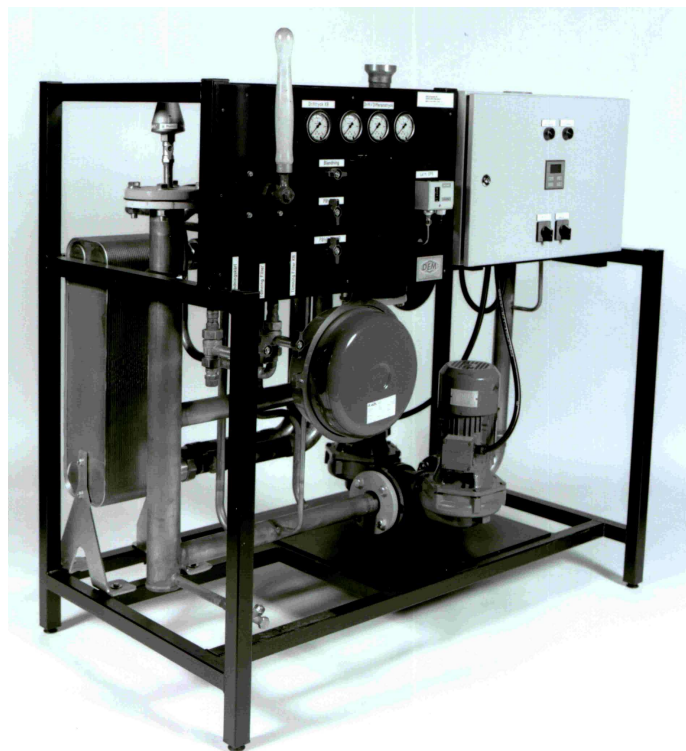




Operating Manual for a Pump Unit





INDEX

Pre-Installation	Page. 3
Arrival of the Equipment	Page. 3
Transport and Handling of the Unit	Page. 3
Electrical Connections	Page. 3
Pipe Connections	Page. 3
Installation of the System	Page. 4
Air Diverter (Bleed-off Valve)	Page. 4
Pressure Testing of the Secondary System	Page. 4
Filling up of the Secondary Fluid System	Page. 5
Calculation of the Total Static Pressure	Page. 5
Calculated Total Static Pressure	Page. 6
Filling up of the Total Static Pressure	Page. 6
Starting up of the Pumps	Page. 6
De-Airing (Evacuating) the System	Page. 6
Cleaning of the Filter	Page. 6
Calculation of the Low Pressure Alarm	Page. 7
Checking of the Working Pressure	Page. 8
Setting of Low Alarm Setpoints	Page. 8
Setting the Alarm for Normal Running Working Pressure	Page. 8
Pre charging of the Expansion Tank, vessels	Page. 9
Safety Valve (Relief Valve)	Page. 9
Control of the Working Pressure under normal running conditions	Page. 9
Pressure Stat Data	Page. 10
Service	Page. 10
Warning	Page. 11
Warranty Claim Procedure	Page. 11
Installation protocol Form	Page. 12
Check List for Pump Installation	Page. 13
Warranty Claim Form	Page. 14
Commissioning Certificate Verification of Secondary System	Page. 15
Protocol for Pressure Testing of Secondary System	Page. 16
Service / Maintenance for Secondary Systems	Page. 17/18

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2



Pre-Installation

We are very pleased to find that you have chosen a quality product from DEM AB and trust that the final result would surpass everyone's expectations. It is most important that you read the instructions before commencing with the installation.

The instructions are a guideline for the correct installation of the product / system and will ensure a technically sound method of setting up of the installation. The instructions will also provide a full-scale checklist of all-important functions prior to the product being put into operation. You will notice from the installations that we have requested that certain safety check levels are followed and adhered to as recommended for the setting up of the system. These instructions must be followed step by step in order to ensure correct functioning of the system.

Arrival of the Equipment

Firstly, ensure that the goods are not damaged and that all equipment delivered is as per the packing list. Should any items be missing or damaged this must be reported immediately to both the company responsible for transporting the goods and DEM with 8 days after the arrival of the goods.

Transport and Handling of the Unit

Use a pallet truck. The frame of the unit is strong enough to sling the unit from the truck, avoiding all assembled parts in the unit from having pressure applied to them from either the fork truck fingers or the slinging straps. This will also ensure that no damage occurs to the units whilst being offloaded.

