National Defence / Défense nationale

B-GL-361-007/FP-001

ENGINEER FIELD MANUAL

COMBAT DIVING

(ENGLISH)

(Supercedes B-GL-320-008/FP-001, 1997-01-27)

Issued on Authority of the Chief of the Land Staff

Canada

National Defence | Défense nationale

B-GL-361-007/FP-001

ENGINEER FIELD MANUAL

COMBAT DIVING

(ENGLISH)

(Supercedes B-GL-320-008/FP-001, 1997-01-27)

WARNING

ALTHOUGH NOT CLASSIFIED, THIS PUBLICATION, OR ANY PART OF IT, MAY BE EXEMPT FROM DISCLOSURE TO THE PUBLIC UNDER THE ACCESS TO INFORMATION ACT. ALL ELEMENTS OF INFORMATION CONTAINED HEREIN MUST BE CLOSELY SCRUTINIZED TO ASCERTAIN WHETHER OR NOT THE PUBLICATION OR ANY PART OF IT MAY BE RELEASED.

Issued on Authority of the Chief of the Land Staff

OPI : DAD 8 **2002-09-03**

Canada

FOREWORD

1. B-GL-361-007/FP-001 *Combat Diving* is issued on authority of the Chief of the Land Staff.

2. It is effective on receipt and supercedes B-GL-320-008/FP-001 (Interim) *Combat Diving Manual*, dated 27 Jan 1997.

3. Suggestions for amendments should be forwarded through normal channels to: Chief of the Land Staff, Attention DAD-8; information copy to the Army Dive Centre at the Canadian Forces School of Military Engineering (CFSME).

4. Unless otherwise noted, masculine pronouns apply to both men and women.

5. The NDID for the French version of this publication is B-GL-361-007/FP-002.

6. This publication is available electronically on both the Defence Information Nerwork (DIN) and the World Wide Web in the Army Electronic Library. Keyword—Army Electronic Library.

PREFACE

AIM

1. The aim of B-GL-361-007/FP-001 *Combat Diving Operations* is to provide information for combat divers, commanders, and their staff on the application of combat diving to support land operations.

SCOPE

2. The doctrine and concepts outlined in this publication are applicable to combat operations. Non-combat operations and training should follow the doctrine in this manual as far as possible.

3. This manual contains the information required for the planning and execution of combat diving operations. This manual does not supersede the diving safety procedures outlined in B-GG-380-000/FP-002 *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus*.

4. The Chief of the Maritime Staff, through the Directorate of Dive Safety, is responsible for all aspects of diving safety, both equipment and procedural, for the Canadian Forces. Combat diving procedures are developed by the Army Dive Centre and are approved by the Directorate of Army Doctrine to ensure that they conform to army doctrine.

5. References pertinent to this manual are outlined at the back of this book.

6. The terminology used in this publication is consistent with that of AAP-6—*NATO Glossary of Terms*. In addition, a glossary is provided at the back of this book.

TABLE OF CONTENTS

LIST OF FIGURE

LIST OF TABLES

CHAPTER 1
COMBAT DIVING

GENERAL

1. Modern military diving dates back to the 1800's when the Royal Engineers first provided divers for the Royal Navy. However, it did not develop its full military potential until WW II with the introduction of closed and open circuit diving gear.

2. Diving in the Canadian Army began in the 1960's when, as a result of the introduction of amphibious vehicles, it was essential to provide a diving capability to the safety organization for the swimming of the vehicles. Amphibious operations also required a better capability for the underwater reconnaissance of crossing sites. Following trials in 1966, diving sections were established in engineer units in 1969. Once the diving capability was established, additional tasks were added to make combat diving an extension of combat engineering into the water. Other tasks such as obstacle construction and breaching, employing and detecting landmines and limited underwater construction were added to the safety standby and reconnaissance tasks.

3. Combat divers provide the Army with the capability of performing combat engineer tasks underwater. They generally conduct tasks as part of the combined arms team; however, if required, they have the ability to execute tasks independently. Combat divers are combat engineers who perform combat diving as a secondary duty. They are grouped into mission-specific teams when a task is identified and ordered, to support operations. Engineer commanders must be able to advise their manoeuvre commanders on the use of combat divers; specific technical information will be provided by divers for difficult or unusual circumstances.

4. Combat divers do the majority of their work on inland waterways, either on the surface or beneath the water with breathing apparatus. They usually work close to shorelines and riverbanks because that is where the rest of the army will be conducting operations. At times the combat divers will work in salt water to support Army operations. In some circumstances, combat divers can be used to conduct reconnaissance in the face of enemy forces. They

would be doing this reconnaissance with the support of the manoeuvre forces, which could assist the dive team with observation and suppressive fire. Combat divers are armed as a means of self-defence and extraction.

5. The loss of the swim capability in the army's vehicles has not reduced the need for divers to inspect far banks and the bottom of waterways. Amphibious crossings with allies or with rafts and ferries will have the same information and work requirements; the combat divers will have to lead with reconnaissance and obstacle clearing operations.

6. B-GL-361-007/FP-001 *Field Engineer Manual, Combat Diving Operations* expands on B-GL-361-001/FP-001 *Land Force Engineer Operations*, Chapter 10, "Combat Diving".

THE ROLE AND TASKS OF COMBAT DIVERS

7. The role of the combat diver is to extend combat engineer operations into the water.

8. **Tasks**. Combat diving tasks, as with all engineer tasks, can be grouped into three of the six combat functions.[1] The traditional engineer roles of mobility, counter-mobility, survivability, and sustainment engineering can be clearly seen in this grouping. Support to geomatics may be carried out as specifically tasked or as an incidental result of reconnaissance.[2]

a. **Manoeuvre**—maintain mobility:

(1) reconnoitre crossing areas and bridges;

---

[1] See B-GL-361-001/FP-001 *Land Force Engineer Operations*.

[2] If divers find information that is not accurately reflected on the geomatics products, or is not shown on the products, they would forward this information up the engineer chain so that the geomatics support team can update their database.

(2) clear underwater obstacles and mines; and

(3) support gap-crossing operations.

b. **Protection**—counter-mobility and enhance survivability:

(1) enhancement of natural obstacles by:

(a) the preparation and execution of obstacles, using non-explosive means and materials;

(b) creating obstacles through explosive demolition; and

(c) laying landmines in shallow water at potential crossing sites; and

(2) removal of battlefield hazards.

c. **Sustainment**—sustainment engineering:

(1) conduct damage assessment of bridges, both civilian and military fixed-span, as well as inspections of ferries, boats, and rafts;

(2) recover essential military equipment;

(3) conduct underwater repair of floating assets in order to permit their recovery or continued use;

(4) clear underwater debris and rubble;

(5) assist in clearance operations on the battlefield, including recovery of vehicles and weapons and disposal of UXO; and

(6) support civil-military co-operation (CIMIC) operations.

9. Table 1-1 provides a summary of combat diving tasks and which divers could be expected to perform these tasks. The division of responsibilities between close support and general support tasks is artificial in the Canadian Army, as the combat divers in our combat engineer regiments (CER) (close support) and Engineer Support Unit (ESU) (general support) are generally equipped and trained identically.

Serial	Task	Normal Location of Divers that Conduct These Tasks		
		Division and Below		Corps and Theatre
		Close Support	General Support	
1.	**Reconnaissance**			
	- Crossing-area reconnaissance	X	X	X
	- Beach reconnaissance **(Note 1)**	X		Special Forces
	- Engineer task reconnaissance	X	X	X
2.	**Demolitions**			
	- Removal or destruction of underwater and surface obstacles	X	X	X
	- Destruction of piers, docks, and underwater installations			X
	- Underwater detection, neutralization and destruction of unexploded ordnance as part of battlefield area clearance operations	X	X	X
3.	**Mine Warfare and Obstacle Construction**			
	- Construction of underwater obstacles, including placement of mines	X		X

Serial	Task	Normal Location of Divers that Conduct These Tasks		
		Division and Below		Corps and Theatre
		Close Support	General Support	
4.	**Construction**			
	- Examination and repair of bridge piers and floating-bridge equipment		X	X
	- Laying and repairing underwater pipelines and communication lines			Specialized divers
	- Construction, maintenance and repair of docks, piers, underwater sewage systems, and water systems			X
5.	**Safety, Search, and Recovery**			
	- Safety standby **(Note2)**	X	X	X
	- Search and recovery		X	X
	- Special operations			Special Forces

NOTES

1. Currently the CF will not conduct amphibious landings from the ocean, other than unopposed landings to support logistics over-the-shore (LOTS) operations. Normally the navy will provide the dive support required for these operations. In some circumstances, combat divers may be tasked for this type of mission, which would require extensive re-grouping, training, and coordination.

2. Combat divers may also perform safety standby duties in support of water-crossing operations. This is essential in peacetime training and may be required during combat, or other, operations.

Table 1-1: Combat Diving Tasks

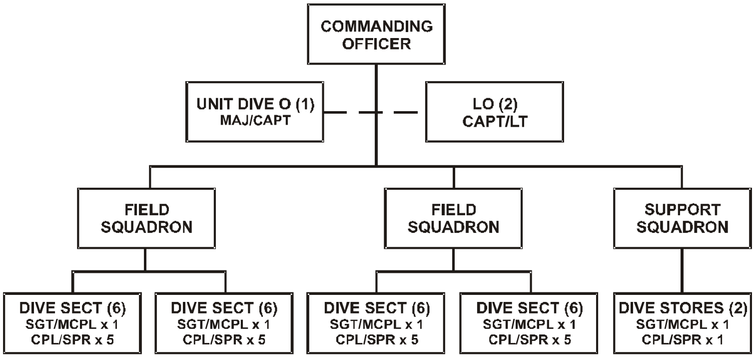
THE COMBAT DIVE TEAM

10. There are dive sections in the close support units (CER) and the general support unit (ESU). Divers in the CER normally do close support tasks, but could also be required to do general support tasks, with some refresher training. Divers in the ESU will focus on general support dive tasks, but are also capable of augmenting close support units, with some refresher training.

11. Divers are organized in the engineer units including one dive supervisor and one storeman to manage the equipment, training, readiness, and provide assistance in dive tasks. The divers are normally grouped in a single section, based on a dive section per field squadron. This type of grouping gives the section an integral capability to conduct dives, with their own dive supervisor, and reduces the turbulence of drawing divers from multiple sections for each dive task. If a formation and engineer unit are formed for an operation, the decision may be made to increase the number of dive sections.

12. Divers generally conduct dive tasks as a six-to-eight man team, although they could be employed in smaller groupings such as pairs. Combat divers are normally armed with either the C8 carbine or C7 rifle for self-defence and extraction. The C8 is preferred due to the reduced size, but it may not always be available. Future acquisitions of a personal defence weapon (PDW) may prove useful for divers. Figure 1-1 and 1-2 illustrate the general disposition of divers within the CER and ESR. This is not an establishment authorization. It is possible that other soldiers are dive qualified and are current, but they are not part of the essential establishment of divers within the regiments.

COMBAT DIVERS IN THE CER



NOTES

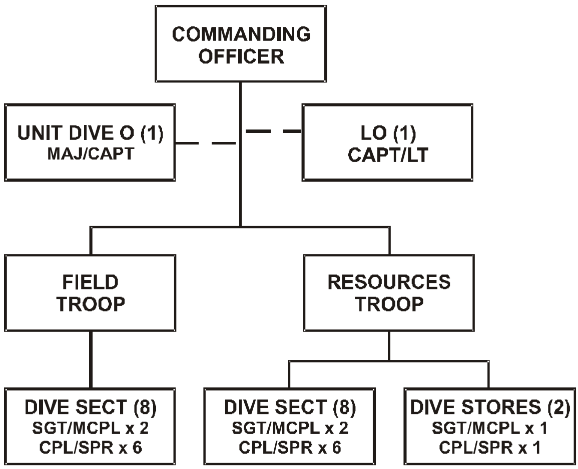
1. Based on one dive section per field troop.

2. The optimum number of divers to execute a task is six. Within a field section, this will leave one driver and one crew commander with the section vehicle during a dive task.

3. Dive stores section, held with the CER Support Squadron, consisting of one supervisor and one diver provides the capability to support a dive task. Additional divers may be assigned to dive stores depending on unit requirements.

Figure 1-1: Combat Divers in a CER

COMBAT DIVERS IN THE ESR



NOTES

1. Based on one dive section per field troop, with one other dive team being formed as a composite team from other elements in the ESR. It is shown in Resources Troop for ease of illustration.

2. Dive sections within the ESR will be expected to conduct dive tasks that require longer periods at depth and of longer duration. An eight-person section provides greater flexibility and manpower for these tasks.

3. Dive stores, with one supervisor and one diver, provide the capability to conduct task reconnaissance and support dive tasks. Additional divers may be assigned to dive stores depending on unit requirements.

4. With the change in organization of the ESR, with some elements going to the ESU, the organization may change. Diving capabilities within the ESU are not confirmed at the time of publication.

Figure 1-2: Combat Divers in the ESR

13. A combat dive team with its stores and equipment has the ability to be self-sufficient for a limited range of tasks. For more sustained, technical, or difficult tasks the dive team will have to rendezvous with the dive stores for the additional equipment. Dive teams work with the field squadron or field troop and their supported manoeuvre unit. They rarely work independently.

14. **Characteristics**. The characteristics of a combat dive team are:

a. **Flexibility**. Combat divers can apply a wide range of engineering skills, resulting in a flexible and adaptable capability.

b. **Mobility**. Combat dive teams have limited mobility while conducting their tasks. They must enter the water relatively close to the task site and they cannot cross large bodies of water without boats. Based on a field section, the dive team has the same ground mobility as the rest of the Engineer unit.

c. **Reliance on Equipment**. Combat dive teams rely heavily on their equipment and breathing apparatus. Even surface swim operations will require the use of bulky personal issued equipment[3] (suits, masks, etc.).

d. **Vulnerability**. Combat divers are vulnerable to unique environmental and operational hazards, which are further detailed in Chapter 2. They are vulnerable to direct and indirect fire as well as explosions transmitted through the water. They are affected by air and water temperature. Water depth could limit the length of time they can work on a particular task. Individual and collective training proficiency in combat diving skills will help to

---

[3] There are very few water areas in which a suit is not required to protect the diver from hypothermia.

counter some of these vulnerabilities, but some physiological ones cannot be changed.

15. **Key Personnel**. The key dive personnel within either of the engineer units and their responsibilities are as follows:

a. **Unit Dive Officer**. A qualified combat diving officer, usually holding the rank of major, is responsible to the CO for the administration and technical proficiency of the unit divers. He will advise the CO on technical aspects of combat diving tasks to support the formation, when required. Working through the unit operations officer and training officer, he will ensure adequate training is carried out. On operations, his role is limited to providing advice as required by the CO; he will rarely deploy to dive sites. The CO and OC of the field squadrons will provide advice to their manoeuvre commanders on the employment of divers.

b. **Liaison Diving Officer**. A combat diving qualified officer in the rank of captain/lieutenant is usually found in the RHQ or a field squadron HQ. This officer has the responsibility of understudying and assisting the unit dive officer in his tasks. He/she may be tasked to run a multi-team dive task. He/she may provide advice on the employment of divers to a squadron OC, as required.

c. **Dive Stores Section Commander**. A Sgt or MCpl, qualified as a combat diver supervisor, assists in the administration and training of unit divers and the maintenance of diving equipment and stores. He/she is available to assist in the planning of dive tasks if it is beyond the ability of the tasked dive section. He/she is responsible for the provision of the required dive equipment to the dive team.

d. **Dive Storeman**. A Cpl, qualified combat diver, is responsible to the dive stores section commander to maintain dive stores and equipment and assist in delivering them to the dive team.

e. **Diving Section Commander**. The dive team leader, Sgt or MCpl, qualified as a combat diver supervisor, is responsible for actual detailed task planning and execution. He/she will be tasked through the chain of command and will be working for the field troop commander.

EMPLOYING COMBAT DIVERS

16. Combat divers execute tactical missions in support of army operations. They have the capability of crossing water obstacles and transporting limited amounts of equipment and stores for use in the water or near the shore. They can be employed on the far shore to support a crossing operation, but they normally carry weapons for self-defence and extraction.

17. A dive team will normally require a dive supervisor, although this may not be the case if a team is deployed on operations in which the risk is accepted by the commanding officer.[4] Normally, the divers are grouped in a dive section of a field troop, with the section commander a qualified dive supervisor. This allows the field squadron commander to task a single troop and section for a dive task, using the section's normal chain of command. A regimental dive task, with divers from different squadrons (or units), may be led by one of the section commanders, a unit dive LO of the regimental dive NCO. When combat divers support and conduct tasks with other engineers and arms, the senior diver present coordinates the dive task and advises the local engineer commander on dive related issues.

18. If the dive task requires equipment from the dive stores, sufficient warning time is required to bring that equipment to a

[4] The commanding officer will carry out risk management with advice from the dive officer. Depending on the operation and the urgency, this decision may be delegated further or may have to be decided at a higher level.

rendezvous with the dive team. At times, the dive stores could be pre-positioned with a field squadron.

19. Combat diving operations extend beyond the scope of other CF diving establishments. There are unique considerations relevant to the employment of combat divers as follows:

a. During operations combat divers will often conduct tasks independent of surface support personnel and safety organizations. The risk of deviating from accepted training safety standards must be analyzed, mitigation steps taken, and appropriate approval given for these deviations.

b. They will use explosives, small arms, equipment and tools on and under the water, with the inherent risks associated with using potentially dangerous equipment in a difficult environment.

c. Divers may be exposed to toxic industrial materials[5] (TIM) during the routine conduct of their tasks.

20. Combat divers can use a wet suit or a dry suit, depending on operational or environmental conditions. Combat divers may conduct operations in one of the following ensembles:

a. **Surface Swimming**. Surface swimming is normally done wearing a wet suit, mask, snorkel and flippers (as a minimum). Combat divers, as surface swimmers, can cross water obstacles more rapidly than with full CABA (compressed air breathing apparatus); they are often used in this configuration if the water is relatively shallow. Speed of deployment will also indicate the use of surface swimmers. Surface swimmers would also be used when the enemy threat is low or a hasty crossing is

---

[5] TIM include toxic industrial chemicals (TIC) and toxic industrial biological (TIB). These are hazardous products that may be released into waterways, deliberately or inadvertently. There are other pollutants, such as sewage, that could also contaminate the water and provide a hazard to divers.

being attempted, which precludes the issuing of CABA stores. The divers will be using their personally held dive kit. Given the proper conditions, surface swimmers can be effective; however, they are vulnerable to detection. If the enemy threat is too high, then suppressive fire and obscuration will have to be provided for the dive work.

b. **Compressed Air Breathing Apparatus (CABA)**. CABA is the normal means of underwater operation. The equipment is normally held centrally within the units in the dive stores. While it is possible, under some circumstances, to detect CABA divers in still water, the CABA also allows the divers to swim deeper to avoid detection. If the enemy threat is too high, then suppressive fire or obscuration must be provided to support the mission. Combat divers with breathing apparatus can conduct tasks within their depth limitation, no decompression limits, and their personal endurance.

c. **Closed or Semi-closed Circuit Breathing Apparatus (CCBA)**. Closed circuit or semi-closed circuit breathing apparatus provides some different capabilities to CABA, such as increased diver endurance and stealth. This equipment is used by navy clearance divers for some of their tasks. This equipment is not currently fielded to combat divers, but future operational requirements may identify a need for combat divers to use it.

d. **Light Weight Surface-supplied Diving-system (LWSSDS)**. This is an open circuit compressed air, surface-supplied, umbilical system. Combat divers can use this equipment to access drowned vehicles, confined spaces, or for sustainment tasks where concealment from surface observation is not important. This system allows audio communications between the diver and surface. It provides for positive control of a diver as individual divers are tended from the surface or from an entry point into a confined space or drowned vehicle.

