

USER MANUAL



AKVA SUBSEA FEEDER

Thank you for choosing AKVA group

AKVA group develops, manufactures and supplies technology and services aimed at solving biological and technical challenges in the global aquaculture industry. All our products, from single components to service assignments and complete farms, are designed to achieve the best possible fish welfare, operational performance and profitability for our customers.

We aim to write easy to understand user manuals, while providing as accurate and updated information as possible. In order to do this, we rely on input, feedback and collaboration with people who use our products. We appreciate all the input we have received, as this helps us provide better and safer equipment and solutions. Please contact us through our websites with questions or suggestions for improvements.

This manual is written with the purpose of complying with the standard "NEK EN 82079-1".

Unless such responsibility has been agreed upon in a separate written contract with AKVA group, we are not responsible for loss, damage or incorrect use of equipment or software that arises as a result of errors in text or illustrations, or by following instructions in this user manuals.

For a thorough introduction to your AKVA group product, carefully read through this user manual before assembling, installing or using the product. Most of our user manuals are available from our website: www.akvagroup.com/user-manuals.

Together we can contribute to making sure that fish farming is an environmentally friendly, sustainable and growing industry that produces safe and healthy seafood for a global market.

Best regards,
AKVA group

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1 HEALTH AND SAFETY

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

We strongly recommend that everyone who are going to be using the AKVA product, all who perform any type of repairs, service, maintenance or other work on AKVA products, and all who work in areas where such products are installed, are aware of the contents of this manual.

This recommendation is based on both personnel safety as well as a desire to keep AKVA products in order, and to avoid risk for damages as a result of not following safety instructions. The purpose of this manual is to provide answers to the most common questions regarding installation, daily use and maintenance of the equipment.

The user manual is to be considered as part of the equipment named in the front page.

1.1 SYMBOLS



WARNING!

Serious health risk or other serious incidents - Safety sign that implies a danger that may cause death, serious (irreversible) personnel injuries or risk of reduced fish welfare or fish escaping.



PROTECTIVE GEAR REQUIREMENTS

Warning symbol indicating required use of personal protective equipment.



NOTE!

Symbol that implies useful hints and recommendations for efficient use of the product.



RECYCLING

Warning symbol indicating information regarding recycling, waste management and disposal.



GO TO

Symbol that indicates a link to a page or section with further information. Click on underlined words to go to the reference or open the link.

1.2 TECHNICAL CONDITION

Any equipment found not to be in perfect technical condition should never be used. To avoid potentially using defective equipment, always follow the procedures in the applicable maintenance guidelines included in this user manual. Using defective equipment has the potential to negatively impact the product functionality and safety functions.

Use only original spare parts supplied by AKVA group. Unauthorised reconstruction and modifications to the equipment are not recommended. This user manual addresses the most commonly asked questions in connection with installation, operation and maintenance.

1.3 RISKS ASSOCIATED WITH LOAD DISTRIBUTION AND STRONG CURRENTS

The AKVA Subsea Feeder shall not be used as suspension for other equipment in the cage. It may, however, be fitted with underwater lights and a camera to monitor underwater feeding. The AKVA Subsea Feeder may tilt slightly under the influence of ocean currents. Table 1 shows how much the AKVA Subsea Feeder can be expected to tilt when exposed to various current velocities.

Table 1: Estimated tilt in relation to current velocity

Current impact (m/s)	Short (°)	Standard (°)
0.00	0.0	0.0
0.07	0.4	0.4
0.14	1.5	1.4
0.21	3.3	3.1
0.28	5.9	5.5
0.35	9.2	8.7
0.42	13.4	12.7
0.49	19.6	18.8
0.56	26.8	25.4

1.4 BAD WEATHER

Check all equipment after a storm or other extreme weather event. Make sure that the suspension and surrounding equipment are intact and in good working order, and pay particular attention to checking the nets.

If any equipment has sustained damage, this must be rectified immediately. Contact AKVA group for assistance, if required. Contact information is found in the end of this manual.

