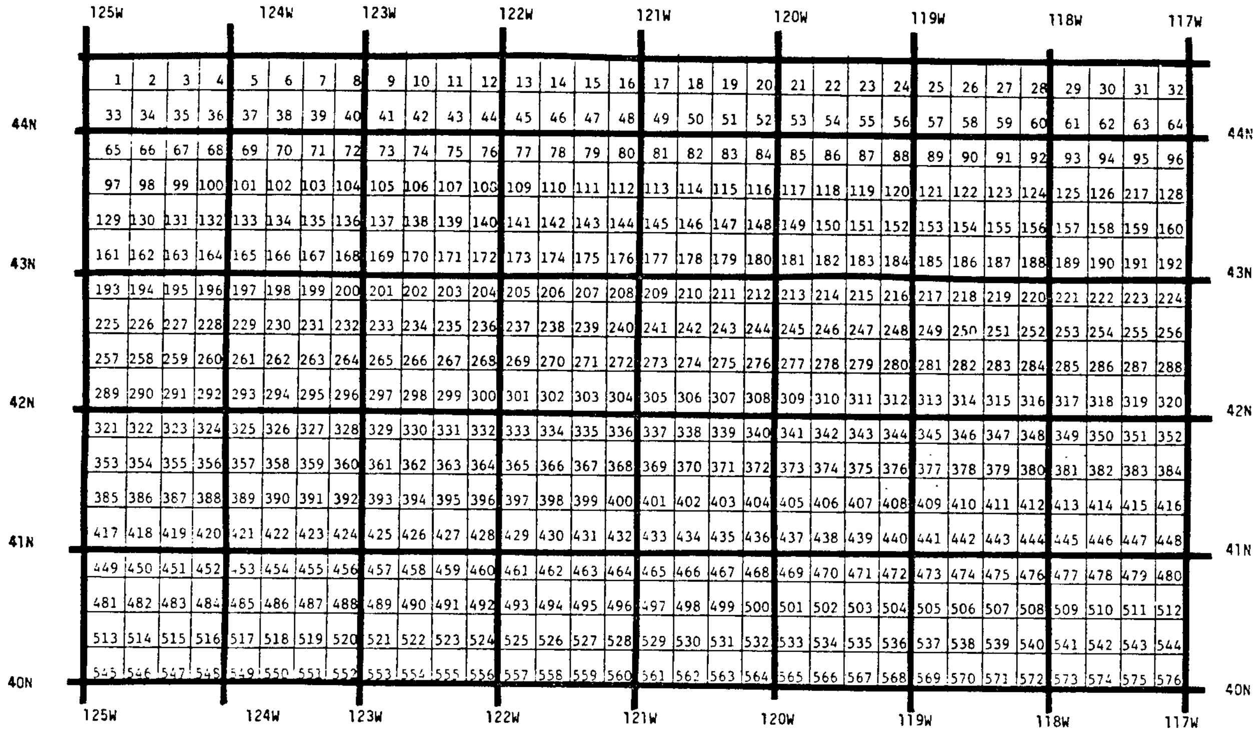


Figure D-19. Klamath Falls Chart Grid

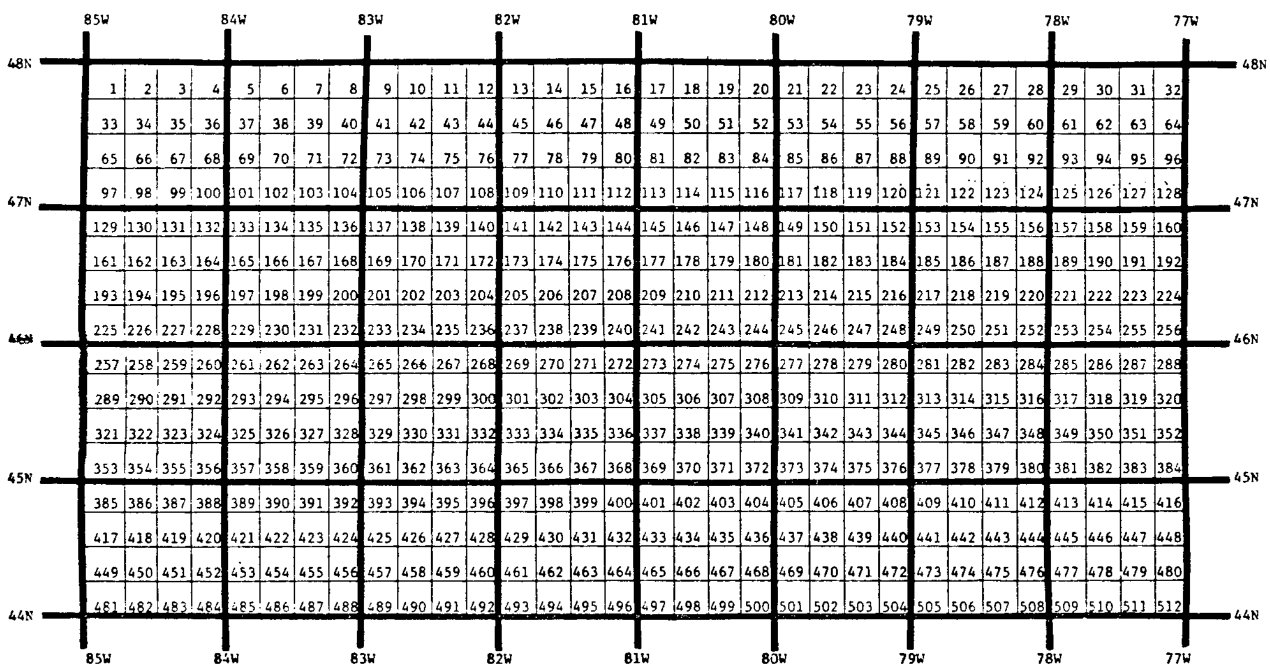


Figure D-20. Lake Huron Chart Grid

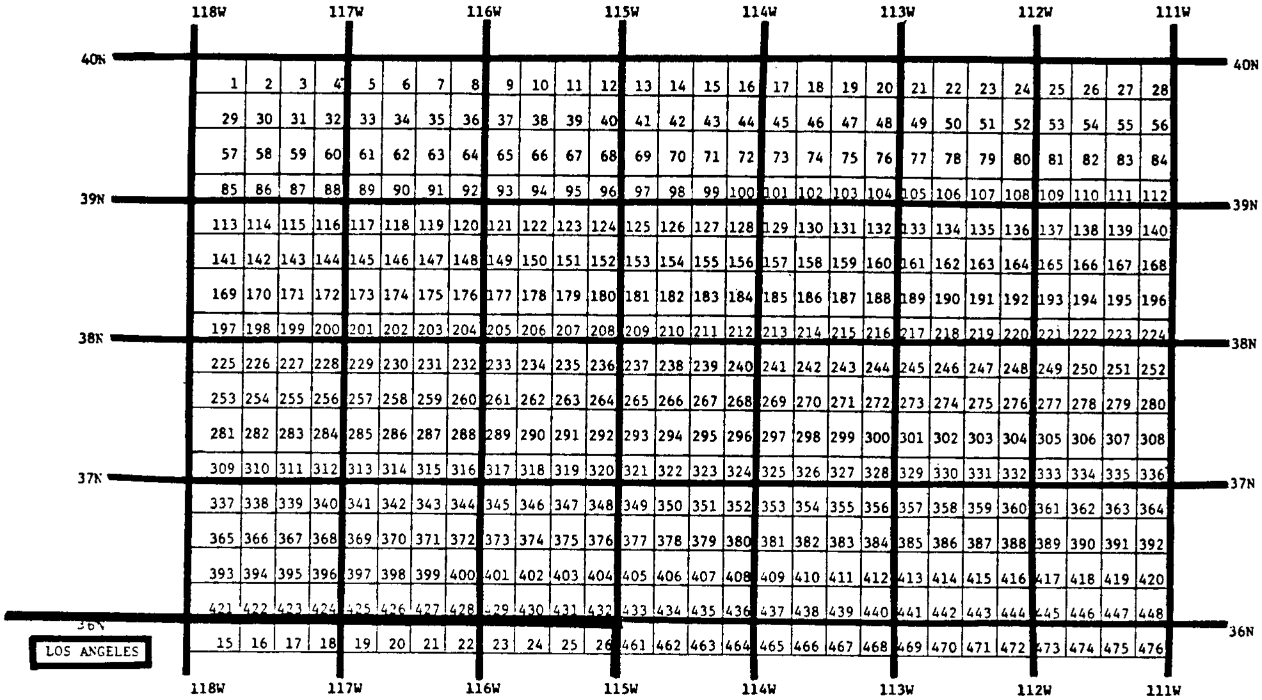


Figure D–21. Las Vegas Chart Grid

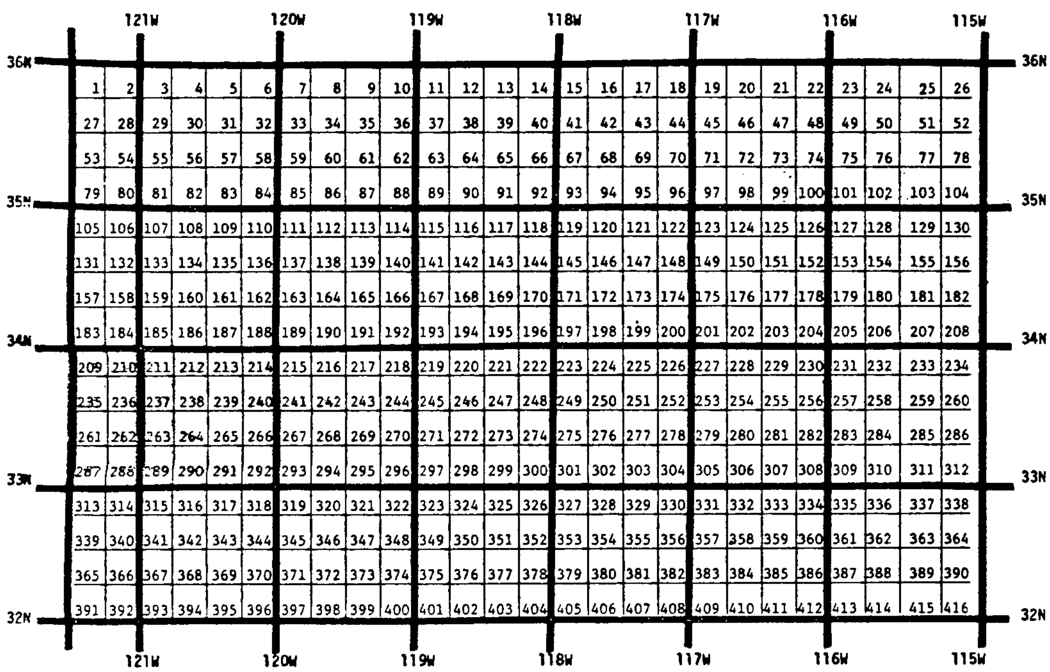


Figure D–22. Los Angeles Chart Grid

