CHAPTER 5
STANDARD OPERATING PROCEDURES

GENERAL DIVING PROCEDURES

501. INTRODUCTION

1. This chapter is organized to correspond to the sequences followed during an actual dive. It is designed so that a step-by-step procedure can be followed to assist in each stage of a dive.

502. DIVE PLANNING - GENERAL

1. Safe diving operations start with careful planning. Define the task, and plan carefully for the people, equipment and transportation. Emergencies or delays should be anticipated and planned for. When planning an underwater task, establish the lines of communication necessary for emergency assistance.

2. Upon completing the operation, proper reporting is important. Proper planning makes a hazardous task safer. Proper reporting makes new techniques known and usable and deficiencies in equipment or training correctable.

503. DIVE TASK PLANNING AND EMERGENCY ASSISTANCE

1. The Diving Supervisor must have all relevant information at hand before starting the dive. The information required in Figure 5-1, CAF Diving Emergency Planning and Task Definition Grid, is to be filled-in as appropriate (this form may be locally reproduced).

2. When conducting initial dive planning, CAF diving teams may be required on occasion to designate a non- CAF recompression chamber (RCC) as their primary emergency treatment RCC during diving operations. This may be due to proximity, access, availability, etc.

3. The two most common situations involving non-CAF RCC support are:

   a. Use of civilian RCC in Canada; and

   b. Use of allied forces RCC.

4. Generally, as part of the planning procedure all aspects of the management of a hyperbaric accident must be carefully weighed and considered in advance. Consultation with a Clearance Diving Officer or Clearance Diver QL6B should be conducted early in the planning process. If required, extracts from the following publications should be requested from the local Fleet Diving Unit:

   a. B-GG-380-000/FP-005, Canadian Armed Forces Diving Manual, Vol. 5, Hyperbaric Chamber - Operation and Treatment Procedures, Article 1305;

b. ADIVP-1 (Navy), Allied Guide to Diving Operations;

c. ADIVP-2 (Navy), Allied Guide to Diving Medicine; and

d. D-87-003-000/SG-001, Canadian Armed Forces Standard, Purity of Compressed Breathing Air and Gases for Divers.

5. Local research must be carried out to identify the most appropriate RCC and its location. Foreign civil RCCs are to be avoided as the varying national standards make it that safety cannot be assured. CAF diving teams deploying abroad are expected to be a subcomponent of a larger CAF element directing support services requirements, and they are expected to utilize CAF transportable/mobile RCCs or recompression chambers of allied forces.

6. Use of a Civilian RCC. The following requirements and features shall be reviewed by Supervisors when determining whether a non-CAF RCC is acceptable for use:

a. Essential Requirements of a Civilian RCC:

(1) Capable of pressurization to 50 msw;

(2) Medical grade oxygen used for breathing systems, meeting the standards set out in D-87-003-000/ SG-001 and CSA Standard Z275.2-92, Tables 2 and 3, Occupational Safety Code for Diving Operations;

(3) Proof of an air quality sample meeting standards IAW D-87-003-000/SG-001 or CSA Standard Z275.2-92, Tables 2 and 3;

(4) Use of USN, CAF or CAF-equivalent oxygen treatment tables;

(5) Functional communications between the Diving Supervisor and personnel inside the chamber;

(6) There is adequate illumination of internal areas of RCC;

(7) Functional built-in breathing system (BIBS) with external exhaust ("overboard dump"), or a designed in-chamber air flushing/ventilation system;

(8) Reliable communications can be established between Diving Supervisor and DRDC(T) or ADMO;

(9) Written copy of treatment profile maintained throughout the treatment and made available to the Diving Supervisor immediately upon completion;

(10) Fitted, available and functional fire-suppression system;

(11) Use of non-static clothing for occupants;

(12) Inward-opening clamshell doors; and

(13) Indicating O_2 monitor mounted externally.

b. Desirable Civilian RCC Features:

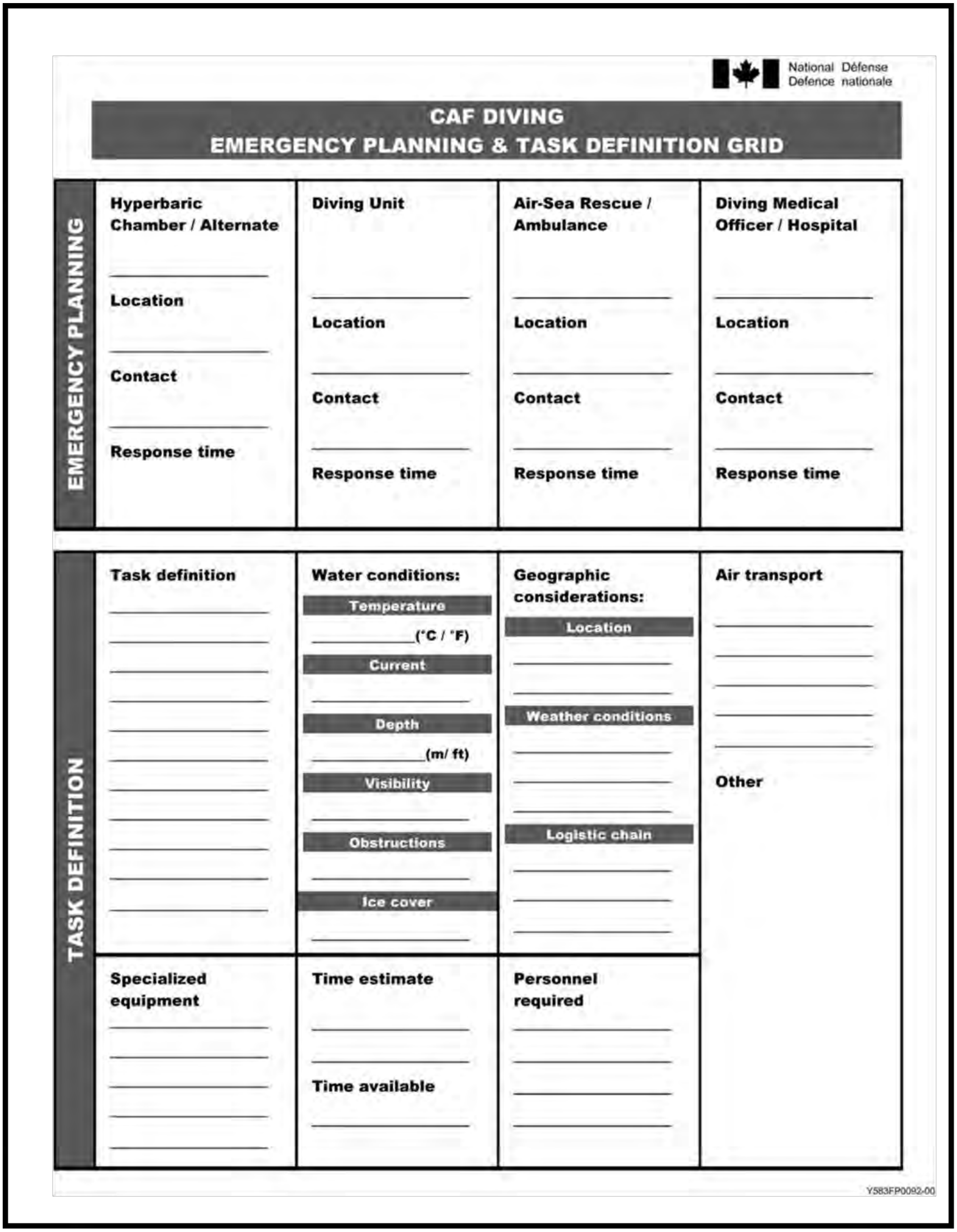
(1) Externally-powered RCC lighting;

(2) Internal environmental control;

(3) Two-lock, two-place configuration; and

(4) Medical lock.

7. Use of RCCs of Allied Forces. Where the RCC is operated by allied forces the guidelines at ADIVP-1 (Navy) and ADIVP-2 (Navy) are to be followed. Such RCCs will generally adhere to procedures and standards of the owning nation.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CAF DIVING
EMERGENCY PLANNING & TASK DEFINITION GRID

EMERGENCY PLANNING

Hyperbaric Chamber / Alternate	Diving Unit	Air-Sea Rescue / Ambulance	Diving Medical Officer / Hospital
Location	Location	Location	Location
Contact	Contact	Contact	Contact
Response time	Response time	Response time	Response time

TASK DEFINITION

Task definition

Water conditions:
Temperature
(°C / °F)
Current
Depth
(m/ ft)
Visibility
Obstructions
Ice cover

Geographic considerations:
Location
Weather conditions
Logistic chain

Air transport

Other

Specialized equipment

Time estimate

Time available

Personnel required

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Figure 5-1 CAF Diving Emergency Planning and Task Definition Grid

505. CABA DIVING STANDARD OPERATING PROCEDURES

1. Supervisor shall confirm **pre-dive checks** are complete and **dive side is correct**.

2. Supervisor shall conduct **dive brief** for task.

3. Supervisor shall ensure divers are ready for the dive by performing **supervisor checks**.

4. CABA underwater swimming procedures **during the descent** are as follows:

    a. Keep mask at ambient pressure by blowing air through the nose to prevent face squeeze and to equalize pressure in ears. If pressure equalization is difficult, rise a few meters, clear and continue descent;

    b. When wearing a dry suit, to control buoyancy and prevent suit squeeze during descent the diver may be required to operate the inflation and exhaust valves on the dry suit (or BC):

        (1) To increase descent rate, activate the exhaust valve; and

        (2) To decrease descent rate, activate the inflation valve.

    c. While descending the diver should expect the volume in the BC or dry suit to decrease as depth increases. The diver must activate the inflation valve to maintain the proper descent rate and to prevent suit squeeze.

5. CABA underwater swimming procedures, while **on the bottom**, are as follows:

    a. If on lifeline, keep lifeline clear and indicate arrival on bottom to attendant. On arrival stop, adjust buoyancy if necessary and orient with respect to the descent line and the work. This may be done by compass, or by observing sunlight or current direction;

    b. If buddy diving, do NOT detach buddy line. In general, the diver should not pass under or through obstructions. In passing around an obstruction keep in mind the side on which passed, to avoid fouling on return;

    c. To maintain neutral buoyancy at working depth the diver may be required to operate the inflation and exhaust valves on the BC or dry suit;

    d. Monitor the SPG. When SPG reads 35 bar the dive shall be terminated; and

    e. (CABA LITE/ULSSDS) If during the dive it becomes necessary to activate the reserve the dive is to be terminated.

6. CABA underwater swimming procedures **during the ascent** are as follows:

a. Look up and keep one arm over the head to prevent inadvertently bumping into something;

b. Breathe normally. Don't hold your breath;

c. To control buoyancy during ascent the diver may be required to operate the exhaust valves on the BC or dry suit. While ascending, the diver should expect the volume in the BC or dry suit to increase as depth decreases; and

d. At the surface the "thumbs-up" signal is to be given until acknowledged by the Diving Supervisor.

506. PROCEDURES FOR DIVING ON A LIFELINE

1. The diver's attendant is the link between the diver and the Diving Supervisor and is often the means of preventing disaster. The attendant must remain alert, in contact with the diver and ready to render assistance at a moment's notice.

2. Attendant's Duties. The following is provided to outline but not to limit the attendant's duties:

a. During descent the attendant must keep all slack out of the lifeline;

b. Once the diver is on the bottom give the diver about 1-metre of slack. This permits the diver to work unhindered but allows the attendant to maintain contact;

c. On receiving a signal from the diver the attendant shall send the same signal back. Emergency signals do not have to be repeated. If the signal is not understood the attendant is to wait until the diver repeats it, then return it;

d. Direction signals, e.g. left and right, are given as though the diver is facing the attendant or shot line;

e. If the diver does not answer a signal the Diving Supervisor shall be informed and the diver's condition should be ascertained as promptly as possible. The diver may not answer for the following reasons:

(1) Diver is in trouble;

(2) Lifelines are too slack;

(3) Lifelines are fouled; and/or

(4) A delay may occur if the diver is too busy.

f. If the diver is working off the bottom the attendant must maintain a firm grip on the lines with a minimum of slack to maintain positive control of the diver.

3. If the lifeline becomes wrapped around the shot line and it cannot be cleared the Diving Supervisor should consider either using the standby diver or recovering the diver and shot line.

507. ULSSDS DIVING

1. ULSSDS is the safest form of diving as air is provided to the diver from the surface and the diver carries a reserve air cylinder to make a safe ascent to the surface. The most recent ULSSDS SOP can be found here: ULSSDS SOP

2. Units may decide not to use this SOP; however, any ULSSDS SOP developed shall have the following information included in the SOP:

a. Confirmation of equipment set up through locally produced checklists;

b. A minimum reserve cylinder air pressure of 280 bar prior to entering water;

c. Reserve cylinder is open before P+ regulator; and

d. Divers landmark critical components before entering water and are able to operate the reserve valve assembly with the left and right hand.

508. WORKING AROUND CORNERS OR INSIDE WRECKS

1. Entrapment, cut lifelines or air hoses or collapse of the structure are ever-present hazards when a diver is working in enclosed spaces or wrecks. Extra precautions are therefore necessary.

2. Working Around Corners. When a diver is required to drag a length of lifeline or lifeline/air hose around corners a diver should be stationed at each corner to tend lines.

3. Wrecks. CABA diving is NOT authorized inside wrecks other than for rescue purposes.

a. As detailed in Chapters 7 and 8, only personnel trained in overturned vessel (OTV/CSRD) rescue procedures are authorized to conduct training inside wrecks

b. Refer to Chapter 5, Annex A, Guidelines for Survivor Extraction from Overturned Vessels.

509. CURRENT OR TIDEWAY

1. The Diving Supervisor must be acquainted with the times and characteristics of the tides and consider that the surface stream is not normally the same as the stream at the bottom. Diving in a tide is potentially dangerous and the Diving Supervisor must decide whether conditions are likely to endanger the diver.

2. Those not experienced in tidal diving will be uncertain as to whether the tide has slackened sufficiently to allow a diver's descent. This uncertainty can best be removed by allowing the diver to try a "testing the tide" descent with the understanding that the diver should return to the surface if the tide is still too strong for managed and safe diving. The behavior of the shot line will give a good indication of when a diver may usefully be sent down.

3. A method of diving in strong tidal streams is to securely anchor the boat upstream of the task and send the diver down the shot line, which is downstream. The diver cannot return to the surface by the shot line under these circumstances and will need to be pulled up. If necessary, the diver must let go of the shot line altogether. This method must NOT be used if the diver has to undergo decompression stops.

4. If there is any doubt of the "plodding" diver's ability to control ascent because of the strength of the current, the diver should be instructed to "keep heavy" and allow the attendant to pull the diver up slowly. Meanwhile, the diver should maintain a good grip on the shot line with legs and both hands.

5. Before the current becomes too strong to remain on the shot line, the Diving Supervisor must ensure that the diver is called up in time to complete any necessary decompression stops and to surface.

6. When divers are in swimming rig, drifting stops using a lazy shot may be safely employed. This prevents the diver being maintained at too shallow a depth because of the catenary of a fixed shot line in a strong stream. In addition, it provides much more comfortable conditions when a sea is running.

7. It is particularly difficult to clear a diver who becomes fouled in a strong tidal stream.

8. A strong swimmer can only maintain a speed of one knot, with bursts of speed of up to two knots. Swimmers must practice using the current to assist them in their tasks.

510. DIVING LIMITS AND HAZARDS - CURRENTS AND TIDAL STREAMS

1. The adverse effects on divers operating in currents and strong tidal streams are numerous. Divers attempting to maintain a fixed position on a task, while in fast flowing water, will be subjected to enormous forces. These may be exerted directly upon divers and their equipment, or translated via lifelines or buddy lines. A single diver facing a current between two to six knots (about 1 to 3 meters/sec) may experience forces between 50 to 700 lbs, depending upon orientation to the current and equipment worn. Buddied divers on a single lifeline could double these forces on the line. Working against such forces will quickly exhaust a diver, and a minor incident can escalade rapidly into a life-threatening emergency. There is also a high risk of entanglement, loss of breathing supply, loss of equipment components, embolism, and impact injury. This section outlines the potential hazards, procedures to reduce risks, and consideration when planning operations in such conditions.

2. The table below illustrates current speeds in relation to diving equipment. Operating in currents exceeding those listed is not only ineffective, but a severe hazard to the diver. Diving in currents exceeding these limits shall only be carried out by order of a Commanding Officer or SAR aircraft commander, taking into account the type of diving equipment, the experience of the diver and the team, and the operational necessity. These limits do not apply to towed diver search methods, which are specifically designed to account for this and can offer some protection from the water forces, plus offer methods for the dive to abort the search with relative safety.

CABA/ULSSDS	Maximum Water Current Knots	km/Hour	m/sec
Initial Training	1.5	2.75	0.75
Proficient Diver	2	3.75	1
Ice Diving	1	2	0.6

Figure 5-2 Recommended Current Limits

3. Surface Current Generated by Wind. Wind-generated surface currents are temporary and depend on the force, duration, and direction of the wind. This surface current must be taken into consideration, especially when working on or near the surface, and when diving on moored vessels or installations. It must also be remembered that an anchored vessels generally "sails" through a regular figure-eight pattern around the mooring centerline and that divers must constantly swim to maintain a position on the hull.

4. Current and Fast Water Hazards. The characteristics of rivers and other fast water hazards vary considerably. Factors in addition to the current velocity must be considered. By identifying potential hazards, divers and supervisors will be able to conduct diving operations with less risk to the divers and greater possibility of mission success. Significant factors to consider are:

a. Underwater Obstacles. There is the potential for divers to become fouled on objects underwater. The hazard increases in currents, especially near logs, rock outcrops, tree roots, abandoned equipment, and debris from destroyed infrastructure.

b. Floating Objects. Objects carried by the current, on or below the surface, pose an extreme risk to a diver, particularly during floods and spring run-off, when divers are often called to assist. If the situation allows, a snag line, boom, or fence may be positioned upstream of the dive site to reduce the risk of material being carried in the current. The snag line or boom must be monitored in case large objects, or a large amount of objects, break free.

c. Whirlpools and Eddies. These hydraulic effects are caused by natural and manmade obstructions to current flow. Eddies and whirlpools can disorient and trap a diver.

d. Current Fluctuations. Precipitations, tides, and structures such as dams and lock systems can affect the water levels or volume of water and current velocity. Precipitations and its effect on the waterway must be considered and can be usually forecasted. Hydrographic publications can provide useful data. The existence of upstream dams and similar systems must be determined, as well as the controlling authority and their operating procedures. Hydroelectric dams, in particular, may release large volumes of water without warning.

e. Water Turbidity. Rapid and turbulent currents generally cause reduced or nil visibility, as the bottom sediments will be carried up into the water column.

5. Equipment Considerations. The following must be considered when diving in currents:

a. Mask and Regulators. Strong currents will tear off masks and can also cause regulators to free flow by pressing against the purge mechanism. In zero visibility, this could lead to rapid air consumption undetected by the diver, owing to the other turbulence around the head and mask. The use of a full-face mask and orientation of the diver to the current can reduce these risks.

b. Weights. Adding weights or donning a weighted vest may assist in maintaining stability and depth. Emergency surfacing and the ability to ditch weight must not be overlooked.

c. Surface Supplied BA. A diver dressed in a surface-supplied system (ULSSDS) will generally be better able to cope with strong currents. Surface-supplied systems also provide voice communication to the diver, and the umbilical has greater strength than a standard lifeline. However, the water drag on an umbilical can be heavy.

d. Plodding Boots or Fins. Fins will allow the diver greater mobility but limited stability. Weighted boots assist in stability and provide protection, however soft river bed and lake bottoms can make the use of boots difficult. A diver working on a soft bottom in a current may soon become exhausted, depending upon the task.

e. Personnel Protective Equipment. Purpose-built helmets, elbow and knee pads may be worn when feasible.

f. Communications. Standard lifeline communications in fast water are generally not effective. As depth or distance increases, line pull communications will become completely masked by the catenary formed by the current. Through water communication systems may suffer from interference or background noise created by currents. Hard wire communications audio may be reduced by turbulence noise around the divers head.

511. WATER INLET/OUTLET HAZARDS

1. There are two types of pressure differential that can create water inlet/outlet hazards:

a. The first is the hydrostatic pressure differential that can be found between bodies of water separated by a barrier, where one body of water is at a higher elevation; and

b. The other is the mechanical pressure differential that exists when water is pulled from a lower elevation to a higher elevation, normally by a pumping system.

2. Any pressure differential creates the following hazards to divers: disorientation, impact injuries and entrapment.

3. Hydrostatic pressure differentials can be found in the following examples:

a. Dams;

b. Weirs;

c. Water reservoirs;

d. Navigational locks;

e. Under ice at the outlet of a lake;

f. Accidental water damming caused by ice, debris or log jams; and

g. Between compartments of submerged vessels, vehicles or aircraft.

