



AFS 2010:16

Diving Work

**The Swedish Work Environment Authority's Provisions
on Diving Work and General Recommendations on the
implementation of the Provisions**

Denna sida ska vara tom.

Provisions and General Recommendations of the Swedish Work Environment Authority on Diving Work

Contents.....	3
Purpose.....	5
Scope.....	5
Definitions.....	6
Planning, dive plan, risk assessment and measures	7
Planning and dive plan.....	7
Risk assessment	8
Measures.....	9
Knowledge requirements, certificates, qualifications and maintenance of knowledge.....	9
Knowledge requirements	9
Certificate for SCUBA diving.....	10
Certificate for hardhat diving	10
Diving supervisor certificate and qualification for diving supervisors	10
Qualification within recreational diving	10
Maintenance of knowledge	10
Equipment.....	11
Diving equipment and working equipment	11
Surface supplied diving.....	11
Buoyancy Compensator Device (BCD).....	11
Communication equipment	11
Tending line and buddy line.....	11
Crew.....	12
Diving team.....	12
Diving supervisor.....	13
Standby diver.....	13
Diver tender	13
Medical supervision.....	14
Breathing gas and partial pressure for oxygen.....	14
Breathing gas.....	14
Partial pressure of oxygen	14
Decompression chamber	15
First aid equipment.....	15
Regulations regarding penalties.....	15
Appendix 1 Table of OUT	16
The Swedish Work Environment Authority's General Recommendations on the implementation of the Provisions on Diving Work	17
Comments on individual sections and appendices	17
Appendix 2 Examples of planning, preparation, measures and emergency situations	25

AFS 2010:16

The Swedish Work Environment Authority's Statute Book



Provisions and General Recommendations of the Swedish Work Environment Authority on Diving Work;

AFS 2010:16

Date of printing 12th of January 2011

Adopted 21th of December 2010.

The Swedish Work Environment Authority prescribes the following with the support of Section 18 of the Work Environment Ordinance (1977:1166) and issues the following general recommendations.

Purpose

Section 1 The purpose of these provisions is to prevent ill-health and accidents during diving work.

Scope

Section 2 These provisions apply for any activity in which an employee, on behalf of an employer, performs work under water and thus inhales breathing gas under elevated pressure (diving work).

A person who undergoes training shall in the implementation of these provisions be equal to an employee.

The employer is responsible for ensuring these provisions are adhered to. Sections 19-21 and 23 in the provisions clarify that other persons are also responsible for ensuring these provisions are adhered to.

An employer is for the purpose of these provisions equal to those who employ temporary labor to perform work in their activities.

The provisions also apply to work which the employer carries out themselves and for activities conducted by two or more persons who are not members of the same family, for their own benefit and without employees.

The provisions, with the exceptions of the provisions in Sections 24-25, apply to those who solely or jointly with a family member but without employees professionally conduct building or construction work. However, if such activities are conducted at a joint workplace, the provisions apply in their entirety.

For those who solely or jointly with a family member but without employees conducts professional activities other than building or construction work, the provisions apply for work at a joint workplace, with the exception for the provisions in Sections 29-30.

The provisions do not apply within the Swedish Armed Forces and the Counter Terrorist Unit, within the National Police of Sweden.

Definitions

Section 3 In these provisions, the following terms are used with the meanings given below.

Breathing gas	gas mixture used for diving.
Buddy diving	two or more divers diving together while connected via a buddy line.
Buddy line	line connected between divers through which the divers maintain contact.
Buoyancy compensator device	device used by diver either to establish neutral buoyancy underwater or to reach water surface in case of emergency. BCD is acronym for B uoyancy C ompensator D evice.
Communication equipment	equipment which at least allows transmission of acoustic information between the surface and the diver in the water.
Decompression	reduction of pressure by ascending in water or the reduction of pressure in the decompression chamber.
Decompression dive	ascent in water with planned stops, using a decompression schedule, in order to avoid i.e. decompression sickness.
Decompression table	a collective term for instruments and tables describing and/or showing safe decompression in order to avoid decompression sickness.
Dive profile	diving depth as a function of time.
Diver	the person employed with diving work.

