USER MANUAL

AKVA Subsea Feeder
- Under water feeding

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For a thorough introduction of Your AKVA product, we ask that all users read this entire manual. If questions occur, contact us!

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1 Safety

Safety for the users of our equipment is top focus when AKVA group ASA develop new products and product manuals.

We therefore strongly recommend that everyone that use the equipment, all that perform any type of repairs, service or other maintenance to the product, and all that work in areas where the product is installed read this entire manual and at least this safety chapter.

This recommendation is based on both personnel safety as well as a desire to keep the products in order and avoid damages risked if the safety instructions are not followed.

1.1 Safety symbols

These safety symbols are used in this manual:

Information

Show caution, danger of minor personnel injuries and damages to equipment

Danger! - Will cause dangerous situations and danger for personnel

1.1.1 Other symbols used in this manual

Go to or see page or chapter for further instructions or more information
1.2 Receiving new equipment

Make sure that all parts are delivered according to the service note. If the order is not complete, or if any defects or transportation damages are discovered, contact AKVA immediately. Contact information is found in the back of this manual.

1.3 Personnel

Everyone working with or around the AKVA Subsea Feeder must undergo training regarding how to use the equipment, and also be aware of all dangers and consequences related to misuse. Owner and farm manager are responsible for making sure that all personnel understand the contents of this manual.

Personal safety equipment, such as antiskid foot wear and personal flotation devices, are mandatory when working on and by the cage, for instance when working on the AKVA Subsea Feeder.

To prevent personnel injuries and equipment damages during installation, maintenance and repairing processes, it is crucial that all instructions provided in this installation and maintenance manual are followed. All applicable safety laws and regulations in the country where the equipment is installed must be complied.

As a main rule, power for the entire feeding system (main power) must be turned off and secured in off position with a personal padlock during all processes, such as installation, maintenance and repairs.
1.4 Safety for equipment

This manual describes how to install and maintain the AKVA Subsea Feeder. AKVA service personnel will execute any remaining tasks. Only when written consent from an AKVA group ASA employee exists, is it possible for others to execute these. Farm owner where AKVA Subsea Feeder is installed, is responsible for complying applicable safety laws and regulations in the current country, such as correctly designed and installed safety devices. Farm owner is also responsible for that all employees are informed about and understand the content of this manual.

All users of this product must know about:

- How the AKVA Subsea Feeder works with the rest of the feeding system
- Which safety considerations that must be taken regarding installation, use, maintenance and other task with and around the under water feeder
- How the AKVA Subsea Feeder functions and how to use it
- How to maintain the AKVA Subsea Feeder according to procedures described in this manual.

1.4.1 Limitations in use of the equipment

AKVA Subsea Feeder must not be used as suspension for other equipment in the cage, however underwater lights and camera that are being used to monitor the under water feeding, may be attached to it.
1.4.2 Currents and load distributions

During normal use, the AKVA Subsea Feeder may tilt some during strong ocean currents. Table for expected tilt for some current speeds:

<table>
<thead>
<tr>
<th>Current speed [m/s]</th>
<th>7.0/5.5/12 [degrees]</th>
<th>4.0/5.5/12 [degrees]</th>
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<tbody>
<tr>
<td>0.00</td>
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<td>0.07</td>
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<td>5.5</td>
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<td>0.56</td>
<td>25.4</td>
<td>26.8</td>
</tr>
</tbody>
</table>

1.4.3 Bad weather

Check all equipment after periods of bad weather for damages. Make sure that all suspensions are intact, that surrounding equipment are ok, checking nets is especially important.

If any damages have occurred, they must be repaired at once, contact AKVA group for assistance if needed. Contact information is found in the back of the manual.
1.5 Disinfecting equipment

If any of the equipment, suspension or other belonging parts are being moved to a new location, it is decreed by law to disinfect everything to prevent contaminations. We recommend rinsing with fresh water after disinfection, because the disinfectants are strong chemicals that may damage the surface materials.
2 Information

This user manual is part of the equipment delivered with AKVA Subsea Feeder. Keep the manual for as long as the under water feeder is used, and make sure that all changes to the equipment are being noted in the back of this manual.

