



MAINTENANCE MANUAL

Akvasmart CCS Feeding System

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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



Very important information



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



Warning - may cause personnel injuries



Danger! - Will cause dangerous situations and danger for personnel



Danger of high voltage

1.1.1 Other symbols used in this manual



Go to or see page or chapter for further instructions or more information

1.2 General



The system must not be operated, and no work may be performed on the system before the safety precautions described in this manual have been read and understood.

This safety information covers functions that are involved in the Akvasmart CCS feeding system maintenance. The information does not cover how to design, install and operate a complete system, nor does it cover all peripheral equipment, which can influence the safety of the total system.

To protect personnel, the complete system has to be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country in which the system is installed. The system users are responsible for following these regulations, this is not AKVA group ASA's responsibility.

The Akvasmart CCS feeding system users have to ensure that the applicable safety laws and regulations in the current country are complied, and that the safety devices necessary to protect people working with the system, have been designed and installed correctly. People who work with the Akvasmart CCS feeding systems must be familiar with the operation and handling of the system, described in applicable documents. Apart from the built-in safety functions, the system is supplied with an interface for external safety device connections. Via this interface, external emergency stop switches can be incorporated into the system. Please refer to the emergency stop switches' own installation manual for information on how to install this.



Safety procedures regarding work with, by or on the feed line and its containing equipment must be followed to prevent personnel and equipment injuries

1.3 Emergency-stop

"Emergency stop is a condition which overrides all other system controls, removes drive power from the motors, stops all moving parts and removes power from other dangerous functions controlled by the system."

The emergency stop must be activated when any danger to people or equipment occurs. A built in emergency stop button is located at the front of the main control cabinet door.

Additional emergency stop buttons can be connected to the safety chain by the user, as long as they fulfill the requirements of "EN 418 Safety of Machinery, Emergency stop equipment, functional aspects."



Before restarting anything after an emergency stop, the reason of the stop needs to be examined and repaired

1.4 Safety risk related to the feeding process

The system automatically starts feeding in accordance with an user defined schedule. This schedule may be predetermined, or it follows signals from Doppler pellet sensor among others.

Feed is transported from the silos to the cages using compressed air, and the fish feed have a high speed when leaving the transport pipe via the rotor spreader. Personnel must not be in the area around the pipe outlet, unless the system main switch has been turned off and secured in locked position, because of the risk of injury related to flying feed pellets. Covers on blowers, dosers and selectors must never be removed during operating mode (feeding).

The farm owner and the operations manager are responsible for installing appropriate warning signs regarding this risk prior to setting the system into operation.

1.5 Risks during installation, use, maintenance and repair

To prevent injuries and damages during installation, use, maintenance and repairs, the regulations applicable in the country concerned, and the instructions from AKVA group ASA (hereunder this manual), must be complied with.

Special attention must be paid to the following points:

- Electric shock may appear because of the static electricity appearing between the pellets and the HDPE pipe material. The electricity inside may cause severe shocks when cutting the pipes endangering the life and health of the user. Cutting should only be performed by qualified personnel
- The instructions in product specification manual, installation-, maintenance- and repair manuals must always be followed
- The system supplier must ensure that all circuits delivered with the safety functions are interlocked in accordance with the applicable standards for that function
- Those who install the system must have the appropriate training for the system in question, as well as for any safety matters associated with it
- Emergency stop buttons must be positioned in easily accessible places so that the system can be stopped quickly
- Those in charge of operations must make sure that safety instructions are available for the installation in question.



Although troubleshooting may, on occasion, have to be carried out while the power supply is turned on, the main rule is that the system must be turned off and secured in OFF position during installation, maintenance and repairs, thus disconnecting all electric leads and disconnecting or connection of units.

1.6 Risk associated with live electric parts

A danger of high voltage is associated with the following parts of the system:

- The mains supply/mains switch of the main control cabinet
- The frequency inverters of the main control cabinet and the selector valve
- The motors for driving the dosers and the selector valves
- The external voltage connected to the main control cabinet mains switch remains live even when the mains switch is turned off.

Electric installations and maintenance of such, must always be performed by authorized personnel.

1.7 Risks associated with high surface temperature

The outlet air of the blower can be hot when the system is running. This means that the air transport pipes are very hot, and these surfaces must not be touched without using protective gloves, because touching presents a risk for personnel injury. Care must therefore be taken to avoid touching these pipes without protective gloves before they have cooled down. Farm owner and the operations manager are responsible for set up warning signs regarding hot surfaces, these signs must be set up prior to any operation of the system.

The dosers' motor and the selector valve motor can become hot during system operation and must not be touched without protection gloves before cooled.

Main power switch must always be turned off and secured in off position before any work to the feed line parts commence, and must not be turned back on before all work is completed.



INFORMATION IN THIS SAFETY CHAPTER MUST NOT BE REGARDED AS A WARRANTY FROM AKVA GROUP ASA. THE FEEDING SYSTEM MAY CAUSE DAMAGE EVEN IF THE SAFETY PROSEDURES ARE FOLLOWED

2 Introduction



This user manual is part of the equipment delivered with Akvsmart CCS Feed System. Keep the manual for as long as the feed system 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 feeding system. Do not hesitate contacting us for more information regarding maintenance for Akvsmart CCS Feed System or any other AKVA product.

The purpose of this manual is to make the user able to maintain the Akvsmart CCS Feed System in a safe and economical way. The manual will show how to perform any maintenance on the various components, and hopefully it will answer most day to day questions regarding the feed system.

If any information is missing from this manual, please contact AKVA group for assistance and help to find a solution to any problems. Contact the AKVA service department, your subcontractor, your local AKCA office or our main office in Norway for assistance and help.

2.1 How to use this manual

This manual describes how maintenance of the different parts in the Akvasmart CCS Feed System are being performed in the safest possible way. This entire manual must be read and understood by ALL participants in the installation process PRIOR to the installation.

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

Chapter 1 is the most important chapter of the manual. Here are all safety precautions, warnings and other safety information that ensures safe maintenance. This, of course, assumes that all workers have read and understood the manuals contents.

Chapter 2 provides general information to how AKVA work, and gives instructions for before starting up the Akvasmart CCS Feed system. This current chapter also provides information about the different parts of the system.

The following chapters, 3-10, provide short introductions to the different parts, and also describes how to maintain, control and clean each one of them.

