

Theory and Practice of Ice Diving

Description of ice diving methods and techniques, practiced at “The Arctic Circle” Dive Centre The White Sea

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With regards to our colleague instructors Ivan Kronberg, Vadim Shestachenko, Natalia Chervyakova, Mikhail Khrobostov, Konstantin Novikov, and respect to all ice divers, who come to dive with us at “The Arctic Circle” Dive Centre.

This document is the description of ice diving methods and techniques, practiced at “The Arctic Circle” Dive Centre. The methods described here have been developed since 1998, as we have been conducting ice diving at the White Sea, and are still being refined.

This document is not a manual, and we don't assume that the methods we use are perfect, all-purpose, and can be acceptable in any case.

The text can be copied and used in any reasonable way for the benefit of the divers' community.

The authors will be grateful for the reference to the original text source.

We'll be glad to get your feed-back, critical comments, ideas, suggestions and advice on our e-mail booking@dive.ru

Comments and argumentation, why we do it this way, are printed in italics.

1. Dive Site Preparation.

1.1 Choosing a dive site.

If you are going to dive in a familiar place, it can be found with the help of landmarks: onshore ones, or GPS coordinates. If you are to dive in a new place (acting as dive-scouts), it should be chosen in accordance with your goals.

In any case, first of all you should assess the thickness of the ice, to be sure that it's neither too thin (divers and line tenders can move safely), nor too thick (you can cut out an ice hole - "maina"). Usually it is done by punching a hole with a **crowbar** or boring holes in the ice with a special hand tool (**ice-drill/ice-auger**). If there is even the slightest doubt in the ice durability, you should check the ice in a zippered up dry suit. In the place, where it is planned to cut out the "maina", the depth is measured through a drilled hole - either with **an echo sounder or a plummet** - a piece of lead or some other **weight attached to a long line**, used for sounding. When a proper place is found, where both the ice thickness and the depth meet the requirements of the planned dive, it's time to cut out the "**maina**" (to saw a man-made ice hole for diving).

1.2. Sawing a "maina".

Use a snow shovel to clear the place, where the "maina" will be cut out, and the ice around it with a radius of 3-4 meters. Mark the future "maina": an equilateral triangle with a side about one and a half to two meters, or a rectangle with sides about 1m. x 2m.

"Maina" quality criteria:

- It should be big enough to fit all the divers, who dive through it at one and the same time (a pair or a threesome, usually).

- Its edges should be durable, safe and comfortable enough for at least six persons moving around it.

- There should be no cracks, no saw-made defects and other possible traps, where the safety rope can get jammed in.

- It's advisable that the corners of "maina" should have straight or sharp angles, it makes the process of getting out of water more comfortable for the divers, who can come close to the corner, turn back, push the edges with their both elbows, and thus get out of water with the help of line tender.

Triangular or rectangular "mainas" meet all these requirements, while penta- or hexagonal, and rounded ones are not convenient.

Different sets of tools can be used for sawing a maina: **a) chainsaw; b) ice-drill + two-handed saw with one handle removed; c) ice-drill + special ice-saw.**

Chainsaw (option "A") is the fastest sawing tool, but it has a number of restrictions.

1. Normal chainsaws have rather short guide bars, and with thick ice they cannot saw through the whole thickness. Saws with longer guide bars are much more expensive.

2. Chain lubricating oil gets into the ice hole, polluting water and smearing diving gear.

3. Chainsaws deteriorate very quickly, especially in sea water.

That's the factors limiting chainsaw use for maina-making.

A sharpened two-hand saw (option "B") is a handy tool, but if you can get a special ice saw (option "C") - it will be even more convenient. In our opinion, option "C" is the optimal choice combining convenience and cleanliness.

When using a **chainsaw**, there's no need to bore additional holes with an ice-drill. But when using a **two-handed saw**, it is necessary to bore several holes, at least one per each side of the "maina". Working with an **ice-saw**, if ice is not very thick, the direction of the saw-cut can be changed - in a manner of jigsaw sawing. But in case of thick ice, most probably, you will have to bore additional holes.

When sawing the sides of the future "maina", it's very IMPORTANT to make saw-cuts with outward slopes, so that pieces of ice can be easily pulled out of the "maina". A large ice floe in the "maina" should be cut into several parts, depending on the thickness of ice, so that each piece can be pulled out of the "maina".

The practice of pushing pieces of ice floe from the maina under the ice surrounding it is not impeccable. These pieces can float back into the maina at the most unsuitable moment, safety rope may cling to these pieces, a diver can hit them while making an emergency ascent. In case if some of the pieces have been, nevertheless, pushed under the ice, then it is better to make them float far away from the edge of maina, avoid piling up and keep their presence in mind during diving and line-tendering. The smaller the size of such ice floes, the better. In no case should you push under the ice a single ice floe that is big enough to block the entire maina.

