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Norhof N2 Cold Gas Supply System

#855 series

User manual

RoHS COMPLIANT

CE

for software version 8.1 and higher

February 2025

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INTRODUCTION

GENERAL DESCRIPTION

The Norhof LN2 microdosing system is a cryogenic N2 cold gas supply system. Nitrogen (LN2) is used as the cooling medium and is taken from a storage vessel (Dewar) with low pressure (max. 300 mBar) and delivered (pumped) through a line to the application in a gaseous cold flow

In the Norhof LN2 cooling systems the Liquid Nitrogen is stored in pressure less cryogenic Dewars. When LN2 transfer is required, a small overpressure is generated by a microprocessor controlled heater element in the LN2, and cold gas will gentle flow out of the outlet pipe.

INTENDED USE

The autonomous cooling systems are designed for use in an instrumentation environment (e.g. scientific instruments) and/or in processes that require perfect control over the "cold" required. Liquid Nitrogen (LN2) is used as the cooling medium and is taken from a storage vessel by a static pump and delivered through a fill line to the application in a micro dosing way of gaseous cold flow.

It is possible to control the temperature range from ambient to -196°C and the capacity. This capacity (= flow) can be adjusted by hand directly on the pump or by remote signals. The system is designed to overcome the drawbacks of LN2 under pressure in which a solenoid valve is used to switch the supply ON / OFF. The system instead delivers a pressure less flow of cold gas.

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1. GUIDE LINES FOR THE USE OF LIQUID NITROGEN (LN2) ALUMINUM CRYOGENIC DEWARS

1.1 GENERAL

- The aluminum Dewar as supplied with the cooling system has a fiberglass/epoxy neck and is insulated with multilayered superinsulation under vacuum.

- These lightweight and highly efficient Dewars are designed to withstand the most severe working conditions. However certain precautions should be taken to protect personnel using these Dewars and to increase the life of your Dewar.

1.2 PRECAUTIONS DURING USE

- always transport and store the vessel in an upright position on an even and level floor, also when the Dewar is empty or out of use. When using a transport trolley, only use the original trolley from Norhof.
- avoid tilting the Dewar, even to withdraw LN2. When not using your Dewar, LN2 will evaporate by itself. If you absolutely want to empty it, do it outdoors and pour on earth or gravel. Remember that most materials become brittle when cooled with LN2.
- when handling the Dewar, do not drop it and avoid impacts when placing the Dewar on the ground
- either the pump or the separate plug must be on top of the Dewar at all times. No compliance will increase the boil off of the Dewar and can lead to ice plug forming in the neck
- the Dewar must be filled by inserting in the neck either a flexible hose or a hand withdrawal pipe connected to a storage vessel. In the case of an installation using a transfer line and if the transfer line is warm, the flexible hose should be inserted into the neck only after appearance of the liquid at the end of the flexible hose
- when filling a warm Dewar, pour liquid slowly to avoid any liquid being propelled out due to rapid vaporization of the liquid inside the Dewar. Fill the Dewar to approximately 50% of the total volume and allow cooling down some hours before topping up. Thermal stability will be reached only after 48hours.
- during filling, it is important to avoid spillage of LN2 onto the top of the Dewar. If any spillage occurs, check during 24 hours that there are no traces of frosting left before re-using the Dewar

1.3 CHECKING THE DEWAR

- if traces of frosting appear on the outer vessel or if the outer vessel is completely frosted over, this shows that the vacuum in the interspace has been damaged or broken and that the LN2 is evaporating very quickly. Contact us for all necessary instructions. No repairs should be done by yourself on the Dewar.

1.4 PRECAUTIONS WHEN HANDLING LIQUID NITROGEN

- Liquid Nitrogen stored in your Dewar has a boiling point of –196°C and has a very high refrigeration capacity. Strict regulations must be applied to handle this fluid.
- contact with LN2 may cause cryogenic burns
- the liquid must be handled, particularly during filling in such a way that splashing is prevented
- when handling LN2, protect your eyes with glasses, your hands with proper gloves and your body with clothes that completely cover your arms and legs
- in the event of LN2 burns, proceed as for a burn. In all cases call a doctor
- Do not rub the skin burns. Gradually bring the affected parts up to normal temperature by placing them against another warm part of the body
- Gaseous nitrogen produced by evaporation of LN2, is odorless and invisible. A concentration of gaseous Nitrogen in a closed room or in a poorly ventilated place may cause asphyxiation by lowering the oxygen. Always use and store your Dewars in a well-ventilated place.

