INSTRUCTION MANUAL

FIREMIKS
All standard models*

Original English version

* FM Approved units have their own Instruction and Operation Manuals

Firemiks AB | Sweden | VAT.no SE 556799500501
Phone +46-8-551 196 10 | info@firemiks.com | **www.firemiks.com**
ISO 9001 Certified by Bureau Veritas

Document number: FIOMAS
Revision number: 202615

Revision log

Revision (YYYYWW)	Description of changes	Section(s)
202404	First version common IOM for all FIREMIKS units	
202406	Minor improvements and clarifications across doc	-
202410	Minor improvements and clarifications across doc	-
202412	New layout, clarification on oil spec of piston pump	7.9.1
202419	Salt water flushing clarified, flushing pump only with sweet water procedure added	6.11.1
202423	Commissioning and acceptance testing sample record added in attachment, other small improvements	13
202547	Clarifications on flushing with concentrates that do not mix with water in storage. Many other small improvements and clarifications.	6.7, 6.8.
202550	Differentiation between PP and GP for maintenance rotation, other small changes	7.3
202615	Clarification salt water use	6.12

INSTRUCTION AND OPERATION MANUAL FIREMIKS®

This instruction and operation manual (IOM) applies to following FIREMIKS models:

- Flow sizes from 150lpm to 10000lpm
- Piston Pump (GP) or Gear Pump (PP)
- All dosing rates (%) and direct or belt drive
- Fixed or selectable dosing rate
- Without FM Approval (FM Approved models have a dedicated IOM)
- Customized configurations or additional features deviating from this Instruction Manual have instructions supplied separately but should be kept together in the provided folder with this instruction manual.
- Mobile units are provided with quick instructions also

TABLE OF CONTENTS

Attachments:

- Commisssioning and Acceptance Testing – sample records
- MAINTENANCE SERVICE AND TEST RECORDS
- Orgalime 2012 – conditions

Datasheet and Dimensional Drawing are supplied separately for each FIREMIKS unit, any deviating instructions there have precedence over this instruction manual. All documentation must be kept together.

Order of validity of documentation, from highest to lowest:

1. Signed letter from Firemiks - additional instructions for custom units
2. Dimensional Drawing (DD)
3. Datasheet (DS)
4. Additional instruction manual for custom units
5. Instruction and Operation Manual (IOM) (this document)
6. Quick instructions (e.g. mobile quick instruction)

1 EC Declaration of conformity

According to European Directive 2006/42/EC
Manufacturer:
Firemiks AB
Mätarvägen 9A
SE-196 37 KUNGSÄNGEN
Sweden
Tel: +46-8-551 196 10
www.firemiks.com, info@firemiks.com

Valid for all FIREMIKS models with:

- Flow sizes from 150lpm to 10000lpm
- Piston Pump (GP) or Gear Pump (PP)
- All dosing rates (%)
- Fixed or selectable dosing rate
- Without FM Approval
- Customized configurations or additional features deviating from this Instruction Manual have instructions supplied separately but should be kept together in the provided folder with this instruction manual.
- Mobile units are provided with quick instructions also

The manufacturer Firemiks AB declares that the above products conform to European Directive 2006/42/EC and are designed according to the following standards: SS-EN ISO 12100-1, 12100-2 and 13565-1

The product is manufactured under a production control system, which guarantees conformity between the manufactured product and technical data.

Installation, connection, maintenance and usage should take place in accordance with the products instructions and design, which are described in the manufacturer's technical documentation as well as according to practice. In accordance with the EC Declaration of conformity, the product must not be modified without the manufacturer's permission. If this occurs, this documented EC Declaration ceases to apply, and the products owner is considered to be the manufacturer and must verify and draw up an addendum to the EC Declaration and file technical data for the inspection authority.

2025-12-05

Firemiks AB
Mikael Aredal, Managing Director

2 Read this first!

2.1 **Check at reception of the goods that the delivery is complete and without damage. Any discrepancies and damage should be informed to the transport company and the supplier immediately.**

2.2 **For your own safety it is very important that you read all information in this Instruction Manual before you install and use this equipment. We want to point out that the user is responsible that the safety instructions are followed strictly. See also the WARNING SIGNS on the unit.**

2.3 **The FIREMIKS unit must be assembled and installed by qualified staff, with the necessary mechanical and technical skills, following the user and safety instructions given in this Instruction Manual. As the user, you are responsible that the safety and operating instructions of any other systems, environment or container where the FIREMIKS unit is installed are followed.**

2.4 **Inform yourself about the fire-fighting concentrate (additive) producer's instructions about leakages and spillage. Observe especially the directions about spillage on hands and eyes. Assure yourself also that local and national regulations are followed concerning environmental protections regarding waste leakage, spillage and tests with the fire-fighting liquid. Firemiks AB encourages any users of their products to do their utmost to prevent unnecessary spillage of any concentrate on and into the ground and groundwater if there is a possibility of a negative impact.**

2.5 **The unit must only be used under the working conditions specified in this instruction. Any deviation from that requires the producer's permission.**

2.6 **The user is responsible that the instructions according to chapter 7 *Maintenance* are carried out without failure.**

2.7 **The unit is designed to dose fire-fighting liquids (=concentrate) in fire-fighting main water line. The FIREMIKS is designed to be robust and serve in fire emergencies. It is not suitable for continuously running 24/7. For all other applications other than firefighting, contact must be made with Firemiks AB for approval, if possible, to give such.**

2.8 **The unit itself makes noise when operating.** Be sure to wear ear protection when you are continuously exposed to high noise levels.

Model size	Approx. Noise level dB (A) at max flow
150	78
450	81
800	84
1200-2400	90
3200-5000	93
6000-8000	95
10000	98

Noise level will vary with the installation. On isolated rubbers it will be lower, if there is resonance in rigid piping, it can be a lot higher.

2.9 **The maximum operating pressure of the unit can be up to 16 bar. If there is a failure of the unit or the surrounding installation, powerful water jets may occur. Always wear eye protection!**

2.10 **If necessary, information is missing in this Instruction Manual, please contact your distributor or Firemiks AB. This is particularly important if the user believes that there exist risks that are not covered in this manual.**

2.11 **If the unit is transferred to a third party, this instruction manual must follow the unit.**

2.12 Warranty terms: **For the warranty of 2 years to be valid, all instructions in this manual must be followed carefully. Full warranty terms are stated in appendix - *Orgalime S2012; General conditions for the supply of mechanical, electrical and electronic products*, unless otherwise agreed in writing.**

3 General description

FIREMIKS® is a dosing system used primarily for different types firefighting, although other applications are possible. They are referred to as **Water Motor Driven Variable Viscosity Proportioners** as they are powered by the main extinguishing water flow, and they can correctly proportion a wide range of viscosity of the concentrate.

The extinguishing water flow from a main water pump or source goes through the FIREMIKS water motor. The power of the water flow generates a circular rotor motion in the FIREMIKS water motor, which is transferred through an internal drive, an external drive gear or belt drive, to the FIREMIKS concentrate pump. The concentrate pump pumps concentrate from an atmospheric tank into the water motor outlet creating the water/concentrate mixture.

FIREMIKS is not a water pump, it is a dosing system driven solely by the existing extinguishing water flow - no additional energy source is required. The volumetric water motor acts both as a ‘flow meter’ to have the pump turn at the appropriate speed to dose correctly, and a power-take-off to power the pump. As such dosing is automatically adjusted from the amount of water that goes through the FIREMIKS, within the dosing limits as presented in your unit’s data sheet.

Designed and developed by Firemiks AB, the in-house designed multi-vane water motor gives early volumetric function without using moving elastomer sealing and without the use of springs to pre-load the vanes.

3.1 Functioning principles

FIREMIKS uses an atmospheric concentrate tank and **requires positive pressure**[1] of the concentrate liquid at the inlet of the Piston Pump (PP) type models, and highly recommended for Gear Pump (GP) type models.

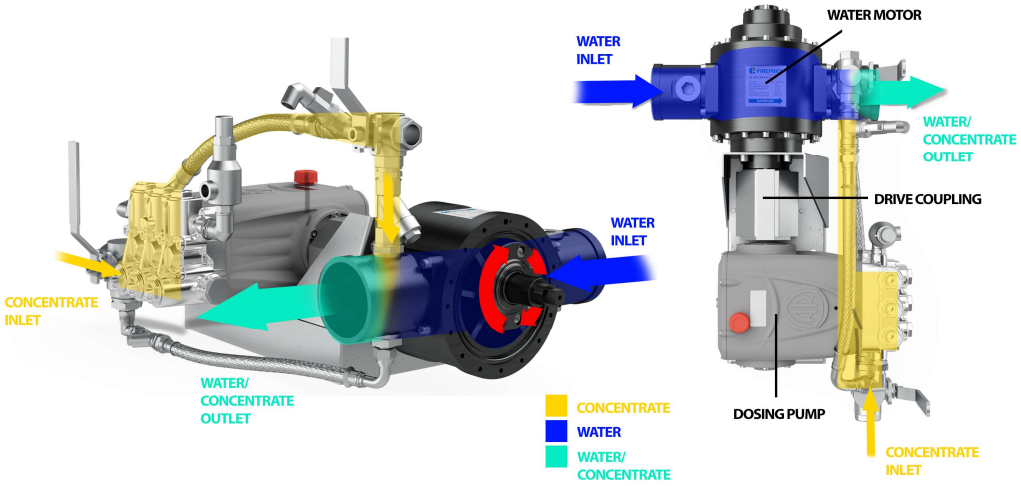


Illustration of functioning principle (piston pump PP shown)

The FIREMIKS water motor is not an engine or water pump, instead it is driven by the water flow through it. The water motor, however, does drive the dosing pump, so it is in this sense that it is a motor.

Likewise, to stop the FIREMIKS from rotating, one must stop the water flow through it.

The FIREMIKS is installed on the piping between the main extinguishing water source and the discharge devices. Most often the placement of the concentrate tank is decisive and the FIREMIKS is installed in closest possible vicinity of the tank.

The flow through the FIREMIKS is governed by the total installation. The FIREMIKS is a passive flow component with its own flow and pressure drop characteristics (see the data sheet of your model) that together with all the other piping, bends, filters, valves, discharge devices etc. will decide the flow through the system as calculated in a **hydraulic calculation**. This calculation can differ depending on the operating state, stand-by with sometimes empty piping, and in steady state flow operation.

[1] Positive pressure is reached when gravity feed overcomes the friction losses in the piping between the tank and the Firemiks pump inlet at all operating conditions.

3.2 Concentrate dosing pump types

FIREMIKS uses two types of concentrate pumps. Piston/plunger Pumps (PP) and Gear Pumps (GP). In the model designation PP or GP designates which pump type the unit has.

Both types are covered in this instruction manual. When the description is different between the two pump types, this will be presented in two columns where possible.

3.3 Automatic flushing

All standard FIREMIKS are equipped with the possibility to flush the pump with water from the main line. This is done with a 3-way valve that automatically switches between dosing (pump connected to the tank) and flushing (pump connected to the main water line) as the handle is operated – referred to as Automatic Flushing. Function and use are covered in this instruction manual.

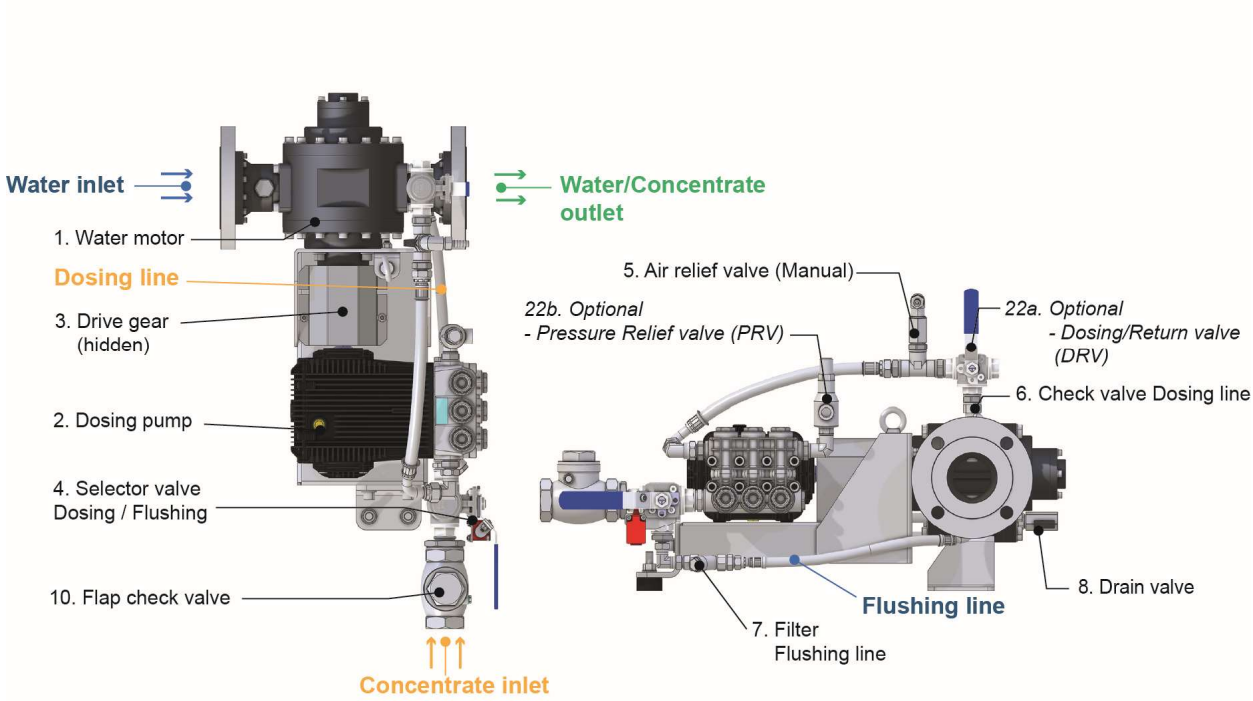
3.4 Dosing / Return Valve

All units can be optionally equipped with a Dosing / Return Valve, abbreviated DRV. This valve makes it possible for the unit to run in a system and pump concentrate from the tank, without injecting the concentrate into the main water line, instead returning it to the tank or elsewhere. This makes it possible to do function tests or, with suitable measuring equipment, dosing tests without creating a water-concentrate mix. Creating a mix when not necessary can be very costly in concentrate consumption and dealing with the clean-up afterwards, also preventing any environmental impact depending on type of concentrate used.
The DRV is always combined with a Pressure Relief Valve (PRV) (either discharge or on some GP models, recirculating) as a blocked return discharge can create overpressure.

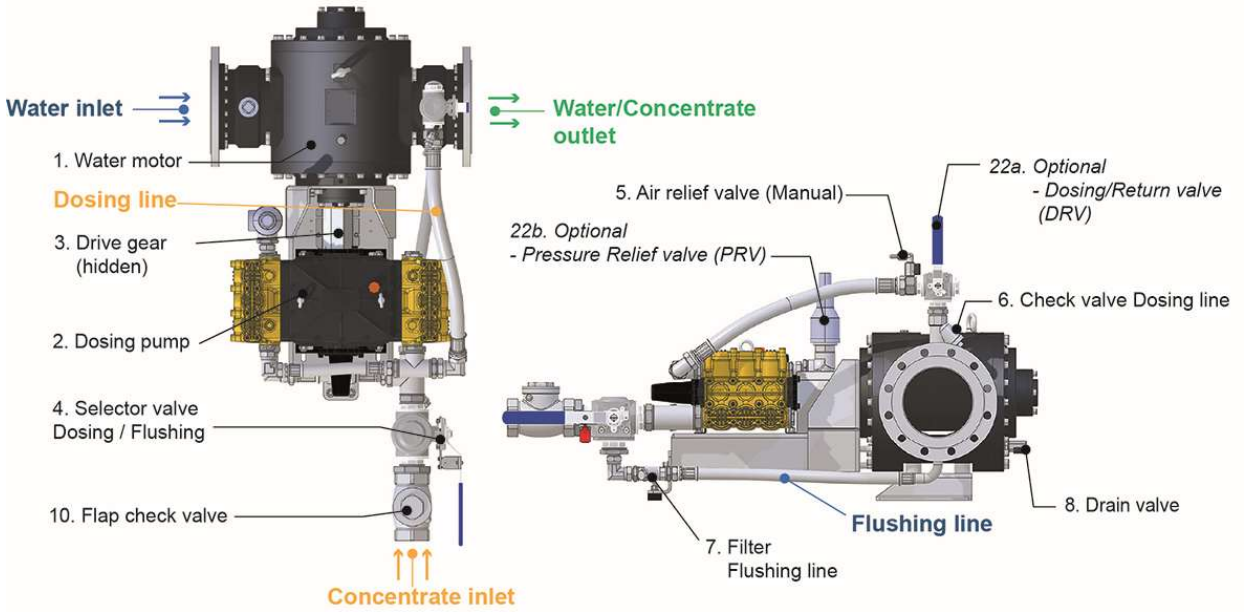
The DRV and PRV function and use are covered in this instruction manual.

3.5 General overview main parts

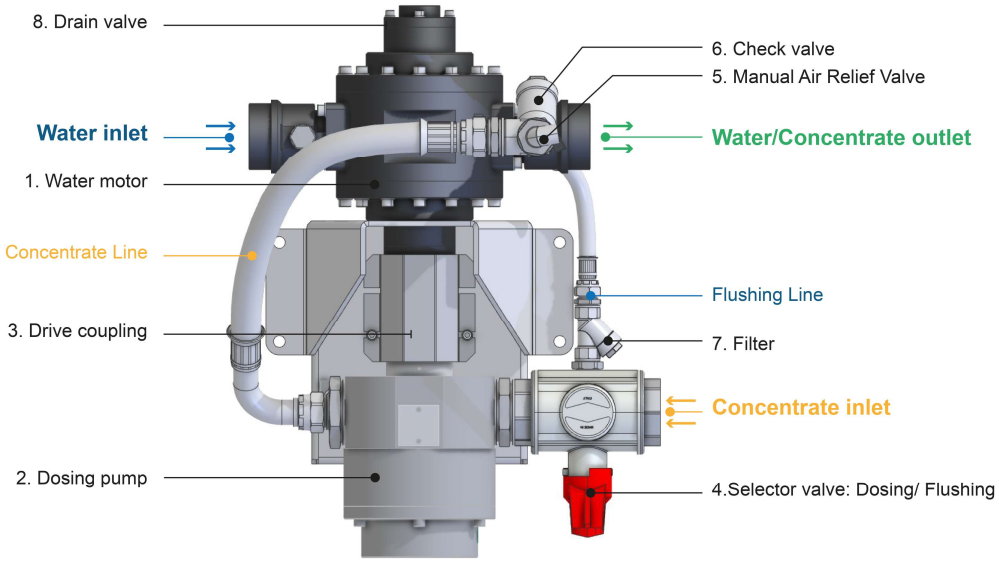
3.5.1 Triplex pump (800 shown)



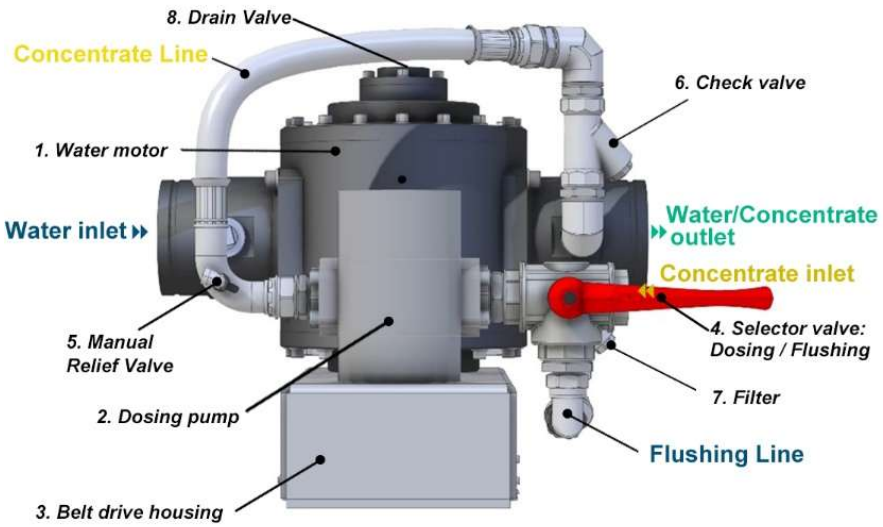
3.5.2 Sixplex pump (6000 shown)



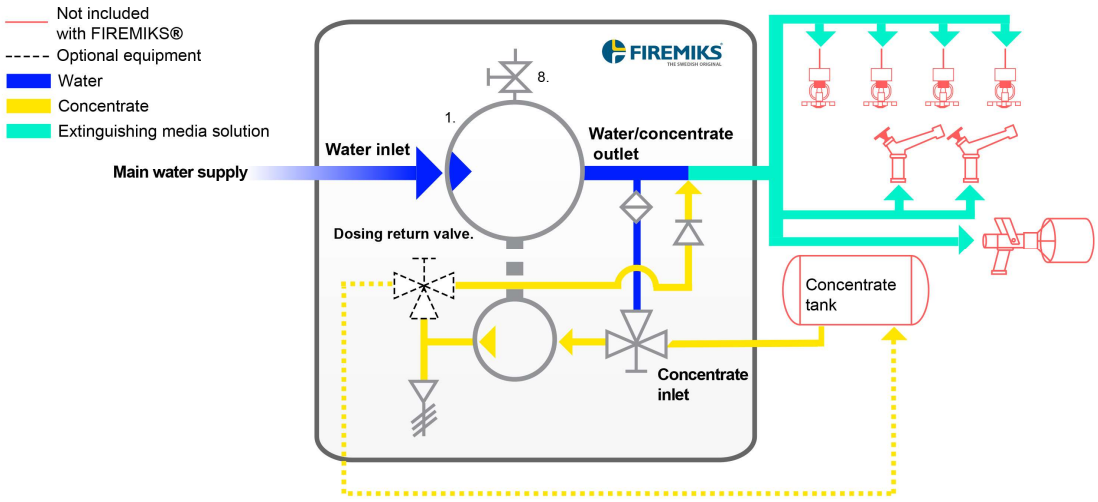
3.5.3 Gear Pump (GP) version



3.5.4 Gear Pump with belt drive version



3.6 Basic principle flow chart



3.7 Key properties of the FIREMIKS

In the following chapters the installation, use and maintenance of the FIREMIKS will be discussed in detail. In order to quickly become familiar with the unit, here we give a ***quick preview*** of the key properties that are important for trouble-free use:

- The FIREMIKS is designed for use with a solids free water supply only. Use appropriate filters where necessary.
- The FIREMIKS is designed to be robust and to serve in fire emergencies. These models have passed endurance tests for 24 hours at each unit maximum flow but is not intended to be used continuously 24/7 (contact your seller to see if such applications are possible).
- The FIREMIKS is part of the hydraulic calculation of the complete system as a passive component. It is not a water pump.
- Before installing the FIREMIKS, all piping before MUST be flushed thoroughly.
- FIREMIKS is designed to be used with water temperatures up to 55 degrees C.
- On Piston Pump (PP) type models, concentrate supply to the FIREMIKS pump inlet must have positive pressure, gravity feed must at all times overcome the friction losses in the piping between the tank and the Firemiks pump inlet. The same is highly recommended for Gear Pump (GP) type models.
- Avoid exceeding the maximum flow (=overflow) when designing the system. Water Flow through the FIREMIKS is governed by the pressure drop over the unit as per hydraulic calculation, no backpressure because of empty piping at start-up changes the hydraulic calculation and can cause overflow that will damage the unit if done repeatedly.
- Place the FIREMIKS as close to the Foam concentrate tank as practically possible. Close = less than 5m.
- The closer the concentrate tank + FIREMIKS are to the hazard, the faster the reaction time of the system and the smaller the risk for overflow.
- The FIREMIKS concentrate pump may not run dry, understand how the valves work and switch to flushing in case the concentrate is finished.
- The FIREMIKS must be operated/rotated, by water or by hand, at set maintenance intervals to prevent the seals in the unit from seizing.
- For saltwater use, do not allow salt water to dry inside the unit as salt crystallization can stop the FIREMIKS from rotating.
- Do not allow concentrate with air pockets to dry inside the FIREMIKS, this can block the unit. Always make sure the FIREMIKS was either completely filled and primed, or that the unit has been flushed with sweet water and then drained.

The above is to give a general idea and does not replace reading this whole instruction manual. In case of doubt, always refer to the chapters that follow.

3.8 Valve function on the FIREMIKS unit

For the operating instruction of *when* the valves must be operated, refer to section 6.1. This section considers the function of the valves.

Modification to valves will void warranty if this modification caused the incorrect functioning or operation of the valves. Remove handles at your own risk, as this makes it possible to incorrectly operate the valves and also makes it possible to put back the handles in an incorrect orientation, causing malfunction of the unit.

3.8.1 Selector valve Dosing / Flushing

The unit comes equipped with a manual selector 3-way valve for Dosing or Flushing.

Warning: Always make a fast and determined switch with the selector valve (No. 4 on Flow chart), leaving it only at its end positions.

Otherwise, if the selector valve is left between its two end positions, the valve may be open for both flushing and dosing and thus pressurized flushing water can enter the suction line and pollute or even overflow the concentrate tank. On fixed units a flap check valve is present that will stop this scenario, even so do not leave the valve in intermediate positions as it leaves the unit without operation.

Piston and gear pump models

Flushing

Dosing

Gear pump models with belt drive

Flushing

Dosing

Dosing means that the concentrate is added to the water stream during rotation of the unit and so fulfilling the dosing function of the unit.