This system was designed for the safety standby of amphibious vehicles swimming and working underwater out of contact with the enemy. It is cumbersome and has limited flexibility.

21. **Principles of Employment**. The principles for employing combat divers are the same as for other engineer assets. The following are the principles for employing combat divers:

a. **Integration With Other Combat Functions**. Combat power is used to find, fix, and strike the enemy. All activities on the battlefield support the integrated combat power. The divers must be conducting tasks in order of priority that supports the achievement of decisive combat power in accordance with the commander's plan.

b. **Centralized Coordination**. Combat diving assets are a limited resource. They need to be centrally coordinated at the highest practical engineer level.[6]

c. **Decentralized Execution**. Combat diving assets, once tasked, are controlled at the lowest possible level necessary for the execution of the task.

d. **Allocation of Priorities**. All effort on the battlefield must be focused on the commander's priorities. Engineers are not held in reserve; therefore dive tasks must be considered with the other priorities to ensure that sections are not pulled away from higher priority tasks to support a lower priority dive task.

e. **Continuity**. The combat dive team most familiar with the area operations and the situation should conduct the reconnaissance and the task. Once committed to a task, it may be tactically and logistically difficult to change that commitment.

---

[6] Normally, the highest practical engineer level would be the squadron, but in some cases the regiment would coordinate dive tasks, such as in preparation for future operations.

f. **Early Warning and Reconnaissance**. Time is needed to withdraw a dive section from other tasks, assemble equipment and conduct preparations and reconnaissance. Divers may also need to rest before a task. Foresight and anticipation of tasks are important, and a reconnaissance is essential. Some types of reconnaissance could be conducted by any engineer officer or reconnaissance Sgt, while some types of tasks will require a diver to conduct the reconnaissance.[7]

EQUIPMENT

22. Combat divers use both CABA and LWSSDS to execute tasks. The dive equipment holding of a CER is based on providing the ability to conduct minor combat diving tasks off the line of march, such as reconnaissance of a water obstacle. Major tasks, such as breaching water obstacles, will likely require the regrouping of dive stores from the support squadron.

23. The equipment holdings of the ESU is similar to the CER; however, their tasks will likely be in support of sustainment engineering operations, such as repair and recovery of military bridging equipment.

24. The operational characteristics of this equipment are detailed in Chapter 2. Chapter 2, Annex A outlines the basic equipment held by a combat diving establishment and Chapter 2, Annex B lists the

---

[7] As an example, a crossing-site reconnaissance could be done by a recce Sgt who would identify harbour areas, potential entry sites, enemy and friendly troops. On the other hand, the clearance of an obstacle belt, in and on the shoreline, should be done by a diver, who may do an in-water reconnaissance.

basic equipment normally issued to individual combat divers. This is not an equipment authorization table, but it provides general information on the scope of equipment used by the divers and that the individual divers must transport

CHAPTER 2
OPERATIONAL PLANNING

1. Combat divers bring a unique capability to the battlefield that must be employed efficiently, effectively, and safely to promote survivability and mission success. B-GG-380-000/FP-002 *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* details the operating procedures, rules, regulations, and safety restrictions governing compressed air diving operations in the CF. This chapter provides a general guide for the planning of combat diving operations.

2. The physiological effects resulting from the physics of diving must be considered when planning combat diving operations. These are unalterable parameters of a dive task, unless the commander assumes high risk to the divers' health. Diving officers brief these limitations to the engineer commanders.

GENERAL CONSIDERATIONS

3. The success of a combat diving mission is the direct outcome of careful and thorough planning. The nature of each task will determine the scope of the planning effort, but certain general considerations apply to every operation. This section details these considerations and factors.

4. **Bottom Time**. Due to the physiological effects of pressure on the human body, bottom time is likely the most crucial element when planning diving operations. Developing measures to conserve bottom time or increase diver effectiveness is critical for success.

5. **Depth**. Combat divers are trained to conduct and supervise non-decompression diving operations to a maximum depth of 100 fsw. Planned dives deeper than 50 fsw and to a maximum depth of 100 fsw require authority from the commanding officer. Since the divers are supporting land operations, these types of deep dives are rarely required since the bottom will not affect the conduct of land operations. Such dives are only used to recover important (mission critical) equipment. In such rare instances that operational necessity requires combat divers to conduct dives beyond their maximum allowable depth and non-decompression limits, authority must be

granted from the operational commander with advice from the unit dive officer. Combat divers and supervisors are qualified and trained to carry out the procedures to conduct safety stops in the event that a dive is authorized or exceeds the no-decompression limit. Depth and bottom time are directly related to each other when planning diving operations. However, a risk management process must be worked through to identify and analyze the risks and to mitigate them. The requirement for air medical evacuation (AME)[8] or ground evacuation as well as diver unique medical support, such as decompression chambers, must be considered as part of the risk management process and briefing to the CO.

6. **Emergency Assistance**. Due the inherent risks of diving, specifically the potential to require recompression in the event of an accident, it is critical to coordinate emergency assistance support and the AME plan before the operation begins. Specialized equipment such as decompression chambers may not be available in local hospitals or within the deployed forces medical facilities. Naval ships in the area may have the equipment.

7. **Surface Interval**. The time spent on the surface between dives must be considered since it has a direct effect on the allowable bottom time and depth for successive dives.

8. **Equipment**. Combat diving tasks are dependent on equipment and stores. Most of the equipment is held centrally in the dive stores.

9. **Operational Conditions**. The nature of combat diving operations potentially exposes personnel to extreme operational conditions. Planners must plan mitigation techniques or procedures for these conditions. Section 2 details environmental and operational hazards.

10. **Weather**. Some types of adverse weather can affect combat diving operations. In other cases, the weather will provide a useful

---

[8] AME covers CASEVAC (without medical personnel on board the helicopter) and MEDEVAC (with medical personnel on board the helicopter).

cover for the task.[9] Dive planning must take into consideration the weather and try to use it to the best advantage, or mitigation techniques must be considered.

11. **Security and Protection**. The dive task planning must take into consideration the security and protection requirements of the site and mission. While divers may be on the far side of a water obstacle, they will still be protected by our own forces. Suppressive fire and obscuration should be on call, or used pre-emptively, to allow the divers to carry out the mission without enemy interference. The divers must also be aware of the situation and be prepared to remain concealed or to defend themselves.

12. **Task Appreciation**. Annex A details the factors and related considerations for a combat appreciation when planning a combat dive task.

13. **Task Duration**. Many factors beyond the control of the dive team executing the task may influence the duration of a diving operation. The table in Annex B outlines the estimated duration of typical combat diving tasks and the suggested number of divers to conduct the task. The times indicated are for the time on the objective and do not account for battle procedure, movement to and from the task site, or pre- and post- dive procedures.

14. **Orders and Battle Procedure**. Combat diving operations use the standard format of orders and steps of battle procedure. However, there are some factors that should be considered due to the uniqueness of most combat diving operations and the coordination of the mission plan and the supporting dive plan. Annex C highlights relevant headings and points in the context of the standard orders format as applied to combat diving operations. Combat diving operations orders should consider the following:

a. There is normally an orders group and a dive briefing for the task.

---

[9] Heavy rain should not affect divers and will cause problems for enemy observation.

b. The orders group for the task follows the normal orders format. All divers executing the task and support personnel should be present for the dive team leader's orders group. Since the dive team is based on a field section and the dive team leader is the section commander, this is the normal means of giving orders.

c. The dive briefing is generally close to or on the dive site. In some circumstances, it may be necessary to give the dive briefing at the same time as the orders for the task.

d. There will likely be two supervisors: one to supervise the task and another to supervise the dive support personnel.

e. Proper use of the battle procedure process, including the proper chain of command, will increase the probability of mission success. If the chain of command and applicable SHQ do not know what is happening, they cannot anticipate or support the dive task.

ENVIRONMENTAL CONSIDERATIONS

15. The nature of combat diving operations will expose personnel to the extremes of operational and environmental conditions. It is beyond the scope of this manual to fully detail all the conditions, and it will be impossible to eliminate exposure to all these hazards. However, they should be considered, and, whenever possible, measures should be taken to mitigate or minimize exposure and risk. Environmental and operational conditions have a major influence on the selection of divers, diving technique, and the equipment to be used. In addition to environmental hazards, a diver may be exposed to operational hazards that are unique to the diving environment. This section outlines the environmental and operational hazards that may impact an operation.

16. **Suits**. Combat divers are issued both wet and dry suits. The choice of which suit to wear depends on water temperature, type and

duration of the task. The dive supervisor will normally decide which suit is to be worn based on the mission and the environmental conditions. Contaminated water diving will normally require dry suits and full face masks. While divers may want to decide on the type of suit, the supervisor will decide since he has the best understanding of the overall situation. The supervisor cannot afford to have a diver stop the dive because he has chosen inappropriate equipment for the conditions. Combat divers need to be familiar and capable with the issued equipment.

17. **Underwater Visibility**. Underwater visibility varies with depth, turbidity, and ambient light conditions. Horizontal visibility is almost always less than vertical visibility. The degree of underwater visibility influences the selection of dive techniques and can greatly increase the time required for a diver to complete a given task.

18. **Water Temperature**. A diver's physical condition and dress will determine how long exposure to extreme temperatures can be endured. In cold water, the ability to concentrate and work efficiently will decrease rapidly. Even in water of moderate temperature (15–22°C), the loss of body heat can quickly bring on exhaustion. Conversely, in warm water, dehydration becomes a critical factor in diver duration and survivability.

19. **Currents**. Combat diving operations generally take place within in-land waterways and rivers. As such, there are unique considerations when operating in rivers and currents. Section 4 of this chapter details these considerations.

20. **Tides, Sea State, and Waves**. Tidal changes, sea state, and waves may directly affect diving operations and must be considered when planning. Tide charts and weather forecasts are important tools used to gather relevant planning data. Weather reports and wind speeds are readily available; however their application to sea state may not be readily apparent. The table in Annex D compares the terms and numbering scale of the three reports most likely available to combat divers. The diver supervisor will advise the engineer commander on the risks, and the decision to execute the task will be made by the

manoeuvre commander after being advised on the risks by the engineer commander.[10]

21. **Cold Weather Operations**. The conduct of combat diving operations in cold weather and sub-arctic conditions increases the complexity of task execution and support. Divers are more vulnerable to cold-related injuries, and their endurance is greatly depreciated. The considerations for conducting combat diving operations in cold weather are outlined in Section 6 of this chapter.

22. **Confined Spaces**. Confined spaces are considered to be any dive area where a diver's movements are reduced, free ascent to the surface is not possible, or natural or structural debris poses a risk to a diver. Some tasks require that a diver be placed in this situation, such as entering the hull of a drowned AFV to rescue a soldier. The recovery of vehicles, equipment, or bodies or personnel is rarely an urgent task, and careful steps must be taken to mitigate risks of operating in confined places. In these conditions, there is an increased risk of injury or fatality. Divers entering a restricted space will always be tended at the point of entry. The following are potential hazards when operating in confined spaces:

a. **Snagging and Entanglement**. The potential for snagging or becoming entangled in lines, harnesses, and debris is increased. The diver and tender must be vigilant to prevent such an occurrence and remain calm in the event the diver becomes fouled.

b. **Entrapment**. When possible, debris and obstructions in any area where a tended diver is working should be cleared to reduce the risk of submerged entrapment.

23. **Contaminated Water**. Operational necessity may require that tasks be conducted in contaminated water. Combat divers have the capability and equipment to safely operate in moderately contaminated water (MCW). Conducting tasks in heavily

[10] This sequence is not required at all times. If the dive supervisor can mitigate the risks and accomplish the mission, then it may not be necessary to discuss it with the engineer commander.

contaminated water (HCW) requires techniques and equipment not inherent to combat divers and are the responsibility of navy clearance divers. Section 7 details the considerations when operating in MCW.

24. **Altitude**. Combat diving operations may take place in bodies of water at higher altitudes. Planning shall address the effects of the atmospheric pressures that may be much lower than those at sea level. In addition, transporting divers by aircraft after diving requires special consideration and planning due to the changes in altitude.

25. **Underwater Obstacles**. Various underwater obstacles, such as wrecks or discarded munitions, offer serious hazards to diving. The actual presence of obstacles might not be discovered until an operation begins. When feasible, a preliminary inspection dive should be considered prior to the actual working dive.

26. **Electrical Shock**. Electrical shock may occur when using electric power equipment on or around a dive site. All electrical equipment shall be in good working condition and be inspected before diving.

27. **Explosions**. Explosions may be set off in demolition tasks intentionally, accidentally, or as the result of enemy action. Because of the shock wave, submerged divers are highly susceptible to severe trauma. The size of the explosion and distance from the site are the two most critical factors. The table below details the minimum safety distance divers should be from an explosion. Whenever possible, and during all training exercises, divers should be out of the water when an explosion is imminent.

MINIMUM SAFETY DISTANCE FOR SUBMERGED EXPLOSIVES

Weight of Submerged Explosives (kg)	Minimum Safety Distance (m)	
	Divers/Swimmers	Surface Vessels
1	300	10
3	500	25
10	700	40
100	1500	100
300	2000	200
1000	3000	350

Table 2-1: Minimum Safety Distances for Demolitions Submerged in the Water

NOTES

1. These distances are for operational use only. During training, all divers will be out of the water prior to initiating the explosives.

2. These distances do not take into consideration any effects on the explosion shock wave due to the bottom topography.

3. Although water will reduce the effect of flying debris and shrapnel, in water depths less then 10 m, surface vessels should use the relevant safety distance based on the target material.

28. **Small Arms and Ammunition**. Combat divers are normally armed with the C8 carbine but could also carry the C7. In the future, they may be issued the PDW. Carrying weapons underwater poses problems with the security and safe handling of the weapon. Divers

must keep their hands free, which means that the weapon must be secured on the diver or equipment. How securely it is fastened will depend on the task and enemy threat; the dive supervisor must decide on how readily accessible they must be.[11]

Figure 2-1: Combat Diver Firing

29. Prior to firing, water must be allowed to drain from the weapon body. The slide should be pulled back to let the water drain from the body and barrel. The barrel should not have any tape or other device on the muzzle since the water must be able to drain freely from the barrel. Water will get into the barrel in any case; therefore it is pointless to cover the muzzle for a dive task.[12] If time permits, the rifle should be turned to allow water to drain from the magazine. Ball

---

[11] If the task is to cross under the cover of friendly suppressive fire or obscuration, the divers may not need to use their weapons unless they are stranded on the far bank. On the other hand, if the dive team must land on the far bank, and the enemy is known to be present, the weapons may have to be immediately available.

[12] For land operations, it is better to cover the muzzle with tape to prevent the entry of material. The tape can be shot through without any damage to the weapon. Shooting through a barrel filled with water is likely to result in a catastrophic failure.

ammunition can withstand moisture seepage and can be submerged for long periods with no added protection. Extra magazines should not be taped and sealed since that will prevent their use.

30. **Explosives and Accessories**. A combat diver can carry or tow approximately 20 kg of explosives and accessories while swimming. This affects both his physical endurance and the efficiency of his breathing apparatus, and these must be considered. Care must be taken to waterproof those explosive components and accessories that will be rendered useless by exposure to water.

31. **Marine Life**. Certain marine life, because of their aggressive or venomous nature, may pose a risk to combat divers. These are normally found in seas and oceans, but fresh water hazards include poisonous snakes, crocodiles, and alligators. Some species of marine life are extremely dangerous, while some are merely an uncomfortable annoyance. Most dangers from marine life are largely overrated because most underwater animals leave human beings alone. All divers should be able to identify dangerous species that are likely to be found in the area of operation and should know how to deal with each of them.

32. **Vessel and Small Boat Traffic**. The presence of water vessels can be a serious problem. In a tactical situation, the boat traffic will be either friendly, enemy, or neutral. In all cases, they must be avoided since it will normally be impractical to issue warnings to the operators, except for friendly vessels. In training, or non-combat operations, some sort of local notice to mariners should be issued. If only a few ships or vessels are likely to be affecting the dive operation, they should be individually notified. When operating in areas with many small boats, operated by people with varied levels of seamanship, divers should assume that these operators are not acquainted with diving signals and take the precautions required to ensure that these vessels remain clear of the diving area. Hazards associated with vessel traffic are intensified under conditions of reduced visibility.

33. **Underwater Communications**. Through-water communications between divers and surface support personnel improves efficiency and promotes safe diving operations. The following types of systems are available and should be used when feasible:

a. **Wireless Through-water Communications**. These systems can provide sub-surface-to-surface or diver-to-diver communications.

b. **Hardwire Systems**. Generally, these systems are integral to the umbilical of surface-supplied breathing apparatus.

c. **Hand-held Sonar or "Acoustic Pingers."** These may be used to track divers.

OPERATIONAL CHARACTERISTICS OF BREATHING APPARATUS

34. The two types of compressed air diving equipment that combat divers employ and their characteristics are detailed in this section.

a. **Operational Characteristics of CABA**. Compressed Air Breathing Apparatus (CABA) refers to an open circuit breathing system, commonly called SCUBA. The following should be considered when planning a combat diving operation and utilizing this diving equipment:

(1) **Mobility**. Combat divers in CABA can cover a considerable distance. They can have an even greater range through the use of diver propulsion vehicles (DPVs), moving freely in any direction.

(2) **Buoyancy**. CABA equipment is designed to have nearly neutral buoyancy when in use, permitting the diver to change or maintain depth with ease. This allows the diver to work at any level within his depth limitation and qualification.

(3) **Portability**. The portability and ease with which CABA equipment can be employed are distinct advantages. CABA equipment

can be transported easily and put into operation with minimum delay. CABA offers a flexible method for accomplishing a range of combat diving tasks.

(4) **Operational Limitations**. Divers shall adhere to the operational limitations of their qualification. Bottom time is limited by the CABA equipment's fixed air supply, which is depleted more rapidly when diving down deep or working hard.

(5) **Environmental Protection**. The CABA diver is not well protected from cold, contact with marine plants and animals, or water borne contaminants and is more easily affected by currents, tides, and waves.

35. **Operational Characteristics of the Light Weight Surface-supplied Diving-system (LWSSDS)**. Combat divers use the LWSSDS consisting of a full face mask and surface umbilical. The characteristics of this diving equipment are as follows:

a. **Mobility**. Surface-supplied gear allows the diver almost as much mobility as the CABA; however, the length of his umbilical limits him. This equipment can be used for penetrating confined spaces, such as drowned vehicles, since it provides for maximum control of the diver and unlimited air supply.

b. **Buoyancy**. The buoyancy associated with this equipment makes it desirable for working on muddy bottoms, conducting lifeline searches, or when the working force of a tool is high.

c. **Operational Limitations**. Divers using surface-supplied breathing apparatus are restricted to the limitations of their qualification. Additional limitations of using the LWSSDS includes additional support from the surface and increased pre- and post- dive procedures.

d. **Environmental Protection**. Because of the full face mask and the use of a vulcanized rubber dry suit, combat divers using the LWSSDS have increased protection when working in contaminated water. In addition, because the diver's negative buoyancy is easily controlled, this equipment allows for greater ease when diving in areas with strong currents.

Figure 2-2: Preparing for a Dive with the LWSSDS

OPERATING IN CURRENTS AND FAST WATER

36. The adverse effects on divers operating in currents and fast water are numerous. The risk of entanglement, loss of primary air supply, and impact injuries while operating in fast water is high. This section outlines the potential hazards to diving, procedures to reduce risks, and considerations when planning combat diving operations in these conditions.