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2 UNPACKING

- **Dewar:** The Dewar has a closing plug, which is needed when filling the Dewar. During transport of the Dewar (empty or filled), this plug should be ON the Dewar for safety, and to prevent entering too much water (ice) into the Dewar. So keep the plug on a place that it could be taken when the Dewar needs to be filled.

- **Pump:** The pump is packed in plastic. Unpack it . On top of the pump is an orange knob. Depending of the packaging, this orange knob is already mounted, OR, the knob is packed separately in a plastic bag to make the pump fit into the package. In that case mount the orange knob firmly on the pump, so that it closes the pump airtight.

- **Sensors:** One sensor is supplied with the systems (standard). The sensor consist out of a thick cable of 2,10 meter, and a thinner part of blue Teflon tubing of 0,20 m. During transport the blue Teflon tubing is covered by a black ribbed tubing, for protection only. This should be removed before use. You may use this black ribbed tubing to guide the sensor to the place where you need the sensor. For that purpose you may cut the ribbed tubing to the right length. Be careful with the sensors !! In the end of the blue tubing there is the sensor element itself. It is a glass sensor of 1,6 mm diameter, which is very fragile.

- **Power Supply :** The transformer supplied has an EURO mains plug connected if it is for 230 Volts. If the system is for use in a country where this plug is not suitable, cut the plug and mount a plug which is suitable for this country. If the system is for use at 100 to 115 Volts, this should be ordered separately, this transformer is supplied with US plug. Check the voltage which is printed on the transformer. Please mount a suitable plug. The green/yellow wire is the ground (shielding).

  Trolley: (optional, if ordered) The trolley is already mounted.

- **Floorstand**: (optional, if ordered) Mount the tube to the baseplate with the bolt supplied. Put the stand on the floor and step on it. This will align the 5 feet with the floor.

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3 PREPARATION FOR 1ST TIME OPERATION

3.1 remove clamp and remove pump from the Dewar

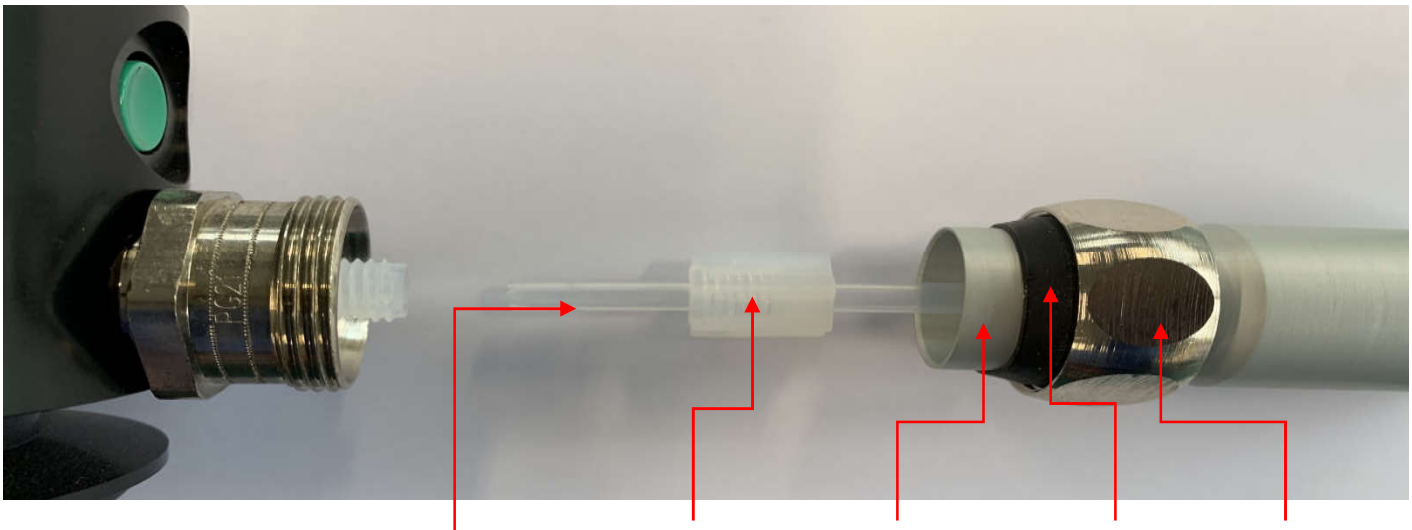
3.2 "park" pump in floorstand or lay it on a table