Flushing is used at the end of using a FIREMIKS to remove concentrate of concentrate pump, exceptions apply, see 6.3 and 6.7. Further exceptions apply for salt water, see 6.12.1

During flushing operation, flushing can make more noise from the pump, this is normal if the filter in the flushing line is clean (see 7.4.1). See also 4.3.8 and 8.10

Automated selector valves
The end user, if necessary for the installation, may automate the valve(s) for Dosing/Flushing. Valves can be optioned with an iso5211 interface when ordering the unit, if not already present. In some cases, it is also possible to order the unit with pneumatic valves, please inquire with your distributor or Firemiks AB.

When automating the valve, double check that the flap check valve (see 3.8.2) has not been removed and that it is working. Also be sure that the automated valves have the correct opening orientation/direction, so that the valve function remains as intended – removing the handle will allow the ball in the valve to rotate into incorrect positions.

3.8.2 Flap / swing check valve

The units for fixed installations are supplied with a flap check valve also called swing check valve. It closes with the help of gravity and backflow. **This Flap check valve is not guaranteed to be drip tight**, it is intended to avoid catastrophic overflow of the concentrate tank when the dosing / flushing valve (No.4) is left in between its end positions leaving it open to all connections, which would otherwise allow pressurized flush water to quickly overflow the atmospheric concentrate tank and eventually leave no concentrate in the tank if left in this state for a longer time.

Flap Check Valve

3.8.3 Manual air relief valve

This valve needs only to be opened when the concentrate liquid is filled into the Firemiks system for the first time to ensure that all air is let out of the concentrate feed and dosing line, otherwise it should remain closed.
It can also be opened when the unit is pressurized and the Selector valve Dosing / Flushing (No.4) in the Flushing position, then it will evacuate any air in the pump and flush the concentrate pump without rotating the FIREMIKS.

Manual Air Relief Valve
without Dosing Return Valve (DRV)

Manual Air Relief Valve
with Dosing Return Valve

3.8.4 Automatic air relief valve.

On units without gravity feed, such as mobile units or Gear Pump units working in suction, it is possible to option an automatic air relief valve. This allows the pump to prime (suck concentrate and fill the pump) automatically, this air relief valve closes automatically at approx.1 bar liquid pressure. On units with gravity feed, as required on fixed Piston Pump units, an automatic air relief valve will leak concentrate.

3.8.5 Drain Valve

All units, except the units with a max flow size of 600lpm or lower, are equipped with a drain valve. This valve is used to drain the unit from water for maintenance or storage. The unit must be completely drained from water if it is stored in freezing conditions, see 6.13. This valve must be closed in regular operation.

Drain Valve

3.8.6 Filter

The flushing line is equipped with a filter so that no debris may enter the pump during flushing.

Opened filter

The system must be made pressure free before opening the filter cap. Then it is also possible to remove the strainer and clean it. This filter type is standard issue on all units covered in this instruction manual.

3.9 Selectable admixture on Piston Pump models

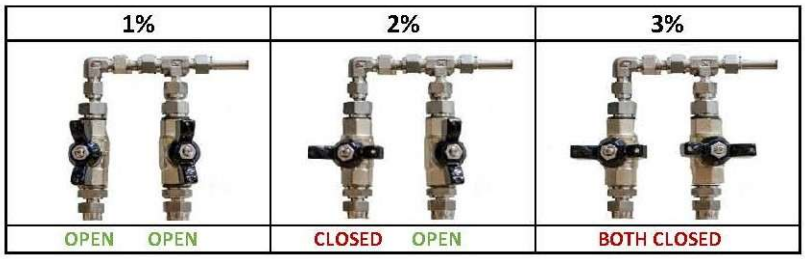
Piston Pump Units can optionally be specified with a selectable admixture by shortcutting some of their pistons/plungers. If the unit is equipped with this functionality this will show in its designation, e.g. a 1800-3-PP then becomes a 1800-1-2-3-PP unit.

For the shortcuts to work properly the unit must be running in a pressurized installation. Testing with the FIREMIKS water outlet open to the atmosphere will not result in significantly reduced change in dosing percentage. Execution may vary per size. See your unit's Dimensional drawing.

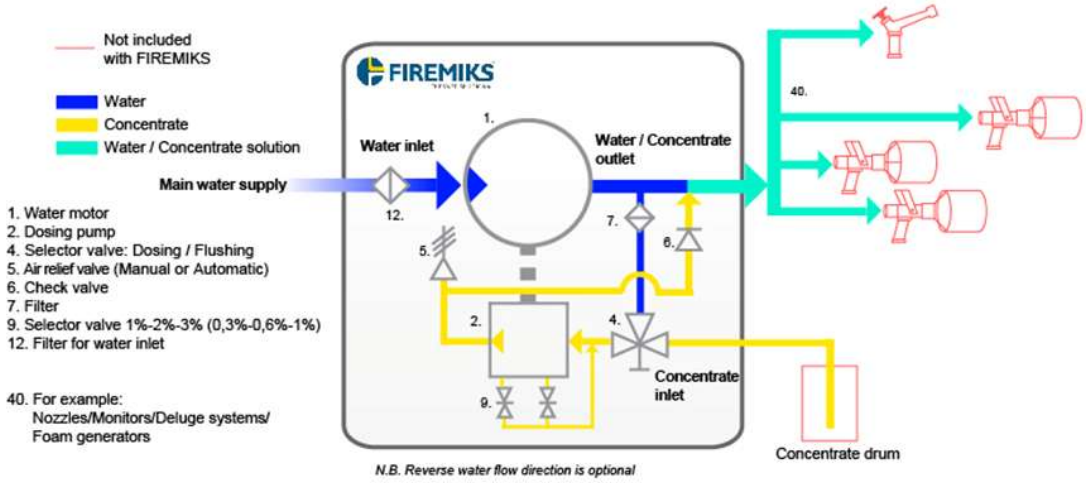
When **flushing** the pump on units with selectable dosing, it is recommended to flush the unit in all dosing rates with the selectable admixture valves in their respective different positions.

For the 1%-2%-3% models equipped with a 3% pump, opening one shortcut valve reduces the admixture with a 1/3 (= 2% dosing), opening both shortcut valves reduces it with 2/3 (= 1% dosing). **For the shortcuts to work properly the unit must be running in a pressurized installation**. Testing with the FIREMIKS water outlet open to the atmosphere will not result in significantly reduced change in dosing percentage.

Selector valve for 1%-2%-3% unit:

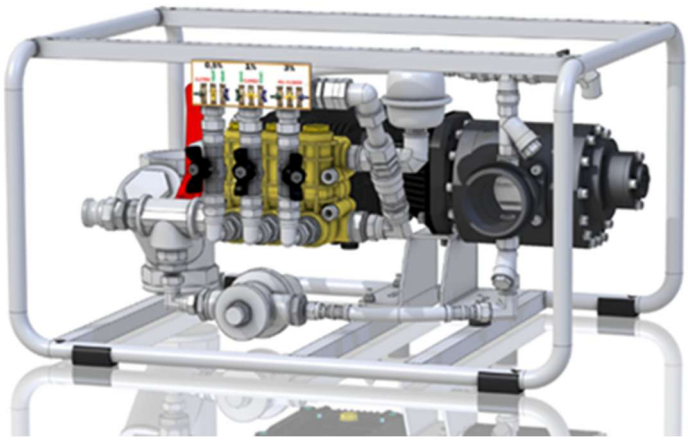


The same applies for the **0,3%-0,6%-1% models** equipped with a 1% pump. Opening one shortcut valve reduces the admixture with 1/3 (= 0,6% dosing), opening both shortcut valves reduces it with 2/3 (= 0,3% dosing).



Flow chart 1%-2%-3% (0,3%-0,6%-1%)

3.9.1 Selectable admixture 0,5%-1%-3%

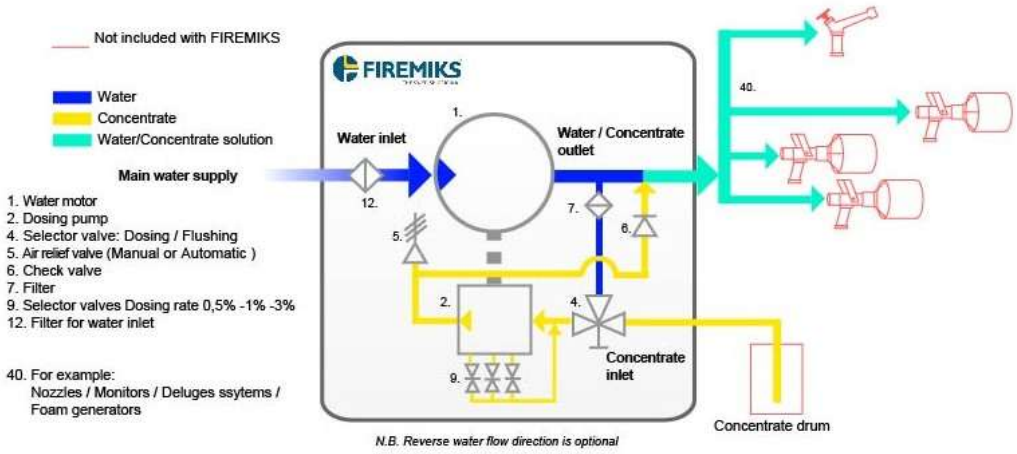


Units can also optionally be specified with a selectable admixture by shortcutting one or two of in total three pistons/plungers. If the unit is equipped with this functionality this will show in its designation, e.g. FIREMIKS 1000-0,5-1-3-PP unit. These models have a piston pump with different piston displacements enabling this dosing selection.

For the shortcuts to work properly the unit must be running in a pressurized installation. Testing with the FIREMIKS water outlet open to the atmosphere will not result in significantly reduced change in dosing percentage.

Selector valves for 0,5%-1%-3%:

Flow chart 0,5%-1%-3%



3.9.2 Sixplex models 0,5-1-3% and 1-2-3-6%

Sixplex piston pump models (with dual pump heads and six pistons) can be further equipped with a shortcut for one entire pump head, thus halving the maximum dosing rate, while on the other pump head it is possible to adjust dosing rates on the individual pistons there with the method of shortcutting individual plungers as documented above. In this way it is possible to have up to six different dosing rates in one unit. The method of selecting dosing rate will be then documented on the data sheet, the dimensional drawing and on signs on the unit itself.

3.9.3 When **flushing** the pump on units with selectable dosing, it is recommended to flush the unit in all dosing rates with the selectable admixture valves in their respective different positions.

3.10 Optional Dosing / Return Valve (DRV)

3.10.1 Some units are equipped with optional Dosing / Return valves, also DRV in short. This valve is not to be used during regular operation, and its handle should remain positioned for dosing into the main water line only. The valve should only be operated by qualified maintenance personnel for maintenance/testing purposes. On some versions, this valve or valves will be locked in the dosing position. We recommend the user does the same if there is risk that unqualified persons change the valve position of this valve on a unit in stand-by.

DRV in dosing position (normal operation)

DRV in return position (testing only!)

3.10.2 A return hose or pipe to the concentrate tank can be connected to the Dosing / Return Valves, making it possible to run the unit with concentrate without creating any mixture and without consuming any concentrate, for testing purposes. **It is strictly forbidden to include any valves in this return line or piping as a mistakenly closed valve can lead to dangerous pressure build-up. See also 3.11** and 6.11.3

3.10.3 WARNING!: Beware that with the Dosing / Return Valve in the return position, any flushing done (Selector valve Dosing / Flushing in flushing position *(No. 4 on Flow Chart*)) will result in water being added into the **concentrate tank** and possibly make it **overflow**. **This can happen even if the FIREMIKS is NOT running if the flushing water is pressurized!** See also 6.2

3.10.4 For regular stand-by operation, it is strongly recommended to lock the handle of the valve in the dosing position in order to avoid unauthorized operation of the Dosing / Return Valve.

3.10.5 **Concentrate tank contamination with water**: some concentrates should not mix even with small amounts of water in storage, then it is important the FIREMIKS is primed with concentrate first before using the Return position, alternatively that no flushing is used on the unit. See 6.8 for more information.

3.11 Pressure relief valve (PRV)

3.11.1 Units equipped with a DRV (Dosing / Return Valve) are equipped with a pressure relief valve, see you Dimensional Drawing for specification. Do not trigger the pressure relief valve on purpose, you may simulate pressure by connection suitable equipment to the DRV valve, see 6.11.3. **The pressure relief valve is solely a safety device that will trigger in a case of incorrect use of the DRV.** This will cause environmental discharge if the pressure relief valve discharge port is not connected to a suitable receptacle permanently.

PRV

3.11.2 **If environmental discharge of the concentrate is unwished for** by law, environmental concern, convenience or any other reason, the discharge port of the pressure relief valve must be connected permanently to a suitable receptacle. It can also be routed back to the concentrate tank; in such case it is **not allowed to have any fitting or valves in this line that could block the discharge!**

Also, a reminder to never use the valve position combination flushing + return, see 3.10 and 6.2. Even if the return position is blocked, running the unit in that valve combination and with this PRV discharge routed back to the concentrate tank, this will result in water in the concentrate tank, contaminating the concentrate and making it overflow.

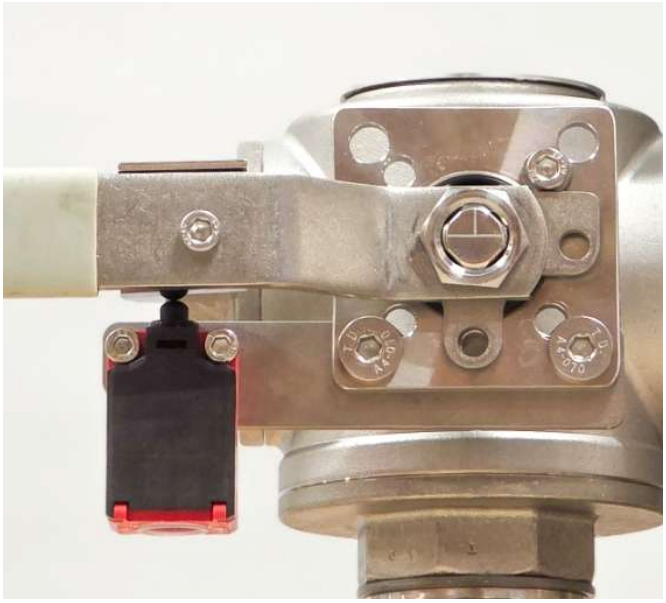
3.12 Supervisory switch

Some units may be optionally equipped with a supervisory switch, which will oversee that the unit is actually in the Dosing setting of the selector valve Dosing / Flushing. For the DRV it is recommended it is then locked in the Dosing position, see 3.10.4.

The supervisory switch 1NC+1NO must be connected to an electric control system that can interpret if the switch is depressed (dosing position) or not. The supervisory switch specification is as follows.

Make: Bernstein TI2-U1Z W
Connection 4 screw connections (M3,5), cable entrance 1 x M16 x 1,5

Rated insulation voltage: Ui 250 V AC
Conv. thermal current: Ithe 10 A AC / 2,5 A DC
Rated operational voltage: Ue 240 V AC; 250 V DC
Utilization category: AC-15, Ue/Ie 240 V / 3 A; DC-13, Ue/Ie 250 V / 0,27 A
Direct opening action: acc. to IEC/EN 60947-5-1, Annex K
Short-circuit protective device: Fuse 6 A gG
Protection class: II, totally insulated
Enclosure and cover: Thermoplastic, glass fibre reinforced UL 94-V0 IP65



Supervisory switch (red)

3.13 Flexible hoses

FIREMIKS uses flexible hoses for the dosing and flushing line. They are maintenance free and are pressure rated for pressures far exceeding the pressure rating of the unit. Connections are with a hydraulic cone connection that does not necessitate a sealant. The thread should however be oiled lightly as it is stainless steel on stainless steel, see also 4.13.11. It is possible to remove and remount the flexible hoses without issue for e.g. maintenance. In case of a leak at the hose connection, it is often sufficient to tighten the nut with hand force. Just be sure not to twist the hoses unnecessarily when tightening.

4 Installation and installation design

Please refer to the European standard EN 13565-2 and NFPA 11 for general requirements on fixed foam systems for firefighting. Any Foam Fire Protection System must be designed in accordance with the Authority Having Jurisdiction whether it is the Insurance Carrier, Fire Marshal, End user or the relevant NFPA Fire Code(s).

RECOMMENDED PRINCIPLE SETUP - FIREMIKS® FIXED TYPE (AUTOMATIC FLUSHING)

The purpose of this recommended principle setup scheme is to inform on the general needs for making a good installation with the FIREMIKS and is not binding or contractual in any way. For information about each specific FIREMIKS model, working conditions, connection types, etc. please consult the respective data sheets. We reserve the right to make changes in this information without prior notice.

FIREMIKS (with DRV)
1. Water motor
2. Dosing pump
3. Drive coupling
4. Selector valve: Dosing/Flushing
5. Air relief valve (manual or automatic)
6. Check valve
7. Filter
8. Drain valve
9. Pressure relief valve (only on DRV)
10. Main water pump
11. (Length does not affect dosing rate of FIREMIKS)
12. Y-strainer, main water line
13. Optional: Flow meter
14. Shut off valves
15. Pipe supports
16. Connections to Water motor
17. Connection to Concentrate inlet
18. Swing check valve, to prevent flushing water to enter the Concentrate tank, (do not use a check valve that is spring loaded, as it restricts the concentrate flow)
19. Optional: Selector Valve
Suction pipe/ Concentrate container
20. Nozzles - Monitors - Deluge system - Sprinkler heads - Foam generators, etc.
21. Internal diameter on suction system must have equal or larger diameter as the inlet of the Selector valve Dosing/Flushing (pos no 4.)
22. Dosing/Return Valve (DRV)

Parts for testing with DRV:
23. Return line to tank (temporary or permanent)
24. Pressure gauge
25. Pressure gauge dampened
26. Manual valve to create pressure (p25=p24)
27. Flow meter (or other means to determine volume per time)

Warning: consult instruction manual for safe testing procedures using the DRV valve!

We recommend gravity-feed of concentrate from tank to dosing pump. (Obligatory for piston pump -PP types).

Main water supply. NOTE! Only clean water is allowed. Flush well the pipes before installing the FIREMIKS-unit.

Bypass line (Recommended for service and as extra security)

Concentrate tank

The above recommended set-up does not show additional features, deluge valves, pressure limiting valves etc. which can be present in an installation and are discussed in this chapter.

Please read the whole chapter before starting your system design.

4.1 Storage

4.1.1 Respect the temperature limits as specified in the data sheet. Standard is

-30°C to 55 °C

4.1.2 If the unit/shipping package is stored in a contaminated environment where there is a risk that dirt, dust, sand or other foreign particles can enter the unit (flooding, sandstorm), make sure to provide additional protection to the unit/shipping packaging or move it to a more secure place. Attempting to run the unit with dirt lodging inside the water motor and/or pump may permanently damage it.

4.1.3 Protection caps: let the yellow plastic protection caps and plugs remain on the unit until it is installed unless you need to use the threads for installation.

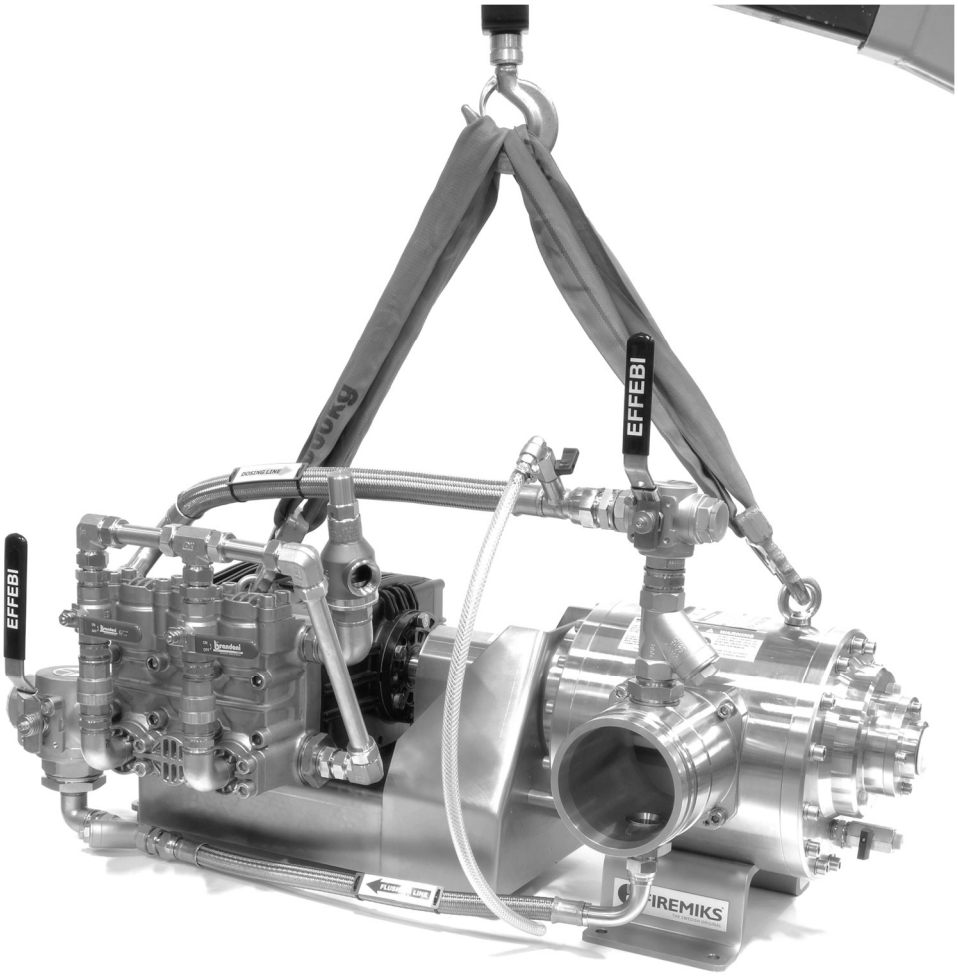
4.1.4 Draining of unit: in case the unit was used or tested and must be drained for e.g. frost season. See section 6.13.

4.1.5 **Maintenance rotation.** If the unit is stored for extended periods of time, the unit must be rotated by hand at least every 6 months, preferably every 3 months in high humidity. As according to chapter 7.3.3 except the unit remains in the flushing position.

4.2 Weight and lifting:

4.2.1 For weight see your unit's Data sheet. Suitable points to lift the unit are shown in your unit's Dimensional Drawing. Larger units also have lifting eyelets shown on the Dimensional Drawing. The unit should not be exposed to knocks or be dropped, then it can become damaged.

WARNING! DO NOT lift the unit using the piping or hoses!



4.3 Requirements for system equipment and installation before and after the FIREMIKS

4.3.1 **FIREMIKS is designed to operate with clean water**. Water must be free from sand, gravel and other debris that may wear out the volumetric water motor quickly. Larger solids can completely block the functioning of the unit and damage the unit. If there is an acute risk of particles entering the FIREMIKS or when polluted or contaminated water is used, the piping system must be designed so that there is a suitable filter or strainer where this pollution can be collected **fully**, placed **before** (upstream of) the FIREMIKS. **There is no warranty for blockage or damage of the water motor by any foreign objects in the water, whatever their size.** Please contact Firemiks AB if you need further guidance in this subject.

Mesh size of a filter/strainer should always be chosen to be able to stop all solids. Many discharge devices have similar requirements for clean water. Approvals, listing or other kinds of compliance of filters or strainers are irrelevant if the filter or strainer is incapable of stopping solids from entering the FIREMIKS and in this sense **smaller mesh size is better** with correct dimensioning for pressure drop in the hydraulic calculation for the application.

4.3.2 **Note**! **Any new piping system before the FIREMIKS must be flushed out thoroughly before the assembly of the FIREMIKS in the system.** (There are often foreign particles from the welding etc., left). Take care so other foreign particles do not come into the unit during installation. Keep the protection caps and plugs on the unit on as long as possible. Also take note of the requirements on clean water for any discharge devices mounted downstream of the FIREMIKS. NFPA 11 etc. also requires the foam delivery system and main water supply system to be flushed before activating the foam delivery system.

4.3.3 **Saltwater use**. If the unit is to be used with salt water and the unit is in a dry system meaning that it dries out after use, then arrangements need to be made so that the **unit can be flushed with sweet water after use**. This is always the case with aluminium water motors that always must be flushed with sweet water after use. Also, the flushing procedure can be modified for use in salt water. See 6.12 for more information on operation with salt water.

4.3.4 Minimum straight pipe length. For vertical* bends, no minimum length of straight piping at the inlet or outlet of the FIREMIKS is necessary. For horizontal* bends, minimum ten pipe diameters before the inlet and five after the outlet are recommended, minimum five pipe diameters before the inlet and two after the outlet are required. The main idea is that no sideways* swirls may enter the water motor, this same principle also applies to FIREMIKS with a vertical water flow direction.

* Horizontal, vertical and sideways referring to a normally installed Firemiks with horizontal flow direction, see also 4.5.1

4.3.5 **Note! It is very important that a shut-off valve is installed before the FIREMIKS unit.** This is to ensure a risk-free service/maintenance, i.e. the risk of sudden rotation of the water motor due to unexpected water flow will be eliminated by closing this valve. When working on the FIREMIKS, put a clear warning sign on this valve stating: ***"Do not open, maintenance work in progress".*** *In case water can backflow from the discharge side, another shut-off valve must also be included directly after the FIREMIKS unit.*

4.3.6 Pipe sizing. Piping sizing is not restricted for the basic functionality of the FIREMIKS but is recommended to be the same or large size as the water connections of the FIREMIKS (different optional connections and sometimes size available, see FM Approved Data sheet). Smaller piping will add pressure drop to the system and needs to be part of the system's hydraulic calculations, see 4.4.1.