The units must finally be placed on a solid floor (concrete slab) or a steel support base. The final positioning of the units must be horizontal and level.

Electrical Connections

A licensed contractor as per the schematic electrical sketch drawings supplied must install the electrical connection.

Pipe Connections

As per the pipe drawing, all pipes must be installed by a qualified technician or specialized pipe fitter and checked prior to commissioning the unit.



Installation of the System

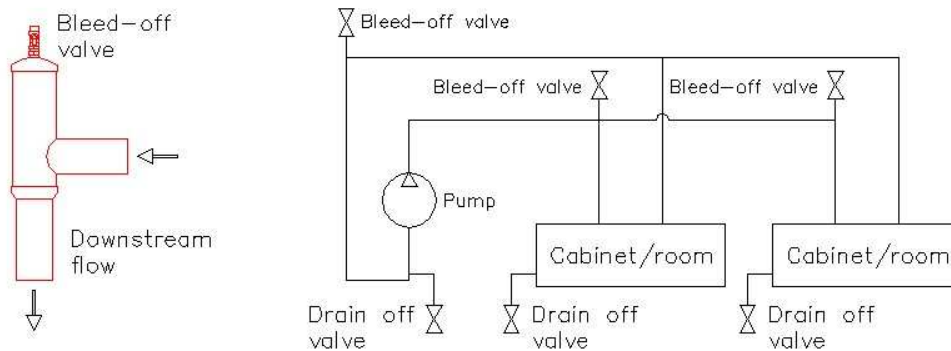
All the lowest points of the secondary fluid piping system must have drain valves fitted where the system is drained from.

Ensure that you always build in a manual air diverter (bleed-off valve) (see detailed sketch of valve arrangement) to all the highest points on the system. All automatic air diverters (bleed-off valve type) must have a facility for the positive shutting off of the air diverter (bleed off valve).

It is vitally important to have sufficient bleed-off valve traps fitted to the pipe work where air bubbles are easily trapped (see sketch of air trap in relation to piping systems and flow direction).

It is recommended, for purposes of future expansion on to the system that isolating ball valves are fitted at the installation stage of the piping to the supply and return of either the medium or low temperature pipe work (as indicated on the drawing).

Figure 1



Air diverter (bleed-off valve)

The unit is delivered standard with a special air diverter (bleed-off valve) that separates all micro bubbles from the liquid. On top of the column filter (inlet / return side of the pump station) there is an automatic air diverter. The air diverter (bleed-off valve) should always be in the closed position when the plant is operational and only manned to bleed off whilst the technician is present.

Pressure Testing of the Secondary Fluid System

All units delivered (in standard) are tested to a pressure of 5.5 bars that is suitable for a secondary fluid operating at a design pressure of 3.5 bars. The pressure test of the pipe system must also be tested at 5.5 bars



Pressure Test = 1.43 x calculated pressure (bar). During the pressure test the pressure should be stable (at least 4 hours). Visual inspections of the total system must be carried out during the test period prior to commissioning. If the test was undertaken using water the total system must be drained of water to prevent the antifrost liquid from spreading out.

Water (H₂O) can be used for the initial pressure testing of the secondary piping system.

Filling up of the Secondary Fluid System (see Figure 3)

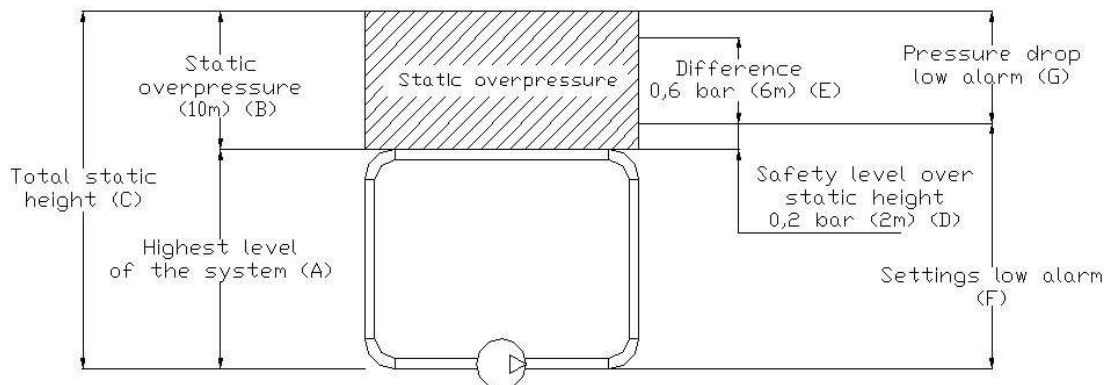
Fill up the system with the appropriate secondary fluid, via propylene glycol 35% concentrate for medium temperature applications and Temper -40 for low temp applications. Remember that mass % (weight) and volume % (space) are different. Ensure that the concentration of the anti-freezing medium is correct.