3.3 fill the storage Dewar for max 90% with LN2, avoid filling LN2 inside the neck , so make sure to keep minimal 18 cm of free space.
Allow Dewar to cool down. A 'fresh' filled Dewar will degas for more that 12 hours, which is not a big problem. You may use it in this stage, but during this cooling down of the Dewar the detecting of the liquid level which is in the pump can not be very accurate. The level as shown on the computer screen in the monitor program, may vary. However, the detection of the warning in the pump for 'too low level' is NOT depending of this. It is a separate sensor, which is NOT influenced by the degassing of a 'fresh' filled Dewar.

3.4 lower the pump slowly into the Dewar, in a way that the liquid does not splashes too much.
WARNING:
- the pump is at ambient temperature and when the "hot" protection pipe hits the liquid, a fair amount of "clouds" are generated
- also liquid might escape through the Teflon coupling, so don't stand in front of it

3.5 keep lowering the pump until it rests on the Dewar.
- put the clamp in place.
- make sure the pump + clamp is placed properly to make an airtight seal. Do not use tools! Hand tight is fine (after all the system works with only millibars of overpressure)

3.6 mount the fill hose to the pump



For a clear instruction how to Leak Free install the Cryo hose, please check our Norhof YouTube instruction Video at:
https://youtu.be/xy8xilgeiJY?si=epIJ_bDJgx2Qbslk

SCAN ME

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- Loosen the big nut on the outlet, and put it on the metal protection tube of the fill hose. Also slide the black rubber gasket as far over the aluminum tube as possible. Loosen the Teflon (plastic) nut 2 turns. Push the Teflon (plastic) fill hose in the nut. Tighten the Teflon nut 2 turns, and gently pull on the fill hose until the groove clicks in the nut. This is easy to feel. Now tighten the nut by hand as tight as possible. Then use a spanner to give the nut one full turn. DO NOT TIGHTEN IT TOO MUCH. It is plastic, and can break if tightened too much.
- Move the metal protection tube into the pump's outlet. Tighten the big nut so that the protection tube is fixed. Tighten by hand only.
- The fill hose is standard 1,5 meter. It can be cut shorter (only in the Norhof factory) for your application. The shorter the fill hose is, the faster the liquid will start to flow. Only make sure that the fill hose is long enough to make it possible to remove the pump from the Dewar while the fill hose is still connected (for refilling the Dewar)

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4 CHECK PUMP OPERATION

**** Each pump is carefully tested before shipment. You may skip the procedure below, but may use it later to periodically check proper working of the system.**

4.1 GENERAL NOTES

- The pump is shipped in the straight pumping mode (working mode switch position 1), unless otherwise is noted on the according test sheet.
- the majority of the signals mentioned below are also elucidated on the label of the pump.