Thank you for choosing AKVA group ASA as supplier for your under water feeding system. Do not hesitate contacting us for more information regarding installation, use or maintenance for AKVA Subsea Feeder or any other AKVA product.

The purpose of this manual is to make the user install and maintain AKVA Subsea Feeder in a safe and economical way. The manual will show how to install and maintain the product, as well as hopefully answer most day to day questions. If any relevant instructions are missing from this manual, please contact us for assistance and help to find a solution to any problems. Contact the AKVA service department, your subcontractor, your local AKVA office or our main office in Norway for assistance and help.
2.1 How to use this manual

This manual describes how to install and maintain the AKVA Subsea Feeder in the best and safest possible way. This entire manual must be read and understood by ALL users prior to installation of the product. Site owner and farm manager are responsible for training all personnel and users know and make sure they all understand the contents of this manual.

Before the first chapter, is the table of contents. The headlines works as links to their respective chapter in the .pdf-file.

Chapter 1 is the most important chapter of this manual, and includes safety precautions ensuring safest possible use. Chapter 2 contains information on AKVA group and AKVA Subsea Feeder, as well as this manual instruction.

Chapter 3 describes necessary procedures that must be executed prior to initializing the assembly process. The assembling process is described in chapter 4. How so suspend the AKVA Subsea Feeder inside the cage and all considerations that must be taken in this process, is explained in chapter 5. How to run this product and special precautions that must be taken are described in chapter 6. How to store and transport the under water feeder parts is shown in chapter 7. Maintenance instructions, including maintenance frequency and maintenance registration forms are found in chapter 8.

Four appendixes are found in the back of the manual: Index, with links to the rest of the manual in the .pdf-document, a deviation form for all deviations with the system, pages for notes about new and extra information are also in the back of the manual and AKVA contact information.

This entire manual must be read and understood, as well as used as aid during installation and maintenance of the AKVA Subsea Feeder
2.2 About AKVA group

With four main brands, AKVA group ASA is a world leading supplier of technical aquaculture equipment. Since 1980 we have developed and produced fish farming equipment, both for cages at sea and for land based hatcheries. AKVA represents an industrial standard, which is presumed to be the turn key to the future. Research, project management, fast deliveries and customer follow-up have been our focus to ensure that we contribute to a positive development within the agriculture industry. Our goal is to deliver the best possible and most cost efficient equipment in order to keep preserving sustainable farming.

We have a wide variety of products, for example: plastic and steel cages, high pressure washers, net washers, boats, feed barges, feeding systems, cameras, sensor systems, under water lighting, software for fish farming and recycling systems.

AKVA has a continuous development of products, and we continue to improve product safety, functions, range of use and reliability. The purpose of this manual is to enable users to install and maintain AKVA Subsea Feeder in a safe and economic way.

All of our equipment is pre-installed, tested and delivered from our own production department. This means that our customers have total control over which components you can choose from, grouping collocation, testing and deliveries. Our production staff consists of people with great expertise and engagement for producing the best possible products. Having our own production site provides excellent service in case something should go wrong, or if assistance is required. Our service staff is available over telephone or on location to assist whenever necessary. Safety, both for users and equipment is main focus when AKVA group develops products and product manuals.
2.3 About AKVA Subsea Feeder

AKVA Subsea Feeder is an efficient feeding system that increases growth and improves fish health. The system feeds in 23 feet (7 meters) depth.

Fast and efficient subsea feeding
   Even feed spread
   Good hygiene
Easy maintenance and practical use
Bird nets no longer necessary
Certified according to NS 9415
Feed (pellets) are carried out to the cage through regular air pressure feeding pipes, and enters the cyclone on top of the subsea feeder tangentially. Water is collected from the deep to secure good hygiene, and is also inserted tangentially into the cyclone, creating a high speed circulating water-pellet-mix. This mix will move down through the main pipe down to the top of the distribution chamber.