4.3.7 In the case that the pressure capacity of the pumping system is higher than the maximum rated pressure of the FIREMIKS unit, it is recommended that correctly dimensioned orifice or a pressure-relief valve with enough capacity to unload the system is installed in the main system.

4.3.8 If the system where the FIREMIKS is installed to run with water only (no dosing) for more than 10 minutes, **a bypass should be installed** and used around the FIREMIKS system so that the FIREMIKS is not running. The flushing system on FIREMIKS units is designed to flush the pump and not for longer use, this can cause unnecessary wear and potentially cause damage if the filter in the flushing line gets full, see also 7.4.1. Still if the FIREMIKS is running anyway and there is no concentrate, be sure that the Selector valve Dosing/Flushing (No. 4 on Flow chart) is in the Flushing position to avoid dry running of the pump, see also 4.9.

4.3.9 **Note! As in all safety-related installations, there should always be a back-up plan**. Never design the installation in such a way so that the water flow through the FIREMIKS is the only source for fire-fighting water. **If the water flow through the FIREMIKS is the only source of water, a bypass must be installed.**

4.3.10 It is possible, with only one main water pump, to design the piping system so there is plain water from some outlets in the system and at the same time concentrate mixed water from other outlets. Flow through each branch is governed by the total pressure drop of each branch and the capacity of the respective discharge devices. The requirement for the FIREMIKS is that the minimum and maximum flow limits are kept.

4.3.11 The outlet system after the FIREMIKS can be divided in many ways, also vary in heights, as long as the minimum and maximum flow limitations of the FIREMIKS are kept as defined in the unit's datasheet.

4.4 Flow dimensioning

4.4.1 **Hydraulic calculations**.

The FIREMIKS dosing system is a passive flow system (not a pump) and must be part of the hydraulic calculation of the complete discharge system, adding its pressure drop as any other component (valve, bend, filter, discharge device etc.) in the system. Pressure drop for a given flow is according to the pressure drop table in the data sheet of the model you have.

4.4.2 **Minimum pressure differential for start**

The FIREMIKS needs a pressure differential over the unit for it to start. Depending on unit and circumstances, this pressure differential can vary from 0,2 to about 1,5 bar at very high system pressures. Usually the main issue is that there is a much too high pressure differential at start-up see 4.4.7, but in some special cases, it can be that the FIREMIKS is expected to start when there is in fact is too little pressure drop over the unit itself, despite high system pressure. This lack of pressure differential can happen when there is a flow regulator valve in the system that uses the differential pressure over the FIREMIKS to measure flow. However, when there is no rotation of the FIREMIKS, there are possible scenarios where the same pressure differential exists with the FIREMIKS stationary with almost zero flow. **This is because pressure drop needed to start a *non-rotating* FIREMIKS can be higher than the pressure drop of a *rotating* FIREMIKS running at a given design flow, in such case a regulator valve may not allow enough flow through the FIREMIKS thinking the pressure differential is at point when in fact there is not sufficient pressure differential to start the FIREMIKS.** If such a scenario is possible it might be better to use the pressure drop over another flow component that does not change characteristics between rotating / non-rotating. Feel free to contact your distributor or FIREMIKS AB if more guidance is needed in this area.

Other than this, there usually is no minimum pressure requirement on the FIREMIKS other than giving the required pressure drop to reach a given flow – discharge pressure can be atmospheric. Firemiks can work in low pressure systems unlike many other dosing systems. See also your unit's datasheet for pressure limitations on your specific unit.

4.4.3 **Maximum flow**

Maximum flow is not to be exceeded, as per calculation in a hydraulic calculation of the complete system. Exceeding maximum flow may lead to excessive wear and premature failure of the unit. If water source pumping capacity is higher than the max flow of the FIREMIKS, some form of flow control may be necessary. If the hydraulic calculation was too cautious, the flow could be too high. Adding an orifice or partly closing a valve in the system can reduce steady state flow. See also 4.4.1 and 4.4.4. If no flow meter is present, rpm can be used as an indication of flow, see 4.4.6

4.4.4 Overflow / overspeed at start-up

Even if the main water pump has a capacity equal or below the max flow capacity of the FIREMIKS, the water flow can exceed the specified maximum flow, i.e. overflow/overspeed, at the start of the system when the piping is (partly) empty, voiding steady state hydraulic calculations. If no flow meter is present, rpm can be used as an indication of flow, see 4.4.6
The flow through the FIREMIKS unit is controlled by the pressure difference before and after the unit. A high-pressure difference at start-up leads to overflow / overspeed. **Overflow / overspeed causes accelerated wear and repeated overspeed can damage the unit:**

A. Up to 10% overflow (<110% of max flow) at start-up is acceptable but then the unit should only be tested once a year with vane replacement after 5 years (standard service interval). For more frequent use, refer to section 7.10

B. More than 10% overflow (>110% of max flow). Additional measures must be taken to remove the overflow at start-up. See below section 4.4.5
It is possible not to amend overflow up to 40% if it can be guaranteed that the unit will only be subjected to overflow ONCE, i.e. during a real fire. **After this, the vanes of the unit MUST be replaced before it is put back into service**. This means that during periodic testing of the dosing performance of the installation, no overflow is allowed. This can be achieved by manually reducing flow by partially closing downstream valves or partly opening deluge valves to fill any empty piping in the installation, before releasing full flow.

4.4.5 Preventing overspeed by design

Several measures can be taken to eliminate or at least reduce this amount and duration of overspeed, some examples:

Reduce pressure before the unit:

- If there is a main water pump that starts after a jockey pump, have it start after the flow has filled the piping or ramp up the speed if there is frequency control (Delayed or soft start).
- Install an overpressure protection valve with bypass around the FIREMIKS, a **differential pressure sustaining valve**. This type of valve will detect excessive pressure drop over the FIREMIKS and open in a bypass to the FIREMIKS, so preventing overflow. See also 4.5.3 for limitations.

Increase pressure after the unit

- In the design and control, minimize the length of empty piping to be filled by placing the deluge valve closer to the discharge
- Alarm valves can be opened slowly or partly until piping is filled. If there are several alarm valves, do not open them all at the same time if possible.
- Install a **differential pressure flow limiting valve** (often combined with the deluge valve) after the FIREMIKS to avoid overflow and water hammer. See also 4.5.3 for limitations.
- Install a dry pipe filling orifice creating the additional backpressure needed, with bypass valve that opens when the piping has been filled. This can be installed directly after the FIREMIKS or deluge valve to avoid overflow and water hammer.

Reduce duration of overspeed

- Place the tank and FIREMIKS as close as possible to the hazard, this also reduces reaction time, see 4.5.6
- Do not use oversized piping between the FIREMIKS and the hazard, resulting in quicker filling also reduces reaction time
- **Avoid overflow during scheduled function/dosing testing by manually reducing flow at start up.**

4.4.6 **Measuring unit rpm** as a measure of flow (4.4.1) and overflow (4.4.4).

Each FIREMIKS is delivered with a handheld contact tachometer to measure unit rpm. This can be used to get an indication of the water flow through it and to make sure it does not overspeed. The tachometer is placed on the hexagon axle end of the water motor to make a measurement. On certain (larger) sizes a fixed wall mounted display tachometer is available as an option.

The unit rpm is related to the main water flow through the unit and can be correlated to the measured main water flow in steady state. At higher flows the relation flow to rpm is linear, *assuming the water motor is in good working condition*. At start-up of a dry system, the peak RPM of the FIREMIKS thus gives a good indication of the highest flow through the FIREMIKS. Unit RPM at maximum flow can be found on the unit datasheet and the type plate on top of the unit. You can also contact your distributor or Firemiks AB if more information is needed about rpm of your specific unit (serial number).

Maximum rpm has been exceeded, use the criteria in 4.4.4 to decide what action is necessary.

4.4.7 Unit pressure drop as a measure of flow (4.4.1) and overflow (4.4.4).

An alternative to using rpm is to use the pressure drop of the unit as a rough estimation of the flow, in case there are pressure gauges before and after the FIREMIKS unit. For normal operation, the pressure drop at different flows can be found in the Data Sheet of the unit. Note: pressure drop is a bit higher at higher system pressures, and a bit lower at lower system pressures at a given flow.

If the pressure drop is more than 20% higher than the published pressure drop at max flow, this is an indication of overflow in the unit is functioning properly otherwise. In extreme cases of 50% overflow, the pressure drop can be approximately double the published pressure drop at max flow.

4.4.8 **Avoiding water hammer.**

Water hammer can happen especially in the case of overflow (see 4.4.4) that reaches a flow limiting device such as discharge devices, sending back pressure spikes through the whole system. Typically, the pressure spikes caused by water hammer do not affect the Firemiks, but it can damage the other parts of the installation and cause malfunction in case of emergency. This is another reason to avoid overflow/overspeed.

4.5 Positioning of the Firemiks in the system

4.5.1 The unit must be installed with the inlet and outlet of the water motor and the pump shaft in horizontal positions. Other configurations of the FIREMIKS are possible but must be configured and approved by Firemiks AB.

4.5.2 For vertical flow configurations of the FIREMIKS (optional at order), always consult the manufacturer FIREMIKS AB for installation advice.

4.5.3 Positioning of water flow regulating or flow limiting equipment

These recommendations are primarily to eliminate or to at least reduce the duration and amount of possible overspeed at start-up, other than that the FIREMIKS is a very flexible system that works in a wide range of flows and pressures:

- Alarm valves / deluge valves: downstream of the FIREMIKS and as close to the discharge as possible (to reduce the risk and duration of overflow)

- Flow regulating valves / pressure reduction valves and permanent orifices/valves to increase pressure drop and reduce flow in the system: In case of dry system piping, the orifice should be upstream of the FIREMIKS or immediately downstream of the FIREMIKS.

- Orifices with bypass valve to reduce water hammer at start-up. This kind of system is perfect to reduce water hammer and overflow at start-up. Once pressure drop across the orifice is reduced as the piping is filled, the bypass valve to the orifice opens and the system operates as if there is no orifice**.** This kind of system is recommended to be installed upstream of the FIREMIKS or immediately downstream of the FIREMIKS.

4.5.4 Wet or dry system

Depending on the existence and position of a deluge valve, and therefore if there is pressurized water in the FIREMIKS at stand-by or not, the system is either wet or dry. This has consequences for tank placement - see 4.10, operating procedure - see 6.3 and salt water use - see 6.12
Especially on dry systems it is extra important to flush the unit after use to avoid drying of salt, see 6.12, or concentrate, see 6.7.

4.5.5 Concentrate Tank placement, fixed or mobile

The atmospheric concentrate tank should be as close as possible to the FIREMIKS, basically they should be right next to each other, see also 4.8. Usually, the tank placement is given and the FIREMIKS must be installed close by, however also take into consideration reaction time and if maybe there are better tank placements possible, see reaction time 4.5.6 and also 4.5.3.
While the atmospheric tank can be fixed in its location, it is also possible to use mobile tanks, either carried by hand for small units, or mounted on a trailer or a vehicle. This manner of operation makes it also possible to continue dosing if the fixed concentrate tank is empty and a mobile tank is connected instead – if this part of the strategy, make sure that ready and reliable connections points are available in the fixed installation to connect these mobile tanks.

4.5.6 **Reaction time** - importance of positioning before dosing is reached.

If the concentrate is available at the pump inlet of the FIREMIKS, it only takes a few seconds of rotation of the FIREMIKS unit before the concentrate is dosed into the water at the outlet of the FIREMIKS unit. When the dosing line is filled with concentrate, dosing is immediate as soon as the unit turns (e.g. fire fighters that open and close the nozzles rapidly to reduce water use but keep throw length). However, if the FIREMIKS is placed far away from the hazard/discharge devices, it can take a long time before the mixture has travelled through the piping and is discharged. Smaller piping with higher flow speed, if allowable considering pressure drop, can greatly reduce this time. Also, without the need for an external energy source other than the water flow to drive the FIREMIKS unit, consider if it is possible to move the FIREMIKS and concentrate tank closer to the discharge devices to reduce this time before foam discharge. If there are many discharge points, for this reason it could also be more favorable to have several smaller decentralized FIREMIKS units with their own concentrate supply instead of one centrally located larger unit. Short response time can be critical to the outcome of a fire, and a good system design using FIREMIKS could be the way to achieve this.

4.6 Multiple FIREMIKS units in parallel.

Multiple FIREMIKS units can be run in parallel. The flow through each unit is controlled by the pressure difference over the unit. If same size units are installed and subjected to the same pressure difference (equal pressure loss in their respective branch of the piping), the flow through them will be the same. In such case, **minimum flow and maximum flow of each unit must be added to each other** to get the total system flow min and max flow limits. Units of different sizes will flow according to the pressure drop that exists over each unit. It is also possible to start one unit first and then when the pressure drops reaches a certain level, a pressure differential sustaining valve opens the water flow to a second unit. Or more units.
Please note that each FIREMIKS should have its own concentrate supply from the tank, branching and combining concentrate supply can have unexpected side-effects especially in case of non-Newtonian fluids.

For more information, please contact your distributor or Firemiks AB.

4.7 Concentrates:

4.7.1 The FIREMIKS can be used with all common foam concentrates / fire-fighting liquid additives as long as they remain within the approved viscosity range (see your unit's Data Sheet).

Note: the stated maximum viscosity allowed is not corrected for all temperatures, it is absolute. It is up to the user to make sure that the concentrate used falls below this upper limit in the whole temperature range where the unit will be used, consult with the concentrate supplier for viscosity data at different temperatures.

Note 2: Minimum water flow rate, the lowest flow rate where the correct dosing rate is first reached, varies with viscosity properties of the concentrate, dosing rate (when selectable) and system pressure.

Applicable for Piston Pump (PP) units	*Applicable for Gear Pump (GP) units*
Higher viscosity and higher system pressure reduce dosing performance, both resulting in an increased minimum flow.	*Lower* viscosity and higher system pressure reduce dosing performance, both resulting in an increased minimum flow.

4.7.2 When ordering, usually the correct pump selection will have been made for the concentrates to be used.

For concentrates with low viscosities, generally a Piston Pump (PP) type FIREMIKS is more suitable. This pump type has lower minimum flow, and minimum flow is less pressure sensitive.

For concentrates with high non-Newtonian viscosities >1800/3600 cP @60rpm #4, generally the Gear Pump (GP) type FIREMIKS becomes more suitable. This type of pump does have a higher min flow that is also more pressure sensitive.

Also see the Data Sheet of your unit if there is stated a suitable viscosity range.

Please note that for using high viscosities, the design of the concentrate delivery to the pump inlet becomes critical, see 4.8

4.7.3 Should there be any questions and thoughts about different additives, please contact your distributor or Firemiks AB and state additive type and brand. Usually, it is possible to make a factory acceptance test (FAT) with the specific concentrate (PFAS free only) to be used if the concentrate is made available.

4.7.4 FIREMIKS is NOT suitable for Gel Forming additives due to the wetting by the flushing line that can cause gelling and blockage inside the unit. Contact your distributor or Firemiks AB for a special version of the FIREMIKS that can handle these additives.

4.8 Concentrate delivery from the atmospheric tank to the unit

The concentrate feed line connects the concentrate tank with the Selector Valve Dosing/Flushing (No. 4 on Flow chart) on the concentrate pump inlet.

The best delivery of concentrate is when it can always flow freely from the tank to the FIREMIKS inlet. The first rule of thumb on how to think is to **place the concentrate tank and FIREMIKS next to each other and with the tank a little higher than the FIREMIKS unit.** Doing this will cover most of the requirements in this paragraph. **Next to each other is considered, as a rule of thumb, less than 5m length of piping between the tank and the FIREMIKS.**

4.8.1 Gravity feed and sizing for gravity feed

Applicable for Piston Pump (PP) units

The supply of concentrate from the tank to the FIREMIKS unit must be done with gravity feed/positive inlet pressure during operation.

Applicable for Gear Pump (GP) units

The supply of concentrate from the tank to the FIREMIKS unit is strongly recommended to be done with gravity feed/positive inlet pressure

Gravity feed means that the lowest possible concentrate level in the tank is higher than the inlet of the concentrate pump(s) on the FIREMIKS in such a way that it delivers the required concentrate flow to the pump inlet by gravity alone under all operating conditions. That is, without relying on suction from the pump. Inlet pressure must always be at least equal or larger than atmospheric pressure. Gravity thus always overcomes the friction losses of the concentrate delivery piping/hoses to the FIREMIKS unit.

Calculation of flow losses
For low viscosity concentrates it is possible to calculate these friction losses quite easily, for high-viscosity non-Newtonian fluids, it is nearly impossible to make reliable calculations of the flow losses due to the non-linear nature of the flow. In the datasheet, it typically states the recommended sizing of the concentrate delivery.

Sizing and always designing for high viscosity
Even if the installation is designed for low viscosity, low flow loss concentrates, we strongly recommend designing the system with worst case high viscosity in mind. In this manner, it will be in the future be possible to use higher viscosity concentrates and the unit will truly be a variable viscosity proportioner.

4.8.2 Pump suction and sizing for suction feed

Pump suction is the scenario where there is no gravity feed and pressure is lower than atmospheric in the concentrate delivery line to the pump inlet.

Applicable for Piston Pump (PP) units	*Applicable for Gear Pump (GP) units*
Gravity feed is a requirement; however, the concentrate pump usually can suck up to a meter below the inlet without problem. Nevertheless, this is not to be relied upon, it can affect the dosing rate and this suction scenario is not covered by warranty.	Especially at higher flows, the Gear Pump has a strong suction. However, for this suction scenario to work, the concentrate line must be designed so that there is very little flow resistance with the viscosity of the concentrate used, otherwise there can be much reduced dosing and cavitation may happen.

Sizing the concentrate line with suction.
This is in principle only allowed on GP models and not recommended. However, for GP models it is possible install the concentrate tank so that the concentrate level is below the inlet of the concentrate pump. However, the concentrate pump needs to pump out the air in the suction piping through the opened air relief valve (=priming) before suction of concentrate liquids starts. This both takes time before dosing starts and there are more things that potentially can go wrong. This is thus a process that must be supervised and is not recommended for automated processes.

It is possible to option an Automatic air relief valve (see 4.7.4) in case the suction priming needs to be automated. After initial priming, if there is no leakage in the suction line and the main system is pressurized, the concentrate should remain in the suction line and the unit should start dosing immediately when resuming water flow. However, if this is to be relied upon in order to avoid priming in a critical emergency situation, a foot valve must be installed at the bottom of the suction line in the concentrate tank. This will assure the suction line remains filled with concentrate liquid once the system is primed over longer time periods. However, this foot valve can in its turn make suction more difficult and therefore the system must always be primed manually before the system is stand-by.

The NPSHR at the concentrate inlet of the FIREMIKS GP models at max water flow and viscosity 50 cSt is approximately 5m. Priming capability and possible suction height depends on suction pipe design and associated losses, the viscosity and steam pressure of the concentrate liquids to be used and the water flow used at start-up (for priming). The higher the viscosity, the larger the diameter and the shorter the length must be to keep cavitation at bay. The Suction / priming scenario is not recommended for very high viscosity concentrates (roughly > 2000 cP non-Newtonian #4

60rpm) or concentrates that are known to be difficult to dose. Calculations for non-Newtonian liquids are not to be relied upon too much, static viscosity can be very high and vary with conditions, shear rates can vary a lot through the cross section of the flow profile and enclosed air in high viscosity concentrates can create additional problems in suction scenarios. In all suction scenarios, always test your installation that priming of the concentrate pump with concentrate (not water, see 6.2.5) is possible at the lowest start-up water flow to be used and that suction height (when the tank is almost empty) does not adversely affect the admixture rate.

4.8.3 **Maximum concentrate pump inlet pressure** must be always lower than main water line system pressure (stationary and running) and at the most 3 bar.

4.8.4 **Dry systems with gravity feed.** For dry systems without water pressure on stand-by, consider that gravity feed with a high tank placement can cause leakage of the concentrate through the FIREMIKS. See 4.10 for more information.

4.8.5 **Sizing and requirements for concentrate tank(s)**

Be aware that there is a dosing tolerance allowable on the dosing rate when calculating concentrate consumption, see datasheet. For e.g. 3% the allowable dosing tolerance is 3% to 3,9%, so when calculating the required tank size for a given run time, it is safest to calculate with a 3,9% concentrate consumption.

Only connect one tank at a time.
Having multiple tanks connected to one FIREMIKS can have unintended consequences, especially with non-Newtonian fluids and different lengths of suction lines. If multiple connected tanks are necessary, please contact Firemiks AB for guidance.

The concentrate is to be stored in an **atmospheric** tank that supplies the FIREMIKS. This means it must be properly vented so no under-pressure can be built as the tank empties. Also, assurance must be made the tank is clean or is cleaned properly before filling with concentrate. ***Special venting valves are recommended that stop circulation of air in the tank that can dry out the concentrate, while still allowing air to flow when tank level changes.***

Tank outlet to the FIREMIKS should be at the bottom of the tank.
Suction from the top of the tank is not allowed in fixed installations, as priming of the vertical pipe can be problematical and air trapped on the highest level can cause issues with the concentrate drying out. Exception for legal requirements for double walled tanks or likewise that must suck from the top. Consult with Firemiks AB in these cases.

4.8.6 Air leakages

For all types of concentrate delivery, suction or gravity feed, it is very important that there are **no air leakages** however small in the concentrate supply line anywhere between the tank and the concentrate pump. There is always a possibility of negative pressure in the system, even if not intended, and then even a small hole can suck large amounts of air that can interfere or even stop dosing altogether, and this is not immediately noticed as there is no liquid leakage. The system should be pressure tested (preferably with a manual hand pump up to about 1 Bar) before the start, to expose possible air leakages, and designed in such a way that its seal is guaranteed to last in time. See also next point 4.8.7

4.8.7 Unsuitable connections for negative pressure

In the concentrate delivery line, it is not allowed to use **Storz, Cut Groove** or any other type of connection systems that is not designed to seal properly with negative pressure and can at any time cause an air leakage despite passing a positive pressure test (see 4.8.6).

4.8.8 Flap check valve

A flap check valve is supplied on the inlet; to avoid sending pressurized flushing water into the concentrate feed line and overflow the tank in case someone halfway opens the Selector valve Dosing / Flushing (No. 4 on Flow chart). See also 3.8.2

4.8.9 Transparent hose

It is advisable to put a transparent suction tube/hose just before the inlet of the concentrate pump to make it easier to see when/if the concentrate feed hose is completely filled with the concentrate. This also minimizes the risk for tensions from a concentrate feed pipe to be transferred to the concentrate pump.

4.8.10 Nozzle loads on concentrate inlet

If there is no transparent hose as in the above point, make sure the piping to the concentrate inlet is properly supported so that there are no tensions and loads on the pump concentrate inlet that can distort the pump position or damage the pump with excessive loads.

4.8.11 Materials and pressure rating

Make sure all the materials in the concentrate delivery system are compatible with the concentrate used. Consult the concentrate manufacturer if necessary. There is no need for a particular pressure rating of the concentrate delivery line, as long as it can withstand pressure of a few bar and also does not collapse under some negative pressure – fire hoses are not allowed, see also 4.8.7. It is very important that there are no air leakages in the concentrate feed line, see 4.8.6

4.8.12 Air relief valve

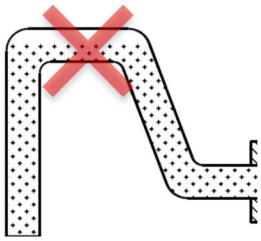
An air relief valve must be installed at the highest point of the concentrate delivery system. Since gravity feed is required on PP models, this is typically close to the tank. This valve can then be opened when the system is NOT running and help filling the complete delivery system completely, thus precluding the possibility of concentrate drying to air. When concentrate comes out of the air relief valve, close the valve.

4.8.13 Bends

Avoid sharp 90-degree bends and keep the concentrate feed line as free as possible from other flow restrictions (bends, bottom valves, unnecessary filters). These increase the flow losses and make it more difficult to fulfil the requirement for PP units for positive inlet pressure under use.

4.8.14 Elevation changes

Avoid elevation changes in the line where air bubbles may stagnate and cause head losses and cavitation: elevation down>up (once) between tank and FIREMIKS = OK. Elevation Up>down anywhere between tank and FIREMIKS = not OK.



4.8.15 Additional valves

Additional valves are discouraged as they increase the risk of operator error and could cause dry running (see 4.9) if a valve is unintentionally closed.

4.8.16 Strainer

If it cannot be guaranteed that the foam concentrate and the tank are 100% free from solid contaminants, the concentrate feed line must be equipped with a free-flowing filter/strainer with a mesh size of 300 µm or less; the filter must be positioned at least 10 diameters from the pump inlet. This is to prevent foreign bodies entering the pump. The filter/strainer must be dimensioned to prevent high flow losses, and the net open area shall be at least four times the area of the piping.

4.9 Avoid dry running:

By design, never let the FIREMIKS run dry without concentrate or flushing water. See 6.6.1 for more info.

4.10 Foam concentrate leakage through the FIREMIKS with gravity feed

4.10.1 Wet systems

When there is an alarm/deluge valve in the installation it should be placed downstream of the FIREMIKS, see 4.5.3. In such case, the Firemiks is flooded/wet when it is standby. The water pressure in the water line closes the check valve in the dosing line, preventing concentrate from leaking into the water line with gravity feed.