Chapter 11 gives instructions for maintenance registration, and frequency tables and registration forms are found here.

Three 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, and pages for notes about new and extra information are also in the back of the manual, and contact information is found in the back of the manual.



This entire manual must be read and understood, and also be used during the maintenance work done to the Akvasmart CCS Feed System

2.2 About AKVA group

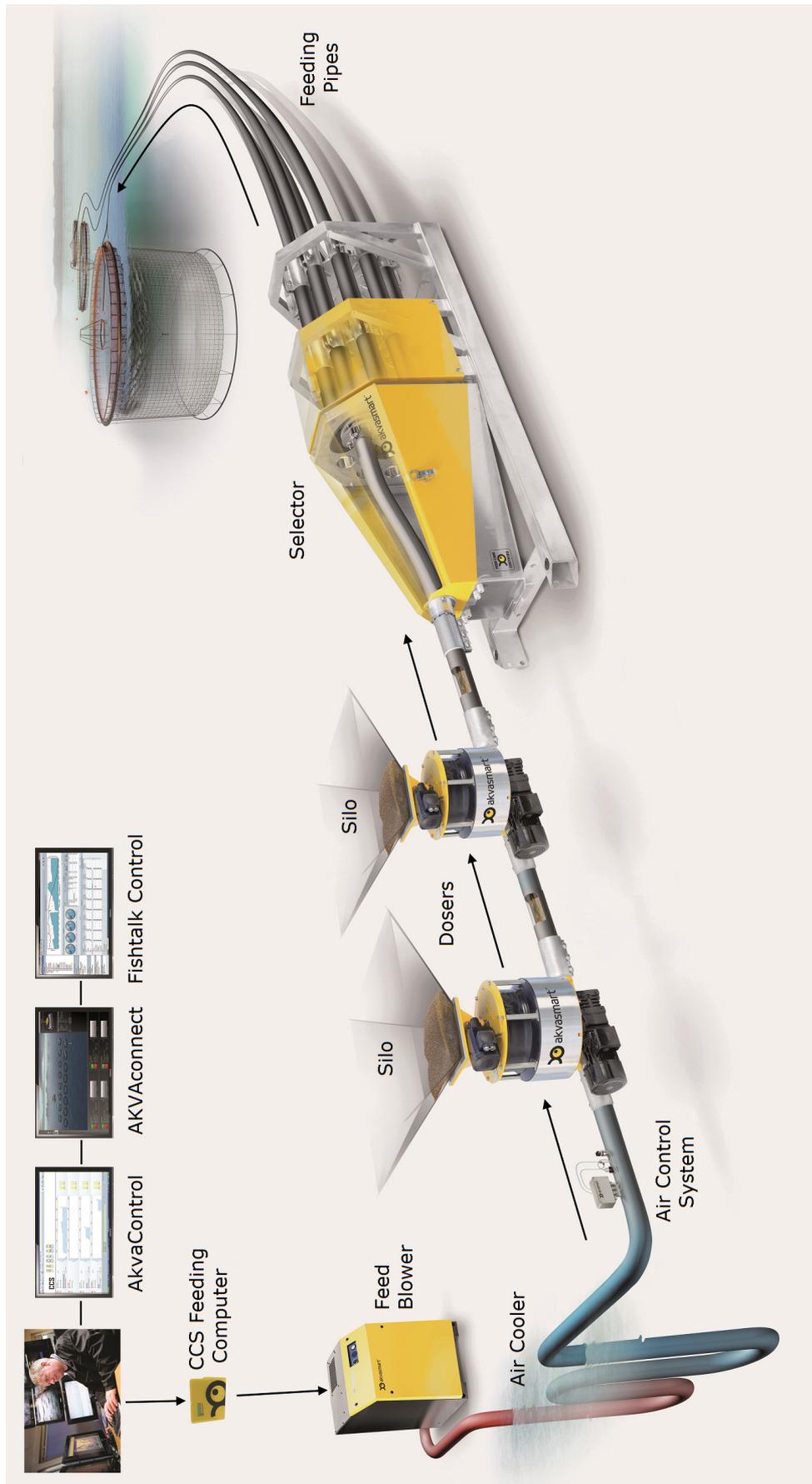
With four main brands, AKVA group ASA is a world leading supplier of technical aquaculture equipment. Since 1980 we have developed and produced fish farming equipment, both for cages at sea and for land based hatcheries. AKVA represents an industrial standard, which is presumed to be the turn key to 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 maintain the components of the Akvasmart CCS Feed System 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 for you. Having our own production site gives you excellent service in case something should go wrong, or if you are in need of any assistance. Our service staff is available on the telephone or on location in order to assist you if necessary. Safety, both for users and equipment is our main focus when developing products and product manuals.

2.3 Components of the Akvsmart CCS Feed System



All of our feeding system products are developed according to these European directives:

- EMC directive, 2004/108/EC
- Low voltage directive, 2006/95/EC
- Machinery directive, 2006/42/EC

The central feed system concept was invented by AKVA in 1980 and Akvasmart CCS Feed System is today the most popular and reliable feed system worldwide. The system is suitable for all species feeding on pellets. It is now also fully integrated with camera control, pellet- and environmental sensors, as well as Fishtalk production control software. All feeding and environmental data is stored in the Fishtalk database. This unique integration allows for full overview and control of all operational activities from farm site to top management level.

The Akvasmart CCS Feed System will feed correct amounts, at the optimal rate, on time every time. This powerful system provides great opportunities to optimizing the feeding process.

The Akvasmart CCS Feed System is designed to handle up to 20 parallel feed lines and several cage or tank units, using centralized- or hopper feeders or a combination of both, all possibly operated from one PC, iPad or smartpone.

Akvasmart CCS is the perfect choice for feeding fish, designed to fit the requirements from low capacity system such as CCS-32, up to high capacity systems such as CCS-110. The Akvasmart CCS Feed System is designed to fulfill all feeding requirements, regardless of species or how you want to feed your fish.

The configuration of the system is based on transport lengths, biomass (feed amount), number of units (cages) and species.

The capacity of the feed system depends on the technical quality of the pellets, the feeding regime and the length of the feeding pipe.