4. Mechanical pressure differentials can be found in the following examples:

a. Water/liquid treatment plants;

b. Industrial complexes requiring water-cooling;

c. Fossil fuel/nuclear power generating facilities;

d. Vessels and floating platforms requiring water-cooling and/or water for consumption; and

e. Water filtration pumping systems in swimming pools and tanks.

5. Divers conducting dives in areas where there is the potential of encountering a pressure differential require the following information:

a. Exact location of the inlet/outlet;

b. Safety features employed at the inlet, e.g. grates;

c. Flow shut-off mechanisms, if applicable;

d. Flow velocity at entrance of inlet/outlet; and

e. If flow cannot be shut off or isolated, distance at which flow has a negligible effect on divers.

6. Dives conducted at or near an inlet/outlet must comply with the following procedures:

a. Article 602 details the procedures for diving on or near ships and is to be used as a template when diving near floating platforms.

b. All members must be briefed on hazards and the measures used to mitigate them.

c. Where there is a possibility of entrapment, two-way voice communication systems must be used.

WARNING

If the diver becomes entrapped by a pressure differential, it is likely that any rescuer will also become entrapped if the flow is not halted first. The force of pressure differentials can be in the order of hundreds or thousands of pounds, and far greater than the strength of the rescuer or the lifeline.

d. Do NOT conduct a dive without a lifeline. The attendant must be outside of the approach area.

e. In all but exceptional cases, the flow of water must be shut off before the diver enters the water. Water flow can only recommence once all personnel are clear of the area. Where conditions do not allow for the flow of water to be shut off, diving can only be conducted under the authority of the Commanding Officer.

512. GUIDELINES FOR SURVIVOR EXTRACTION FROM OVERTURNED VESSELS

1. The rescue of survivors from an overturned vessel is of the more dangerous situations a CAF diver will encounter. The rescue of survivors of a marine disaster is best left to those CAF divers that have been properly trained in survivor extraction techniques, i.e. Search and Rescue Technicians (SAR Techs) and Clearance Divers (CL DVR).

2. Although it is unlikely that a non-SAR CAF diving team would be tasked to conduct a rescue, Chapter 5, Annex A, Guidelines for Survivor Extraction from Overturned Vessels, is designed to give the diving team some basic information that should be considered prior to the attempt.

3. Rescue diving procedures are detailed in:

(1) Chapter 5, Annex A;

(2) Standard Manoeuvre Manual (SMM) 60-130-2605 (SAR),SAR Tech CABA Diving Operation;

(3) SMM 60-149, Cormorant;

(4) (4) B-GA-002-146/FP-001, Griffon;

(5) RCAF Flight Operations Manual (FOM),Search and Rescue Technician Safe Training Practices; and

(6) OJTS SAAC TRSET Directive.

4. Diver's lifeline shall be utilized IAW RCAF Flight Operations Manual (FOM), Search and Rescue Technician Safe Training Practices. The remainder of the SAR Rescue Diving configuration is at the discretion of the on-scene SAR Tech Supervisor using guidelines and SOPs IAW Chapter 5, Annex A.

513. ICE DIVING STANDARD OPERATING PROCEDURES - CABA/ULSSDS

1. Ice diving is a specialized form of CABA/ULSSDS diving that introduces several additional hazards to the diving environment, such as equipment freeze-up, hypothermia and diver entrapment. However, divers properly trained and experienced in under-ice and cold weather diving have an extremely low accident rate. Although ice diving techniques are not so very different, planning for ice diving operations includes additional safety precautions and equipment.

2. Refer to Chapter 5, Annex B, Ice Diving Standard Operating Procedures - CABA/ULSSDS.

514. TOOLS

1. Always use the proper tool for the job. Special adaptations may be required to make surface tools usable in the water. Dropped tools are easily lost in limited visibility or in silt and should have a buoyant brightly colored lanyard attached to aid location.

2. Tools that the diver carries should be fitted with a lanyard that can be slipped over the arm.

3. Since the diver can carry only a limited weight or volume on descent or ascent, arrangements should be made on the surface to ensure that the proper tool arrives at the task site at the time the diver needs it.

4. A heavy canvas tool bag fitted with drains is useful for sending tools to the diver.

5. A suitable tool line should be run from the surface to a point at hand to the diver, with sufficient angle that the tool bag will sink to the task site. A light in-haul line is used by the surface to retrieve the tool bag.

NOTE

> To lower tools, attach them to a shackle on the tool line and control them in the same way as the tool bag. Care should be taken to ensure the shackle pin cannot come free while working the tool line.

515. LAZY SHOT DIVING PROCEDURES

1. Lazy shot diving is a specialized form of CABA diving. Situations may arise which make it necessary to dive in unknown waters to recover lost equipment. The lazy shot is used to control a diver's depth during in-water decompression stops when they have exceeded No-D limits IAW CAF Air Diving Tables 1S or 1.

2. A tender must be made available when lazy shot diving.

NOTE

> The shot line assembly must be light enough to be physically hauled up by a minimum of two (2) persons in case of a fouling situation.

3. Supplementary decompression/lazy shot signals are used in lazy shot diving. See Figure 5-3.

DIVER to ATTENDANT

At bottom: **1 –PULL**	**I have made bottom. I have left bottom.**
At the first stop: **1 –PULL**	**OK.**
At The first stop: ***3-Bells***	***I have exceeded planned max depth***
At the first stop: **2 –PULLS followed by 2 –BELLS**	**I have reached the lazy shot. I have disconnected the lazy shot.**

ATTENDANT to DIVER

2 –PULLS followed by 2 –BELLS	**Disconnect the lazy shot from the shot line.**

Figure 5-3 Supplementary Decompression/Lazy Shot Signals

4. Procedures

a. Diving Supervisor's Considerations in Lazy Shot Diving:

(1) Maximum depth of the dive,

(2) Size of team to safely carry out the dive,

(3) Distance to the RCC,

(4) Review "Omitted-D" procedures,

(5) Tides, currents and wind, and

(6) Water and air temperature.

b. Required Equipment. For required equipment see Figure 5-4.

5. Lazy shot and associated equipment for decompression diving must be deployed when the possibility of decompression diving exists or when diving deeper than 30 m.

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LAZY SHOT DIVING REQUIRED EQUIPMENT

______1) **SOUNDING LINE and/or hand-held DEPTH SOUNDER**

______2) **SHOT LINE**

6m longer than maximum depth expected, 18 mm (3/4 in.) dia. synthetic line marked IAW Article 124.

______3) **LEAD SHOT**

7 – 14 kg

______4) **DANFORTH ANCHOR**

4.5 kg

______5) **CHAIN**

6 mm , 2 – 2.5 m in length

______6) **SEARCH LINE**

10 m in length, 10 mm dia. synthetic line

______7) **CHEM-LITE**

Minimum of one is required. A distinctively coloured Chem-Lite shall be attached to the lazy shot during night diving operations.

______8) **LAZY SHOT**

12 m in length, 9 mm dia. synthetic line, marked IAW Article 124.

______9) **WEIGHT, LAZY SHOT**

7 – 14 kg *(the heavier is used if fast tides or current are expected)*

_____10) **DIVER'S LIFELINE**

60 m in length, 9 mm dia. synthetic line marked IAW Article 124.

_____11) **CARABINER *(preferred)* or a Shackle**

One 10 cm on a 30 cm pennant to lazy shot weight

_____12) **SHACKLES**

Qty 2, to connect chain to Danforth anchor and to shot

_____13) **FLOAT, 'NORWEGIAN'**

Attached to the end of the shot line prior to being lowered. Buoyant enough to keep the assembly up in the event it is dropped at depth exceeding 30 msw.

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Figure 5-4 Required Equipment for Lazy Shot Diving

6. Diving with a Lazy Shot:

a. Take sounding of dive site;

b. Lower to bottom:

(1) Danforth anchor (4.5 kg);

(2) Shot (lead, 7 - 14 kg);

(3) Shot line (6 m longer than maximum depth expected, 18 mm dia. synthetic, marked IAW Article 124);

(4) Search line (coiled, 10 m n length, 10 mm dia., synthetic); and

(5) Chem-Lite (minimum of one attached 3 m from bottom).

c. Plumb the float (take up slack) and confirm depth;

d. Secure the dive boat to the float;

e. Brief diving team;

f. Divers enter water;

g. Divers descend to the bottom at a rate of 18 mpm or slower;

h. Tender gives maximum lead angle on the lifeline to prevent the diver(s) from getting tangled around the shot line;

i. Divers on reaching bottom signal with 1 - PULL ("I HAVE MADE BOTTOM"), extend anchor out from shot and continue dive task;

j. On the surface, secure running end to boat and clip lazy shot to main shot line.

(1) When no decompression stop is planned, the lazy shot may be clipped to the shot line and remain in the boat.

(2) The lazy shot shall be at ready notice to be lowered to the 6-metre mark.

k. Upon completion of the task or when the divers are recalled, the divers signal the surface when leaving bottom with 1 - PULL ("I HAVE LEFT BOTTOM"), then proceed to the lazy shot at an ascent rate of 18 ±3 mpm;

l. When decompression is required, the lazy shot is lowered over the side and the divers align the lazy shot with the centre of their chests. Divers: DO NOT PASS THE LAZY SHOT. The lead diver signals the surface with 1 - PULL ("OK");

m. If the lazy shot must be disconnected from the shot line (e.g. due to currents /wind) the Supervisor will signal the lead diver 2 - PULLS followed by 2 - BELLS ("DISCONNECT THE LAZY SHOT FROM THE SHOT LINE"). The diver will disconnect and then acknowledge;

n. In a strong tideway or open sea the diving boat should be allowed to drift free to ensure that the diver is kept as close to the correct stop depth as possible. Failure to do this may cause the shot to maintain an angle and compromise the diver's decompression;

o. Drifting stops: The diving boat should be an inflatable, which has the advantage of riding seas well and causing minimal disturbance and hazard to the diver;

p. The Diving Supervisor has the lazy shot raised to the designated stop; and

q. When the 3-msw decompression stop is completed the Diving Supervisor will have the lazy shot raised to the surface. The diver is to follow the lazy shot to the surface.

NOTE

If there is a possibility that the diver's air supply is low, and if an additional dive cylinder is available, fit it with a standby dive regulator (two second-stages) and send it down the lazy shot.

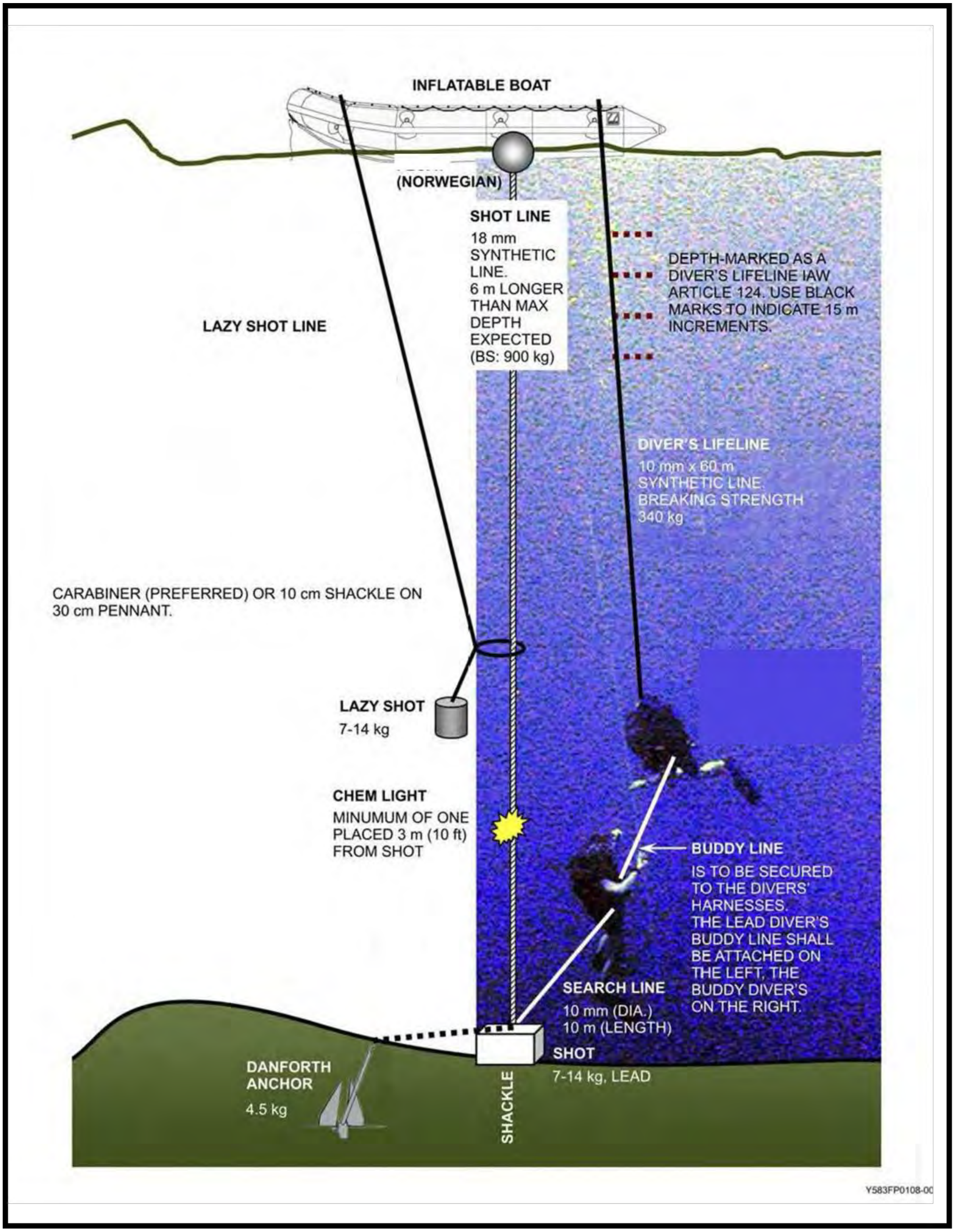

Figure 5-5 CABA Lazy Shot Diving, General Arrangement

SEARCH PROCEDURES

516. INTRODUCTION

1. A number of search procedures are described in the following articles. They are intended as a guide in searching the seabed.

2. No single search technique will be usable in all areas and under all conditions. To carry out a proper search the Diving Supervisor planning the operation must take into consideration the following:

   a. Weather conditions;

   b. Sea state;

   c. Underwater visibility;

   d. Nature of the sea bed;

   e. Currents;

   f. Location, size, shape and depth of area to be searched;

   g. Size and shape of object searched for;

   h. Accuracy of the datum and navigation method;

   i. Water temperature;

   j. Number of divers available; and

   k. Craft, diving equipment and support facilities available.

3. Finding an object on the seabed frequently takes more planning, time and labour than the actual work on the object itself once it has been located. Efficient and effective underwater searches therefore become an integral part of almost every diving operation.

4. The seabed search techniques described in this section are considered to be the most efficient and thorough methods of systematically covering a given area. However, they may have to be modified to suit the conditions prevailing at the time.

5. Basic seabed searches used by CAF divers are:

   a. LIFELINE SEARCH;

b. CIRCULAR SEARCH;

c. TOWED-DIVER SEARCH; and

d. LIGHT JACKSTAY SEARCHES;

(1) SNAGLINE SEARCH;

(2) GRID SEARCH ; and

(3) MULTIPLE-DIVER SEABED SEARCH.

517. LIFELINE SEARCH

1. A lifeline search (see Figure 5-6) is used off to locate objects within a limited distance.

2. The diver stretches out the lifeline until at its maximum distance 60 metres from the attendant at the start point.

3. Keeping the lifeline taut, the diver commences the search until reaching the shore or jetty or receiving a signal from the attendant to stop.

4. The diver then moves-in twice the visibility distance or two arm lengths and, again keeping the lifeline taut, searches in the opposite direction.

5. This operation is repeated until the area is covered.

6. If the object is located, the diver secures a marker line to it and swims back to the tender.

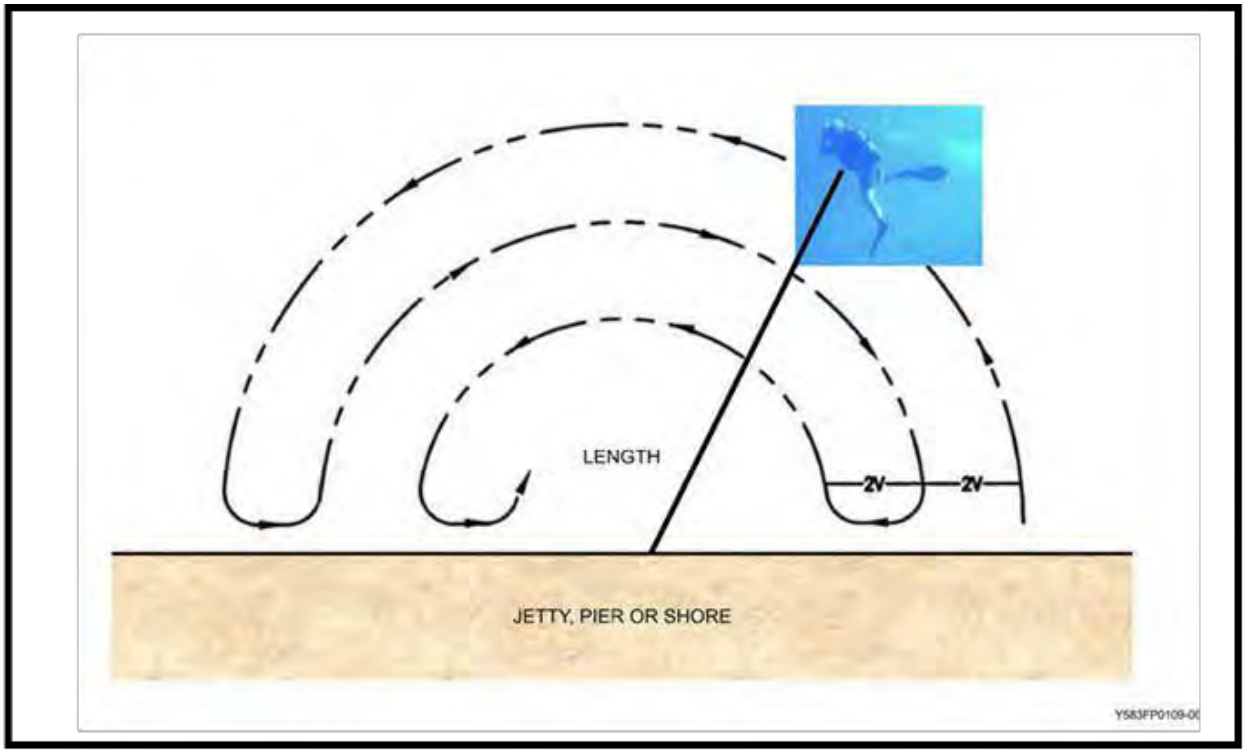

Figure 5-6 Lifeline Search

518. CIRCULAR SEARCH

1. The circular search (see Figure 5-7) is the simplest form of seabed search to undertake because it involves a minimum of people and equipment to make it effective. It is an efficient technique for covering an entire area and should be used when the position of the object to be found is known with reasonable accuracy.

2. Equipment required includes:

   a. A buoy,

   b. A shot line,

   c. A shot and

   d. A distance line.

3. The diver swims down the shot line, breaks out the distance line and moves away from the weight until the distance line is fully extended. At this point the diver should, if possible, note or mark the seabed as a starting point to indicate when the first circle has been completed.

4. Holding the distance line taut, the diver moves in a circle. When there is no visibility, the attendant will control the diver's position.

5. When the circle is completed, the diver moves-in on the line for twice the visibility distance and starts a circle in the opposite direction.

a. If visibility is limited the diver moves-in on the line for two arm lengths.

b. If a lifeline is used the surface attendant signals the diver to indicate when the circle has been completed.

CAUTION

If the direction of search is not reversed after each circle, the lifeline will become fouled around the shot line and signals will not be transmitted. In poor visibility this will make it impossible to conduct an efficient search.