- ❑ Open the valve to the storage tank (9)
- ❑ Open the mixing valve (6) and mix the liquid by the filling pump (8) before filling up the system. This is to ensure that there is no separations of the anti freeze liquid due to long standing periods.
- ❑ Close the mixing valve (6) and open the filling up valve (7). Fill up the system with anti freeze liquid.
- ❑ Close all valves (6, 7 & 9) before changing back to normal running of the system.

Calculation of the Total Static Pressure

Ensure that you always have pressure in the system of at least the height of the highest pipe above pump level of the system plus an extra 10m (1.0 bar). Static height (A) = the highest point in the system above the pump level. The calculated total static pressure (C) = real static pressure (A) and at least 10m more (B) (static overpressure).

Figure 2





Calculated Total Static Pressure

Highest level of system	(A)	=	<u>5</u>	m x 0,1 =	<u>0,5</u>	bar
Static overpressure	(B)	=	<u>10</u>	m x 0,1 =	<u>1,0</u>	bar
Total calculated static height	(C)	=	<u>15</u>	m x 0,1 =	<u>1,5</u>	bar

Filling up of the Total Static Pressure

Open the valve to the storage tank (9)

Open the filling up valve (7); fill up the system to the design total static pressure with the filling up pump (8).

Record the total static pressure on the pump unit (see data sticker on pump)

Starting up of the Pumps

Do *never* start a pump without charged of liquid. Check to ascertain if the rotation of the pump is correct and that the electrical contactors and overloads are set up correctly. Should you encounter abnormal pressure on the readings of the manometers (fluid gauges), stop the pump immediately and recheck that all bleed-off valves are closed and all the butterfly valves (isolating valves) are open.

De-Airing (Evacuating) the System

Air in the brine and dry-cooler system is the cause of the largest problems for the secondary fluid system. In a very short time the air could cause a break down of the stability of the solution and neutralized liquids resulting in the fluids becoming very aggressive, unstable and very corrosive that will cause an attack on the metals and pump shaft seals causing fluid to leak.

During the start up period only automatic air diverters (bleed-off valves) must be opened. NB: All other manual bleed-off valves on the system must be closed. When the system has been cleared of all air they must be closed. In order to ensure that the micro bubbles leave the liquid freely a temperature of the secondary fluid system must be at above +35°C. To ensure that all air has been removed from the system could take days but if the piping system is installed in the correct manner it could take a shorter period. The de-airing (can be assisted by use of a high efficiency vacuum pump on the system) of the secondary fluid system must be complete and that the system is filled up with anti freeze liquid and that the system is 100% free of any air in the system prior to starting up the refrigeration system (primary side).

Cleaning of the Filter

After initially starting up the system, the filter should always be checked and cleaned after a couple of day's operation. This is to ensure that any foreign debris is removed from the system from when the secondary piping is initially installed. The following procedure must be followed:

- Stop the pump and close the valve / butterfly valve (10) and (11)

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6

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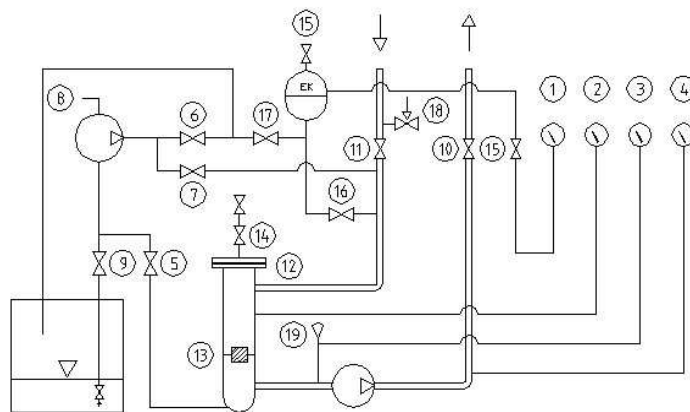