Shortly before the end of sawing, or right after that, **climbing ice screws** are secured into the blocks of ice. A rope with loops or knots is attached to the ice screw's handle with a carabiner or knot, and a group of people takes hold of the rope, pulling pieces of ice from the maina onto the ice. Having been pulled out, ice floes should be dragged 2-3 meters aside from the maina. Sometimes it is convenient to pull the ice floes apart to the four (or two) sides of the maina to mark its position. Sometimes, on the contrary, the ice floes are pulled to the one side, so as not to obstruct the passage to the maina. After that, a large strong **landing-net or strainer** (shovel with holes) is used to take small pieces of ice and snow crumbs out of the maina. If the ice is thin, it can be broken up with a straight crowbar and then taken out with a strainer.

If the maina is not being newly sawed, but renewed after some break, it may be enough to use an **axe, straight crowbar, or machete** to break the thin ice, and then take out ice chips and snow with a landing-net or strainer.

Recently, we have developed a way of pulling out large blocks of ice with a snowmobile using a special trapezium-lever, hooking blocks of ice with a rope and a transverse tube, threaded through the previously drilled holes in the block. A detailed description of this device and process will be also provided one day.

1.3. Maina-preparation equipment, noted in Section 1, and requirements to the pieces of it.

1. Ice-drill (ice-auger)
2. Straight crowbar
3. Plummet - a long piece of halyard with a small piece of lead or some other weigh on one end, used for sounding (to measure the depth)
4. Snow shovel
5. Chainsaw, two-handed saw, or special ice-saw
6. Mountain climbing ice screws, 2pcs minimum
7. Metal carabiners, better with threaded clamp, 2 pcs minimum
8. Piece of halyard with loops and knots
9. Large and strong landing-net (dip-net) or strainer (sieve, sifter)
10. Axe, straight crowbar or machete
11. Dry suit to move across thin, dangerous ice.

1.4. When the dives are finished for the day, the maina should be marked and fenced off properly, so that nobody can fall into it accidentally. You can use branches of trees, conifer, boards, coloured marker tape, sawed blocks of ice, set vertically, and other objects.

2. Organization of ice diving. Usage of safety rope.

2.1. Divers and line tenders. In each dive, two teams are involved: a team of divers (or "buddy-team", two persons), and a team of line tenders (preferably two persons per pair of divers).

2.2. Safety rope. Ice diving is performed with the obligatory use of a safety rope, which connects divers with safety persons (line tenders) on the surface. On the surface, the halyard is held by a line tender - a safety person, who should monitor the rope's position, and either release it or pick it up depending on the movement of the divers. Line tenders also maintain communication with divers, transmit signals via the halyard, and, if necessary, help the divers to make an emergency ascent.

The safety rope must be securely fastened to a stationary object on the surface (continue reading for details).

Safety Rope's Functions:

- To show the way back.
- To accelerate the emergency ascent with the help of line tenders.
- To prevent the divers from being carried away from the "maina" by the current.
- To communicate with the buddy.

2.3. Generally accepted "BUDDY SYSTEM" is kept up in ice diving. Ice dives are conducted by a pair of divers who go underwater together as a "buddy-team".

There are two possible variants of performing an ice dive:

A. Each diver is tied to his own safety rope and has his own line tender.

B. Both divers are tied to one safety rope, diver №2 - to the end of the rope, diver №1 - at a 2-3 meters' distance from the end (i.e., from the diver №2). A pair has one line tender on the surface, who should also have an assistant.

IN OUR PRACTICE, OPTION "B" IS PREFERRED.

Advantages and disadvantages of these methods.

Method A. *Dives with separate halyard - two ice divers, two line tenders.*

- Advantages: *both divers are free in their movements and can ascend independently in normal and emergency modes.*
 - Disadvantages: *the divers start to perceive their tenders as their main partners and don't communicate effectively with their underwater buddy, thus switching psychologically to solo diving. When trying to help each other in an emergency ("share air", for example, when a diver needs to breathe from the buddy's back-up regulator), the jerks of the safety rope can make interaction with the buddy difficult or even impossible. Besides, individual safety ropes will slow down the approaching of divers to each other due to the halyards' tension and significant resistance in the water.*

Method B. *A pair of divers is attached to one safety rope.*

- Advantages: *ice divers act in pairs, they don't swim away from each other, their attention is less distracted by the communication with the line tender, thus they can easily help each other in an emergency situation. Diver #2 is free from communication with the tender and can perform some work - photographing, for example.*

- Disadvantages: *the freedom of movement of each diver is restricted due to their connection with each other, and an emergency ascent can be performed only together.*

WE RECOMMEND THE METOD "B", WHEN THE INTERACTION IN THE PAIR OF DIVERS HAPPENS ACCORDING TO THE PRINCIPLES OF PARTNERSHIP, COMMON FOR MOST DIVERS ("BUDDY-SYSTEM").