1.5 SECURING THE CYCLONE



WARNING

In the worst-case scenario, failing to secure the AKVA Subsea Feeder as per the instructions may cause it to come loose and damage the net, leading to the escape of fish.

As an added safety precaution, we recommend using a safety rope between the cyclone and the cage during the lifting operation to prevent that a potential incorrect manoeuvre during the lifting operation results that the cyclone falls into the net and causing damage and potential fish escaping.

2 ABOUT AKVA SUBSEA FEEDER

The AKVA Subsea Feeder is manufactured by Nærøysund Aquaservice AS, who has the following business address: Marøystrand Næringsområde, Marøystrandvegen 29, NO-7900 Rørvik, Norway. Telephone: + 47 51 77 85 03. E-mail: supportakvasmart@akvagroup.com

Variants of the AKVA Subsea Feeder: AKVA Subsea Feeder Long (13 m +)

AKVA Subsea Feeder Standard (7 m)

AKVA Subsea Feeder Short (4 m)

The AKVA Subsea Feeder is a feeding system designed for sea-based fish farming sites. It enables underwater feeding at a maximum depth down to 20 m. The purpose of feeding fish deeper in the water column is to keep the fish at a certain depth and prevent lice from attaching, and also enhance growth of the fish. Lice thrive near the surface, which is why keeping the fish at a deeper level reduces the spread of lice in the cage.

Feed pellets are delivered to the cage through a normal air hose and enters the cyclone at the top of the feeder tangentially, where the pellet speed is reduced. A spiral motion circulates the pellets down into the cyclone until they reach the water level at the top of the main pipe and then sink. The pellets are transported down into the distribution chamber and then distributed evenly via a cone shape out to the fish through 12 branching pipes that spread the feed across an area with a circumference of about 17 m. The feed is transported at a speed of up to 50 kg per minute, and experience has shown that bird nets are not necessary when feeding with the AKVA Subsea Feeder.

When using an long feeder (13 meter feeding depth or deeper) or using smolt feed, we recommend creating a current in the water column in the main pipe. This is achieved by using a pump to collect water from a deeper level, and pumping it up into the distribution chamber, where an ejector generates negative pressure in the main pipe. Water from the same depth as the pump is transported into the top of the main pipe to create a downward pressure that forces the water down through the pipe. This downward motion is maintained as the pellet-and-water mixture moves down through the main pipe. This motion ensures that the branching pipes distribute the feed to the fish evenly at the correct depth.

Pellets are transported to the cage through a feed pipe, and enters the cyclone at the top of the AKVA Subsea Feeder tangentially. Here, water is also added in the same tangential direction. The water and feed combine and generates a cyclonic motion, that is maintained as the mixture travels down through the main pipe and out in the desired depth. The water intake pipe is fitted with a filter to prevent planctonic stages of salmon lice from entering the feeding system.

The sinker tube that encircles the branching pipes is weighted to provide stability.

The AKVA Subsea Feeder pump requires 230 V/50 Hz – 970 W and is delivered with a power cable that reaches the edge of the cage, where the user then ensures sufficient power supply.

The feeder may be used without the pump, but in such case, we recommend removing the filter in the riser pipe to avoid pellet build-ups. Choosing not to use a pump will require monitoring the process with extra care, particularly for large doses.

2.1 COMPONENTS IN AKVA SUBSEA FEEDER

Illustration 1: AKVA Subsea Feeder components



Floating collar – the cyclone is equipped with a floating collar that makes the Subsea Feeder easy to place and move when carrying out other essential operations.

Main pipe – pipe that runs from the cyclone down to the distribution chamber.

Distribution chamber – unit between the main pipe and the branching pipes (ejector, funnel, distribution chamber).

Sinker tube – round, perforated ring that is heavily weighted (approx. 80 kg) and designed to encircle and protect the branching pipes.

Branching pipes – pipes leading from the distribution chamber to the feeding points at the sinker tube.

Cyclone – aluminium component installed above the floating collar that releases air from the feeding system and guides the pellets down the main pipe.