37. Table 2-2 illustrates current speeds in relation to diving techniques and equipment. Operating in currents exceeding these speeds may be unsafe and ineffective. Experience of the diver and operational necessity have to be considered when operating in currents in excess of shown speeds. The final decision to execute the task remains with the combat diving supervisor and the divers executing the task.

TECHNIQUE OR ENSEMBLE	MAXIMUM CURRENT SPEED
Swimming in the CABA	1 m/sec
Tended in the CABA	1.2 m/sec
Swimming with the LWSSDS	2 m/sec
Plodding in the LWSSDS	3 m/sec
Ice Diving	0.6 m/sec

Table 2-2: Diving Techniques in Relation to Current Speeds

38. **Surface Current Generated by Wind**. Wind-generated surface currents are temporary and depend on the force, duration, and direction of the wind. If the wind has been blowing steadily for some time, this current should be taken into consideration, especially when planning surface swimming.

39. **Current and Fast Water Hazards**. The characteristics of rivers and their fast water hazards vary considerably. Factors other than the speed of the current need to be considered. By identifying

potential hazards, divers and supervisors will be able to conduct diving operations with lower 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 snag 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 along with the current, on or below the surface, may pose a risk to a diver. The hazards due to floating debris are greatest during flooding and spring run-off. If the situation allows, a snag line, boom, or fence may be positioned upstream of the dive site to minimize problems from 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 disorientate and trap a diver.

d. **Current Fluctuations**. Precipitation, tides, and structures such as dams and lock systems can affect the water levels or volume of water and current speed. The possibility of precipitation and its effect on the waterway must be considered and can usually be forecast. The geomatics support team, integral to the brigade engineer staff, can provide some useful data. The existence of upstream dams must be determined, as well as who controls them. Hydro-electric dams, in particular, could release large volumes of water without warning.

40. **Equipment Considerations**. The following should be considered when diving in currents:

a. **Mask and Regulator**. Strong currents could tear off half masks. The currents could also make the regulators free flow. The use of a full face mask may reduce this risk.

b. **Weight**. Additional weight or the donning of a weight vest may assist in maintaining stability and depth.

c. **Air Cylinders or Surface-supplied Air**. A diver dressed in a surface-supplied system will be affected less by strong currents. Surface-supplied systems will also provide audio communications to the diver, and the umbilical can function as a safety tending line.

d. **Plodding Boots or Dive Fins**. Fins will allow the diver greater mobility but limited stability. Weighted boots assist in stability and provide protection. Soft river and lake bottoms make the use of boots difficult.

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

f. **Communications**. Standard line/rope communications in fast water are generally not effective; however, encasing the line/rope into tubing may assist. Wireless audio communication systems may be interfered with by the background noise created by currents.

DIVING SUPPORT BOATS

41. Combat divers often operate from small boats on inland waterways and coastal areas. Generally they use inflatable 10 and 15 person boats with outboard engines, as these are available in the CER or ESR. These boats are generally used in dive tasks out of contact with the enemy, including water-crossing operations or general support tasks. The BBE MkII, as well as other types of boats, can be

used to support combat diving tasks. The general requirement is room for divers, equipment, and a design that allows divers to enter and exit the boat for the dives. Almost any inland or coastal water vessel can be adopted for use to support combat diving tasks. Boat operators must be skilled and practised in operating with divers. The boat operator must understand the effects of wind, current, tide, and the position of divers while moving the boat. Factors to consider when choosing a boat to work from are:

a. Nature of the task, when the divers could be expected to work a long time from the boat, protected cabins, showers, and additional space may be required. A short drop-off, pickup, and return to shore task could use a more cramped boat.

b. The number of divers, surface support personnel, and equipment that must be carried.

c. Ease of exit and entry for the divers for the tasks.

d. **Seaworthiness**. The dive supervisor must be satisfied with the seaworthiness of the boat and with its load, intended mission, and weather conditions. This would also include making sure that the boat has:

   (1) lifesaving and other safety gear; and

   (2) a reliable engine.

e. Shelter available for the divers and surface support personnel, especially in cold or cool weather operations.

f. A well-trained operator or crew. This is more important if a boat is received from contract or host nation support. A trained crew provided by an allied or coalition partner will be self-evident in this regard, but if the dive supervisor has any doubt, he should confirm their qualifications.

COLD WEATHER OPERATIONS

42. This section details factors that affect or should be considered when planning combat diving operations in cold weather conditions. This information is not restricted to through-the-ice dives (which are rare or non-existent in operational theatres) but also applies to dives in near zero temperatures on open water. Some sustainment engineering dive tasks may require ice dives. B-GG-380-000/FP-002, *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* details standard operating procedures for ice diving.

43. **Equipment Considerations**. The effects of cold on diving equipment are numerous. An awareness of potential equipment problems is critical in order to anticipate and prevent malfunctions. The equipment, especially the CABA, will normally function well in near-freezing water. Above surface temperatures may subsequently cause problems. The following should be considered:

a. Belts and straps on the diver should not constrict blood circulation. Poor circulation will increase the effects of the cold.

b. Wet suits must fit properly and be well maintained to provide proper insulation and reduce the risk of hypothermia.

c. A dry suit will provide better insulation and should be worn when possible to improve a diver's endurance. Punctures, torn suits, or a malfunctioning zipper will cause a loss of protection; the diver may have less protection against the cold than he would with a wet suit. The diver may have to abort the dive or reduce the dive time, depending on the severity of the leak and the water temperature. The power inflator and exhaust valves could also freeze.

d. When preparing to operate under ice, the CO2 cartridge in the buoyancy compensator will be functioned prior to the dive to prevent accidentally actuating the cartridge under ice. An uncontrolled ascent will cause impact with the ice surface, which could cause injury or unconsciousness. In cold conditions, on the surface, use of the oral inflator may be difficult. Persistent use of the power inflator increases the risk of a free flow in the valve causing an uncontrolled ascent.

e. Filling high-pressure air cylinders to capacity at very cold temperatures and then storing them in a warm place may cause the blow-off valve to function.

f. To prevent regulator malfunctions, they must be properly maintained and stored between dive operations. While conducting operations, the diver should attempt to minimize exposure of the wet regulator to subzero conditions.

44. **Physiological Considerations**. Combat diving operations in cold weather increase the risk of cold-related injury. Divers may be adequately protected in the water, to be subsequently affected by above surface conditions if there are no provisions for shelter or warmth. The following physiological and medical factors are pertinent to diving operations during cold weather:

a. **Hypothermia**. Divers are at risk both in the water and while tending and working on the surface. Properly dressed, fed, rested, and acclimatized personnel are less at risk. Supervisors must ensure their personnel are provided with the shelter necessary for the task at hand. Dive profiles and surface tasks should be planned and conducted to reduce the risk.

b. **Oxygen Treatment**. If it is required to administer oxygen it must be done with caution since oxygen bottles left exposed to the elements may be extremely cold. Cold oxygen introduced into the lungs may increase heat loss. Resuscitator kits should be kept as warm as possible yet accessible for use.

c. **Frostbite**. Wet and cold conditions will accelerate the effects of frostbite and wind chill. All personnel should be constantly vigilant for signs of frostbite.

d. **Laryngospasm Reflex**. The initial immersion into cold water or the loss of a mask underwater may cause a constriction of the upper throat and prevent normal breathing. It can induce panic in a diver. Divers must be aware of this reflex, its potential risk, and the fact that the sensation will pass allowing for normal respiration.

CONTAMINATED WATER

45. When the potential exists and it is operationally required for combat diving operations to be conducted in mildly contaminated water (MCW), extra precautions must be taken and special procedures must be followed. In general, MCW can be described as any water with a presence of biological or chemical contaminants in excess of that allowed for recreational swimming. Determining the exact levels and types of contaminant is a complex procedure generally requiring testing beyond the readily available resources of a dive team. When planning for operations in MCW, protective ensemble and appropriate preventative medical procedures shall be taken. Diving equipment that gives the diver maximum protection consistent with the threat shall be selected. The two main contaminants that combat divers are potentially exposed to are:

a. **Biological Contamination**. A diver working in waterways in which raw sewage is dumped may be exposed to biological hazards. CABA divers with half masks, open regulators, and wet suits are especially vulnerable to ear and skin infections when diving in waters that contain biological contamination. Divers may also inadvertently take polluting materials into the mouth, posing physiological problems.

b. **Chemical Contamination**. Fuel, oil, and other fluids leaking from drowned vehicles or damaged infrastructure can adversely affect both the diver and the equipment. There may be chemical pollutants in the water due to poor environmental practices in the country of operation. Toxic materials or fuels can irritate the skin and damage equipment.

46. When operating in waters where a contamination threat is known or suspected, the risk to the diver must be considered in regard to the requirement to conduct the task; all necessary precautions should be implemented. B-GG-380-000/FP-002 *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* details the procedures and equipment for operating in contaminated water. General considerations are outlined below.

47. **Pre-dive Procedures**. When planning operations in unfamiliar water or if the presence of contaminants is suspected, the following may be evidence of possible contaminants and should be considered:

a. **Intelligence Preparation**. Consult with the unit intelligence officer and the geomatics support team through the brigade engineer staff for information on sewage, industries, damaged plants, environmental practices in the country, as well as NBC strikes that may affect the dive task location.

b. **On Site**. Look for visible indications of the presence of contaminants, such as:

(1) lack of marine, aquatic life, or vegetation;

(2) concentrated algae;

(3) slicks on the surface; and

(4) presence of foul odour.

c. Conduct a basic water analysis using the Water Quality Test Kit. Water samples can also be taken for more detailed laboratory tests in case of medical problems with the divers.

d. Set up a wash down area for personnel and equipment.

48. **Post-dive Procedures**. Immediately after a diver surfaces, he should be sprayed down with potable water prior to removing his equipment. As his equipment is removed, he is further washed off and his equipment is cleaned and rinsed in detail.

49. **Medical Follow-up**. Exposure to a biological or chemical contaminant may result in an illness, hours or days, after the dive. The details of the dive should be logged, including any information from the water tests. If a diver shows any symptoms or illness, he must seek medical attention immediately and ensure that they are aware of the dive as a possible cause. The diver should also inform the chain of command so that other divers on the same site can be warned of potential problems. The need to examine all of the divers will be decided by the MO.[13]

---

[13] As an example, if one diver has a skin rash and no one else has a problem, the MO may decide to treat the one diver and treat others if they develop a problem. The MO will decide based on the problem and the water test results.

CHAPTER 3
INSERTION AND EXTRACTION

GENERAL

1. On the ground, combat divers have the same mobility characteristics as the manoeuvre force they support. They have the added ability of being able to move and conduct tasks on and under the water. All combat diving tasks are conducted in support of the manoeuvre element. In some cases, a degree of stealth will be necessary to ensure security of the mission and its success. For example, when conducting reconnaissance tasks for a gap-crossing operation, stealth is an element required to prevent compromise of the future operation and intent.

2. A key consideration in combat diving operations is the method of insertion and extraction from a task site. Insertion and extraction are normally different than moving to and from the task site. The dive team (field section) moves to the task site in its section carrier. They could then be inserted and extracted by walking into the water or using an inflatable boat. The ground transport is not considered part of insertion and extraction. This chapter details techniques, procedures, methods of transport, and equipment relevant to combat diving operations.

3. At times, direct access to a dive site may be restricted due to restrictions on reconnaissance, enemy activity, obstacles, or the operational security (OPSEC) plan. Rarely will a dive site be inaccessible due to ground restrictions, as generally divers will only be operating where the army will be able to go with its vehicles. In the rare case of a displaced entry point (from the task site), the divers will have to choose a means of insertion and extraction. This may have to be covert, which will usually negate the use of powered craft or helicopters.

4. The following outlines the factors that should be considered when determining the method of insertion and extraction of combat divers:

   a. **Distance**. Combat divers will generally swim, either on the surface or underwater, to the objective.

The distance will determine the appropriate technique, diving ensemble, dress, breathing apparatus, and other equipment. Swimming distances depend on the physical fitness and endurance of the individual diver. There are also navigational difficulties with long-range swimming insertions. There is a limit, both in physical endurance and doctrine, since combat divers are not trained or equipped for long-range missions. The general planning figure, depending on the current, load and weather is 1500 metres; this distance should be considered the maximum one-way distance for swimming insertion. Whenever feasible, boats, motorized or manpowered, should be used to reduce swimming distances. However, the use of vehicles, boats, aircraft, or other propulsion vehicles cannot compromise mission security.

b. **Time**. The length of time to travel to and from a task and the duration of the task are directly linked to the required diving equipment and air supply for diving operations.

c. **Air Consumption**. When using breathing apparatus, air consumption rates must be factored in. Section 2 further details consumption rates and endurance.

d. **Enemy Threat and Capabilities**. The presence of the enemy and surveillance methods and technology must be considered when determining method of insertion and extraction.

e. **Security**. Combat divers are limited in their ability to protect themselves. They are armed with the C8 carbine or C7 rifle for personal protection and generally will avoid contact with the enemy. This may require the protection or over-watch of other arms surveillance and weapon systems.

f. **Diving Technique and Ensemble**. The method of insertion and extraction, the diving technique, breathing apparatus, and diver's dress are inter-related. Breathing apparatus and wet or dry suits are not conducive to dismounted movement over long distances. Section 4 details dismounted operations.

g. **Mission Equipment and Stores**. Combat diving operations often depend on large amounts of equipment, boats, and stores. The quantity and types of these items required to support a task will determine insertion and extraction methods.

h. **Water Conditions**. The water conditions, including depth, current, waves, and tides must be considered as they will determine swimming distance and technique, diver endurance, and the type of support vessel.

i. **Environmental**. Weather conditions and forecast, artificial and natural ambient light sources, and ambient noise in the target area all should be considered and can be both beneficial or detrimental to the method of insertion or extraction.

j. **Deception Plan**. It may be beneficial to coordinate a deception plan with supporting elements to cover the insertion and extraction of the dive team. For example, indirect fire support could be coordinated with the anticipated time on the objective of the dive team.

SELECTING SWIMMING OR DIVING TECHNIQUE

5. Combat divers are required to swim for extended periods of time and distances. In addition to their breathing apparatus, they often carry or tow equipment and stores to conduct tasks. They may often incorporate a combination of swimming while submerged and surface swimming. This section details characteristics and factors relevant to swimming on or beneath the surface.

6. **Swimming Beneath the Surface**. The use of underwater breathing apparatus allows a combat diver to approach an objective

and conduct tasks beneath the surface. Section 3 of Chapter 2, details the operational characteristics of breathing apparatus. Combat divers must be highly proficient in the skills and techniques required to use this equipment efficiently and safely to ensure successful arrival at the objective and subsequent execution of their assigned tasks. Some factors to consider are:

a. The distance a combat diver can swim beneath the surface varies greatly. Many factors will affect this distance, such as air supply, currents, and personal fitness. Generally, submerged swimming distances should be kept to a maximum of 1500 m.

b. Submerged divers can easily become disorientated, and they are vulnerable to the effects of underwater explosions. The lack of reference points when submerged imparts a feeling of sensory deprivation. Section 3 details the factors relevant to underwater navigation. During the conduct of some tasks, such as reconnaissance of a water-crossing site, it is often preferable to make the final approach onto an objective after removing breathing apparatus, and swimming on the surface, or approaching on land.

7. **Air Consumption**. Air consumption rate is a critical factor when planning insertion and extraction phases of a tactical combat diving operation. Many factors affect consumption rate, some are environmental, such as depth and water temperature, and some are physiological, such as individual fitness level. The estimated duration based on different consumption rates is shown in Table 3-1. Consumption rate also varies with the diver; therefore this table is a guide only. The average consumption rate when swimming hard, for example in moderate current and towing equipment, is three cubic feet per minute (3 cfm).

Cylinder Capacity @ 3000 psi (Cubic Feet)	Consumption Rate (cfm)		
	2	3	4
160	80 mins	53 min	40 min
100	50 mins	33 min	25 min
80	40 min	27 min	20 min

Table 3-1: Estimated Duration, in Minutes, of Standard Compressed Air Cylinders

8. **Buoyancy Control**. The combat diver must be able to control his buoyancy. Buoyancy control is a key factor in maintaining a desired depth when travelling to an objective and while doing a task. Depth control and bottom times are directly related to air consumption and diver endurance. Failure to control buoyancy and exceeding the planned depth of the dive will affect a diver's ability to conduct successive dives, increase the risk of decompression sickness, and therefore jeopardize the diver's effectiveness and safety, as well as that of the team and mission success. When swimming, submerged combat divers should be in a state of neutral buoyancy. A diver's ensemble, equipment load, and type of water affect buoyancy and will vary from task to task. Drills and rehearsals to adjust buoyancy must be included in battle procedure.

9. **Surface Swimming**. Combat divers will often surface swim to a task site. The distance is only limited by the physical endurance of the divers, and they are better able to negotiate the effects of currents and other obstacles. The surface swimming techniques used by combat divers promote efficiency, endurance, stealth, and concealment. Some factors with surface swimming are:

a. While surface swimming, divers are less vulnerable to the adverse effects of explosives and the lack of external reference points. They are vulnerable to detection from observation when crossing open bodies of water and can only conduct tasks in shallow water, limited by their breath-holding ability.

b. When surface swimming, divers are positively buoyant. Surface swimming eliminates the use of breathing apparatus, requires less equipment and preparation, and, in addition, the physiological aspects of water pressure do not affect the diver.

10. **Towing Stores and Equipment**. Combat divers can tow or carry equipment and stores to accomplish their mission. With the use of waterproof bags and load-bearing vests, a combat diver can efficiently transport about 20 kg of equipment and stores in excess of the diving equipment and personal weapon. Some factors with towing stores are:

a. Waterproof bags containing stores are towed behind a diver, swimming submerged or on the surface, tethered by a rope fastened to the diver's body. Generally these towing systems are ad hoc, designed from locally available material.

b. The combat diver's buoyancy control device or ensemble should never be considered integral to any buoyancy requirements for carried or towed equipment and stores. If the load has to be ditched, the diver's buoyancy should not change. Whenever possible, waterproof bags with oral and power inflator valves to control buoyancy should be used to provide and control the buoyancy of the towed equipment.

11. **Water-land Transition**. During the transition between water and land, combat divers are vulnerable to observation and detection since they are often burdened with heavy equipment, water draining is noisy, and the bottom is often unstable. The transition must be planned and rehearsed. Transitions may be required at water entry points, the objective, or along a route. Some factors on transistions that must be considered are:

Figure 3-1: Combat Divers Securing an Area Prior to a Recce

a. Whenever conducted, stealth and noise discipline is crucial. If the approach was submerged, there may be a requirement to remove breathing apparatus in shallow water prior to surfacing.

b. During a transition, the divers must work together, generally as pairs, to provide assistance and security for each other. A general procedure is as follows:

(1) The divers observe a listening halt. The duration will depend on the surface and water conditions.

(2) Security on the bank is established.

(3) Team members then exit the water, move in-land (task, terrain and time will determine the required distance), and establish a secure RV.

(4) Upon being confident the team has not been compromised, the task will continue. It is essential that all personnel have been accounted for; in particular if this transition consists of recommencing a dive.

12. **Camouflage and Concealment**. Strict adherence to the principles of camouflage and concealment and a proficiency in these skills will greatly improve the combat diver's probability of mission success and survival. Some factors that a diver must consider for camouflage and concealment are:

a. The divers will try to use dead ground, whenever possible, for the transition. The divers may add camouflage to their equipment, as long as that does not compromise the safe operation of the dive equipment. The use of suppressive fire, obscuration, or a demonstration by the manoeuvre force (such as harassing fire in a location offset from the transition point and dive objective) should be considered as part of the plan.

b. In addition to the basic techniques of personal camouflage, there are unique factors to which the combat diver must pay particular attention. These factors include reducing the glare and shine on diving equipment (e.g., by removing the diving mask prior to surfacing), padding hard surfaces and equipment (such as air cylinders) to reduce noise, and ensuring air inflators and hoses are secure to prevent noise from leaks and excessive bubbles.