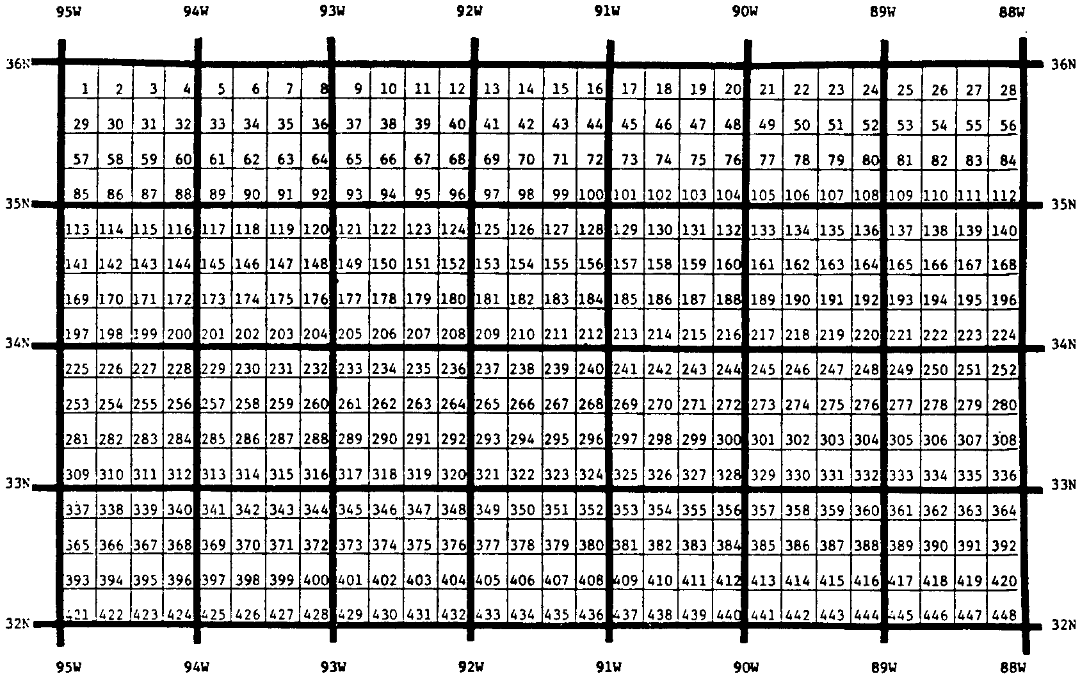


Figure D-23. Memphis Chart Grid

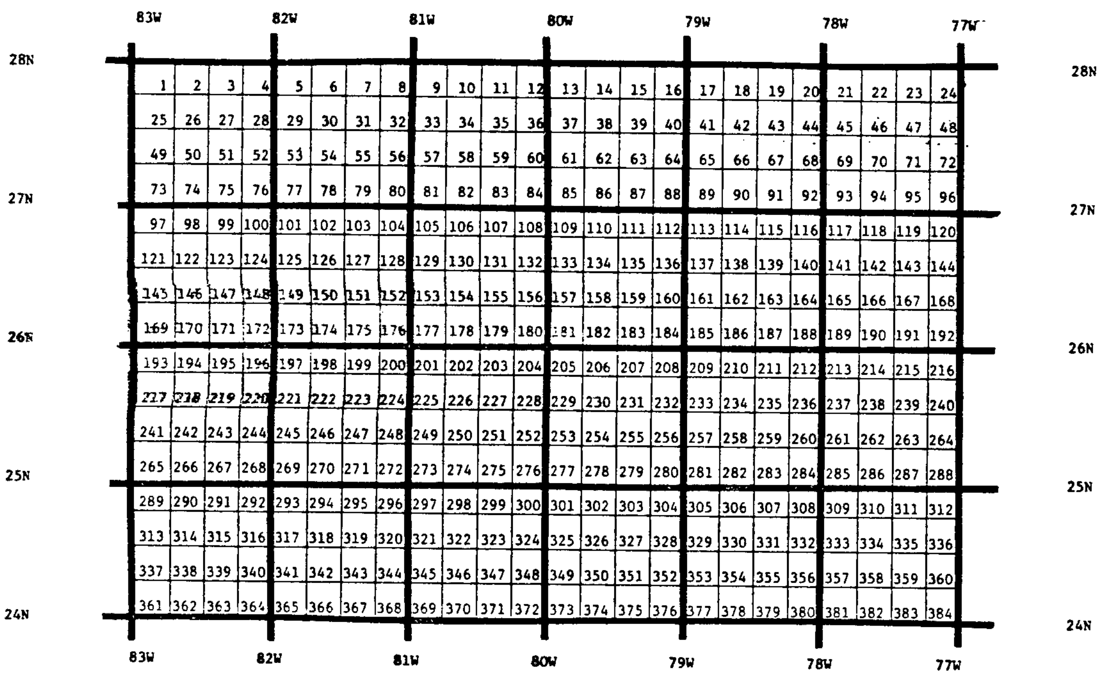


Figure D-24. Miami Chart Grid

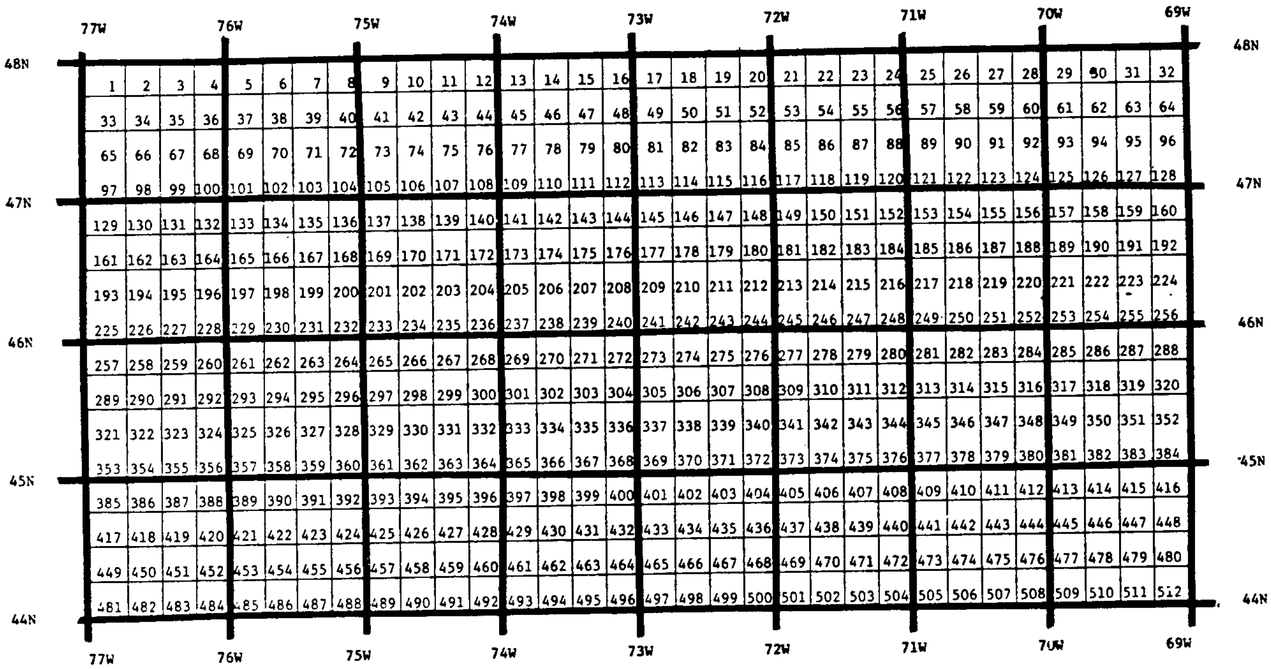


Figure D-25. Montreal Chart Grid

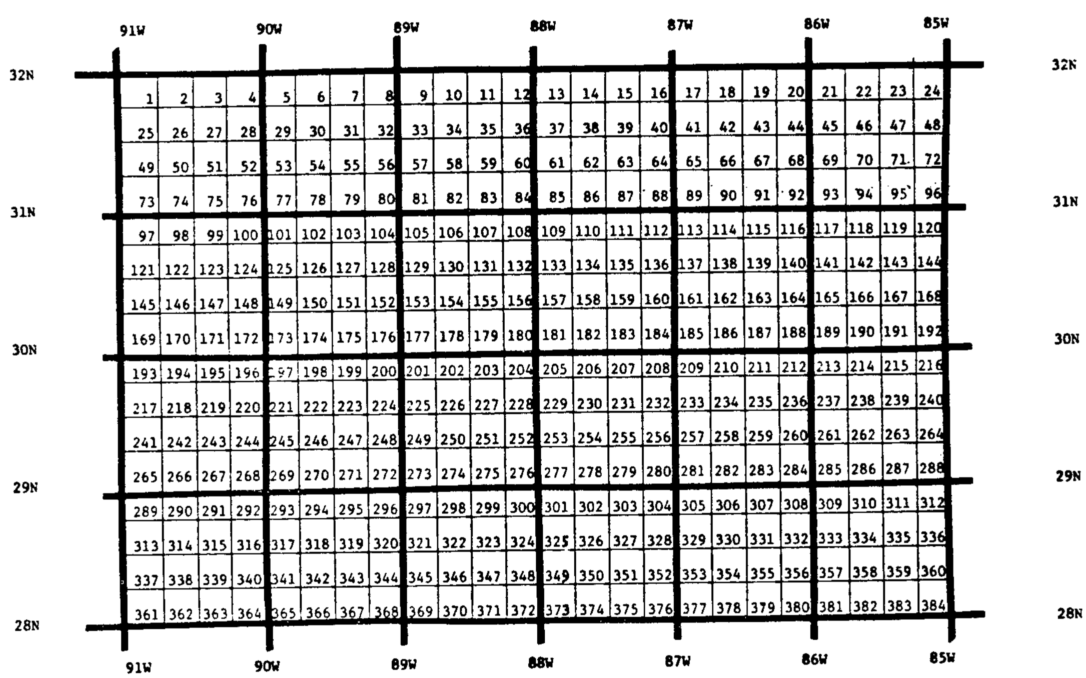


Figure D-26. New Orleans Chart Grid

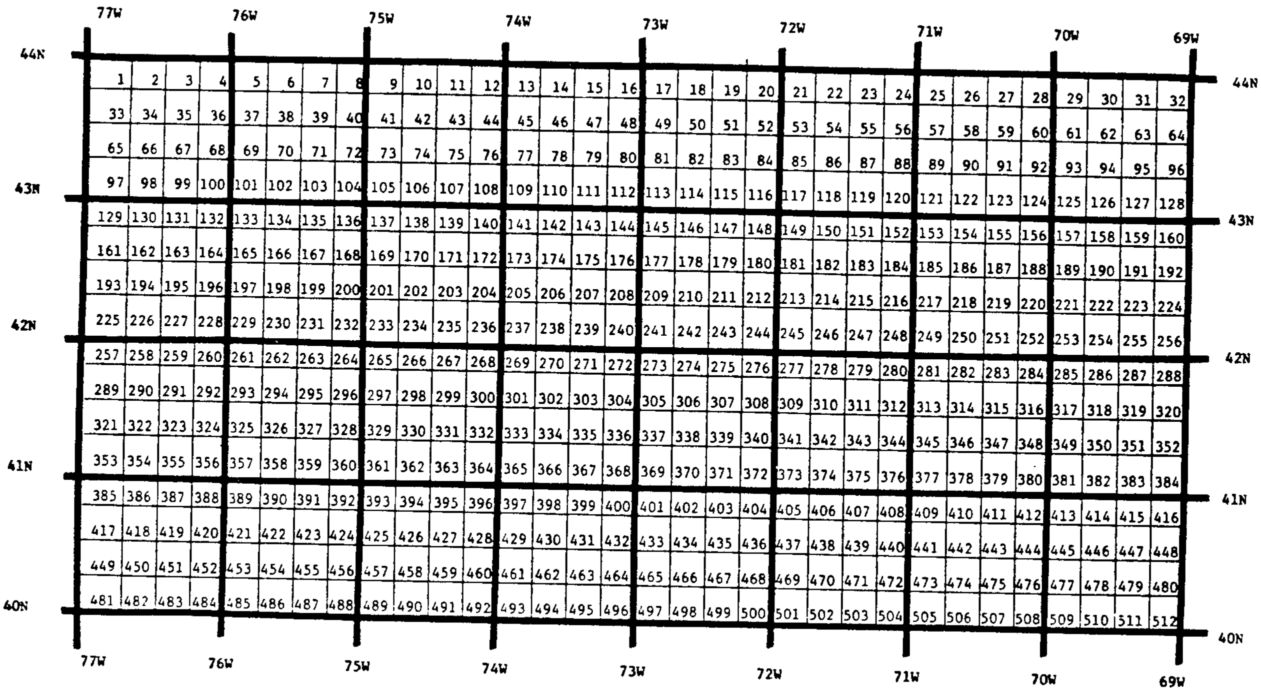