4.2 START

- **DO NOT CONNECT SENSOR** (use pump as it comes out of packing and with the fill hose you have just installed)
- **DO NOT PUSH BUTTON**

step	Do the following	result	elucidation
1	Remove safety pressure relief valve (orange knob on top)	System will remain pressure less	this prevents LN2 to come out from outlet
	we are first going to test if all electrical signals work properly		
2	Put 25D connector in place, connect to power supply and connect power supply to mains	Status led will flash at slow speed (every 5 seconds); indicating that the pump is in sleep mode	
	we are now going to test if the system will pump		
3	Put safety valve in place		**WARNING** If you press the button now, the system builds up pressure to transport cold N2 gas. So be aware that N2 escapes from the fill hose when you put the pump in standby mode.
4	Press button once to put pump in standby mode	N2 cold gas will flow through outlet	
5	Set the flow to a desired rate by adjusting the numbered wheel		For testing a setting of about “3” is fine. Be aware that it initially takes a few seconds before the tubing is cold and a steady flow is achieved. Once this is the case you may change the setting while cold gas flows until you are satisfied with the flow. **note:** when you increase the setting, you basically increase the pressure and thus the flow; you will not hear any valve action. When you decrease the flow, the excess pressure is relieved and you will hear the internal valve doing so.
6	Press button once to put pump in sleep mode		

	we are now going to test the system built-in protection		
7	Be sure the pump is in SLEEP mode		
8	Remove the clamp and raise pump above the Dewar with all connections in place. You may put the pump in the floor stand (or keep it raised) Make sure the external sensors are still cold. Press button once to put pump in standby mode. (To try pumping with the pump out of the LN2)	After two minutes the built-in sensor senses that it is no longer in LN2: • Warning led lights continuously red to warn for refilling the Dewar • beeper double beeps every 30 sec. Keep the pump raised • beeper will beep every second to indicate that pump is not in LN2	By raising the pump above the Dewar you simulate that the liquid level drops below the built-in level sensor This double beep reminds you to refill the Dewar even if you do not watch the front LEDS. In other words when the Dewar really runs empty the pump stops pumping
9	Press button once to put pump in sleep mode		

RESULT

By doing above test, you assured yourself

- that system does pump (step 4)
- that flow can be tuned to your application (step 5)
- that you are timely warned to refill the Dewar (step 9)
- that the system is protected when the Dewar runs dry (step 9)

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5 PUMP ON COMPUTER SCREEN

With the pump comes a Monitor Software package (on the USB stick included in the shipment) that makes the pump visible on a computer screen. This is not a static schematic, on the contrary. The picture on display changes with the various switch positions, the number of sensors in use, etc.

The screen allows you to:
- scroll through all modes of the switch with a specification of each mode
- see the status of each active component
- read pressure and temperature of each sensor
- read the level of LN2 in the Dewar (when not pumping)
- read the (calculated) level in your application
- adjust the pump to the height of your application (relative to the exhaust height of the pump) (default = 20 cm)
- adjust the output flow for your application (by the white thumbwheel on the side of the pump)
- etc.

Also with this software it is possible to adjust the pump on a feeding height (if you need to pump the LN2 to a higher level than the pump), and to adjust the pump to a longer filling line than the standard 1,5 meters line.

It is highly advisable to connect your PC to the pump for educational purposes during your familiarization with the system. All necessary parts are included.
If you do, make sure that the pump + PC are on the same mains, otherwise ground loops may prevent proper operation, or cause damage.

The PC is by no means mandatory to operate the system.
In this monitor software you can also read all different working modes and below that is an overview of all pin connections.

If you have any question or feel a hesitance to do something, contact us, preferably by e-mail: info@norhof.com

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6 The Monitor software

The pump is delivered including a USB stick containing the monitor software. During installation, or if there is a problem with the pump, of course it is the best to connect the pump to the PC and read out all of the behavior on screen.
The pump can be connected with the (supplied) 5 meter cable with the 9 pin D connector on pump side. The pump should be connected to a (serial) COM port on the PC.
If the computer does not have a COM port (such as many laptops have nowadays), you can simply use a USB to COM converter cable. With this adaptor there is created a virtual COM port on the PC. In the hardware setup of the computer you can set this COM port to a fixed port number. The monitor software can handle port numbers from 1 to 8. When possible, assign your USB to COM port adaptor to COM1, because the monitor software starts default on COM1.