AFS 2010:16

Diver tender	the person appointed to maintain direct contact with the diver in the water.
Diving equipment	equipment allowing a diver to be in water and perform work.
Diving supervisor	the person appointed to plan, manage and supervise diving.
Hardhat diving	diving with a helmet where the diver is supplied with breathing gas from a free-flow system or a demand valve system.
HBOT	therapy with oxygen in sealed, pressurized chamber. HBOT is acronym for H yperbaric O xygen T herapy.
Response time	the time it takes between a diver in distress requiring assistance and the standby diver's assistance arriving.
SCUBA diving	diving with self-contained underwater breathing apparatus where the diver is supplied with breathing gas from the surface or from a supply he or she carries himself or herself. SCUBA is acronym for S elf- C ontained U nderwater B reathing A pparatus
Surface decompression	decompression which takes place in a decompression chamber above water, in accordance with special surface decompression tables.
Surface supplied diving	diving where the diver is supplied with breathing gas from the surface via a hose.
Tending line	line between the diver and the diver tender on the surface through which contact between them is maintained and signals can be exchanged.
Unlimited a/no deco	ascent to the surface, which, in accordance with the decompression table, does not require decompression stops.

Working equipment machines, devices, tools, gears or installations used in the work.

Planning, dive plan, risk assessment and measures

Planning and dive plan

Section 4 Diving work shall be planned so that it can be conducted in a safe manner.

A written dive plan shall be established before any diving work can commence. The dive plan shall be based on a risk assessment of the planned diving work (see Section 5) and measures (see Section 6).

The dive plan shall at least contain information on:

1. the type of diving work to be conducted,
2. the crew and division of tasks within the diving team and among others participating in the diving work,
3. what certificates and qualifications each member of the diving team has,
4. what diving and communication equipment shall be used,
5. what breathing gas and decompression table shall be used,
6. which measures have been planned in the event of an accident or emergency situation and
7. where there is access to a decompression chamber and how long it will take to get to it.

Risk assessment

Section 5 The planned diving work shall be risk-assessed.

The risk assessment shall be documented, dated and stored in a suitable format. The person conducting the risk assessment shall have good knowledge of methods for risk assessment and of the special risks involved in staying and working under water.

During the risk assessment the following shall be highlighted:

1. the composition of the diving team: numbers, equipment, competence and experience,
2. the division of tasks within the diving team and among others participating in the diving work,
3. the diving and working equipment being used,
4. the choice of breathing gas and decompression table,
5. the diving equipment's compatibility with the breathing gas in use,

AFS 2010:16

6. the use of surface supplied diving
7. the use of BCDs, tending lines and buddy lines,
8. the communication between divers and diver tender and in-between divers,
9. the response time for standby divers,
10. access to the diving site/workplace,
11. weather, water and bottom conditions at the diving site/workplace,
12. the coordination of the diving work with any other work tasks at the diving site/workplace,
13. planned measures at the event of accidents and emergency situations and
14. where there is access to a decompression chamber and how long it will take to get to it.

Measures

Section 6 If the risk assessment in accordance with Section 5 warrants it, measures which minimize the risks at diving work shall be executed.

When choosing measures, the following measures shall be especially considered:

1. to expand the diving team,
2. to reallocate work tasks within the diving team and among others participating in the diving work,
3. to choose another diving method, diving equipment, breathing gas, decompression table,
4. to choose different working equipment,
5. to obtain technical aids which supplement or replace diving,
6. to provide additional training,
7. to provide information so that the diving and working equipment is used in a proper and safe manner and
8. to design and plan the workplace and diving site in a different way.

Diving work cannot commence until measures to reduce risks have been taken.

If the planned diving work cannot be implemented in a safe manner, despite measures minimizing the risks having been taken, the diving work cannot be executed.

Knowledge requirements, certificates, qualifications and maintenance of knowledge

Knowledge requirements

Section 7 The person who executes or participates in diving work shall have the theoretical and practical knowledge which corresponds to the requirements the diving work poses and may come to pose, with consideration taken to the used diving and work equipment as well as the work tasks which shall be carried out.

The knowledge shall be documented in the form of a certificate or qualification.

The certificate or qualification shall be issued by a national or international authority or organization and shall clearly specify the scope of the knowledge.

The requirement for a certificate or qualification does not apply to those undergoing training.

Certificate for SCUBA diving

Section 8 Those who carry out diving work in the form of SCUBA diving to a depth of 30 meters shall hold a diving certificate at least equivalent to a Swedish professional diver certificate S 30.

When conducting diving work in the form of SCUBA diving to a depth greater than 30 meters, a diving certificate at least equivalent to a Swedish professional diver certificate A 40 is required.

For instructors within recreational diving, see Section 11.