Warning: Do not open the concentrate feed to the FIREMIKS when the system is not standby and filled with water. If this is not possible, this installation must be treated as a dry system installation, see 4.10.2

4.10.2 Dry systems

Sometimes there is no alarm valve, and the system is dry/not pressurized, or the alarm valve must be upstream. In this scenario, the Firemiks is dry at standby. In this scenario there is a risk that the concentrate with gravity feed from the tank will leak through the FIREMIKS if the concentrate tank is open to the FIREMIKS. An active choice should be made to avoid this:

- Operational: the Dosing / Flushing valve must only be opened to Dosing once the system is running. See also 6.1

OR

- If it is possible that the unit is open to the concentrate tank when the main water line is dry, the check valve in the dosing line of the FIREMIKS should have an opening pressure that is **larger** than the possible head from the concentrate tank – the height difference of highest filling level of the concentrate tank to the FIREMIKS pump inlet. Check valve opening pressure varies per FIREMIKS model and a check valve with a higher opening pressure is an option when ordering the FIREMIKS. It can also be retrofitted, in such case please contact your distributor or FIREMIKS AB.

4.11 Return line to tank for test using the DRV

It is possible to permanently route the return line from the Dosing / Return Valve (see 3.10) back to the tank. This line is used to test the unit and should not contain any valves or equipment other than those needed to do the testing, see section 6.11.3.

As for the concentrate return, this line must use materials compatible with the concentrate. Additionally, the pressure rating of any piping or hoses must be able to withstand 20bar working pressure (or whatever the PRV is rated to, see 3.11) up to any valve that can be either closed or is used to create backpressure pressure, see 6.11.3.

4.12 Mobile use of FIREMIKS

Smaller FIREMIKS units can be used as a portable mobile device – mobile versions with carrying handles and feet or wheels are available and the concentrate tank is placed next to the unit, or the mobile FIREMIKS is placed next to the location, vehicle or trailer with the concentrate tanks (see 4.8).

Larger units can be installed on trailers or vehicles, either with the concentrate tanks mounted on the same or placed next to the location, vehicle or trailer with the concentrate tanks (see 4.8).

Typically, mobile use is a dry system activated by starting the main water pump or opening a hydrant valve, and personnel is present to operate the FIREMIKS. The Firemiks flow size must be adapted to the expected flow from the discharge devices (Nozzles, foam pipe, etc.).

For mobile use, unless the hoses after the FIREMIKS are very long, overflow is typically not an issue at start-up. If hoses are long, usually it can help to only partially open a nozzle the hoses are vented first.

A mobile unit will have a handle and feet or wheels and does not need to be installed as in the next section 4.13. For these conditions, here are the main points from this chapter to consider:

- The FIREMIKS' flow size must be adapted to the expected flow from the discharge devices (Nozzles, foam pipe, etc.).
- A suitable strainer must be present upstream of the FIREMIKS if there is a possibility that the water used is polluted with solid / foreign particles, see 4.3.1
- Equipment before the FIREMIKS must be flushed before connecting the FIREMIKS, see 4.3.2
- Tank as close as possible to the FIREMIKS unit and the concentrate delivery hose should be as short as possible and not have elevation changes that allow air bubbles to get trapped. Hose diameter must be sufficient for the viscosity. Mobile units are supplied with a suction hose with pipe for use with foam concentrate containers, these fulfil these criteria. See also 4.8
- Gravity feed is recommended, i.e. the tank level is higher than the FIREMIKS pump inlet. That said, in mobile applications, this is rarely critical and most of the time there is no issue with having both the FIREMIKS unit and the tank on the ground with personnel present, see next point:
- For operation, see also chapter 5 and 6, dosing / flushing valve is operated by personnel:
    - In case of gravity feed it should first be switched to dosing once there is water going through the FIREMIKS water motor. See 4.10.2
    - In case of no gravity feed, the Dosing / Flushing selector valve can be swiftly switched to Flushing a few times in case there is no gravity feed to aid the priming of the FIREMIKS concentrate pump.

- Flushing the concentrate pump can be done by putting the suction hose+pipe in a **clean** water source, thus also cleaning the suction hose+pipe.
- After use, rinse and clean the suction hose also from the inside, if not using the method in the previous point.

See also the mobile quick instructions delivered with the unit!

4.13 Unit installation

4.13.1 The unit itself does not require any **welding or painting** for installation, suitable pipe connections are to be bolted (cut groove) or threaded (iso 228-1 (BSPP)) and the unit is held in place with screws, see 4.13.7. However, the supporting installation can require welding and painting, in such cases be careful not to contaminate the in- and outlets of the FIREMIKS unit. It is not allowed to paint the FIREMIKS unit.

4.13.2 Before unit installation, it is of utmost importance that **the piping upstream has been flushed and rinsed** from all debris, welding slag and parts that can be left when such a system has been constructed/built. See also 4.3.2

4.13.3 The unit must be installed with the inlet and outlet of the water motor and the pump shaft in **horizontal positions** (±5°) (static). Exceptions apply for moving applications (vehicles, ships etc.), where this angle may be exceeded in dynamic movement. Other configurations of the FIREMIKS are possible but must be configured and approved by Firemiks AB.

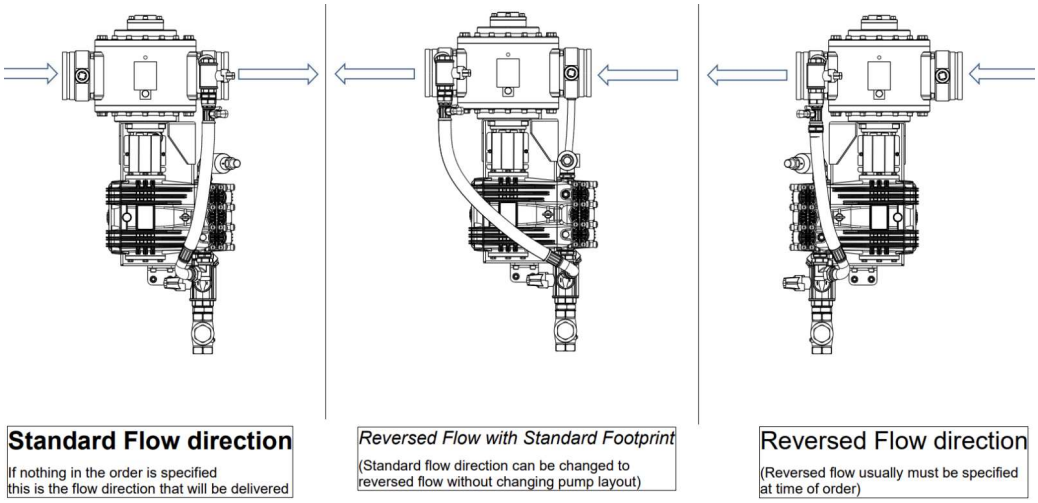
4.13.4 **Temperature limits**. The unit should preferably be installed and used in a **frost-free environment**. Frost free means that the liquids in the unit do not solidify/freeze, this can be significantly below 0°C for salt water and some concentrates. If this is not possible it is important to drain the unit completely before frost season, see draining instructions in section 6.13. It should not be exposed to higher temperature than 55 degrees Celsius even when the unit is not in use. This is most important for the water temperature inside the unit.

Note! Be observant for direct solar radiation that can heat up the unit and eventually the water inside above 55 degrees Celsius, in these cases use a sunroof. Higher water temperature tolerances, above 55 degrees Celsius, are available at order. Or contact your distributor or FIREMIKS AB if any questions arise.

4.13.5 If the unit has been contaminated during storage, see also 4.1, make sure to carefully clean the inside of the unit before installation. If contamination is especially aggravated and/or temperature limits have been exceeded, please contact your distributor or Firemiks AB on how to proceed.

4.13.6 Flow direction

The water flow must be in the direction shown by the arrow on the upper side of the water motor (Note! The flow arrow is not the same as the direction of rotation). The unit can optionally be configured at order with the water flow in the opposite direction. See also your unit's Dimensional Drawing.



Examples of flow direction arrows on the unit.

4.13.7 Mounting points

The possible mounting points of the FIREMIKS unit are denoted on the unit's Dimensional Drawing. There are two main methods of mounting the unit:

Mostly smaller units are equipped with mounting feet on the pump brackets With these feet, the unit can easily be mounted on a flat surface using bolts to secure the unit. See your unit's Dimensional Drawing for the key dimensions of the mounting interface (when available).

IMPORTANT: it is very important that the main water lines before and after connected to the water motor are well fixated, or flexible couplings are used to connect to the Firemiks. Be sure there is no movement that can forcefully distort the pump bracket of the Firemiks which can lead to failure of the drive gear alignment and ultimately the whole unit. Do not rely on the FIREMIKS bracket as support for the main water line. If unsure, the first above method is more secure.

Mostly larger units are equipped with floor brackets mounted under the water motor and sometimes also at the end of the pump bracket.
This water motor bracket method allows the unit to easily mount on the floor. Any slight deformation of this floor bracket in the installation is by design, we want the bracket to deform, and not the FIREMIKS unit or the FIREMIKS pump bracket. **If the unit is equipped with rubber feet support bracket on the rear of the unit, this pump bracket support is not to be bolted to any structure or floor, it is only there to support the weight of the unit.**

For alternative ways of fixating the unit, contact Firemiks AB.

4.13.8 Nozzle loads

It is very important that there are no movements on the water main line that could create tensions on or between the water motor inlet and outlet. If any such movement exists on the connecting pipes, separate support(s) must be made to stabilize the connecting pipes before connecting to the FIREMIKS. Alternatively, a flexible connection to the FIREMIKS is also a possibility to relieve Nozzle loads. Please contact your FIREMIKS representative if there are more questions about allowable Nozzle loads on a case-by-case basis.

4.13.9 Space around unit

Make sure there is enough space around the unit to enable easy access for service and maintenance, especially on the back gable side of the water motor (opposite side of the concentrate pump).

4.13.10 Venting plug - for Piston Pump (PP) models only.

Once the unit is installed horizontally, remove the plastic plug from the top of the concentrate pump, and replace it with the supplied oil dipstick. The oil dipstick (when present in the vented plug) is a secondary way to check the oil level and the cap is also vented to remove any pressure from the crank case during operation. **Not removing the transportation plug may result in pressure build-up and oil leakage from the Piston Pump crankcase.**

4.13.11 Stainless steel fittings

Be aware that some valves on the Firemiks are made of stainless steel. If assembling other stainless-steel threaded parts to the threads of these valves, be sure to use suitable lubrication to avoid galling and the threads seizing together permanently.

4.14 Commissioning parts

No specific commissioning parts are needed for the FIREMIKS unit. After following all instructions in this Instruction Manual up to the next chapter to make the unit stand-by, the unit is ready for use, see chapter 6. This can be a commissioning test if so desired or required to verify the whole system. See section 6.10 for commissioning procedure.

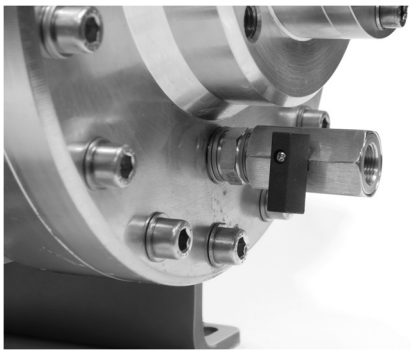
Do not hesitate to contact your FIREMIKS representative if you have any questions regarding the installation of the FIREMIKS!

5 Check before first start

5.1 Check this:

5.1.1 Check once again that installation is made according to instructions above in section 4 Installation, and specifically that the flow direction of the unit has been respected. See 4.13.6

5.1.2 Check that the drain valve on the water motor is closed (no drain valve on 150-500 sizes)



5.1.3 **NOTE!** Make sure that the Drive gear protection is in place and the Protection cap on the back gable side are in place. (Note! On some of the smaller models the dosing pump are connected directly to the Water motor, i.e they have no Drive gear).

Label on Drive gear protection **Protection cap**

5.1.4 For Piston pumps: check the oil level in the concentrate pump. Use the dip stick (must be changed, see 4.13.10) or the oil level window if available on your unit. Refill if necessary, according to section 7.9.1

5.1.5 High Viscosity concentrates

On high viscosity non-Newtonian concentrates, open the air relief valve at the highest point of the concentrate delivery system (see 4.8.12), to remove any air and make sure the whole delivery system is filled without air. When concentrate comes out close this air relief valve and make sure it cannot be opened inadvertently (NC). The same effect can also be achieved by opening the connection slightly so that air can escape, if the hose/pipe connection to the tank allows this.

5.1.6 Follow the instructions for first start-up in the next chapter.

6 Operation

6.1 Optimized start-up and shut down procedures

In this section you will find the operating procedures for the FIREMIKS, according to different versions and operating scenarios. Please read through the whole chapter so you do not miss any exceptions for specific scenarios.

6.1.1 Definition of terms

Wet system	There is always pressurized water in the main piping and the Firemiks, also when stand-by. See also 4.5.4.
Dry system	Main piping and Firemiks are filled with water first at start-up of the flow. See also 4.5.4.
Gravity feed	A steady and sufficient supply of concentrate by gravity to the concentrate inlet of the Firemiks (inlet pressure always higher than atmospheric pressure). (mandatory for Piston Pump PP)
Suction priming	The atmospheric concentrate container is below the inlet of the Firemiks which will need to suck the concentrate to the inlet before the pump is primed (=filled with concentrate)
Flushing	Selector valve (No. 4 on Flow Chart) in Flushing position*
Dosing	Selector valve (No. 4 on Flow Chart) in Dosing position*

6.1.2 Warnings:

*** Warning:** When switching between Dosing/Flushing, always make a quick change between the end positions. See also 3.8.1

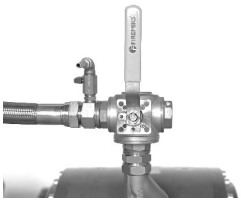
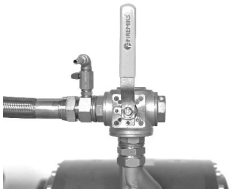
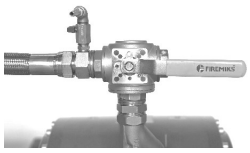
Warning: with the optional Dosing return valve connected to the concentrate tank, be careful not to use flushing when the Dosing / Return is open, this will fill your concentrate tank with water! See also 3.10.3

Warning: Do not let the pump run dry. If the concentrate is finished, switch over to flushing! See also 3.8.1 and 4.9. Or stop the whole system altogether.

Warning: Do not operate the Firemiks with only flushing for extended times (more than 10min), see also 4.3.8

FOR GEAR PUMPS *without* timing gear
Warning: Never use water instead of a concentrate for dosing. The FIREMIKS gear pump type will not dose correctly with water. More importantly, the pump needs the concentrate for lubrication and attempting to dose with water only may seriously damage the pump.

6.2 **Overview of handle positions for different operation modes** (for illustration only, the unit is equipped with signs showing the positions)

Operation mode	4. Selector valve Dosing/Flushing (No 4.)	(Optional) Dosing / Return Valve DRV (No 22a.)	Manual air relief valve	Drain valve
DOSING - Unit standby (ready for operation) - Operation with dosing (rotating)	Dosing position (!) 	Dosing position (!) 	Closed	Closed
FLUSHING - To clean pump from concentrate after operation - Temporarily stop dosing during operation - To make maintenance rotation with hand crank (1-2 turns)	Flushing position 	Dosing position 	Closed	Closed
Dosing Return FOR TESTING ONLY	Dosing position 	Return position 	Closed	Closed

WARNING: No other valve positions allowed!

Note for selectable dosing % units. Dosing is done in the preferred dosing setting, see 3.9. **Flushing must be performed in all the available dosing settings**, from low to high, so to ensure all piping is rinsed.

6.3 Below are several operating procedures for different kind of scenarios, choose the correct one for your unit.

	Operating procedure for Gravity feed of concentrate	
	Wet system	Dry system
First Start-up (The pump and piping system are still dry, e.g. after installation or moving the unit.)	Make sure the concentrate supply is filled up to the inlet of the FIREMIKS concentrate pump, use the air relief valve (see 4.8.12) to remove any unwanted air while the system is NOT running, when concentrate comes out close it. With the selector valve in the flushing position, gently start the main water flow through the piping to prevent over-speeding so that the pump and piping is wetted by pressurised flushing water, then immediately after select the dosing position. Check if dosing is working correctly. If the unit is equipped with a manual air relief valve (or optional dosing return valve), with a suitable collection receptacle at the discharge, shortly open the valve to see if concentrate comes out	
Start-up in a stand-by system	Just let the water flow through the unit, dosing starts immediately. (The instructions for first start-up and Shut down have been followed)	Gently start the main water flow through the piping to prevent over-speeding of the unit, then change the selector valve into the dosing position to start dosing. Operation of the selector valve can be automated. The wet system operation procedure can be used if conditions in section 4.10.2 are fulfilled.
Shut down procedure	With water flowing through the system, flush the FIREMIKS concentrate pump. After approx. 1 minute flushing, stop the main water flow through the unit. After the unit has stopped rotating, put the selector valve into the Dosing position again. This ensures minimal concentrate in the pump, yes still makes immediate dosing at start-up possible. * it might be preferable to NOT flush the concentrate pump: • Salt water: if the concentrate is not very corrosive or there is sweet water available, see 6.12.1. the concentrate does not mix with water in storage, see 6.8.2	With water flowing through the system, flush the FIREMIKS. After approx. 1 minute flushing, stop the main water flow through the unit. Leave the selector valve in the flushing position. The wet system operation procedure can be used if conditions in section 4.10.2 are fulfilled. Salt water: complete unit MUST be flushed with sweet water. See 6.12.3
Emergency stop	Stop the main water flow. See also 6.5 and 6.7	Stop the main water flow. See also 6.5 and 6.7

	Operating procedure for Suction priming of concentrate	
	Wet system	Dry system
First Start-up (The pump and piping system are still dry, e.g. after installation or moving the unit.)	With the selector valve in the flushing position, gently start the main water flow through the piping to prevent over-speeding so that the pump and piping is wetted by pressurised flushing water, then immediately after select the dosing position and open the manual air relief valve to start suction of the concentrate. Close the air relief valve when concentrate comes out, then the pump is primed and ready for use. If the pump does not suck the concentrate, intermittently flushing the unit by quickly switching the selector valve to flushing and back to dosing after approx. 1 second can help improve the suction. Suction will be stronger at higher main water flow rates (within the approved flow range).	
Start-up in a stand-by system	Just let the main water flow through the unit, dosing starts immediately. (The instructions for first start-up and Shut down have been followed)	Gently start the main water flow through the piping to prevent over-speeding of the unit, dosing starts immediately. (The instructions for first start-up and Shut down have been followed)
Shut down procedure	After dosing, flush the FIREMIKS concentrate pump*. *Note: On wet system this can be done without running the unit by opening the manual air relief valve while the system is pressurized in the flushing position.* After approx. 1 minute flushing, stop the main water flow through the unit. After the unit has stopped rotating, put the selector valve into the Dosing position again. This ensures minimal concentrate in the pump, yes still makes immediate dosing at start-up possible, assuming that the priming was done properly before and that there is no air leakage in the suction piping/hoses. * it might be preferable to NOT flush the concentrate pump: • Salt water: if the concentrate is not very corrosive or there is sweet water available, see 6.12.1. • the concentrate does not mix with water in storage, see 6.8.2	As wet system. Salt water: complete unit MUST be flushed with sweet water. See 6.12.3
Emergency stop	Stop the main water flow. See also 6.5 and 6.7	Stop the main water flow. See also 6.5 and 6.7

6.4 Admixture details:

6.4.1 The nominal admixture is stated in your unit's Data Sheet. Depending of flow and pressure the admixture can vary up to +30% the nominal admixture, following EN ISO 13565, FM5130 and NFPA 11 (or between 6-7% for non-standard 6% units). If the flow goes under the stated minimum flow the admixture will be less. Note: Minimum water flow rate varies depending on system pressure, viscosity of the concentrate and, if applicable, selected dosing rate.

6.4.2 Units with selectable admixture

See 3.9

6.4.3 The unit is equipped with a label showing min. and max. flow, max. pressure and nominal admixture. It is placed on the upper side of the water motor.

6.4.4 Different discharge devices in the system after the FIREMIKS can be opened and closed independently of each other without affecting the correct admixture, as long as the min. and max. limits in pressure and flow of the FIREMIKS are kept, considering that the min flow may vary with the viscosity and the system pressure as also stated in the data sheet.

6.5 Stop dosing during operation

6.5.1 When the Selector valves Dosing / Flushing on the concentrate pump inlets *(No. 4 on Flow Chart)* are closed for Dosing it automatically opens for flushing with water of the concentrate pumps as long as the system is pressurized with water. No dosing or admixture is done in this position by the FIREMIKS. **Note! The selector valve handle must only be positioned in its two end positions.** Do not use this feature for prolonged time, see also 4.3.8

6.5.2 Warning: Do not flush with the optional Dosing / Return Valve (22a) in the Return position, this will result in flushing water returning into the return line and into any connected concentrate tank, causing possible tank overflow and diluting the concentrate. To stop "dosing" (no actual dosing is happening) in this scenario, just stop the water flow.

6.6 Dry running and drying of concentrate.

Note! Never let the FIREMIKS run dry without concentrate or flushing water, this will damage the concentrate pump.

6.6.1 The concentrate pumps can withstand some dry running without damage for a limited time. Dry running must however never be purposely chosen or relied upon.

6.6.2 When all concentrate liquid is finished, quickly switch to Flushing with the Selector valve Dosing / Flushing on the concentrate pump inlet *(No. 4 on Flow Chart)*. Or stop the FIREMIKS altogether by shutting down the main water flow.

6.6.3 If the unit has run dry, it is important to flush the pump, see 6.7

6.7 Importance of Flushing after use, and avoiding drying or decomposition of concentrate.

Do not allow concentrate with air pockets to dry inside the FIREMIKS, this can block the unit. This can happen particularly after dry running and not flushing afterwards.

Do not mix concentrate and water inside the concentrate pump, as some concentrates can react to different % of water and coagulate or separate and cause issues.

Always make sure the FIREMIKS is either:

- completely filled and primed with either concentrate OR flushing water.
- that the unit has been flushed with sweet water first and then drained if the unit is to be dry.

In some cases, flushing may be actively chosen to not be done, see next point 6.8 if the unit has a Dosing / Return Valve (DRV) connected back to the concentrate tank, and 6.12.1 for salt water use.

6.8 Concentrates that do not mix with water in storage in units with DRV (Dosing / Return Valve) connected back to the concentrate tank

6.8.1 Reminder. NEVER flush the unit when DRV valve is in the return position. See 3.10.3 (DRV valve details) and 6.2 (approved valve positions)

6.8.2 Concentrates that do not mix with water because their properties may be affected in storage, must **never be flushed** if there is no special concern about the corrosive nature of the concentrate. Make sure the concentrate pump is properly primed so there are no air pockets that can dry out and cause issues.

If there is concern about the corrosive nature of the concentrate, the unit shall be flushed after use as per instruction in 6.3. Before operating the DRV valve in the return position, the concentrate pump must first be primed, that is completely filled, with concentrate.

Procedure for priming the concentrate pump with concentrate can be done with or without running the unit on the water flow:

- **If it is OK to run the system for a very short time with concentrate dosing in the water stream acc. to 6.3, then this will fill the FIREMIKS concentrate pump with concentrate. You may check for concentrate coming out of the air relief valve and immediately shut down the main water flow when this is the case.**
- Without running the main water flow. Put the unit in dosing position according to 6.2. Put a receptacle on the air relief valve drain tube and open it. Rotate the unit with the maintenance crank until pure concentrate emerges from the air relief valve. Close the air relief valve and turn the maintenance crank another 45 degrees. Now the unit is primed with concentrate.

After one of these procedures, testing can proceed according to 6.11.2

6.9 After operation in a fire:

6.9.1 After use of the unit in a fire, or in a test with large water flows; check the function according to paragraph 7.8

6.9.2 When the unit has served in a fire and the operator wants to ensure optimum future functioning, it may be appropriate to change the vanes in the unit. See also 7.10. Contact your distributor or Firemiks AB for spare parts and instructions for your unit. These spare parts and qualified personnel must be held standby if a quick turnaround of the installation is crucial.

6.10 Commissioning and acceptance

acceptance procedures shall be in accordance with the requirements outlined by the certification agency, the Authority Having Jurisdiction, and NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, or the equivalent national code of the country of use.

An appropriate Authority Having Jurisdiction representative should be given advance notice of acceptance, commissioning and reconfirmation testing and be present for commissioning of the system.

A trained manufacturer's representative should be present to properly test and reset the system following any acceptance, commissioning and reconfirmation testing.

No special commissioning parts are needed. An example checklist on what should be checked at commissioning is included in attachment. This list is not exhaustive; in essence the complete installation must be made according to chapter 4. A function test of the complete installation according to chapter 5 and paragraphs above 6.1 to 6.7 and also 6.12 for salt water use.

When doing acceptance at commissioning, **special attention must be given to the following two points:**

6.10.1 Overflow at start-up

In case the maximum rpm is exceeded during start-up, typically due to dry/empty piping in the system, depending on the amount of overflow, different measures must be taken to reduce this start-up overflow:

Comissioning
It is recommended to measure rpm during the first start-up and to register the maximum value, this feature is usually available on most tachometers.

- Up to 10% overflow (<110% of max flow) at start-up is acceptable but then the unit should only be tested once a year (NFPA) with vane replacement after 5 years (standard service interval).
- More then 10% overflow (>110% of max flow). Additional measures must be taken to remove the overflow at start-up. See chapter 4.4.5
  It is possible to not amend overflow up to 40% excess if it can be guaranteed that the unit will only be subjected to overflow ONCE, i.e. during a real fire. After this, the vanes of the unit MUST be replaced before it is put back to service. This means that during periodic testing of the dosing performance of the installation, no overflow is allowed. This can be achieved by manually reducing flow by partially closing downstream valves or partly opening deluge valves to fill any empty piping in the installation, before releasing full flow.