UNDERWATER NAVIGATION

13. Combat divers may have to approach a task site underwater to minimize detection and observation from the enemy. They must be highly proficient at the skills and techniques required to navigate underwater. The lack of visible features, currents, tides, and waves are factors that affect underwater navigation. There are no visible references when navigating underwater, and frequent ascents to the surface increase the chance of detection and increases air

consumption. Combat divers use a combination of time and kick cycles to measure the distance they have covered under water.

14. Combat divers must know the length of time and number of kick cycles it requires for them to cover a fixed distance, generally 100 m, with various loads, diving ensembles, and water conditions. This component of underwater navigation varies greatly between individuals and must be practised and exercised, regularly and often, to maintain. With the use of an attack board, knowing the time required and number of kick cycles to cover a set distance, combat divers can navigate underwater free swimming, as pairs or as part of a group, to approach an objective. The components of an attack board are:

a. **compass**—with a luminous face or back lighting;

b. **chronograph**—a digital timer, used to monitor time travelled; and

c. **depth gauge**—to maintain a consistent, planned depth.

15. A detailed study of maps and marine charts and knowledge of currents and tides are essential when planning a task involving underwater navigation. Once the current and tide information is calculated, an approach plan is developed with distances, any turning or way points, and times of travel. Increasing the number of way points and the distance, increases the possibility of error unless there are prominent landmarks, water reference points, or planned surface checks. With the navigational plan completed, the divers will follow the basic procedures for a submerged navigation swim:

a. Ensure operability of artificial light sources on the compass board or its components.

b. Preset bearings and, if possible, times, distances, and maximum planned depth; upon entering the water, link up with the diver's partner, confirm and set bearing.

c. Descend to planned depth and immediately commence swim. The use of the buddy line will ensure pairs remain in contact. The diver who is not navigating will prevent possible collision with any obstacles.

d. Confirm location along the route if necessary. The navigator will break the surface with minimum exposure and confirm the bearing; the partner can assist in descending by remaining submerged at the extent of the buddy line, then pulling the navigator down. The team then descends to the planned depth and continues.

e. Upon reaching the objective, if a transition to land is required, the procedure detailed earlier will then be conducted.

16. **Group Navigation Control System (GNCS)**. Some combat diving tasks require divers to approach an objective as a team. A GNCS may be used to achieve this. By adapting the basic concepts of underwater navigation as free-swimming pairs, a team of divers can move as a group. The basic formation consists of pairs of divers in file, with a light buoyant line extending between them. Figure 3-2 illustrates the GNCS. The general procedure for this system is:

a. The lead pair of divers acts as the primary navigator for the group. One diver navigates while the other controls the GNCS line and communicates with trailing pairs with the line.

b. After entering the water, the team links up, establishes the formation, and descends to the planned dive depth.

c. While swimming, all divers are responsible to maintain the planned depth of the dive.

d. A designated diver in each pair maintains control and tension of the line.

e. A second pair may be designated as secondary navigator; this will likely be the last pair in the formation.

f. In the event that a diver has to ascend due to an emergency, the buddy will ascend with him or her. The pair nearest the ascending team will be notified. If a pair ascends, then the team supervisor must regroup the team and reconsider the approach; this may require aborting the dive.

17. The key elements to success and safe implementation of this system are the use of the buddy system, detailed planning, as well as the rehearsal of all procedures and potential contingencies. All team members must be proficient in buoyancy control and have an awareness of the planned details of the dive and navigation.

18. The GNCS line will be a continuous length of buoyant nylon or polypropylene rope. It must be long enough to accommodate the team, prevent members from interfering with each other while swimming, and prevent the fouling of any towed loads. The line should be of suitable diameter to be easily visible, and it should not of the same colour as the buddy-lines. Non-corrosive snap-links, fastex buckles, or clips are spliced or fastened along the line at each pair's position. A snap link or clip is attached to each pair's buddy line, then clipped into the group line at each respective location. Standard or prearranged rope signals will be used to communicate along a GNCS line.

19. Through-water wireless communications should be considered when using a GNCS as they will facilitate control and passage of information; however, use of rope signals can be applied. The use of such communications devices will depend on the threat, the ability of the enemy to monitor our through water communications, and the warning the enemy may have on the use of divers. Generally, an enemy threat will preclude the use of a through-water communications system.

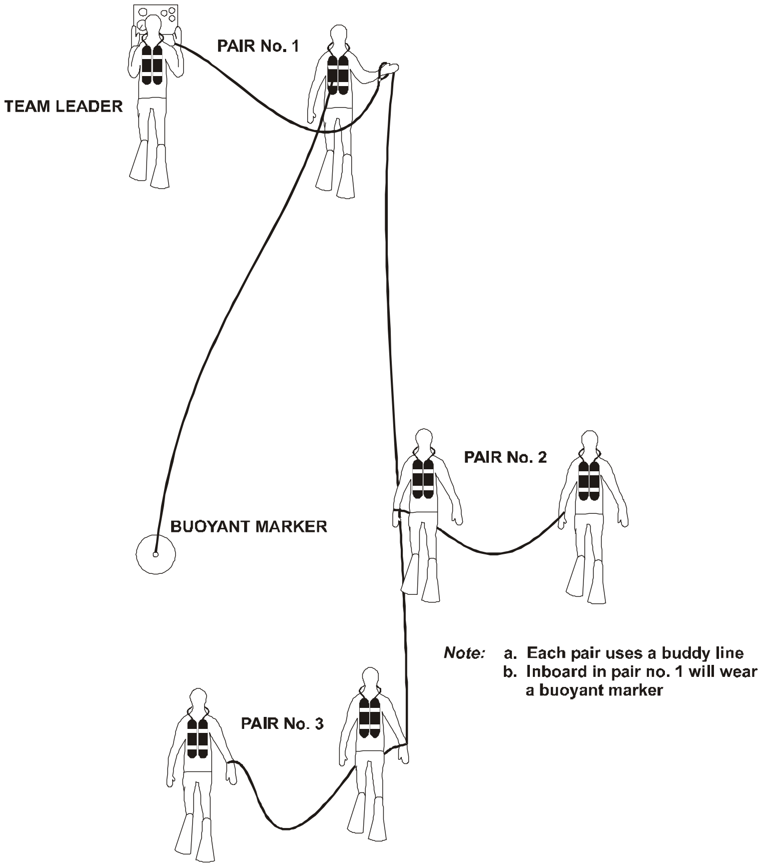


Figure 3-2: Group Navigational Control System

DISMOUNTED PATROLLING

20. Combat divers will sometimes take part in dismounted reconnaissance or fighting patrols with the manoeuvre arm they are supporting (generally the infantry). If divers are specifically assigned to a patrol, it will be because the patrol has been mounted with the primary mission of escorting the divers to an objective. The intent will be to escort the dive team to the water insertion point to allow the divers to conduct their reconnaissance.

21. If the enemy threat in the patrol area is high, it is possible that a fighting patrol will be mounted, even though the task of the combat divers will be to conduct reconnaissance. The patrol commander's mission, in either type of patrol, is to ensure that the divers reach the correct location, provide security, and bring the reconnaissance information back.

22. It is possible that the commander will want to make a covert insertion on the far bank prior to the beginning of a water-crossing operation; the commander will order an escort to get the combat divers to a location in order to secure, or mark, a far bank objective. This approach may have to be done dismounted.

23. When the divers accompany a patrol, the patrol commander is in charge and the soldiers are there to provide protection, not to carry dive equipment. If the diver's mission-essential equipment is too heavy for the duration and distance of the patrol, additional divers or sappers will have to accompany the patrol to share the load. There must be sufficient time in the battle procedure for link up with the patrol commander, rehearsing patrol drills, and ensuring that the patrol commander is aware of the diver requirements for the patrol. When a dive task is the mission of the dismounted patrol, the following factors should be considered:

a. CABA and other dive equipment and apparatus are generally heavy and difficult to carry.

b. Divers cannot wear their diving ensemble if moving long distances over rough terrain or close country.

c. Patrols should have sufficient numbers of personnel to provide security at equipment caches, objective rendezvous points, and, if possible, water-land transition points. The organization of the patrol is the responsibility of the assigned patrol commander, but the patrol commander must be briefed on dive specific requirements during battle procedure.

d. Types of dress for the divers, in particular footwear and load-carrying systems for mission-essential equipment, breathing apparatus, and stores must be considered.

e. The duration of the patrol will determine the extent of requirements in regard to support, security, equipment, and replenishment.

f. **Reconnaissance Information**. The mission is to bring back the information. Therefore, the tasked dive supervisor must prepare the reconnaissance information rapidly and ensure that a copy is given to the patrol commander. It may be necessary to provide periodic updates to the patrol commander so that an early withdrawal does not mean the loss of all information.

g. **Rest Requirements**. Depending on the task, the divers may need some recovery time before the patrol returns.

24. **Securing a Far Bank**. A dismounted patrol will have limited objectives. If a far bank must be reconnoitred or secured by the divers, the size and depth of the incursion inland must be clear in the orders. Generally, combat divers will only go as far inland as required to gather the relevant reconnaissance details or breach and secure a section of the far bank or landing site. Any further incursion changes the nature of the diving operation and should be changed to an infantry patrol. Combat divers do not operate independently on long-range reconnaissance or fighting patrols.

25. Conduct of a dismounted patrol is a major task requiring detailed planning and preparation to ensure success. The tasked dive supervisor must work closely with the patrol commander to ensure proper planning and coordination. Combat divers can be used as a vital part of the information gathering process on the battlefield.

BOAT CAST AND RECOVERY

26. Boat cast and recovery is a method to deploy and recover combat divers within swimming distance of their objective. This can be executed quickly to minimize exposure and detection. Combat divers can be cast as surface swimmers or with breathing apparatus. If, in an emergency, a high-speed recovery is required, the divers will have to abandon all of their equipment. This procedure is covered in

this chapter in case it must be done, but it is not a recommended practice. If the enemy can see the boats, this procedure is too dangerous; if they cannot, it is not necessary.

27. Boat cast and recovery is a procedure that has been developed to allow high-speed transit to a diver site, allowing the drop-off and recovery of divers. It is rarely used in combat operations as the element of surprise is lost. It can be useful, at times, in getting divers closer to the task site and reducing their swim times. In this limited scenario, there is no requirement for a high-speed cast with its increased risk of lost equipment, injuries, and disorientation before the real mission has even started. There is even less need for a high-speed recovery, unless it is an emergency. Recovery should be done from a stopped or very slow moving boat.

28. To dispatch the divers, an inflatable boat will be lashed to the side of a larger motorized boat. The divers will move into the inflatable boat as they approach the cast site. The inflatable boat is preferred since it puts the divers closer to the water for their entry. The bulk of the combined boats, with a potential for reduced speed, further increases the signature and vulnerability of the team attempting this type of insertion. The use of the boat must be coordinated with friendly forces because the boat may cross several unit and/or formation boundaries. An additional risk to this procedure is the possibility of casting the divers into obstacles or snags.

29. When selecting or preparing the boat(s) to support this procedure, the following factors should be considered:

a. space for the dive team and its equipment;

b. space for the surface support team; and

c. the free board, which should be as low as possible to reduce the distance to the water.

30. **Casting Procedure**. As the delivery boat approaches the cast point, the divers line up inside the delivery boat. On the Diving Supervisor's signal, the first pair enters the inflatable boat and lay down on the outboard tube. The second pair follows and prepares to move on the outboard tube. On the Supervisor's signal, the divers roll into the water. As soon as the first pair has rolled off, the next pair

prepares to enter the water. The procedure is repeated until all divers are dispatched.

31. When casting divers from a boat at high speed, there is the potential of personal injury and loss of equipment. Deploying combat divers in this method should only be considered when it is absolutely required. Limitations for a boat cast are:

a. cast from the stern, working forward along the tube;

b. maximum speed—20 km/h;

c. cast zone—20 m per team member; and

d. interval—3 seconds between each diver.

32. **Recovery Procedure**. For a high-speed recovery, the divers will form a line in the water and discard their equipment. Separation between divers should be approximately 30 m. A recovery person positions him- or herself in the bow of the inflatable boat, facing forward and holding a rubber hoop out of the water. The hoop should be secured to the boat. As the boat approaches, the diver holds the appropriate arm above the head, bent at the elbow, as a target for the recovery person. Just before the boat reaches the diver, the diver should kick as hard as possible to rise out of the water. When the diver feels the hoop drop over the arm, the diver grasps his or her wrist and rolls into the inflatable boat. The diver then quickly clears the inflatable boat for the recovery of the next diver. Limitations for boat recovery are:

a. minimum speed—10 km/h;

b. maximum speed—15 km/h; and

c. recovery zone—30 m per diver.

33. This procedure should be rehearsed during battle procedure. Boat operators should be practised and experienced with this procedure and operating with divers in the water. The use of boats in this manner should only be considered when adequate security and protection is being provided, either directly or indirectly, from weapons and surveillance systems of supporting arms.

HELICOPTER TRANSPORTATION

34. The use of helicopters is a viable mode of transport when speed of deployment is essential. The helicopter will normally be used to transport a dive team to a dive site because of the urgency of the task or the difficulty in getting the section vehicle across the area of operations. The helicopter is rarely, if ever, required for casting and recovery of divers. Divers are employed to support the manoeuvre of the army; therefore they are employed where the army must be able to move and manoeuvre. If the divers cannot reach a site with their section vehicle, then it is unlikely that the army will be going there. The cast and recovery procedures are high risk and have limited or no tactical utility. They are described here in case of emergency. There is an increased risk of personal injury and loss of equipment when dispatching or recovering divers from a helicopter.

35. The use of helicopters in a tactical situation is limited as they present a slow moving and noisy target for enemy observation and fire and may draw unwanted attention to the divers and their task. Canadian helicopters are not designed or used in cross forward-line-of-own-troops (FLOT) missions, nor in near FLOT missions. Generally, helicopters will pick up and drop off divers on landing zones, within proximity of the water. This section focuses strictly on operations over water.

36. Aircraft capabilities and their load limitations are unique and depend on the payload, distance (due to fuel weight), air temperature, and other factors. Close liaison with the aviation cell at brigade headquarters by the brigade engineer staff will ensure that these considerations are factored into the mission design, helicopter configuration, and ancillary flight equipment. CFACM 40-46 details the procedure for helicopter operations and will be the governing manual for the planning and conduct of helicopter operations.

37. Liaison between the dive team supervisor for the mission and the air crew is vital. All personnel involved must understand the intent of the mission, requirements, capabilities, and limitations. If the divers are being cast from a helicopter, the general mission parameters are:

a. Air speed maximum: 20 km/h. The helicopter will normally have a minimum forward air speed for ease of control and to avoid collision between divers.

b. Altitude for drop, minimum and maximum—6 m. The helicopter has a minimum altitude over water due to the spray of water from the ground effect of the rotors. The helicopter (CH-146 Griffon) cannot safely fly below the 6-m level.

c. The water depth must be known to be at least 5 m, or deeper.

d. Wind speed: no greater than 35 km/h.

e. Wave height maximum—0.6 m.

f. Cast zone—100 m x 500 m, in alignment with the prevailing winds.

38. The following should be considered with regard to the divers during a helicopter cast:

a. **Breathing Apparatus**. The second stage of the regulator should be tucked under the right arm and held tightly to the side of the body. Cylinders must be held securely down by one hand to prevent them from causing injury to the diver on entry into the water.

b. **Mask**. The straps of the full face mask (FFM) or half mask shall be under the diver's hood if the diver is wearing it on the cast.

c. **Fins**. Fins should be secured to the diver's ankles with a loop of string.

d. **Equipment Security**. Other equipment should be secured in such a manner as to prevent loss without impeding the diver's movement.

e. A combat diver equipped with a diving ensemble and a fighting order can weigh up to 130 kg.

f. Ancillary equipment and stores to support a combat diving operation may weigh in excess of 200 kg. This weight would be divided between and towed by the divers. The dispatcher may drop it to the divers in the water as a separate bundle.

39. The key personnel in helicopter cast and recovery are the dive team supervisor, the dispatching dive supervisor (dispatcher), and the flight engineer (FE). Their responsibilities are:

a. **Dive Team Supervisor**. Prior to the mission, the dive team supervisor must coordinate with the dispatcher and FE to ensure all aspects of the operation are understood. The dive team supervisor will be dispatched with the dive team and will:

(1) supervise and check preparation of the divers;

(2) conduct a briefing on the diving operation;

(3) conduct a briefing on emergency dive procedures; and

(4) conduct a supervisor's check of the divers.

b. **Dispatcher**. Will be a qualified combat diver supervisor and is responsible to the dive team supervisor. The dispatcher will not be dispatched with the dive team and will conduct the following tasks:

(1) liaise with the FE;

(2) relay any special requirements in regard to the helicopter to the dive team supervisor;

(3) check the rigging of the helicopter;

(4) assist the dive team supervisor with the supervisor's check;

(5) conduct a supervisor's check on the dive team supervisor;

(6) assist the FE with the loading and securing of the divers and their equipment;

(7) in flight, will maintain communications with the aircraft captain and the dive team supervisor;

(8) dispatch the dive team;

(9) monitor the entry of the divers into the water; and

(10) inform the FE or aircraft captain of the status of the divers after the drop.

c. **Flight Engineer**. Is responsible to the aircraft captain, will coordinate with the dive team supervisor and dispatcher, and will perform the following tasks:

(1) configure and rig the aircraft;

(2) conduct a briefing on in-flight emergency procedures;

(3) load and secure the divers and their equipment;

(4) assist in dispatching the divers and their equipment; and

(5) inform the aircraft captain of any unusual situations and the status of the divers in-flight and after the drop.

40. When detailed liaison and rehearsals have been conducted, it is allowable for the FE to act as the dispatcher. This arrangement also allows for greater payload capacity in the aircraft, thereby increasing the number of divers to be cast or the equipment they can bring on board.

41. **Cast Procedure**. The procedures for a helicopter cast are as follows:

a. the divers prepare for the cast and wait at a landing zone under the control of a Landing Zone (LZ) controller;

b. when instructed, the divers board the aircraft in order of dispatch, secure their equipment, don fins, and fasten their seat belts;

c. the FE confirms security of the dive team;

d. the dispatcher positions himself in view of both the pilot and the divers;

e. in-flight, the FE and dispatcher monitor the divers, and the dispatcher keeps the divers informed of the flight progress;

f. on the approach to the cast zone and under control of the dispatcher, the divers prepare for the cast;

g. on the signal from the pilot that the aircraft is in the cast zone and at the specified height and speed, the dispatcher conducts the cast;

h. under control of the dispatcher, the divers are cast; and

i. the FE and dispatcher monitor the divers' entry into the water, secure the aircraft, and inform the pilot of the divers' status.

42. **Recovery Procedure**. Combat divers may be recovered directly from the water with the use of a ladder or sling. Slinging

divers beneath the aircraft is preferred, as it can be conducted quickly; however this method restricts the manoeuvrability of the aircraft. Having the divers climb into the aircraft from a ladder is physically difficult and extends the time in a hover, increasing the vulnerability of the aircraft and divers. It may be required for the divers to ditch breathing apparatus and dive weights to facilitate a helicopter extraction. This could also result in the loss of other equipment, such as weapons. A general recovery procedure is:

a. The divers form a line in the water recovery zone, in pairs, with 25 m between each pair.

b. The aircraft approaches into the wind with the recovery device lowered and dragging along the water surface.

c. The helicopter maintains forward movement; the FE monitors and advises the pilot on speed and progress.

d. The divers secure themselves to the recovery device as it passes them.

e. Upon receiving a signal from the dive team supervisor the FE informs the pilot that the team is secure.

f. The pilot regains altitude and continues on the specified flight path. It may be necessary to set down on land and have the divers emplane once in a secure area.