6.1 Other version software

You should use ONLY the monitor software version supplied with the pump. During the years we made changes in the pumps and the software. Only the same version number as the pump has will correspond fully. It can do no harm if you just connect an other pump to older (or newer) software to check for the version number, but you should NOT write any calibration values or feeding height into the pump with software which does not correspond to this pump. Writing in a pump with the wrong version could make the pump unusable.
Also, when a wrong version number software is connected to the pump, the readout on screen can give numbers which are not for real. For example, the readout for the feeding height was changed somewhere in 2008. When connecting an older pump to newer software, the readout for the feeding height on screen could give for that pump 26 meters, but inside the pump the construction of this number is build in a new way. So do NOT write in this case a new value of 20 cm in this pump, because probably the real feeding height in this pump was OK, but the readout with the newer software was wrong only on screen.

6.2 Firmware version number of the pump

On the right bottom in the monitor screen is the firmware version of the pump. (the firmware is the software which is inside the microprocessor in the pump). This is shown once when the software is started up or when a pump is connected. If you connect an other pump and you want to read the firmware version, you should close the monitor software and start it up again.
The firmware version should correspond with the version number of the monitor software itself (in the top blue bar, before the version date.) It will read "Norhof Monitor Program v. 7.51 21 March 2012".
The firmware version of the pump will read also : "firmware in pump: ver 7.51 12 March 2012".
The dates does not need to be the same exactly, because the date gives the date of the last changes. There can have been made a small change in the same version number while not changing the version number.

6.3 Pump model

The monitor software will recognize the pump model automatically. There is one version of the monitor software which is suitable for all pump models.
In the left part it will display the pump model, and what working mode the pump is in.
For the #855 model the working mode can be selected by yourself with the mode selector switch, mounted inside the pumphead.

6.4 Pump drawing

On the right part is a picture of the pump in the Dewar and a symbolic drawing of the application. The form of this drawing depends on in what working mode the pump is. If it is a working mode with one sensor, this sensor is drawn on screen.

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7 MODE SELECTION FOR YOUR APPLICATION

Now that you have verified that the system works and have the pump on screen, we are going to configure the system to your application.

Feeding Height:
Important is to set the fill line feeding height and length for your application. If your application is on a table, the pressure needed to have some liquid will be lower than when your application is 2 meters from the floor.
Also for some working modes it is important that the liquid is almost at the top of the fill line before regulation starts.
The highest point in the fill line can be entered at the SET button next to the fill line.
The value you can enter here, is the distance from the exhaust on the pump to the highest point in the application.
If the application is on a table, probably the default setting of 20 cm will be good. (the pump exhaust is probably 70 cm from the floor and the table probably also 70 cm and the application height 20cm.)
But if the application to fill is at 200 cm from the floor, the feeding height should be entered as 200-70=130 cm.
In that case an extra pressure is calculated to be added to the overall pressure, to reach the highest point.
The fill line length should be on 2 meters if your fill line is 2 meters or shorter. If you have a longer fill line, or (see later) you have a very thin application so that you sometimes have false "exhaust blocked" alarms, this value can be set according your fill line, or some higher when you have this alarm.

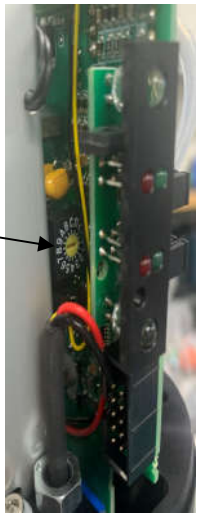
Working Mode:
The built-in controller can be set in different working modes. Remember that the shipping mode is position 1 (straight pumping mode)). Now we have to select the working mode for your application.

SENSOR for temperature control

- Make sure to set the sensor to ‘non heating’, you should set some jumpers on the pump, and recalibrate for this mode. This is possible with the ‘calibrate’ screen in the monitor software (see later)
  It depends on which working mode will be chosen, how you should choose the sensor setting.