Figure D-27. New York Chart Grid

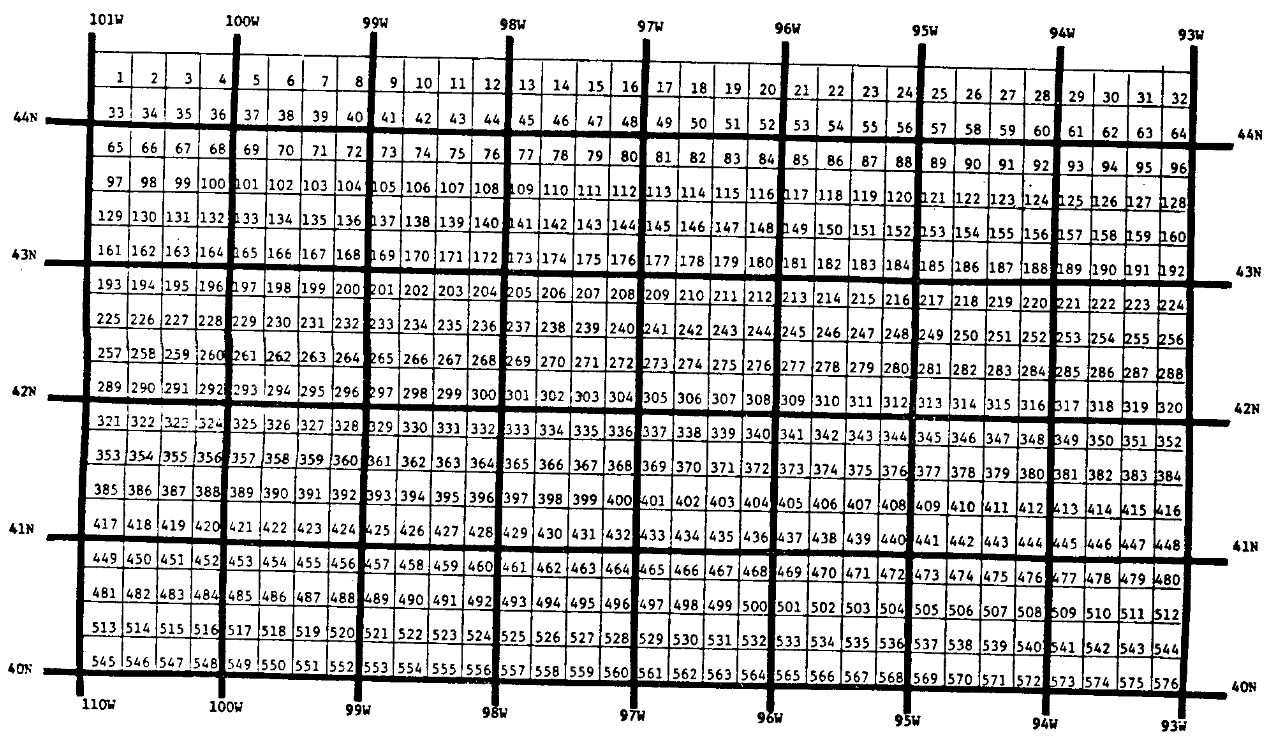


Figure D-28. Omaha Chart Grid

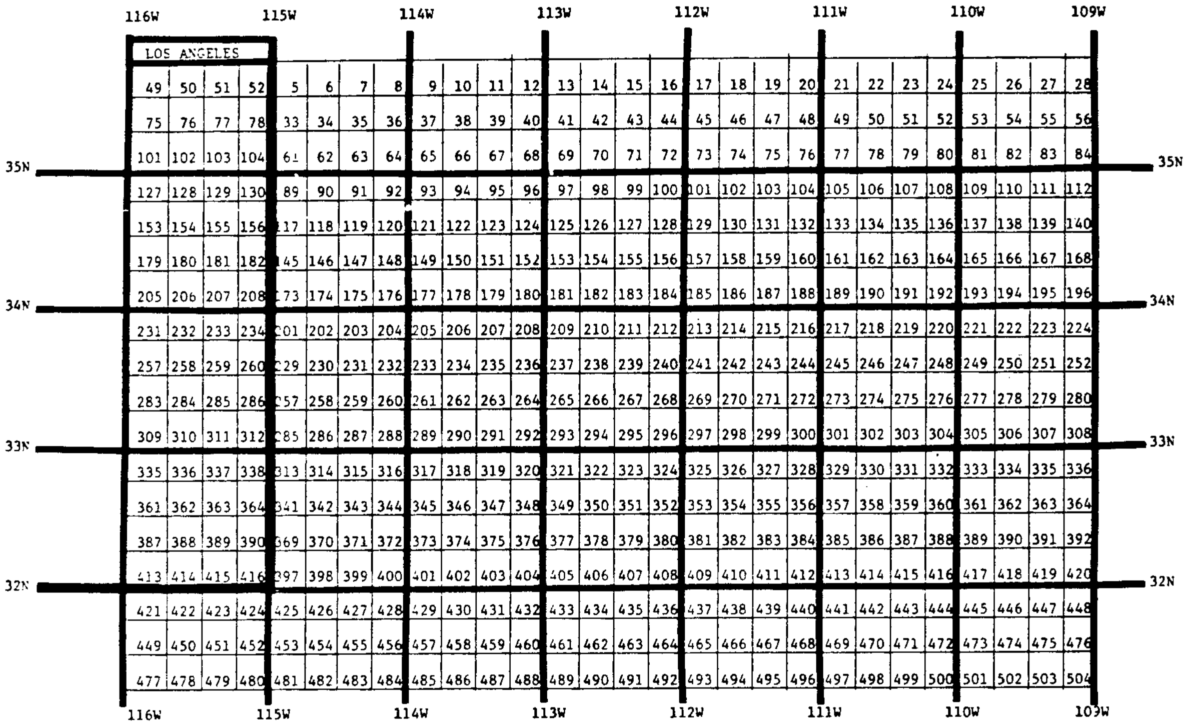


Figure D–29. Phoenix Chart Grid

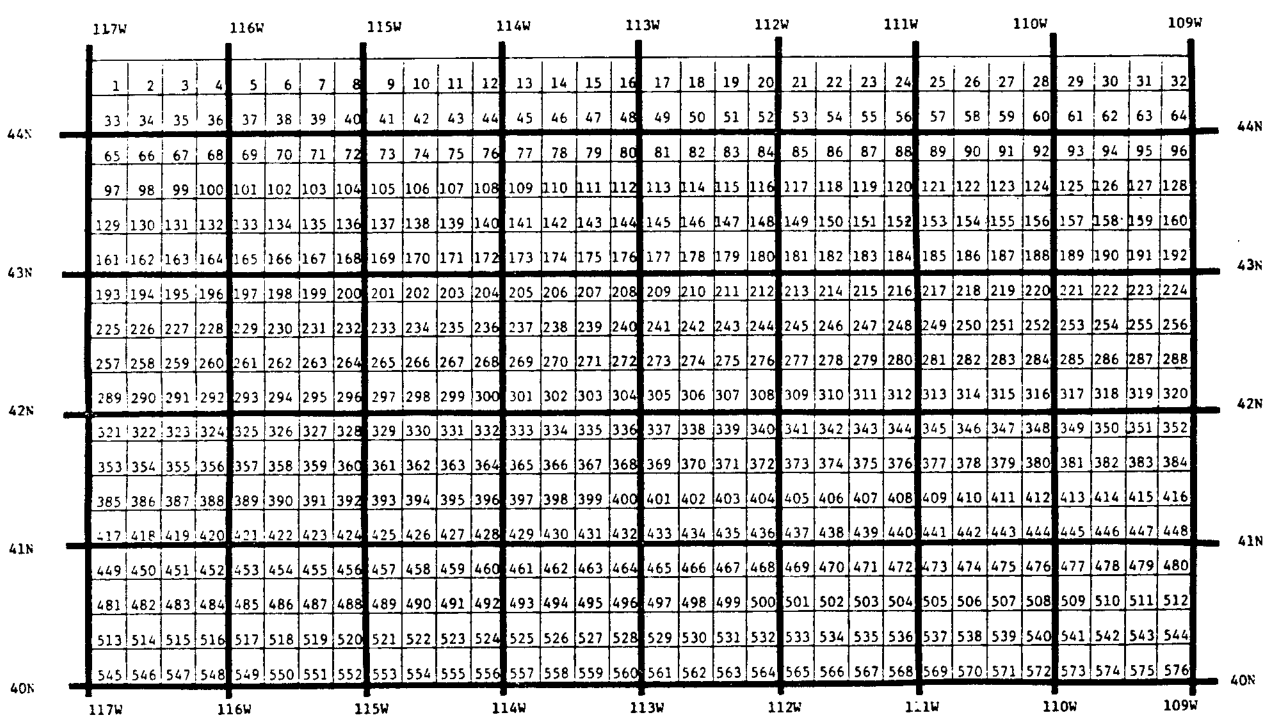


Figure D–30. Salt Lake City Chart Grid

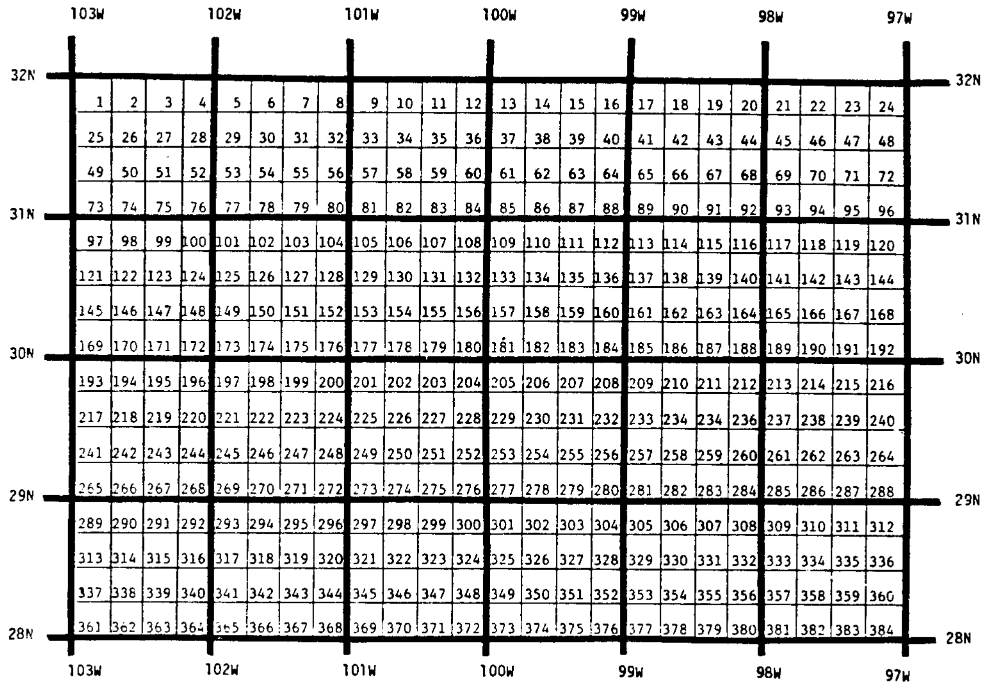


Figure D-31. San Antonio Chart Grid