6. Variations of the circular search may be carried out as conditions dictate.

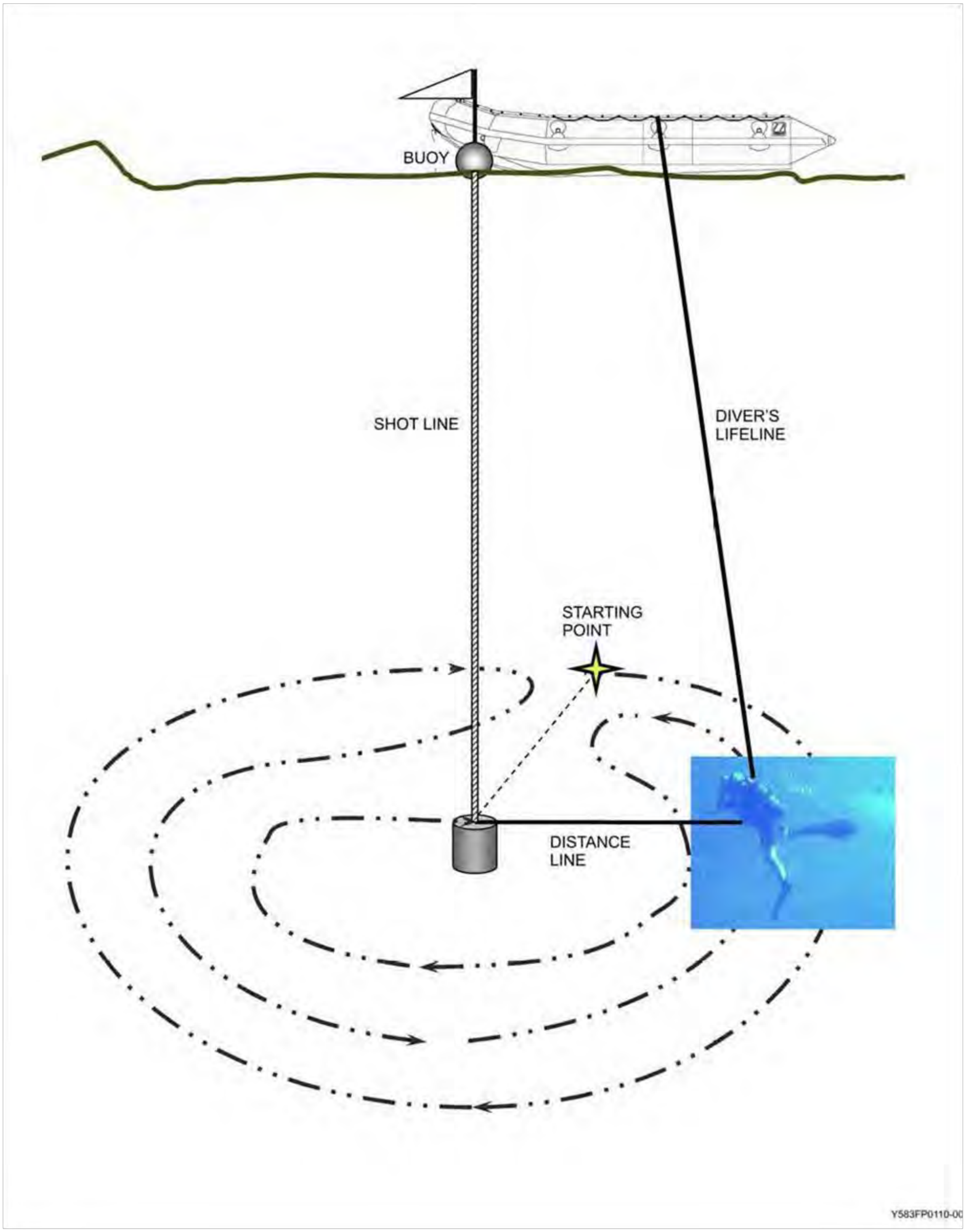

Figure 5-7 Circular Search

519. TOWED-DIVER SEARCH

1. The towed-diver search is used as the precursor to one of the more thorough seabed searches. It should be used only when the visibility is good and the seabed is reasonably flat. Under these conditions, the towed diver search may be used to cover an extensive area in a relatively short time.

2. The diver is towed behind the boat at a speed of 2 - 3 knots. Methods such as sinker and toggle or planning board should be used to allow the diver to control depth and some side-to-side direction.

3. The diver should be neutrally buoyant as for swimming. Since a towed diver is not active, the diving dress should be selected to provide adequate warmth, as the diver is likely to feel cold even in moderately warm water.

4. The diver and Supervisor must discuss signals for indicating speed, change (right or left), bailout and stop, as the diver will be secured to a line about 4.5 metres longer than the depth of water, with a marker float secured to the end of it.

5. During towing, the marker or float should be retained inboard to be used as a signal line.

   a. It should be thrown overboard only when the diver bails out.

   b. Keeping the marker line in hand in the boat also prevents it causing any unnecessary drag on the diver.

   c. For decompression purposes the marker line is to be tied off at the maximum depth used for planning the dive.

6. The towed-diver search makes up in speed for what it lacks in accuracy. Even a well-buoyed search area will not guarantee success.

NOTE

> Efficiency of searching deteriorates rapidly in adverse conditions of visibility, temperature and navigation.

Signal	From Diver	From Attendant
1 - PULL	Affirmative; Confirmation; OK.	Are you all right?
2 - PULLS	Less speed.	
3 - PULLS	More speed.	
4 - PULLS	I am surfacing.	Surface.
2 - BELLS	Shorten tow.	
3 - BELLS	Lengthen tow.	
4 - BELLS	I am bailing out.	
5 - BELLS	Let go the shot.	

Figure 5-8 Code for Passing Signals by Marker Float line in a Towed-diver Search

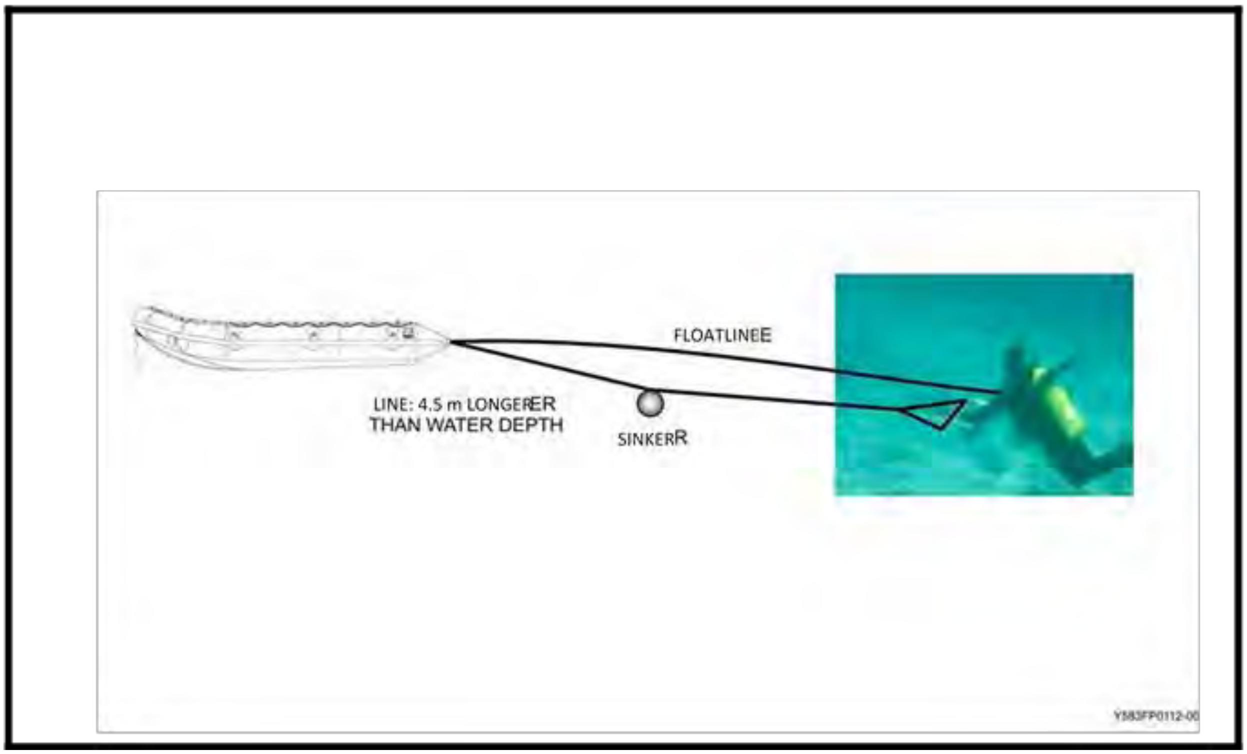

Figure 5-9 Towed-diver Search

520. LIGHT JACKSTAY SEARCHES

1. Searches conducted using the light jackstay, although slow, are the most reliable. When faced with unfavourable seabed conditions and poor underwater visibility, a search using light jackstays (i.e. snag line, grid and multiple-diver seabed searches) is the only search that can promise any success.

2. If an area is too big to be covered all at once, the search must be so rigged that it can be shifted to an adjacent section without creating gaps and wasteful overlaps.

3. Buoys must mark each cleared section.

4. The light jackstay and the technique for its use have been developed to lay guidelines quickly and accurately on the seabed for diving searches.

5. The jackstays are made up in 900 m lengths with sinkers, risers and floats spaced evenly every (90 m).

6. Light Jackstay Components. (see Figure 5-10) The equipment has been designed for assembly from local resources using the following components:

a. Chute. This is constructed of aluminium and is long enough to contain the component parts of a 900 m jackstay.

b. Jackstay Reel. This is constructed of aluminium mounted on a wooden platform fitted with a windlass handle and brake. It should be capable of carrying a minimum of (1800 m) of jackstay line.

c. Jackstay. The jackstay is a 3 mm nylon line in 90 m lengths with Inglefield clips at each end. Gun line or parachute shroud line is suitable.

d. Sinkers. A sinker is a lead weight weighing approximately 7 kg with an eyebolt on it.

e. Hook Lines. These are pieces of 12 mm nylon line, half a metre in length with spring clips seized in each end.

f. Risers. Made from 12 mm nylon line with spring clips seized in each end, the finished risers are either 9 m or 18 m in length. They are combined for depths between 18 and 27 msw.

g. Floats. May be constructed from plasticised Styrofoam, each float has a 60 cm length of broom handle through the centre with a canvas flag painted day glow red nailed to the top end and a grommet containing a spring hook seized to the bottom end.

7. Preparing to Lay the Light Jackstay. Prepare to lay the light jackstay as follows:

a. The jackstay reel is secured to the floorboards of the inflatable boat.

b. The required number of jackstays are clipped together and reeled evenly onto the jackstay reel.

c. The chute is secured to the top of the portside gunwale of the inflatable.

d. One end of the hook line is clipped to the eyebolt on the sinker.

e. Risers are coiled, as illustrated in Figure 5-11, to prevent fouling when being laid.

f. One end of the riser is clipped to the eye bolt on the sinker and the other end is clipped to the grommet on the float.

g. The length of the riser depends on water depth:

(1) Less than 9 msw: 9 m risers are used.

(2) Between 9 and 18 msw: 18 m risers are used.

(3) Between 18 and 27 msw: Both risers are combined.

8. **Laying the Jackstay**:

a. Two people are required to lay the jackstay: one to drive and one to lay the jackstay.

b. Lay the jackstay as follows:

(1) The outboard end of the jackstay is clipped to the nearest line.

(2) The boat is manoeuvred toward the starting position of the jackstay line and its course set along the required direction of the jackstay.

(3) On reaching the starting position, the first sinker is pushed out of the chute and the boat is driven at a suitable speed.

(4) The sinker will sink to the bottom taking the riser with it, while the float remains on the surface. The sinker pulling on the jackstay will also cause the reel to turn and the jackstay will be laid out on the seabed/

(5) As the jackstay runs out, it passes through the eye of the spring clip on the second hook line until the Inglefield clips joining the first and second lengths come up against the spring clip. This will then drag the second sinker from the chute. The sinker will fall to the seabed, pull out the riser and leave the float on the surface above it.

(6) As soon as the sinker has gone, the third hook line should be clipped to the jackstay. This procedure should be repeated until the whole jackstay has been laid, the sinkers being slid aft as space becomes available in the chute.

WARNING

If the reel handle of the jackstay reel cannot be removed, care must be taken to keep clear of it while laying the jackstay or injury may result.

9. **Recovering the Jackstay**:

a. An additional person will be required to reel-in the jackstay.

b. As the sinkers are not positively secured to the jackstay but held only by the hook line clips, the jackstay should be recovered in the same direction in which it was laid.

c. Recover the jackstay as follows:

(1) The boat proceeds to the first float laid and recovers it.

(2) The attached sinker is recovered by the individual amidships who separates it from the jackstay and secures the jackstay to the reel.

(3) The bowman reels-in the jackstay and the boat is driven towards the next float. Care must be taken when the jackstay is reeled-in to ensure that it lies evenly and tautly on the drum, otherwise it will cause riding turns and foul during the next laying.

(4) When the next float is reached it is recovered and the procedure repeated until the whole jackstay has been reeled-in.

(5) While the recovery is in progress, the boat driver should maintain a course and speed that keeps the jackstay taut enough to prevent it leaving the reel, but not so taut that it bites into the turns already on the reel.

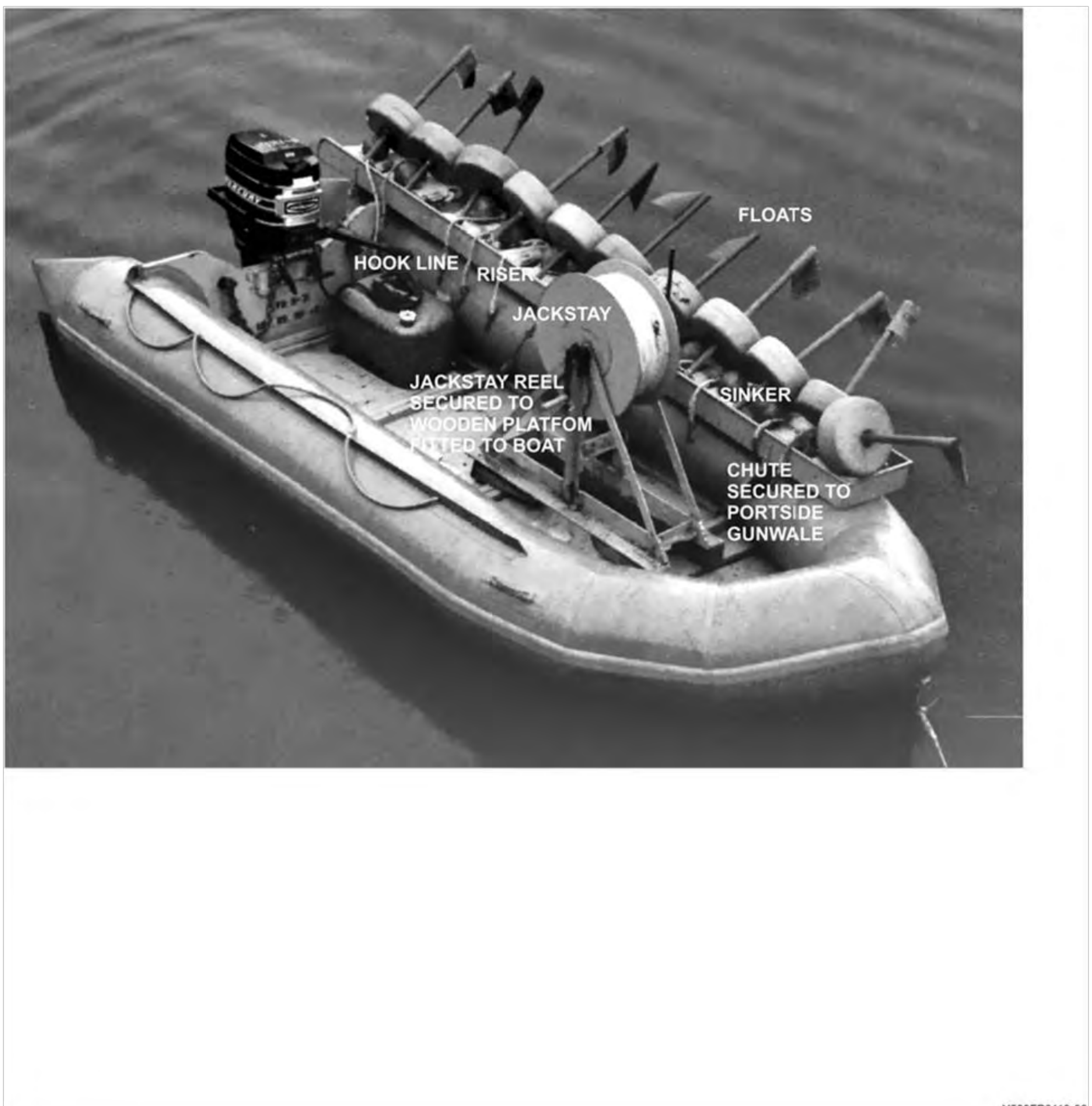

Figure 5-10 Light Jackstay Components Mounted on an Inflatable Boat

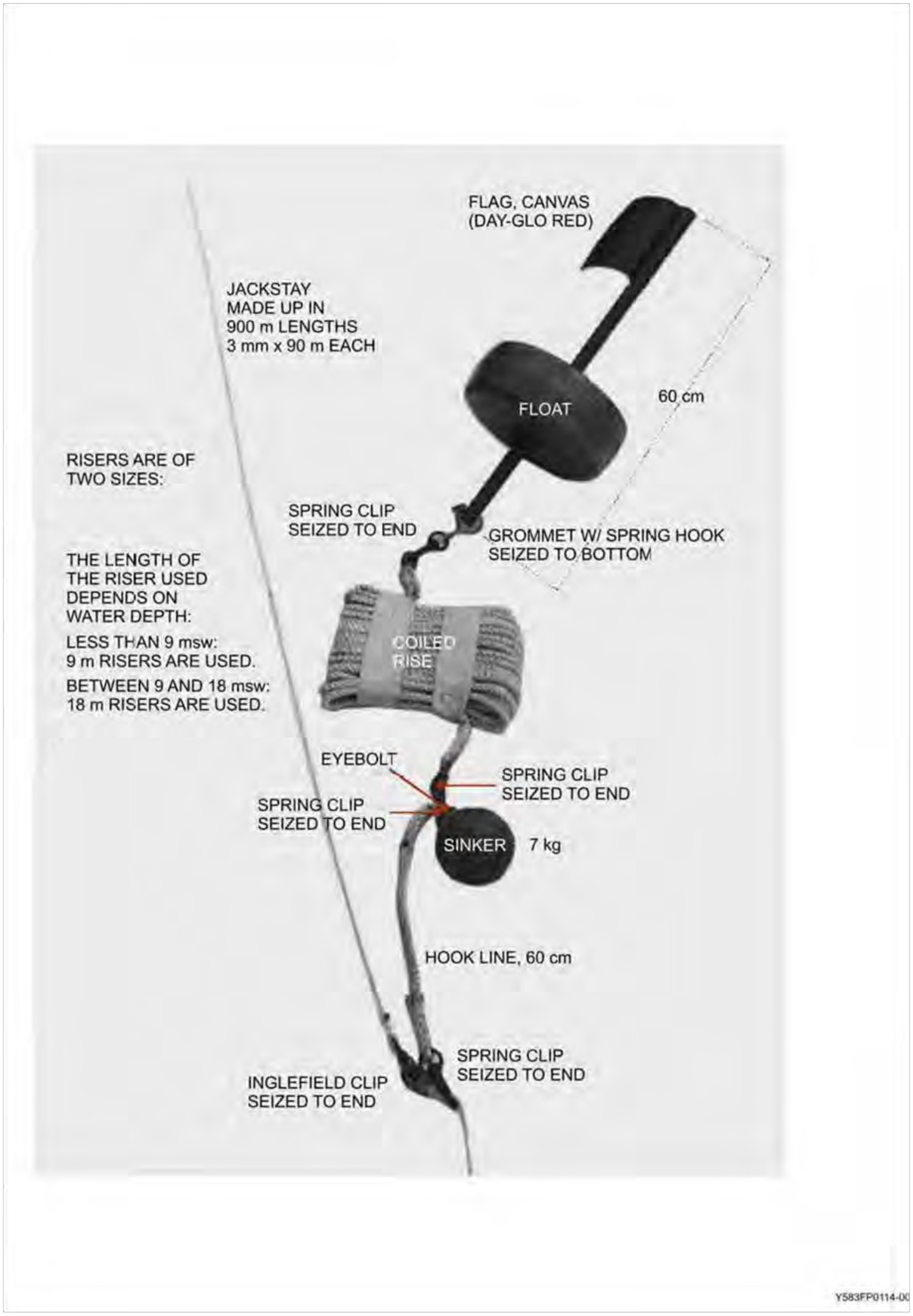

Figure 5-11 Riser Assembly, Light Jackstay

521. SNAG LINE SEARCH

1. A snag line search is used when the seabed is reasonably flat and clear of obstructions and the object to be found protrudes a good distance from the seabed. Jackstays are laid parallel to each other in sufficient numbers to cover the area to be searched. The length of the jackstays and the distance between them will vary to suit the situation.

2. To carry out the search, two divers descend one on each leg of the jackstay, holding between them a snag line. On the bottom, the senior diver signals to commence the search and the two divers move downstream on their respective jackstays. The divers surface at the end of their jackstays. As prearranged, one diver brings up the snag line.

3. If the snag line fouls, both divers bend the line onto their jackstays and go along it to the snag. If it is the object of the search it is marked with the marker buoy. If it is not, the snag line is cleared and the divers return to their respective jackstays and continue the search.