Certificate for hardhat diving

Section 9 Those who carry out diving work in the form of hardhat diving to a depth of 30 meters shall hold a diving certificate at least equivalent to a Swedish professional diver certificate H 30.

When conducting diving work in the form of hardhat diving to a depth greater than 30 meters, a diving certificate at least the equivalent of a Swedish professional diver certificate B 50 is required.

Diving supervisor certificate and training certificate for diving supervisors

Section 10 Diving supervisors shall have a diving supervisor certificate or qualification as diving supervisor as well as having at least the theoretic knowledge the equivalent of the requirements for being issued with a Swedish professional diver certificate S 30.

AFS 2010:16

For diving supervisors within recreational diving, see Section 11.

Qualification within recreational diving

Section 11 Those who conduct diving work as an instructor and diving supervisor within recreational diving shall have a qualification at least the equivalent of the requirements of SS-EN 14153-3:2003.

Maintenance of knowledge

Section 12 The employer shall ensure that those who carry out or participate in diving work maintains sufficient knowledge and proficiencies.

Those who carry out or participate in diving work within the rescue services shall maintain their knowledge and proficiencies by conducting at least ten exercises per year. If diving work is conducted throughout the year, the number of exercises may be decreased accordingly.

The exercises shall be spread evenly over the year.

Equipment

Diving equipment and working equipment

Section 13 Diving equipment shall meet the requirements imposed in the Swedish Work Environment Authority's provisions on the design of personal protective equipment.

Diving equipment shall be used according to the Swedish Work Environment Authority's provisions on the use of personal protective equipment.

Working equipment and use of working equipment shall meet the requirements imposed in the Swedish Work Environment Authority's provisions on the use of working equipment.

Surface supplied diving

Section 14 Surface supplied diving shall normally be used for the following diving work:

1. building or construction work,
2. welding and thermal cutting,
3. use of power-driven working equipment,

4. in tunnels, passages, pipes and other enclosed spaces where the diver cannot make a direct ascent to the surface,
5. in and around underwater structures where the diver can become stuck, snared or trapped by suction and
6. in contaminated water.

Buoyancy Compensator Device (BCD)

Section 15 Buoyancy compensator device shall be used for all diving unless the risk assessment in accordance with Section 5 shows that the use entails an increased risk or is clearly unnecessary.

Communication equipment

Section 16 Communication equipment shall be used for all diving unless the risk assessment in accordance with Section 5 shows that it is clearly unnecessary.

Tending line and buddy line

Section 17 A tending line or buddy line shall be used for all diving unless the risk assessment in accordance with Section 5 shows that the use entails an increased risk or is clearly unnecessary.

Crew

Diving team

Section 18 Before diving work can commence, a diving team shall be appointed.

A diving team shall consist of no less than three persons: a diving supervisor, a diver and a standby diver.

In a diving team there shall also be a diver tender for each diver in the water who dives with a tending line or with gas supply from the surface.

The diving supervisor may at the same time serve as diver tender to a diver in the water if the risk assessment in accordance with Section 5 shows that the diving work can be executed in a safe manner and if all of the following circumstances prevail:

1. the number of divers in the water does not exceed two,
2. diving with unlimited a/no deco planned and

AFS 2010:16

3. the dive is to a depth of no more than 30 meters.

When diving with a decompression chamber at the diving site, there should also be a person in the diving team with competence on managing a decompression chamber.

Diving supervisor

Section 19 The diving supervisor shall at the diving site plan, manage and supervise the diving work in accordance with the dive plan (see Section 4) and the risk assessment (see Section 5) as well as in general make sure that the diving work can be conducted in a safe manner.

The following shall be highlighted:

1. inform the diving team and others participating in the diving work about the dive plan and the risk assessment,
2. ensure that all the necessary diving equipment and working equipment is available, in good condition and ready to be used,
3. check that the diving equipment is adapted for the breathing gas used and the temperatures at the diving site and in the water,
4. make sure that breathing gas, which is needed for the diving and for emergency situations, is available and has the correct composition,
5. plan the diving based on the decompression table in use,
6. make sure that the circumstances at the diving site do not affect the diver's work in a negative manner,
7. ensure that there are devices which enable the diver to get into and out of the water safely,
8. make sure that dive flag A is used when necessary and lit up when dark,
9. estimate the response time for standby divers (see Section 22),
10. ensure that an injured diver can be lifted out of the water and
11. make sure that there is access to first aid at the diving site

Diver

Section 20 The diver shall

1. report before the dive if the diver does not feel capable of carrying out the diving work for physical reasons or other,
2. follow the diving supervisor and diver tender's instructions,
3. test the diving equipment under the surface and give the all-clear if the equipment works the way it should,

4. during and after diving notify the diving supervisor immediately if he or she feels any discomfort,
5. terminate the diving work if something abnormal occurs with the breathing gas, diving equipment and working equipment or with the work equipment as well as
6. terminate the diving work if he or she needs to switch to the emergency supply of breathing gas.