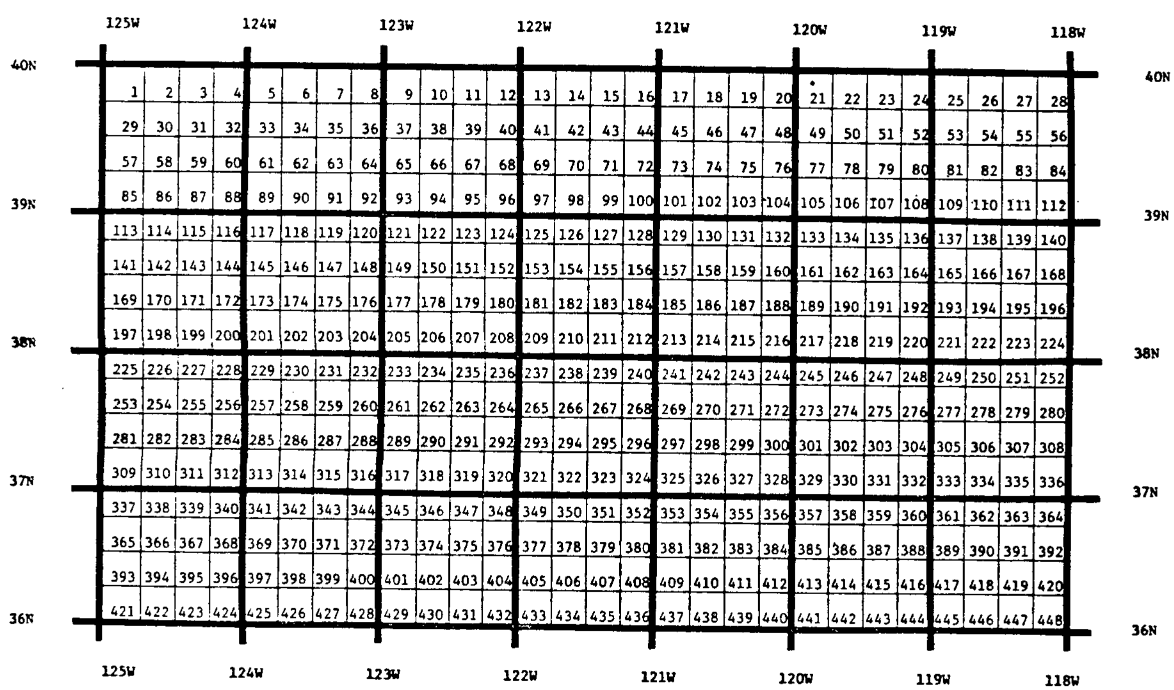


Figure D-32. San Francisco Chart Grid

125W 124W 123W 122W 121W 120W 119W 118W 117W

49N 48N 47N 46N 45N

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
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513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576

125W 124W 123W 122W 121W 120W 119W 118W 117W

Figure D-33. Seattle Chart Grid

91W 90W 89W 88W 87W 86W 85W 84W

KANSAS CITY

40N 39N 38N 37N 36N

25	26	27	28	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
53	54	55	56	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
81	82	83	84	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
109	110	111	112	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
137	138	139	140	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
165	166	167	168	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168
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445	446	447	448	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448