An ejector installed in the upper part of the distribution chamber, and a cone in the center of the bottom part of the chamber works with the circulating forces from the inserted water as well as the water-pellet-mix. Together, these elements provide a homogeneous distribution of feed that is sent out through the branch pipes, spreading feed in desired depth.

The feed is distributed through 12 single branch pipes, providing a 55 feet (17 meter) feeding circumference. Feed rate may be up to 50 kg feed per minute, and tests show that bird cages are not necessary in cages where AKVA Subsea Feeder is being used.

The main purpose of the AKVA Subsea Feeder is to keep fish in cages in a certain depth. Sea lice thrives in upper water layers, where temperatures are higher. Keeping fish in deeper, cooler areas, prevents lice population from increasing.

Both water intakes have water sieves, avoiding contaminations in the system. The bottom ring that surrounds the branch pipes, is filled with weight for stability purposes.

The pump requires 230V/50Hz - 970W and is delivered with power cable that reaches from the AKVA Subsea Feeder to the cage edge for proper high quality power. AKVA Subsea Feeder may be used without the pump, but then we recommend removing the sieve in the riser pipe end to avoid that the pipe is filled with pellets from the inside. In addition, monitoring the feeding process is highly recommended (especially when feeding higher doses). We recommend always using the pump with AKVA Subsea Feeder.
2.3.1 Explaining the parts of the AKVA Subsea Feeder

**Main pipe** - pipe between cyclone and distribution chamber

**Distribution chamber** - the entire unit between main pipe and branch pipes (ejector, funnel and top and bottom part of the distribution chamber)

**Bottom ring** - circular shaped perforated ring with inlaid weight (approx. 80kg), encircling and protects branch pipes

**Branch pipes** - smaller pipes from the distribution chamber and out, distributes the feed

**Cyclone** - aluminum component, installed above the floating collar, frees air from the feed system, leads pellets in a cyclonic movement down to the main pipe

**Ejector** - placed in the top part of the distribution chamber, creates a suction effect and transports pellets to the lower part of the distribution chamber and out through the branch pipes

**Pump** - Two different pumps, both collecting water from deeper areas, adding it to the system. One pump carries water into the cyclone, where the water is mixed with pellets before entering the main pipe and moving down to the distribution chamber. The second pump leads water into the distribution chamber, increasing the cyclonic movement from the water-pellet-mix for best possible distribution of the feed out through the branch pipes. Both water intakes have sieves that inhibit contaminations from entering the system
2.3.2 Technical specifications

Feeding depth: 23 feet (7.0m)
Diameter bottom ring: 18 feet (5.5m)
Number of branch pipes: 12
Weight cyclone: 63kg
Weight entire AKVA Subsea Feeder: approx. 570kg

Item no.: 10002158

AKVA Subsea Feeder 7.0/5.5/12*

*Feeding depth / diameter bottom ring / number of outlets

[m] [m]
3 Assembly preparations

Before commencing the assembly process:

- Farm owner and manager are responsible for that all installers and users of the AKVA Subsea Feeder read, and at least understand the contents of this entire manual prior to commencing the assembling and installation processes.

- We recommend that all users attend an introduction to the system and its principles at our production site.

- Control all parts of the system and make sure that no transportation damages have occurred. The unit must be in perfect condition when used.

- Control that the pump stands vertically when the AKVA Subsea Feeder bottom part stands upright.

- Equipment for assembling the AKVA Subsea Feeder is part of the total delivery. Make sure that all parts are delivered according to the service note.

  - bolts
  - hose clamps
  - plastic strips
  - wrench
  - loading straps
  - ropes (20mm, rapture strength 6650kg)
  - pump with hose
  - hex key for hose clamps
4 Assembly

Read and execute the instruction in chapter 3 before commencing the assembling process for the AKVA Subsea Feeder.

If any problems occur during the assembling process, contact AKVA group for assistance over telephone or on location. Contact information is found in the back of this manual.

During rough weather conditions with waves and strong currents, the mooring has to be placed in a 45 degree angle against the weather direction, as illustrated with the yellow arrow here:
4.1 The assembling process

The assembling process must be executed in an area that can fit the entire bottom ring diameter, Ø = 18.1” (5.5m).