4. After the first leg of the jackstay is searched and if tidal/current conditions permit, the divers swim back along the next leg of the jackstay, searching as before. If the current prevents this, the swimmers surface, are picked up by the safety boat and are returned to the upstream end, where they again descend to the bottom and continue the search.

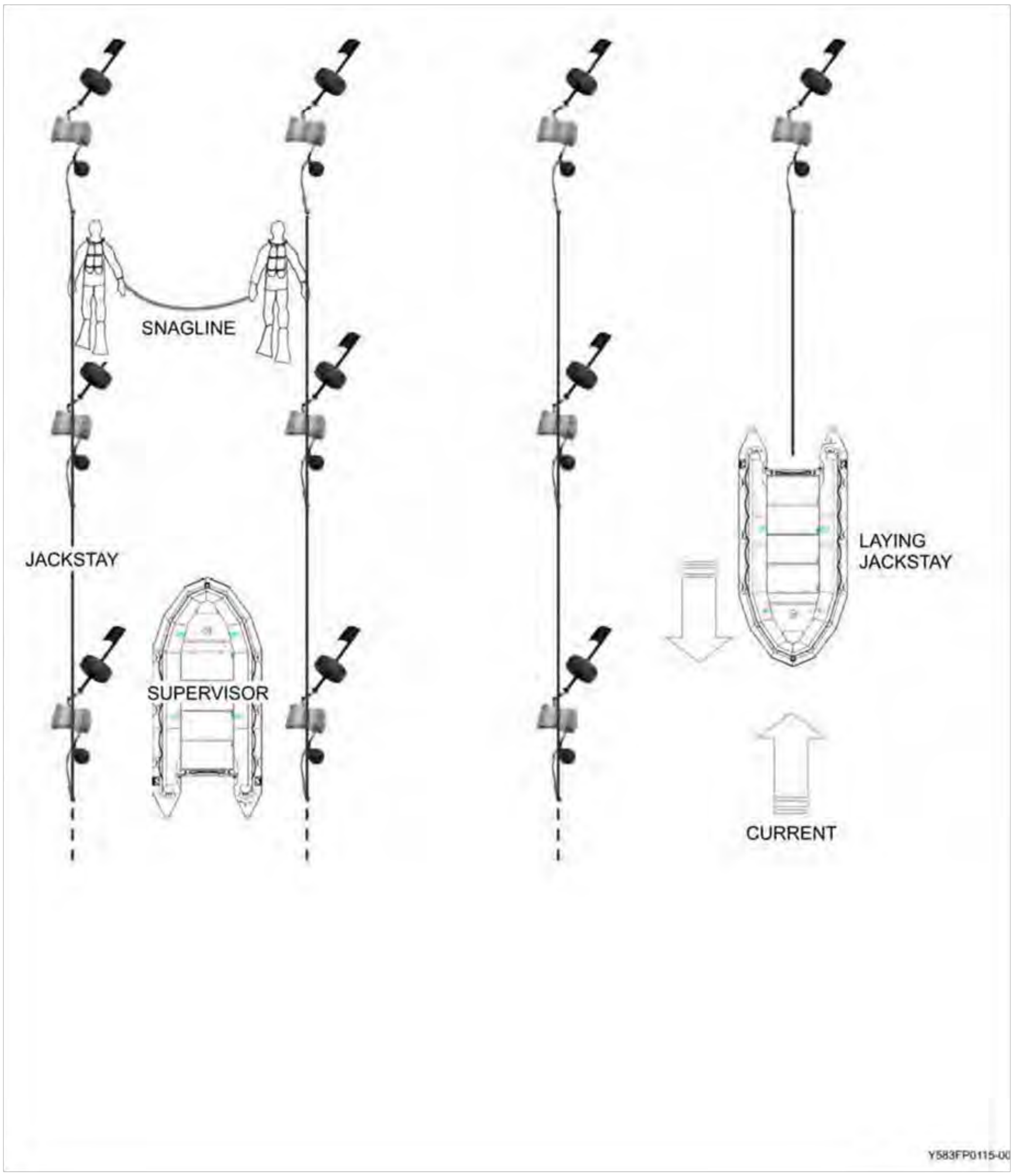

Figure 5-12 Snag line Search

522. GRID SEARCH

1. The grid search is probably the most thorough and efficient bottom search. This type of search is worked on a rectilinear basis. It entails the laying of standing jackstays to form the side of the rectangle with a movable cross- connecting jackstay for conducting the search.

2. Two divers are sent down. They start from opposite sides of the rectangle and swim along the movable jackstay, one on either side, searching their side to the maximum visibility distance. Each diver then moves his or her end of the jackstay along the standing jackstay to a position twice the visibility distance from the old one. The divers then swim back along the movable jackstay. In conditions of nil visibility, after each lap the jackstay is moved two arms' spread (an arms' spread being approximately 1.5 metres) for a total approximate distance of 3 metres.

3. When the area has been searched the grid can then be moved and re-laid immediately beside the area covered by the first grid. The search is continued as necessary, until the required area has been completely covered by a series of adjacent rectilinear searches.

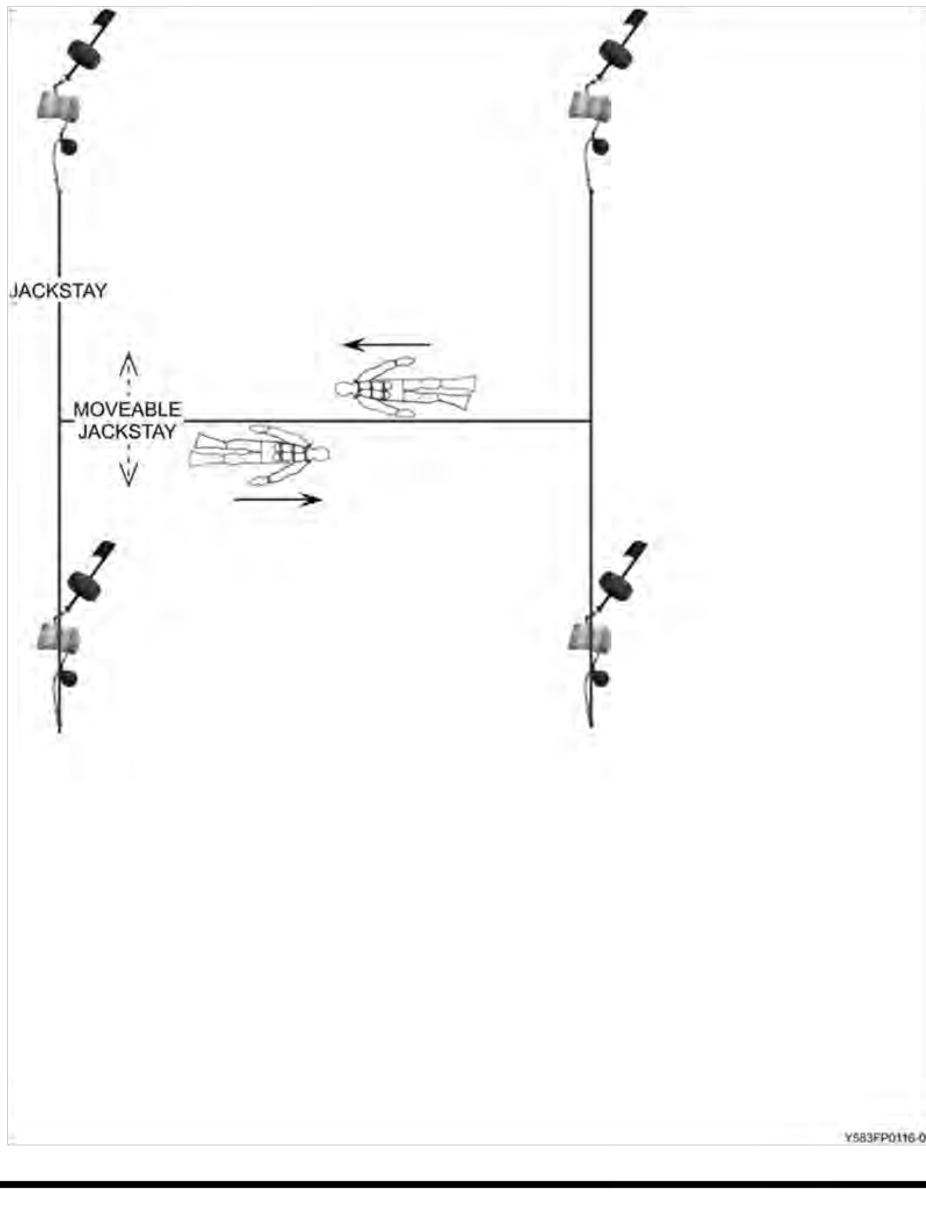

Figure 5-13 Grid Search

523. MULTIPLE DIVER SEABED SEARCH

1. This type of search also works on a rectilinear basis. It entails the laying of standing jackstays to form the sides of a rectangle.

2. Divers position themselves on a moveable cross-connecting jackstay on the surface between the starting marker buoys or descend to the bottom and space themselves evenly between the two riser shot weights. Spacing may be based on visibility or a snag line method may be used.

3. On a pre-arranged signal from the lead diver the divers commence swimming from one end to the other, keeping abreast.

4. Once the search is completed all divers surface.

5. This search can also be performed under a ship's hull when the laying of a jackstay is not possible. Refer to Article 607 and 608 for techniques and procedures applicable to searching a ship's bottom. These should be reviewed prior to conducting a multiple diver seabed search.

6. The two end divers must ensure they remain on the bottom of the harbour under the appropriate ship being searched.

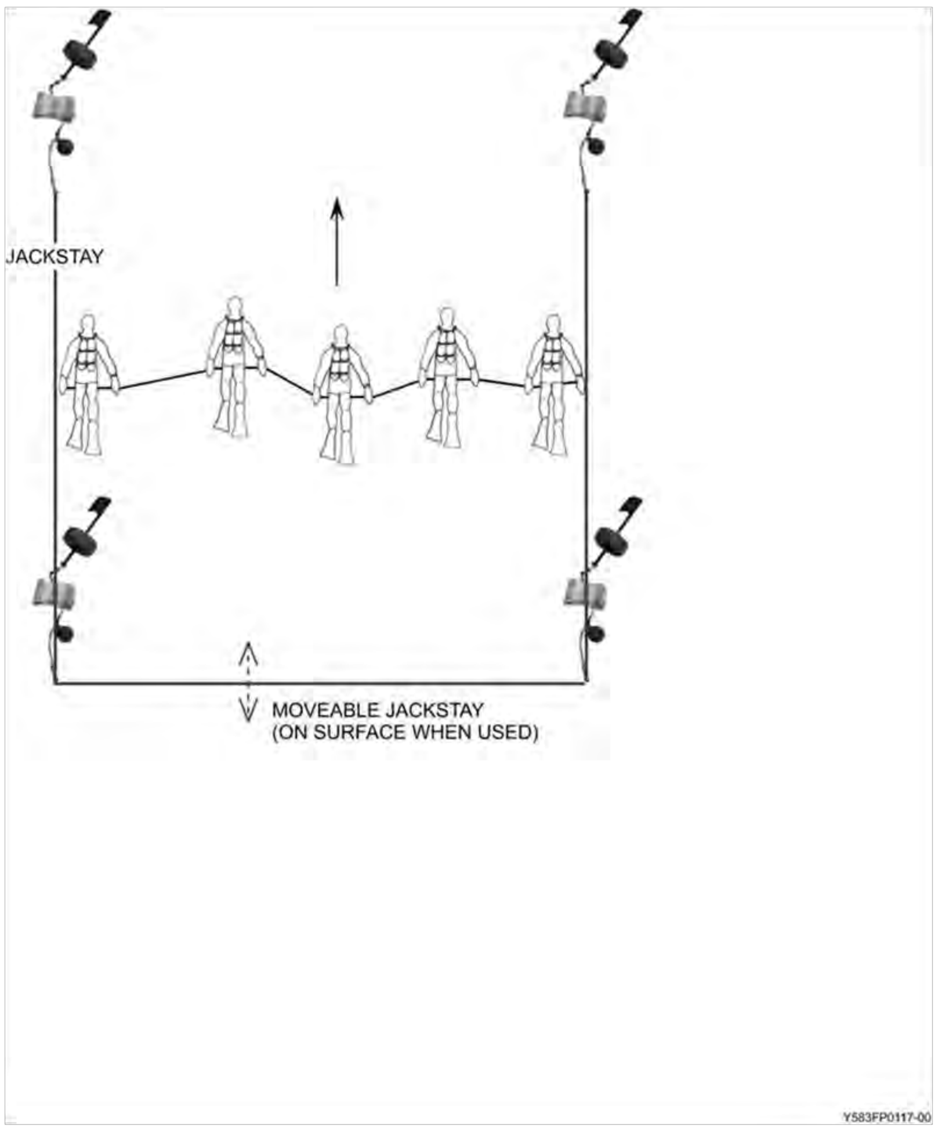

Figure 5-14 Multiple Diver Seabed Search

524. LOST JACKSTAY OR DISTANCE LINE PROCEDURE

1. If the diver loses the distance line in the dark:

    a. The diver should feel carefully all around before moving away.

    b. No time should be wasted searching for the line.

    c. The diver should signal as appropriate to either come up or return to the shot line or some other point where the distance line can be retrieved.

2. If the diver loses the jackstay:

    a. The diver should search for it at right angles to the direction in which it is laid using the direction of current, stream or bottom features to orient.

    b. If unsuccessful the diver must return to the surface without wasting further time.

UNDERWATER TOOLS AND WORK METHODS

525. U/W LIFTING TOOLS

1. Open End Lifting Bags. Special underwater lifting bags are available from military and commercial sources. These bags resemble hot air balloons in shape and are fitted with harnesses for holding diving tanks and shackles for attaching slings or hooks. They usually have air bleed-off valves and/or can vent through the bottom. Their lift capabilities vary according to their displacement. However, the safest way to conduct UW lifting is to use closed lifting bag operated remotely.

526. U/W LIFTING

CAUTION

Extreme caution shall be exercised by all divers utilizing any air-filled lifting tool.

CAUTION

Both Supervisors and divers must appreciate the danger of the object breaking mud suction and rapidly propelling to the surface –uncontrolled. Severe injury can be caused to a diver whose equipment becomes entangled with a lifting aid that has suddenly broken free.

1. **Rigging**:

   a. In order to ensure that objects being recovered are not dropped back into the water when lifted out (e.g. breaking lines or shackles) basic rigging considerations must be applied in all lifting operations.

   b. Most objects weigh considerably more in air than in water. Therefore, rigging calculations should use the weight (W) of the object rather than the lift requirement (L).

2. **Air Expansion**:

   a. If a lifting aid is not completely full when the lift commences the air will expand on the way up. Lift will increase and the rate of ascent will accelerate. This could be dangerous. All lifting aids should have a simple means of being vented.

   b. It is safer to use a number of smaller lifting aids – all completely full when the lift commences – than one large one only partially-filled.

c. The diver must have an escape route planned and stay clear of all lines during the lift.

3. **Suction**:

a. If an object has been lying for a long time on a silt or mud bottom a great deal of lifting force will have to be applied in order to break the suction. Application of such force is often difficult and may result in an uncontrolled ascent.

b. Excess lifting force should not be applied but rather the suction should be broken through the use of a tunnelling lance or dredge whenever possible.

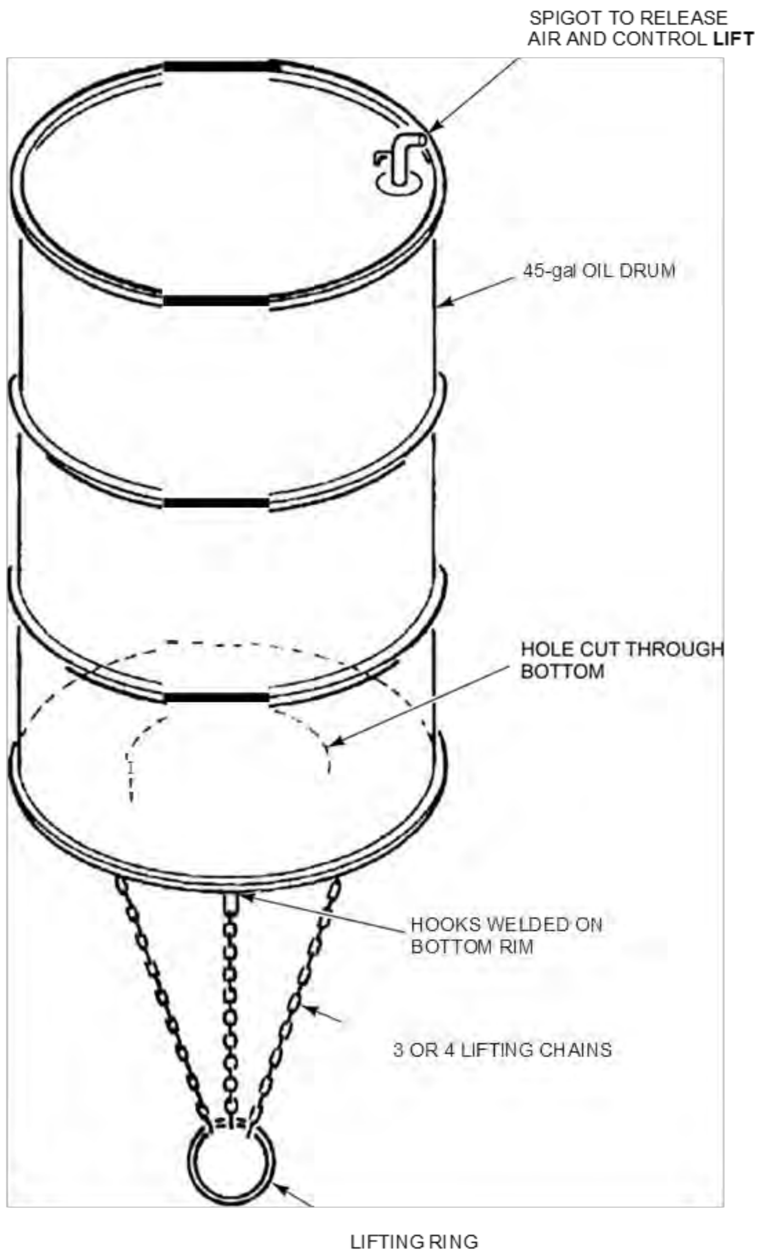

Figure 5-15 Improvised Lifting Aid an Oil Drum

527. U/W CONSTRUCTION

1. General. During wartime, one of the major tasks for divers is the construction and placing of underwater obstacles. Other engineering tasks that may require divers in war and peace are the construction and repair of underwater pipelines, power and communication cables, piers, docks, dams, sewer and water systems and other military installations, provided the supervisor and diver(s) have been trained for the task. Water conditions and the capabilities of the divers set limitations to underwater construction. Construction procedures, equipment and tools required are similar to those used on land.

2. Construction Methods. Divers will find a great deal of difficulty in handling building materials underwater. Buoyant materials tend to float away while heavier ones like sand bags or steel are awkward loads to carry. Currents interfere with the placement of large flat materials such as plywood and limited visibility restricts each diver's safe working area. All of these result in a requirement for a high degree of simplicity and over-design in terms of strength and prefabrication in underwater construction.

528. U/W TIMBER AND WOOD CONSTRUCTION

1. Guidelines. Wood is the most common U/W building material. The following instructions should be followed when using wood in underwater construction:

a. All pieces should be pre-cut, pre-bored and clearly marked;

b. Wood should be properly treated with an appropriate preservative if the structure is to last more than a few years;

c. The buoyancy of wood may be reduced by leaving it to soak in water overnight before its use (provided any swelling has been accounted for in the design);

d. Large lag bolts that can be screwed with a ratchet wrench are more suitable for underwater use than nails and/or drift pins that have to be driven by hand; and

e. Wood should be weighted and tethered when being lowered to divers.

NOTE

Neoprene rubber deteriorates quickly when placed in contact with many types of wood preservative. Divers should wear service coveralls over wetsuits when working with this chemical or with preserved wood. Soap and water should be available for washing wetsuits each day. As well, exposure to this chemical could cause mild skin irritation. More severe discomfort can be prevented by ensuring divers do not unnecessarily wear wetsuits when not actually engaged in diving and follow normal hygiene procedures.