6.10.2 At commissioning, the admixture can be tested according to the next paragraph 6.11.

6.11 Testing admixture

An admixture test can be done in several different ways, for example with a refractometer or by measuring the consumed additive at a defined water flow.

We can distinguish between two main methodologies, one where foam is actually discharged and the other where there is no mixing happening and dosing is simulated, each is discussed here:

6.11.1 Discharge

The most realistic test is to do the discharge test in the actual installation at all the operating scenarios. However, downside is this will create cost of concentrate used and the cleaning up and destruction of used foam. Dosing rate is typically measured using the conductivity test. It is also possible to measure the amount of foam used per time if the exact tank dimensions are known and the level can be accurately measured, or if the concentrate tank can be weighed before and after. The water flow can be approximated by measuring the FIREMIKS rpm using a tachometer, if no water flow meter is present. Contact FIREMIKS AB to get the rpm to flow conversion tables for your FIREMIKS serial number, if not present on the type plate of the unit or in the data sheet. Please not that this assumes that the water motor is working correctly and this is thus used as a verification of the installation. As a verification of the FIREMIKS itself or similar type of system, using the rpm is invalid as converting rpm to flow already assumes the dosing system is working correctly.

6.11.2 Simulated dosing test without foam concentrate mixing with the water – environmentally friendly

This method uses the return position of the optional Dosing / Return Valve (DRV) on the FIREMIKS. Thus, the concentrate is not mixed into the water flow and only water will be discharged. If water discharge on the hazard is not possible, discharge can be diverted to another more suitable place.

CAUTION:
The optional Dosing / Return Valve (valve) **should only be operated by qualified personnel for maintenance/testing purposes.** See 3.9 for more information.

In its simplest form, the Dosing Return Valve can be used to see if the pump is working by opening the valve to the return position and see if the foam is coming through when running the system, gathering it in a suitable receptacle.

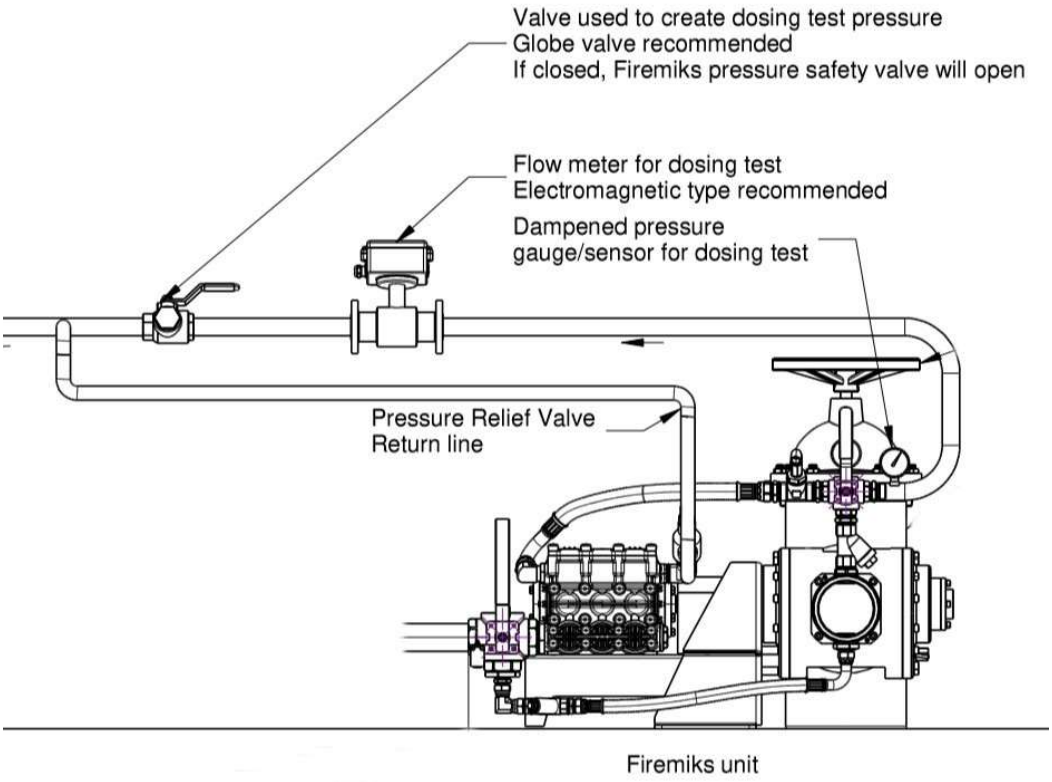
To make a dosing test accurately, it is necessary to match the return line pressure to the actual pressure in the water line after the FIREMIKS and to measure the concentrate and water flow. Measuring equipment is needed as outlined in section 6.11.3 and the measuring method in section 6.11.5. However, if this equipment and method are too advanced, it is possible to simplify the equipment and methodology and still get a good indication of dosing performance. These simplified methods are described in section paragraph 6.11.4.

6.11.3 Measuring equipment needed for dosing test without mixing the additive.

- **Two dampened pressure gauges**, one on Firemiks outlet and one on return line
- A **valve to create backpressure** in the return line, preferably a globe or needle valve so backpressure can be accurately chosen
- The **return line** going back to the tank.
- A concentrate **flow meter** for the return line that can accurately measure the concentrate flow, recommended is an electromagnetic flow meter, or in short a mag flow meter.
- A **water flow meter**.

All measuring equipment can be purchased as a kit through FIREMIKS if so desired. If so it comes with updated instructions.

Arranged as illustrated in the below illustration:



The second pressure gauge in the water line after the FIREMIKS is not shown in the above illustration.
The correct order in the return line is **pressure gauge – flow meter – backpressure valve – (pressure relief valve return line) – tank**.

Measuring Procedure without mixing concentrate

WARNING: when opening the DRV valve to the return position, be 100% sure the Selector Valve Dosing / Flushing is set to the DOSING position and NOT the flushing position. Flushing the unit with the return open would mean filling the tank with pressurised water from the main water line, diluting the foam concentrate and eventually overflowing the tank.

If the concentrate does not mix with water, prime the pump with concentrate first or never flush the pump, see 6.8

With the valves in the correct 'Dosing return' testing position, see 6.2, so that the foam concentrate is connected to the concentrate pump inlet and then is routed back to the tank, and the backpressure valve on the return line open:

- start the main water flow to the intended working point
- once the water flow is reached, read out the pressure in the main water line after the FIREMIKS
- close the backpressure valve slowly until the pressure in the return line matches the pressure in the main water line.
- Read out the concentrate flow and the main water flow, alternatively the water motor rpm. Contact FIREMIKS AB to get the rpm to flow conversion tables for your FIREMIKS serial number.

This principle method of measuring dosing without injecting the concentrate is accepted method for this type of equipment, equivalent method according to EN 13565-1, NFPA 11 Annex D section D.5.3.2 and FM 5130 4.26.1.2.

Note: Pressure relief valve (PRV)

The FIREMIKS is equipped with a pressure relief valve (PRV) on models with a Dosing / Return Valve (DRV). In case one by accident closes the backpressure valve completely or in some other manner blocks pump discharge, this will trigger the pressure relief valve. If this can happen, have a suitable receptacle to gather the concentrate discharge from the pressure relief valve, or route the pressure relief valve discharge back to the tank.

IMPORTANT: nothing in the pressure relief discharge line may obstruct its flow back to the tank or receptacle. No valves etc. in this line allowed!

6.11.4 Simplified methods

The above-described method is the most accurate and versatile covering all usage scenarios but can be overkill. It is possible to simplify several parts:

Water flow meter => measuring RPM

If no water flow measuring equipment is available, it is possible to approximate the water flow by measuring the FIREMIKS unit **rpm** using a **Tachometer** as an indication of the water flow, the rpm can be taken mechanically on the axle end on the back side of the water motor, or by using no-contact optical method on the same or the drive gear. Contact FIREMIKS AB to get the rpm to flow conversion tables for your FIREMIKS serial number.

Note!: Dosing performance is the result of the performance of the complete unit, water motor and concentrate pump combined. By using the rpm to measure water flow, one is effectively using the Water motor itself as measuring equipment, this method therefore does not evaluate the water motor performance, rather it accepts is as a given. Using this method is thus not a scientific valid method of evaluating the complete unit dosing performance. However, assuming the water motor function is unquestioned, it can give a good indication of the dosing performance of the dosing pump.

Concentrate flow meter => sampling of foam

The concentrate flow meter can be replaced by sampling the foam under a determined time, e.g. 30s or 1 minute. The foam concentrate is then wholly collected in a suitable receptacle sized for the expected volume. Recommended is a 3-way valve in the unpressurised part of the return line (after all other valves) which is quickly switched over on the clock. Concentrate flow can then be calculated by either having a receptacle where the volume can be read out, or by weighing the concentrate and converting to volume with the known density. *Dividing the flow with the sampling time gives the concentrate flow.*

Pressure gauges and backpressure valve => pressure relief valve

It is possible to replace the pressure gauges and backpressure valve with a pressure relief valve set to a fixed pressure which is close to the expected pressure in the downstream system and sized appropriately to take the expected concentrate flow. With this method, reading out the pressure gauges and manually setting the backpressure is not necessary, one only needs to determine the water and concentrate flow. Alternatively, an adjustable pressure relief valve can be used, again appropriately sized for the expected concentrate flows.

6.11.5 Dosing rate calculation:

Dosing rate is calculated as follows:

$$Dosing\ rate\ \% = \frac{Add\ flow}{Water\ flow + Add\ flow} * 100$$

Acceptable % range EN 13565-1 section 5.3, NFPA 11 section 11.6.4, FM 5130 section 4.4.2.2 for dosing rates up to 3%:
'nominal dosing rate' to 'nominal dosing rate x1,3'

For a 3% unit, the acceptable range is from 3% to 3,9%

Note: for 6%, acceptable range depends on what standard (6%-7% or 6%-7,8%).

Note 2: in applications where perhaps other standards are applicable, e.g. in some case of for fire brigades and fire trucks, the allowable tolerance can differ

6.12 Salt sea water use

The Firemiks may be operated with salt water. There are different scenarios, please read through this whole section to decide the best actions for safe salt water operation.

6.12.1 Flushing of units in wet systems with salt water

When operating in salt water, the flushing arrangement on the FIREMIKS unit concentrate pump becomes questionable, as one would replace potentially corrosive foam concentrate with corrosive salt water. In case there is no sweet water available, an informed decision must be made if the concentrate or the salt water is most corrosive, and thus the unit must be respectively flushed or **NOT flushed after use**. In case of doubt, do NOT flush as usually salt water is more corrosive than the foam concentrate. Both these options under the condition that the concentrate pump is properly primed and cannot drain during stand-by, otherwise section 6.12.3 applies!

In case there is a sweet water source available at the installation, i.e. a water tap, a much better solution is to remove the flushing line from the water motor and plug the water motor, and to connect the flushing line to the sweet water source permanently. Then there are two possible scenarios:

- In case the flow capacity of the sweet water source is similar as the concentrate flow, then when switching the selector valve Dosing / Flushing (no.4) to the Flushing position, the pump will be flushed with sweet water when the main water flow is running.
- In case the flow capacity of the sweet water source is less than the required additive flow at a given main water flow rate, the concentrate pump must be flushed with the main water flow shut off and the unit is

stationary. Switching the selector valve Dosing / Flushing (no.4) to the Flushing position and then opening the manual air relief valve (see 3.8.3), the pump will be flushed with sweet water and the flushing effluent must be collected or drained to a suitable place from the manual air relief valve. This operation is thus manual and must be planned for in the operation plan of the installation.

6.12.2 Special instructions for the Aluminium water motor in wet systems

FIREMIKS with the aluminum water motor **must always be flushed completely with fresh sweet water after use with salt water.** This is to avoid excessive corrosion of the aluminum housing. The surface treatment has good resistance to corrosion, however with use any scratches into the coating may corrode after exposure to salt water and impair correct functioning of the unit.

At order, an Aluminum unit can be specified for use with brackish or low salt water. In such cases the unit can be excepted from flushing with fresh sweet water on wet systems in specific cases, and only after approval from the Firemiks AB the manufacturer. In this case it is extra important that clear water is used so that there are no damages to the black coating, and sufficient cathodic protection is then used to prevent corrosion of exposed aluminum. Sacrificial anodes must be inspected every six months and replaced if they are almost consumed. A separate instruction is included for these units. These units will have a shorter lifespan than bronze units used in salt water.

6.12.3 Special instructions for DRY systems including Stainless Steel and Bronze water motor materials

On dry systems, meaning systems where the unit - water motor and/or concentrate pump are possible to become drained during stand-by, the unit **MUST be flushed with fresh SWEET water thoroughly after use**. Otherwise, crystallizing salt will impair the correct function of the water motor and the concentrate pump.

6.13 Draining of unit

Sometimes it is necessary to drain the unit from fluids, e.g. if the unit will be exposed to freezing temperatures or for maintenance. Follow these steps to drain the unit:

1. Flush the pump by running the unit shortly in the flushing setting. See 6.1 and 6.7. Optional DRV should be in the dosing setting, see 3.10. For salt water, the unit must be flushed with fresh water first, see 6.12. And keep the unit in the flushing setting.
2. Shut off the water supply to the water motor, see also 4.3.5 and drain the piping where possible.
3. Open the manual air relief valve, see 3.8.2. Larger units also have a plug on top of the water motor that can be removed.
4. Open the drain valve, see 3.8.4 and let the water flow out.
5. Disconnect the water line to the water motor where possible (and always on the smallest units without drain valve), preferably at the lowest point.
6. Open the filter and let the water flow out.
7. Rotate the unit using the wrench until no more water comes out of the unit. See also 7.3.3.
8. Close all piping, valves and filters.

7 Maintenance

For maintenance of your complete installation surrounding the FIREMIKS, please refer to European standard EN 13565-2 for general requirements. The required maintenance in this chapter are based on international practice and requirements as outlined in international standards such as NFPA 11 and 25.

7.1 Maintenance record

7.1.1 Keep and maintain a maintenance record of the FIREMIKS, preferably for the complete system where the FIREMIKS is/are installed. In this record maintenance done according to the instructions below on the FIREMIKS unit(s) and any deviations from the normal situation. It is also very beneficial to record any tests done and any operation of the system. This can be very helpful if any problems should arise with the system.
An example of a maintenance record is attached

7.2 WARNING! It is extremely important that at every service or maintenance of the unit you must assure yourself that the unit cannot be started by mistake.

7.2.1 Close completely a shut-off valve in the main water supply before the unit and make sure it cannot be opened while you are working on the unit, see also 4.3.5.

7.2.2 After service, put back the unit into stand-by, with the shut-off valve before the unit opened again.

7.2.3 Note also WARNING SIGNS on the unit.

7.3 **Once a month** (every second week with salt water)

7.3.1 (Secure that unit cannot be started, see 7.2). Check there are no leakages on the unit, on the hoses, in the connections or couplings, and that no fasteners on the unit and installation are loose. Also check under the drive gear protection and the axle water motor and pump seals for signs of leakage.

7.3.2 Check the oil level on units equipped with piston pump(s) (PP) or gear pumps with timing gear (black rear cover). Use the dip stick or the oil level window if available on your unit. Refill if necessary, according to section 7.9.1 or 7.9.2

7.3.3 Rotate the water motor and the concentrate pump manually, as required by NFPA for foam concentrate pumps.

For PP piston pump units, three different scenarios exist depending on what medium is inside the concentrate pump, and if there is a return to the concentrate tank.

A. **Flushing water** inside the concentrate pump (normal procedure, see 6.3):

   a. Put the selector valves Dosing/Flushing in the flushing position (see 6.2).

   b. Remove the protection cap on the back gable and use the supplied or similar socket wrench to turn the water motor rotor 1,5 turns (see image next page).

   c. Put back the protection cap and put the valves back into your chosen stand-by position (see 6.3).

B. **Concentrate** is inside the concentrate pump (see 6.8.2 or 6.12.1) AND if the DRV is connected to the concentrate tank (see 4.11):

   a. Put the valves in ‘Dosing return’ position (see 6.2).
   b. Remove the protection cap on the back gable and use the supplied or similar socket wrench to turn the water motor rotor 1,5 turns.
   c. Put back the protection cap and put the valves back into the Dosing position (see 6.2).

C. **Concentrate** is in the concentrate pump (6.8.2 or 6.12.1) AND there is no DRV connected back to the concentrate tank

   a. Put a receptacle like a bucket to collect concentrate under the Manual Air Relief Valve hose (see 3.8.3)
   b. Keep/put the valves in the ‘Dosing’ position (see 6.2) and open the Air Relief Valve (see 3.8.3)
   c. Remove the protection cap on the back gable and use the supplied or similar socket wrench to turn the water motor rotor 1,5 turns **SLOWLY**. Concentrate will come out of the air relief

valve, collect this and dispose correctly or, if there is no contamination, put back into the concentrate tank.

d. Put back the protection cap and put the valves back into the Dosing position (see 6.2).

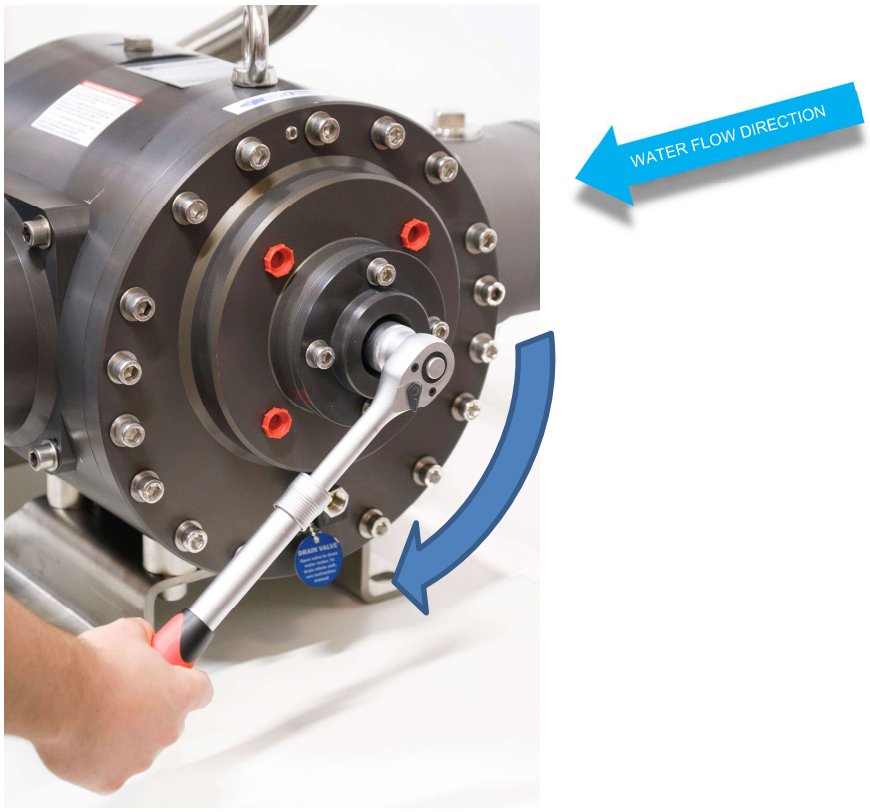
For GP gear pump units

Remove the protection cap on the back gable and use the supplied or similar socket wrench to turn the rotor of the unit approx. 20° (about 1/8th of a turn) without any valve changes. Put back the protection cap on the back gable.

Interval

If initially there is much resistance to rotation which releases once there is movement, shorten the rotating interval to once every second week. With **salt water**, rotation must also be done at least **every second week**.

Under certain conditions, extended longer maintenance intervals can be approved, contact your distributor or Firemiks AB in such cases.



Rotate by hand after making sure the water flow cannot start (see 7.2)

Record the service in the chosen service record and make the unit stand-by again.

7.4 **Every quarter** *in addition to the above points!*

7.4.1 Check the filter on the flushing line for cleanliness. If the filter is clogged, open the complete filter, make sure that it is emptied and returned to its previous placement including all seals.

Opened filter

Warning: The system must be depressurized before opening filter cap.

Depending on the size of the unit and the size of piping connected before the shut off valves, a significant amount of water and perhaps also concentrate can come out. Be prepared to collect and dispose this in an appropriate manner.

If you know for sure the flushing feature has not been used other than maybe the maintenance rotation, you may skip this step, up to the yearly check.

7.4.2 Also check other filters in your installation.

7.5 Once a year *in addition to the above points!*

7.5.1 On units with a drive gear, remove the drive gear protection (4mm Allen) and check the condition of the drive gear. No cracks, no play on axle and good condition of the plastic insert. Also take a good look if the pump bracket is not deformed, this can cause drive gear failure. Reinstall the drive gear protection.

7.5.2 Piston Pumps and Gear pumps with timing gear: change oil in the pump, see 7.9

7.5.3 On units with belt drive, open the belt drive cabinet and check the condition of the belt for visible cracks and material degradation.

7.5.4 Complete function test, letting the unit function shortly by mixing additive, with special care taken to prevent overflow/overspeed (by e.g. manually partly closing a valve upstream or directly downstream of the FIREMIKS). This is to check the function of the system but not to cause unnecessary wear that may be cause by overspeed, see 6.10.1. Use the ***commissioning and acceptance testing sample record*** in the appendix to record this test, in addition to the general maintenance record. If the unit is not working satisfactorily, read section 8. Troubleshooting.If the unit is not working satisfactorily, read section 8. Troubleshooting.

7.5.5 Complete function test, letting the unit function shortly by mixing additive, with special care taken to prevent overflow/overspeed (by e.g. manually partly closing a valve upstream or directly downstream of the FIREMIKS). This is to check the function of the system but not to cause unnecessary wear that may be caused by overspeed, see 4.4.4. Use the ***commissioning and acceptance testing sample record*** attached at the end of this manual to record this test, in addition to the general maintenance record also attached there. If the unit is not working satisfactorily, read section 8. Troubleshooting.

Note: In general to have a complying system, an appropriate **Authority Having Jurisdiction** representative should be given advance notice of this reconfirmation testing. And a **trained** manufacturer's representative should be present to properly test and reset the complete system following reconfirmation testing. Contact Firemiks AB if there are more questions about this.

7.5.6 Afterwards clean the filter according to 7.4.1

7.5.7 Consider if the unit has been subjected to overflow and if the vanes need to be changed, see overflow 4.4.4 vane replacement 7.10

7.5.8 On GP units using suction, do a pressure test of the concentrate suction line, see 4.8.6

7.6 Every 5 years *in addition to the above points!*

Standard maintenance interval for water motor vanes, also read vane replacement paragraph 7.10.
Recommended replacement interval of 'recommended spare parts' listed in:
9.1 Water motor spare parts overview
9.2 Piston pump spare parts overview
9.3 Gear pump spare parts overview

7.7 Every 10 years *in addition to the above points!*

Make a wet* pressure test of the complete FIREMIKS up to at least 1,5x operating pressure and replace seals where necessary, see spare parts in chapter 9.

On belt driven gear pump units (GP-BD), the belt must be replaced, see 7.11

*complete unit filled with water

7.8 After every use in a fire or similar live testing

- Consider if the water motor vanes need replacement, see paragraph 7.10
- Check for leaks and oil level, see 7.3.1 and 7.3.2
- Check the drive gear condition, see 7.5.1, or belt condition, see 7.5.3
- Clean all strainers, see 7.4.1

7.9 Pump oil change:

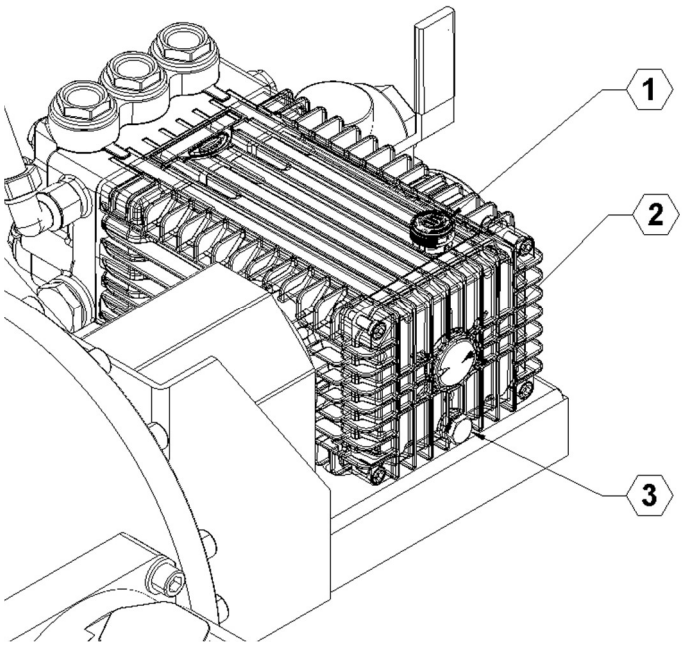
The oil should be changed **every year**. If the unit is installed in a climate controlled room with low humidity, the time interval may be extended to two years.

7.9.1 Oil change instructions Piston Pump:

Check the dimensional drawing for more specifications and filling volume needed on the larger units. Contact your distributor or Firemiks AB if any questions remain.