Standby diver

Section 21 The standby diver shall come to the aid of the diver in the water in the event of an emergency situation or other event which entails the diver in the water requiring assistance.

A standby diver shall be available for immediate response during dives:

1. without gas supply from the surface,
2. to a depth greater than 30 meters or
3. if a decompression dive is planned.

For buddy diving and dives where there are several divers in the water, the divers may act as standby divers for each other if the risk assessment in accordance with Section 5 allows this.

Section 22 During diving, other than that described in Section 21, standby divers shall be available and prepared.

The response time for the prepared standby diver shall be decided by the diving supervisor.

Diver tender

Section 23 A diver tender shall assist the diver when diving with gas supply from the surface and when diving with a tending line.

The following shall be especially prioritized:

1. ensure that the diver gets into and out of the water safely,
2. check that the diving equipment when tested under the surface does not leak or have any other faults which the diver cannot notice themselves,
3. manage the diver's tending line and exchange the agreed signals,
4. communicate with the diver if communication equipment is used and
5. monitor the supply of breathing gas on the surface.

Medical supervision

Section 24 The person carrying out or who is to carry out diving work shall undergo a medical supervision in accordance with the Swedish Work Environment Authority's provisions on occupational medical supervision.

Breaches of this provision may result in fines, see Section 31.

Section 25 A person who is pregnant and has informed the employer of this may not conduct diving work.

Breaches of this provision may result in fines, see Section 31.

Breathing gas and partial pressure for oxygen

Breathing gas

Section 26 Breathing gas which is needed for diving and in emergency situations shall be available in sufficient quantities, have the correct composition for the planned dive profile and be free from harmful contaminants.

Section 27 Divers shall have immediate access to emergency supplies of breathing gas.

Partial pressure for oxygen

Section 28 The partial pressure for oxygen in open breathing systems at diving may not exceed 160 kPa during the descent and the bottom phase.

If the diving work is estimated to be strenuous, the partial pressure of oxygen shall be kept lower. The oxygen level may not exceed the values in Tables 1 and 2 and Appendix 1.

During decompression in the water, the partial pressure for oxygen may not exceed 190 kPa.

In decompression chambers, the partial pressure for oxygen may not exceed 280 kPa.

Decompression chamber

Section 29 There shall be access to a decompression chamber during a dive in accordance with the below.

1. It shall be possible to reach a two-compartment decompression chamber and HBOT shall be able to commence within six hours after the diver breaking the water surface when diving deeper than nine meters, which is

planned with unlimited a/no deco or with decompression diving where the decompression time is less than 31 minutes.

2. It shall be possible to reach a single or two-compartment decompression chamber and HBOT shall be able to commence within 30 minutes after the diver breaking the water surface with staged decompression and if the planned decompression time exceeds 31 minutes or if the planned dive depth is greater than 40 meters.

3. A multi-compartment decompression chamber shall be available at the diving site for diving with planned surface decompression.

Equipment for first aid

Section 30 The first aid equipment shall contain equipment and a supply of 100% oxygen which allows a diver to breathe 100% oxygen under atmospheric pressure for at least 60 minutes.

During buddy diving, the equipment and oxygen supply shall allow two divers to breathe 100% oxygen under atmospheric pressure for at least 60 minutes.

Regulations regarding penalties

Section 31 The regulations in Section 24 constitute the provisions in accordance with Chapter 4, Section 5 of the Work Environment Act.

The regulations in Section 25 constitute the provisions in accordance with Chapter 4, Section 6 of the Work Environment Act.

Violations of these provisions may result in fines, in accordance with Chapter 8, Section 2 of the same act.

These provisions shall enter into force on 1 July 2011. By these provisions, the Swedish National Board of Occupational Safety and Health's ordinance with provisions (AFS 1993:57) on diving work is repealed.