43. **Recovery Equipment**. The most efficient method to recover a dive team from the water is with a sling. Up to six divers, with breathing apparatus, may be slung under a helicopter. A sling fabricated from rope, nylon, or steel wire rope (SWR) is secured to the aircraft in the same manner as for a rappel. Hard points are rigged into the sling. The divers are equipped with rappel harnesses and snap links. Any extra equipment is clipped into the last loop on the sling.

44. **Risks**. There are operational risks and risks to the divers by using helicopter cast. In operations, it is possible that divers will be

injured on insertion due to shallow water, obstacles, or snags. Equipment could be lost on entry, and divers could be injured from the fall if the pilot is unable to maintain altitude. On recovery, dive equipment will have to be discarded; equipment is in limited supply in the unit.

CHAPTER 4
MOBILITY (CROSSING AND BREACHING OPERATIONS)

GENERAL

1. Combat engineers provide and maintain mobility on the battlefield. Combat divers extend that capability into the water and allow the commander to manoeuvre with as few restrictions as possible. Water is a natural obstacle that is easily enhanced with the emplacement of obstacles and mines at or below the waterline and along the banks or shore. This chapter outlines combat diving factors and procedures in support of gap-crossing and breaching operations. B-GL-361-001/FP-001 *Land Force Engineer Operations*, Chapter 7, Section 2 Mobility (Crossing and Breaching Obstacles) provides additional information pertaining to the planning and conduct of hasty and deliberate water-crossing and obstacle-breaching operations.

GAP-CROSSING OPERATIONS

2. Typical gap-crossing operations are:

a. fixed and floating bridges;

b. ferries and rafting;

c. assault boat crossings;

d. vehicle and personnel fording; and

e. amphibious crossings.

3. Combat divers may be employed during the conduct of all stages of a gap-crossing operation. Typical tasks they may be required to perform when supporting the in-place and bridgehead forces are:

a. conduct reconnaissance of the potential crossing sites, especially the bottom profile and far bank;

b. breach obstacles in the water and on the far bank, including mined areas;

c. mark exit points and any obstacles in the water that would affect the crossing operation;

d. form part of the safety organization if it is determined that divers are needed as part of that organization; and[14]

e. as part of the assault echelon, combat divers can assist infantry reconnaissance parties on the water and inland within proximity of the waterline as guides for the bridgehead and breakout force.

4. Gap-crossing operations are considered as either hasty or deliberate:[15]

a. The hasty crossing operation is normally executed from the line of march using resources within the force. Very little reorganization of the assault echelon is required, and drills may be developed for crossing to commence with little or no additional orders being given. Some crossing assets, such as AVLB or Medium Raft (MR) may be pushed forward to allow a hasty crossing of more difficult water obstacles. Divers may not be employed in most hasty crossings due to a lack of time. They could be used to confirm and mark a ford or remove demolitions from a bridge that has been captured.

b. A deliberate crossing operation is only undertaken when no other option is available. Deliberate crossings require thorough reconnaissance, detailed planning, extensive preparations, rehearsal, and heavy or specialist engineering equipment. It is

---

[14] The commander may determine that no safety organization is required or that safety lines and surface boats are sufficient. This is not a recommended solution, but the type of safety organization in an operation will depend on many factors. Divers will only be one part, if at all, in such an organization.

[15] B-GL-361-001/FP-001 *Land Force Engineer Operations*, Chapter 7, Section 2 describes crossing operations in detail.

conducted because of the complexity of the obstacle, the strength of the enemy, or when a hasty crossing has failed. While it is often considered that only a division could perform a deliberate crossing operation, it can be performed by a battle group or brigade, depending on the extent of enemy opposition. A deliberate crossing will involve the regrouping of resources and more complete reconnaissance of the water obstacle. Combat divers will be employed to confirm the selected crossing sites and the far banks of those crossing sites. They could assist the assault force by marking beachheads and supporting the preparations of the in-place force by clearing obstacles.

c. In either operation, divers may be employed to recover equipment or bodies after the successful completion of the crossing operation.

5. **Reconnaissance Considerations**. Combat divers may be used to conduct a reconnaissance to confirm the suitability of a crossing site. They can identify the extent of preparation, if any is required, and confirm the presence and extent of mines and obstacles. Geomatics, air and satellite imagery as well as HUMINT will assist in identifying potential crossing sites and allow for the efficient employment of combat divers and economy of effort.

6. **Reconnaissance Details**. The Crossing Site Recce Report, E112B (DND 2106) outlines the technical data required to support a gap-crossing operation. In addition to the details of the E112B, the minimum details combat divers should attempt to gather are the following:

a. Width of gap.

b. Water depth—when the water is deeper than the snorkelling depth of the AEV, the depth of the water is no longer relevant. It is critical to know the more shallow depths, and to a greater accuracy, as those will affect bridges and rafts.

c. Natural and emplaced obstacles, including mines.

d. Bottom type and estimated ground-bearing pressure of approaches and landing site.

e. Speed of current.

f. Condition and slope of banks and work required.

g. Exits on the far bank from the beach area. Approaches should also be considered, but that information can be gained from a multitude of sources.

h. Enemy activity.

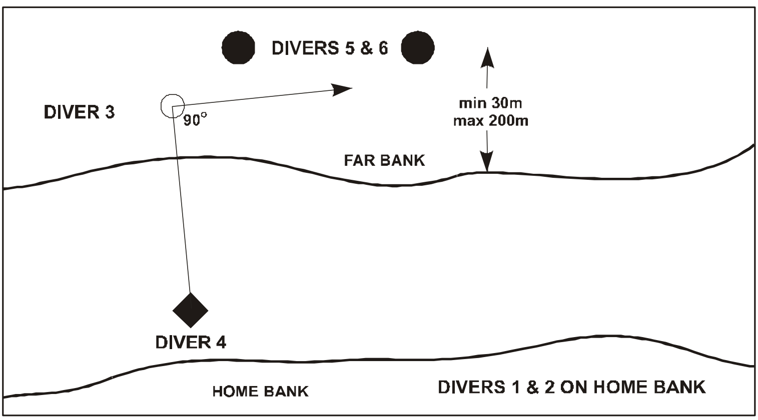


Figure 4-1: Water Crossing Recce with 6 Divers

7. **Reconnaissance of a Crossing Site**. Combat divers may conduct this task as surface swimmers, with breathing apparatus, or using a combination of techniques. Enemy threat and capabilities and the physical characteristics of the objective will be deciding factors in the approach and equipment used. A passage through friendly lines will have to be coordinated for this task. The general procedure for a gap-crossing recce is as follows:

a. a team of combat divers approach the beach with or without breathing apparatus;

b. the objective is secured;

c. the required details are gathered;

d. the team regroups, leaves the objective; and

e. disseminates information at an operational Rendez-vous (ORV).

Figure 4-2: Combat Divers Securing Their Arcs During a Water-Land Transition

8. This task may be conducted in pairs or as a team. Factors that will decide the size of team are the extent of reconnaissance required and the size and complexity of the obstacle. Generally, one pair will be able to conduct a reconnaissance of one crossing site. If time permits, they may be re-tasked to reconnoitre another site.

9. **Procedure as a Pair**. To conduct a crossing-site reconnaissance as a pair:

a. the combat divers enter the water at the site or upstream of the proposed crossing site;

b. move down the river to the proposed site;

c. conduct an initial assessment of the site suitability and gather required details; and

d. continue downstream to an RV point where they may link up with other divers and disseminate information.

10. Pairs of divers should be assigned specific sections of the obstacle. The length of each section must be determined by the availability of divers and the time to conduct the task. Their responsibilities are:

a. diver 1—provide security; and

b. diver 2—gather reconnaissance details.

11. This method can quickly provide a crossing-area commander with confirmation of suitable sites and the extent of preparations required. This is the preferred method when conducting a hasty crossing operation, but it could also be used for deliberate crossing operations.

12. **Procedure as a Team**. Combat divers working as groups of six can gather more accurate details required when planning a deliberate crossing operation. In other cases, the water gap is large enough or the site complex enough that a dive team may be required to do the reconnaissance. The dive team will normally concentrate on the reconnaissance, and the manoeuvre forces or force in place will provide security. (If it is a good site for us, it is a good site for the enemy and therefore should be guarded by our own forces.) The general concept is as follows:

a. the home bank is secured by elements of the manoeuvre unit;

b. the dive team conducts a bottom profile with a reel of line and/or handheld sonar;

c. the dive team confirms the presence and extent of obstacles or mining; and

d. RV and disseminate information.

13. Responsibilities of the team members are:

a. Divers 1 and 2—gather recce details of the home bank.

b. Divers 3 and 4—gather recce details of the far bank.

c. Divers 5 and 6—provide security and backup divers. in addition, the team leader should be in this pair and control the task.

14. Reconnaissance information requirements may vary for several reasons. Divers must be able to adapt the reconnaissance to suit the limitations and capabilities of the gap-crossing equipment that will be used.

15. **Landing Site Reconnaissance**. The techniques used for a crossing-site reconnaissance may be adapted for a landing site along a linear water obstacle, such as an ocean beach. This operation will not be conduced as an opposed water crossing, but it may be necessary for combat divers to assist in the use of beaches for logistical reasons. The navy is normally responsible for all clearance activities up to the high-water mark, but combat divers may have to supplement the naval capability. This type of operation will require specific training as it is a complex operation that requires a thorough understanding of the tides, types of landing craft and ground-bearing requirements for the vehicles arriving on shore. It is included here for information purposes. A beach on a lake or river, used to support assault boats or rafts, is handled in the same way as a normal exit reconnaissance. Factors that make this task different from a river-crossing site are:

a. action of the surf;

b. tidal zones and the effects of tides;

c. the objective is generally linear and large;

d. characteristics and nature of the beach and shoreline; and

e. boat and ship drills are often conducted in rough water.

UNDERWATER OBSTACLE BREACHING

16. In support of a gap-crossing operation, there may be a requirement for combat divers to breach complex obstacles at or below the water line for the assault echelon. The reconnaissance will identify the nature, type, size, and number of obstacles. The reconnaissance party should be prepared to mark submerged obstacles and mines with the use of chem-lites or similar items secured to or near the target or mine. Such markings might give away proposed crossing sites if there is any delay between the reconnaissance and the crossing operation.

17. All obstacles should be considered mined. Therefore, when breaching obstacles, line charges, such as an Mk 8 Demolition Hose or a Bangalore Torpedo, will be placed at intervals perpendicular to the target area to eliminate or reduce any possible mine threat. The explosive breach of obstacles will likely be conducted in two stages with two distinct groups of divers:

a. **Marking Team**. Divers, on the surface or using breathing apparatus, approach the target area and mark and indicate individual targets and locations for line charges. A second group of divers will execute the demolition of the obstacles and mines and breach paths or lanes through the objective.

b. **Demolition Team**. Table 4-1 outlines the general tasks and team composition for combat divers conducting an explosive obstacle breach.

Reconnaissance Party	Firing Party
(1) Team Leader	(1) Team Leader (initiation set)
(2) 2nd Diver Marks Targets	(2) Team 2IC, Firing Circuit
	(3) Charge Placement
	(4) Charge Placement

Table 4-1: Demolition Team—General Composition and Tasks

18. Combat divers will plan to use military explosives and accessories in pre-manufactures form (such as satchel charges) or made into purpose made charges for a specific task. All in-service military explosives and accessories have good water resistant characteristics if properly handled and prepared. Prolonged submersion should not be considered without special waterproofing efforts. Detailed charge placement procedures, current devices and accessories, and safety considerations are outlined in B-GL-361-008/FP-003 *Demolitions, Part 2, Engineers*. General considerations for combat diving operations involving explosives are:

a. Waterproofing of demolition accessories and initiation sets. Products, such as silicon sealant, waterproof bags, and Styrofoam, are used to water proof accessories and non-electric initiation sets.

b. Table 2-1, outlines safety distances for submerged explosives.

c. Maximum firing circuits with dual initiation points should be used.

d. Initiation points should be on the shore to reduce the risk of misfire.

e. The effects of currents and waves must be considered when securing charges and the firing circuit. The use of zap-straps, elastic or rubber cordage, and spikes to secure components of the firing circuit may have to be considered.

19. The factors that will ensure the successful execution of an explosive breach of underwater obstacles are:

a. detailed reconnaissance of target area;

b. rehearsals of procedures and drill;

c. minimal time on target;

d. command and control of the team by the leader; in particular, accounting for all members prior to initiating the demolition;

e. sound insertion and extraction plans;

f. stealth; and

g. risk management.

MINEFIELD BREACHING

20. Combat divers may be required to breach mined areas in the water and on the exit areas in support of a gap-crossing operation. As detailed in Section 3, all obstacles are considered mined; however, there may be sections of rivers and fording or bridge sites that are mined with no other artificial obstacles.

21. It is not feasible for combat divers to neutralize and disarm submerged mines. These are limitations caused by the lack of visibility, manual dexterity, and the physical difficulties of manipulating the mines underwater. Normally, combat divers will use explosives, either placed on individual targets or as line charges, to destroy submerged mines. Generally, mines will not be employed in depths greater than 3 m because vehicle do not ford deeper than 1.8 m; most of the mines are concentrated in water depths of 1.5 m or less. Mines, other than magnetic influence mines, located in water deeper

than the operating depth of the assault vehicles, rafts, or ferries may not have to be dealt with except as a follow-on operation.

22. The crossing-site commander must be aware of the limitations and capabilities of the combat divers supporting the operation. The engineer advisor will provide this information, with technical details being confirmed with the dive team leader. The key factors and method employed for successful breaching of an underwater minefield are:

a. accurate reconnaissance details;

b. knowledge of nature and types of mines;

c. coordination and liaison with the combat engineers from the force in place;

d. an accurate understanding of the capabilities and proximity of the enemy;

e. security of the objective from enemy observation and fire; and

f. combat divers proficient and rehearsed in breaching procedures.

23. **Assault Breaching of Mined Areas**. In support of the force in place, combat divers can breach lanes with explosives. They may or may not use breathing apparatus. The organization detailed in Table 4-1 can be adapted to conduct this task. This method is designed to be quick, effective, and ensure surprise. It will provide lanes for AFVs and landing sites for rafts and assault boats on the enemy bank of a water obstacle. This method is similar to the method used during the execution of a hasty obstacle-crossing operation. This breaching method will provide the bridgehead force a foothold on a far bank and will significantly reduce the submerged mine threat for AFVs and dismounted troops. The general procedure is:

a. The recce party marks the charge locations.

Figure 4-3: Minefield Breaching on Land

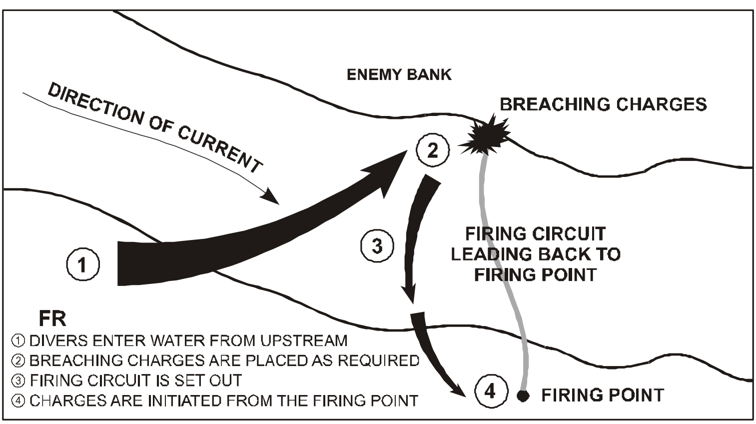


Figure 4-4: Assault Breach

b. The demolition team places and initiates the charges.

c. Divers move clear of the target area. They may move onto the enemy bank and act as guides for the assault echelon.

d. Bridgehead force lands.

24. The following methods can be used when a site is relatively secure from enemy observation and fire, such as when expanding a bridgehead.

a. **Water Depth is 1.5 m or Less**. The general procedure is:

(1) force in place combat engineers breach and secure a foothold on the home bank;

(2) a diver, without breathing apparatus, on a marked tending line begins clearing a 1 m area, moving against the current;

(3) mines found are marked as the arc is completed;

(4) mines on each arc are destroyed on site;

(5) once mines are disposed of, a new arc is cleared; and

(6) force in place combat engineers breach and secure a foothold on the far bank.

b. **Water Depth is 1.5 m or Greater**. The basic concepts of the method above can be applied; however, the use of breathing apparatus will make working conditions awkward. The general procedure is:

(1) force in place combat engineers breach and secure the home bank;

(2) line charges are placed and secured to the target area;

(3) charges are initiated; and

(4) combat divers breach and secure a foothold on the far bank.

c. **Magnetic Influence Mines**. Magnetic influence mines pose a significant risk to combat divers; through intelligence, their presence must be confirmed. When the threat of these mines is likely, combat divers should not be employed to breach these areas unless they are using wet suits and non-metal face masks only. Otherwise, their ensemble and other equipment could initiate the mines.

MARKING APPROACHES AND LANDING SITES

25. Combat divers will likely be the first elements of the force in place on the far bank during a gap-crossing operation or amphibious landing. As such, they must be prepared to mark the approaches and landing sites for the bridgehead and break-out forces. Expedient or standard marking systems may be used. Expedient systems could include plastic bottles or floats, while standard mine marking systems could also be used. The requirements and method used will depend on the size and type of crossing equipment being employed by the force in place and bridgehead forces, the tactical situation, and the time available. B-GL-332-006/FP-001 *Tactical Aide-Memoire Insert—Engineer* section 805.34 provides detailed information pertaining to full standard marking.

26. The use of subdued IR, or normal chem-lites, indicating the centreline or left and right arcs on the bank and placed on small floats in the approach may be used during the initial assault. Rehearsals will have to clearly identify colours and placement on the left or right of the landing zone. As the bridgehead develops, combat engineers assisted by divers, as required, can emplace standard defile and approach marking systems.

27. The divers will normally be part of the force in place, leaving the bridgehead and break-out forces with their full complement of supporting engineers. The engineer commander will ensure that the marking system is passed on to these forces, as well as ensuring divers are briefed on recognition signals

CHAPTER 5
PROTECTION

GENERAL

1. Counter-mobility and survivability operations are a key role of the engineers and are carried into the water by the combat divers. Counter-mobility operations are conducted to support the manoeuvre commander's plan to fix and strike the enemy. The barrier plan is developed and coordinated at all levels with the manoeuvre commanders. The combat divers must understand the intention for the obstacles that they are putting in. Normally, at a water obstacle, the intent is to disrupt a crossing site, turn the enemy away from the site, or block the enemy from using a site. These intents require an increasing level of work and resources required to accomplish them. Obstacles are an important part of force protection and survivability. They mould the enemy to the commander's intent and increase the enemy's vulnerability while acting as a force multiplier.

2. Typical counter-mobility operations are:

a. denial of terrain and approaches;

b. flank protection; and

c. rear area security.

3. The employment of combat engineering resources is key in the implementation of counter-mobility operations, and, as such, combat divers provide a valuable asset and means of execution. This chapter outlines typical tasks combat divers may be required to conduct to support counter-mobility operations and to enhance force survivability.

COUNTER-MOBILTY

4. **Counter-mobility Tasks**. Combat divers' counter-mobility tasks are:

a. Putting in anti-tank landmines at crossing sites, below water and on the far bank. Mining of the home bank is not a diver specific task, but it could be done by divers.[16]

b. Putting in obstacles in the water and on the far bank, including cratering in the water.

c. Assisting in demolition tasks on infrastructure, such as bridges, docks or piers.