Ejector – component placed in the top part of the distribution chamber that creates suction and draws the pellets down to the lower part of the distribution chamber and out through the branching pipes.

Pump – unit that pumps water into the distribution chamber to facilitate the rotation that ensures the best possible distribution of the feed through the pipes.

Filter – The water inlet is fitted with a filter to maximise the hygiene level of the feed.

Illustration 2: Filter at water intake



2.2 TECHNICAL SPECIFICATIONS

Table 2: Tekniske spesifikasjoner for varianter av AKVA Subsea Feeder

AKVA Subsea Feeder	Short	Standard	Long
Feeding depth (m)	4	7	13-20
Diameter, sinker tube (m)	5.5	5.5	5,5
Number of branching pipes (stk.)	12	12	12
Weight cyclone (kg)	63	63	63
Total weight feeder (kg)	520	569	666-780

3 STORAGE AND TRANSPORTATION



WARNING

The AKVA Subsea Feeder must not be placed on the side before it has been disassembled as described in this user manual. Laying the whole unit down on its side will expose it to forces that may bend parts and render them unusable.

When transporting the AKVA Subsea Feeder over longer distances or when storing it in a location with insufficient height to allow for it to stand upright, the feeder shall be divided it into 2 parts:

- **Top** part including the cyclone, floating collar, main pipe and upper distribution chamber.
- **Bottom** part including the sinker tube, branching pipes and lower distribution chamber.

The unit is divided by releasing bolts in the flange between distribution chamber and main pipe.

All parts of the AKVA Subsea Feeder can be stored outdoors, but the pump must be dismantled and run in fresh water before storage for longer periods.

The top part can be laid down on deck or other surfaces, while the bottom must be upright on the ground as shown in illustration 3: [Properly stored AKVA Subsea Feeder bottom part.](#)

Illustration 3: Properly stored AKVA Subsea Feeder bottom part.



3.1 TRANSPORT TO AND FROM PEN



PROTECTIVE GEAR REQUIREMENTS

Wearing floating garments is mandatory when working on or by the sea. After completing SJA, and if measures have been introduced for the transport to and from the cage may be carried out in a safe manner, work can be commenced.

Provided that a crane that is long enough to lift the entire AKVA Subsea Feeder in a safe manner is available, the AKVA Subsea Feeder may be loaded and unloaded using four lifting straps attached to the main pipe as shown in illustration 4: [Lifting straps attached to main pipe for lifting.](#)

Illustration 4: Lifting straps attached to main pipe for lifting



Illustration 5: Lifting the AKVA Subsea Feeder



3.2 TOWING

Avoid towing the AKVA Subsea Feeder, since this can cause it to tilt as a result of water resistance. The risk is possible deformation, resulting in it no longer being usable. Towing the feeder for short distances (such as from barge to pen) is however possible, provided the feeder is not exposed to forces greater than what it would normally be subjected to while moored in the pen. Measure current direction and velocity and refer to Table 1: [Estimated tilt in relation to current velocity](#) for the maximum load distribution.

4 INSTALLATION



PROTECTIVE GEAR REQUIREMENTS

Wearing floating garments is mandatory when working on or by the sea. After completing SJA, and if measures have been introduced for the transport to and from the cage may be carried out in a safe manner, work can be commenced.

4.1 PREPARATIONS

Before commencing the installation process, site manager and owner and site manager are responsible for ensuring that everyone who installs and/or uses the AKVA Subsea Feeder is informed of and understands the contents of this manual before commencing the installation. Before using the feeder, check all components for potential damages caused during storage or transportation. Never place a damaged unit inside a pen.