MIKAEL SJÖBERG

Claes Trägårdh

Anna Middelman

AFS 2010:16

Appendix 1

1 OTU (Oxygen Tolerance Unit) is the biological effect obtained under exposure to oxygen with a partial pressure of 100 kPa during one minute.

Table 1: OTU per unit of time at various partial pressure O₂

Partial pressure [kPa]	OTU/minute	OTU/hour
60	0,26	16
70	0,47	28
80	0,65	39
90	0,83	50
100	1,00	60
110	1,16	70
120	1,32	79
130	1,48	89
140	1,63	98

Table 2: Maximum permissible cumulative OTU

Exposure [number of consecutive days]	OTU/day
1	850
2	700
3	620
4	525
5	460
6	420
7	380
8	350
9	330
10	310

AFS 2010:16

The Swedish Work Environment Authority's general recommendations on the implementation of the provisions on diving work

The Swedish Work Environment Authority communicates the following general recommendations for the implementation of the Swedish Work Environment Authority's Provision (AFS 2010:16) on diving work.

The legal status of general recommendations differs to that of provisions. They are not mandatory; instead their function is to clarify the meaning of the provisions, e.g., by explaining suitable ways of fulfilling the requirements, giving examples of practical solutions and procedures, as well as providing recommendations, background information and references.

In accordance with the Work Environment Act, the employer has the main responsibility for the work environment in the activity. The act describes comprehensively how the responsibility shall be fulfilled. The basic obligations included in the employer's work environment management can be found described in the Swedish Work Environment Authority's provisions on systematic work environment management. In accordance with these provisions, the employer shall regularly examine and perform a risk assessment of the working conditions in the activity and determine which measures are needed in order to prevent ill-health and accidents at work. The types of measures are specified in other provisions issued by the Swedish Work Environment Authority, such as the provisions on the design of personal protective equipment, use of personal protective equipment and the provisions on the use of working equipment. Furthermore, the employer shall take the necessary measures, regularly check whether these measures have had the intended effect and, if necessary, take further measures.

The provisions on diving work supplement the provisions on systematic work environment management in matters of risk assessment at diving work. The provisions specify how an employer shall proceed in order to fulfil their responsibility for the work environment when it comes to diving work.

The expression **normal** in the provision texts refers to the requirements in the section text being met except for isolated occasions on which special circumstances entail the need for exceptions.

Comments on individual sections and appendices

Guidance on Section 2 The Work Environment Act applies to all work that an employee performs for an employer.

Chapter 3, Section 12 of the Work Environment Act contains provisions on responsibilities for those who hire in labour. The provisions apply when an employer is paid to make labour, who are employed by him/her, available to a purchaser/lessee in order to perform work included in the purchaser/lessee's activities. The purchaser/lessee has the use of the labour and at the same time, exercises the direct work management. The purchaser/lessee's responsibility for the hired labour is in principle equal to an employer's work environment management but it is limited to the current work at the unfamiliar workplace.

The act also applies in part for sole traders and family companies. Persons who solely or together with a family member conduct an activity without employees are however only obliged to adhere to that which has been stipulated in the Work Environment Act and with the support of it "in matters of technical devices and substances which can cause ill-health or accidents, and in respect of joint workplaces", see Chapter 3, Section 5, second paragraph of the Work Environment Act. In relation to work included in the Swedish National Board of Occupational Safety and Health's provisions on building and construction work, however, an extended responsibility applies for sole traders and family-run companies. A basic provision on this can be found in Section 2 of the Swedish National Board of Occupational Safety and Health's provisions on building and construction work. See also the guidance on this section.

Examples of groups of employers which are included in the scope of the Work Environment Act and of the provisions on diving work are employees within the building and construction industry, employees within the municipal and governmental rescue services, other governmental or municipal administrations, employees and students at universities and colleges. The term 'student' also includes anyone undergoing workplace training, subject-related placement or practical work orientation or other similar forms of unpaid long or short-term placements. In certain cases, some students are employed by a company during their study period. This may apply for apprentice training.

Another group included by the law and provisions are employees who train and/or supervise recreational divers.

Guidance on Section 3 The choice of decompression table is important in order for the diving work to be executed in a safe manner. A decompression-table describes, for a given breathing gas, how deep and for how long a diver can dive without risking decompression sickness. In order to generate a decompression table, a decompression algorithm is used, calculated based on the model used to describe the uptake of inert gas by the body's

AFS 2010:16

various tissues. The decompression table can be printed out, or the decompression algorithm can be programmed into a diving computer which makes calculations and shows, for example, the time it will take for the diver to complete a direct ascent. In these provisions, a printed decompression table is considered equivalent to a diving computer's table.