5. **Reconnaissance**. Combat divers may be used to conduct reconnaissance in support of a counter-move, withdrawal, denial, breaking contact, and flank protection. The majority of reconnaissance details are the same as those required for land based combat engineer tasks (Crossing Site Recce Report, E112B (DND 2106)). The reconnaissance must be coordinated with the commander's intent and support barrier, withdrawal, and counter-moves plans.

6. **Obstacle Emplacement**. The principles employed in obstacle emplacement on land can be applied in the water. Generally, obstacles used on land can be extended to or constructed at or below the waterline. Vehicle traction is greatly reduced in water due to the buoyancy of the vehicle and reduced friction on the bottom. This reduced traction affects the vehicle's ability to break obstacles or to climb exit banks. These characteristics need to be taken into account;

---

[16] In principle, only the home bank should be mined in order to allow our forces to breach the obstacle more easily and to make it more difficult for the enemy forces to breach the mined area.

both to our advantage and to ensure that our obstacles are effective.[17] Considerations when emplacing obstacles in the water are:

Figure 5-1: Bottom Profile

a. Obstacle intent, including what it is expected to stop or affect.

b. The action of currents, tides, and waves, which could make emplacement difficult and could move, bury, or destroy the obstacles.

c. Slope and nature of the banks or beach, and whether they could be used to augment other obstacles. A step cut into the bank may prevent a vehicle from exiting the water. Certain soils or sands may be effective obstacles with minimal preparation.

7. Obstacles that could be emplaced by combat divers are:

a. Submerged log booms with wire or spikes anchored to the river bed or shoreline.

[17] Reduced ground-bearing pressure could mean that a pressure fuzed mine may not be set off.

b. Chain or SWR running between piles beneath the water line.

c. Concrete obstacles, normally prefabricated but sometimes improvised using highway barriers or curbs. These are difficult and time consuming to put into place with most of the work carried out above water to transport them to location and lower them off the boat, raft, or barge.

d. Steel obstacles, normally improvised from beams or railway tracks. They are normally pre-fabricated on shore and moved into place by boat, raft, or barge. The divers help to place them accurately on the bottom.

e. Wire obstacles, usually for dismounted soldiers.

8. **Landmines**. Combat divers will use anti-tank mines to extend tactical minefields into the water, close minefield lanes in advance of anti-tank scatterable mine closure, or to put in nuisance minefields at potential crossing sites. The principles, mine preparation techniques, patterns, and recording and marking procedures for underwater emplacement of mines are detailed in B-GL-361-009/FP-003, *Mines And Booby Traps, Engineers*. Mines will normally be laid in shallow water, less than the normal deep ford depth of the vehicles. This practice will ensure that the vehicles have sufficient ground-bearing pressure to activate pressure-fuzed mines. Mines are not required in deeper water as we are not trying to prevent the use of the middle of the waterway, just the entrances and exits.

9. **Landmine Laying**. Combat divers will normally put anti-tank mines in water that is shallow enough to avoid the use of CABA. Emplacing mines in the water is labour and time intensive. The planning rate for laying anti-tank mines is five mines per hour per diver. This estimate does not take into consideration the work required to protect the mines from the effects of exposure to water and depth, currents, and waves. The in-service anti-tank mine DM 21 does not require additional water proofing for use at these shallow depths. It may need to be anchored against current, waves, or tides. Strong currents in deep water will prevent amphibious vehicle crossings (the intelligence officer will confirm *go/no-go* currents for enemy

equipment). Ford crossings are not seriously affected by strong currents. Fixing mines to steel grates and pinning them down with spikes is an example of improvisation to meet the problems posed by currents.

10. **Recording**. Recording requires that combat divers improvise and adapt as required. It may be necessary to use at least two benchmarks on the bank for reference and recording. Benchmarks should be easily identifiable, clearly indicated on the minefield record, and placed above the high-water mark. An E122D (DND 2109), Minefield Completion Report will be completed and submitted through the chain of command for all underwater mining.

11. **Landmine Emplacement Drills**. When conducting mining operations in the water, the basic principles of working in echelon, staying behind armed mines, and one person per mine are applied. There are two methods generally used by combat divers to place and record mines in the water. For either drill, divers will be tended from the shore. Tending supports the diver. The tending line can be graduated and used as a measuring device for recording. The two drills typically used are:

a. linear drill; and

b. half circle drill.

12. **Linear Drill**. This method will likely be used when extending rows from tactical minefields into the water. The general procedure and considerations are:

a. Establish a benchmark.

b. Establish a baseline on shore, running parallel to the water.

c. Pickets are driven in at intervals along the baseline. These will indicate rows or start points for bearings on which mines are placed.

d. Tended divers, with the pickets as a reference point, emplace mines in the specified design.

e. Mines will be armed as they are placed.

f. Accurate details for recording are maintained.

g. Upon completion, the baseline is removed and pickets driven flush to the ground.

13. **Half Circle Drill**. This method will likely be the most common method used. It applies itself well to nuisance mining. It is less time consuming than the linear drill. This method is similar to that of placing and recording anti-tank mines in protective minefields. The diver is sent out from a central point on a tending line that is graduated to indicate distance. The tender and supervisor keep the diver on a set bearing. The general procedures and considerations for this drill are:

a. establish a benchmark;

b. the diver is sent out with a prepared mine on a bearing;

c. he is controlled by the tender and supervisor;

d. mines are placed and armed; and

e. minefield record is produced.

14. When using either of the above drills, a boat may be used to transport mines to divers.

15. **Execution of Demolition Obstacles**. Generally, combat divers will not execute these tasks, as they usually require large amounts of explosives, types of tools, equipment, and preparation. Combat divers may be used to assist other combat engineers in the reconnaissance and preparation of targets and target areas. In some situations, combat divers can attack a specific target, but these would be within our own areas. Combat divers are not trained nor equipped to conduct long-range patrols to attacks targets. In these situations, detailed reconnaissance, coordination of support, security, and a sound insertion and extraction plan are essential.

SURVIVABILITY

16. Combat divers can be used to assist other combat engineers in the execution of survivability tasks. They can be employed for those tasks that may involve repair to or emplacement of fortifications and facilities on or near the waterline.

17. **Removal of Battlefield Hazards**. Combat divers may be used in the removal of battlefield hazards, specifically:

a. support battlefield area clearance operations; and

b. removal of obstructions and debris in waterways.

18. The methods and procedures for these tasks are outlined in Chapter 6, Sustainment Engineering

CHAPTER 6
SUSTAINMENT ENGINEERING

GENERAL

1. Sustainment engineering allows a force the ability to maintain, regenerate, and reconstitute itself. The Engineer Support Regiment has combat divers who carry out general support and sustainment engineering tasks. Divers from combat engineer regiments could also be employed on these types of tasks.

2. Typically, combat divers may be tasked to execute or support the following during sustainment engineering operations:

a. search, recovery, and repair of military equipment, such as drowned vehicles, bridges, bridge components, or damaged floating bridges;

b. battlefield area clearance to dispose of mines and UXO in the water;

c. conduct inspections and damage assessments;

d. assist in the clearance of debris and rubble from waterways; and

e. assist in repair work on civil infrastructure, such as water treatment plant inlets.

3. This chapter outlines the methods, procedures, and equipment combat divers may employ when conducting or supporting sustainment engineering operations and tasks.

RECOVERY OF EQUIPMENT

4. Combat divers will be tasked to recover large high value items, such as an AFV or a bridge pontoon. The combat diver is not trained or equipped to search for objects smaller than weapons. Tasks that combat divers will conduct when recovering equipment are:

a. search;

b. lift; and

c. repair.

5. **Underwater Searches**. Combat divers can conduct searches to locate, and conduct the subsequent recovery of, equipment and personnel. B-GG-380-000/FP-002, *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* details search techniques and considerations. Searching for objects underwater can often turn into a long and intensive task, requiring many resources beyond those immediately available to a dive team. Committing to a search task may require extensive logistical support and additional manpower to assist in surface support tasks. Coordination of resources and a sound search and dive plan will ensure success.

6. **Searching Procedures**. Search procedures will be influenced by several factors and adapted to the situation. Combat divers will use one of the following methods:

a. lifeline search;

b. circular search;

c. towed diver search;

d. snag line search;

e. grid search;

f. light jackstay; and

g. fast water searches.

7. **Factors Affecting Searches**. The following factors should be considered when planning and conducting searches:

a. **Witness Information**. Information from witnesses that is relevant to the location, description of the lost item, and water conditions is useful in determining a search method.

b. **Size of Object**. The size of the lost object may determine the search method (for example, a snag line search for a large object or a detailed grid search for smaller items).

c. **Water Depth**. Depth will be a factor in the dive plan, search method, and support equipment.

d. **Nature of Bottom**. Soil type, profile, and known obstacles or structures will determine the methods used (for example, a towed diver search may not be acceptable if the profile is uneven due to large rocks or sunken piers).

e. **Speed of Current**. Current speed will determine the diver's ensemble, search method, and also be a factor in determining the estimated location of the lost item.

f. **Surface Indicators**. The location of oil slicks, flotsam, and debris may assist in reducing the search area.

g. **Hydrographic Features**. Eddies, back currents, and tidal streams will move objects along the bottom, often a considerable distance from the original point of entry into the water. Studying the flow or reading charts may assist in reducing the search area and choosing a search method.

h. **Weather Conditions and Sea State**. Conditions, during the search and forecasted, may affect the search method and equipment (for example, waves resulting from high winds will have an adverse affect on placing and controlling a light jackstay).

i. **Available Divers**. The number of divers will determine the search method and dive plan, especially for prolonged searches in deep water.

j. **Time**. The amount of time available or urgency when trying to find an object will affect the search method (for example, an attended diver conducting a circle search may be faster when looking for drowned personnel).

k. **Equipment**. Available equipment and stores will determine the search method. For example, when conducting a fast water search, it may be required to construct an SWR cableway across the search area to secure and control divers.

l. **Security and Protection**. When conducting searches in an area of operation, a protection party may be assigned to the task since it is likely that the divers will be focused on the search and diving operation, making them vulnerable to attack.

8. **Searching Equipment**. The following equipment is held within dive stores and is readily available for use by dive sections when planning and conducting searches:

a. submersible, hand-held mine detectors;

b. submersible, video drop cameras;

c. hand-held or surface sonar devices;

d. towed sleds;

e. underwater communications equipment;

f. rope grids; and

g. retractable line reels.

9. **Fast Water Searches**. Combat divers generally work in rivers and inland waterways and are often required to conduct search and recovery tasks in strong currents and fast water. To conduct a search in fast water, the basic lifeline search method is modified. This modification usually includes the use of anchorage systems and fixed cables strung across the search area. B-GL-361-004/FP-001, *Rigging* should be referred to for design and construction of cableway and anchorage systems.

10. In addition to the factors detailed in Chapter 2, Section 4, the following should be considered when planning and conducting fast water searches:

a. safety of the diver;

b. redundant safety devices and harnesses;

c. positive control of divers on tending lines and cables;

d. diver endurance and fatigue from the effects of the current and extra weight;

e. the use of the LWSSDS;

f. the use of full face masks; and

g. the use of through water communication systems.

LIFT AND RECOVERY

11. **Lifting and Recovery**. Generally, searching tasks will lead into a lift and recovery task. This will often require other regimental resources, such as a raft, cranes, or other recovery equipment and personnel. When planning and executing lifting and recovery tasks, the following should be considered:

a. **Location and Disposition of Object on the Bottom**. Exact position and the way an object is resting on the bottom will be factors in lifting requirements and method.

b. **Type of Object**. The following should be considered with regard to the object being lifted:

(1) **Internal Buoyancy Capacity of Object**. Can the object be sealed and air pumped in, to minimize the use of lift bags?

(2) **Structural Integrity of Object**. Will the object's integral frame withstand the forces applied during a lift?

(3) **Mass and Density**. These affect the buoyancy requirements and must be calculated. Table 805.5 in the Tactical Aide-memoire Engineer Insert shows the density of common materials.

(4) **Lifting Points**. Position of hard points on the object to attached lifting bags and winches should be confirmed and used when possible.

(5) **Repair Requirements Prior to Lifting**. Some items, such as pontoons, may be patched prior to lifting so that they may be inflated with air to increase buoyancy.

c. **Depth**. The depth of water an object is in will determine the lift method, calculations for buoyancy, diver endurance, and lift requirements.

d. **Nature of Bottom**. Specifically the soil and silt layer. If an object has sunken into a soft bottom, it will require substantial force to break the suction effect with buoyancy. This will likely be in excess of the requirement for lifting once the object is free. Excavating the area around the object with an air lift or water hose may have to be considered.

e. **Hazards**. Hazards and mitigating measures must be identified and put into place (for example, the potential release of fuel from a vehicle as it is being lifted).

f. **Environmental Conditions**. Weather and ambient light conditions may adversely affect the duration of the task. In addition, the effect of currents, tides, and waves has to be considered, and methods of mitigating these affects need to be put in place (for example, an anchorage system to prevent a rising and buoyant object from drifting away as a result of the current flow).

g. **Available Equipment and Resources**. Recovery equipment not held by dive stores should be considered, such as armoured recovery vehicles or cranes to assist in lifting and removal from the water.

h. **Available Number of Divers**. The number of divers available will affect the dive plan and could allow support to a task with greater depths and limited bottom times.

i. **Security**. In areas where enemy contact is a threat, security may need to be provided for the dive team. Normally recovery operations take place where and when minimal site security is needed.

12. **Lifting Equipment**. The following equipment may be used during lifting tasks:

a. **Lifting Bags**. Dive stores holds lifting bags of various design and capacity.

b. **Nylon and SWR Slings and Chains**. These are available from within the support squadron.

c. **Improvised Lifting Devices**. Ad hoc devices, such as 45 gal drums, can be used to provide buoyancy during a lift.

d. **Mechanical Winches**. Within the engineer support squadron, there are a wide variety of winches and jacks that may be used to assist in lifting and recovering objects from the water.

e. **Land-based Recovery Vehicles**. ARVs, engineer section vehicles, AEVs, and cranes may all be employed to assist in lifting and recovering sunken objects.

13. **Considerations During a Lift**. During the actual lifting task, the following factors should be considered and relevant contingencies developed:

a. a coordinated plan between divers and surface support;

b. ensure rigging and slings meet the load requirements;

c. be prepared for structural failure of the object;

d. minimum number of divers required will be in the water;

e. the use of buddy and tending lines should be eliminated;

f. through water communications for divers and surface support;

g. be prepared to control the object immediately upon surfacing; and

h. lift and buoyancy requirements change as the object surfaces.

14. Recovery tasks are rarely conducted in isolation and generally require additional logistical support. The combat diving supervisor is given control of recovering the object from its submerged state to shore. Once secured on shore, the control responsibility reverts to the holding unit.

15. **Repairs to Equipment**. B-GG-380-000/FP-002 *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* details the methods and techniques to affect temporary repairs and patches to recovered or float-damaged equipment. Combat divers may be required to repair boats, pontoons on bridges, rafts, and ferries. The following should be considered when planning and conducting repair tasks:

a. the nature and extent of the damage; and

b. available equipment or materials for use.

16. The following are materials that may be used to fabricate patches:

a. plywood and timber;

b. plastic, rubber, or canvas sheets;

c. epoxies and fiberglass;

d. hook bolts and clamps; and

e. inflatable bags and devices.

17. Repairs conducted by combat divers are only temporary and likely conducted in conjunction with a lifting and recovery task.

BATTLEFIELD AREA CLEARANCE

18. Mines and unexploded ordnance pose a significant hazard on the battlefield. Once time and resources are available, engineers will be tasked to start the clearance to support military activities. Combat divers will be required to find and dispose of UXO and mines in water that affect military operations. In some cases, limited clearance for civilian purposes will be ordered to assist in stabilizing the civilian population.

19. CER and ESR will have soldiers trained in battlefield munitions disposal tasks. Battlefield Munitions Disposal (BMD) is a concept of operations and describes the training provided to engineer soldiers and officers. BMD includes the detection, identification, field evaluation, and disposal of unexploded ordnance and munitions, friendly or enemy, in a theatre of operations. The disposal will normally be carried out by blowing in place or removal. Rendering safe or other EOD procedures will be carried out by advance qualified EOD operators. CER and ESR have designated NCOs with advanced EOD qualifications that allow them to render safe or carry out advanced EOD operations on UXO in order to dispose of them. Disposal and mine clearance underwater has additional hazards and risks.

20. The basic techniques, methods, and concepts used in breaching operations may be applied to clearing operations. However, the operational security and conditions will likely permit combat divers to use the searching techniques and equipment outlined in Section 2 of this chapter. Detailed considerations and factors for a clearance operation are outlined in B-GL-361-009/FP-003 *Mines and Booby Traps, Engineers*.

21. **Factors Affecting Clearance Tasks**. Planning factors to consider when conducting a clearing and disposal operation underwater are:

a. Security of the area. Clearance operations should not take place if the threat of enemy interference exists.

b. Land-based combat engineers should clear up to the water line, leaving the divers to deal with the water.

c. Nature of the ordnance.

d. A detailed risk assessment must be conducted to determine the method of disposal.

e. Remote search methods should be used if they are available.

f. Currents, tides, and waves, which will affect the diver and may have disturbed the UXO.

DAMAGE ASSESMENT

22. Combat divers may be tasked to conduct inspections and damage assessments of infrastructure and facilities underwater, or they may gather the technical details required for assessment by experts on the surface. Factors that affect visual inspections are:

a. visibility; and

b. currents, waves, and tides.

23. Combat divers can conduct inspections using:

a. visual observation;

b. still photography;

c. video photography;

d. remote cameras; and

e. sketches.

24. Inspections and assessments may be conducted on:

a. retaining walls;

b. structures;

c. footings, abutments, and piers; and

d. utility infrastructure.

CONSTRUCTION

25. Sustainment engineering operations may require the execution of tasks to maintain lines of communication, clear debris, and restore utilities and infrastructure facilities. Combat divers can conduct basic construction tasks, or they can support tasks conducted by combat and construction engineers.

26. **Underwater Construction Tasks**. Typical construction tasks include:

a. repair of docks, retaining walls, or piers;

b. clearance of debris from waterways;

c. dredging and excavation; and

d. laying and repairing of underwater pipelines and communication lines.

27. The following are considerations relating to underwater construction:

a. a detailed assessment and plan is required;

b. complete as much preparations on the surface as possible;

c. plan and prepare for the effects of buoyancy on materials;

d. the effects of currents or tides;

e. identify potential hazards;

f. work within diving and physical limits; and

g. using through water communications will improve efficiency.

28. In regard to safety, there are specific precautions that must be considered for underwater construction tasks. They are:

a. underwater tools must have all safety guards on and properly secured;

b. the actuating force for the tool will be controlled by or with signals from the diver operating the tool;

c. tools will only be operated and maintained within their respective specifications;

d. additional cables, hoses, and lines used increase the hazards of fouling;

e. any equipment or structure that poses a threat to the diver must be isolated, removed, or turned off as applicable; and

f. when feasible, ear and eye protection will be worn.

29. **Underwater Tools and Construction Equipment**. Generally, all hand tools can be used underwater. Special consideration must be taken in regard to securing them to the diver task site and their post-dive maintenance. Combat divers may use tools and equipment that are powered by hydraulics, low- and high-pressure air, or ignition of gases:

a. **Hydraulic Tools**. Hydraulic tools provide consistent power, are generally safer to use, have little or no depth limitations, are generally lighter per unit power output, do not produce bubbles that obscure vision and require nominal maintenance.

b. Safety precautions, operating and maintenance requirements for hydraulic tools can be found in B-GL-361-003/FP-001 *Basic Field Engineering*.