- Oil specification: use a quality automotive Engine oil **SAE 5W-30, 5W-40, 10W-30** or **10W40** or Gearbox oil **SAE 75W, 75W-80, 75W-85 or 75W-90**. This specification has precedence on what is written on the piston pump itself, it is however not critical, as long as either is followed it is OK.
- Preferably change to oil after the unit has operated so that the oil will be thinner.
- Find the oil drain plug and put a container under it (3)
- Remove the oil dipstick (1) and then the drain plug (3).
- Wait until all the oil has drained out, then screw the drain plug (3) back in and tighten.
- Fill with new oil until the middle of the oil level indicator (2) is reached, screw back the oil dipstick by hand.
- Check for leaks

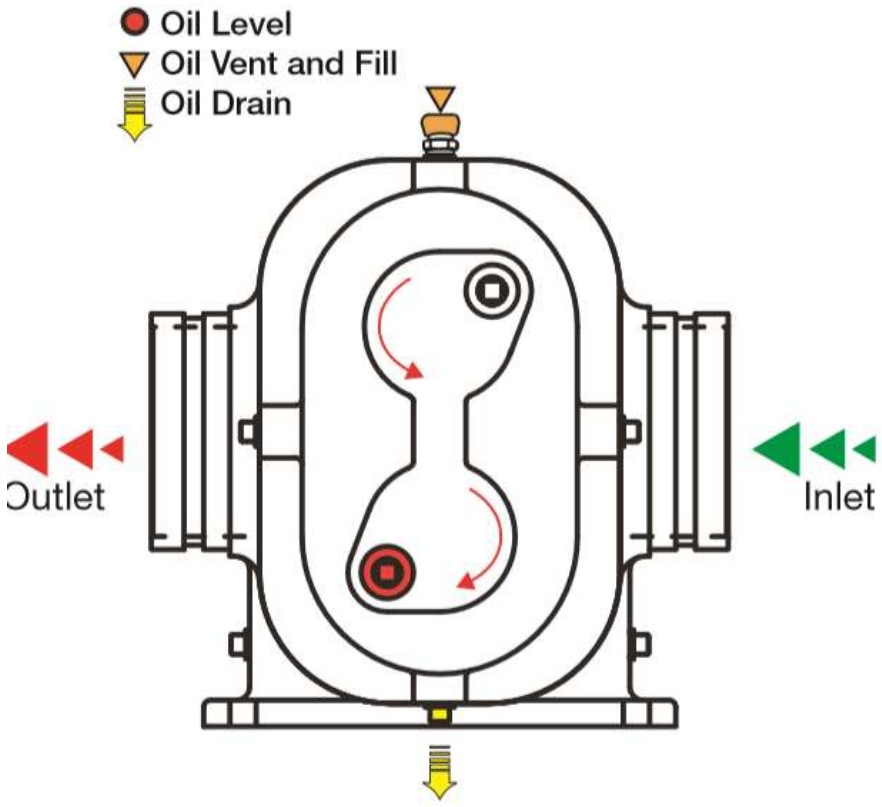
- Note: The extracted old oil must be collected in a suitable container and disposed of in an environmentally responsible way, using the appointed method as required by law at the least.



7.9.2 Oil change instruction for Gear Pump with timing gear (black steel cover).

- Oil specification: use a quality oil with specification SAE W30
- Amount of oil needed approx. 0,12 liter.
- Find the oil drain plug and put a container under it
- Remove the drain plug.
- Wait until all the oil has drained out, then screw the drain plug back in and tighten.
- Open the oil fill and fill with new oil until the oil level plug. Remove the oil level plug to remove excessive oil if filled too much.
- Put all plugs back in their original place.
- Check for leaks

Note: The extracted old oil must be collected in a suitable container and disposed of in an environmentally responsible way, using the appointed method as required by law at the least.



7.10 Replacement of vanes

7.10.1 5-year standard replacement interval

Vanes wear to a varying degree depending on run time, run speed, load, water quality and pollutants, temperature, amount of wear already present, ageing, exposure to excessive heat and overspeed at start-up. To ensure the vanes remain fresh and in as new condition in the event of a fire, the general requirement is to change vanes every 5 years on standby units that are tested every year as required. Vanes are part of the 2-5 years recommended spare parts and come with instructions on how to change the vanes.

7.10.2 Exceptions

Units that are tested or run on a frequent schedule or run exceptionally long must have a separate maintenance schedule for vane replacement. Examples are intensive monthly test schedules, frequent waste disposal fires, slow burning mine fires, etc. Please contact Firemiks AB for the most suitable replacement schedule for your specific case.

7.10.3 Criteria for changing vanes with frequent use

Vanes must be replaced in the following cases:

a) Testing shows a measurable drop in dosing performance that cannot be explained by other changes
b) The vanes have been exposed to more than 70°C
c) Noise levels increase noticeably with subjectively less smooth running. A baseline measurement can be made with a decibel meter in identical conditions (same flow and pressure, same measurement point, same environment and installation) preferably close to the water motor, and if noise has increased measurably, more than 2 dB(A), the vanes need to be replaced.
a) If there is access to the inlet or outlet of the water motor with the piping disconnected, the play on the vanes back and forth should be less than 1mm (units up to 2400 in size) and less than 2mm (larger than 2400 sizes). If play is higher, vanes must be replaced.
b) The unit has been subjected to overspeed exceeding 10% more than the maximum flow for longer than 5 minutes IN TOTAL (*accumulative of all occurrences*), and immediately if the unit has been oversped more than 40% more than the maximum flow.

If any of the above criteria have been met and the vanes have been replaced, the next time the vanes should be replaced in half the same use interval or less, to ensure the vanes are fresh in case of an incident.

7.11 Belt drive maintenance

For units with a belt driven gear pump (belt drive inside large vertical cabinet).

7.11.1 The self-tensioning multi V-rib belt is maintenance free within its protective case, given that the maintenance schedule of rotating the unit is followed. **The belt drive must NOT be oiled or lubricated.** If it becomes dirty through the case ventilation, it can be cleaned using a microfiber cloth and water, use a mild soap in the water if necessary.

The recommended change interval is 10 years. Should on inspection the material show signs of degeneration due to aging or contamination, the belt needs to be replaced sooner. Contact your distributor or Firemiks AB for spare parts and instructions on how to change the belt.

An unmounted spare belt has a limited shelf life of two years.

8 Troubleshooting

8.1 NOTE! It is extremely important that when troubleshooting the unit, when it is not already running, you must assure yourself that the unit cannot be started by mistake.

8.1.1 Close completely a shut-off valve in the main stream before the unit and make sure it cannot be opened while you are working on the unit, see also 4.3.5. Note also WARNING SIGNS on the unit.

8.2 NOTE! **There is a risk for powerful jet streams of water at leakages when the system is under pressure. Be sure to make the unit (and if necessary the system) without pressure when doing service.**

8.3 <u>If the water motor and the concentrate pump is rotating but there is no suction of concentrate, or the admixture is too low:</u>

a) If there is no admixture at all, stop the water flow immediately as there is a risk that the concentrate pump is running dry that may damage it.

b) Check if there are any valves in the suction line that are closed or partly closed or blocked filters in your installation.

c) At suction scenario; check for possible air leakage in the suction line, in all couplings and hoses/pipes. Air leakages are hard to spot as there is no spillover and can't be heard in a noisy environment, and very small holes suffice to remove any vacuum. Make a pressure test or check for suction by hand if possible. Tighten the air leakage when found. Also make sure that section 4.8 is fulfilled.

d) Check that the stated minimum water flow is achieved, you may use a tachometer as guidance, see 4.4.6. Increase if necessary.

e) If the pump is not priming/sucking properly, it is possible to flush the concentrate pump a couple of seconds by selecting Flushing Line position on the selector valve *(No. 4 on Flow Chart)* to flush out any air in the concentrate pump.

f) For high viscosity concentrates and gravity feed, any air trapped in the concentrate delivery hose between the tank and FIREMIKS can be removed by opening the air relief valves when the system is NOT running. See 3.8.3 and 5.1.4

g) Check that the maximum pressure (16 bar) is not exceeded. Lower the system pressure if necessary.

h) Check the oil level on the oil level indicator on the pump. If the level is too low, fill again to required level and retest.

i) Check the pump for leaks.

j) If the pump is noisy and capacity has dropped a third or two thirds from normal on PP models, it is likely that one or two pistons or their suction or delivery valve(s) is/are malfunctioning. The valves of the pump must be opened and check for debris and/or damage. Contact your distributor or Firemiks AB for spare parts.

k) If the admixture performance has decreased over time to a too low level and none of the previous points could account for this, it is possible that the vanes in the water motor have become too worn. This is accelerated if the water is not free from contamination (dirt, sand, etc.). If so, contact us to order a set of spare parts and for instructions on how to replace the vanes.

8.4 Leakage in the couplings in the piping/hoses between water motor and pump:

a) Coupling can start to leak when exposed to knocks.
b) Check that all pipe couplings are properly tightened. It is important to use two wrenches when doing this. One to tighten and one to hold against. Most couplings can be resealed just by tightening.
c) If b) does not work, contact your distributor or Firemiks AB for guidance in your specific case.

8.5 Leakage between gable and middle part on the water motor:

a) Check if any screws have become loose. If so, retighten them with the correct tightening torque using a calibrated torque wrench in a slow and deliberate manner. The correct tightening torques are listed in 10.1. If you ever find an original screw loose, please let us know. **Note! Do not use higher torque as you may cause damage or stretch the screw, so making the assembly less strong.**

b) If this is not sufficient the O-rings between gable and middle part must be replaced. See 9.1 Water motor spare parts overview.

8.6 Oil leakage from the pump

a) Be sure the transport oil plug on the pumps has been replaced by the vented oil level plug, see 4.13.10. Failure to replace this can cause overpressure in the crank case and cause oil leakage. Refill oil if necessary. If oil leakage persists with the vented oil plug, it may be possible to replace the leaking oil seal. Contact your distributor or Firemiks AB for guidance.

8.7 Leakage between connection pipe and middle part on the water motor:

a) See 8.5 a)

b) If this is not sufficient the O-rings between connection pipe and middle part must be replaced. See 9.1 Water motor spare parts overview.

8.8 Water motor rotor and additive pump are difficult to rotate with crank on the rotor shaft end:

a) This is normal in a wet pipe system where a unit which is filled with pressurized water and is attempted to be manually rotated, rotation will be heavy.

b) Should however a unit that is dry also be difficult to rotate, check the unit by putting the Selector valve Dosing / Flushing *(No. 4 on Flow Chart)*. in flushing position and let the specified minimum flow of water go through the unit for a couple of minutes, to flush out foreign particles, etc. **Note! The selector valve handle must only be positioned in its two end positions.** If there are no unusual noises and the unit has an easy rotation after flushing, this is sufficient.

c) If the guidelines in section 6.1 and section 7.3 have not been followed, the concentrate pump may seize and refuse to rotate. Contact us on how to proceed.

d) If the problems remain after acting accordingly to the above, or if there are heavy unusual noises, contact your distributor or Firemiks AB for detailed guidance in each case.

8.9 The maximum water flow is not achieved:

a) Make sure the FIREMIKS is rotating properly according to section 7.3

b) Check if there are restrictions in the piping system before or after the unit. Remove them if necessary.

c) Check if any filter or other valves in the main line is filled with pollution. Clean if necessary.

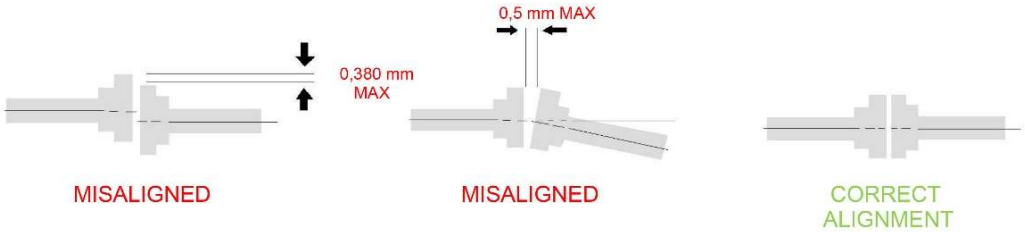
d) Check that the main water pump is working correctly and that there are no air leakages affecting this pump.

8.10 Excessive vibration/noise:

a) Excessive, previously unheard, vane noise (loud ticking) can be heard from the water motor during operation. If this occurs on a used unit, this can be an indication that the vanes are worn and need replacement. This can be caused by age, exposure to high temperatures or overspeed. Typically, dosing will be lower then normal if the vanes are worn.

b) For units equipped with a drive coupling between the water motor and concentrate pump, these have been aligned at the factory.

However, if they for any reason, e.g. during transport, became out of alignment, this will cause excessive vibration and noise. This should be adjusted as soon as possible as it can cause excessive wear and material failure. See illustration below for allowable tolerances. As a rule of thumb, the plastic insert should be able to moved freely back and forth by hand.



c) If the unit is operating in flushing when the noise is exhibited, check the filter on the flushing line. A clogged filter can cause the pump to cavitate and produce excessive noise.

8.11 Unusual high pressure drop

a) Unusual high pressure drop at a given flow can be an indication that there is a problem with either the water motor or the foam concentrate pump using additional power. Stop running the unit if possible and contact Firemiks AB for guidance on how to proceed.

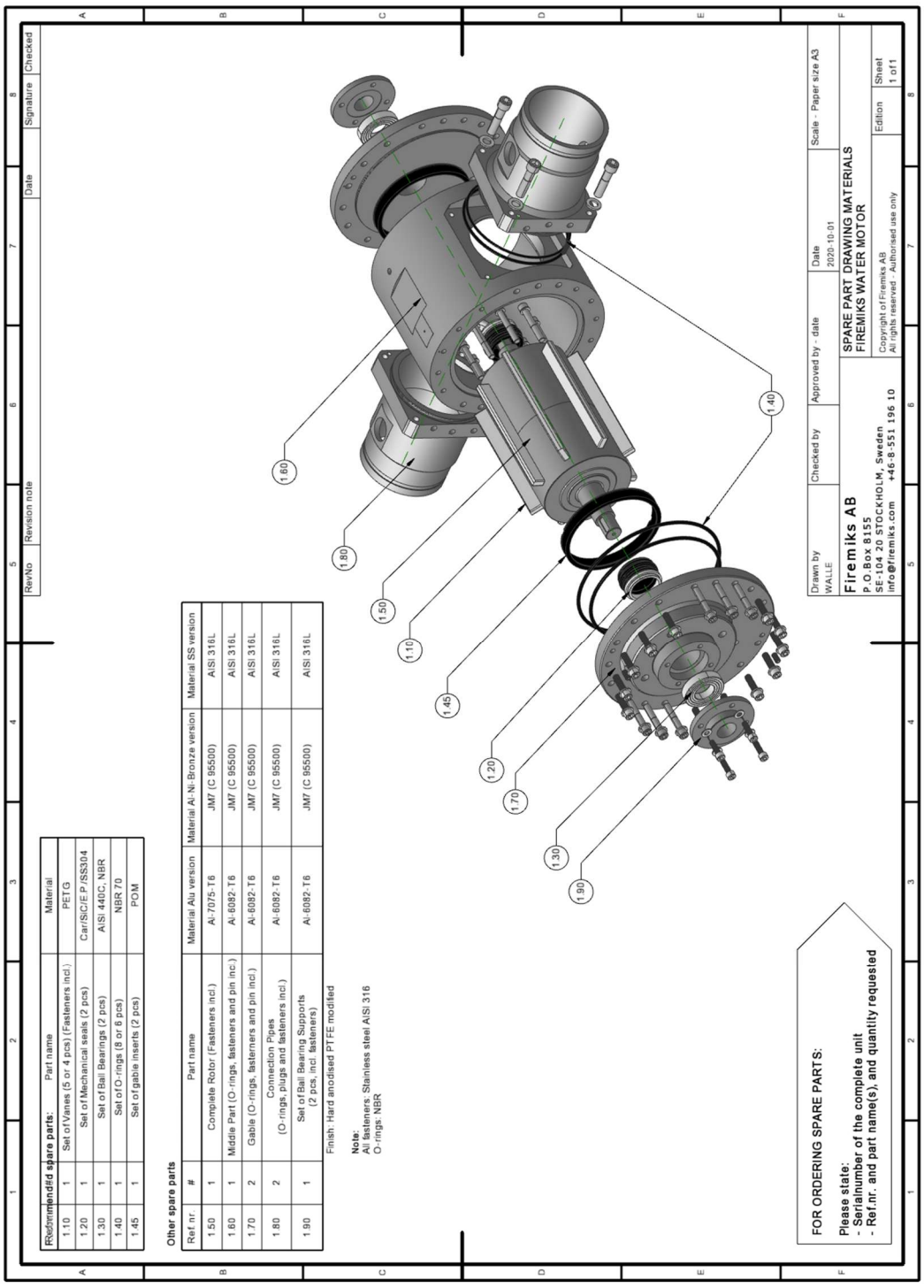
b) If the unit is operating in flushing when the pressure drop is exhibited, check the filter on the flushing line. A clogged filter can cause the pump to cavitate and produce excessive noise and pressure drop.

For any issue, do not hesitate to contact Firemiks AB if questions arise!

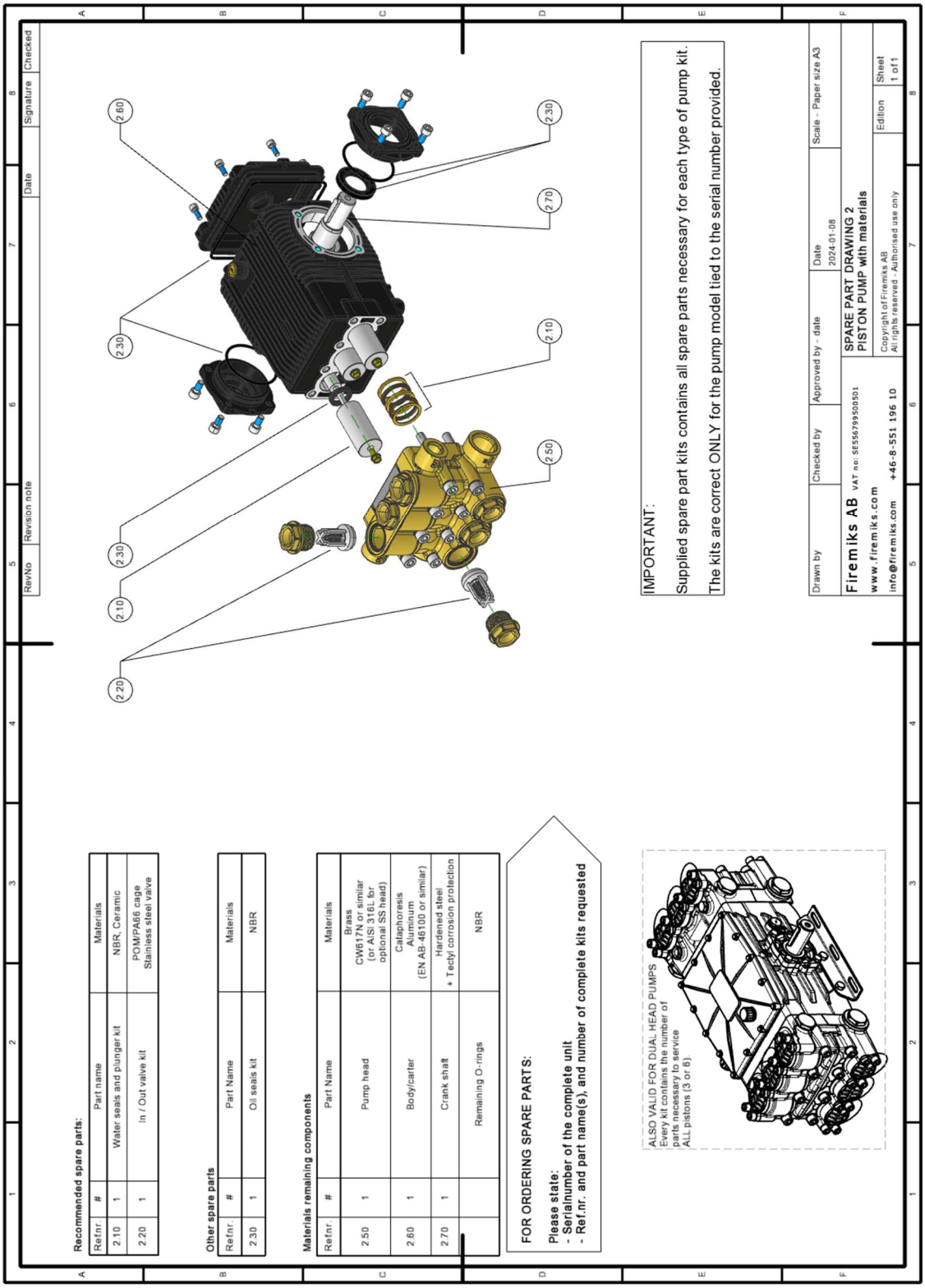
9 Spare parts

Spare parts are listed on the Data Sheet of your unit. Here there also is a general overview of the spare parts of different FIREMIKS types. ***Spare parts come with instructions on how to exchange them on the unit.***