In the Swedish Armed Forces' Rules of Naval Diving Safety (RMS-Dyk), decompression tables are provided for various breathing systems and breathing gases. When choosing decompression tables, it is important to choose tables that provide a level of safety which corresponds to that provided by the tables in RMS-Dyk.

Guidance on Section 4 In Appendix 2 there are examples of appropriate considerations when planning diving work.

Guidance on Sections 5-6 The Swedish Work Environment Authority's provisions on systematic work environment management stipulate how employer and employee shall systematically investigate the working conditions, identify hazards and assess risks. Measures aimed at removing or reducing the risks in the work shall be put in place by the employer.

The employer is the party responsible for ensuring the risk assessment is carried out. The employer may however delegate the task to carry out the risk assessment to a party that has received sufficient authority and resources and has the necessary expertise for the task (see also the Work Environment Authority's provisions on systematic work environment management concerning distribution of information and knowledge). A natural choice for the delegation of the task may be the person appointed as diving supervisor for the planned diving work. It is however appropriate that the risk assessment is carried out by a group of people with varying levels of expertise and different functions.

The starting point of the risk assessment for diving work is normally a matter of what type of diving work is planned, e.g., photography of benthos, rescue operation, diving in contaminated water, construction work or training. The purpose of the risk assessment is to investigate whether the planned work can be carried out safely or if the risks are too great and the work is considered impracticable despite measures taken to reduce the risks.

Guidance on Section 7 It is not possible to specify an unambiguous requirement for a certificate or qualification for any diving work as the tasks involved may differ considerably from what is included in the formal education for a certificate or qualification. It is therefore important that every member of the diving team has, in addition to a certificate or qualification,

complementary knowledge for the tasks included in the work at hand. The employer is responsible for ensuring that all members of the diving team have the necessary training/education, expertise and experience for the planned diving work.

European Diving Technology Committee (EDTC)

EDTC is a European network consisting of representatives from a number of European countries which conduct diving operations. EDTC provides recommendations on diver training, among other things.

IDSA (International Diving Schools Association)

IDSA, which is also a member of the EDTC, is an international organization which has produced a number of different standards for the training of divers and has, for example, harmonized the Swedish professional diver certificates with IDSA.

Swedish professional diver certificate

The Armed Forces is the authority in Sweden which specifies the Swedish training requirements and issues the Swedish professional diver certificate and the diving supervisor certificate. The Swedish diver certificates/diving supervisor certificates are:

- Certificate S 30/diving supervisor S 30 -SCUBA diving, with and without gas supply from the surface, to a depth of 30m.
- Certificate H 30/diving supervisor H 30 - Hardhat diving to a depth of 30m.
- Certificate A 40/diving supervisor A 40 - SCUBA diving, with and without gas supply from the surface, to depths greater than 30m.
- Certificate B 50/diving supervisor B 50 - Hardhat diving to depths greater than 30m.
- Certificate C/diving supervisor C - Diving with a dry diving bell.

Training which results in a diving and diving supervisor certificate is provided by the Swedish Armed Forces and schools approved by the Swedish Armed Forces.

The Swedish professional diving certificate and diving supervisor certificate can also be obtained via an equivalency assessment of other certificates or qualifications against the requirements for a Swedish certificate. The assessment is performed by the Swedish Armed Forces.

Scientific diving/scientific diver

For scientific diving, two certificates have been produced in Europe for scientific divers, within the European Scientific Diving Committee. The lower level certificate is entitled "European Scientific Diver" (ESD) and the higher "Advanced European Scientific Diver" (AESD). Apart from diver expertise, the fundamental difference between these two certificates is that the AESD training grants eligibility to supervise scientific diving as it includes a basic diving supervisor education, whereas ESD only grants eligibility to participate in scientific dives.

The ESD certificate is deemed to be equivalent to the Swedish professional diver certificate S 30.

Instructors in recreational diving

The European standards SS-EN 14413-1:2004 and SS-EN 14413-2:2004 specify what knowledge and proficiencies a diving instructor should have so that they may instruct in recreational diving.

The European standard SS-EN 14153-3:2003 specifies what knowledge and proficiencies a diving supervisor should have so that they may be a diving supervisor for recreational diving.