30. Available underwater hydraulic tools include:

a. drills;

b. impact wrenches;

c. breakers and hammers;

d. chain saws;

e. cut-off saws; and

f. pumps.

31. Portable or vehicle mounted hydraulic pumps may be used to power tools and implements. The hydraulics integral to combat engineer section vehicles may also be used.

32. **Pneumatic Tools**. The effectiveness of pneumatic tools is a function of the volume of air being supplied and the pressure at which it is supplied. Both are affected by depth and water pressure, and generally pneumatic tools do not work effectively below 50 fsw. Also, air bubbles from operating the tools impair the operator’s vision. Other factors are:

a. Most tools can function at pressures as low as 75% of the optimum. Some compressors are capable of supplying air at higher initial pressures in order to provide the optimum pressure at the working end. However, unless a compressor is specifically designed with such built-in adjustability, no attempt to alter the design characteristics should be made.

b. The operating, maintenance, and safety precautions specific to compressors and compressor tools are found in B-GL-361-003/FP-001 *Basic Field Engineering*.

33. **Power Velocity Tools**. Power velocity tools are specifically designed for underwater applications. The barrel or shot is sealed for use in water. The firing mechanism may be fired remotely or manually. The advantages power velocity tools have over drills or cutters are speed and the absence of surface power sources. These tools can be used to fasten charges to targets, apply patches, and secure eyes and hooks for lifting, and cutting cable and small bars. There are two basic types of power velocity tools:

a. **Bolt Drivers**. Stud or bolt drivers are normally used to penetrate steel. They provide a variety of studs and bolts designed to either secure material or to puncture material.

b. **Wire Cutters**. Remotely fired wire cutters can cut cables under load.

34. **Underwater Concrete**. There are several applications for the use of concrete underwater. Concrete may be used to repair or construct a wide range of structures and facilities. Major design and construction of concrete structures is beyond the capabilities of a combat diving team. However, expedient repairs, minor erosion repair, underwater patches, small repairs to walls and dams, and construction of small footings are all within a dive team’s capabilities. When planning and conducting tasks involving concrete, the following should be considered:

a. **Site Preparation**. Removal of debris and rubble or excavation of the bottom may be required.

b. **Concrete Forms**. Generally fabricated from wood; therefore, buoyancy and prefabrication on the surface must be considered.

c. **Types of Concrete Mix**. Water may segregate the aggregate. A slump of 150-230 mm is likely required.

35. **Methods of Placing Concrete**. Water may cause the aggregate to segregate; therefore, exposure to ambient water must be minimized until after it has been placed. The following methods can be used and will depend on the size of the task:

a. **Sandbags**. Sandbags filled with concrete can be used as expedient footings. Dam-sacks are designed for this purpose and require no surface preparation.

b. **Tremie**. This is a watertight pipe reaching the form to the funnel on the surface. Either steel or PVC may be used with watertight seals. The end of the pipe remains in the concrete during the pour to prevent washing action on the concrete. If the flow is interrupted, the pipe must be kept charged with concrete and the end of the pipe forced into the previously poured concrete to prevent segregation of the concrete due to water.

c. **Toggle Bag**. This is a watertight canvas bag that can be filled with concrete and emptied into a form.

d. **Concrete Pumps**. Pumps are the most suitable method for placing concrete underwater and are effective to a depth of 100 fsw.

e. **Hydro-valve**. Using a collapsible sealed hose, the concrete is poured into a hopper or funnel. When concrete is not filling the hose, water pressure reseals the hose.

36. **Clearing Debris and Rubble**. Combat divers may be required to clear debris and rubble from waterways in order to conduct construction tasks or to remove hazards for boats and ferries. The

techniques, methods, and equipment for lifting and construction may be used; however, divers may use other methods or equipment such as:

a. demolition with explosives;

b. dredging; and

c. thermic arc cutting tools.

37. **Demolition with Explosives**. Using explosives is an effective method to clear debris and rubble from waterways. B-GL-361-008/FP-003 *Demolitions, Part 2, Engineers* details the procedures, precautions, planning considerations, and calculations for the use of explosives.

38. **Dredging and Excavation**. Underwater dredging and excavation may be required as part of a lifting or construction task. Combat divers, using ad hoc and improvised methods, can dredge small areas around sunken objects to assist in lifting or the preparation for placing a concrete form. Bottom type will be a major factor when determining the dredging method and equipment. Methods and equipment for minor dredging and excavation tasks are:

a. **Airlifts**. The principal of operation for airlift is that air from a low- pressure compressor enters a collar chamber at the lower end of a tube. Tubes may be fabricated from PVC or aluminum pipes. Standard air compressors can be used with the fittings, and air cocks fitted to an improvised tube.

b. **High-pressure Water**. A standard hose with a nozzle from a pump or hydrant will provide adequate pressure to excavate soil and silt from around objects or prepare rock beds to receive concrete.

39. **Thermic Arc Cutting Tool**. These tools can cut or melt through most materials including cast iron, stainless steel brass, ferrous metals, and concrete. This equipment may also be used for preparing boreholes for charges on concrete or rock targets, cutting edges during a patching task, and cutting holes into objects for recovery.

CHAPTER 7
ORGANIZATION, SAFETY, TRAINING, ADMINISTRATION, AND EQUIPMENT

GENERAL

1. Combat divers extend combat engineering into the water providing army formations the capability of projecting their combat power on to and under the water. There are inherent requirements in regard to safety, operations, training, administration, and equipment for combat divers and combat diving teams. While not normally part of a doctrine manual, this chapter is included to ensure that the basic principles and concepts for training and administering combat divers are understood.

2. This chapter outlines the unique requirements of combat diving or identifies the source documents or orders pertaining to the subject. Annex A of this chapter outlines all relevant documents, orders, and publications pertinent to combat diving.

KEY ARMY DIVE APPOINTMENTS

3. **The Army Dive Centre**. The Army Dive Centre has been established at CFSME to provide a central focus for all army dive issues. As such, they coordinate the activities and administration of the divers in the field units. There is a full-time staff at the Army Dive Centre. There are two key appointments for peacetime training, administration, and development of combat diving.

4. **Office of Primary Interest (OPI) for Army Diving**. The OPI for army diving is the commandant of CFSME. The duties of the OPI for army diving are as follows:

   a. act as principal advisor to commander of the army on combat diving;

   b. represent combat diving at the engineer branch council;

c. issue directions to the officer in charge of army diving regarding CF policy and the chief of the land staff and branch direction regarding combat diving;

d. provide authority, in conjunction with the maritime staff (MSCRM 6), to use non–CF diving equipment and other exclusions (as shown in Reference A); for all LFC combat diving establishments (as detailed in Reference D); and

e. approve the concept for the annual army collective combat diving exercise (Exercise ROGUISH BUOY (EX RB)).

5. **Officer in Charge of Army Diving (OIC of Army Diving)**. The OIC of army diving is a combat diving officer of the rank of major appointed by the OPI for army diving. The duties of the OIC of army diving are as follows:

a. represent the army on all committees, working groups, and conferences pertaining to combat diving;

b. control the Army Dive Centre;

c. authorize waivers for the requirement to rescind diving qualification for lapses in currency and qualification;

d. staff requests and waivers for authority to use non-CF diving equipment and other exclusions as shown in Reference A, as directed by the OPI for army diving;

e. plan, coordinate, and execute the annual army collective combat diving exercise and act as the exercise director;

f. monitor unit combat diving manning, training, and equipment requirements, including allocation of course positions; and

g. ensure that trials are conducted on combat diving equipment through the appropriate DLR 7, CLS, and CMS staff agencies.

6. **Sergeant Major, Army Diving (SM Army Diving)**. A qualified combat diving supervisor, MWO or WO, appointed by the OPI for army diving. The duties of the SM, army diving are as follows:

a. coordinate operation of the Army Dive Centre;

b. attend meetings, conferences, and working groups pertaining to combat diving;

c. assist the OIC of army diving with the planning, coordinating, and execution of the annual LFC collective combat diving exercise;

d. provide technical advice pertaining to combat diving procedures, equipment, and administration;

e. pursue and develop the evolution of combat diving equipment; and

f. support and develop individual combat diver training.

DISPOSITION OF COMBAT DIVERS

7. **Combat Diving Establishments**. The Land Force combat diving capability is resident in regular force engineer units. CFAO 43-2 “Diving Organization, Responsibilities and Administrative Instructions” outlines the establishment and organization of combat diving teams.

8. **The Army Dive Centre**. Mandated to develop combat diving doctrine, training, techniques, and procedures and is the focal point for all matters and policy issues concerning combat diving.

SAFETY

9. **Combat Diving Safety**. The most effective safety mechanism in diving is a proficient combat diver. The procedures and methods outlined in B-GG-380-000/FP-002, *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* will not be superseded by this or any other CF document unless authorized. B-GL-380-0001/FP-002 is the source document for, and governs, the conduct of all CF self-contained compressed air diving.

10. It is not within the scope of this manual to detail all the pertinent safety requirements, procedures, and considerations. Specifics are outlined and maintained in the relevant references, documents, and material (see Annex A of this chapter). In addition to those related to diving, the following factors must be considered:

a. the use and effects of explosives and explosive accessories;

b. the use and effects of small arms and ammunition;

c. operational safety;

d. training safety;

e. operation of boats and watercraft;

f. operations in contaminated environments;

g. helicopter operations;

h. geographic and climatic setting;

i. environmental impact; and

j. the safe transportation and handling of dangerous goods, hazardous materials, and weapons.

11. **Safety Support to Operations and Training Over Water**. Combat divers may be tasked to provide safety support to training and operations over water. B-GL-381-001/TS-000, *Operational Training, Training Safety* details the requirements for safety organizations.

Combat divers have the capability to support a safety standby organization for the following types of tasks and training activities:

a. all-arms watermanship training;

b. assault boat operations;

c. amphibious vehicle operations;

d. parachute operations involving, or the potential of, water drops;

e. rafting and ferrying operations;

f. deep fording operations; and

g. low altitude fixed- and rotary-wing aircraft operations and training.

12. **Safety Standby Organization**. The senior combat diver supervisor, supporting the training, exercise, or operation must be prepared to offer advice to the safety standby commander on dive related matters.

13. **LWSSDS**. The LWSSDS is to be used during certain types of safety standby tasks, as this equipment will facilitate the entry into drowned vehicles or aircraft and provides the diver supervisor with direct control and communications with the rescue divers. The minimum required number of divers and support personnel when using LWSSDS are:

Figure 7-1: LSSWDS

a. diving supervisor: will tend standby diver No. 3;

b. stand-by diver No. 1—in CABA, at the immediate state;

c. stand-by diver No. 2—LSSWDS at the immediate state;

d. stand-by diver No. 3—in CABA at the ready state; will automatically go to the immediate state at the onset of an emergency;

e. diving tender—will tend diver No. 2; and

f. boat operator.

14. **Safety Boat and Equipment**. The dive boat will be equipped as per IAW standard diving safety procedures. The safety boat will be equipped as detailed in B-GL-381-001/TS-000, *Operational Training, Training Safety*.

COMBAT DIVER TRAINING

15. Combat divers, supervisors, and officers receive initial and continuation training for their qualification at a fleet diving unit. Collective training and maintenance of combat diver proficiency are functions of the army chain of command and the field engineer units.

16. **Candidate Selection and Evaluation**. As a limited number of vacancies are available for a given combat diving course serial, candidate selection is of the utmost importance to avoid wasting vacancies. This can be prevented by having a surplus of candidates or by conducting pre-dive courses in order to select the most suitable candidates. Course nomination and preliminary training of potential candidates is conducted at the unit level.

DIVE PRELIMINARY COURSE

17. Potential candidates must meet the selection criteria stated in A-PD-055-003/PQ-001 OSS AFEP or ADUV, including completion of a pressure tolerance test. This is the minimum requirement and could suffice to send a fit soldier or officer on the course if there are not enough candidates. Commanding officers have the prerogative to nominate candidates without the completion of diver preliminary training and selection. Generally, a preliminary course is conducted at the unit level over a two-week period in order to evaluate all of the volunteers and send the best soldiers.

18. **Conduct of Candidate Selection**. The standards outlined in CFAO 43-2, "Diving Organization, Responsibilities and Administrative Instructions", for physical fitness should be considered the minimum. Candidates must meet these standards. Units should not

create higher standards as prerequisites. Volunteers for combat diving are already qualified and experienced soldiers; hence the course is not a right of passage. The dive preliminary course must focus on the dive specific physical adaptations. The curriculum for the combat diver preliminary course should be based on the concept of specific adaptation to imposed demands. Additional physical and mental conditioning of the candidate is not the aim of the course.

19. The basic outline for the conduct of combat diver selection should be :

a. Aerobic endurance and strength evaluation: in order to ensure that the soldier can meet the standards of the CFAO 43-2 and the course. A two-week course is not sufficient time to significantly improve the soldier's aerobic endurance and strength.

b. Introductory surface swims in open water and currents to evaluate the ability of the soldier to deal with open water. Endurance swims are not part of this course.

c. Breath hold diving, as required by the dive course, to evaluate if the soldier has the basic ability and lack of fear.

d. Black water conditions in order to evaluate the soldier's reactions to these conditions.

e. Water entries from height: a maximum of a 3 m board or platform should be used, as this will demonstrate if the soldier is willing and able to jump from these heights.

f. Introductory lectures on procedures, equipment, diving medicine, and physics. The intent is to ensure that the soldier has the mental capacity to understand the material and do the right calculations.

g. Introduction to diving procedures: in order to make the soldier comfortable with the equipment and to evaluate if the soldier will have any problem doing these activities on the dive course. This could include clear mask, swim w/snorkel and mask, swim w/snorkel no mask, and ditch and don mask.

h. Clear mask in full CABA, buddy breath w/qualified diver, ditch and don CABA, and dive w/blacked out mask. The aim is to evaluate if the soldier will be able to function without panicking in these situation.

i. Use of underwater line signals.

20. The overall aim of this process is to familiarize the soldier with the unique stresses of the combat diving environment, the procedures and equipment inherent to combat diving and evaluate a candidate's suitability for combat diver training. The dive preliminary course is not intended to teach the soldier the material that he will receive on the combat dive course.

21. **Conduct of the Combat Diver and Combat Diver Supervisor's Course**. Candidates receive all formal qualification training at one of the fleet diving units (FDU). A combat diving supervisor and a combat diver will normally be tasked to assist the FDU staff with course administration and with conducting and maintaining the relevant combat diver performance objectives. Individual combat diver training must include conditioning and techniques that expose candidates to the conditions and stress they will likely encounter in the execution of tasks. The aim is to help them adapt physically and mentally, gaining confidence and strength, while making diving skills second nature.

22. **Maintaining Combat Diving Currency and Proficiency**. B-GG-380-000/FP-002 *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* details the required standard for diver currency and proficiency in the CF. Maintenance of currency and proficiency is the responsibility of the chain of command. Combat divers must be given every opportunity to maintain the standards outlined in B-GG-380-000/FP-002. Operational tempo, career courses, posting assignments, and temporary medical category may prevent a combat diver from maintaining currency. In such situations, in accordance with the procedures in B-GG-380-000/FP-002, waivers for the requirement to rescind the

qualification will be requested to the OPI for army diving, through the OIC of army diving.

23. **Unit Dive Team Training**. The skill sets required to be a combat diver require a high level of proficiency to be maintained. As such, every opportunity must be exploited to allow combat divers to train as a team. Unit dive team training must be integrated into the training calendar and should include combined all-arms training to develop interoperability.

24. **Collective Combat Diver Training Exercises**. Regularly scheduled collective training of LFC combat diving teams will standardize and develop combat diving techniques and procedures and identify evolving equipment requirements.

25. **Training with Foreign Dive Teams**. Training and participating in exercises with divers from foreign armies will assist in the development and evolution of CF combat diving. In addition, it fosters interoperability with potential allies and coalition forces. Units should establish and maintain a relationship with potential Small Unit Exchange (SUE) participants within their formation contacts. Requests to use foreign dive equipment must be staffed through OIC of army diving.

COMBAT DIVING ADMINISTRATION, EQUIPMENT, AND STORES

26. **Administration**. Administrative procedures for combat diving are detailed in B-GG–380–000/FP-002*, Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus*. Annex A outlines additional references relevant to combat divers.

27. **Unit Dive Stores Facility**. The facility provided for dive stores within unit lines should offer adequate space and security. In addition, it should offer the following:

a. Section stores area—for stores and equipment not on personal charge and accessible only to the storeman.

b. Divers' storage area—for storage of diving kit on personal charge and drying and repair of wet suits.

c. Wash and shower area—for cleaning diving equipment and suits and for showering. This may be available in other areas of the unit lines.

d. Bottle filling station—for installation of air cascade system, bottle filling, and storage. Requirements for air purity dictate that bottle filling stations be located away from sources of possible air pollutants such as engine exhaust.

e. Adequate ventilation and heating.

28. **Unit Held Equipment and Stores**. A record of the current ECL and a Material in Use Status Report (MIUSR) is maintained by the unit's quarter master. The appointed unit dive storeman and diving officer are responsible for the maintenance and verification of the ECL and MIUSR.

29. **Maintenance Procedures**. The dive storeman or other qualified personnel may conduct first line maintenance. FDU personnel will conduct second line maintenance of diving equipment. B-GG–380–000/FP-002, *Canadian Forces Diving Manual, Volume 2, Compressed Air Breathing Apparatus* and the relevant CFTO, detail the procedures and responsibility for maintenance procedures of diving equipment.

30. **Personal Issued Dive Equipment**. Qualified and current combat divers will be issued personal equipment in accordance with the current scale of issue. The member is responsible to maintain, repair own dive equipment, and report any losses.

31. **Deployment of Diving Equipment**. In support of operations and training, it may be required to deploy diving equipment and stores by road, rail, air, or sea. Liaison with the relevant agency, or section, to advise them of the nature of the equipment, and for the dive equipment to be prepared in accordance with the current regulations, must be conducted.

GLOSSARY OF COMMON DIVING TERMS

Term	Definition
Ambient Pressure	The external pressure to which the diver is subjected underwater or in a decompression chamber.
Ascent Rate	A specific rate of travel that the diver must maintain up to and between decompression stops. The ascent rate is 60 plus or minus 10 fsw/min.
Anoxia	A condition caused by complete lack of oxygen.
Attendant (Tender)	A competent person on the surface who acts as a communication link between the diver and the diving supervisor. This person monitors the length of the umbilical or lifeline paid out to the diver in the water and the diver's actions during the dive. Also called a tender.
Attended Diving	Diving in any equipment wearing a lifeline (or umbilical designed to also serve as a lifeline).
Bends	Popular name for decompression sickness.
Buddy Line	A short piece of cord used to secure buddy pairs of divers to one another. Usually between 2 and 6 m in length; secured to both divers' life vests or harnesses.

Term	Definition
Bottom Time	The total time elapsed from when the diver leaves the surface to the time (next whole minute) that the diver begins to ascend, measured in minutes.
CABA	Compressed Air Breathing Apparatus.
Combat Diving	A swimming or diving activity carried out by combat divers in a tactical setting using an underwater breathing apparatus.
Combat Swimming	A tactical operation in which swimmers do not use breathing apparatus.
Descent Rate	The maximum rate of travel allowed in descending to the bottom (60 fsw/min maximum).
Decompression	The procedure whereby a diver is slowly brought back from ambient pressure to surface pressure using precalculated procedures to allow gas to diffuse from the body tissue safely in order to avoid decompression sickness. The procedure can be carried out in the water or in a recompression chamber.
Decompression Sickness	A term used to describe the physiological symptoms associated with problematic decompression from a dive. May be caused by failure to follow proper procedures (e.g., skipping required stops during ascent) but may even occur if procedures are followed. Symptoms range from mild joint pain to complete parasthesia.