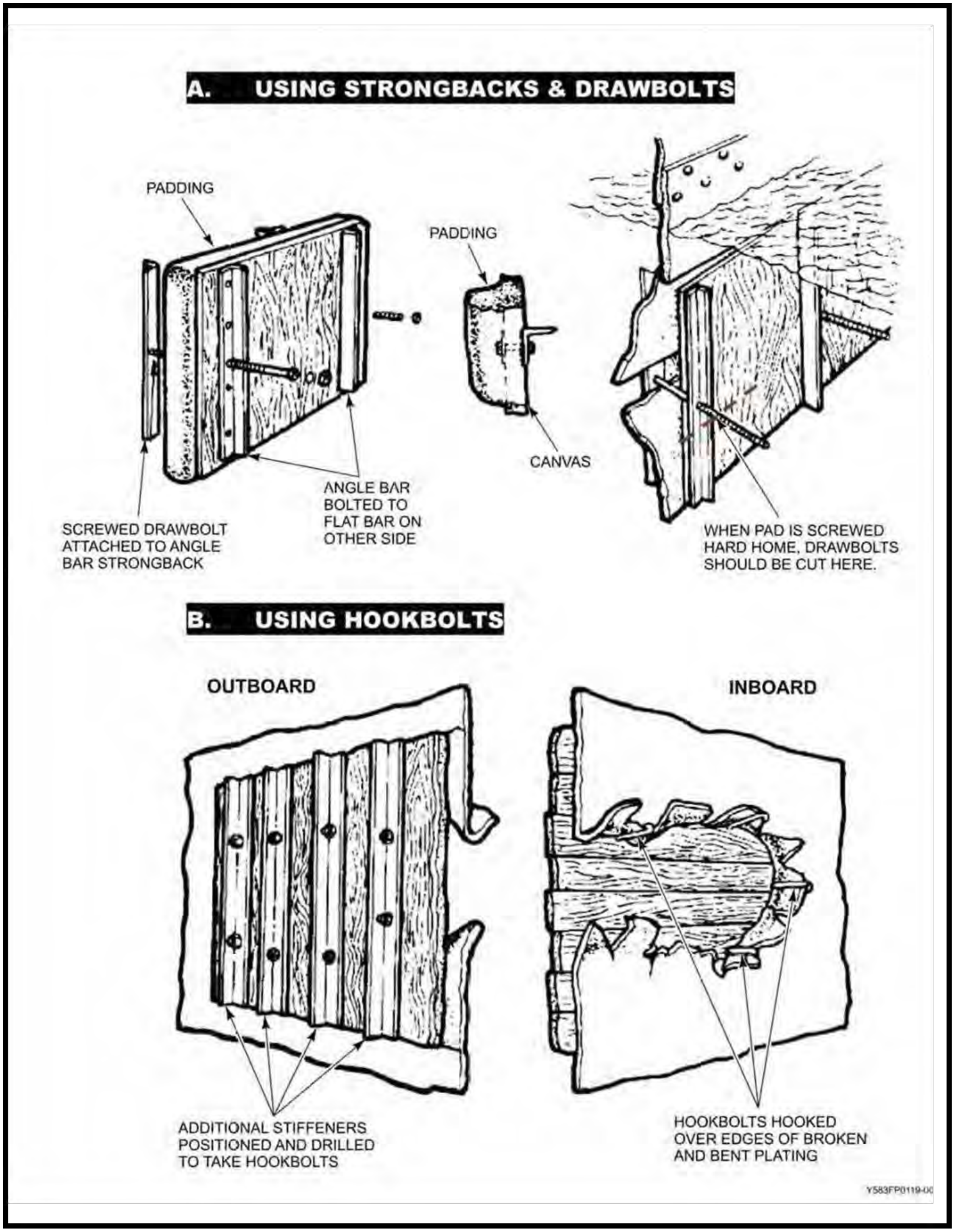

Figure 5-16 Methods of Securing a Timber Patch

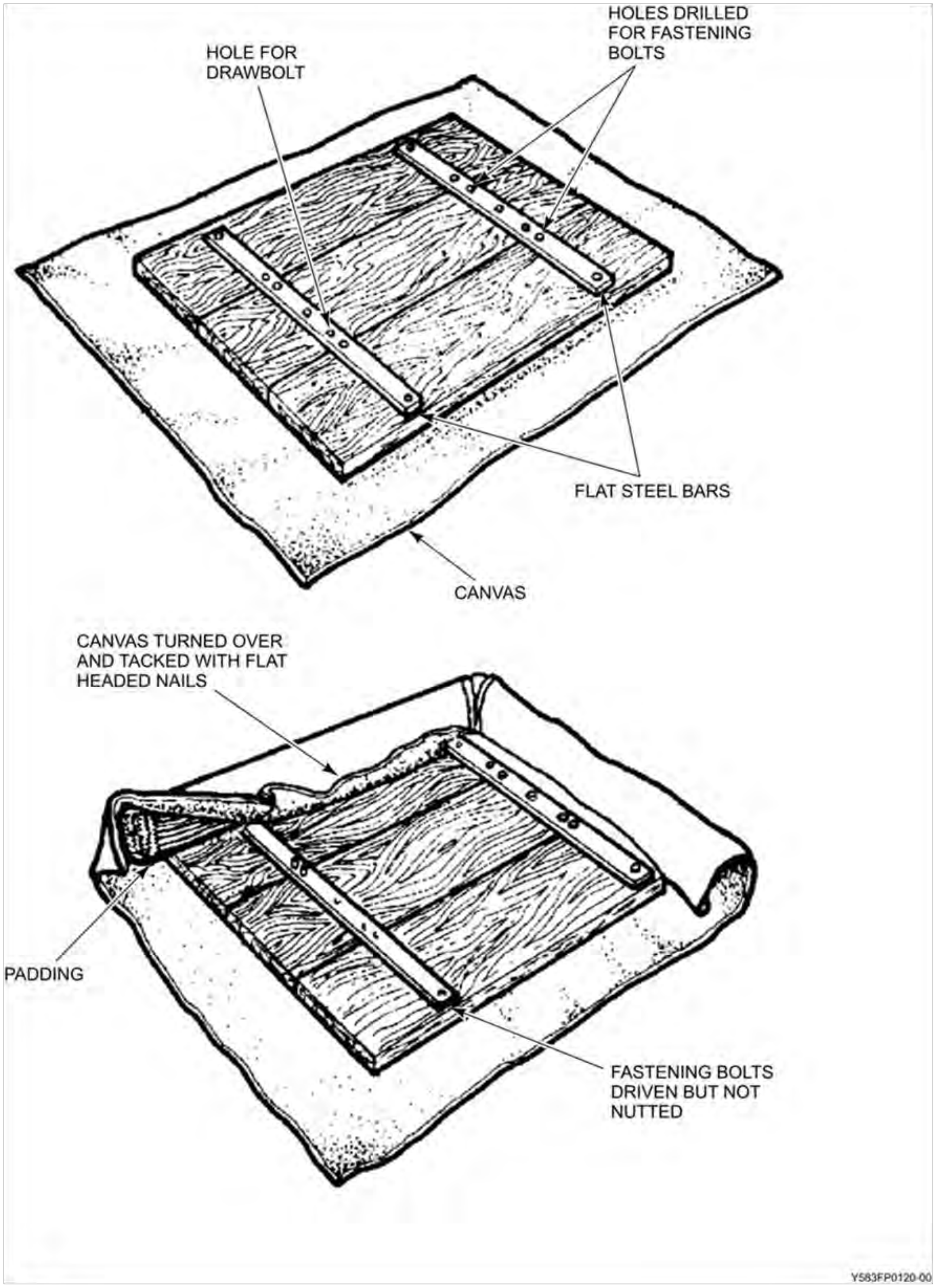

Figure 5-17 Timber Patch

529. REPAIRS TO MILITARY FLOATING EQUIPMENT

1. **Temporary Repairs**:

   a. It may be necessary to make temporary repairs to military vessels, floating bridges or rafts without removing them from the water. There are various types of metal patching kits available that may be used for small patching jobs.

   b. If patching kits are not available improvised patches can be used.

2. **Small Holes**:

   a. Where the hole to be closed is small and the surface of the damaged metal plating is without any undue curvature, a timber patch suitably stiffened with light steel sections to withstand the hydrostatic pressure is most easily and quickly applied.

   b. For small punched holes, long narrow holes or where the plating is thin and the frames widely spaced the most efficient method of securing the patch is by means of draw bolts and angle or channel-bar strong backs as shown in Figure 5-24.

3. **Large Holes**:

   a. For larger holes where the span is too great to permit the use of strong backs, hook bolts are used, these being passed through the patch and hooked onto any convenient part of the damaged plating or onto frames, etc., as shown in Figure 5-24.

   b. When using hook bolts a template must first be made.

      (1) Light wooden boards are nailed together in the shape and size of the intended patch and this rough template is lowered and positioned over the damaged area.

      (2) The diver takes down additional boards and nails them across the template in positions where the hook bolts are to be fitted and marks the positions of the bolts on the boards. The completed template can then also be used to mark off the position of the boltholes on the patch.

4. **Timber Patch**:

   a. The materials used in the construction of timber patches depend largely upon what is available at the time. Tongue and groove planking is most suitable because it provides greater strength (and improves water- tightness, but that is of no great importance as timber patches are always canvas-covered on the pressure side).

b. The patch should be constructed of material that is at least as strong as the hull material. If the patch is to be secured by strong backs and draw bolts, the following additional materials will be required and used as illustrated by Figure 5-24 and 5-25.

(1) Two pieces of flat steel bar of length equal to the width of the patch.

(2) Two equal pieces of angle or suitable channel-bar of similar length.

(3) Two pieces of angle or channel-bar (to act as strong backs) fitted with long draw bolts.

(4) Sufficient canvas to cover an area approximately 1 metre in excess of the length and width of the patch.

(5) A quantity of padding around the edges of the patch.

DIVING IN CONTAMINATED WATER

530. GENERAL

1. There is an ongoing requirement for CAF divers to perform working dives in waters contaminated by a variety of pollutants. These may include pathogenic microbes, toxic or noxious chemicals and nuclear reactor effluents. Because water pollution is common in Canadian harbours and estuaries, and indeed in many of the locations around the globe in which CAF divers are required to operate, all divers should be aware of the hazards associated with contaminated-water diving. They should also be familiar with the necessary pre-and post-dive procedures, equipment requirements and medical surveillance activities required by this type of diving.

2. Figure 5-17, Table for Assessing the Possibility of Exposure to Contaminants in Dive Site Waters (3 sheets), provides planning guidelines for assessing the extent of contamination at dive sites.

3. For the purposes of this section, Moderately Contaminated Water (MCW) is defined as: Waters contaminated with pathogenic microbes or chemicals that do not present a documented risk to the diver unless orally or nasally ingested or entering the body by way of cuts, abrasions, or the mucous membranes.

4. The diver can be reasonably protected from this type of contaminant by use of a full facemask and a non- compressible/vulcanised dry suit. Differentiating MCW from non-contaminated water is a complex decision, but a faecal coliform count in excess of that allowed for bathing (swimming) can be considered one criterion.

5. For the purposes of this section, Heavily Contaminated Water (HCW) is defined as: Waters polluted with chemicals, nuclear effluents, biological organisms or other toxic materials requiring complete isolation of the diver, including the skin surface.

6. The additional protection required for this type of diving includes use of a completely dry helmet and extra heavy-duty dry suit with attached dry gloves, and extra precautions taken during decontamination.

a. Only Clearance Diving units should be tasked with this type of operation.

b. Procedures for diving in HCW will be promulgated in B-GG-380-000/FP-003, CAF Diving Manual, Vol. 3, Surface-Supplied Diving Manual.

7. Research is continuing on the specific hazards and effects on diver safety and health of these occupational exposures and on the development of equipment and procedures to protect divers from such hazards. Individual tolerance to toxins varies widely throughout the population and it is therefore impossible to say with absolute certainty that exposure to a particular microbe or chemical will have no long-term effects on an individual diver.

EXPOSURE TO CONTAMINANTS IN DIVE SITE WATERS

Typical Locales	Likely Contaminants	Likely Indicators	Likely Symptoms
Industrial harbours / Great Lakes ports and the Great Lakes / St. Lawrence Seaway System	• Sewage • Chemicals • Metals • Hazardous protozoa • Bacteria	• Dead animals • Notable dead marine life, *e.g.* fish kills, *etc.* • Visible sewage • Sewage smell • Visible suspicious outfall outflows • Heavy slick / sheen on water • Chemical smell from water • Significant visible floating garbage • Nearby outfalls • Nearby heavy industry (*e.g.* chemical / metal / paper) • Heavy algae / slime in water column/on surface • Heavy sludge / sediments on bottom (*i.e.* not natural clays, sands, silts, *etc.)*	• Skin irritation / infection • Eye irritation / infection • Ear, nose, throat irritation / infection • Visual disturbances • Digestive system: Cramps Nausea Vomiting Diarrhoea • Skin blistering / peeling • Mental / psychological disturbance
Small harbours / ports	• Sewage • Chemicals	• Visible sewage • Sewage smell • Nearby outfalls • Nearby heavy industry (*e.g.* chemical / metal / paper) • Heavy algae / slime in water column/on surface	• Ear, nose, throat irritation / infection • Digestive system: Cramps Diarrhoea
Open seas	• Hazardous protozoa	• Heavy sludge / sediments disturbed from seabed in water column / on surface • Protozoa blooms on surface (visible films) • Protozoa / algae strands in water column	• Skin irritation / infection • Eye irritation / infection • Digestive system: Cramps Nausea Vomiting Diarrhoea • Mental / psychological disturbance
Rivers	• Highly variable. from industrial (black water) to pristine.	• Ranges from none to all listed under *Industrial Harbours.*	• Ranges from none to all listed under *Industrial Harbours.*

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Figure 5-18 (Sheet 1 of 3) Water contaminants exposure

B-GG-380-000/FP-002 DRAFT

EXPOSURE TO CONTAMINANTS IN DIVE SITE WATERS *(cont'd)*

Typical Locales	Likely Contaminants	Likely Indicators	Likely Symptoms
International sites of any locale / type above *(in states with limited or no pollution legislation)*	• Sewage • Chemicals • Metals • Marine fuels – all grades • Lubricants • Explosives • Hazardous protozoa	• Ranges from none to all listed under *Industrial Harbours*	• Ranges from none to all listed under *Industrial Harbours.*
Specific operational sites *(e.g. wrecks, crashes, specified targets)*	• In addition to contaminants of surrounding site as above, additional sources and signs are listed below.		
Ships' hulls	• Sewage • Chemicals • High toxicity anti-fouling	• No sign of marine flora / fauna growth on hull • Sewage / oils from overboard discharges • Dirty / smelly overboard discharges • Visible underwater plumes from hull openings	• Severe sudden skin irritation / infection (toxic paints) • Skin blistering / peeling (toxic paints) • Eye irritation / infection • Ear, nose, throat irritation / infection • Digestive System: Cramps Nausea Vomiting Diarrhoea
Shipwrecks	• Marine fuels / hydraulics • Lubricants • Explosives • Radioactive material • Asbestos • Decaying cargo • Illicit drugs • Infectious diseases	• Fuel stream to surface • Heavy slick / sheen on water • Chemical smell from water • Human / animal remains • Fuel / chemical smells in air • Cargo manifest	• Skin irritation / infection • Eye irritation / infection • Illicit drug reactions / overdose • Hepatitis / HIV

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Figure 5-17 (Sheet 2 of 3) Water contaminants exposure

EXPOSURE TO CONTAMINANTS IN DIVE SITE WATERS *(cont'd)*

Typical Locales	Likely Contaminants	Likely Indicators	Likely Symptoms
Aircraft wrecks	• Aviation fuels / hydraulics • Radioactive material • Carbon fibre particles • Infectious diseases	• Fuel stream to surface • Heavy slick / sheen on water • Fuel / chemical smells in air • Human remains • High-performance military aircraft	• Skin irritation / infection • Eye irritation / infection • Hepatitis / HIV
U/W installations	• Oils • Fuels • Gasses • Other contained liquids / solids	• If any of these LIKELY CONTAMINANTS are possible, treat as if listed under *Industrial Harbours.*	• Ranges from none to all listed under *Industrial Harbours.*

NOTES

1. This table lists common diving locales and contaminants that may be present. If there is any indication that the locale listed may be contaminated by means other than those listed here, it should be treated as MODERATELY CONTAMINATED.
2. **Likely Indicators** are listed in descending order of assessed concern. Observing any one of the Likely Indicators shown above the black lines confirms the water should be treated as MODERATELY CONTAMINATED. Observing more than one of the Likely Indicators shown above the black lines indicates the water may be more heavily contaminated. Note that the contamination level of outfall outflows may vary greatly if subject to 'first flush' rainfalls, when accumulated contaminants are rapidly flushed off the land and roadways. Tidal cycles may also greatly vary the water quality.
3. **Likely Symptoms** have a good probability of being associated with one or more of the Contaminants and Likely Indicators. If divers begin to experience such symptoms, even when no sign of contamination is detected, the site should be treated as at least MODERATELY CONTAMINATED and additional measures taken immediately.

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Figure 5-17 (Sheet 3 of 3) Water contaminants exposure

531. MICROBIAL HAZARDS

1. Microbial pathogens such as bacteria, viruses, parasites, protozoa, fungi, and algae may be naturally present or may be introduced through human/industrial activity such as sewage or chemical wastes from industrial sources, ships or agricultural run-off. In addition, pollutants may "clump" together to form highly concentrated hot spots in an area. According to the U.S. National Oceanic and Atmospheric Administration (NOAA), divers are most likely to be exposed to hazardous contaminants during dives near or on soft bottom sediments. These tend to accumulate contaminants and encourage microbial growth. NOAA states that concentrations of heavy metals such as those associated with waste petroleum products may reduce diversity in a manner that favours pathogenic species. Seasonal variation in Canada also affects the distribution of many species of microbes and divers are generally at greater risk of infection during the summer months. Foreign warm-water locations are also high-risk.

2. Divers working in waters contaminated with harmful microbes may be subject to a variety of maladies, including:

a. Ear infections,

b. Eye infections,

c. Respiratory tract infections,

d. Inflammation of the intestinal tract,

e. Warts,

f. Skin infections,

g. Central nervous system effects, and

h. Systemic or pulmonary fungus infections.

3. The best method of protecting divers operating in microbial contaminated waters is to prevent inadvertent ingestion, to reduce skin contact with these organisms and to ensure that divers are adequately decontaminated after completion of each dive. Protective equipment and procedures designed to achieve these goals were tested by the EDU at DRDC (formerly known as DCIEM) and are described below.

531. CHEMICAL HAZARDS

1. Divers operating in waters contaminated by chemicals, many of which are toxic, have experienced upper respiratory tract infections, difficulty in breathing, skin reactions, nausea, burns, severe allergic reactions and tingling of the limbs. Because of delayed onset, it may be difficult to relate cause and effect.

2. Industrial chemicals commonly found in contaminated water include:

a. Phosphates,

b. Chlorates,

c. Peroxides,

d. Acids,

e. Solvents (benzene, xylene, toluene), and

f. Petroleum and petroleum products (the most common chemical hazards encountered by divers).

3. When diving operations in chemically contaminated water are contemplated, the nearest Fleet Diving Unit should be contacted so an adequately protected team can be deployed.

NOTE

Because oil destroys neoprene and rubber, divers should avoid wetsuits or neoprene dry suits when diving in oily water.

532. CONTAMINATED WATER DIVING EQUIPMENT

1. Standard CABA (with a free mouthpiece) offers inadequate protection to divers operating in contaminated water environments. When diving with free mouthpiece CABA, the diver's mouth is directly exposed to the water and the process of inhalation introduces droplets of water into a diver's respiratory tract. CABA divers who are wearing a dry suit and full facemask (FFM) mated to a second-stage regulator can be exposed via skin contact (at the neck, hands, etc.), but if the FFM is properly fitted and worn the probability of ingestion is greatly reduced.

2. For Heavily Contaminated Water the skin exposure and small but finite possibility of ingestion associated with hybrid CABA/FFM arrangements requires that the Fleet Diving Units be contacted so an adequately protected team can be deployed.

3. The recommended system consists of a "smooth-skin" dry suit with attached hood and boots. All CAF CABA divers are being outfitted with an upgraded CABA diving ensemble that will provide highly effective protection against MCW. Selected CAF diver categories will in addition retain the standard wetsuit CABA variant mentioned at paragraph 1 for use in clean waters. Because neoprene material acts as a sponge, wetsuits and dry suits made of neoprene are less desirable in contaminated water.

a. The suit seams should be sealed by vulcanisation or a similar procedure.

b. The number of openings in the suit should be minimized to reduce the number of potential failure points.

c. Requiring boots to be attached to the suit permits the number of openings to be reduced to 3 or 4, depending on whether or not the suit is of the neck-entry or shoulder-entry type. The boots should be made of a thick, smooth material that is resistant to abrasion and punctures, have a non-slip sole and be designed to accommodate fins.

d. Because gloves are the weakest point in the suit systems used in polluted-water diving, they should be carefully selected with consideration given to compatibility of material with the chemicals likely to be encountered and the resistance of the material to puncture and stress.

e. The dry suit hood may have an installed relief valve that automatically vents any air that accumulates in the hood and the skirt surrounding the face must have a smooth outer surface to facilitate sealing with the FFM.

f. The FFM should be internally pressurized to prevent the inward leakage of contaminated water. Most models of the AGA FFM have this feature. Divers should make a test dive in clean water to ensure that the mask remains completely dry.

g. In pre-dive planning consider that for a given diver the FFM often has a higher rate of air consumption than standard CABA set.