System:

		CCS-32	CCS-63	CCS-90	CCS110	Comments
Feeding pipe size	[mm/"]	32/1	63/2	90/3	110/4	Imperial (North America)
Wall thickness	[mm/"]	2,9/0.11	4/0.16	7/0.28	6,3/0.25	

Feeding data (for each feed line):

Pellet sizes */**	max.(mm)	5-7	9-12	17-25	25+	Must be evaluated for each cage
	min. (mm)	No.2 crumb	1.2	3	3	
Max feeding capacity */**/**	kg/hour	648	2520	5220	5220	With VariDoser 1500
	kg/hour	-	-	11520	11520	With FeedDoser 4000
Max feeding rate */**/**	kg/min.	10.8	42	87	87	With VariDoser 1500
	kg/min.	-	-	192	192	With FeedDoser 4000
Min feeding rate */**/**	kg/min.	1.2	2.4	3	3	
Min feed dose (single dose) */**	grams	10	20	40	50	With VariDoser 1500
	grams	-	-	200	200	With FeedDoser 4000

*Depending on actual transport distance

** Depending on feed type, technical feed quality, pellet size, feed rates, system settings

*** At continuous feeding

Transport lengths:

Max. feed pipe length	m	300	600	800	1400	*/**
Max. feeding rate at max. feeding pipe length	kg/min.	3.6	12	10	30	***
Max. feeding rate at half of max. feed pipe length	kg/min.	5.4	21	108	150	***
Max. feeding rate at short feed pipe length */**	kg/min.	10.8	42	87	87	With VariDoser 1500
	kg/min.	-	-	192	192	With FeedDoser 4000

*Depending on actual transport distance

** Depending on feed type, technical feed quality, pellet size, feed rates, system settings

Power consumption (max):

Feed Blower	kW	7.5	15-18.5	22-30	45	
Selector Valve	kW	0.18	0.18	0.18	0.18	
FeedDoser	kW	0.37	0.75	-	-	Max load/unit
VariDoser	kW	0.37	0.75	-	-	Max load/unit
Auger and sluice	kW	1.5	1.5	1.5	1.5	

2.3.1 Blowers



The blower generates the air pressure to transport the feed to each tank/cage. The combination of air control system and frequency regulated blowers makes it possible to optimize the pellet transportation. The air speed can be adjusted to optimize both feed spread and gentle feed handling. The blowers are delivered in high quality silencer cabinets which ensures a comfortable work environment.

AKVA provides four different feeding pipe line sizes: 32mm, 63mm, 90mm and 110mm, and we provide different blowers for the different pipe sizes. To simplify the selection of blower capacity, we have created a blower standardization:

Blower type	Effect
CF32	7.5kW
CF63	15kW
CF90	22kW and 30kW
CF110	37kW and 45kW

The engine capacity is provided from actual load from the blower; the systems back pressure.

Back pressure depends on several variables, such as:

- Pipe length
- Blower speed
- Feeding regime (kg/min).

2.3.2 Cooling system

The transport air will be compressed from ambient pressure up to a maximum of 1 bar over-pressure. The pressure depends on feed pipe length and feeding regime. Compressed air generates heat (up to 120°C), and it is important to cool down transport air as well as surrounding components to a minimum temperature before it reaches the dosers. Preferably down to 25°C, depending on the location. Therefore we install the air cooler after the blower.

AKVA provides both air-to-water-cooler, gives air temperature 5-10°C higher than ambient temperature, and air-to-air-cooler, that gives air temperature 5-20°C higher than sea water temperature.



2.3.3 Dosers



Custom Feed Doser Valve are used to transfer feed into the air flow. This is a critical part of any feed system, and in order to meet all our customer's needs, we can offer both feed doser valves and feed augers with sluice valves for this purpose. The Akvasmart Feed Doser Valves are designed in two main models: VariDoser 1500" and FeedDoser 4000".

Compared to the auger concept, the new doser rotor will more carefully and accurately transfer the pellets down to the feed pipe, and they cause minimum pressure contact and pellet damage. The pellets are transported in controlled separate doses from the silos to the feeding pipe below, and then they are blown out to the cages. Service and cleaning of the feed doser can easily be done in 30 minutes.

The feed capacity for Akvasmart Dosers varies from 10g per second up to 192 kg per minute, and 8 different dosers may be connected to each feeding line.

Feed Doser	VariDoser Start	VariDoser	Doser 4000
Min. feed rate (g/sec)	30	100	200
Min. feed rate (g/sec) - pulse	15	75	150
Max. feed rate (g/sec)	400	1250	2500
Material	Polyethylene (PE)/ Cast iron/ Stainless steel	Polyethylene (PE)/ Cast iron/ Stainless steel	Polyethylene (PE)/ Cast iron/ Stainless steel
Weight	75kg	75kg	95kg

2.3.4 Selectors



The Feed Selector Valve is the connection point for the HDPE feeding pipes. The pipes are exposed to the full forces of the ocean, and consequently we have designed a very rugged strain relief bracket that can handle the expected loads.

AKVA's product line includes a wide variety of Selector Valve models with connections from 4 to 60 feeding pipes (depending on model).

Feed Selector	CCS32	CCS63	CCS90	CCS110
PE pipe dimension	32mm (1")	63mm (2")	90mm (3")	110mm (4")
Max pellet size	5-7mm	9-12mm	25mm (1") *	25mm+ (1"+)
Outlets	32-60	24-32	4, 10 or 24	4 or 8
Materials	Stainless steel/ aluminum	Stainless steel/ aluminum	Stainless steel/ aluminum	Stainless steel/ aluminum
Weight	45-55kg	45-55kg	50-65kg	50-65kg

* Depending on model/ex. pipe restrainer

2.3.5 Rotor spreader



The unique Akvasmart Rotor Spreader is designed to provide excellent feed spread in cages. All our models have adjustable lightweight aluminum rotor pipes that allow for lower air speed for start-up and rotation. The Akvasmart Rotor Spreader requires 20-30% less air speed than other feed spreaders. This means less dust and breakage, power consumption, back pressure, air temperature, noise and wear and tear on the feed pipes. The unique ventilated Zenon bearing does not corrode, and due to its light displacement and low point of gravity, the Rotor Spreader is very stable in rough seas. All Akvasmart Rotor Spreaders are easy to install and simple to maintain.