2.4. Attachment of the safety rope to the diver. The safety rope must be attached to a metal D-ring of a BCD with a climbing carabine (carabiner with a threaded clamp) or tied around the diver's waist (using a "bowline" knot). It's recommended to attach the halyard to the carabine using a "figure-of-eight" knot ("stopper" knot). If divers go under water with one safety rope, the first to be tied up is the Diver #1 (who is closer to the line tender), and the Diver #2 - afterwards (at the end of the rope).

The method of tying the rope around the diver's waist, although less convenient, is still more reliable. If there is even the slightest doubt in the reliability of the metal D-rings of the BCD, you should tie the halyard to the waist.

2.5. Basic rope signals and their meaning. Rope signals are given by jerks (tugs). The strength and amplitude of the jerk should correlate with the length of the rope (i.e. with the distance between the divers and the line tender) - the farther from the "maina", the sharper and with greater amplitude there should be a jerk.

- **One tug** = "OK", both from the surface to the divers, and from under the water to the surface, both the question, and the answer, analogue of the standard "OK"-sign, which requires a mandatory response. Upon receiving one tug from the surface, the diver must ask the same question to the partner, get a clear answer and send the response to the tender with one tug. You should not answer the question "How are you?" immediately, so that the answer is not to block the passage of the second tug, if the given signal consists of more than one tug. *If the line tender does not get a reply within 5 seconds for the signal "OK?" given from the surface, the signal must be repeated again, and once again after 5 seconds check, if necessary. If there is no answer three times in a row, then the line tender acts according to the "Emergency Ascent" procedure, i.e. pulls the diver or pair of divers onto the surface as soon as possible. This means that, when answering the question "OK?", it is necessary to keep within 5 seconds (including buddy interaction time and the answer to the surface).*

- **Two tugs** from the surface to the divers = "Check your Air supply", from the divers back to the surface - "we have checked the air, the supply is sufficient". After receiving two tugs from the surface, the diver should check his/her own air supply (look at the pressure gauge), ask their buddy the same question, get an answer, and send a reply to the tender by a double-jerk (not single one!). *If the diver responds with a single jerk, the tender will be not sure, if the signal has been understood correctly - as one jerk from the surface ("OK?" signal) or as two jerks.*

- **Three tugs** from the surface to the divers = "Ascend", must be confirmed from under the water with one tug "OK". The signal "three tugs" is never given from the divers to the surface. *We completely eliminated the signal "three tugs" from the bottom up from our practice, so that there is a gap between the signals "two tugs" and "four and more tugs".*

The signal "three tugs" is given by the tender from the surface to the divers in case when it is necessary to complete the dive quickly (change of ice situation, weather, other emergency circumstances, or preliminary agreement on giving this signal, for example, after a certain period of time).

- **Repeated jerks (four times and more)** from the divers to the surface = "**Emergency!** Pull us up as quickly as you can!". Upon receipt of this signal, the tender should call for help and pull the diver or a pair of divers onto the surface as soon as possible.

2.6. The main criteria for the quality of line-tendering:

- Signals must pass in both directions without interference and with 100% recognition.
- Rope must not hinder the divers' movement, but also it should not sag, and even more so it should not lie on the bottom, touch any objects or items. The only touch which is acceptable is on a lower edge of the ice hole (such a touch can sometimes be avoided if the divers are directly under the ice, away from the maina).
- In case of an emergency ascent, the rope should meet no obstacles and withstand the load.

3. Line tenders, the order of their actions, and necessary equipment.

3.1. Preparation before the dive. Before ready-to-dive divers approach the maina (in advance or right before the divers come onto the ice), the following equipment should be prepared:

3.1.1. Two or three meters away from the maina a **climbing ice-screw** is secured in the ice or a large frozen block of ice (if in a block of ice, then it must be heavy or frozen into the ice, so that two people can move it by pulling the rope attached to the climbing ice-screw).

3.1.2. A "surface-end" of the safety rope is attached to this climbing ice-screw with a **carabiner or a "bowline" knot**. The **halyard** is shifted from the "surface-end" end to the "diver's-end" to make sure it will not get entangled.

Alternative: the halyard can be attached to any stationary object on ice or on the shore (for example, a tree on the shore). The reliability criterion is the same.

3.1.3. A large **thermos bottle** with hot water should be placed close to the maina.

3.1.4. A sufficient amount of **spare weights** should be available (10-12 kg at the first dive and 4-6 kg at any dive). It is better if these are two (four) pieces of 1 kg and two (four) pieces of 1.7-2 kg.