Crane or a similar device that manages to lift the cyclone with main pipe safely is required for moving the AKVA Subsea Feeder out to the cage.

When connecting the top and bottom parts, all bolts must be tightened with 12Nm moment.

Procedure:

1. Read through this entire procedure before commencing the work

2. Attach the bottom and the top parts of the distribution chamber with bolts and 12Nm moment

3. Attach the hose between pump and distribution chamber with the pump power cable along a branch pipe with plastic strips. The power cable must also be attached to the main pipe with the riser hose, use strips for this too. If underwater camera and/or light is installed with AKVA Subsea Feeder, their cables must also be attached along the main pipe with the other cables and hose

4. Attach the 4 cargo straps to the main pipe and lay them across the floating collar
5 Re-examination before starting up use of AKVA Subsea Feeder:

- Control the unit for surface cracks, other damages or any sharp edges
- Make sure that all hoses and cables are properly attached to the unit with plastic strips
- Make sure that the feeding hose is properly connected to the cyclone intake
- Make sure that loading straps are properly fastened to the floating collar, and that they are placed across the collar.

6 Measure and mark 30 cm from the end and inwards on the feeding hose. Slide the hose into the opening on the side of the cyclone until the mark meets the edge of the cyclone inlet. Attach the hose properly. The inlet is fitted for 90mm feeding hose.
7 Tread the other end of the straps to 4 ropes, and attach these ropes to the cage edge.

Rope length must be the total of:

length for tying the rope to a strap with a safe knot

+ length from knot in strap out to cage edge

+ long enough to fasten rope to cage edge*

+ 1m available for horizontal movability
5 Attaching to cage

AKVA Subsea Feeder is attached to the cage edge by using 4 ropes, as explained in chapter 4.

The ropes must be attached to the cage as instructed for the user manuals for the cage model and net pen model.

In some cages, ropes may be attached to the hand rail. This depends on the cage type and its hand rail.

If the rope must be attached to cage pole or cage floating collar, threading the rope through the net will be necessary, and this may only be executed according to net pen user manual. The threading area will often require reinforcement in such cases.
6 Use

All of the personnel that will be involved in use of the AKVA Subsea Feeder must, as a minimum, read and understand the contents of this manual before they start working with it. We also recommend that all users visits our production site for an introduction to the product and it's main principals, how to treat the system, reasons why pump should be used, benefits of using camera surveillance and other useful information. AKVA service personnel may assist in the assembling, installation and start up processes, and may also instruct users in AKVA Subsea Feeders main principles and how to use the system.

6.1 Daily handling and use

It is important to control that all suspension ropes between AKVA Subsea Feeder and cage edge are in order and that the system floats as it should in the center of the cage. Camera surveillance provides a great advantage with the AKVA Subsea Feeder, because it gives total control over factors such as wether the pump is running when it should, and wether feed exits all of the branch pipes.

6.2 Special conditions

During extraordinary weather conditions in the winter, such as freezing and drift ice, site leader must considered wether the AKVA Subsea Feeder should be removed from the cage until these conditions improve to prevent damages, suspensions from loosening, and damaging surrounding equipment or net.

6.3 Short term extraordinary conditions

The AKVA Subsea Feeder must not be suspended too tightly, but have 1 meter movability possibility for when service, feed or carrier boats dock or hits the cage edge or any of the cage suspensions, as this may deform the cage ring quite severely and cause severe load to the AKVA Subsea Feeder main pipe.
6.4 Ideal air velocity

Air velocity has to be set to a speed that is low enough to avoid breakage, yet high enough to move the pellets through the pipes and the feeder. Stable pressure is important, and this must be surveilled and adjusted by the software air monitoring function.

Deciding factors for air velocity:
- Feedline quality and length
- Pellet size and quality
- Temperature
- Feed velocity set according to biomass.

Stable air pressure inside the feeding hose is critical to achieve a minimum of breakage and feed dust inside the feeder, and must therefor be adjusted according to the factors mentioned above.