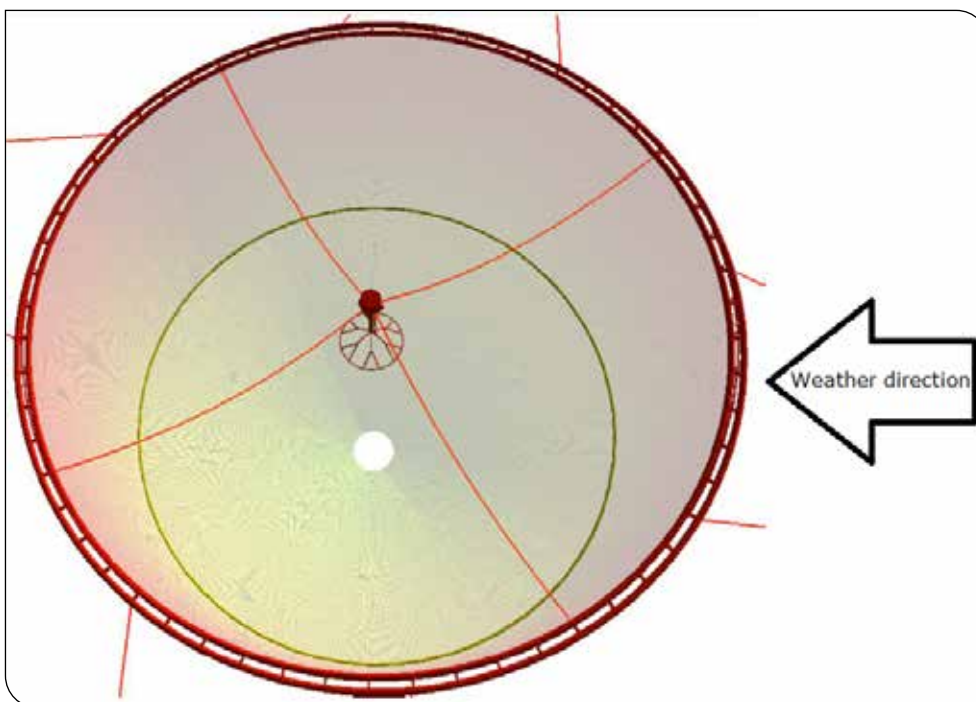
Before commencing the installation, check that the pump is in the correct vertical position and the AKVA Subsea Feeder is positioned upright.

The feeder is supplied with the relevant equipment for installation. Control whether the delivery note corresponds with the amounts and sizes of the materials supplied, such as:

- bolts
- hose clamps
- wrenches
- loading straps
- pump with hose
- hex wrench for hose clamps

In rough weather (waves and strong currents), the AKVA Subsea Feeder must be moored at a 45-degree angle against the weather direction, as shown in illustration 6: [Mooring the AKVA Subsea Feeder 45 degrees against the weather direction](#).

Illustration 6: Mooring the AKVA Subsea Feeder 45 degrees against the weather direction



4.2 ASSEMBLY AND INSTALLATION GUIDE

The Subsea Feeder must be assembled in an area that can accommodate the full diameter of the sinker tube ($\varnothing = 5.5$ m).

Once assembled, use a crane or similar capable of safely lifting the cyclone and main pipe to move the AKVA Subsea Feeder to the pen. The top and bottom parts must be flanged together with bolts tightened to a torque of 12 Nm.

Procedure:

1. Attach the top and bottom sections of the distribution chamber together using flange bolts tightened to a torque of 12 Nm.
2. Attach the hose between the pump and the distribution chamber using hose clamps. Use tape to attach the hose to the branching pipe.
3. Tape the cable from the pump and riser pipe to the main pipe.
4. If an underwater light and/or camera is attached to the unit, cables shall be taped to the riser pipe and pump cable.
5. Tie 4 loading straps around the main pipe and drape them over the floating collar.
6. Follow-up inspection before placing the AKVA Subsea Feeder in the cage:
 - Check the unit for surface cracks, other potential damage and sharp edges.
 - Make sure all hoses and cables are properly attached/taped to the unit/main pipe.
 - Ensure the feeding hose is properly attached to the cyclone.
 - The loading straps to moor the unit must be properly tied around the main pipe and draped over the floating collar.
7. Measure 30 cm in from the end of the hose and mark that spot. Slide the hose 30 cm into the opening on the side of the cyclone. Make sure to attach the hose properly. The inlet on the cyclone fits a 90 mm feeding hose.
8. Attach a 20 mm rope to each of the four straps. Rope length shall be from end of lifting strap to pen and attachment around the pen edge with 1 m slack in each direction.