3.1.5. Line tenders should be equipped with **warm waterproof gauntlets** to hold the rope during the dive.

3.1.6. List and requirements for the equipment used:

1. **Climbing ice screws and carabiners** (already mentioned).
2. **Safety rope.** Nylon or kapron halyard, thickness from 8 to 12 mm, without knots and splices. The length of the halyard is chosen in accordance with the upcoming dive (educational, research, etc.). The maximum acceptable length of the halyard is 40 m. For the training dives, the length is at the discretion of the instructor. For the divers, whose ice diving experience is less than 7 ice dives, the length is 20 m. It is convenient, if the halyard is brightly coloured, for example, every ten meters have its own colour. It may also be convenient if the halyard is put in a tight bag, where a "surface" end of the halyard is taken out through a hole in the bottom of the bag.
3. **Thermos bottle.** Large volume (not less than 2 liters), better metal one. It is convenient, if it is equipped with a tap or a pump.
4. **Gauntlets** for line tenders. Preferably insulated waterproof rubber gloves. It is convenient to have several pairs in case of getting wet and freezing.

3.2. Discussion of the dive plan. **IMPORTANT PRINCIPLE:** line tenders discuss in detail the dive plan with the divers. The tenders should be informed on the planned dive time, where and how the divers will move, how deep they are going to descend, whether they plan to make long stops in one place, the ascent procedure.

3.3. Procedure.

3.3.1. Tenders help divers to put on their gear. **IMPORTANT PRINCIPLE:** the process should be organized so that divers are ready at the same time, and don't have to wait for each other at different stages of readiness (for details, see section 4.2). Tenders must also be prepared for the dive, so that divers do not have to wait for them (the actions described in paragraph 3.1.).

3.3.2. Line tender No.1 helps divers to attach the halyard or checks if it's fastened securely. Since the moment, when divers are ready to enter the water, the tender No.1 takes the halyard, and his/her attention must be completely focused on the safety rope. Then it's the tender No.2, who helps divers to finish their dressing and preparation for the dive.

3.3.3. After the divers go under the water, the tender No.1 keeps stable contact with them. During the first three minutes of a dive, while the divers are going through the check-stop procedure, the line tender should not let them go farther than 2 meters from the maina. At the end of the check-stop, the tender and the divers exchange "OK"-signals, after it the divers can start moving away from the maina.

3.3.4. Halyard should go without kinks and, if possible, without touching anything, straight from the tender's hand to the hand of Diver #1, from the hand of Diver #1 to his/her fastening, then to the fastening of Diver #2. Line tender

controls that the halyard does not constrain the divers' movements and at the same time, that it goes without slack. Every few seconds, the tender pulls the halyard gently to check the slack. The halyard should be held with both hands. The halyard is released by hand-wringing, the tender should not let it slip. In case of receiving a signal from the diver - one or more tugs - the rope must be fixed (held) and not slip in the tender's hands. At least one hand must remain fixative and move with the rope as a spring. Otherwise, if the first jerk of the diver pulls the rope from tender's hands, the halyard will have a slack that can extinguish the following jerks. This can have the most unfortunate consequences, if it is an alarm "Drag me from under the ice as quickly as possible" (4 and more jerks of the halyard). The tender should stand securely, being ready for a strong jerk from under the ice at any second. Also, at any second you need to be prepared to receive an "emergency ascent" signal and act immediately after that.

3.3.5. Once in every 5 minutes, if there is one safety rope for a pair of ice divers, and once in every 3 minutes, if there is a personal safety rope for a diver, the line tender must give an "Are you OK?" rope signal (1 tug from the surface) and must receive a response signal. "Are you OK?" signal is also requested in case, if the line tender is concerned about the actions of divers (long unplanned stillness of the safety rope, convulsive twitching of the halyard, etc.). 20 minutes after the beginning of the dive, the tender gives a "Check the Air" signal (2 tugs from the surface) and must receive an appropriate response. After that, the request "Check the Air" should be repeated every 10 minutes. The strength and amplitude of the tug (jerk) should be adequate to the halyard's length (linear distance between the divers and the "maina"). With a full length of the safety rope - which is 40 meters - the amplitude of the signal should be at least 1 meter.

3.3.6. At the end of the dive, the line tender should pick up the slack of the rope while the divers are approaching the maina (unless another exit procedure has been specified beforehand). Divers surface in the maina and can get out of it onto the ice on their own or with the help of their line tender. In the latter case, the tender helps the divers to come sitting on ice, pulling them out of the water by the handle of the tank or by the BCD. Line tenders help divers to remove and carry out equipment, to take off their dry suit etc.

3.4. The line tender No.2 assists divers with the entry and exit from the water, notes the dive-time, removes ice and snow crumb from the maina and the halyard, helps to cope with halyard entanglement on the surface, warms up the frozen equipment with hot water, if necessary, and provides various other assistance. The tender No.2 should be ready to replace the tender No.1, if necessary (in case of feeling frozen, tired, etc.). The procedure of replacement of the line tender is as follows: tender No.1 asks the divers "Are you OK?" with one tug of the halyard and immediately passes it to tender No.2, so that he accepts the answer. In this case, both tenders will be sure that the divers have been safe and sound at the moment of their replacement. The tender, who has taken the halyard, becomes No.1, and the other one, who has given it, becomes No.2.