It is not possible to recommend one ideal air velocity, because this is not a fixed value. It will vary during the growth of each generation and each cage. Please contact AKVA group service personnel for assistance to deciding air velocity for feeding with the AKVA Subsea Feeder. Contact information is found in the back of this manual.
7 Storage and transportation

AKVA Subsea Feeder must not be lied down before it is disassembled as described in this chapter. If the entire AKVA Subsea Feeder lies down on the surface, it will be exposed for unwanted forces that may deform and destruct the entire system

For transportation over longer distances, and for storage in areas that is not tall enough to store the unit standing up, the AKVA Subsea Feeder must be divided into two parts:

**Top:** cyclone, floating collar, main pipe, upper distribution chamber

**Bottom:** bottom ring, branch pipes, lower distribution camber

The system is parted by dividing the distribution chamber.

All parts of the AKVA Subsea Feeder may be stored outdoors, however, the pump must be disassembled and rinsed through with fresh water before long term storage.

The upper part can lie down on the surface, and the lower part must stand upright on the surface as shown in the image below:

If the AKVA Subsea Feeder is being transported on a boat deck during bad weather, supporting pillars must be set up from deck up to the under side of the distribution chamber.
7.1 Transport to and from cage

When the entire AKVA Subsea Feeder unit is assembled, it may be lifted by all four loading straps attached to the main pipe:

This method may only be used for shorter distances, for moving the system from barge to cage, for lifting it up from the cage for inspection, service and maintenance, and for bringing it up to and down from boat or dock.

7.1.1 Towing

AKVA Subsea Feeder must not be towed, unless the distance is short (from barge to cage) or if the unit is not disposed for forces larger than when standing inside the net pen, see table in chapter 1.4.2 for maximum loads. Measure ocean currents and adjust towing from these values according to direction and other conditions.
8 Maintenance

The feed system main power must be turned off and secured in locked position with a personal padlock before commencing maintenance work with the AKVA Subsea Feeder

Personal safety equipment, such as antiskid footwear and flotation device (safety vest) are mandatory to wear when working on and by the cage edge, for instance when working with the AKVA Subsea Feeder

The AKVA Subsea Feeder will have 5 years operating time when treated correctly. If the unit is damaged in any way, the entire construction may be affected, and must not be used. All damages must be corrected before it is used after damages.

After bad weather, boat crashing into the cage edge or similar incidents, that may affect suspensions as well as the AKVA Subsea Feeder, the entire unit must be controlled before using it. This is done by ROV, diver, or taking the unit out from the cage for control. Control all welds, flanges, connections and fastening points, and make sure that the unit does not have any leaks, dents or other damages to any of the parts.

If the AKVA Subsea Feeder is covered in sprout and algae, unwanted weight is added to the construction and it may, in worst case, sink. Control how heavy it floats visually, and control with under water camera or diver/ROV during periodic controls.

If the bottom ring or other parts are covered with barnacle and/or shells, these must be removed immediately. If these touches the net when the AKVA Subsea Feeder is pulled in to the cage edge, such build-ups may damage the net and cause danger of fish escaping. Lift the AKVA Subsea Feeder out from the net and use a high pressure cleaner to remove any growth. Whenever the unit is taken out from the cage, control it for any damages.
Icing may occur during the winter season, and all ice must be removed as this affects the units weight.

The water inlet sieves, one in the end of the pump hose and one in the end of the rising hose, must both be controlled every month during the summer/growth season, and cleaned when it is has sprout on the surface. Flush with water, and scrape if necessary. A clean sieve is important for the water inlet:
8.1 Maintenance frequencies

All AKVA Subsea Feeder maintenance must be performed on a regular basis in order to obtain maximum operating time.