Term	Definition
Depth	The maximum depth attained, measured in feet sea water (FSW) or metres sea water(MSW).
Diver	Any person who is exposed to an environment greater than atmospheric pressure.
Diving Manual	Comprehensive information and instructions to guide all diving operations and ensure they are carried out safely and competently.
Diving Officer	The officer responsible to the CO for the proficiency of diving personnel, the organizing and preparing of all diving operations, scheduling of exercises, training of personnel to maintain proficiency and qualification, maintenance of diving records, and scheduling the maintenance of diving equipment in accordance with current technical institutions.
Diving Supervisor	A person who is competent and qualified to be in charge of a specific diving operation.
Duration of Dive	The time interval between the time the diver leaves the surface and the time the diver returns to the surface.
Float Diving	Diving in CABA wearing a lifeline secured to a float of sufficient buoyancy to support the divers in their heaviest conditions.

Term	Definition
Free Flow	Free flow is the continuous releasing of compressed air through the second stage of the regulator.
Free Swimming in Pairs	**(With buddy line)** Submerged combat divers operating in pairs, unmarked, unattended, but attached to each other with a buddy line.
Free Swimming in Pairs	**(Without buddy line)** Submerged combat divers operating in pairs, unmarked, unattended, and not attached to each other. Divers must remain in visual contact with one another.
Grid Search	A type of search that is worked on a rectilinear basis. It involves the laying of standing jackstays to form the side of a rectangle and a moveable cross connecting the jackstays for conducting the search.
Hyperbaric Chamber	A pressure vessel, rated for human occupancy, in which the pressure may be maintained at a value greater than atmospheric pressure.
Jackstay	A rope or wire laid on the seabed to guide divers in an underwater search.
Lifeline	A rope, hose, communications cable, or any combination of cable that is suitable and strong enough to recover and lift a diver from the water.
Lifeline Search	A search normally conducted off jetties or piers to locate objects within a

Term	Definition
	limited distance.
Repetitive Dive	Any dive that takes place within 12 hours of a previous dive.
Repetitive Group	A letter given in the CF Diving Decompression Tables which relates directly to the amount of residual nitrogen in a divers body immediately on surfacing from a dive.
Residual Nitrogen	Nitrogen in excess of normal conditions that is still dissolved in a diver's tissues after the surface has been reached.
Snag Line Search	A search normally conducted when the seabed is reasonably flat, clear of obstructions, and the object to be found protrudes a good distance from the seabed.
Standby Diver	A qualified diver, ready equipped and capable of rendering direct assistance to a diver in the water.
Standby Regulator	A CABA regulator equipped with one first stage and two second stages.
SCUBA	Self-Contained Underwater Breathing Apparatus (USN Term).
Surface Interval	The time that the diver has spent on the surface following a dive, beginning as soon as the diver surfaces and ending as soon as the diver leaves the surface for the next dive.
Tender	Popular name for an attendant.

Term	**Definition**
Umbilical	A connecting link between the surface and a diver. It can contain life support gas, communication lines, hot water, power supply cables, and a strength member.
Unqualified Attendant	A person who is not qualified as a diver but is fully conversant with the use of diving signals and the use of a lifeline.

ORDERS AND REFERENCE PUBLICATIONS

DIVING SAFETY AND PROCEDURES

B-GG-380-000/FP-001	*CF Diving Manual Volume 1—Diving History, Physics And Physiology*
B-GG-380-000/FP-002	*CF Diving Manual Volume 2—Compressed Air Breathing Apparatus*
B-GG-380-000/FP-003	*CF Diving Manual Volume 3—Surface Supplied Breathing Apparatus*
B-GG-380-000/FP-005	*CF Diving Manual Volume —Hyperbaric Chamber Operations*
B-GG-380-000/FP-006	*CF Diving Manual Volume —Diving Supervisor's Handbook*
B-GG-380-000/FP-007	*Manuel de Plongée dans les Forces Canadiennes Volume 7—Aide-Mémoire du Superviseur de Plongée*

DIVING ADMINISTRATION AND POLICY

CFAO 43-2	"CF Diving Organisation, Responsibilities and Administrative Instructions"
CFAO 34-30	"CF Medical Standards"
CFAO 50-4	"Military Swimming Standard—Annex A"
CFAO 50-10	"CF Sport and Recreational Diving"

CFAO 205-25	"Annex F—Diving Allowance"
CFAO 205-25	"Annex G—Casual Diving Allowance"
CFMO 2707	"Divers"
A-PD-055-003/PQ-001	*OSS AFEP, Combat Diver*
A-PD-055-003/PQ-001	*OSS AHNX, Combat Diving Supervisor*
A-PD-055-003/PQ-001	*OSS ADUV, Combat Diving Officer*

OPERATIONAL AND TRAINING SAFETY AND PROCEDURES

B-GL-381-001/TS-000	*Operational Training, Training Safety*
B-GL-361-001/FP-001	*Land Force Engineer Operations*
B-GL-361-003/FP-001	*Engineer Field Manual, Basic Field Engineering*
B-GL-361-004/FP-001	*Engineer Field Manual, Rigging*
B-GL-361-005/FP-001	*Engineer Field Manual, Obstacles*
B-GL-361-006/FP-001	*Engineer Field Manual, Field Protection*
B-GL-361-008/FP-001	*Engineer Field Manual, Demolitions, Part 1, All Arms*
B-GL-361-008/FP-003	*Engineer Field Manual, Demolitions, Part 2, Engineers*
B-GL-361-009/FP-001	*Engineer Field Manual, Mines and Booby Traps, All Arms*

B-GL-361-009/FP-003	*Engineer Field Manual, Mines and Booby Traps, Engineers*
B-GL-361-010/FP-001	*Engineer Field Manual, Gap Crossing*

NATO

ADivP – 1	*Allied Guide to Diving Operations*
ADivP – 2	*Allied Guide to Diving Medical Disorders*

EQUIPMENT

C-03-005-033/AA-000	*Compressed Air Systems Part 17 Section 9*
C-27-834-000/NY-002	*HP Hoses*
C-87-010-101/MS-003	*Operating and Maintenance Manual Diver's HP Air Compressor* NSN 4310-21-869-3745 (gasoline driven) NSN 4310-21-869-3746 (Electric-Motor Driven)
C-87-010-011/MS-001	*Care, Inspection and Testing of Aluminium Diving Cylinders*
C-87-011-000/TB-001	*Divers Breathing Air Compressor Lubricating Oils*
C-87-011-004/MS-000	*Respiratory Devices*
C-87-020-001/NG-001	*Special Test Instructions Divers' Breathing Air Analysis*

D-87-003-000/SG-001	*Canadian Forces Standard Purity of Compressed Breathing Air and Gases for Divers*
C-87-161-000/NY-Z01	*Diver Control Communications System*
C-87-167-000/MS-001	*Operation and Maintenance Instructions Hydraulic Divers Tools*
C87-167-000/NY-001	*Divers Tools Hydraulic System*
C87-167-000/NY-Z01	*Divers Tools Hydraulic System*
C-87-197-000/NY-Z01	*Ramset 200H D*
C-87-210-000/NY-003	*Divers Miscellaneous Equipment Group (Hydraulic Hammer SK 58)*
C-87-210-000/NY-006	*Divers Miscellaneous Equipment Group (Hydraulic Chipping Hammer)*
C-87-210-000/NY-007	*Divers Miscellaneous Equipment Group (Chain Saw)*
C-87-210-000/NY-008	*Divers Miscellaneous Equipment Group (Inflatable Lifting Bags)*
C-87-210-000/NY-009	Divers Miscellaneous Equipment Group (Stanley Cut-Off wheel)
C-87-210-000/NY-012	*Divers Miscellaneous Equipment Group (Hydraulic Grinder)*
C-87-210-000/NY-013	*Divers Miscellaneous Equipment Group (Impact Wrenches)*
C-87-210-000/NY-014	*Divers Miscellaneous Equipment Group (Rebar Cutter)*

C-87-210-000/NY-015	*Divers Miscellaneous Equipment Group (Wire Rope Cutter)*
C-87-210-000/NY-021	*Divers Miscellaneous Equipment Group (Thermal Arc Cutting Equipment)*
C-87-210-000/NY-Z21	*Divers Miscellaneous Equipment Group (Thermal Arc Cutting Equipment)*
C-87-210-000/NY-023	*Divers Miscellaneous Equipment Group (ARCAIR Underwater Cutting and Welding Torch)*
C-87-210-000/NY-Z23	*Divers Miscellaneous Equipment Group (ARCAIR Underwater Cutting and Welding Torch)*
C-87-256-000/MS-001	*SEATEC Buoyancy Compensator* NSN 4220-21-892-4996 NSN 4220-21-892-4997
C-87-273-000/MF-001	*AGA Mk II Diving Mask* NSN 4220-21-903-1913
C-87-273-000/NY-001	*Divers' Mask*
C-87-273-000/NY-Z01	*Divers' Mask*
C-87-285-000/MF-001	*Divers' SE-2/ARCTIC Regulator* NSN 4220-01-393-0750
C-87-285-000/NY-001	*Regulator, Air Pressure, Demand (Divers' ARCTIC SE-2/SE3 Regulator)*
C-87-285-000/NY-Z01	*Regulator, Air Pressure, Demand (Divers' ARCTIC SE-2/SE3 Regulator)*
C-87-298-000/NY-001	*Aluminium Diving Air Cylinders*
C-94-010-003/MG-000	*Compressed Gas Cylinders*

ANNEX A
COMBAT DIVING TASK ESTIMATE—AIDE-MÉMOIRE

Factor	Considerations	Deductions
Type of Task	Support to Gap Crossing	Obstacle breach
	Crossing/Landing Site Recce	Obstacle emplacement
	Battlefield Area Clearance	Search, Demolitions
	Infrastructure Inspection	Recovery and Lift
	Demolition Recce	Demolitions, tools to attach
	Safety Standby	Confined spaces
Water	Inland/Coastal	Navigation hazards
	Depth	Visibility
	Current	Temperature
	Tides	Contamination
	Bottom	Inlets/Outlets
	Banks	Structures (dams, docks, piers)
Ground	Terrain Feature	Concealment Approaches to water (banks, routes)
	Road type	Urban areas

Factor	Considerations	Deductions
	Approaches	Local Population
	Boat Launching and Recovery	Proximity, availability
	Landing Zones	Pickup and drop-off points
Friendly Forces	Support	Protection and Security
	Fire Plan	Suppressive fire, Obscuration (smoke)
	Passwords	Observation and listening posts
Enemy	Threat	Location
	Proximity to task site	Capability
	Surveillance	Strength
Dive Team	Size	Weapons
	Capability	Special equipment (NVGs, GPS)
Time and Space	Distance to task site by ground	Time to task site
	Insertion Method (if applicable)	Outside to unit assets, Other unit assets

Factor	Considerations	Deductions
	Extraction Method	Outside to unit, warning or assistance from friendly forces
	Routes	Weather conditions
	Rehearsal and preparation time	Sub-surface recce, on-site rehearsal, or in harbour; RV with dive stores if required
	Travel Time	
	Task Execution Time	
	Movement Restrictions (time, terrain and unit boundaries)	
	Dive Plan	
	Surface Interval	
Service Support	Rations	Water
	Fuel	Ammunition
	Replenishment	Explosives
	Batteries	Medical
	Medical support	Decompression
	Casualty Evacuation (CASEVAC)	Procedures, contacts, LZ

Factor	Considerations	Deductions
Command and Signals	Communications method	Normal or additional communications required
	Through water communications	
	Emergency signals	
	Codewords and nicknames	
	Diver recall method	
	Night recognition signals	
	Phone numbers and call-signs	

ANNEX B
ESTIMATED DURATION OF COMBAT DIVING TASKS

Ser	Task	Number of Divers (Note 1)	Duration (Hrs) (Note 2)	
			Good Visibility (Day)	Poor Visibility (Night)
1	Water-crossing recce—Detailed gap profile both banks. For each 50 m crossing distance. (Note 3)	4	2.5	4
2	Landing-site recce—far bank only 100 m wide	6	2	3
3	Bottom survey (50 m x 50 m)	8	4	6
4	Recce point obstacle	4	2	3
5	Recce linear obstacle (100 m)	6	2	4
6	Breach a safe lane with explosive line charges 9 m wide x 10 m deep (Notes 4 & 5)	8	1.5	3
7	Explosive breach of point obstacle (Note 5)	6	1	2
8	Clearance of debris using explosive cutting charges	6	1.5	3
9	Clearance of debris non-explosively	8	2	4

Ser	Task	Number of Divers (Note 1)	Duration (Hrs) (Note 2)	
			Good Visibility (Day)	Poor Visibility (Night)
10	Extend tactical minefield into water (per 10 mines)	8	1	2
11	Nuisance mining (per 10 mines)	4	1.5	3
12	Area clearance (30 m x 60 m) Survey only	6	2 hrs	Note 6
13	Munitions or mine disposal—destroy in place (per 4 pieces)	4	1	Note 6
14	Buoyancy assisted winch recovery of AFV	6	4	6
15	Winch recovery of AFV	6	2	3
16	Buoyancy assisted recovery of MR pontoon (not including patching)	6	3	6
17	Patch 100 cm^2 hole in MR pontoon	6	2	4
18	Bore hole pattern in concrete (4 holes x 500 mm deep)	6	3	5
19	Lifeline search 30 m x 60 m	4	1.5	3
20	Circle search 30 m radius from shot	4	1.5	3

Ser	Task	Number of Divers (Note 1)	Duration (Hrs) (Note 2)	
			Good Visibility (Day)	Poor Visibility (Night)
21	Towed diver search 50 m x 250 m	6	1	Note 7
22	Snag line search 50 m x 100 m	6	3	6
23	Grid search 50 m x 100 m	8	4	6
24	Fast-water searches 50 m x 25 m (Note 8)	8	2	Note 8
25	Recover person or equipment (< 200 kg)	4	1	1.5
26	Recover equipment (> 200 kg)	6	1.5	3
27	Infrastructure inspection	6	2	4
28	Emplace concrete form 3 m x 1.5 m x 1.5 m	8	2	3

NOTES

1. The number of divers for each task assumes one is the diving supervisor and one is the stand-by diver. A group of six divers is the optimal number of divers for most tasks; this number allows for two pairs of working divers, a standby, and a diving supervisor. During all training dives, exercises, and when it does not detract from the operational security, a diving supervisor, standby diver, and a tender will be on the surface in a safety boat monitoring the dive. In addition, another supervisor may be leading the task from above or below the surface. When conducting tactical operations, the smallest element of divers should be four. For example: two divers gather recce details and two provide security. However, some tasks may be best conducted with only two divers.

2. Task duration time is for action on the objective or task site and assumes that the team is worked-up and proficient. Duration times do not include travel time. Increasing the number of divers may not necessarily shorten the task duration.

3. When conducting a recce of the enemy side of a water obstacle, details will only be gathered, unless it is required to go further inland, 30 m beyond the waterline.

4. When breaching obstacles, divers will only breach enough to allow the assault echelon a foothold on the enemy bank (this may require assaulting troops to dismount in water up to 0.75 m deep). It is assumed that all obstacles are reinforced with mines. Therefore, a pattern of line charges will be placed in such a manner to clear obstacles and detonate mines.

5. Precise recce details of obstacles and targets will expedite the speed of this task. Surface swimmers may be used to float charges closer to shore, increase the depth of the breach, and then initiate the demolition.

NOTES

6. Conducting the tasks in serials 12 and 13 at night or during poor visibility conditions, place the divers in greater risk and will not ensure a proper clearance and disposal has been conducted.

7. This search method is not recommended during night or in poor visibility conditions.

8. This task will generally require rigging a cableway across a river. The time indicated does not include the construction of the cableway. This method is not recommended during night or in low visibility conditions.

DIVING OPERATIONS ORDERS FORMAT

1. Considerations when planning combat diving operations and tasks:

a. All divers and support personnel should attend the orders group.

b. The dive briefing and supervisor's check must be separate from the mission orders.

c. The commander who issues the orders may be a member of the team conducting the mission; therefore he or she cannot supervise the dive.

d. The pre-dive brief and supervisor check focuses on diving safety aspects of the task; therefore it must be conducted as close as possible to the commencement of the actual dive.

e. Extensive battle procedure increase the probability of success.

f. Regrouping of combat divers and their equipment must be anticipated.

2. The standard orders format is applied to diving operations and tasks. The following details should be outlined in the orders:

SAMPLE DIVE ORDERS

3. Situation

a. **Enemy**:

(1) Effect on entry and exit;

(2) Obstacles on crossing site; and

(3) Anti-diver capabilities.

b. **Friendly**:

(1) Availability of divers;

(2) Protection and security; and

(3) Fire plan.

c. **Ground**: Characteristics of entry and exit points, shoreline.

d. **Water**:

(1) tides;

(2) depth;

(3) current;

(4) visibility;

(5) bottom;

(6) charts;

(7) temperature;

(8) contamination;

(9) ice; and

(10) structural hazards.

e. **Meteorological**:

(1) wind and sea state;

(2) illumination; and

(3) temperature.

4. **Mission**:

5. **Execution**:

a. **Concept of Operations**. Commander's intent.

b. **Coordinating Instructions**:

(1) actions on dive incident;

(2) regrouping of divers;

(3) dive safety;

(4) dive plan;

(5) concurrent activity;

(6) rehearsals;

(7) insertion and extraction;

(8) action on the objective; and

(9) passage of lines.

6. **Service and Support**:

   a. transport;

   b. equipment (air, O2, life support);

   c. recompression chamber;

   d. medical support;

   e. evacuation plan;

   f. weapons and ammunition;

   g. explosives and accessories; and

   h. replenishment.

7. **Command and Signals**:

   a. dive signals (surface, sub-surface);

   b. communications (surface, sub-surface);

   c. dive supervisor during task (surface, sub-surface); and

   d. recognition signals.

DIVER SUPERVISOR'S DIVE BRIEF

8. The content of the dive briefing is outlined in B-GG-380-000/FP-006 *Diving Supervisor's Handbook*. This briefing deals with the specifics of the diving aspects of the task (for example, the dive plan and diving emergency procedures). The tactical and operational situation will determine when and where the dive briefing will be conducted; however it should be in a secure location as close to the start of the dive as feasible.

9. It is highly unlikely that combat divers will choose to enter the water while in direct contact with the enemy. Therefore, even in an

operational situation the diving supervisor, or team leader, should conduct a supervisor's check prior to the divers entering the water. The intent of this check is to ensure that essential life support systems are functioning on an individual diver's apparatus. In the event that a supervisor is unable to conduct this check, divers should use the buddy system and check each other's equipment. A likely scenario for this situation would be when the approach to or from an objective involves a transition from land to water and donning breathing apparatus.

ANNEX C
COMPARISON OF SEA-STATE SCALES AND WEATHER FORECASTS

SEA STATE (US NAVY)		ENVIRONMENT CANADA MARINE WEATHER FORECAST	BEAUFORT WIND SCALE		WIND SPEED (KNOTS)
0	Sea like a mirror	LIGHT	0	Calm	0-1
	Ripples without crests		1	Light Air	1-3
1	Small wavelets		2	Light breeze	4-6
			3	Gentle breeze	7-10
2	Large wavelets		4	Moderate breeze	11-16
3	Small waves	MODERATE WINDS	5	Fresh breeze	17-21
4	Moderate waves				
5	Large waves form	STRONG WINDS SMALL CRAFT WARMING	6	Strong breeze	22-27
6	Heaped up sea		7	Near gale	28-33
7	Moderately high waves	GALE WARNING	8	Gale	34-40
8	High waves		9	Severe Gale	41-47
9	Exceptionally high waves	STORM WARNING	10	Storm	48-55
			11	Violent Storm	56-63
			12	Hurricane	64-over