3.4.1. **Warming up the equipment.** Frozen items of diving equipment are warmed by pouring hot water from a thermos bottle. You need to be careful not to scald the diver. If a regulator has got frozen in a free-flowing position, close the valve it is connected to, pour hot water into the mouthpiece and the valves of the reg's second stage, and onto its first stage. Then the second stage should be dipped into the water, and after waiting a while, the valve of the tank may be opened again.

3.5. The tender No.2 is constantly close to the maina but does not distract the tender No.1 with extrinsic actions and empty talk. **IMPORTANT PRINCIPLE:** the attention and thoughts of tenders should be focused only on divers and their actions. Only in this case the procedure of line tendering fully meets its objectives.

3.6. IMPORTANT PRINCIPLE: OBLIGATORY discussion between the divers and the tenders after the dive on the quality of their duties' performance (if there was any interference/distraction/interference, too much slack, etc.), explain possible miscomprehension during the dive (delays in the responses to signals, stops, etc.). Only this way we can steadily improve the quality of line tendering.

3.7. There can be a **single line tender** in the following situations:

1. If there is a second person ready to perform all the functions of Tender No.2 at the request of Tender No.1, sent either orally or by radio communication, not later than within 3 minutes after the request.
2. In an exceptional situation, with a high total experience of all participants of the process. For example, if one of the two divers under the ice is an instructor, and the line tender is an employee of the dive centre.

3.8. To act as a line tender a person must be either a diver, who has a permission for ice diving at the "Arctic Circle" Dive Centre, or a properly trained employee of the Dive Centre. The permission to act as a line tender is provided by an instructor of the Dive Centre.

3.9. Emergency procedures for line tenders.

IMPORTANT PRINCIPLE: an indistinct response to the signal should be perceived as NO response!

1. **No response to "OK?" signal.** Repeat the signal after 5 seconds. If there is no answer, repeat the signal after 5 more seconds. If there is no answer within 5 seconds after the third signal - pull the diver(s) up as soon as possible, calling out for help simultaneously. Tender No.2 helps to pull the rope.

2. **The alarm "Repeated jerks 4 times and more"** has been received. Pull the diver(s) up as soon as possible, calling out for help simultaneously. Tender No.2 helps to pull the rope.
3. **Halyard has got entangled** (stuck) under the water, the signals do not pass, it is impossible to pull out the halyard. Send a pair of certified Rescue divers into the water quickly (or divers with similar level of training of other systems). Immediately inform the dive leader, or the most experienced diver. If the dive supervisor (the only instructor, dive master, the most experienced diver) is under water, he should be given a signal to ascend.
4. **The signal "Two tugs" was answered by "One tug"**. Repeat the signal "Two tugs" to be understood properly.
5. **Weird rope signals** come from the divers. Follow the procedure described in paragraph 1.
6. **Halyard has got entangled on the surface**. Untangle it, without letting the divers go further, until you do it (i.e. without releasing the entangled section of the halyard into the water).

4. Ice divers, their equipment and procedures.

4.1. Diving equipment. For ice diving, each diver uses the following equipment:

1. **Dry suit** with a warm undergarment **or a thick wetsuit**, with a helmet, gloves, boots, socks. It is recommended to use a **dry neoprene suit**.
2. **Fins, mask.**
3. **Weight systems:** weight belt, BCD weight pockets, weights on the fastening belts (straps). You can also use additional ways of weights placement: in undergarment pockets under the dry suit, ankle weights, weights attached to the fins. *The issues of weights' distribution and placement are discussed in the Dry Suit training course. It is useful to recollect some principles: 1) since there are lots of weights, it is better not to concentrate the whole weight in/on one object (for example, on the weight belt), but distribute it between the two systems evenly (for example, belt and BCD pockets); 2) at least half of the weights must be quick-release ones; 3) the following problem may often arise, when diving in a dry suit with a lot of insulation: the feet gain positive buoyancy and float upward. Then you should move the centre of gravity down: move part of the weights from the BCD pockets to the belt, into the undergarment pockets, to the ankles.*
4. **Single tanks with V-valves or twin-set tanks** with/without manifold. Steel tanks are preferable. *You need less weights with steel tanks, because their buoyancy is less than that of aluminum ones.*
5. **Two regulators.** Requirements for the regulators:
It is MANDATORY to use two independent regulators. Each one must have a first stage, a second stage, BCD- or Dry suit inflator hoses and a pressure gauge.
 - The regulators must be specially designed for diving in cold water.
 - It is recommended to perform full maintenance of the regulators prior to the ice diving series (right before the trip).
 - When using a dry suit, the inflator hoses of the BCD and the Dry suit must be attached to the different first stages.

Variants of "Two Regulators" configurations.

It is possible to use two configurations of regulators: let's call them **classic and technical**. We recommend the technical configuration.