The various tasks that must be performed to maintain the unit are here separated into tasks performed every day, every week, every month or every six months:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Task</th>
</tr>
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<tbody>
<tr>
<td>Daily</td>
<td>Control all suspensions</td>
</tr>
<tr>
<td></td>
<td>Control buoyancy</td>
</tr>
<tr>
<td>Weekly</td>
<td>Control the unit for sprout, remove if necessary (summer season)</td>
</tr>
<tr>
<td></td>
<td>Control the unit for icing, remove if necessary (winter season)</td>
</tr>
<tr>
<td></td>
<td>Remove deposit of fat inside the cyclone*</td>
</tr>
<tr>
<td>Monthly</td>
<td>Visual control of welds (with under water camera)</td>
</tr>
<tr>
<td></td>
<td>Visual control of pipe damages (with under water camera)</td>
</tr>
<tr>
<td></td>
<td>Visual control and rinse of inlet sieves (growth season)</td>
</tr>
<tr>
<td>Twice a year</td>
<td>Lift AKVA Subsea Feeder out from the water</td>
</tr>
<tr>
<td></td>
<td>- straps and ropes are controlled and changed when required</td>
</tr>
<tr>
<td></td>
<td>- all metal parts are controlled for corrosion and abrasions</td>
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<tr>
<td></td>
<td>- control all bolts</td>
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<tr>
<td></td>
<td>- control all plastic welds</td>
</tr>
<tr>
<td></td>
<td>- clean and remove sprout and shells and barnacle when necessary</td>
</tr>
</tbody>
</table>

* if fat deposits are not removed regularly, the cyclone and other parts of the AKVA Subsea Feeder will be clogged. If this occurs, the entire unit must be disassembled and rinsed through.

- In order to secure regular maintenance, all performed tasks must be registered in the maintenance forms in the next chapters
- Sign with your initials to keep track of who did what and when
- Remember to register correct date, week, month and year for each performed task.
### 8.1.1 Daily and weekly maintenance registration

Make copies of the form before filling anything out. Sign in the correct box after maintenance task is performed. Fill in week number and year. Daily tasks are performed every day, weekly once a week (preferably same weekday each week).

Check also means fix or replace when required

<table>
<thead>
<tr>
<th>Year_____</th>
<th>Week_____</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
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<td>Check ropes (daily)</td>
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<td>Check buoyancy (daily)</td>
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<td>Check fat deposits inside cyclone (weekly)</td>
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<td>Check for icing (winter season, weekly)</td>
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<td>Check for sprout (summer season, weekly)</td>
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<table>
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<tr>
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<td>Check for sprout (summer season, weekly)</td>
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### 8.1.2 Monthly maintenance registration

Make copies of the form before filling anything out. Sign in the correct box after maintenance task is performed. Fill in year and month names. Perform monthly tasks approximately same date every month. Check also means fix or replace when required.

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Control welds</th>
<th>Control pipe damages</th>
<th>Control both inlet sieves</th>
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8.1.3 Maintenance twice a year

Control ropes and straps at least once every six months, and change these when required.

Take the entire AKVA Subsea Feeder out from the cage for total control and cleaning every six months.

Make copies of the form before filling anything out. Sign in the correct box after maintenance task is performed. Fill in correct year. Perform these tasks approximately same date every six month. Check also means fix or replace when required

<table>
<thead>
<tr>
<th>Year</th>
<th>1st half year</th>
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<td>Clean the entire unit</td>
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<tr>
<td>Year</td>
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<td>2nd half year</td>
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<td>Control all ropes and straps</td>
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<td>Clean the entire unit</td>
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8.2 Spare parts

A complete set of bolts and parts are included in each AKVA Subsea Feeder delivery. Stainless bolts (8mm*65) with washers and lock nuts in A4 quality are used. These are coated with P40 assembling paste for stainless materials by the producer. Do not use any other types of bolts, washers or nuts in the AKVA Subsea Feeder, it is important that correct types of bolts of the correct material are used in order to keep the unit up to standard.

The water pump running the injector is a Pedrollo MC-I. User manual with spare part overview for this pump is delivered with the rest of the equipment. Never run the pump dry. Rinse trough with fresh water before long term storage on land.
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# Appendix B - Deviation form

Make copies of this form before filling anything in

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Deviation description:

Follow up proposition:

Date and signature, declarer:

Follow up directed:

Status:

New action for deviation no.:

Date and signature, follow up:
### Appendix C - Notes

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User manual AKVA Subsea Feeder

Document no. DC10000901

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