- ❑ Open the automatic air diverter (14) and the valve to the filter (5)
- ❑ Open the mixing valve (6) and empty the filter with the **Filling up pump** (8)
- ❑ Open the flange lock on top of the inlet column filter (12) remove the filter (13) and clean it
- ❑ Replace the filter, check for proper sealing of the flange (12)
- ❑ Close the mixing valve (6) and the valve to the filter (5)
- ❑ Open the valve for storage tank (9) and valve for filling up (7)
- ❑ Fill up the pumpset with the filling pump (8) and purge air from the air driers (14)
- ❑ Open the valve / butterfly valve (10) slowly and tap up from the system.
- ❑ Open the valve / butterfly valve (11) and close the valve for storage tank (9)
- ❑ Close the valve for filling up (7) and close the bleed off valve
- ❑ Return to normal operation of the system
- ❑ Don't forget to purge and tap up the system after a few minutes of running

Legend

- | | |
|---|--|
| 1. Manometer for pressure in expansion tank (extra) | 11. Return isolating valve |
| 2. Manometer for pressure before filter | 12. Flange for column filter |
| 3. Manometer for pressure after filter | 13. Filter screen |
| 4. Manometer after pump | 14. Automatic bleed off valve |
| 5. Filter valve | 15. Schrader valve for checking pressure in expansion tank |
| 6. Mixing valve | 16. Valve expansion tank |
| 7. Valve for filling up and draining of the system | 17. Drain of expansion tank |
| 8. Filling up pump | 18. Relief valve |
| 9. Valve for storage tank | 19. Low pressure alarm |
| 10. Supply line isolating valve | |

Figure 3



Calculation of the Low Pressure Alarm (see Figure 2)

The safety pressure stat (19) of the low pressure in the system is connected in the pipe between the filter and the pump (on line of (3)). Always ensure that there is an overpressure (greater than the highest point) in the system. The pressure stat will also sound an alarm when the filter is clogged with dirt.

It is recommended that the low alarm pressure be set to 2m (0.2 bar) (D) over the static pressure (A) and the alarm will only reset when the pressure rises to 8m (0.8 bar) (D&E) over the static pressure thus giving a differential range of 6m (0.6 bar) (E). The alarm is activated when the pressure falls 8m (0,8 bar) (G) and only resets when the pressure of 8m (0.8 bar) (D&E) above static pressure is attained. The operating system overpressure (working pressure) (A&B) is at a static pressure (A) plus 10m (1 bar) (B) over the static pressure.



Check the Working Pressure

Check the pressure on the manometers before and after filter (3) = working pressure.

The working pressure could be a little lower than the total static pressure due to the pump having more capacity, resulting in “under pressure” reading on the manometer. This could be the result of the pressure drop across the column filter.

Note the working pressure on the pump.

Setting of low alarm set points

Work / system pressure	=	<u>14</u>	m x 0,1 =	<u>1,4</u>	bar
Total calculated static pressure	=	<u>15</u>	m x 0,1 =	<u>1,5</u>	bar
Pressure difference	=	<u>-1</u>	m x 0,1 =	<u>-0,1</u>	bar

Static Height (A)	=	<u>5</u>	m x 0,1 =	<u>0,5</u>	bar
Safety Level for Alarm (D)	=	<u>2</u>	m x 0,1 =	<u>0,2</u>	bar
Standing pressure low alarm setpoint (F)	=	<u>7</u>	m x 0,1 =	<u>0,7</u>	bar
Pressure Drop Correction	=	<u>-1</u>	m x 0,1 =	<u>-0,1</u>	bar
Correction for Alarm Setpoint	=	<u>6</u>	m x 0,1 =	<u>0,6</u>	bar

Difference in Pressure Rise (E) (to reset alarm to normal mode)	=	<u>+6</u>	m x 0,1 =	<u>+0,6</u>	bar
Rise in Pressure	=	<u>13</u>	m x 0,1 =	<u>1,3</u>	bar
Correction for Working Pressure	=	<u>-1</u>	m x 0,1 =	<u>-0,1</u>	bar
Corrected Rise in Pressure	=	<u>12</u>	m x 0,1 =	<u>1,2</u>	bar

Standing Pressure = Static Pressure in System (pumps not operational)

Operating Pressure = Pressure in System (pumps operational)

Difference in Pressure (corrected) = Pressure Drop across the Filter / Pipes

Setting the Alarm for Normal Running Working Pressure

The following procedure must be followed:

- Start up the pump
- Open the valve to the storage tank (9)
- Open the valve to the filter (5)
- Slowly open the valve to the mixing valve (6) and carefully drop the pressure
- Set the valve of the pressure stat (19)
- Close the mixing valve (6) and the filter valve (5)
- Open the filling up valve (7) and fill up the pressure to raise the pressure on the pressure stat to above the alarm set point
- Test the system once again until you are satisfied that the alarming function is operating correctly.