For maintenance for rotor spreaders:

www.akvagroup.com/products/user-manuals

Rotor spreader	RS-63C	RS-90C	RS-110C
PE pipe dimension	63mm (2")	90mm (3")	110mm (4")
Max pellet size *	12mm (1/2")	25mm (1")	25mm+ (1"+)
Recommended RPM *	50-100	50-100	50-100
Spread diameter (adjustable) *	Approx. 4-12m Ø (12-40')	Approx. 5-18m Ø (16-60')	Approx. 5-18m Ø (16-60')
Materials	Stainless steel/alum Rotor/POM (Delrin) Polyform buoy	Stainless steel/alum Rotor/POM (Delrin) Polyform buoy	Stainless steel/alum Rotor/POM (Delrin) Polyform buoy
Height above water	1.2m (4')	1.2m (4')	1.4m (4'6")
Draft	1.8m (6')	1.8m (6')	1.8m (6')
Total weight	Approx. 30kg (66lbs)	Approx. 33kg (73lbs)	Approx. 38kg (84lbs)

**Depending on feed system and feed type*

2.3.6 Air Control System

The Air Control System is installed between the Air Cooler and Feed Doser and allows for real time measurement of airflow, back pressure and temperature, ensuring optimal feed handling, as well as significantly reducing the risk of blockage and breakage.



- if air speed is too low, the risk for pellet breakage and blockage increases
- if air speed is too high, dust and breakage increases

The system will also supervise and log air speed, back pressure and air temperature.

2.3.7 Smart Remote Control



This remote control item provides new opportunities for the fish farmer. The rugged Tablet PCs give you access to all the functionality in AkvaControl and Fishtalk while away from the control room. You can control the feed system, look at environmental sensor readings and watch video from the feeding cameras, only using the Remote Control.

2.3.8 Cleaning feed pipes

A injector for feed pipe cleaners is installed between the air control and the first doser in the feed line, and works as an entrance for cleaning plugs that collect condense and feed remnants and other waste out through the feed hoses.

AKVA provides three different types of injectors:



- "Cleaning Plug Injector" is the first generation injector, and is an y-shaped fully manual injector. Open the lid, insert the plug and close the lid



- "Feed Pipe Cleaner Manual w/handle" with handle has a magazine where the plugs are stored. The plugs are sent into the feed pipes by turning the handle placed between the magazine and the feed pipe



- "Feed Pipe Cleaner Motorized" injector also have a magazine for plugs, and by pressing a button, the plug will be inserted to the feed pipe. This button is mounted on the engine box, and may also be installed in the barge control room.



For maintenance for feed pipe cleaners:

www.akvagroup.com/products/user-manuals

3 Blowers

When operating, this component gives a continuous air-flow to the pipe-system, and thereby transports the feed through the system in order to feed each unit in the system.



*For more information on blowers, see chapter 2.3.
Maintenance parameters are found in chapter 11.*



Remember to always turn the main switch off and secure it in locked position before any work is done with the blowers!

In the Akvasmart CCS Feed System, two different types of blowers are used; the Robuschi and the Kaeser blower.

3.1 Check and change air filter Robuschi blower



No tools needed.

- 1 Turn off the main power switch and secure in off position to make sure the blower will not start while working
- 2 Open the filter box by unscrewing the black handle on top of the filter box
- 3 Pull out the air filter and replace it with a new one
- 4 Put the lid back on, and tighten the black handle/screw by hand
- 5 Turn the main switch back on.

3.2 Check and change air filter Kaeser blower



Refer to Kaeser maintenance and repair instructions manual.

4 Dosers

Dosers are the feed distributors in the feeding system. Feed amounts per unit are set in the feeding software.



Always turn the main switch off and secure it in locked position before any work is commenced with the dosers



Disassemble dosers before maintaining gaskets and rotor. Some doser types require different disassembling methods, follow correct instructions for the current doser



If cleaning or replacing broken gaskets does not stop the air leakage, if loose couplings are a repetitive problem, or if any couplings must be replaced, contact AKVA service personnel.



For more information on dosers, see chapter 2.3.



Maintenance parameters: see chapter 11. These parameters dosers are visual controls and cleaning, and is performed by the site personnel.

If a doser leaks air, the gaskets need to be taken out and controlled. Vacuuming and a soap wash will most often stop the leaking. Lubricate the rubber gaskets with a thin layer of silicon grease after cleaning.



Always place gaskets in the rotor in exact same order as they were placed before for the doser to function

If pipe couplings leak, tighten or replace.
Also tighten, repair or replace loose electro motor wires. If they are broken and need to be changed, contact AKVA service personnel.

4.1 Gasket and rotor cleaning



After maintenance, place all gaskets in the rotor in the same order they were originally assembled



Note that images and illustrations in this chapter may deviate from how the dosers in your feed system actually looks

Procedure:

1 First, and most important, turn off the main power switch or service switch where installed, and lock it in OFF position.



2 Disassembled the doser when still attached to the silo. If the silo contains pellets, use the silo hatch that is installed between silo and doser funnel to prevent the pellets from falling out during the maintenance process. If the space is too tight for the hatch to move, loosen the bolts attaching the funnel to the silo a little bit.

3 Remove the cover before maintenance and remember to replace and lock the cover afterwards.

4 Make sure to follow the correct information for the actual doser:

- **Chapter 4.1.1:** CF10000, CF15000 and CF4000
- **Chapter 4.1.2:** VariDoser CF 1500 MKII
- **Chapter 4.1.3:** Doser CF4000 MKII

4.1.1 CF1000, CF1500 and CF4000

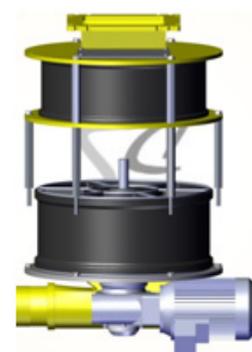
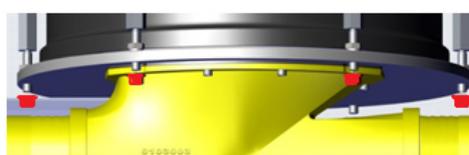


The bottom parts of these dosers has to be lowered to reach the rotor, and they are very heavy, up to 95kg. Always have HSE in focus when maintaing dosers, and make sure to protect both personnel and equipment during this maintenance operation. We recommend using a jack to lower the bottom doser parts

Procedure:



- 1 Remove the inspection hatch and vacuum inside the feeder unit through the inspection opening
- 2 Re-attach the inspection hatch after the feeder unit is cleaned
- 3 Place a jack under the doser
- 4 Release the pipe couplings and push them aside
- 5 Unscrew the six nuts underneath the base plate (red color)