Guidance on Sections 13-17 The Swedish Work Environment Authority/Swedish National Board of Occupational Safety have issued special provisions for the design of personal protective equipment, on the use of personal protective equipment and on the use of work equipment.

The Swedish Armed Forces' Rules of Naval Diving Safety (RMS-Dyk) stipulate, for example, how breathing and gas systems, rescue systems, balancing systems, diving suit systems and communication equipment is to be designed for use in the Armed Forces. Even if these rules are only strictly applicable within the Armed Forces, it is appropriate in the design of the equipment referred to in the provisions to observe the rules in RMS-Dyk, provided this does not contradict the Work Environment Act or the Swedish Work Environment Authority's provisions.

Guidance on Section 14 The Swedish National Board of Occupational Safety's provisions on building and construction work include a list of various types of building and construction work carried out on land. The list only provides examples of building and construction work and is not exhaustive. It is appropriate to use this list as guidance for what can be considered as building and construction work under water.

Examples of contaminated water are expanses of water containing a concentration level of chemical, biological or radioactive substances which entails a risk of serious or long-term ill health.

Examples of machine-driven work equipment are electrical, pneumatic and hydraulic tools, cleaning nozzles, high pressure cleaning apparatus and sludge suction units.

Examples of underwater structures are wrecks, collapsed constructions, cables and pipes. Other examples are dykes, floodgates and water intakes/outlets at power plants.

Guidance on Section 15 An example of when the use of a BCD can entail an increased risk is when diving under ice and in sealed spaces.

Guidance on Section 16 It is important that the diving supervisor or diver tender is able to maintain contact with the diver. How this contact is maintained depends on the diver's equipment and on how the breathing gas is supplied to the diver. Where there is a gas supply from the surface, it is important that the diving supervisor or diver tender can hear the diver's breathing and/or can speak with the diver.

An example of when communication equipment can be deemed unnecessary is during buddy diving.

Guidance on Section 17 An example of when the tending line to a diver in the water can be deemed unnecessary is during buddy diving.

When diving in pools, aquariums or similar, where the diving supervisor can visually follow and observe the diver(s) in the water throughout the dive, tender lines or buddy lines can be deemed unnecessary.

An example of when a tender line can entail an increased risk is during searching with aid of a towed diving board.

Guidance on Section 18 The diving team - the diving supervisor, diver and standby diver - can be increased with the addition of a few extra members, or in certain cases one member can have several duties. One example is when two divers dive each with their own tending line. This way, the diving supervisor can also take on the role of diver tender to a diver in the water and also, where required, be the operator of the decompression chamber. If three or more divers dive with tender lines or gas supply from the surface, the diving supervisor for example may, where required, be the operator of the decompression chamber.

Guidance on Section 19 The diving supervisor has an important task in the systematic work environment management. The person appointed diving supervisor by the employer shall, in accordance with the provisions on

AFS 2010:16

systematic work environment management, have the competencies, resources and knowledge required for the task. The diving supervisor plans, manages and supervises the dive at the diving site so that the dive is carried out in accordance with the risk assessment. This role also includes the authority to make decisions and take measures such as to discontinue diving work if unforeseeable risks arise.

Guidance on Section 22 It is not possible to specify an exact timeframe within which the standby diver shall be ready to dive; this time must be decided by the diving supervisor, based on a joint assessment of the prevailing conditions during the diving work at hand. It is important that the time frame for the standby diver's response is adapted according to e.g., the depth of the distressed diver as a delayed response can affect the driver's decompression and entail a significant risk of decompression sickness.

Once the response time for the standby diver is decided, the following can be appropriate to observe:

- choice of diving equipment,
- the distressed diver's access to breathing gas,
- the decompression table used,
- the distressed diver's dive profile,
- access to the diving site and workplace,
- weather, water and basal conditions at the diving site and workplace.

Guidance on Section 26 Planning and performing risk assessments for the diving work involves among other things the gas mixture used as breathing gas. The most common gas mixture used in professional diving is air, oxygen, oxygen-enriched air (Nitrox), a mixture of oxygen, nitrogen and helium (Trimix) and a mixture of oxygen and helium (Heliox). The diver may use only one gas mixture throughout the dive, or they may use combinations of different gas mixtures during one and the same dive, depending on the planned dive profile. It is of the utmost importance that the breathing gas has the correct composition at each depth throughout the dive in order to avoid compression sickness. It is not possible to specify which gas mixture is required for a given diving work; the choice must be made based on the conditions which prevail for the planned diving work.