Classic configuration - *we call it so, because it is very similar to the traditional recreational configuration that most divers use in the world, diving with one regulator.* Regulator No.1 consists of a first stage, a second stage on a standard hose, a BCD or Dry suit inflation hose, and a pressure gauge. Regulator No.2 is functionally similar to an octopus, and consists of a first stage, a second stage on a longer (1m) hose, a pressure gauge and a BCD or Dry suit inflation hose. In this case, the reserve second stage should be fixed by a reliable fixator in the area of the octopus attachment (triangular zone, from the chin to the lower border of the chest). With this configuration, if it's necessary to share air with the buddy, the diver gives his partner an octopus, as it is done in the standard OWD exercise.

Technical configuration - *we use this name, since this configuration came into our practice of ice diving from cave and decompression dives.* The primary second stage in this case is placed on an long hose (1-2 meters), and the back-up one - on a standard length hose (80cm) is placed on a rubber strap around the neck. In case of need to share air with the buddy, the diver gives his/her primary second stage to the buddy (which is specially on a long hose), and switches to his/her back-up second stage.

6. **BCD** - buoyancy compensator device or stab-jacket. It's preferable to use BCD with an integrated weight system, or at least with strong, securely closed pockets.
7. **Diving computer** or a set of water resistant watch+ depth gauge. In the latter case, the use of tables is mandatory.
8. **Diver's knife.** It's convenient to use small knives attached to the hose of the pressure gauge or to the BCD (inflator or pocket). Traditional attachment of the knife to the leg - on the inner or outer side of the shin, is

inconvenient, since the safety rope in your hand can make it very inconvenient to take the knife out of and put it back into the sheath on the shin.

4.2. Getting dressed. The procedure of getting dressed, going out to the ice, safety rope attachment, etc. should be well thought out, so as neither to freeze, nor to sweat before diving. Both of these problems reduce the comfort and quality of the dive significantly. **IMPORTANT PRINCIPLE:** arrange dressing up so that divers are ready to go into the water at the same time. **PLEASE, DEVOTE MUCH ATTENTION TO THIS MATTER.**

The procedure of getting dressed and attached to the safety rope depends on the weather, the number of dives, and the dive site arrangement: what is there on the ice, where it is, how far the maina is, etc.

***Option 1:** divers dressed up in dry suits come to the maina, put on their weight belts, attach the safety rope, put on their fins, after that they sit down and put on their SCUBA gear, sitting on the edge of the maina, and finish preparation for the dive. **Option 2:** divers get dressed in the warm hut, the safety rope is also brought to that hut and is attached to the divers there, they put on their SCUBA gear in the hut as well and go out to the maina being completely ready for the dive.*

Pay attention to the order of putting on gloves. We recommend that the diving gloves should be put on in advance, after the dry suit and hood and before putting on BCD, fins, mask and devices (gadgets). If in spite of this the diver puts on the gloves last, he/she should wear mittens till that moment to keep their hands warm all the time.

4.3. How to prevent equipment from freezing. *The air temperature contributes to freezing of the equipment much more, than the water temperature (although we must note the difference between fresh water ice diving, where the water temperature is 0/+4°C, and marine ice diving, where the water temperature is 0/-2°C). Therefore, the lower the air temperature, the more carefully you should observe the following precautions.*

4.3.1. Try not to leave any water inside the equipment. This is especially true of regulators (the first stage of those models where it is not isolated, and the second stage of all models), and the BCD inflator. It is better that the equipment is absolutely dry before ice diving. If the equipment is not completely dry (for example, several dives are performed in a row), you need to shake out the drops from the regulators and the inflator carefully before taking the scuba out to air with negative temperature.

When the regulator is being rinsed, pay special attention to make sure that water does not penetrate the first stage and into the low-pressure hose, connecting the first and the second stages. Do not press the bypass button, when the regulator is being rinsed. Pour water out of the BCD thoroughly. If there is no warm room near the dive site, it is better to have all equipment absolutely dry (including the dry suit, BCD, weight belt), and stock up a large amount of hot water in a thermos bottle(s). In such conditions, it's better not to plan repeated dives (the equipment gets frozen after the first dive, and it's not easy and not safe to use it for the second dive).

4.3.2. Try to arrange everything in such a way that the equipment is in the air with a negative temperature for a minimum time. If possible, take it out of the warm room at the very last moment.

4.3.3. Open the valve of the tank and check the scuba gear in advance in a warm room. Do not check the regulator by breathing out of it or by pressing the bypass button in the cold air. *If a long time passes between the check of the equipment in a warm place and the dive, the scuba gear should be moved with the valves closed or taken apart and reassembled at the dive site. In this case it's better to open the valve at the moment when the diver is already in the maina, and the second stages of the regulators are under the water.*

4.3.4. After the parts of the equipment have been submerged, they should no longer be lifted into the air (especially the second stages of the regulators and BCD inflator). Do not breathe from the second stage on the surface - it is better to take it into your mouth and start breathing with your face dipped into the water.