- 6 Use the jack to carefully lower the bottom part of the doser (with rotor attached). Leave all stretch bolts attached to the middle- and base plates
- 7 Remove the rotor
- 8 Clean the base plate, the middle plate and the drain



9 Look over the inside of the rotor and see if it is enough to vacuum, or if it needs a proper cleaning

- a If all is good, proceed to step 11
- b If a proper cleaning is required, or if any gaskets needs to be changed, remove all gaskets from the rotor

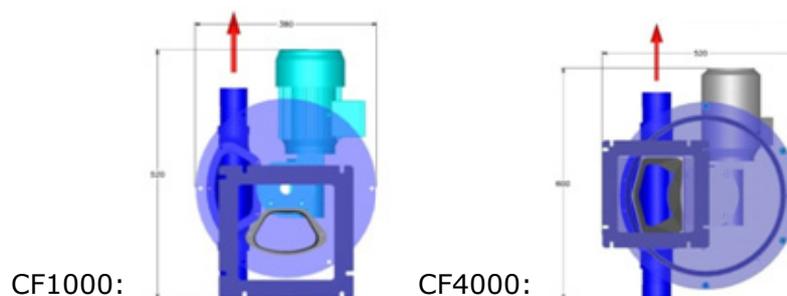
! *Remember to place the gaskets back into the rotor in the exact same order as they were placed before*



10 Clean the gaskets with warm mild degreasing soap water. Lubricate rubber gaskets with siliconc grease after cleaning. If any of the gaskets are damaged, they need to be replaced

11 After potential cleaning, and greasing, replace all gaskets in the rotor, remember correct order

12 Use the jack to lift the bottom part up to the doser top again. Make sure that the rptpr is placed correctly according to the illustration below, if not, all pellets will be crushed inside the doser during the feeding process





If the rotor is not placed correctly in the CF1000 and CF4000 dosers, the pellets will be crushed between feeder and rotor arms. This does not concern the CF1500, because it has both top and bottom gear

13 Re-attach the 6 bolts below the bottom plate

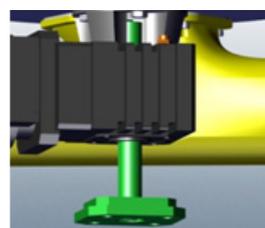
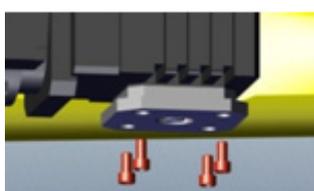
14 Re-attach the pipe couplings

15 Clean the dosers outside.

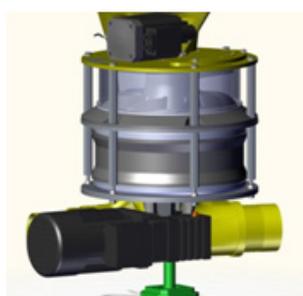
4.1.2 Varidoser CF 1500 MKII



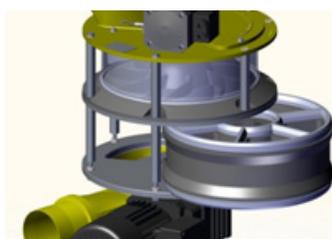
- 1 Remove the inspection hatch and vacuum inside the feeder unit through the inspection opening
- 2 Re-attach the inspection hatch after the feeder unit is cleaned
- 3 Unscrew the 4 hex bolts in the lower gear under the doser (red) and pull the shaft (green) down around 1 inch



- 4 Loosen all bolts over the top plate, about 2 turns per bolt. Remove 2 of the bolts in the front of the doser, and also remove appurtenant bolts under the bottom plate
- 5 Remove the 2 distance bolts that belongs to the removed bolts:



- 6 Loosen all distance bolts between the middle- and bottom plates just a bit
- 7 Remove the rotor from the doser
- 8 Clean the bottom- and middle plates





9 Look over the inside of the rotor and see if it is enough to vacuum, or if it needs a proper cleaning

- a If all is good, proceed to step 11
- b If a proper cleaning is required, or if any gaskets needs to be changed, remove all gaskets from the rotor

! Remember to place the gaskets back into the rotor in the exact same order as they were placed before



10 Clean the gaskets with warm mild degreasing soap water. Lubricate the rubber gaskets with silicone grease after cleaning. If any of the gaskets are damaged, they need to be replaced

11 After a potential cleaning, and greasing, replace all gaskets in the rotor, remember correct order

12 Replace the rotor in the doser

13 Replace all distance bolts and attach them

14 Also tighten the other distance bolts, plus all bolts in top- and bottom plates

15 Replace the gear and attach with the hex bolts

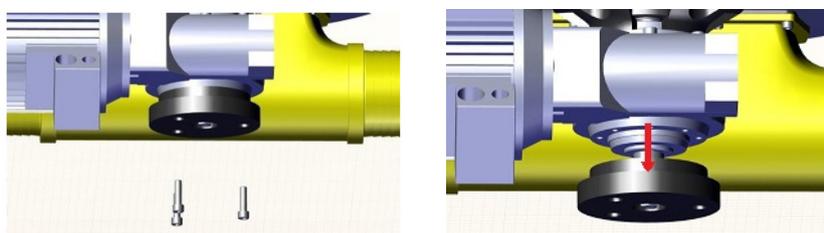
16 Clean the doser outside.

4.1.3 Doser CF4000 MKII

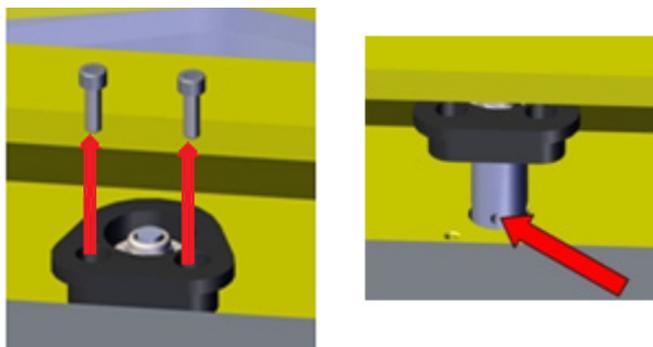


- 1 Remove the inspection hatch. Vacuum inside the feeder unit, through this opening
- 2 Re-attach the inspection hatch after the feeder unit is cleaned