When diving with Nitrox, for example, it is very important that the oxygen content in the breathing gas is carefully decided and correctly specified so that the diver actually receives the gas mixture planned for the dive. When diving with breathing gas in cylinders, it is important to analyse the gas with which the cylinders are filled. When diving with gas supply from the surface, it is important that this analysis is performed on the gas supplied to the diver.

When oxygen is mixed into a Nitrox mixture, it is important to ensure that the partial pressure of oxygen is not so high that the diver is afflicted with oxygen toxicity. This applies particularly in the case of repeat dives on consecutive days, see Appendix 1.

The Swedish Armed Forces' Rules of Naval Diving Safety, RMS-Dyk, describes e.g., gases, gas mixtures, requirements for their purity, partial pressure. Even if these rules are only strictly applicable within the Armed Forces, it is appropriate that the choice of the breathing gas's composition and its use during diving is based on the rules in RMS-Dyk, provided that this does not contradict the Work Environment Act or the Swedish Work Environment Authority's provisions.

Guidance on Section 27 If the supply of breathing gas to the diver is for whatever reason cut off during the dive, it is very important that the diver has immediate access to an emergency supply of breathing gas.

Where gas supply from the surface is used, it is appropriate for the diver to have, for example, a small gas container on the back, a "Bailout" device, which allows the diver to safely discontinue the dive.

When diving with carried gas containers, it is appropriate for the diver to have access to breathing gas via two independent gas lines. If a scuba set is used, an extra 2nd stage regulator connected to the same gas container as the diver's primary 2nd stage ("Octopus") regulator can be deemed to meet the requirements in this paragraph.

Swedish Armed Forces' Rules of Naval Diving Safety (RMS-Dyk) describe, for example, how redundant breathing systems and backup equipment for gas supply from the surface shall be designed for use in the Armed Forces. Even if these rules are only strictly applicable within the Armed Forces, it is appropriate that in the design and choice of the backup system the rules in RMS-Dyk are observed, provided that this does not contradict the Work Environment Act or the Swedish Work Environment Authority's provisions.

AFS 2010:16

Appendix 2

Examples of what is appropriate to consider during planning, preparations, measures before and after diving and in emergency situations.

Planning

1. Weather conditions including prognoses which can affect the dive.
2. Currents/tidal conditions.
3. Boat and marine traffic at the site.
4. Air and water temperatures.
5. Breathing gas, depth, decompression table.
6. Diving equipment and equipment on the surface.
7. Other work equipment.
8. Employees' training/education, expertise, experience.
9. Effect of flying or transport at high altitude following the dive.
10. Foreseeable changes in the conditions.
11. Access to and time for the decompression chamber.

Pre-dive actions

1. Contact with the company in charge of coordination or a person who has information on conditions which may affect the safety of the divers.
2. Choice of diving equipment, breathing gas, decompression table.
3. Checking diving equipment and equipment on the surface.
4. Choice of diver and other personnel and checking the divers' state of health.
5. Measures to counteract the effects of the cold, in and above the water.
6. Arranging lighting and personnel spaces.
7. Establishing which signals are to be used.
8. Measures to counteract risks underwater.

Actions in connection with the dive

1. Allocate tasks to the diver, diving supervisor and diver tender, and to other personnel on the surface.
2. Check the use of the personal diving equipment.
3. Check the gas supply including min. and max. partial pressure for gas mixture, if used. The requirement for gas for emergency situations is also observed.

4. Check the use of tools and machinery.
5. Check the permitted diving depth and exposure time.
6. Ensure that ascent tables are available, for repeated dives as well, where appropriate.
7. Ensure that the divers are close to the decompression chamber for a sufficient length of time after the dive (if applicable).
8. Pay attention to any changes in conditions at the diving site.

Post-dive actions

1. Write up minutes for the dive with the following information:
 - a. Which persons, in addition to the diver, diving supervisor and diver tender, participated in the operation and what their duties were.
 - b. What equipment was used on the surface.
 - c. Which company was in charge of coordination.
 - d. What measures were taken in the event of decompression sickness or other state of ill/health.
 - e. If an accident or incident of any kind has occurred and who took measures in response to this.
2. Report to the company in charge of coordination when the work is completed.

Preparations for emergency situations

1. Establishing emergency signals.
2. Planning assistance below and above the surface.
3. Access to decompression chamber and transport alternatives to the same.
4. Planning of medical assistance.
5. Reserve power in the event of a disruption of the electricity supply.