Pre charging of the Expansion Tank, vessels

The pre charge in the expansion tank should have the same pressure as the total static pressure. Should the total static pressure start rising also check the pressure of the expansion tank. The standard delivery pre charge pressure on the expansion tank is 1.5 bars.

The following procedure should be followed (see Figure 3):

- ❑ Stop the pumps when you test the pressure
- ❑ Close the valve to the expansion tank (16)
- ❑ Open the valve (17) to drain the pressure inside the expansion tank
- ❑ Control the pressure at the expansion tank by releasing the pressure on the Schrader valve (15) or by reading the manometer (1) (extra)
- ❑ Fill up or reduce the pressure in the expansion tank by compressing air in the Schrader valve (15)
- ❑ Return to normal operation of the system

If you change the pressure in the expansion tank always mark the new pressure on the expansion tank.

Safety Valve (Relief Valve)

The standard delivery safety valve on the pump units is 3.5 bar (operating pressure) and the system calculated pressure at a maximum of 3.5 bar. Should there be a need to increase the pressure in the system to a new operating system pressure, then the relief valve must be changed to suit, ie 4 bar, etc and the pressure stat reset to suit the new operating pressure.

Pressure test = 1.43 x calculated pressure bar (C). Ensure that the calculated pressure on the pressure tank is correct for the new pressure level.

Control of the Working Pressure under normal running conditions

The system working pressure changes during the operating period due to the temperature change of the fluid. When the temperature drops in the fluid after initial start up, the pressure similarly will drop proportionately during the operating period. The system will have to be compensated by filling up (at intervals) with fluid until such time as the system operating temperature of the fluid is reached, ie -31°C, -8°C. At the designed operating temperature the system pressure must be at a pressure equal to the highest level of the system pressure (A) plus static overpressure (B) (10m = 1 bar) (see Figure 2). Temperature variation of the secondary fluid will take place due to the defrosting periods, the pressure in the system will change proportionately which will be taken up in the expansion tanks.

When the working temperature is stable then the primary refrigeration plant setup must be checked for proper operating performance against the calculated system design specifications.



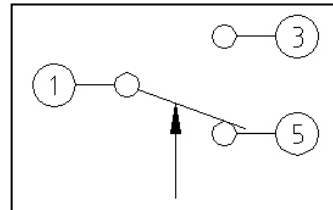
Pressure Stat Data (19)

Operating pressure parameters	-0,6 – 4,0 bar
Difference	0,4 - 2,0 bar
Maximum operating pressure	16,5 bar

Electric Data

		Power Factor	Current 125/250V AC
Resistance Load		1	12A
Inductive Load	Max	0.75	12A

Pressure stat terminal connections



Service

Servicing, maintenance and function control must be undertaken by a person qualified to undertake these works on a regular basis (minimum twice per annum). The following guidelines must be adhered to:

- Open and check all bleed-off valves for any air in the system
- Clean the inlet filter
- Check the fluid concentrate of the anti freeze liquid (secondary fluid)
- Take a sample of this fluid
- Record the total static pressure (standing pressure)
- Record the pressure in the expansion tank
- Record the cut in / cut out set points of the pressure stats and the operation of the pressure stat
- Record any abnormal sounds from the pump unit
- Check for leaks
- Check for air in the system (listen to sound of the fluid)
- Test the pH level
- Do general visual inspection of the system



Warning

Never close the supply and return isolating valves on a cabinet or blower coil or a section of the piping system when the system is at operating fluid temperature, as this is most dangerous!

The reason for this is that when cold fluid is trapped in a sealed circuit and begins to warm up, the fluid expands and the pressure increases proportionately. The pressure build up could cause the tubing to split and the fittings to blow off. Should it be necessary to isolate a section or cabinet / blower coil, the method to be used is to close only one of the isolating valves initially. Once the section / cabinet / blower coil fluid temperature has risen to the surrounding ambient temperature the second isolating valve can be closed. To raise the temperature to the section / cabinet / blower coil that needs to be isolated, one can manually force a defrost to this section before isolating any of the isolating valves. Once the defrost has terminated then the procedure of closing one isolating valve first and then the other isolating valve only once the fluid has reached the ambient surrounding temperature.