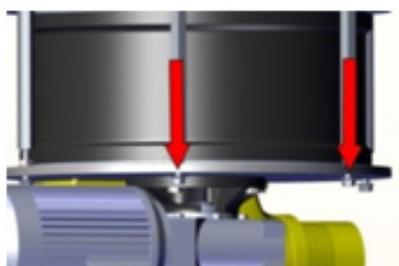
- 3 Unscrew the 3 Unbraco bolts underneath the doser, and pull the lower gear about 3cm (1.2 inches) downwards



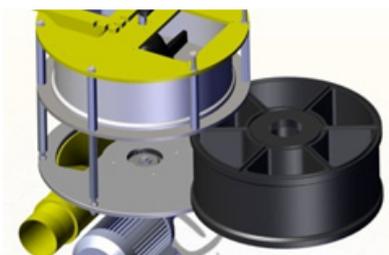
- 4 Unscrew the bolts on the top gear and pull it upwards. Put for instance a 4mm (0.16 inch) Unbraco-key in the holes in the gear shaft to prevent the gear from falling down during the work



- 5 Loosen all of the 6 nuts underneath the base plate about 2-3 revolutions. Remove the 2 nuts on the front side



- 6 Unscrew the 2 appurtenant bolts over the top plate and remove the 2 front stretch bolts
- 7 Lift the 2 top plate bolts' appurtant distance bolts from the middle plate and remove the appurtant stretch bolts
- 8 Remove the rotor and clean the middle- and base plates, and clean the drain



- 9 Clean the middle- and bottom plates, and clean the drain



- 10 Look over the inside of the rotor and see if it is enough to vacuum, or if it needs a proper cleaning

c If all is good, proceed to step 11

d If a proper cleaning is required, or if any gaskets needs to be changed, remove all gaskets from the rotor

! Remember to place the gaskets back into the rotor in the exact same order as they were placed before



- 11 Clean the gaskets with warm mild degreasing soap water. Lubricate the rubber gaskets with siliconc grease after cleaning. If any of the gaskets are damaged, they need to be replaced

- 12 After a potential cleaning, and greasing, replace all gaskets in the rotor, remember correct order

13 Replace the rotor in the doser

14 Replace the rotor on the base plate. If this is done the wrong way, all pellets will be crushed inside the doser during the feeding process



15 Replace all distance bolts and attach them

16 Re-attach top plate bolts

17 Re-attach the 2 bottom plate bolts, and tighten the other bolts under the bottom plate

18 Replace both top and bottom gears and attach them with hex bolts

19 Clean the doser outside.

5 Selector

Remember to always turn the main power switch off and secure in locked position before any work done with the selectors!

All of the visual maintenance parameters, as well as internal and external cleaning is performed by the farm personnel.

If any irregularities are discovered during selector maintenance or during use, do contact AKVA service personnel.



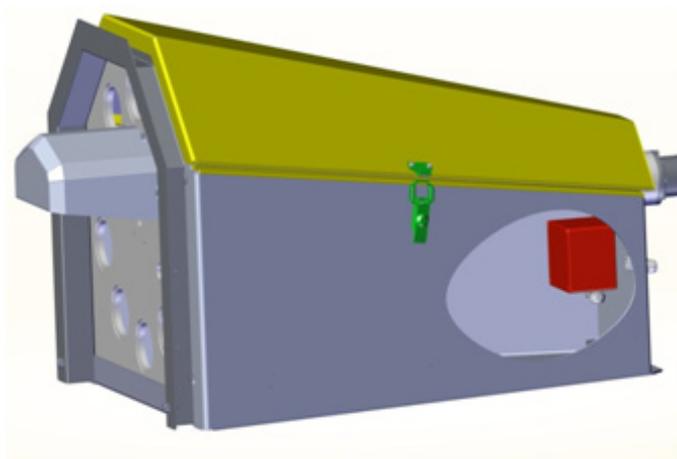
For more information on selectors, see chapter 2.3.
Maintenance parameters are found in chapter 11.



Remember to always turn the main switch off and secure in locked position before any work is commenced with the selectors

5.1 Internal selector cleaning

- 1 Unlock the cover-lock (green color)
- 2 Remove the cover (yellow color)
- 3 Vacuum then clean with warm soap water
- 4 Rinse well with a **normal water pressure hose** (never use high pressure washer here, this can destroy the electro motor)
- 5 Also be careful not to get water on or into the control box



- (red color) if this is installed inside the selector. Cover it or keep the water away from it during the cleaning
- 6 Rinse out the selector drains when necessary.

6 Feeding pipes

Whether it is necessary to remove or repair parts of the feeding pipes , or the entire pipe requires replacement, it is very important to follow these instructions and precautions:



Remember to always turn the main switch off and secure in locked position before work is commenced with the feeding pipes



Electric shock may appear because of the static electricity appearing between pellets and the HDPE pipe material. The electricity inside may cause severe shocks when cutting the pipes endangering the life and health of the user.



Therefore, the instructions in chapter 6.1 (next page) must be followed carefully

When only parts of a pipe needs to be repaired, cut off the broken part according to given instructions, and splice the extra pipe-length to the rest when necessary. Remember that the feeding pipes need enough length that they can follow the motions in the ocean at all weather conditions.

Always use adjusted pipe couplings for the pipe splicing.



6.1 PREVENTION INSTRUCTIONS

- 1 Safety equipment shall always be used while working with the feeding pipes; this includes isolating gloves and isolating foot wear. Avoid wet clothes, these may cause transient overvoltage
- 2 Set up a voltage unloader (earthing/grounding):
 - a Remove insulation in minimum 2,5mm² for proper earthing (established earthing points)
 - b Put about 2m of the cable into the feeding pipe through the selector opening
 - c Disconnect the feeding pipe from the selector
- 3 When adjusting or cutting broken pipe-parts, always make sure that the cutter is earthed
- 4 Never work with assembling or reassembling of feeding pipes by yourself, and remember to always wear approved safety-garments when working near or on the sea.

From the user manual for cartwheels, center support stands and feeding pipes, («Bruker og montasjeveiledning for hamsterhjul, fuglenettflottør og fôrslanger»), rev A, 12.12.12.

7 Rotor spreader

Regular maintenance on the rotor spreader bearing is important in order to maintain an even rotation during feeding. AKVA group recommend bearing inspection minimum every sixth month. Clean and change if required.