WARNING

When divers are operating on compressed air near spill sites, extra care should be taken to monitor the air intake location to avoid the danger of compressing contaminated air. Similar to the approach indicated in Figure 5-41, the absence of smoke, airborne plumes, chemical or other unusual smell or fumes in the ambient air will generally assure this. If toxic contaminants undetectable to the human senses are suspected, the entire team should be withdrawn from the hazard area.

WARNING

Day/night distress flares should not be used in contaminated waters suspected of containing flammable fumes.

533. MODERATELY CONTAMINATED WATER (MCW) DIVING PROCEDURES AND PRECAUTIONS

1. Divers required to work in contaminated waters must rigorously observe a series of procedures designed to provide maximum protection of the diver and the support crew. In addition to the careful selection of equipment, divers and support crewmembers must be specially trained in the hazards of polluted-water diving.

2. Diving at known contaminated sites such as sewage outfalls, industrial discharges or stagnant pools is to be avoided whenever possible, unless required for operational reasons. Do NOT conduct training dives in these locations unless properly equipped.

3. Consult local authorities such as the Municipal Health Department or Provincial Environment Ministry for information on water quality.

a. Environment Canada also publishes Canadian Water Quality Guidelines (CWQGs):

(1) Canadian Water Quality Guidelines for the Protection of Aquatic Life,

(2) Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses,

(3) Guidelines for Canadian Drinking Water Quality and

(4) Guidelines for Canadian Recreational Water.

b. If necessary, take water samples and obtain lab analyses.

4. Once these pre-operation preparations have been made and the proper equipment has been assembled the following special precautions should be observed:

a. Emphasize Dive Site Hygiene

(1) All personnel should keep direct contact with contaminated water to a minimum.

(2) Food should not be consumed while tending divers or handling other equipment that has been in the water.

(3) Personnel should wash with anti-bacterial soap prior to eating or drinking.

(4) A "Clean Area" should be designated where personnel can take meals and breaks.

(5) No diving with open cuts or abrasions is permitted. Any skin lesions that occur during the dive must be disinfected and dressed without delay.

Although uncommon, certain extremely aggressive microorganisms may enter minor wounds and lead to rapid incapacitation requiring full hospital care. Infection is indicated by rapid deterioration surrounding a minor wound, such as swelling, dramatic colour change, inflammation and rapidly spreading symptoms. Accordingly, every skin lesion must be reported, and carefully monitored at a minimum every few hours for the first 24 hours.

(6) Keep hands away from eyes, ears, nose and mouth.

(7) Snorkels and buoyancy compensator oral inflators should NOT be used.

b. Post-dive. Ensure divers rinse their ear canals with an ear solution such as Vosol, Domboro or aluminium acetate.

5. All divers must receive the full range of inoculations, vaccinations and prophylactic medications IAW the currently approved regimen promulgated by the applicable CAF medical authority. This will generally cover most infectious diseases endemic to the area plus specific prophylaxis against operational risks. Divers handling human remains will be well protected by strict adherence to all the precautions in this section. Other than infection via wounds or contact with mucous membranes, waterborne human remains have not, in and of themselves, proven to be a significant disease transmission vector.

534. POST-DIVE DECONTAMINATION PROCEDURES

1. Both divers and tenders must go through a decontamination process after completing a dive in contaminated water, because evidence shows that divers infected with microbes can contaminate their suits and thus spread infection or re-infect themselves unless the suit is adequately decontaminated. Team members are to wear decontamination protective equipment, up to and including full NBC protective gear if the contaminant justifies it.

2. After each dive the diver is rinsed with fresh water, followed by three separate spraying solutions:

a. The first involves a neutralising agent or disinfectant appropriate for the particular contaminant. A one- percent solution of ANTEC®/DuPont® Virkon® S is recommended.

b. The second consists of a detergent wash-down.

c. The third and final spray is a freshwater rinse.

3. If contamination is severe heavy-duty brushes can be used to scrub the zippers, mask, boots, boot soles and seams of the suit system. The diver remains effectively encapsulated throughout the procedure and is thus subject to hyperthermia, so there should be no delays during this process.

4. After undressing, the diver should shower with an antibacterial soap as soon as possible. Special attention should be given to ears, hair and beards.

5. The diver's equipment should be attended to by support personnel wearing appropriate protective gear as follows:

a. Dry suits should be air-dried.

b. If the suit was flooded the interior should be washed with a one-percent solution of Virkon® S disinfectant, rinsed with fresh water and air-dried. Wetsuits should also be re-washed with Virkon® S solution, rinsed and air-dried.

c. Boots, gloves, hoods, CABA assemblies and all other diving peripheral equipment such as knives, weights, gauges, fins and facemasks should be soaked in Virkon® S disinfectant for 10 minutes, rinsed and air-dried.

d. Buoyancy compensators/life vests should be inflated, immersed in Virkon® S disinfectant for 10 minutes, rinsed and air-dried.

e. Work clothing used by surface personnel should be cleaned before stowage.

f. Regulators and masks (while still connected to the air source) are to be immersed in one-percent Virkon® S disinfectant for 10 - 15 seconds, rinsed in fresh water, purged three times for approximately 10 seconds, disconnected from the air source and air-dried.

6. Instructions for the proper use of Virkon® S as per manufacturer's direction:

a. Virkon® S comes in a dry powdered form and needs to be diluted to a one-percent solution for normal use and two-percent solution for severe contamination

b. Rebreather counter lungs need to be soaked in one-percent Virkon® S solution for 10 minutes in order to kill all bacterial, viral and fungal organisms

c. The equipment then needs to be thoroughly rinsed in fresh water to remove any Virkon® S residue. There is potential that improper rinsing may result in irritation to the lungs or cause long-term equipment damage

d. For severely biologically contaminated equipment (e.g., blood, human remains, a suspected disease is present, etc.) a two-percent solution with a soaking time of 30 minutes is recommended.

WARNING

Caution should be exercised when using Virkon® S in its powdered form, as it can cause eye, skin and respiratory irritation. Personnel are to review Material Safety Data Sheet No. 7496 (Virkon) prior to using this material.

535. LONG-TERM MEDICAL PRECAUTIONS

1. Divers who work in contaminated waters should advise the DMO of this during their annual medical examination.

2. DMO administering these examinations should pay particular attention to the respiratory and gastrointestinal systems and to the ears and skin.

3. A diver who may have been exposed to contaminated waters should receive a medical follow-up examination with appropriate documentation (i.e. CF 98, DND 663) at an appropriate interval post-dive.

ANNEX A A GUIDELINES FOR SURVIVOR EXTRACTION FROM OVERTURNED VESSELS

A. INTRODUCTION

1. These guidelines were developed from the Search and Rescue Technician's (SAR Tech) Guidelines for Survivor Extraction from Overturned Vessels (1 CAD/TRSET Directive 2004).

2. The rescue of survivors from an overturned vessel is likely the most dangerous situation a CAF diver will encounter. Any CAF diving team may be tasked by the Rescue Co-ordination Centre (RCC) to investigate and attempt to rescue survivors of a marine disaster.

3. The rescue of survivors of a marine disaster is best left up to those CAF divers that have been properly trained in survivor extraction techniques, i.e. Search and Rescue Technicians (SAR Techs) or Clearance Divers (CL DVR). Although it is unlikely that a CAF diving team would be tasked to conduct a rescue, this Annex is designed to give the team some basic information that should be considered prior to the attempt.

4. Every situation is different and poses its own set of problems that must be taken into consideration by the team. These procedures are not comprehensive; they do not take into account of all possible hazards and variables. They provide the team with options and a starting procedure. Some modification will be necessary, based on the training and experience of the Supervisor and the team, once they are on location and have surveyed the situation.

B. FACTORS

1. The Commanding Officer, in consultation with the most senior and experienced members of the team must weigh all the known and suspected factors in order to determine the most feasible option for safe execution of the task. Throughout this Annex, reference to decisions made by the Commanding Officer are based upon a ship-borne operation; in the event the team is operating detached from its unit, the officer in tactical command or the on-scene commander will undertake these decisions and considerations.

WARNING

> If there is no probability of survivors there is NO justification for entering an unstable OTV in self-contained CABA. Such dives should always be conducted in surface-supplied mode with hard-wire communications, as part of salvage operations.

2. The use of divers will be limited by the estimated submergence survival time of the victims. The decision to use divers in a SAR mode, such as described in this Annex, must be based on a Command decision that there exists a likelihood of survivors remaining entrapped in the vessel. If there is no confidence that any survivors remain, the risks to the divers permitted in

this Annex cannot be justified and the vessel should be treated as a salvage operation rather than a rescue. In salvage, all normal rules and procedures described in other Chapters must be followed.

C. EQUIPMENT

1. Due to the likelihood of encountering contaminants from the overturned vessel, the CABA MCW Ensemble with dry suit, FFM and emergency regulator should be worn. (i.e. the site is to be considered MODERATELY CONTAMINATED IAW the Table at Figure 5-26). Not all contaminants in the water will be visible, e.g. POLs and battery acid.

2. The stab jacket should include:

a. Integral weights,

b. Safety knife,

c. Whistle,

d. Line cutter/scissors,

e. Spare dive light,

f. Strobe light, and

g. Securing lanyards.

PROCEDURES FOR DIVING ON CAPSIZED VESSELS

D. PRE-ARRIVAL

1. Question RCC or persons on scene concerning:

a. Vessel's position,

b. Number of persons on board,

c. Number of persons unaccounted-for,

d. Type of vessel,

e. Attitude of vessel in the water: upside down, bow up, stern up, etc.?

f. Cause of capsize (sea state, collision, taking on water, etc.),

g. Hull damage,

h. Water depth, and

i. State of tide or known currents.

2. Request a back-up team from RCC in the following order of preference:

a. SAR TECH diving team.

b. Coast Guard diving team (West coast, Vancouver Area).

c. Clearance diving team.

NOTE

May not be trained in survivor extraction.

d. RCMP or other police diving team.

NOTE

May not be trained in survivor extraction.

e. Commercial divers.

NOTE

May not be trained in survivor extraction.

3. If a backup team is not immediately available, request re-supply of filled cylinders from the nearest available source. Expect a delay in response time, as most of the above resources do not have immediate access to transportation to the dive site.

4. Ensure that VTS (Vessel Traffic Service) demands a "SLOW BELL" (minimum wake from passing vessels).

5. Ensure that Coast Guard Radio broadcasts a "REQUEST FOR MINIMUM WAKE" in the area on CHANNEL 16.

6. Request salvage bags or large vessels for stabilizing the capsized vessel.

7. First unit on scene: DO NOT cut a hole in the hull. Pound on the hull to determine if there are conscious survivors inside and search the surrounding water for any escaped survivors.

8. Prepare medical equipment: oxygen, airways, stretchers, bag and mask, electric blankets, advance casualty care equipment, etc.

E. ON SCENE

1. Assess site, weather and sea state.

2. Determine water depth and confirm state of tide/currents.

3. Re-confirm with Command as to whether divers will be committed.

4. Assess vessel stability (Refer to Article I).

5. Question any survivors as to the number of persons possibly trapped, the vessel layout and where on the vessel missing persons were last seen.

6. Attach a marker line to the vessel. This is a marker in the event the vessel sinks.

7. **Vessel Slowly Sinking**:

   a. If the vessel is slowly sinking, note where the water line is on the hull. Mark it with a dive knife. Scribe a large arrow pointing down to the scribed water line mark. Check the water line mark frequently.

   b. If possible, stabilize the vessel with salvage bags or other vessels (refer to Article I for stabilization options).

8. **Capsized Vessel**:

   a. If the vessel is completely capsized but on an even keel it will be very stable, provided that air is not escaping and that it does not have excessive freeboard.

   b. If the vessel is capsized due to collision, check for hull damage where air might escape (refer to Article I for stabilization options).

9. **In Strong Tidal Steams or River Current**. As a general rule, allow the vessel to drift with the current. Do not anchor the vessel, as the divers will then have to contend with a "relative current" and will rapidly exhaust their air supply.

10. If **Conducting Dive Operation From Another Vessel**. Secure it to the capsized vessel if the sea state allows.

    a. Use a light (12 mm) line rigged for self-slipping. A light line is necessary so that if the vessel sinks or the slip line jams the line will break before pulling the diving platform under.

    b. Instruct the crew of the vessel not to allow this line to come under tension.

F. DIVER PREPARATIONS

1. Once on the scene, determine a dive plan and identify a suitable vessel to act as a surface diving platform (if available).

2. When dressing for capsized vessel/confined space operations pay particular attention to eliminating potential fouling hazards in the diver's dress. The diver must be as streamlined as possible.

3. During the dive nothing should be carried in the diver's hands and no gauges or other equipment should be secured to the diver's forearms or wrists. All accessory equipment should be fastened snugly to the diver so that it does not dangle or hang free. All important equipment should be located in the diver's "safety triangle" (triangle formed by diver's chin and the lower corners of the ribcage) so that it can be positively located by feel alone. In particular, the diver's instrumentation (SPG, depth gauge, bottom timer and compass) and the safety knife and line cutter/scissors should be located in this triangle, accessible by either hand.

4. The remainder of the equipment must be secured to the diver or stored in pockets so that hanging gear will not snag during entry/exit of vessel or on other submerged debris.

5. Keep in mind to:

   a. Preserve buoyancy,

   b. Plan an exit, and

   c. Keep the exit clear.

G. ADDITIONAL EQUIPMENT

1. Light system	
2. Small spare diver's light	Secured to stab jacket harness or taped to pressure gauge hose
3. Spare facemask	Used for the survivor(s).
4. Additional diving cylinders and regulators (or FFMs if available)	
5. Safety knife	Attached to stab jacket.
6. Line cutter/scissors	Attached to stab jacket. Used for cutting nets or fishing line.
7. Work gloves	
8. Buoyant lights (Chem-Lites)	Left in survivor's air pocket as a form of reassurance for the survivors. Aids in relocating the air pocket.
9. Strong pry bar	Used for opening jammed doors, hatches, breaking windows, etc.
10. Short lanyards	Used to secure hatches/doors (most door/hatch latches don't work when a vessel is upside down).
11. Strobe light	Used for surface signalling.
12. Whistles	Used for communications should divers become separated at the surface.

Figure 5A-1Additional Equipment Required for Capsized Vessel/Confined Space Operations

H. DIVING PROCEDURES

CAUTION

> Do not use the strobe light inside the vessel. Its use may disorient the divers.

1. Prior to the dive and final safety checks, review signals, dive plan and communications plan with the support vessel.

2. The Supervisor locates to the support vessel and ensures all required equipment is on deck.

3. Develop a communications plan. Select an attendant. Brief the attendant on the use of Standard Tender/Diver Signals and other emergency signals.

4. Divers are to dress for the dive minus the FFM.

5. The diver who will do the initial penetration of the vessel is to be secured to a lifeline.

6. Complete safety checks on all divers.

7. Don the FFM and adjust the fit of the mask.

8. Enter water, reconfirm mask fit and perform diver checks. Depending on the scenario, one diver is to tend the diver about to penetrate the vessel. The diver-tender tends from the water with the same lifeline the surface tender is using.

9. Depending on the situation the Supervisor may elect to initially leave the team on the surface to conserve air. The team enters water upwind/up-current of the vessel if possible and if not, then surface swims to the bow and starts the dive from this location.

10. The divers must note in detail:

    a. Vessel type and conditions, i.e. visibility, lines hanging, hatches, windows open/closed,

    b. Hull damage,

    c. Special hazards,

    d. Air escaping from vessel, etc.

    e. This information will be passed on to the Supervisor and other team members so that they remain updated on changes in any significant factor affecting the situation.

11. The diver gives the capsized vessel an initial quick survey, checking the wheelhouse first. The diver then decides on an entry point and informs the Supervisor, the buddy and the standby diver (refer to Article K for considerations on entry).

12. The diver should then tie back any rigging near the entry point that may get in the way, secure the hatch/door in the open position with lanyard(s) (carried in the stab jacket pockets).

13. The diver-tender tends the diver who is penetrating the vessel, keeping the lifeline clear and ensuring the entry point remains open. Before entry, the penetrating diver should coil some line in hand and pay it out upon entering, to prevent it from chafing against sharp corners.

14. The diver enters the vessel and proceeds either to:

a. Last known place of missing persons, or

b. The compartment most likely to contain survivors, e.g. foc'sle bunks, mess, engine room or space with highest air pocket.

15. The diver is to note what is encountered in case other divers are also required to enter the vessel. It is important to clear the way and tie debris back from the entry point. The diver should frequently signal for any survivor's attention throughout the search.

16. On entering an air pocket containing survivors:

a. Release a buoyant light,

b. Surface away from the buoyant light and

c. Note the number of survivors found.

d. It may be an option to secure a secondary line to an object in the air pocket to become a guideline to follow back and forth, if more than one survivor found.

17. Do not remove facemask or regulator to communicate with survivors. Air within the pocket may be contaminated with fuel and/or oil, or oxygen levels may be depleted. Communicate by speaking more loudly than normal, but do not yell through the FFM mask. Reassure survivors, and advise them not to panic. Explain that they are going to be taken out one at a time. Instruct them on how to use the emergency regulator and facemask. Make sure to brief survivors to breathe normally and not hold their breath. Show them how to perform a Valsalva maneuver if their ears hurt (refer to Article M on preparing survivors for extraction).

18. It cannot be stressed enough that divers are not to remove their own facemask and regulators inside air pockets, as fuel ingestion is probably inevitable.

19. Take out conscious survivors first ("save the saveable").

20. Follow the lifeline out, protecting the survivor's head when passing through openings. Watch for signs of panic from survivors, as this will be a terrifying experience for them. Constantly reassure them on the communication circuit if available.

21. If survivors are holding their breath underwater, consider giving them a squeeze before ascending to the surface. This is done to prevent them from surfacing with an air embolism.

22. Upon exiting the vessel with the survivor, the Supervisor determines if the diver has enough air remaining to conduct further extractions of survivors. If the diver's air is low the divers will change positions and the second diver will penetrate the vessel to extract any remaining survivors.

23. The surface team must be prepared to recover the survivor immediately, and the diver should waste no time at the surface.

CAUTION

No lines are to be attached to the diver when jumping from an elevated platform.

I. ASSESSING VESSEL STABILITY

1. Assess vessel stability as follows:

    a. MODERATE to GOOD STABILITY in a Capsized Vessel

        (1) Vessel is floating relatively level, both transverse and longitudinally.

        (2) Hard chine vessels: The hull is immersed between 25 - 60% of its depth amidships.

        (3) Round bilge vessels: The hull is immersed between 25 - 40% of its depth amidships.

        (4) Hull has several compartments, which will control the rate of flooding, amount of free surface, and degree of loll.

        (5) Vessel appears "stiff" in the water and is it is not rolling easily.

        (6) Hull is beamy (wide) and full form (such as hard chine fishing vessels with deep chines amidships).

        (7) Capsized vessel has heavy deck gear (e.g. big winches, drums, booms, etc.).

        (8) Vessel's trim and list are remaining steady.

b. LOW STABILITY in a Capsized Vessel, at High Risk of Turning onto its Side

(1) Vessel is floating with a large trim (a sizeable portion of the hull length is immersed).

(2) Vessel has a noticeable angle of list (i.e. greater than 5°).

(3) The hull is floating high in the water (such as a fishing vessel floating mainly on its foc'sle).

(4) Hard chine vessels: The hull is immersed beyond 60% of its depth.

(5) Round bilge vessels: The hull is immersed beyond 40% of its depth.

(6) Given the sea conditions, watch for signs of loll (the vessel is rolling more than expected, caused by excessive free surface movement of trapped water). This is very dangerous and can lead to violent rolling or re-positioning of the vessel.

(7) The hull is narrow and fine.

(8) Vessel's heel or trim is changing (indicative of further sinkage).

(9) Vessel has capsized because of damage to a hull compartment.

2. If a capsized vessel exhibits any of the above factors, secondary stabilization should be seriously considered before a diver enters the hull.

3. During diving operations the following is recommended to help preserve vessel stability:

a. Heavy items which are hanging below the hull such as a power block on a cable, skiff, anchor, or lead weights hanging from a net, should NOT be cut away, as they may be acting to lower the vessel's centre of gravity, thereby improving stability.

b. Do not use flotation bags on one side of a vessel to correct a list, unless the list is unquestionably caused by offset weights or asymmetric flooding. Fitting bags to one side can cause an even greater list to the other side when the vessel lolls or lists in that direction.

c. Never locate flotation bags or attach lifting apparatus below the vessel's centre of gravity, as it will create righting moments that can turn the vessel on its side, spill entrapped air and sink the vessel.

d. Monitor water depth below vessel frequently. A mast touching bottom can turn the vessel on its side, causing it to sink.

e. Do not change the trim of a capsized vessel with lifting apparatus, as air may spill from the hull due to change in water plane and cause further sinkage.

f. Points of entry into the hull should be from the underside as low as possible such as through a wheelhouse window or door. Always enter as vertically as possible into the air pockets. If possible, do not open doors or hatches in transverse bulkheads between compartments, as this may cause further flooding. Maintain hull subdivisions to the greatest extent possible. Close all watertight doors or hatches that are not required for access or escape.

g. If a large vessel is available and the capsized vessel is in deep water, attach a preventer line to keep the vessel from going to the bottom if it should sink completely.

h. If possible, plug points from which air is escaping.

i. DO NOT pierce the hull above or near the waterline, as this will cause air to escape and the vessel will sink further.