The lower the fluid system temperature is the greater the pressure build up will be in the system when the temperature of the fluid rises to the ambient temperature.

Freezing risk

Caution must be exercised when working with fluid at low temperatures; below 0°C i.e. liquid burns to the skin can be caused by contact with the fluid.

Warranty Claim Procedure

- ❑ Always check that the details on the spec sheets are as per the original offer to purchase
- ❑ Any potential flaw / defect / damages must be advised to DEM immediately on arrival
- ❑ Inform DEM in writing of any latent defects that may occur during the guarantee period (see Warranty Claim Form)
- ❑ Should you wish to advise any details by telephone, please supply the following information at the time of calling:

Order / Invoice No.

Part No

Description

Cause of problem

Estimated costs to correct

DEM will not pay costs for any items not covered under the original agreement. Any potential claims must be forwarded to DEM for their evaluation before sending any equipment back to them for exchange purposes.

The new equipment installed will be warranted for a period of one year from the date of installation to be free from faulty materials and workmanship. This will be done on an exchange basis, as per the manufacturers normal guarantee terms and conditions and provided that the necessary regular servicing of the equipment is taking place. In the event of faulty equipment, replacements will be supplied free from the Factory. The regular servicing of the equipment is to be done by a qualified contractor appointed by ourselves.

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11

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<http://www.dem.se>



Installation Protocol

Project Name: _____

Address: _____

Pumpset Serial No: _____

System Data: _____

Calculation of Total Static Pressure

Highest level of system = _____ m x 0,1 = _____ bar

Static Overpressure = _____ m x 0,1 = _____ bar

Total Calculated Static Height = _____ m x 0,1 = _____ bar

Work / system pressure = _____ m x 0,1 = _____ bar

Total calculated static pressure (C) = _____ m x 0,1 = _____ bar

Pressure difference = _____ m x 0,1 = _____ bar

Static Height (A) = _____ m x 0,1 = _____ bar

Safety Level for Alarm (D) = _____ m x 0,1 = _____ bar

Standing pressure low alarm setpoint (F) = _____ m x 0,1 = _____ bar

Pressure Drop Correction = _____ m x 0,1 = _____ bar

Correction for Alarm Setpoint = _____ m x 0,1 = _____ bar

Difference in Pressure Rise (E) (to reset alarm to normal mode) = _____ m x 0,1 = _____ bar

Rise in Pressure = _____ m x 0,1 = _____ bar

Correction for Working Pressure = _____ m x 0,1 = _____ bar

Corrected Rise in Pressure = _____ m x 0,1 = _____ bar

Pressure Readings Across Pumps

Pump A Before = _____ bar After = _____ bar

Pump B Before = _____ bar After = _____ bar

Signature _____

Name: _____

Date: _____



Check List for Pump Installation

Project Name: _____

Address: _____

Pumpset Serial No: _____

System Data: _____

	OK		OK
Pre Delivery Inspection	<input type="checkbox"/>	Check for air in system at Bleed-off Valves	<input type="checkbox"/>
Alarm System Checked	<input type="checkbox"/>	Valves on auto purges closed	<input type="checkbox"/>
Pipe Connections Checked	<input type="checkbox"/>	Inlet Column Filter cleaned	<input type="checkbox"/>
Auto / Hand Bleed Off Valves Checked	<input type="checkbox"/>	Calculation of low alarm setpoint	<input type="checkbox"/>
Pressure Testing of Piping System Checked	<input type="checkbox"/>	System Pressure Checked (working)	<input type="checkbox"/>
Antifrost Concentrate Checked	<input type="checkbox"/>	System Pressure Recorded (working)	<input type="checkbox"/>
Calculated Total Static Pressure Checked	<input type="checkbox"/>	Setting of Low Alarm Pressure Stat Checked	<input type="checkbox"/>
Filling Up of the System to the correct levels checked	<input type="checkbox"/>	Expansion Tank Pressure Checked	<input type="checkbox"/>
Static Pressure Recorded	<input type="checkbox"/>	Safety Valve Checked	<input type="checkbox"/>
Operation of Pump Direction Checked	<input type="checkbox"/>	System Operating Pressure Checked	<input type="checkbox"/>
Abnormal Pressure Checked	<input type="checkbox"/>	Pressure checked before and after pumps	<input type="checkbox"/>