For more information on the rotor spreader, see chapter 2.3, and Rotor Spreader user manual. Maintenance parameters are found in chapter 11.

Follow the instructions below in order to perform the parameters correctly.



Remember to always turn the main switch off and secure in locked position before any work is commenced with the rotor spreader

7.1 Bearing cleaning



- 1 Unscrew the 3 Unbraco bolts and remove the bearing. Clean the bearing in warm, mild degreasing soap water
- 2 If the bearing is OK, put it back to its place. If it is not OK, replace it with a new bearing
- 3 Reattach all 3 bolts before tightening. Then torque one by one maximum 6Nm. If the torque is too tight the bearing house will bend.

8 Main control cabinet

The main control cabinet contains must be closed at all times, except when labor is preformed inside it. This is to prevent pellet-dust and other particles from enter the cabinet.



All information on maintenance are found in chapter 11.

In older main control cabinets, the main power switch is placed on the door of the cabinet. It is therefore easy to access for switching it off and on.



Newer main control cabinets have this switch mounted inside the cabinet, and only instructed personnel are allowed to open this cabinet.



Only instructed personnel have access to the MKII cabinets



It is important to keep the access to the main control cabinet clear and open, so that there is no problem opening it whenever it is necessary

8.1 Air filter

The air filter must be changed every three months and the air filter house must be cleaned every time the filter is changed.

9 Emergency stop



The feed systems emergency stop button is placed on the main control cabinet. In case of any emergency that can damage equipment or personnel, or if other irregularities should occur, the emergency stop has to be activated. This is done by pushing the button inwards.

It is very important that the main control cabinet, and then, also the emergency stop button, is easy to get to. Nothing must be placed in front of this cabinet.

Before the system is reset after an emergency stop, the cause of the stop needs to be determined, examined and fixed.

To reset the emergency stop button, simply twist the button either way.



Always keep access to main control cabinet and emergency stop button open and easy to reach

10 Cooler



The cooling engines needs to be checked regularly according to the maintenance plans in chapter 11. All these parameters may be checked by the fish farmers and barge personnel.

If anything is wrong, broken or torn, contact AKVA service personnel in order to repair or replace.

Further maintenance are visual controls.



Remember to always turn the main power switch off and secure in locked position before any work done with the cooling engines

11 Dust and breakage measurement

This procedure is developed to determine amount of dust and breakage of fish feed. Following the procedure ensures that all dust and breakage analysis are executed the same way, ensuring equal parameters for all measurements.

Two methods are described;

1. Manual shaking procedure and
2. Automatic procedure using an automatic sieve shaker.

11.1 Required equipment

- Scale (accuracy +/- 0.1 gram or better)
- Sieves:

Pellet	Dust	<20%>60%	<60%>80%
4 mm	1.00 mm	2.36 mm	3.55 mm
6 mm	2.36 mm	3.55 mm	5.60 mm
9 mm	2.36 mm	5.60 mm	8.00 mm
12 mm	2.36 mm	8.00 mm	10.00 mm

- Sieve pan
- Sample bags
- Container
- Cover or stretch sheet (alternatively, use a jute bag)
- Brush

Automatic shaking, also requires a test sieve shaker, HAVER EML 200 digital T.

11.2 Collecting fish feed samples:

We recommend two different alternative methods for collecting feed samples, using a large cover or a stretch sheet.

Collect the fish feed in the end of an at least 330 feet (100 meter) long feed pipe that is connected to a valve selector. The feed will exit the pipes in full speed, and then land in the collecting device.



Notice that for absolute best test results, the feed has to be handled with great care so that no more breakage or dust is created from the feed sample after it has exited the feedlines

Collecting method A: Large cover

This method creates less breakage and dust when collecting. Stretch a large cover across the cage surface, where feed lands when exiting the feed spreader, and to collect a sample of minimum 5Kg fish feed.

Collecting method B: Stretch sheet

Attach a stretch sheet at the end of the feed pipe to collect a sample of minimum 5Kg fish feed. This is the most used method.



Using the jute bag method for collecting feed will create an unknown amount of dust and breakage due to its heavy deceleration of the feed

11.3 Test procedures

11.3.1 Manual shake analysis procedure

1 Set up the sieves according to the illustration:

- a Sieve <60%>80%
- b Sieve <20%>60%
- c Dust sieve
- d Sieve pan



2 Weigh up the collected sample of fish feed, and note as (aT)

3 Place approximately 500 grams and carefully shake for 30 seconds

4 Place all unbroken pellet located in the <60%>80% sieve (the top sieve) into a garbage container

5 Place all <60%>80% breakage located in the <20%>60% sieve into a sample bag (aB)

6 Empty all <20%>60% breakage located in the dust sieve into a new sample bag (aEB)

7 Empty all dust located in the sieve pan into a third sample bag (aD)

8 Repeat steps 3 to 5 until the entire feed sample is screened

9 Calculate Breakage% in Sieve<60%>80%:

$$- (\text{total } aEB/aT) \times 100 = \underline{\hspace{2cm}}$$

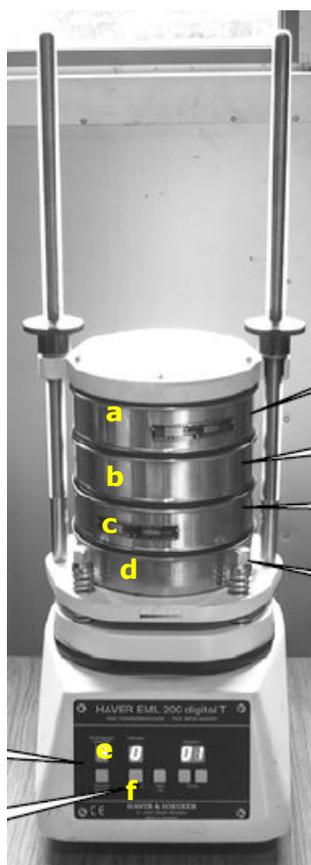
Calculate Breakage% in Sieve<20%>60%:

$$- (\text{total } aB/aT) \times 100 = \underline{\hspace{2cm}}$$

Calculate dust%:

$$- (\text{total } aD/aT) \times 100 = \underline{\hspace{2cm}}$$

10 Clean sieve pan and sieves.



11.3.2 Automatic shake analysis procedure

- 1 Set up sieves on the test sieve shaker according to this list:
 - a Sieve <60%>80%
 - b Sieve <20%>60
 - c Dust Sieve
 - d Sieve Pan
 - e Intensity set to 9
 - f Time set to 1 min
- 2 Weigh up the collected sample of fish feed , and mark it down as (aT)
- 3 Place approximately 300 grams of (aT) in the <60%>80 sieve, and turn the machine on for 1 min. with intensity set to 9
- 4 After 1 minute, empty the unbroken pellet in the <60%>80% sieve in a container
- 5 Place all <60%>80% breakage in the <20%>60 sieve in a sample bag (aB)
- 6 Place all <20%>60% breakage in the dust sieve in a second sample bag (aEB)
- 7 Place all dust located in the bottom sieve pan in a third sample bag (aD)
- 8 Repeat steps 3 to 5 until the entire feed sample is screened
- 11 Calculate Breakage % in Siev <60%>80%:
 - $(\text{total } aEB/aT) \times 100 = \underline{\hspace{2cm}}$
 Calculate Breakage % in Sieve <20%>60%:
 - $(\text{total } aB/aT) \times 100 = \underline{\hspace{2cm}}$
 Calculate dust %:
 - $(\text{total } aD/aT) \times 100 = \underline{\hspace{2cm}}$
- 9 Clean sieve pan and sieves.

12 Maintenance intervals

All components each have its own maintenance-button in the iControl software. Use this to register all maintenance rendered for the components and units.

Blowers, dosers and selectors have automatic hour-counters. The users will have total control over when the blower oil was changed the last time, and thereby know when the next change must be performed. This simplifies ordering services, parts and other equipment for the feed system.

AKVA group recommend that Akvasmart CCS Feeding System service is performed by AKVA service personnel 2 times a year.



Visual maintenance is performed by the farm personnel and is executed according to the check lists in chapter 11.3-11.6.

Non-visual maintenance:

- cleaning cooler radiator
- cleaning dosers, selectors and main control cabinet
- change filter in main control cabinet
- cleaning rotor spreader bearing

These tasks must always be performed by properly instructed and trained personnel.

12.1 Expected life cycle for the equipment

Rotary spreaders

Ball-bearing: 600 tons feed. Preventive change 80% (480 tons) to ensure the bearing 100% up time.

Aluminum pipes: Pipe connected to ball-bearing: Same interval as ball bearing (480 tons)

Pipe outlet: Preventive change: 1000 tons feed

Selectors

O-rings for S-pipe (2 inlet and 1 outlet):

- Change preventive every 2 years

Blocking device/wing:

- Change every 2 years – performed only by AKVA service personnel

Dosers

PEHD gaskets and silicon gaskets: Change every year

Engines and gear (both for selector and doser)

No oil change. Change complete unit every year.

Cooler

Galvanic anode: Change every 3 years (or when required)

Blower

Belts: Preventive change after 12000 hours or every 2 years

Oil change: 500 hours after startup. After that: 6000 hours or every year

Air filter: Every 2500 hours or every year

Lubrication generally

No maintenance with grease lubrication shall be performed

12.2 Maintenance frequencies

Blowers

Listen for noise	Once a week
Oil level	Every 6th week
Oil leakage	Once a week
Oil change*	Twice a year
Filter blockage	Once a month
Tighten belt*	Once a year
Check wear*	Once a year
Change belt*	Every 15000 hour

Coolers

Clean radiator and check for leaks	Once a week
Check fan blades	Once a week
Check engine fan	Once a month
Check hose and pipe connections	Once a month
Check electric engine cables	Once a month

Dosers

Clean dosers inside and out	Once a week
Check for air leakage and connections	Once a week
Check couplings in pipes and hoses	Once a week
El.engine: check cables and couplings	Once a month

Selectors

Clean inside	Once a week
Check for leakage	Once a week
Visual control S-pipe position, accuracy	Once a week
Check engine cables	Once a month
Listen for noise in gear	Once a month

Rotor spreader

Clean or change bearing	Twice a year
-------------------------	--------------

Main control cabinet

Change air filter and clean cabinet	Four times a year
-------------------------------------	-------------------

**executed by AKVA service personnel*

12.3 Check lists

In addition to iControl software, it is sensible to have a manual list for maintenance registration. Make copies of the check-lists on the following pages.



Go through the daily routine list every day (chapter 11.3).
Go through the weekly routine list one constant day a week (chapter 11.5 and 11.6).

Sign inside the white check boxes when the task is performed.
Do not check the gray check boxes, only the white ones.

Fill in the number of the first week the feed system is used, and fill the following first half year, then continue on the second half year in order to achieve correct maintenance frequency.

Use these lists when recording maintenance in iControl.



Copy or print more copies of the check lists, especially the daily routines. Put these in a binder and mark the last copy with a post-it note marked "Last copy" or anything similar, so it is easy to recognize the last copy and when it is time to make more.

12.6 Daily maintenance



*Fill in the week numbers to ensure correct maintenance intervals
Make copies of this maintenance plan before filling anything in*

Blower, week_____	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Pressure							
Temperature							
Effect							
Noise							
Coolant flow							
Filter vacuum							

Cooler, week_____	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Radiator leakage							
Cooler pipe leakage							

Blower, week_____	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Pressure							
Temperature							
Effect							
Noise							
Coolant flow							
Filter vacuum							

Cooler, week_____	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Radiator leakage							
Cooler pipe leakage							

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Appendix B - Deviation form


Make copies of this deviation form before filling anything in

Deviation control	No.:
--------------------------	-------------

Unit:	Producer:	Prod.no.:	Purchase year:

Deviation description:

--

Follow up proposition:

--

Date and signature, declarer:

--

Follow up directed:

--

Status:

--

New action for deviation no.:

--

Date and signature, follow up:

--

Appendix D - Contact information

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DECLARATION OF CONFORMITY**AKVA group ASA - Bryne (Head Office)**

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Home page: www.akvagroup.com**Declaration of Conformity for:** Akvasmart CCS Feeding System**AKVA group ASA declares that the system named above conforms with the following EC directives:**

- Machinery directive, 2006/42/EC
- EMC directive, 2004/108/EC
- Low Voltage Directive (LVD), 2006/95/EC

Place: Bryne

Signature:

A handwritten signature in blue ink, appearing to read 'Jan Inge Tjølsen'.

Date: 29.01.16

Jan Inge Tjølsen

Manager HW R&D

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