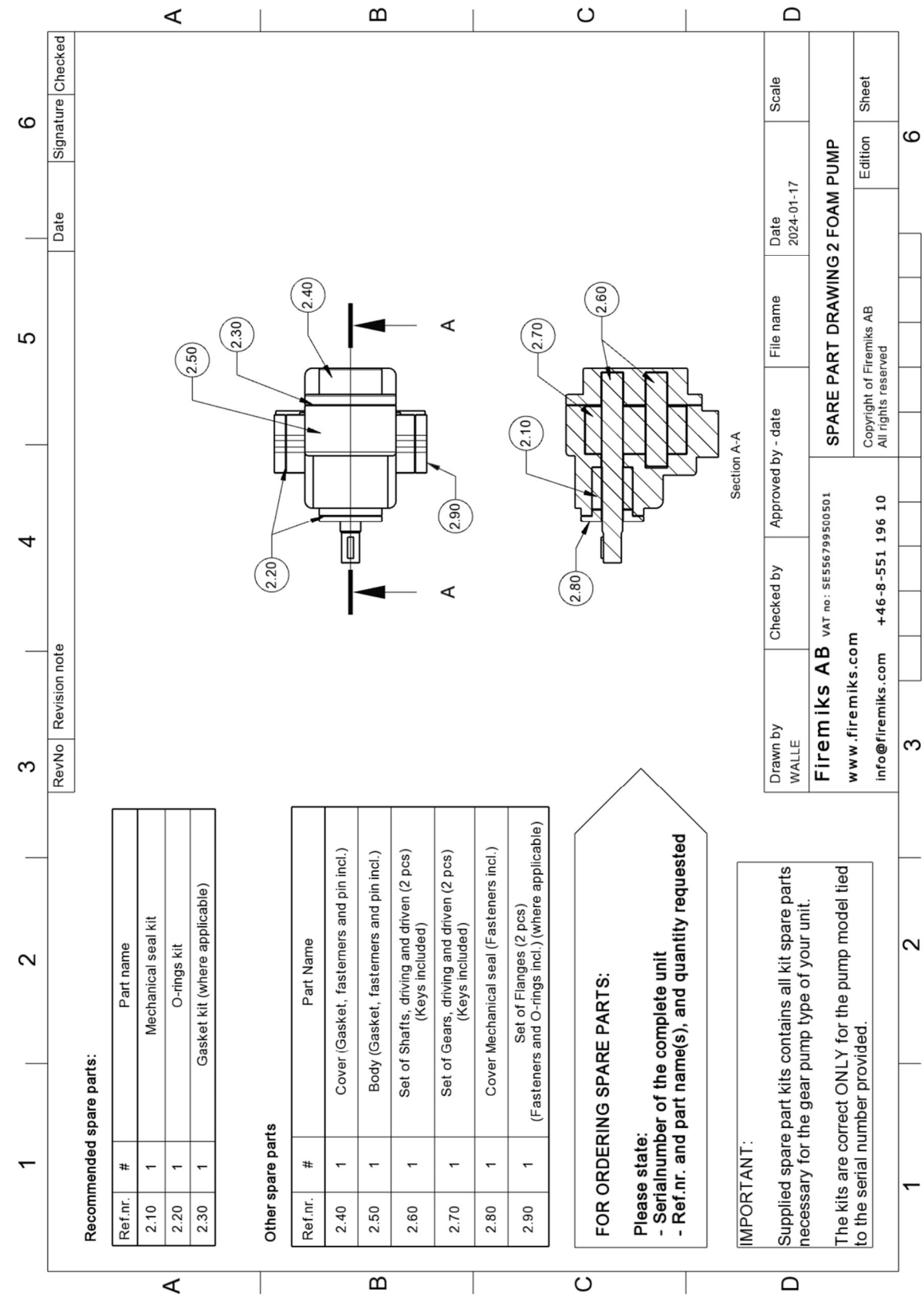
9.1 Water motor spare parts overview



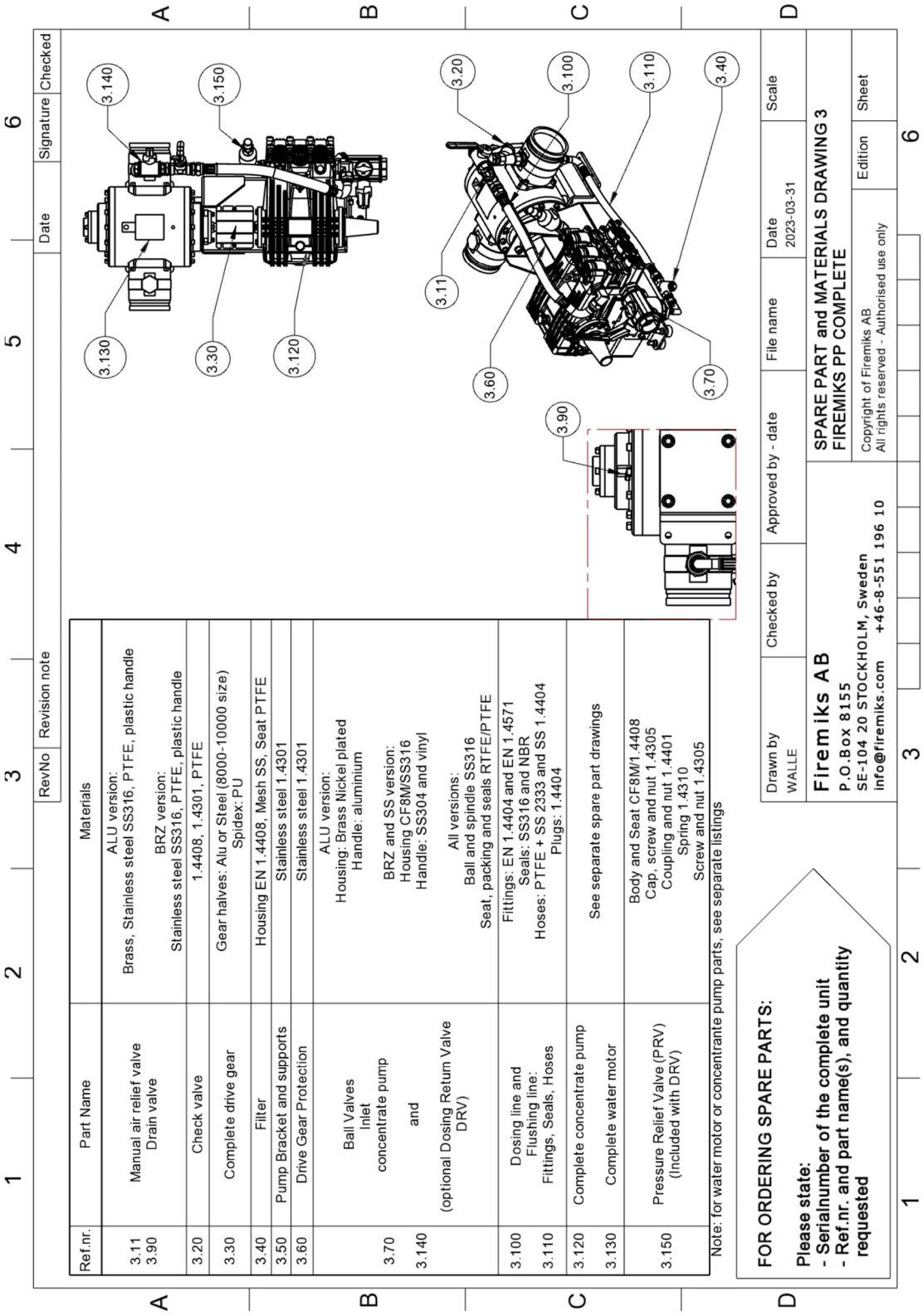
9.2 Piston pump spare parts overview



9.3 Gear pump spare parts overview



9.4 Complete unit spare parts overview Piston Pump



Ref.nr.	Part Name	Materials
3.11 3.90	Manual air relief valve Drain valve	ALU version: Brass, Stainless steel SS316, PTFE, plastic handle BRZ version: Stainless steel SS316, PTFE, plastic handle
3.20	Check valve	1.4408, 1.4301, PTFE
3.30	Complete drive gear	Gear halves: Alu or Steel (8000-10000 size) Spidex: PU
3.40	Filter	Housing EN 1.4408, Mesh SS, Seat PTFE
3.50	Pump Bracket and supports	Stainless steel 1.4301
3.60	Drive Gear Protection	Stainless steel 1.4301
3.70 3.140	Ball Valves Inlet concentrate pump and (optional Dosing Return Valve DRV)	ALU version: Housing: Brass Nickel plated Handle: aluminium BRZ and SS version: Housing CF8M/SS316 Handle: SS304 and vinyl All versions: Ball and spindle SS316 Seat, packing and seals RTFE/PTFE
3.100 3.110	Dosing line and Flushing line: Fittings, Seals, Hoses	Fittings: EN 1.4404 and EN 1.4571 Seals: SS316 and NBR Hoses: PTFE + SS 2333 and SS 1.4404 Plugs: 1.4404
3.120 3.130	Complete concentrate pump Complete water motor	See separate spare part drawings
3.150	Pressure Relief Valve (PRV) (Included with DRV)	Body and Seat CF8M/1.4408 Cap, screw and nut 1.4305 Coupling and nut 1.4401 Spring 1.4310 Screw and nut 1.4305

Note: for water motor or concentrante pump parts, see separate listings

RevNo | Revision note | Date | Signature | Checked

FOR ORDERING SPARE PARTS:

Please state:
- Serialnumber of the complete unit
- Ref.nr. and part name(s), and quantity requested

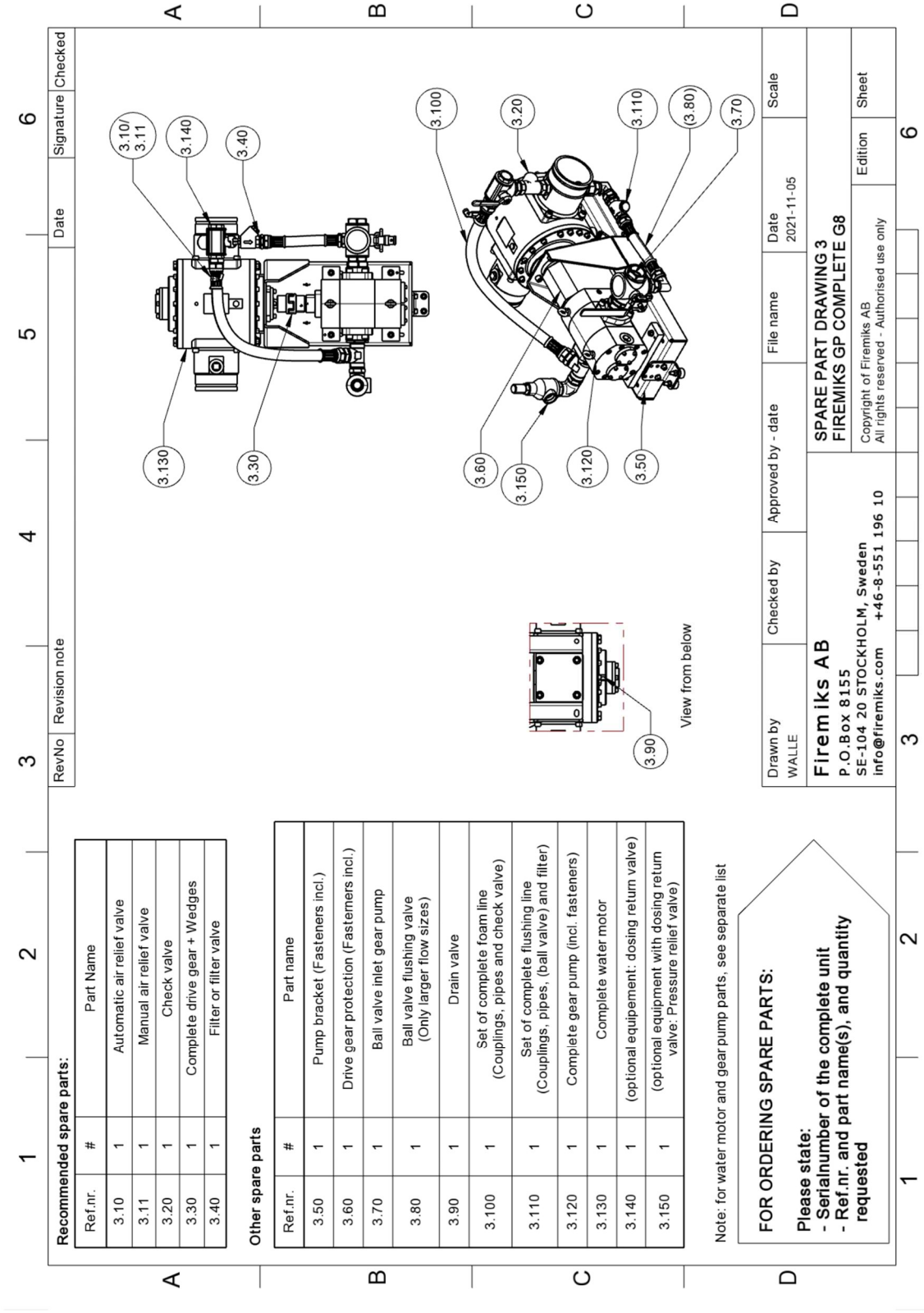
Drawn by WALLE | Checked by | Approved by - date | File name | Date 2023-03-31 | Scale

Firemiks AB
P.O.Box 8155
SE-104 20 STOCKHOLM, Sweden
info@firemiks.com +46-8-551 196 10

SPARE PART and MATERIALS DRAWING 3
FIREMIKS PP COMPLETE

Edition | Sheet

9.5 Complete unit spare parts overview Gear Pump



Recommended spare parts:

Ref.nr.	#	Part Name
3.10	1	Automatic air relief valve
3.11	1	Manual air relief valve
3.20	1	Check valve
3.30	1	Complete drive gear + Wedges
3.40	1	Filter or filter valve

Other spare parts

Ref.nr.	#	Part name
3.50	1	Pump bracket (Fasteners incl.)
3.60	1	Drive gear protection (Fasterners incl.)
3.70	1	Ball valve inlet gear pump
3.80	1	Ball valve flushing valve (Only larger flow sizes)
3.90	1	Drain valve
3.100	1	Set of complete foam line (Couplings, pipes and check valve)
3.110	1	Set of complete flushing line (Couplings, pipes, (ball valve) and filter)
3.120	1	Complete gear pump (incl. fasteners)
3.130	1	Complete water motor
3.140	1	(optional equipement: dosing return valve)
3.150	1	(optional equipment with dosing return valve: Pressure relief valve)

Note: for water motor and gear pump parts, see separate list

FOR ORDERING SPARE PARTS:

Please state:
- Serialnumber of the complete unit
- Ref.nr. and part name(s), and quantity requested

RevNo | Revision note | Date | Signature | Checked

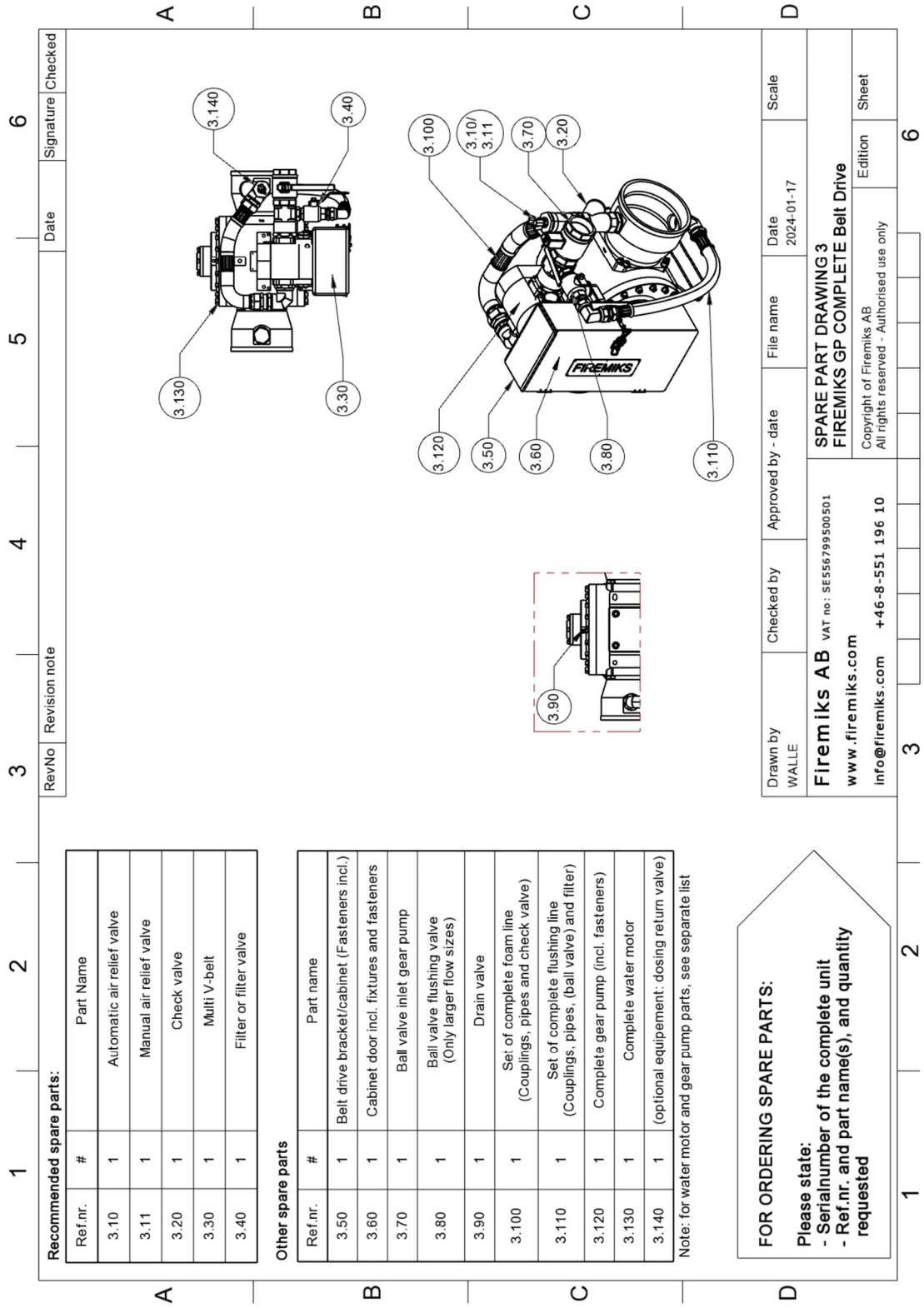
Drawn by WALLE | Checked by | Approved by - date | File name | Date 2021-11-05 | Scale

Firemiks AB
P.O.Box 8155
SE-104 20 STOCKHOLM, Sweden
info@firemiks.com +46-8-551 196 10

SPARE PART DRAWING 3
FIREMIKS GP COMPLETE G8

Edition | Sheet

9.6 Complete unit spare parts overview Gear Pump



10 Tables and drawings

10.1 Table 1: **Tightening torque stainless steel screws for FIREMIKS**

Screw material: A4-70			Screw material: A4-80	
Dimension	Tightening torque (±5%)		Dimension	Tightening torque (±5%)
M6	7 Nm		M6	9 Nm
M8	17 Nm		M8	22 Nm
M10	33 Nm		M10	43 Nm
M12	57 Nm		M12	75 Nm
M14	89 Nm		M14	119 Nm
M16	136 Nm		M16	181 Nm

11 Material recycling guide

- The materials included in the FIREMIKS system are aluminum, stainless steel, brass, rubber (NBR) and plastic (PTFE and PETF). The seals and plungers consist of (partly) ceramic material.
- Applicable regulations and legislation: The system contains no material which is subject to special rules that affect the recovery.
- Marking of materials: The various components of the system are not individually marked. An exploded view attached shows the different parts and what materials they are composed of.
- Recyclability: The parts of aluminum, stainless steel and brass can be recycled as scrap metal. These make up an estimated 95% of the total system weight. Rubber and plastic components can be recycled in accordance with normal procedures for rubber and plastics. The small volumes of ceramic materials in the seals and concentrate pump can be recycled separately.
- Ingredients and Units: The water motor consists essentially of aluminum and the motor wings of plastic (PETF). The O-rings are made of rubber (NBR). The concentrate pump is made of aluminium, brass and ceramics. The drive coupling is aluminum. The pump bracket, couplings and screws consist of stainless steel. The hoses are made of stainless steel and PTFE. As stated above there is ceramic material in the seals and concentrate pump.
- Data for decontamination and dismantling of the system: The system contains no chemicals or ionizing radiation. After using the concentrate liquid, normally the system is easily flushed with water. As the concentrate liquid is not part of this unit, Firemiks AB cannot comment on the recyclable nature of the concentrate.

12 Overview and repetition of paragraphs essential for safety

(2) Read this first!

The whole section 2 is important to read!

(4) ***Installation***

(4.2.1) For weight see your unit's Data sheet. Suitable points to lift the unit are shown in your unit's Dimensional Drawing. Larger units also have lifting eyelets shown on the Dimensional Drawing. The unit should not be exposed to knocks or be dropped, then it can become damaged.

DO NOT LIFT THE UNIT USING THE PIPING

(4.13.9) Space around unit
Make sure there is enough space around the unit to enable easy access for service and maintenance, especially on the back gable side of the water motor (opposite side of the concentrate pump).

(3.10.1) Some units are equipped with optional Dosing / Return valves, **also DRV in short. This valve is not to be used during regular operation, and its handle should remain positioned for dosing into the main water line only. The valve should only be operated by qualified maintenance personnel for maintenance/testing purposes.**

(4.3.1) **FIREMIKS is designed to operate with clean water**. Water must be free from sand, gravel and other debris that may wear out the volumetric water motor quickly. Larger solids can completely block the functioning of the unit and damage the unit. If there is an acute risk of particles entering the FIREMIKS or when polluted or contaminated water is used, the piping system must be designed so that there is a suitable filter or strainer where this pollution can be collected fully, placed before (upstream **of**) the **FIREMIKS**. There is no warranty for **blockage or damage of the water motor by any foreign objects in the water, whatever their size. Please contact Firemiks AB if** you need further guidance in this subject.

(4.3.5) **Note! It is very important that a shut-off valve is installed before the FIREMIKS unit.** This is to ensure a risk-free service/maintenance, i.e. the risk of sudden rotation of the water motor due to unexpected water flow will be eliminated by closing this valve. When working on the FIREMIKS, put a clear warning sign on this valve stating*: "Do not open, maintenance work in progress".*

(4.3.8) **If the system where the FIREMIKS is installed to run with water only (**no dosing) for more than 10 minutes, a bypass should be installed and used around the FIREMIKS system so that the FIREMIKS is not running. The flushing system on FIREMIKS units is designed to flush the pump and not for longer use, this can cause unnecessary wear and potentially cause damage if the filter in the flushing line gets full, see also 7.4.1. Still if the FIREMIKS is running anyway and there is no concentrate, be sure that the Selector valve Dosing/Flushing (No. 4

on Flow chart) is in the Flushing position to avoid dry running of the pump, see also 4.9.

(4.9) **By design, never let the FIREMIKS run dry without concentrate or flushing** water. See 6.6.1 for more info.

(5) Check before first start

(5.1.3) **NOTE!** Make sure that the Drive gear protection is in place and the Protection cap on the back gable side are in place. (Note! On some of the smaller models the dosing pump are connected directly to the Water motor, i.e they have no Drive gear).

(6) Operation

(6.1.2) Read the warnings on page 50

(7) Maintenance

(7.2) WARNING! It is extremely important that at every service or maintenance of the unit you must assure yourself that the unit cannot be started by mistake.

(7.2.1) Close completely a shut-off valve in the main water supply before the unit and make sure it cannot be opened while you are working on the unit, see also 4.3.5.

After service, put back the unit into stand-by, with the shut-off valve before the unit opened again.
Note also WARNING SIGNS on the unit.

(8) Troubleshooting

(8.2) NOTE! There is a risk for powerful jet streams of water at leakages when the system is under pressure. Be sure to make the unit (and if necessary the system) without pressure when doing service.

FIREMIKS® is a registered trademark owned by Firemiks AB.
We reserve the right to make changes in the specifications without prior notice.

COMMISSIONING and ACCEPTANCE TESTING SAMPLE RECORDS

Serial nr:	***Installation reference:***	***Issued by:***	***Date:***
Ref IOM	**Item to check**	**Acceptance criteria**	**Result, pass/no pass and sign**
4.1	Unit was stored according to instructions	Unit is clean and rotates freely	
4.3.1 4.8.16	Suitable filter/strainer installed	No solids allowed in water flow and concentrate pump through FIREMIKS	
4.3.2	Piping thoroughly flushed before FIREMIKS installation	Confirmation with installer	
4.3.3 6.12	Saltwater use	Sweet water flushing for dry systems in place if possible	
4.3.4	Straight pipe length	As per dimensional drawing	
4.3.5	Shut-off valve upstream of FIREMIKS	Present	
4.3.8, 4.3.9	By-pass in case of planned use of water only, or if only source of extinguishing water	Bypass installed if applicable	
4.7.1	Concentrate within approved viscosity range at operation temperature	Viscosity concentrate confirmed by supplier < allowed viscosity in datasheet	
4.8	Concentrate delivery according to recommendations	Compliance to whole section 4.8, no leak acc. to 4.8.6	
4.8.5	Concentrate tank	Atmospheric and outlet at bottom One tank open at a time	
4.9	Operating procedures avoid dry running	Operating procedures mention the need to avoid dry running	
4.10	No foam leakage	No foam leakage when system is dry and stand-by	
4.13.6	Flow direction of the unit	As per flow arrow on type plate	
4.13.3	Unit installed with pump horizontal	horizontal +-5° static	
4.13.4	Frost-free environment and sunshade if necessary	Temperature may not exceed 55°C	
4.13.7, 4.13.8	Unit mounted properly	Only Floor bracket under water motor may be bolted/fixed	
4.13.10	Vented plug installed on concentrate pump	Vented plug present	
	System test		
5	Double check items in chapter 5	Flow direction, Drain valve closed, Drive gear Protection and plugs in place. Oil level ok and vented plug in place	
6.2	Check valve positioning	As per table in 6.2	
6.3	Operation procedures followed according to wet or dry system	As per table in 6.3	
6.10.1 0	Record unit flow at start-up (may use RPM acc. to 4.4.6)	**No overflow according to criteria in 6.10.1**	
6.11	**Measure and/or calculate dosing rate**	**See criteria in 6.11.5**	
6.10.1	Replacement of vanes if unit was subjected to overflow during testing	>110% of max flow	
6.10.1 4.4.5	If overflow was present, amend according to 4.4.5 and retest	Amended acc. to 4.4.5	
7.5.1 4.13.7	Drive gear check and no distortion of unit after test	See 7.5.1	
6.3	Unit is flushed before shutdown	As per table in 6.3	

COMMISSIONING and ACCEPTANCE TESTING SAMPLE RECORDS

Serial nr:	***Installation reference:***	***Issued by:***	***Date:***
Ref IOM	**Item to check**	**Acceptance criteria**	**Result, pass/no pass and sign**
4.1	Unit was stored according to instructions	Unit is clean and rotates freely	
4.3.1 4.8.16	Suitable filter/strainer installed	No solids allowed in water flow and concentrate pump through FIREMIKS	
4.3.2	Piping thoroughly flushed before FIREMIKS installation	Confirmation with installer	
4.3.3 6.12	Saltwater use	Sweet water flushing for dry systems in place if possible	
4.3.4	Straight pipe length	As per dimensional drawing	
4.3.5	Shut-off valve upstream of FIREMIKS	Present	
4.3.8, 4.3.9	By-pass in case of planned use of water only, or if only source of extinguishing water	Bypass installed if applicable	
4.7.1	Concentrate within approved viscosity range at operation temperature	Viscosity concentrate confirmed by supplier < allowed viscosity in datasheet	
4.8	Concentrate delivery according to recommendations	Compliance to whole section 4.8, no leak acc. to 4.8.6	
4.8.5	Concentrate tank	Atmospheric and outlet at bottom One tank open at a time	
4.9	Operating procedures avoid dry running	Operating procedures mention the need to avoid dry running	
4.10	No foam leakage	No foam leakage when system is dry and stand-by	
4.13.6	Flow direction of the unit	As per flow arrow on type plate	
4.13.3	Unit installed with pump horizontal	horizontal +-5° static	
4.13.4	Frost-free environment and sunshade if necessary	Temperature may not exceed 55°C	
4.13.7, 4.13.8	Unit mounted properly	Only Floor bracket under water motor may be bolted/fixed	
4.13.10	Vented plug installed on concentrate pump	Vented plug present	
	System test		
5	Double check items in chapter 5	Flow direction, Drain valve closed, Drive gear Protection and plugs in place. Oil level ok and vented plug in place	
6.2	Check valve positioning	As per table in 6.2	
6.3	Operation procedures followed according to wet or dry system	As per table in 6.3	
6.10.1 0	Record unit flow at start-up (may use RPM acc. to 4.4.6)	**No overflow according to criteria in 6.10.1**	
6.11	**Measure and/or calculate dosing rate**	**See criteria in 6.11.5**	
6.10.1	Replacement of vanes if unit was subjected to overflow during testing	>110% of max flow	
6.10.1 4.4.5	If overflow was present, amend according to 4.4.5 and retest	Amended acc. to 4.4.5	
7.5.1 4.13.7	Drive gear check and no distortion of unit after test	See 7.5.1	
6.3	Unit is flushed before shutdown	As per table in 6.3	