Illustration 7: AKVA Subsea Feeder is placed in the pen centre



4.3 ATTACHING TO PEN

Attach the AKVA Subsea Feeder to the edge of the cage using four loading straps attached to rope, as shown in illustration 6: [Mooring the AKVA Subsea Feeder 45 degrees against the weather direction](#).

The ropes must be attached to the pen as instructed in the relevant user manuals for the specific pen and net used. In some pen, ropes may be attached to the handrail. Whether this is possible depends on the capacity of the specific pen and handrail. In cases where the rope must be attached to the bottom of the post or around the pen ring, pull it through the net as instructed in the user manual for the relevant net. Reinforcing the relevant section of the net will probably be required.

4.4 INSTALLATION IN TUBENET™

When installing the AKVA Subsea Feeder in a Tubenet™, follow the installation procedure described in this user manual. Personnel who will be installing the Tubenet™ shall review and familiarise themselves with the process before proceeding with the installation. When installing the Subsea Feeder in a Tubenet™, do this before the inner float in the Tubenet™ is moored into position in the middle of the outer float. Temporarily moore the inner float near the edge of the floating collar to simplify lifting the Subsea Feeder into position in the tube. Make sure to use approved lifting equipment and a crane with sufficient capacity for the operation. We recommend using two cranes when lifting the AKVA Subsea Feeder for installation in a Tubenet™.

5 OPERATION

It is important to check that all mooring ropes between the AKVA Subsea Feeder and pen are intact and that the unit floats properly when in use. Underwater camera surveillance is a great advantage when using the AKVA Subsea Feeder, as it allows monitoring whether the pump is running and the feed is coming out of all the branching pipes as expected.

5.1 PARTICULAR ENVIRONMENTAL CONDITIONS

In extraordinary weather conditions in winter, such as frost and drift ice, determine whether it is necessary to remove the AKVA Subsea Feeder from the pen until conditions improve, to prevent the feeder from coming loose, causing damage, and ultimately damaging the net in the worst-case scenario.

5.2 SHORT-TERM EXTRAORDINARY LOADS

The AKVA Subsea Feeder shall not be moored so tightly to the pen that it risks being exposed to direct loads in the unfortunate event that a feeding boat or wellboat hits pen or moorings. Have some slack in the attachment rope, to avoid extraordinary loads deforming the pen ring significantly and ultimately causing a heavy load on the AKVA Subsea Feeder main pipe.

5.3 IDEAL AIR VELOCITY

Feeding air velocity shall be low enough to avoid crushing pellets, and high enough for the pellets to be transported through the Subsea Feeder. The pressure must be steady, and is monitored and adjusted with air monitoring in the feeding software (such as AKVAconnect). The pressure in the individual feed pipe shall always be kept steady.

Ideal air velocity depends on factors such as quality and length of the feed pipe, quality and size of pellets, and temperature. Velocity shall therefore be adjusted to achieve stable pressure.

Feed rate will also vary with biomass and amount of feed to be distributed, and air velocity shall therefore also be adjusted according to the feed amount.

Contact AKVA service personnel for assistance with adjusting air speed. Contact information is found at the back of this manual.

6 MAINTENANCE

An AKVA Subsea Feeder will, when treated correctly last for 5 years. Do not use the feeder if damage that may impact the construction is caused to it before 5 years have elapsed. Such damages must be repaired before the feeder is used.

Following a storm, impact from a boat and similar unforeseen events, the entire unit must be inspected as soon as possible. This can be done in the sea with a diver or ROV, or by lifting the entire unit out from the sea for control. It is important to check all welding points, flanges, connections and attachments, and ensure that there is no damage, such as of holes, dents or other damages to the various components.

AKVA Subsea Feeder must not accumulate high amount of biofoul, as this causes unwanted weight to the construction, and thus not function as expected. Visually control how the feeder floats in the sea: the floating collar shall always be visible and the cyclone kept so high that it is not filled with water due to waves.