J. DISORIENTATION

1. If diver becomes disoriented in the capsized vessel, consider the following:

a. Turn upside down and "stand" on the deck. This may help in visualising the layout of the vessel and where to go next.

b. Follow the lifeline out until reoriented. This may be the only option in zero visibility conditions.

K. CAPSIZED VESSEL SINKING

1. The sinking of a capsized vessel may not be apparent to the diver within the vessel. Divers should be aware of changes of pressure in the ears indicating a change in depth. Divers should continually check their depth gauges.

2. The dive tender on the surface must keep an eye on the waterline level of the capsized vessel and inform the divers of any changes.

3. If line signals cannot be used, the diver shall respond to the following:

a. AIR ESCAPING RAPIDLY ....GET OUT NOW!

b. RAPID CONTINUOUS POUNDING ON HULL ....GET OUT NOW!

4. Divers must disconnect from their lifelines if they are hampered in any way by the line while escaping from the vessel.

5. The second diver is to wait until the diver is out of the vessel. Both divers then ascend together to the surface.

L. ENTANGLEMENT

1. A diver's knife is very poor tool for cutting monofilament line. In addition to the safety knife (a part of the CABA Ensemble), standard working scissors or specially designed line cutters are the most effective tools for this situation. They must be attached to the diver's chest area on the stab jacket for ease of access when tangled.

2. An entangled diver should not struggle, as this often worsens the situation, but should first try to calmly work free and should secondly advise the dive partner.

3. If the anchor point of the line or net is below the diver, the diver should gain a little positive buoyancy in order to tension the line or net before attempting to cut it.

4. If the anchor point is above the diver, the diver should gain a little negative buoyancy.

5. If unable to free, call the second diver or standby diver for assistance. Use 2 - PULLS / 2 - PULLS / 2 - PULLS on the lifeline or, if the diver is within reach, squeeze signal 2-2-2.

M. PREPARING SURVIVORS FOR EXTRACTION

1. A lot can be accomplished to alleviate panic in the survivors when the diver first meets them in the air pocket. A calm, reassuring attitude together with understating their predicament and trying to convince them they have already been rescued will go a long way to preparing them for the most difficult part - extraction.

2. Divers should report number and condition of survivors to the surface.

3. A survivor may be:

   a. Conscious,

   b. Calm,

   c. Panicked:

      (1) Mildly panicked,

      (2) Severely panicked (aware of surroundings but out of control),

      (3) Incoherently panicked (unaware of surroundings),

   d. Unconscious.

4. The principal medical complication of the survivors will likely be hypothermia, or fuel oil aspiration or ingestion. The oxygen content of the air pocket may be low or contaminated with gas, oil, dirty bilge fumes, battery acid, etc.

5. Communicate to survivors by speaking loudly through the mask. The diver should briefly explain how to hold the emergency regulator in the mouth and how to purge it.

CAUTION

> Ensure that the survivor's facemask is sealed and does not flood. Ensure the survivor knows that if the mask floods it is still possible to breathe via the mouth, otherwise the survivor may inhale water through the nose.

6. On the first survivor to be extracted, the diver fits the spare facemask and places the regulator in the survivor's mouth and then together they proceed out. The diver should reassure the survivor all the way.

7. Unconscious, breathing survivors in an air pocket should be removed last. The diver will have to assist the survivor with breathing by depressing the purge button on the emergency regulator.

8. The priority is the conscious survivors in an air pocket. If submerged drowned victims are encountered along the way, they may be passed out to the second diver if expedient.

9. If unable to extract survivors and if available, consider using SCOTT Air-Pak®, Genesis or Flynn oxygen tanks to increase the amount of oxygen in the survivor's air pocket. SCOTT Air-Pak® tanks may be borrowed from nearby vessels or ferries. Use air from the diver's cylinders only if there is enough for the diver to complete the operation.

N. SURVIVOR PANIC

1. When there is a survivor panicking in an air pocket, take out the stable survivor(s) first. Reassure remaining survivors. A full explanation may help, or consider bringing in the second diver to assist in the extraction.

2. If a survivor panics during the extraction, use lifeguard techniques. The best position to be in is behind and slightly below the survivor, to protect the diver's mask and regulator.

3. When pulling the survivor from the vessel, the surface team must be ready to assist.

O. OTHER CONSIDERATIONS

1. **Diving in Zero Visibility**:

a. In zero visibility conditions, proper site evaluation and history of the incident will provide the ability to ascertain whether to dive or not.

b. Zero visibility diving should only be attempted when the Supervisor, in consultation with the Commanding Officer, has determined that the risk is acceptable using parameters including but not limited to:

(1) Fishnets,

(2) Drifting debris (e.g. ice, logs, partially buoyant vehicles, etc.),

(3) Currents IAW those stated in,

(4) The diver's ability to cope with the situation,

(5) Depth,

(6) History of the case (possible suicide),

(7) Log booms and

(8) Vessel traffic encountered.

c. Standard line hand signals should be utilized in zero visibility. Hard-line voice communications is the preferred method if available.

2. **Night Diving Operations**:

a. Night diving operations present the diver with more stress and anxiety than encountered in a similar daylight environment. Managing this stress when it's experienced is essential to safe and effective night operations.

b. With the exception of additional lighting, night diving dress does not vary from standard CABA diver dress. However, due to the reduced visibility it is important to ensure that alternate air sources are clearly identifiable.

c. The emergency regulator should be positioned in the diver's "safety triangle".

d. All instrumentation, i.e. compass, timer, depth gauge and pressure gauge will be luminous/illuminated for easy reading.

e. A whistle should be attached to the divers stab jacket for redundant surface communications in the event of diver separation and/or communication equipment failure on the surface.

f. Each diver should carry a securely fastened backup dive light.

g. Chemical light sticks are useful in night diving operations. They can be used for marking ascent/decent lines, a diver's position, entrances to confined space, etc.

h. The use of voice communicating systems will alleviate the tendency for the diver to feel alone. However, through-water communications are not available to all CAF diving teams.

3. **Reference Line Ascent and Descent**. During diving in zero visibility or during night diving operations, visual references for diver orientation may be difficult to maintain in the limited lighting offered by the diver's light. For this reason and when operations permit, descent and ascent should be conducted with the aid of a "reference line". Anchor lines or lines from marker buoys are well suited for this purpose and will be available aboard most surface support vessels.

4. **Dive Site Illumination**:

a. Dive site illumination (for depths 0 - 12 msw) may be effectively enhanced by having surface vessels direct their searchlights onto the surface.

b. When surface lighting is in use surfacing divers must shield their eyes.

c. Both surface lighting and divers' lights will attract underwater organisms to the area of the diving operation. These will generally be non-harmful "schooling" -type fish and marine mammals. Left alone, they should not interfere with diving activity.

5. **Communications System Failure**:

a. If the communications system fails and where no voice alternative exists, the first step is to attract the attention of the second diver.

WARNING

DO **NOT** USE DIVER SIGNAL RECALLS. Large amounts of fuel may be in the immediate area of the capsized vessel that could ignite if a diver recall was to be used.

(1) Standard hand signals may be used by shining the dive light on the diver's signalling hand.

(2) Rapping on a tank or waving a light slowly up and down are attention-getting signals.

(3) The light may be used for signaling.

(4) Making a large circle or illuminating the diver's head means "ALL IS OK."

(5) Waving rapidly from side-to-side means "HELP - DISTRESS."

(6) At the surface a whistle can be used to attract attention.

ANNEX B ICE DIVING - STANDARD OPERATING PROCEDURES

SECTION 1

GENERAL

1. Ice diving is a specialized form of diving that introduces several additional hazards such as equipment freeze- up, entrapment and hypothermia. However, divers properly trained and experienced in under-ice and cold weather diving have an extremely low accident rate. Situations regularly arise in which it is necessary to dive beneath ice for reconnaissance, EOD operations, or recovery of personnel, vehicles or equipment that have fallen through the ice. Ice diving operations may be required in any of the inland waters of Canada as well as the Arctic Ocean. Although the actual diving techniques are not very different, certain planning factors, equipment and safety precautions must be kept in mind during ice diving operations. The Diving Supervisor must also remember that while each item increases the diving teams' effectiveness, it adds to the overall weight for transport, thereby decreasing the portability of the ice diving package. In addition, all personnel must adequately prepared for and briefed on of the signs, symptoms and prevention of cold stress, hypothermia, frostbite and snow blindness.

2. Some procedures in this chapter may not be practical in operational situations but the basics/safety related equipment remains the same. Since many operational ice dives have been conducted for aircraft crash investigation, additional hazards from fuel, jagged metal, human remains and explosives/pyrotechnics may need to be planned for. Only Clearance Diving teams are trained in safe removal of aircraft explosives and pyrotechnics.

3. The preferred breathing apparatus employed to conduct ice diving is ULSSD. However, if ULSSD is not available, ice diving may be conducted using CABA configured for ice diving as promulgated at this article (refer to).

SECTION 2

PROCEDURES

1. **Diving Supervisor Considerations During Initial Dive Planning**:

    a. **Ice Thickness**. Minimum 15 cm - varying types, provided at least 7.5 cm of the required 15 cm is clear ice. If thickness is unknown then personnel testing the ice shall wear a floater suit/dry suit/PFD and must have a lifeline securely attached;

    b. **Wind Speed and Direction**. Determine wind chill IAW Environment Canada ChillDex/FroiDex chart;

    c. Water and air temperatures;

    d. Tides or current;

    e. Nearest RCC, hospital, ambulance, doctor and phone;

    f. Maximum depth of water (utilizing sounder/marked line once a small hole is cut using ice auger/chainsaw);

    g. Equipment is free of moisture. Life support equipment is prone to failure when moisture is present in components;

    h. Underwater obstructions/hazards/bottom type/visibility;

    i. Altitude (detailed topographical maps or altimeter can be used);

    j. Distance over terrain to be traversed to/from support vehicles/shore site; and

    k. Pyrotechnics/diver recall are not mandatory when conducting ice diving.

2. **Dive Site Preparations**:

    a. The unloading process begins after a determination of requirements and type of equipment to be utilized, and confirmation that ice thickness is sufficient to permit the diving operation to be safely conducted.

    b. Equipment should be offloaded in a clear area /tarpaulin or canvass, to prevent the loss or damage of gear in the snow. Cleared paths, for access to the dive site must be made, utilizing shovels, snow blowers or snowmobiles. Hand-carrying equipment should be avoided; the use of sleds to transfer equipment over soft uneven terrain is preferred.

c. At the dive site, a hole is cut to confirm ice thickness, depth of water and current. This hole can be used to start cutting the diving hole. One person stands at the proposed hole site, holding one end of the diver's lifeline, and another person walks a path circumscribing 360 degrees around the site. Once that is done, the circle is cleared out 0.5 - 1.0 m wide and divided into six equal parts by clearing paths (spokes) 0.5 m wide from the center to the outer ring. The work area, approximately 10 m in diameter, is then cleared in the center where the spokes meet, making a wagon-wheel pattern. The wagon-wheel pattern allows light to pass through and serves as a visual underwater highway and guide for the divers to navigate safely back to the entry hole. If the environmental conditions/surface conditions do not allow for effective creation of the spokes, the supervisor may alter or omit the use of the wagon wheel pattern).

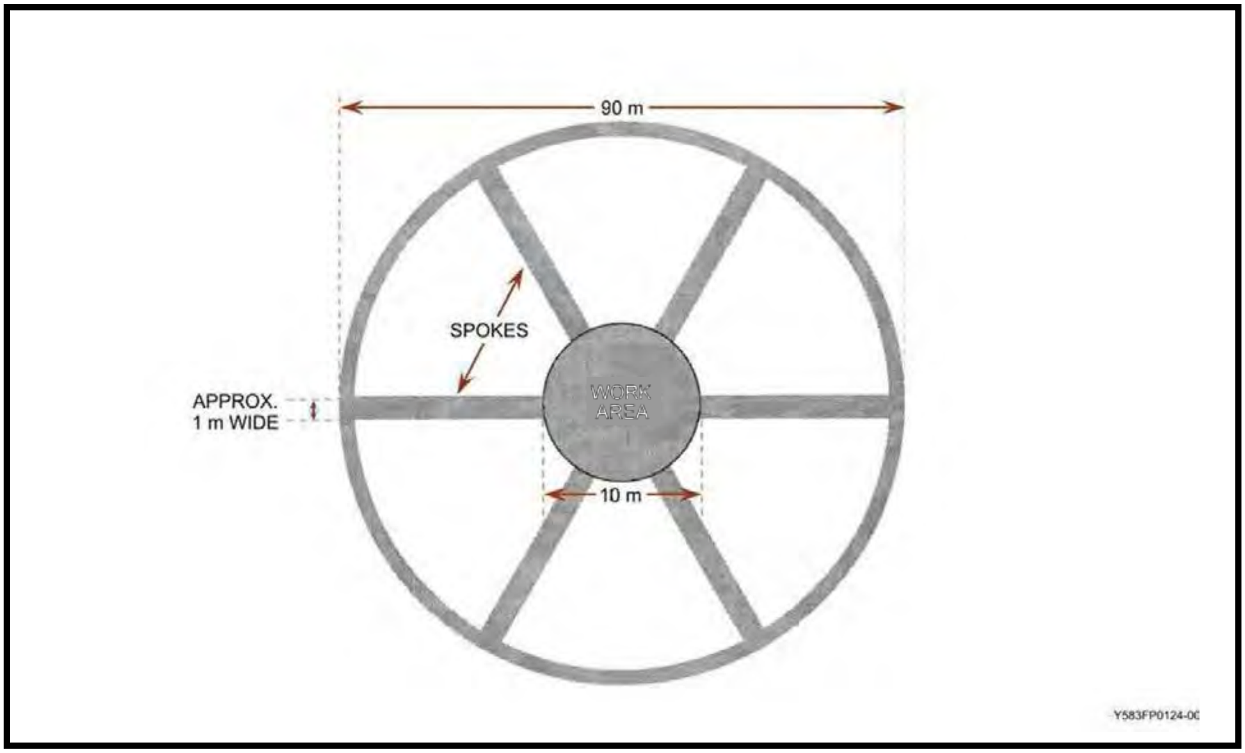

Figure 5B-1 Ice Diving Site

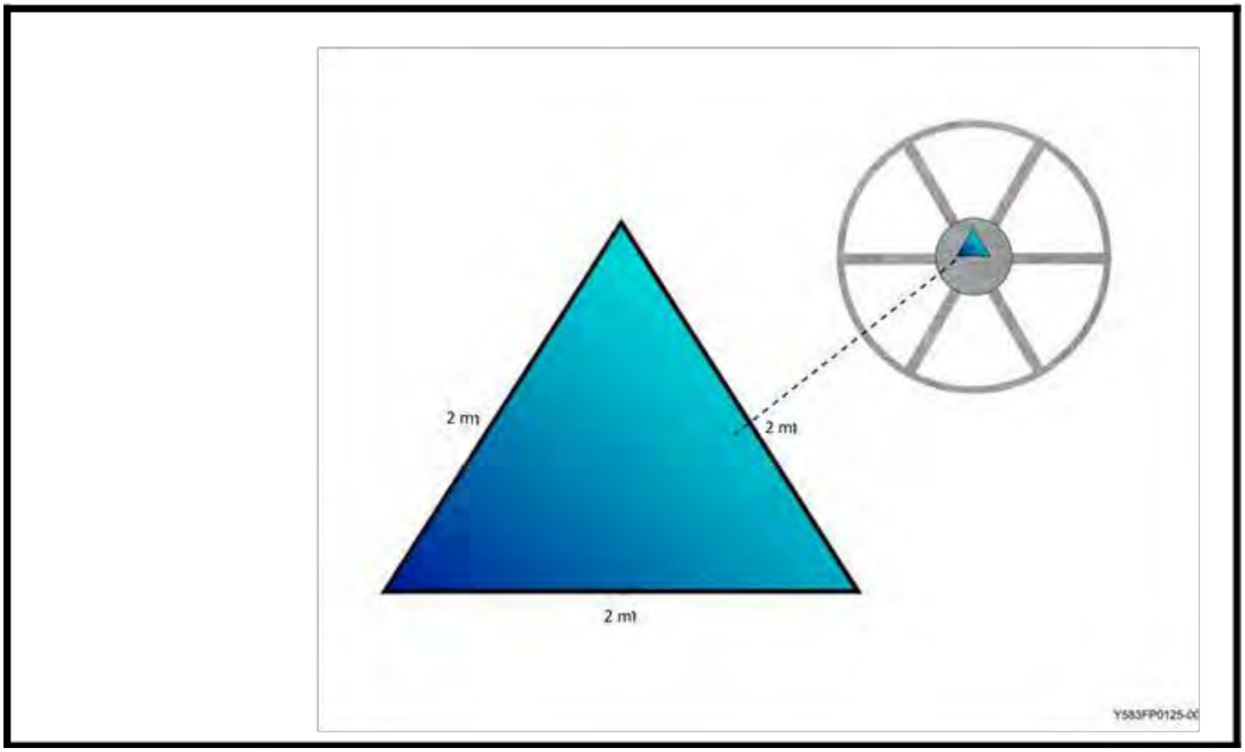

Figure 5B-2 Ice Diving Hole

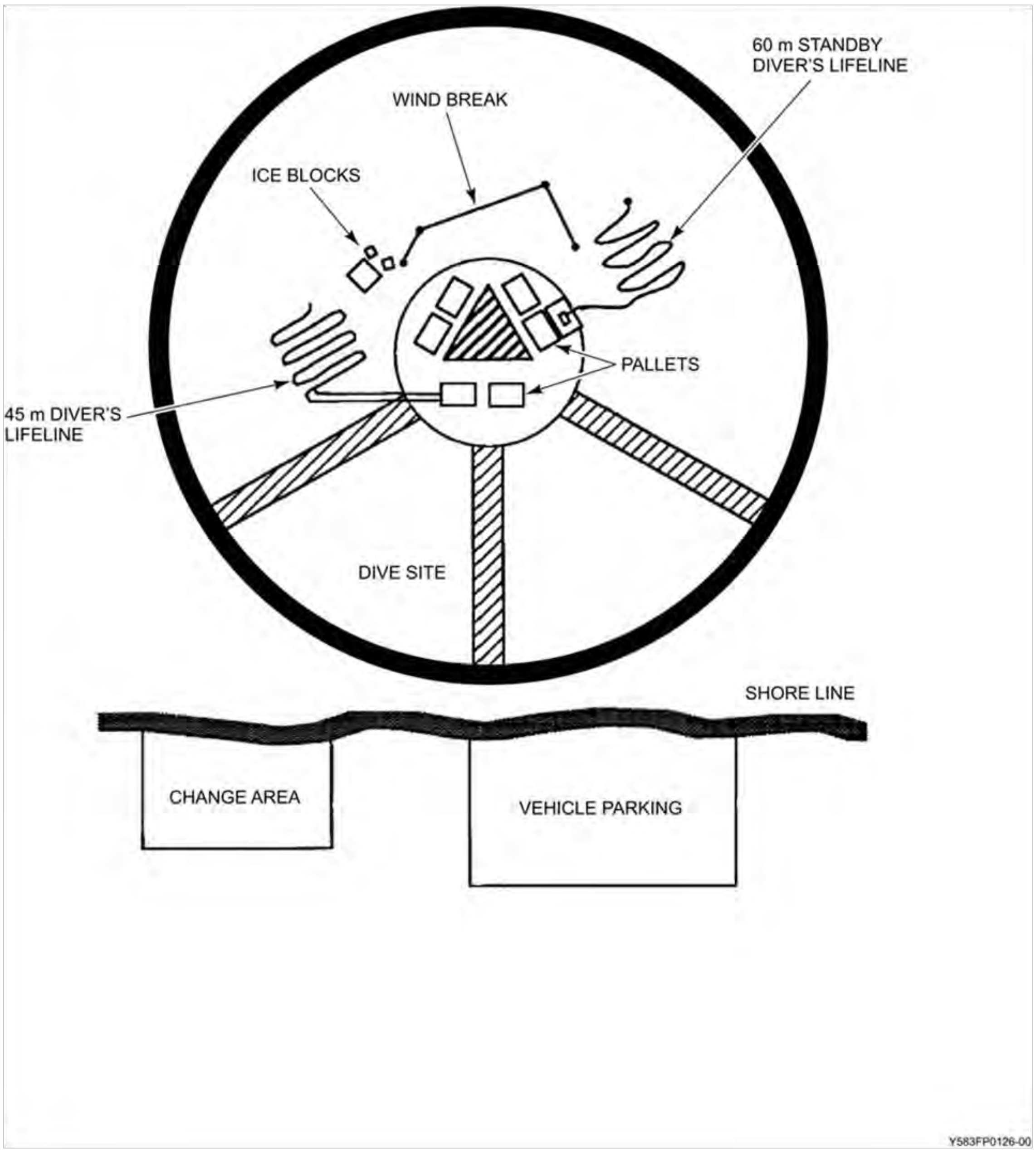

Figure 5B-5-19 Dive Set-up, Ice Diving

3. **Entrance/Exit Hole**:

a. The hole is cut in a triangular shape with approximately 2-metre sides. This shape allows easier access in and out of the water by the divers;

b. All ice blocks must be removed and placed on the ice surface on the edges of the cleared dive site area (can be used to weight the edges of modular tentage). Ice blocks shall not be pushed under the ice surface for three reasons:

(1) The blocks will be present as an unnecessary obstruction underwater, fouling the divers lifeline;

(2) They could slide back up into the hole blocking the diver's exit;

(3) For safety of others, the ice blocks must be replaced in the hole after the diving is completed; and

c. Place two pallets or rubber matting/coco matting on each side of the hole, 0.3 m from the edge and place the seventh close by with the standby diver's bench/seat on it. More pallets/rubber matting may be required if flooding around the hole is expected. A hole that is located in relatively thin ice will erode, due to the exhaust bubbles eroding the edges of the ice access hole. If diving operations must be conducted when operating over suspect or deteriorated ice, an inflatable boat or pallet dock system should be available as a safety platform for Diving Attendants and equipment.