4.3.5. Warming up the scuba gear. Frozen items of the diving equipment are warmed up by pouring hot water from a thermos bottle. You need to be careful not to scald the diver. If a regulator has got frozen in a free-flowing position, close the valve it is connected to, pour hot water into the mouthpiece and the valves of the reg's second stage, and onto its first stage. Then the second stage should be dipped into the water, and after waiting a while, the valve of the tank may be opened again.

4.4. Plunge into the water and submersion

4.4.1. The most convenient way to enter the maina is from the sitting position, sliding down with a turn. If the maina is big enough, it is possible to use a giant stride entry. In this case, it is important to check that the halyard won't pull your buddy into the maina.

4.4.2. When both divers are in the maina and ready to submerge, they start to descend. At this moment, the diver's right hand keeps the primary second stage, without taking it out from under the water, and the left hand operates with the inflation valve of the dry suit, the exhaust valve of the dry suit should be open. With the head under the water, the diver puts the second stage of the regulator into his/her mouth and starts breathing from it. It's absolutely normal, if your buoyancy is slightly positive during the first seconds of the dive. It is most convenient to grab the edge of the maina, and push yourself under the ice, not moving away from the maina's edge further than 1 meter. Using a slightly positive buoyancy, press the top of your head up against the ice, and perform the check-stop procedure.

4.5. Check-stop is a mandatory procedure for ice diving.

4.5.1. Check-stop objectives:

- Wait for your face to adapt to ice-cold water.
- Catch your breath.
- Wait until the regulators' and other equipment's temperature levels with the water temperature to be fully operational. While the regulators are cold, the probability of their freezing is great. Therefore, during the check-stop, you should try to breathe as slowly as possible.
- Wait until excessive air comes out of the equipment, and calmly adjust your buoyancy. If a diver is trying to achieve neutral buoyancy in the maina, most often there is still a lot of air inside the suit, vest, and simply in uncompressed equipment and as a result the diver becomes overloaded. This especially applies to the first dives.
- Check the operation of both regulators.
- Check the valves operation of your BCD and dry suit.
- Place yourself properly in the water, regarding the position of your buddy, the "maina" and safety rope, before the dive.

4.5.2. Actions of divers:

- Divers should be facing each other, with the tops of their heads pressed to the ice, at a distance of no more than a meter from the edge of the maina.
- Divers should wait for a while quietly, trying to breathe slowly.
- Without hurrying, dump the air out of your dry suit, compressing it gradually.
- Both divers, in turn (one is performing, the other is observing, keeping constant eye contact and being ready to help), check the regulators: take three deep breaths from the primary regulator while looking at pressure gauges. Breathing should be comfortable, and the needle of the pressure gauge should not make any appreciable fluctuations. It is advisable to look at both pressure gauges simultaneously to completely eliminate the error possibility while choosing the proper one. Having checked the primary, the diver switches to the back-up one, and the procedure is repeated. At the same time, the reliability of the spare regulator's attachment is also checked, and how easy it can be released from the attachment. After that, the regulators should be returned to their original position (primary one - in the mouth, back-up one - in its place). If there is any suspicion that one of the regulators is not working properly, then it is necessary to interrupt the dive, get out onto the ice and test the equipment thoroughly.
- If by the end of the check-stop, after a calm adjustment of buoyancy, it is still necessary to add some weights, the diver should surface in the maina and take the weights from the line tender. It is better to discuss such a probability in advance (to inform the tender and leave some places for additional weights in the BCD pockets) - then you can take the weights without even going out of the water. REMINDER: once the equipment has been dipped into the water, it's better not to take it back to the cold air, if possible.
- Divers place themselves in the water, regarding the position of the "maina" and the direction of their motion: Diver No.1 takes the halyard with his right hand (if with the left one, then all further recommendations should be mirrored), turns with his/her right side to the maina; Diver No.2 takes the halyard in his/her right hand, turns to the diver № 1 right side turns with his/her right side to the Diver No.1.
- As soon as Diver No.1 is ready for the descent, he/she gives the line tender an "OK" signal. After the tender's reply, the divers start to descend.

The purpose of the regulators' check at the check-stop: we recommend to check both of the two regulators at the beginning of each dive. When diving with one regulator, you start to breathe from it at the very first minute of the dive, and thus make sure that the valve is open and the first stage is working. If you dive with two regulators, they are mounted onto different valves and have two different first stages. In this case, using the primary regulator, you do not check if the back-up regulator's valve is open and if it is working properly. If you or your buddy need it in case of emergency, and it turns out that the second valve is closed or not fully open, or the regulator is not working - it will be distressing. In addition, it is merely very useful to make sure that all items of your breathing equipment are in good condition before you swim away under the ice in very cold water. The procedure of the regulators' check at the beginning of the dive is performed at a shallow depth, and can be carried out right in the maina, under the surface of water. The main thing is that the conditions are comfortable, simple and allow you to get back to the surface in case of any emergency.