Check with an underwater camera underwater, preferably at the same time as divers or ROV are inspecting the cage periodically.

If significant growth of shells and barnacles is detected on the sinker tube, it is important that this is removed immediately, as this may come into contact with the net when it is pulled in to the pen edge. This may damage the net, and the consequent danger of escape.

AKVA Subsea Feeder may be lifted out of the net and cleaned with a high pressure cleaner. When the feeder is out of the water, check all components for damages.

Icing may occur during the winter season, and all ice must be removed, as this also affects weight and stability of the AKVA Subsea Feeder.

Both pump hose and the riser pipe have a strainer at the water inlet. These must be checked every month during periods of high temperatures/summer season, and must be cleaned if they are exposed to biofouling. Rinse with water and scrape gently if necessary. Be careful not to damage the strainer surface. A cleaned strainer is important for proper water intake.

6.1 DISINFECTING EQUIPMENT

If any of the equipment, ropes or other components are being moved to a new location, it is legally obligated to disinfect everything to prevent potential contamination. We recommend rinsing the equipment with fresh water after disinfection, since disinfectants tend to contain corrosive chemicals that may damage surfaces.

6.2 MAINTENANCE INTERVALS

To maximise the service life, it is important to have the AKVA Subsea Feeder serviced regularly. The various tasks required to maintain the AKVA Subsea Feeder are divided into daily, weekly, monthly and biannual (every six months) procedures.

All performed maintenance tasks must be recorded on a dedicated form, to ensure they are performed according to the correct maintenance schedule. Use signatures/initials to track who has carried out the various tasks, and remember to fill in relevant date/week/year for each completed task.

Daily:

Check mooring ropes.
Check buoyancy.

Weekly:

Check biofouling and remove if necessary (high water temperature, summer season).
Check icing and remove if necessary (low water temperature, winter season).
Remove grease deposits from inside the cyclone *

Monthly:

Visual inspection of welds (with camera).
Visual inspection of damage to pipes (with camera).
Visual inspection of strainers, clean if necessary (periods of high water temperature).
Visual inspection of zinc on pump and earthing.

Twice a year, the AKVA Subsea Feeder is taken out of the sea:

Control straps and ropes, and replace if required/worn.
Control metal components for corrosion and wear.
Check bolt connections.
Check plastic welds for cracks visually.
Clean the entire feeder.

** Clean the inside of the cyclone with a high pressure washer and/or brush. If grease deposits are not removed regularly, it may cause densifications inside the AKVA Subsea Feeder. In such case, the entire unit must be dismantled and cleaned inside.*

7 DECOMMISSIONING



RECYCLING

Recycle equipment according to relevant regulations.
Recycle as much as possible.

All components of AKVA Subsea Feeder shall be delivered to the nearest recycling station after use. The feeder unit consists of PE and aluminum (the cyclone) which can be recycled entirety. The pump used to power the main pipe shall be disposed of as electronic waste (EE).

- Sort and dispose of metal parts, supply different types of metal for recycling.
- Deliver electrical parts for recycling.
- Deliver plastic for recycling.

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APPENDIX A - MAINTENANCE FORM

- Use one form per Subsea Feeder per month/4 weeks.
- Grey box = do not execute the task.
- White box = execute the task and sign after execution.
- Fill in deviation form for any deviation discovered.

Date	Check mooring ropes	Check buoyancy	Check biofouling and remove when required	Check icing and remove when required	Remove grease deposits inside the cyclone	Visual inspection of welds, pipe damages	Visual inspection of strainers, clean if required	Visual inspection of zinc on pump and earthing	Comments

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About AKVA group

AKVA group is present in all markets with offices in Norway, Chile, Denmark, Scotland, Spain, Greece, Iceland, Canada, Australia and Turkey. AKVA group is a unique partner with the capability to offer both pen farming and land based aquaculture operations with complete technical solutions and service.

By developing technology focused on solving the biological challenges, we contribute to the continued development of a sustainable industry. Good operational performance and fish welfare are paramount in achieving good results, and investing in our technology will help deliver both.

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