COMMISSIONING and ACCEPTANCE TESTING SAMPLE RECORDS

Serial nr:	***Installation reference:***	***Issued by:***	***Date:***
Ref IOM	**Item to check**	**Acceptance criteria**	**Result, pass/no pass and sign**
4.1	Unit was stored according to instructions	Unit is clean and rotates freely	
4.3.1 4.8.16	Suitable filter/strainer installed	No solids allowed in water flow and concentrate pump through FIREMIKS	
4.3.2	Piping thoroughly flushed before FIREMIKS installation	Confirmation with installer	
4.3.3 6.12	Saltwater use	Sweet water flushing for dry systems in place if possible	
4.3.4	Straight pipe length	As per dimensional drawing	
4.3.5	Shut-off valve upstream of FIREMIKS	Present	
4.3.8, 4.3.9	By-pass in case of planned use of water only, or if only source of extinguishing water	Bypass installed if applicable	
4.7.1	Concentrate within approved viscosity range at operation temperature	Viscosity concentrate confirmed by supplier < allowed viscosity in datasheet	
4.8	Concentrate delivery according to recommendations	Compliance to whole section 4.8, no leak acc. to 4.8.6	
4.8.5	Concentrate tank	Atmospheric and outlet at bottom One tank open at a time	
4.9	Operating procedures avoid dry running	Operating procedures mention the need to avoid dry running	
4.10	No foam leakage	No foam leakage when system is dry and stand-by	
4.13.6	Flow direction of the unit	As per flow arrow on type plate	
4.13.3	Unit installed with pump horizontal	horizontal +-5° static	
4.13.4	Frost-free environment and sunshade if necessary	Temperature may not exceed 55°C	
4.13.7, 4.13.8	Unit mounted properly	Only Floor bracket under water motor may be bolted/fixed	
4.13.10	Vented plug installed on concentrate pump	Vented plug present	
	System test		
5	Double check items in chapter 5	Flow direction, Drain valve closed, Drive gear Protection and plugs in place. Oil level ok and vented plug in place	
6.2	Check valve positioning	As per table in 6.2	
6.3	Operation procedures followed according to wet or dry system	As per table in 6.3	
6.10.1 0	Record unit flow at start-up (may use RPM acc. to 4.4.6)	**No overflow according to criteria in 6.10.1**	
6.11	**Measure and/or calculate dosing rate**	**See criteria in 6.11.5**	
6.10.1	Replacement of vanes if unit was subjected to overflow during testing	>110% of max flow	
6.10.1 4.4.5	If overflow was present, amend according to 4.4.5 and retest	Amended acc. to 4.4.5	
7.5.1 4.13.7	Drive gear check and no distortion of unit after test	See 7.5.1	
6.3	Unit is flushed before shutdown	As per table in 6.3	

COMMISSIONING and ACCEPTANCE TESTING SAMPLE RECORDS

Serial nr:	***Installation reference:***	***Issued by:***	***Date:***
Ref IOM	**Item to check**	**Acceptance criteria**	**Result, pass/no pass and sign**
4.1	Unit was stored according to instructions	Unit is clean and rotates freely	
4.3.1 4.8.16	Suitable filter/strainer installed	No solids allowed in water flow and concentrate pump through FIREMIKS	
4.3.2	Piping thoroughly flushed before FIREMIKS installation	Confirmation with installer	
4.3.3 6.12	Saltwater use	Sweet water flushing for dry systems in place if possible	
4.3.4	Straight pipe length	As per dimensional drawing	
4.3.5	Shut-off valve upstream of FIREMIKS	Present	
4.3.8, 4.3.9	By-pass in case of planned use of water only, or if only source of extinguishing water	Bypass installed if applicable	
4.7.1	Concentrate within approved viscosity range at operation temperature	Viscosity concentrate confirmed by supplier < allowed viscosity in datasheet	
4.8	Concentrate delivery according to recommendations	Compliance to whole section 4.8, no leak acc. to 4.8.6	
4.8.5	Concentrate tank	Atmospheric and outlet at bottom One tank open at a time	
4.9	Operating procedures avoid dry running	Operating procedures mention the need to avoid dry running	
4.10	No foam leakage	No foam leakage when system is dry and stand-by	
4.13.6	Flow direction of the unit	As per flow arrow on type plate	
4.13.3	Unit installed with pump horizontal	horizontal +-5° static	
4.13.4	Frost-free environment and sunshade if necessary	Temperature may not exceed 55°C	
4.13.7, 4.13.8	Unit mounted properly	Only Floor bracket under water motor may be bolted/fixed	
4.13.10	Vented plug installed on concentrate pump	Vented plug present	
	System test		
5	Double check items in chapter 5	Flow direction, Drain valve closed, Drive gear Protection and plugs in place. Oil level ok and vented plug in place	
6.2	Check valve positioning	As per table in 6.2	
6.3	Operation procedures followed according to wet or dry system	As per table in 6.3	
6.10.1 0	Record unit flow at start-up (may use RPM acc. to 4.4.6)	**No overflow according to criteria in 6.10.1**	
6.11	**Measure and/or calculate dosing rate**	**See criteria in 6.11.5**	
6.10.1	Replacement of vanes if unit was subjected to overflow during testing	>110% of max flow	
6.10.1 4.4.5	If overflow was present, amend according to 4.4.5 and retest	Amended acc. to 4.4.5	
7.5.1 4.13.7	Drive gear check and no distortion of unit after test	See 7.5.1	
6.3	Unit is flushed before shutdown	As per table in 6.3	

Example, record should be kept of complete installation incl FIREMIKS

MAINTENANCE SERVICE AND TEST RECORDS

Date	Service item	Comments	Performed by
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		

MAINTENANCE SERVICE AND TEST RECORDS

Date	Service item	Comments	Performed by
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		

MAINTENANCE SERVICE AND TEST RECORDS

Date	Service item	Comments	Performed by
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		

FIREMIKS
THE SWEDISH ORIGINAL

MAINTENANCE SERVICE AND TEST RECORDS

Date	Service item	Comments	Performed by
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		

MAINTENANCE SERVICE AND TEST RECORDS

Date	Service item	Comments	Performed by
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ____________________		

MAINTENANCE SERVICE AND TEST RECORDS

Date	Service item	Comments	Performed by
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ________________		
	☐ Unit rotation ☐ Leak check ☐ Drive gear check ☐ Filter check ☐ Test run without overflow (detail in comment) ☐ Part replacement (detail in comment) ☐ ________________		

GENERAL CONDITIONS FOR THE SUPPLY OF MECHANICAL, ELECTRICAL AND ELECTRONIC PRODUCTS

Brussels, October 2022

PREAMBLE

1. These General Conditions shall apply when the parties agree thereto. Any modifications of or deviations from them must be agreed In Writing.

DEFINITIONS

2. In these General Conditions the following terms shall have the meanings hereunder assigned to them:

   – **« Contract »** : the agreement In Writing between the parties concerning supply of the Product and all appendices, including agreed amendments and additions In Writing to the said documents;

   – **« Gross Negligence »** : a deliberate or reckless failure to take such care as is obviously required in the circumstances to avoid serious consequences for the other party;

   – **« In Writing »** : communication by document signed by both parties or by letter, electronic mail, fax and by such other means as are agreed by the parties;

   – **« the Product »** : the object(s) to be supplied under the Contract, including software and documentation;

   – **« Contract Price »** : the agreed price, which shall be either a fixed price or, in case the parties have specifically agreed on a price revision clause, the revised price.

PRODUCT INFORMATION/INSTRUCTIONS

3. All information and data contained in general product documentation and price lists, regardless of form, shall be binding only to the extent that they are by reference In Writing expressly included in the Contract.

4. The Supplier shall, not later than at the date of delivery, provide free of charge information and drawings which are necessary to permit the Purchaser to install, commission, operate and maintain the Product. Such information and drawings shall be supplied as one paper copy of each and also electronically. The Supplier shall not be obliged to provide manufacturing drawings for the Product or for spare parts.

INTELLECTUAL PROPERTY AND CONFIDENTIALITY

5. All intellectual property rights in the Product, including in any embedded software, and in any technical information relating to the Product, shall rest with the Supplier or, in the appropriate case, with a third party which has licensed the Supplier to sublicense these rights. Subject to any limitations that may have been agreed between the third party and the Supplier, the Purchaser shall acquire a non-exclusive, perpetual and transferable right to use these intellectual property rights, but limited to the extent required by the purpose of the Contract. The Supplier shall not be obliged to provide the Purchaser with the source code or with updates for any embedded software.

   This clause shall also apply when the Product and/or software has been specifically developed for the Purchaser, unless otherwise agreed In Writing.

6. Technical, commercial and financial information and information, which has been declared as confidential or which must by its very nature be deemed to be confidential, disclosed In Writing or orally by one party to the other, shall be treated confidentially. The information shall therefore not without the consent of the disclosing party In Writing be used for any other purpose than that for which it was provided. It may not, without the consent of the disclosing party In Writing, be transmitted, communicated or otherwise disclosed to a third party.

ACCEPTANCE TESTS

7. Acceptance tests provided for in the Contract shall, unless otherwise agreed, be carried out at the place of manufacture during normal working hours.

   If the Contract does not specify the technical requirements, the tests shall be carried out in accordance with general practice in the appropriate branch of industry concerned in the country of manufacture.

8. The Supplier shall notify the Purchaser In Writing of the acceptance tests in sufficient time to permit the Purchaser to be represented at the tests. If the Purchaser is not represented, the test report shall be sent to the Purchaser and shall be accepted as accurate.

9. If the acceptance tests show the Product not to be in accordance with the Contract, the Supplier shall without

delay remedy any deficiencies in order to ensure that the Product complies with the Contract. New tests shall then be carried out at the Purchaser's request, unless the deficiency was insignificant.

10. The Supplier shall bear all costs for acceptance tests carried out at the place of manufacture. The Purchaser shall however bear all travelling and living expenses for his representatives in connection with such tests.

DELIVERY. PASSING OF RISK

11. Any agreed trade term shall be construed in accordance with the INCOTERMS® in force at the formation of the Contract.

    If no trade term has been specifically agreed, the delivery shall be Free Carrier (FCA) at the place of manufacture of the Product.

    If, in the case of delivery Free Carrier, the Supplier, at the request of the Purchaser, undertakes to send the Product to its destination, the risk will nevertheless pass to the Purchaser as soon as the Product is handed over to the first carrier.

    Partial delivery shall not be permitted, unless otherwise agreed In Writing.

TIME FOR DELIVERY. DELAY

12. If the parties, instead of specifying the date for delivery, have specified a period of time within which delivery shall take place, such period shall start to run as soon as the Contract is entered into and all agreed preconditions to be met by the Purchaser have been fulfilled, such as official formalities, payments due at the formation of the Contract and securities.

13. If the Supplier anticipates that he will not be able to deliver the Product at the time for delivery, he shall forthwith notify the Purchaser thereof In Writing, stating the reason and, if possible, the time when delivery can be expected.

    If the Supplier fails to give such notice, the Purchaser shall be entitled to compensation for any additional costs which he incurs and which he could have avoided had he received such notice.

14. If delay in delivery is caused by any of the circumstances mentioned in Clause 46, by an act or omission on the part of the Purchaser, including suspension under Clauses 22 and 49, or any other circumstances attributable to the Purchaser, the Supplier shall be entitled to extend the time for delivery by a period which is necessary having regard to all the circumstances of the case. This provision shall apply regardless of whether the reason for the delay occurs before or after the agreed time for delivery.

15. If the Product is not delivered at the time for delivery, the Purchaser shall be entitled to liquidated damages from the date on which delivery should have taken place.

    The liquidated damages shall be payable at a rate of 0.5 per cent of the Contract Price for each commenced week of delay. The liquidated damages shall not exceed 7.5 per cent of the Contract Price.

    If only part of the Product is delayed, the liquidated damages shall be calculated on that part of the Contract Price which is attributable to such part of the Product as cannot in consequence of the delay be used as intended by the parties.

    The liquidated damages shall become due at the Purchaser's demand In Writing but not before delivery has been completed or the Contract is terminated under Clause 16.

    The Purchaser shall forfeit his right to liquidated damages if he has not lodged a claim In Writing for such damages within six months after the time when delivery should have taken place.

16. If the delay in delivery is such that the Purchaser is entitled to maximum liquidated damages under Clause 15 and if the Product is still not delivered, the Purchaser may In Writing demand delivery within a final reasonable period which shall not be less than one week.

    If the Supplier does not deliver within such final period and this is not due to any circumstances which are attributable to the Purchaser, then the Purchaser may by notice In Writing to the Supplier terminate the Contract in respect of such part of the Product as cannot in consequence of the Supplier's failure to deliver be used as intended by the parties.

    If the Purchaser terminates the Contract he shall be entitled to compensation for the loss he suffers as a result of the Supplier's delay, including any consequential and indirect loss. The total compensation, including the liquidated damages which are payable under Clause 15, shall not exceed 15 per cent of that part of the Contract Price which is attributable to the part of the Product in respect of which the Contract is terminated.

    The Purchaser shall also have the right to terminate the Contract by notice In Writing to the Supplier, if it is clear from the circumstances that there will occur a delay in delivery which, under Clause 15, would entitle the Purchaser to maximum liquidated damages. In case of termination for this reason, the Purchaser shall be entitled to maximum liquidated damages and compensation under the third paragraph of this clause.

17. Liquidated damages under Clause 15 and termination of the Contract with limited compensation under Clause 16 shall be the only remedies available to the Purchaser in case of delay on the part of the Supplier. All other claims against the Supplier based on such delay shall be excluded, except where the Supplier has been guilty of Gross Negligence.

18. If the Purchaser anticipates that he will be unable to accept delivery of the Product at the time for delivery, he shall forthwith notify the Supplier In Writing thereof, stating the reason and, if possible, the time when he will be able to accept delivery.

    If the Purchaser fails to accept delivery at the time for delivery for a reason which is not attributable to the Supplier, he shall nevertheless pay any part of the Contract Price which becomes due at the time for delivery, as if delivery had taken place at the time for delivery. The Supplier shall arrange for storage of the Product at the risk and expense of the Purchaser. The Supplier shall also, if the Purchaser so requires, insure the Product at the Purchaser's expense.

19. Unless the Purchaser's failure to accept delivery is due to any of the circumstances mentioned in Clause 46, the Supplier may by notice In Writing require the Purchaser to accept delivery within a final reasonable period.

    If, for a reason which is not attributable to the Supplier and not the result of any of the circumstances mentioned in Clause 46, the Purchaser fails to accept delivery within such period, the Supplier may by notice In Writing terminate the Contract in whole or in part. The Supplier shall then be entitled to compensation for the loss he suffers by reason of the Purchaser's default, including any consequential and indirect loss. The compensation shall not exceed that part of the Contract Price which is attributable to that part of the Product in respect of which the Contract is terminated.

PAYMENT

20. Payment shall be made within thirty days after the date of invoice.

    Unless otherwise agreed, the Contract Price shall be invoiced with one third at the formation of the Contract and the remaining part when the Product is delivered.

21. Whatever the means of payment used, payment shall not be deemed to have been effected before the Supplier's account has been irrevocably credited for the amount due.

22. If the Purchaser fails to pay by the stipulated date, the Supplier shall be entitled to interest from the day on which payment was due and to compensation for recovery costs. The rate of interest shall be as agreed between the parties or otherwise 8 percentage points above the interest rate of the European Central Bank for the main refinancing operations (MRO). The compensation for recovery costs shall be 1 per cent of the amount for which interest for late payment becomes due.

    In case of late payment or in case the Purchaser fails to give an agreed security by the stipulated date the Supplier may, after having notified the Purchaser In Writing, suspend his performance of the Contract until he receives payment or, where appropriate, until the Purchaser gives the agreed security.

    If the Purchaser has not paid the amount due within three months the Supplier shall be entitled to terminate the Contract by notice In Writing to the Purchaser and, in addition to the interest and compensation for recovery costs according to this clause, to claim compensation for the costs and loss he incurs, including indirect and consequential loss.

RETENTION OF TITLE

23. The Product shall remain the property of the Supplier until paid for in full to the extent that such retention of title is valid under the relevant law.

    The Purchaser shall at the request of the Supplier assist him in taking any measures necessary to protect the Supplier's title to the Product.

    The retention of title shall not affect the passing of risk under Clause 11.

LIABILITY FOR DEFECTS

24. The Product shall be in conformity with the Contract. Pursuant to the provisions of this clause and Clauses 25-44, the Supplier shall remedy any defect in or nonconformity of the Product (hereinafter termed defect) resulting from faulty design, materials or workmanship.

25. The Supplier shall not be liable for defects arising out of a design, materials or production methods provided, stipulated or specified by the Purchaser.

26. The Supplier shall only be liable for defects which appear under the conditions of operation provided for in the Contract and under proper use of the Product.

27. The Supplier shall not be liable for defects caused by circumstances which arise after the risk has passed to the Purchaser, e.g. defects due to faulty or incorrect installation, maintenance or repair, or to any alteration, carried out by the Purchaser or by a third party on behalf of the Purchaser. The Supplier shall neither be liable for normal wear and tear nor for deterioration.

28. The Supplier's liability shall be limited to defects which appear within a period of one year from delivery. If the use of the Product exceeds that which is agreed, this period shall be reduced proportionately.

29. When a defect in a part of the Product has been remedied, the Supplier shall be liable for defects in the repaired part or in the part in replacement under the same terms and conditions as those applicable to the original Product for a period of one year. For the remaining parts of the Product, the period mentioned in Clause 28 shall be extended only by a period equal to the period during which and to the extent that the Product could not be used as a result of the defect.

    The Supplier shall not be liable for defects in any part of the Product for more than one year from the end of the liability period referred to in Clause 28 or from the end of any other liability period agreed upon by the parties.

30. The Purchaser shall without undue delay notify the Supplier In Writing of any defect which appears. The notice shall contain a description of the defect. Such notice shall under no circumstances be given later than two weeks after the expiry of the period given in Clause 28 or the extended period(s) under Clause 29, where applicable.

    If the Purchaser fails to notify the Supplier In Writing of a defect within the time limits set forth in the first paragraph of this clause, he shall lose his right to have the defect remedied and any other rights in respect of the defect.

    Where the defect is such that it may cause damage, the Purchaser shall immediately notify the Supplier In Writing. The Purchaser shall bear the risk of damage to the Product resulting from his failure so to notify. The Purchaser shall take reasonable measures to minimise damage and shall in that respect comply with instructions of the Supplier.

31. On receipt of the notice under Clause 30, the Supplier shall at his own cost remedy the defect without undue delay, as stipulated in Clauses 24-44. The time for remedial work shall be chosen in order not to interfere unnecessarily with the Purchaser's activities.

    Remedial work shall be carried out at the place where the Product is located unless the Supplier deems it more appropriate that the Product is sent to him or a destination specified by him.

    If the defect can be remedied by replacement or repair of a defective part and if dismantling and re-installation of the part do not require special knowledge, the Supplier may demand that the defective part is sent to him or a destination specified by him. In such case the Supplier shall have fulfilled his obligations in respect of the defect when he delivers a duly repaired part or a part in replacement to the Purchaser.

32. The Purchaser shall at his own expense provide access to the Product and arrange for any intervention in equipment other than the Product, to the extent that this is necessary to remedy the defect.

33. Unless otherwise agreed, necessary transport of the Product or parts thereof to and from the Supplier in connection with the remedying of defects for which the Supplier is liable shall be at the risk and expense of the Supplier. The Purchaser shall follow the Supplier's instructions regarding such transport.

34. Unless otherwise agreed, the Purchaser shall bear any additional costs which the Supplier incurs for remedying the defect caused by the Product being located in a place other than the place specified in the Contract for putting the Product into service, or if not specified, the place of delivery.

35. Defective parts which have been replaced shall be made available to the Supplier and shall be his property.

36. If the Purchaser has given such notice as mentioned in Clause 30 and no defect is found for which the Supplier is liable, the Supplier shall be entitled to compensation for the costs he incurs as a result of the notice.

37. If the Supplier does not fulfil his obligations under Clause 31 or 43, the Purchaser may by notice In Writing fix a final reasonable period for completion of the Supplier's obligations, which shall not be less than one week.

    If the Supplier fails to fulfil his obligations within such final period, the Purchaser may himself undertake or employ a third party to undertake necessary remedial work at the risk and expense of the Supplier, provided the Purchaser or third party does so in a professional manner.

    Where successful remedial work has been undertaken by the Purchaser or a third party, reimbursement by the Supplier of reasonable costs incurred by the Purchaser shall be in full settlement of the Supplier's liabilities for the said defect.

38. Where the defect has not been successfully remedied, as stipulated under Clause 37,

    a) the Purchaser shall be entitled to a reduction of the Contract Price in proportion to the reduced value of the Product, provided that under no circumstances shall such reduction exceed 15 per cent of the Contract Price, or

b) where the defect is so substantial as to significantly deprive the Purchaser of the benefit of the Contract as regards the Product or a substantial part of it, the Purchaser may terminate the Contract by notice In Writing to the Supplier in respect of such part of the Product as cannot in consequence of the defect be used as intended by the parties. The Purchaser shall then be entitled to compensation for any loss, including any consequential and indirect loss, up to a maximum of 15 per cent of that part of the Contract Price which is attributable to the part of the Product in respect of which the Contract is terminated.

39. Save as stipulated in Clauses 24-38, the Supplier shall not be liable for defects. In consequence, the Supplier shall not be liable for any other loss the defect may cause, including loss of production, loss of profit and other indirect loss. This limitation of the Supplier's liability shall not apply if he has been guilty of Gross Negligence.

LIABILITY FOR INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS

40. Unless otherwise agreed, the Supplier shall, in accordance with this clause and Clauses 41 - 44 be liable towards the Purchaser for the Product infringing patents, copyrights or any other intellectual property rights of a third party in the Purchaser's country. The Supplier shall in such case indemnify the Purchaser and hold the Purchaser harmless against claims of third parties, provided that such claims are confirmed as valid by a final award or a settlement approved by the Supplier. The Supplier shall however not be liable for the Purchaser's loss of production, loss of profit, loss of use and loss of contracts, unless the Supplier has been guilty of Gross Negligence.

41. The Supplier shall have no liability for infringement of intellectual property rights arising out of:

- the Product being used elsewhere than in the Purchaser's country;
- the Product being used otherwise than agreed or in a way the Supplier could not have foreseen;
- the Product being used together with equipment or software not supplied by the Supplier, or
- a design or construction stipulated or specified by the Purchaser.

42. The Supplier shall only be liable if the Purchaser notifies the Supplier In Writing without delay of any claim as referred to in Clause 40 which he receives and allows the Supplier to decide how the claim shall be dealt with.

Defence against claims referred to in Clause 40 shall be for the Supplier's account. The Supplier shall compensate the Purchaser for any amounts the latter is obliged to pay under a final award or a settlement approved by the Supplier.

43. Infringement of intellectual property rights shall, at the Supplier's discretion, be remedied by:

- providing the right for the Purchaser to use the Product,
- adjusting the Product so that the infringement ceases, or
- by replacing the Product with another product, which can be used without infringing applicable intellectual property rights.

44. If the Supplier fails to remedy the infringement in accordance with Clause 43 without undue delay, Clauses 37, 38 and 39 shall apply.

ALLOCATION OF LIABILITY FOR DAMAGE CAUSED BY THE PRODUCT

45. The Supplier shall not be liable for any damage to property caused by the Product after it has been delivered and whilst it is in the possession of the Purchaser. Nor shall the Supplier be liable for any damage to products manufactured by the Purchaser or to products of which the Purchaser's products form a part.

If the Supplier incurs liability towards any third party for such damage to property as described in the preceding paragraph, the Purchaser shall indemnify, defend and hold the Supplier harmless.

If a claim for damage as described in this clause is lodged by a third party against one of the parties, the latter party shall forthwith inform the other party thereof In Writing.

The Supplier and the Purchaser shall be mutually obliged to let themselves be summoned to the court or arbitral tribunal examining claims for damages lodged against one of them on the basis of damage allegedly caused by the Product. The liability between the Supplier and the Purchaser shall however be settled in accordance with Clause 51.

The limitation of the Supplier's liability in the first paragraph of this clause shall not apply where the Supplier has been guilty of Gross Negligence.

FORCE MAJEURE

46. Either party shall be entitled to suspend performance of his obligations under the Contract to the extent that such performance is impeded or made unreasonably onerous by force majeure, meaning any of the following circumstances: industrial disputes and any circumstance beyond the control of the parties such as fire, war, extensive military mobilization, insurrection, requisition, seizure, embargo, restrictions in the use of power, currency and import or export restrictions, epidemics, natural disasters, extreme natural events, terrorist acts and defects or delays in deliveries by sub-contractors caused by any such circumstance referred to in this clause.

    A circumstance referred to in this clause whether occurring prior to or after the formation of the Contract shall give a right to suspension only if its effect on the performance of the Contract could not be foreseen at the time of the formation of the Contract.

47. The party claiming to be affected by force majeure shall notify the other party In Writing without delay on the intervention and on the cessation of such circumstance. If a party fails to give such notice, the other party shall be entitled to compensation for any additional costs which he incurs and which he could have avoided had he received such notice.

    If force majeure prevents the Purchaser from fulfilling his obligations, he shall compensate the Supplier for costs which the Supplier incurs in storing, securing and protecting the Product and avoiding unreasonable interference with his other activities.

48. Regardless of what might otherwise follow from these General Conditions, either party shall be entitled to terminate the Contract by notice In Writing to the other party if performance of the Contract is suspended under Clause 46 for more than six months.

ANTICIPATED NON-PERFORMANCE

49. Each party shall be entitled to suspend the performance of his obligations under the Contract, where it is clear from the circumstances that the other party is not going to perform his obligations. A party suspending his performance of the Contract shall forthwith notify the other party thereof In Writing.

CONSEQUENTIAL LOSSES

50. Save as otherwise stated in these General Conditions or in case of Gross Negligence there shall be no liability for either party towards the other party for loss of production, loss of profit, loss of use, loss of contracts and for any other consequential or indirect loss whatsoever, whether the loss was foreseeable or not.

DISPUTES AND APPLICABLE LAW

51. All disputes arising out of or in connection with the Contract shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the said Rules.

52. The Contract shall be governed by the substantive law of the Supplier's country.

Orgalim aisbl
BluePoint Brussels
Boulevard A Reyers 80
B1030 | Brussels | Belgium

+32 2 206 68 66
legal.publications@orgalim.eu
www.orgalim.eu
VAT BE 0414 341 438