91W 90W 89W 88W 87W 86W 85W 84W

Figure D-34. St. Louis Chart Grid

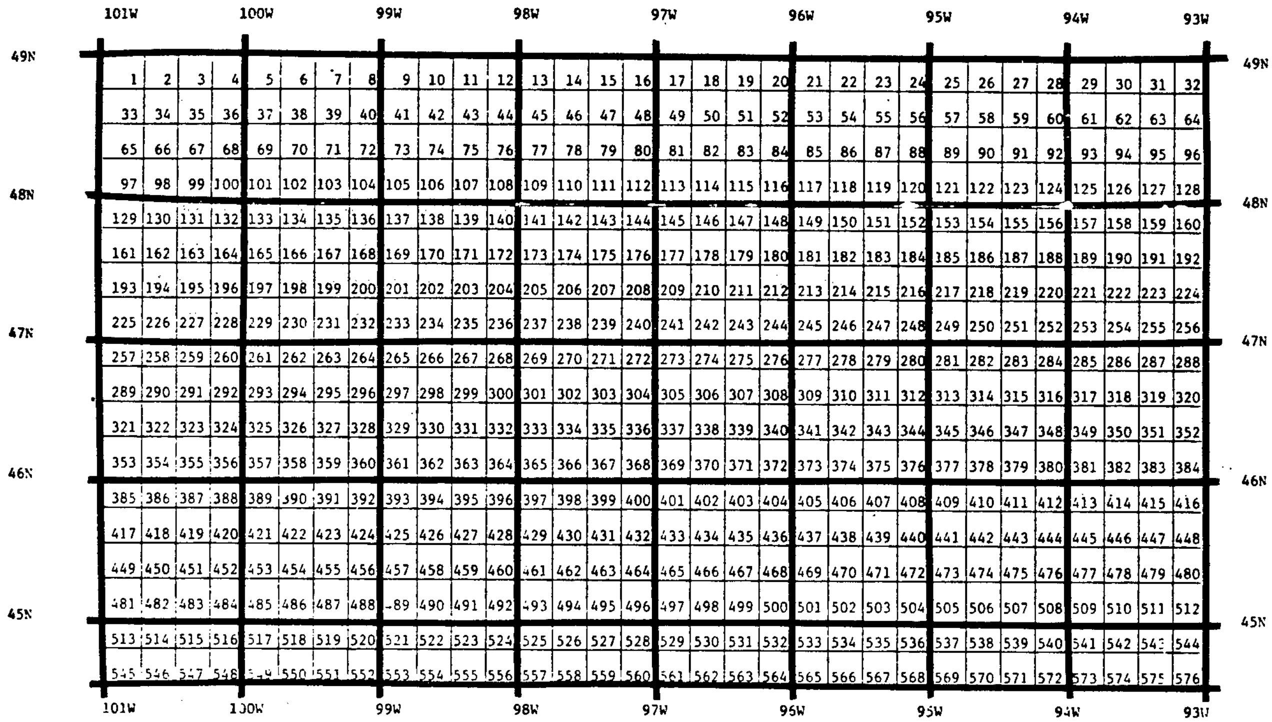

Figure D-35. Twin Cities Chart Grid

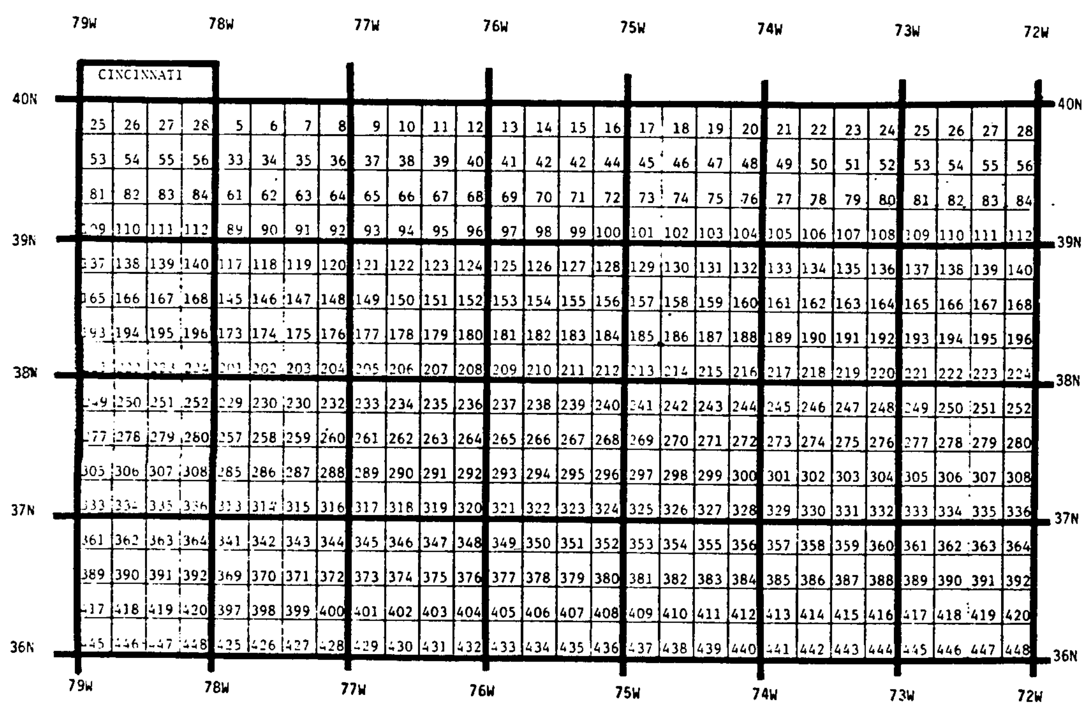

Figure D-36. Washington Chart Grid

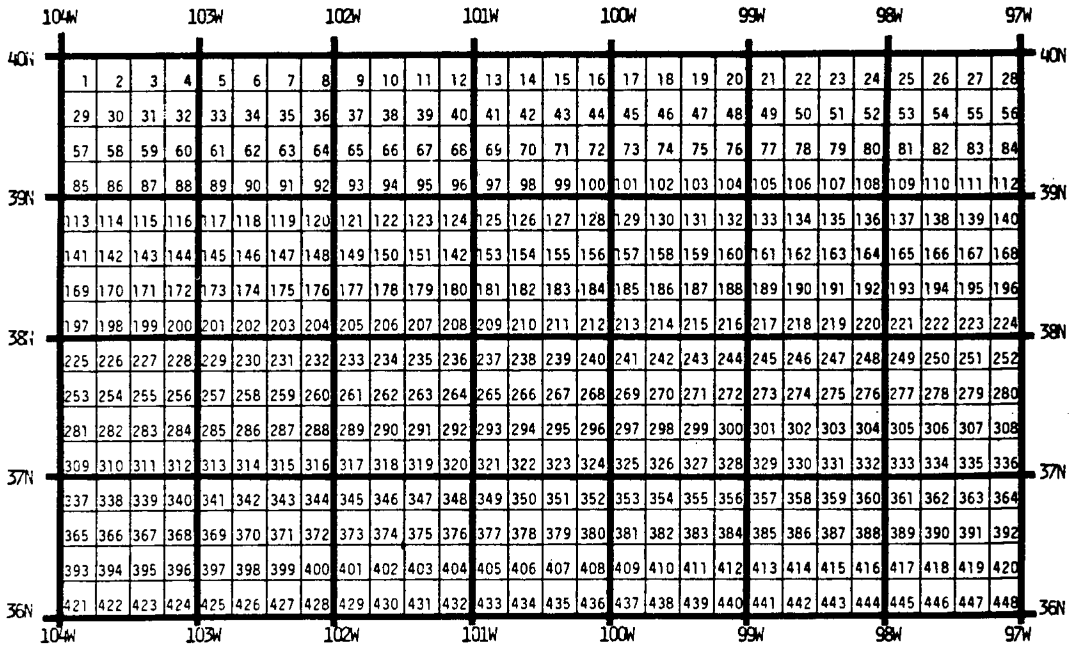

Figure D-37. Wichita Chart Grid

FOOTNOTES

CHAPTER 1:

1 Hayward, J.S., B.Sc., Ph.D., The Physiology of Immersion Hypothermia, in The Nature and Treatment of Hypothermia, edited by Pozos, R.S., Ph.D. and Wittmers, L.E., Jr., Ph.D., Copyright (c) 1983 by the University of Minnesota. Reprinted by permission of the University of Minnesota Press.

CHAPTER 4:

1 Robe, R.Q. and Hover, G.L., Visual Sweep Width Determination for Three Visual Distress Signaling Devices. Report NO. CG-D-30-86. U.S. Coast Guard Research and Development Center, and Analysis & Technology, Inc., September 1986.

2 Robe, R.Q., Lewandowski, M.J., Hover, G.L., and Searle, H.S., Preliminary Sweep Width Determination for HU-25A Airborne Radars: Life Raft and Recreational Boat Targets. Report NO. CG-D-11-88. U.S. Coast Guard Research and Development Center, and Analysis & Technology, Inc., Interim Report December 1987.
[Robe, R.Q., Lewandowski, M.J., Hover, G.L., and Searle, H.S., Sweep Width Determination for HU-25B Airborne Radars: Life Raft and Recreational Boat Targets. Report NO. (pends approval). U.S. Coast Guard Research and Development Center, and Analysis & Technology, Inc., May 1989.]

CHAPTER 5:

1 COSPAS-SARSAT Terms and Acronyms Used in the United States: Adopted by the U.S. COSPAS-SARSAT Program Steering Group, June 1988.

APPENDIX D:

1 Civil Air Patrol Manual (CAPM) 30-15, Attachment 15.

LIST OF EFFECTIVE PAGES

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