4.6. Descent, bottom part of the dive, ascent.

4.6.1. Divers descend slowly using buoyancy control system, without hanging on the safety rope.

4.6.2. Moving under the water, divers move along the radii (from the maina and back) or in circle. Diver No.1 is responsible for the part of the rope from himself/herself to the line tender, Diver No.2 - for the part of the rope from himself/herself to tNo.1. Divers keep an eye on the position of the safety rope, each other, and other underwater objects. Divers avoid variants of placement, which lead to an uncomfortable position of the halyard and the possibility

of entanglement. You can call it: thinking all the time about where the halyard and the buddy is, and where they are moving (= line and buddy awareness).

4.6.3. Diver No.1 communicates with the line tender, exchanging rope signals. It is convenient to hold the halyard in the right (or left) hand bent at the elbow, and keeping that hand with the halyard away. The hand should be relaxed so that the line tender's rope signal does not pull the diver up. The response to the signal is better to be given in two or three seconds (not at the same time) to be able to differentiate the signal between "one tug", "two tugs" or "three tugs".

4.6.4. Divers move in parallel, trying not to overtake one another. They always keep their buddy in mind. Divers move slowly, with pauses.

4.6.5. Usually, when the dive is completed, the divers swim back in the direction of the halyard, get under the maina, and ascend, using the means of buoyancy control system. There are no special rope signals for the diver and the line tender to exchange at the ascent.

4.7. Actions in case of emergency.

4.7.1. **The second stage of your primary regulator is free-flowing** (that is, it has started to deliver air uncontrollably). Switch to the back-up regulator, inform your partner, abort the dive, start the ascent.

4.7.2. **The second stage of your primary regulator delivers no air.** Switch to the back-up one, while preparing to share air with the buddy (ie, during the switchover, move towards your buddy, if the dive is performed with one safety rope, do it by pulling yourself up the halyard). If your spare regulator doesn't deliver any air either, switch to your buddy's one.

4.7.3. **Your regulators deliver no air, and it's impossible to share air with your buddy.** Send an alarm to the line tender - "Repeated tugs of the rope more than 3 times" - and make an emergency ascent.

If the dive is performed with one safety rope, in this case Diver No.2 gives the signal to Diver No.1, simultaneously approaching him/her. If you cannot switch to your buddy's second stage, you can grab the rope leading to the tender and give the signal - "Repeated tugs of the rope more than 3 times" - and make an emergency ascent.

4.7.4. **The primary second stage dropped out of your mouth.** Switch to the back-up one.

4.7.5. **Loss of buoyancy control, uncontrolled ascent to the surface under the ice.** If you can not regain buoyancy control, the most important thing during an uncontrolled ascent is to be constantly exhaling on the way up, producing a sound. Beneath the ice, press your hand to the ice, restore the vertical position, dump excessive air, regain buoyancy control, bring the halyard to its normal position, catch your breath. After consulting with your buddy, continue or finish the dive.

4.7.6. **Your buddy has lost buoyancy control and is ascending uncontrollably.** If the dive is performed with separate safety ropes: slowly ascend following him/pyk. If the dive is performed with one safety rope: try to slow down the ascent by dumping the air from your BCD and dry suit. Exhale constantly on the way up. When you are right under the ice, help your buddy, if necessary.

4.7.7. **Diver is entangled in the halyard.** Stop. The main thing is not to make abrupt movements, which will be misinterpreted by the line tender. If the depth is shallow - you can ascend to the surface under the ice. If the divers are above the bottom, and the type of the bottom makes it possible - you can go down to the bottom. Untangle the halyard with slow movements. If it is more convenient to do it with the help of your buddy, give him/her a sign about it, stop the moving at all and wait until your buddy untangles the halyard. If it was impossible to respond to the line tender's signals during the disentanglement, it is likely that they will start to pull the divers up. In this case you should perform the emergency ascent procedure: exhale while moving up.

4.7.8. **Halyard does not move, there is no slack, the signals do not pass.** Most likely, the reason is a snag (jamming, tangling) of the rope. Do not try to pull the halyard towards yourself. Start to move back along the halyard, picking it up on the way. Having reached the point of engagement, try to release the halyard. If it's possible, give the OK signal to the line tender and allow him to pick up all the slack. After that, once again, exchange "OK" signals, and continue diving. If you cannot untangle the halyard, hold the part of the halyard which leads to the tender, cut off the part of the halyard which leads from you to the tangling, and, ascend to the maina without losing contact with the halyard.

4.7.9. **Halyard lies at the bottom, the signals do not pass.** Most likely, the reason is an engagement, or a breaking of the halyard on the surface. Do not try to pull the rope towards yourself. Start to move back along the halyard, picking it up on the way. Act as described above in case of engagement. After reaching the tangling spot, look up - most likely, the maina will be very close.