Signature _____

Name: _____ Date : _____



Warranty Claim Form

From Customer	
Address	
Tel	Fax

To
D.E.M. Production
AB

Olvägen 17

340 30 Vislanda

SVERIGE

Quantity	Part no	Description	Order / Inv No.	Inv Date (part exchange)

Remarks

Signature _____

Name: _____

Date : _____

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Commissioning Certificate Verification Secondary Refrigeration System

Project Name: _____

Address: _____

Pump set Serial No: _____

System Data: _____

Calculation of Total Static Pressure

Highest level of system = _____ m x 0,1 = _____ bar

Static Overpressure = _____ m x 0,1 = _____ bar

Total Calculated Static Height = _____ m x 0,1 = _____ bar

Calculation of Alarm Installation

Work / System Pressure = _____ m x 0,1 = _____ bar

Total Calculated Static Pressure = _____ m x 0,1 = _____ bar

Pressure Difference = _____ m x 0,1 = _____ bar

Drop in Pressure (to set point) = _____ m x 0,1 = _____ bar

Pressure Drop of Alarm = _____ m x 0,1 = _____ bar

Lowest Pressure Set Point = _____ m x 0,1 = _____ bar

Difference in Pressure Rise = _____ m x 0,1 = _____ bar

Pressure Rise = _____ m x 0,1 = _____ bar

Pressure Readings Across Pumps

Pump A Before = _____ bar After = _____ bar

Pump B Before = _____ bar After = _____ bar

Signature _____

Name: _____ Date: _____



Protocol for Pressure Testing of Secondary System

Project Name: _____

Address: _____

Pump set Serial No: _____

System Data: _____

Material:

Steel	<input type="checkbox"/>
Stainless Steel	<input type="checkbox"/>
Copper	<input type="checkbox"/>
Plastic	<input type="checkbox"/>

Testing Media

Compressed Air	<input type="checkbox"/>
Water	<input type="checkbox"/>
Nitrogen	<input type="checkbox"/>

Testing Gauges

Gauge Range From / To Bar

System Pressure Test Results Bar

Holding Test Pressure Period Hours

Ambient Air Temperature °C

System Design Pressure Bar

Comments:

Signature _____

Name _____ Date _____



Difference in Pressure across Filter Before _____ Bar
 After _____ Bar
 Differential _____ Bar

If pressure drop is more than 2 bar, the filter must be cleaned

Difference in Pressure across Filter Before _____ Bar
after cleaning After _____ Bar
 Differential _____ Bar

Comments: _____

For analysing purposes, take ± 1 litre of secondary fluid _____

Record of Antifrogen Point Media _____ Freezing Point _____ °C

Record of pH Value PH _____

Comments: _____

Record of Total Static Pressure Total Static Pressure _____ Bar

Record Expansion Tank Pressure Expansion Tank _____ Bar

Record Low Pressure Alarm Actual Low Pressure _____ Bar
 setpoint

Comments: _____

Signature _____

Name _____ Date _____



Commissioning Schedule



Project Name: _____

Address: _____

Pumpset Serial No: _____

System Data: _____ design temperatur _____ C°

Elektic checklist

				<i>checked</i>	
Do not ever start the pumps without checking that there is fluid in the pump housing and the system		<input type="checkbox"/>		OK	
Current supply	3 x 230 V	<input type="checkbox"/>	3 x 400 V	<input type="checkbox"/>	
		Yeas			
Check for corrected rotation of the pump A		<input type="checkbox"/>	Testing of overload protection of Pump A	<input type="checkbox"/>	OK
Check for corrected rotation of the pump B		<input type="checkbox"/>	Testing of overload protection of Pump B	<input type="checkbox"/>	OK
Running Current pump A	L1=	<input type="checkbox"/>	L2=	<input type="checkbox"/>	L3=
Running Current pump B	L1=	<input type="checkbox"/>	L2=	<input type="checkbox"/>	L3=
		Yeas		no	
Check for abnormal operating temperatures of the pumpmotors		<input type="checkbox"/>		<input type="checkbox"/>	Ambient temperatures
				<input type="checkbox"/>	C°

Difference in Pressure across Pumps

	Before	_____ Bar
Adjusted flow: _____ l/s	After	_____ Bar
	Differential	_____ Bar

Antifrost media

Type _____ Freezing point _____ °C

Comments: _____

Signature _____

Name _____ Date _____