4. **Wind Break/Tent**:

a. A windbreak upwind of the entry/exit hole for the surface crew, especially the standby diver, is very important. Ice screws or steel pegs should be used as required. If it is possible to erect tent over the entrance hole or at minimum half modules on the windward side, it will make for a much more habitable work site; and

b. A heated shelter (tent, dive truck or trailer) should be placed at or as near as possible to the dive site to protect divers/personnel from the elements.

5. Use of Small Vehicles. Although small vehicles (e.g., ATVs or snowmobiles) may be used for haulage and station set-up, they should not be left unattended on the ice. See Figure 5-B-3.

6. Emergency Exit Holes. In some cases, additional holes should be cut through the ice, around the entrance hole, to provide possible emergency escape or to aid in the dispersion of exhaust from the divers. These holes become very important when the ice is layered due to differences in freezing. In a river, the extra holes are needed downstream only. Except in the case

of ice diving, emergency exit holes are normally only used in initial training or during the lost diver drill explained in Emergency Procedures.

7. **Under-Ice Navigation**:

a. Navigation can be maintained as if conducting normal CABA ops with particular attention paid to the lifeline and umbilical for direction back to the entrance/exit hole;

b. A weighted shot line may be hung through the hole to aid in ascent and descent;

c. It may be helpful to suspend a light above or below the surface when tentage is utilized over the work area to help indicate the surface; and

d. When the work or u/w target is located, a distance line should be laid from the shot to the work.

8. **Divers' Lifelines**:

a. The diver's lifeline is to be configured in accordance with Article 124;

b. The surface end of the lifeline is affixed in the ice with an ice screw adjacent to the entrance/exit hole or, if ice screws are not available, by boring a hole approximately 150 mm in diameter about 6 meters from the diving hole (due to flooding). The lifeline may be secured through the hole with a 60 cm x 10 cm x 10 cm piece of wood, shoved down through the augured hole to act as an anchor. Use a second piece of wood above the ice to keep the block tightly in place;

c. Fake the line out on the ice for ready use or maintain within a suitable storage arrangement; and

9. **Diver Configuration**:

a. ULSSD is the preferred method of conducting ice diving operations. This ensures a standardized configuration for ice diving, an increased air supply, and increased safety through the use of hardwire communications. Refer to article 414 and 506 for ULSSDS characteristics and SOP’s;

b. CABA LITE is not permitted for ice diving; and

c. CABA Ice Rig Configuration is detailed in the following figures:

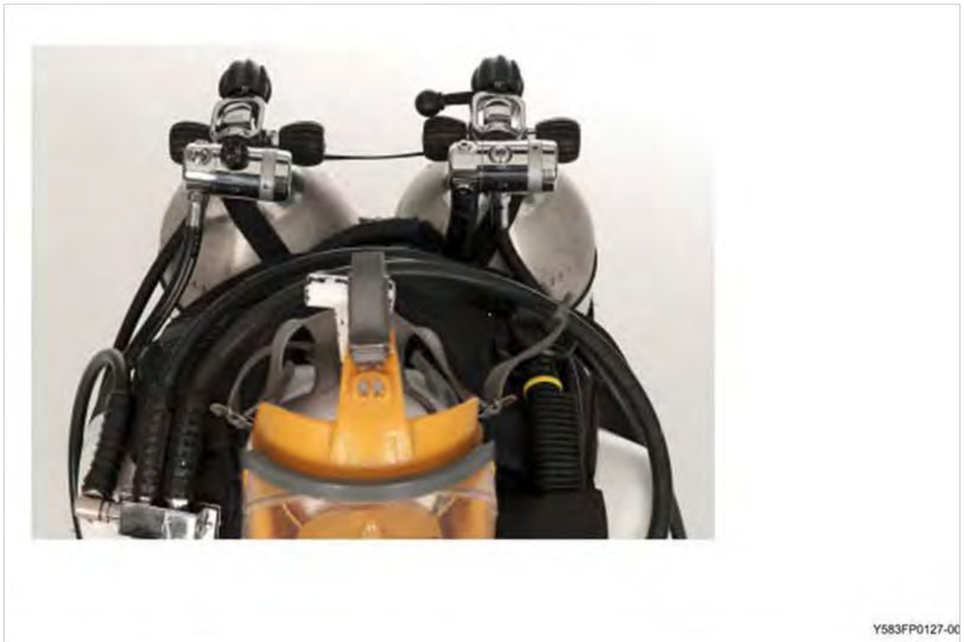

Figure 5B-4 Two Single 2265-Litre (80-Cubic Foot) Cylinders Rigged for CABA Ice Diving with Mini Gauge

Figure 5B-5 CABA Ice Diving Configuration

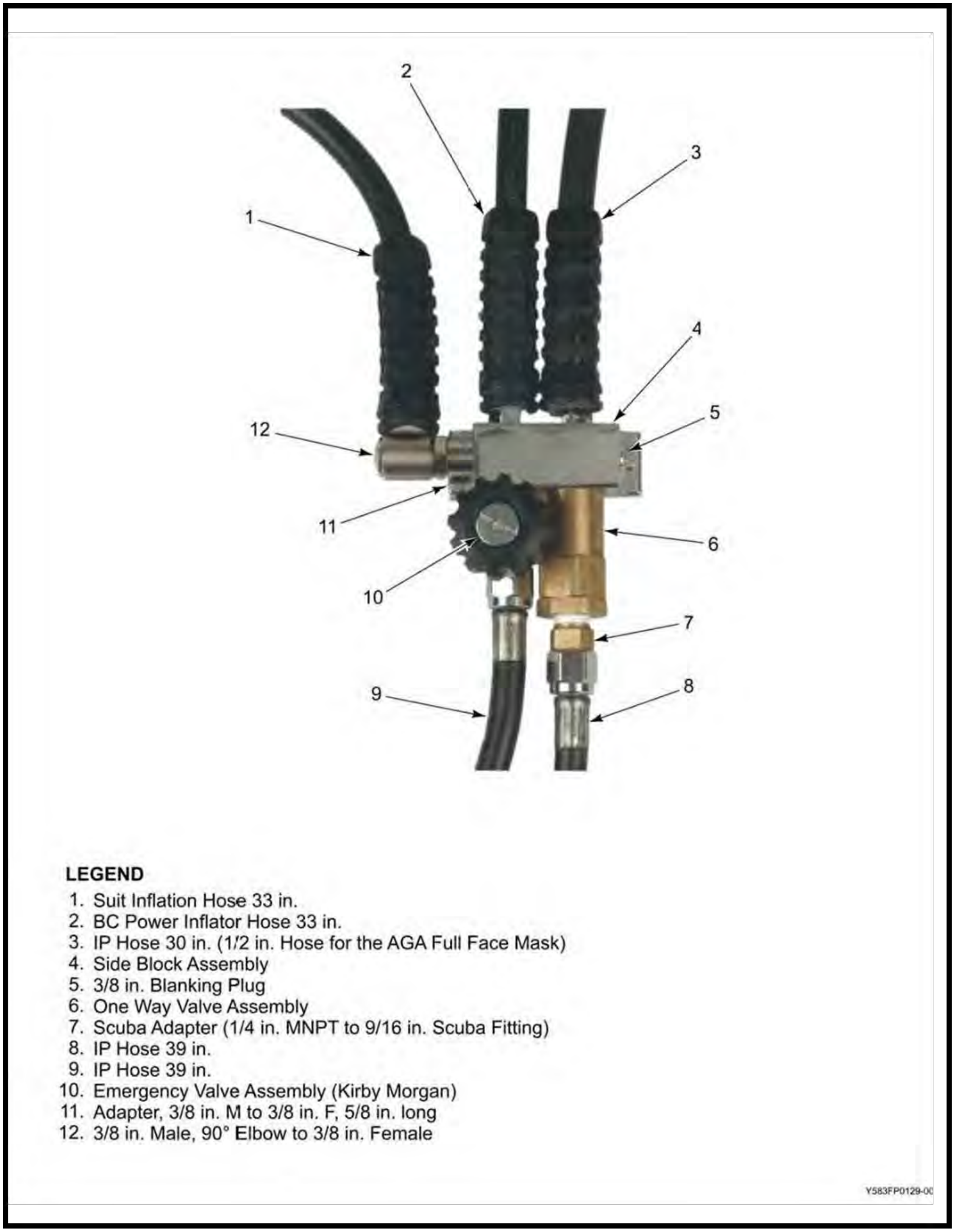

Figure 5B-6 CABA Ice Diving Side Block Assembly

LEGEND

1. AGA Octopus Hose 39 in.
2. IP Hose 39 in.
3. Mini Gauge (SPG)
4. Emergency 1st Stage APEKS DST Regulator
5. IP Hose 39 in.
6. Primary 1st Stage APEKS DST Regulator
7. SPG (metric)
8. AGA FFM
9. BC Power Inflator Hose 33 in.
10. IP Hose 30 in. (1/2 in. Hose for the AGA Full Face Mask)
11. Side Block Assembly (Figure 5B-6)
12. Suit Inflation Hose 33 in.
13. AGA Hybrid Octopus 2nd Stage Regulator

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Figure 5B-7CABA Ice Diving Side Block Assembly

Figure 5B-8 Example of Octopus Regulator Marked for Ice Diving

(1) A strobe light and indicator light shall be worn by all divers. The divers are to turn it on and check its operation prior to diving. Should an emergency occur, the diver shall activate the strobe light. This action will permit easier detection of the diver(s). The use of a day/night distress flare is of little value and not required in ice diving;

(1) Each diver should carry an ice screw in addition to both dive knives. In the event the diver becomes disconnected from the lifeline, the ice screw will provide a more secure anchor while waiting for the arrival of the Standby Diver; and

(2) The divers shall use a BCD buoyancy compensator.

10. **Divers**:

a. Ice diving operations are normally conducted in pairs. One diver is assigned as the "Lead Diver";

b. The diver(s) and the standby diver are to normally dress in sheltered areas, and when ready, proceed with their attendant(s) to the dive site. Divers should be burdened with only the minimum equipment while walking over snow/ice terrain. Sled/snowmobile or support personnel can transport their equipment;

c. Diver(s) secure their own lifelines with Carabiners IAW paragraph 8., of this Section, "Divers' Lifelines";

d. The Supervisor must conduct surface checks of all divers prior to anyone entering the water. Divers shall demonstrate clear knowledge of the location of the dive equipment (e.g. side block, suit inflation, alternate octopus second-stage); and

e. Attendants should leak check all HP/LP fittings with cold temperature leak detector. If this is not possible, the divers will conduct a leak check under the direct supervision of the Supervisor immediately upon entering the water.

11. **Standby Diver**:

a. The standby diver shall be at Immediate Notice;

b. Do NOT conduct in-water leak check with standby diver, as equipment will freeze;

c. The standby diver must be capable of providing an alternate breathing source to a stricken diver regardless of the breathing apparatus in use; and

d. Diving Supervisors should never allow a diver that has been in the water to continue as standby diver after a dive. Always allow divers to fully re-warm before taking over the duties of the standby diver or attendant.

12. **Attendant**(s):

a. Attendant(s) shall be dressed warmly and with flotation;

NOTE

Attendants and surface crew working close to the hole shall wear flotation devices/clothing. Use of "ice stud" slip-on footwear should be considered.

b. When diver(s) have left the surface, the attendant(s) shall maintain positive control of the umbilical by:

(1) Standing at the opposite side of the hole from the diver(s), and

(2) Being aware of the amount and direction of line paid out to the diver(s).

c. Attendant(s) are to be trained in the manual line signals being used and must remain alert at all times. Manual signals must be implemented immediately in the event of electronic communications failure.

13. **Communications**:

a. Hardwire electronic two (or three)-way communications is recommended;

b. If hardwire communications are not available, thru-water communications are permitted. However, operators must be aware of the potential of signal overload if more than one team is operating in a small area;

c. When diving in pairs the Lead Diver is to send/receive all signals. The Buddy Diver receives all signals and acknowledges all orders after the Lead Diver when round-robin electronic communications are employed. In this situation, the Lead Diver shall use the call sign "Red Diver" and the Buddy Diver shall use the call sign "Yellow Diver";

d. If electronic communications are lost, the diver(s) and attendant(s) will revert to manual signals; and

e. If there is any confusion/doubt as to what is being signaled, the Diving Supervisor must recall the diver(s) to clarify the situation.

14. **Conduct of the Dive**:

a. The Diving Supervisor will direct the Lead Diver to enter the hole after the dive brief and surface checks have been completed. This must be done carefully and slowly so as not to damage plastic/rubber components due to cold temperatures;

b. Entering at a corner with the attendant's help is the preferred method of entry. Once in the water, the diver moves aside to allow the next diver to enter;

c. During the dive all personnel should remain watchful for cold stress, hypothermia, frostbite and snow blindness; and

d. Except in an emergency, never operate/tend more than two divers from one entry/exit hole.

15. **Decompression Dives**:

a. The "No-D" time limit must be established prior to diving and briefed to the divers; and

b. In-water decompression should be avoided due to cold stress to the divers and support crew.

16. **Post-dive Procedures**. On completion of a dive, the diver(s) should be assisted out of a corner of the entry/ exit hole (buddy diver followed by the lead diver) and escorted by attendant(s) immediately to a warm change area.

17. **Freeze-up Precautions**. To avoid equipment (regulator/mask/BC/dry suit) freeze-up:

a. Ensure all components are dry and free of moisture prior to dressing-in;

b. Avoid allowing diving equipment to freeze overnight when ambient temperatures are extremely low; experience has shown that many components will malfunction when pressurized or operated the next day. Every effort should be made to protect all life support equipment from extended storage in freezing temperatures;

c. Do **NOT** breathe through the regulator on the surface except when using the AGA DIVATOR II;

d. Avoid using the purge button on second-stage regulators;

e. Avoid prolonged use of BCD/dry suit inflation valves during the dive; and

f. Diver(s) should be well briefed on freeze-up emergency procedures (EP's) prior to the dive.

18. **Thermal Considerations**. The next diving team should remain warm in a sheltered area if possible until required on site. Hot soup/fluids should be available for all personnel. The Standby Diver must be kept as warm as possible and other support personnel rotated frequently. Warm clothing must be layered to prevent hypothermia and should include thermal underwear, a

warm parka (waterproof/breathable material) or environmental suit (floater suit) for cold and wind protection, waterproof gloves and boots (insulated rubber boots).

SECTION 3

SECURING THE DIVE SITE

1. The following actions are to be completed upon completion of the diving operation:

   a. Remove all equipment from the dive site;

   b. Replace ice blocks in entry/exit hole;

   c. Mark the site with stakes and highly visible marking tape to alert all person(s) of the danger area; and

   d. Return and remove stakes/tape from entry/exit hole after ice has sufficiently frozen.

SECTION 4

EMERGENCY PROCEDURES (EPS)

1. **Freeze-up Emergency Procedures**:

   a. To avoid frostbite when freeze-up occurs:

      (1) Hold AGA mask in a position as to allow the escape of LP air. The inherent design allows for proper spacing between mouth/nose via the oral-nasal, thus reducing cold air effects. However, rapid and severe frostbite damage of gums and teeth can occur if care is not taken.

      (2) Switch to alternate air source.

   b. Inform surface/buddy diver;

   c. Abort the dive.

   d. Conduct a controlled ascent to the entry/exit hole.

2. **Diver's Loss of Umbilical** (in all Conditions of Visibility).

   a. Diver(s) must ascend to the lower ice surface, insert ice screw(s) or standard dive knife, switch on strobe lights and wait for the Standby Diver.

   b. Consider inflating stabilization jacket, dry suit and/or ditching weights.

c. Hang vertically if possible to increase the possibility of snagging the search line.

d. If electronic communications are fitted, provide details of surroundings (e.g. vicinity of nearest spoke).

3. **Lost Diver**. In the event that an attendant loses or believes that the diver may have lost the lifeline:

a. The attendant shall **IMMEDIATELY** inform the Supervisor of how much line is out and in what direction. If electronic communications are used, communicate intentions to divers. The Supervisor will assess the situation and instruct the Standby Diver to enter the water, and direct another senior member to organize a surface search.

b. Upon entering the water, the Standby Diver, as directed by the Supervisor, proceeds straight to the end of the line in a direction 15 degrees to one side of the lost diver's last known or suspected position.

c. The Standby Diver/Attendant shall maintain a taught lifeline on the underside of the ice so as to best aid in the lifeline snagging on the lost diver. Once at the end, the Standby Diver begins to sweep 360 degrees towards the lost diver's probable position in attempt again to snag the diver(s)/ice screw. Should the search fail it should be repeated once more before moving the search to the most likely emergency hole.

NOTE

If not already cut, spare personnel should be immediately detailed to cut extra access entry/ exit holes.

4. **Ice Failure**. Frequently the ice surface will move or sag, leading to slow flooding of the dive site. Bearing this in mind, some precautions can be taken to provide raised working platforms for personnel who would otherwise end up standing in near-freezing water for extended periods. As rapid failure of the ice surface can also occur, flotation suits, jackets, inflatable craft and similar safety equipment should be utilized as appropriate.

ICE DIVING EQUIPMENT	
LIFE SUPPORT ICE DIVING EQUIPMENT	Check
1. Dry suit	
2. Mitts (Three-fingered)	
3. Arctic Hood	
4. Distress Light	
5. UW Flashlight	
6. Working Knife	
7. Safety Knife	
8. Ice Screw (2 x divers/3 x ULSSDS ensemble)	
9. ULSSDS ensemble (Red and Yellow Diver)	
10. ULSSDS ensemble (Standby Diver)	
11. CABA Ice Rig	
12. BC with weights	
13. Sufficient primary and secondary air sources must be available on site for the duration/depth of planned dive. The secondary air source must provide a minimum of another 33% of the calculated requirement for the task.	
14. Ice diving life line IAW Art 124 if diving CABA Ice Rig.	
15. Ice diving buddy line IAW Art 124.	
16. Shot Line/Lazy Shot Line IAW Art 124	
17. DUOCOM RCC (Subject to regulations on distance from nearest suitable treatment RCC facility).	
18. First Aid Kit	
19. DAN O2	
20. Blanket	

Figure 5B-9 (Sheet 1 of 2) Ice Diving Equipment Checklist

ICE DIVING EQUIPMENT		
EQUIPMENT	QTY	Check
1. Chemical lights	5 boxes	
2. Ice Auger, ici scrapers/chippers, ice tongs	2	
3. Depth sounder	2	
4. Chainsaw with environmentally safe chain lubricant, tools and personal protective equipment (helmet with face shield and ear defender, chaps and safety harness).	2	
5. Handsaw		
6. Axe		
7. Steel pegs		
8. Sledge hammer		
9. Rubber matting or wooden pallets		
10. Ground tarpaulins		
11. Plywood sheets		
12. Benches		
13. Tent		
14. Snow shovel		
15. Toboggans		
16. Snow blower		
17. Thermometer		
18. Portable stove		
19. Generator		
20. Heater (Propane, gas or electric)		
21. Air Compressor		
22. Ground support vehicles		
23. Safety vehicle		

Figure 5B-9 (Sheet 2 of 2) Ice Diving Equipment Checklist