Working mode

- look in appendix A on the next page
- remove the orange knob (=safety relief valve) on top and remove the cap
- select the mode you want to work in and read the switch position (the black with yellow switch is located on the PCB behind the set of LEDS)
- with a small screwdriver put the switch in the proper position
- re-install the cap and the orange safety relief valve
- remove the test tubing and install the fill line supplied
- connect mains
- The pump will beep 9 times during start up, and will show the yellow led slow flashing



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8 Appendix A : switch modes overview

switch position	working mode	model **855**	Flow Control	Temp Control	Number of Sensors
0	- not used	**-**	-	-	-
1	Pumping by using pump push button	**x**	I	-	-
7	Pumping by using pump push button (no frozen alarms)	**x**	I	-	-
8	Autonomous temperature control	**x**	-	I *2)	1 *3)
9	Remote flow control	**x**	A *1)	-	-
A	Remote temperature control	**X**	-	A	- *5)
B	Remote flow control	**X**	A *1)	-	1 *3)

Note: I= internal A= external Analogue RS232= via Norhof software driver

*1) When an external analog or a RS232 source is used to control the flow, the pump flow control knob (0-9) limits the flow to the value as set by the knob.
*2) a full turn of the temp. Adjust knob covers either a limited range of +/- 20°C over an internally preset temperature or the full range from ambient to -160°C. This depends upon a jumper setting inside the pump. See Appendix D
*3) the sensor is to be plugged into the main sensor socket on the pump
*5) signal on pin 9 of 25D connector
*8) the sensor to control the temperature is to be plugged into the main sensor socket on the pump

For temperature regulation, mode 8, read appendix H

NOTE: When the pump is in the LN2, the power should be kept on the pump. When the power is OFF, the leading hose of the pump may freeze because water vapor will enter the pump slowly and freeze the exhaust. There is a small heater element in the pumphead to prevent this. If the pump is longer (several hours) without power, the pump could internally freeze. Only solution then is to warm up the pump completely.

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9 Appendix B : working modes , switch position, detailed

Switch position 0 == for future use (in older pumps this was the calibration mode)

Switch position 1 == straight pumping mode (no sensor)
"deliver cold N2 gas as controlled by pump button or external signal"

Button on pump allows operator to toggle between Standby and Sleep
Standby = pumping on
Sleep = stop Standby, set internal freeze protector ON to prevent ice clogging in risepipe
pump can be put in STANDBY mode with TTL signal or +24V signal on 25D connector
pump can be put in SLEEP mode with TTL signal or +24V signal on other pin of 25D connector
FLOWRATE is set by potmeter on pump

Switch position 7 straight pumping mode (no sensor) with no frozen alarms

"deliver cold N2 gas as controlled by pump button or external signal"
This mode is to imitate a pressurized Dewar

Button on pump allows operator to toggle between Standby and Sleep
Standby = pumping on
Sleep = stop Standby, set internal freeze protector ON to prevent ice clogging in risepipe
pump can be put in STANDBY mode with TTL signal or +24V signal on 25D connector
pump can be put in SLEEP mode with TTL signal or +24V signal on other pin of 25D connector
FLOWRATE is set by potmeter on pump

Switch position 8 == local temperature control (1 sensor)
"deliver cold N2 gas as controlled by temperature setpoint on pump, or external analog 0-5V signal"

Button on pump allows operator to toggle between Standby and Sleep
Standby = pumping as long as sensor is above- , not- or soft-pumping when sensor is below temperature setpoint(*1)
pumping flow is depending of the speed of the temperature changes. (P.I.D.)
Sleep = stop Standby, set internal freeze protector ON to prevent ice clogging in risepipe
pump can be put in STANDBY mode with TTL signal or +24V signal on 25D connector
pump can be put in SLEEP mode with TTL signal or +24V signal on other pin of 25D connector
maximum FLOWRATE is set by potmeter on pump
adjust flowrate so, that in stable situation the squeezing is ab. 30-50%
read also appendix H for mode 6, because mode 8 uses a similar PID

(*1)temperature setpoint is depending on jumper setting JP7
1 as set by potmeter on pump front(*2)
2 as set by external 0-5 analogue signal on pin 11 of 25p D connector
(*2)range is depending on jumper setting JP6
JP6 open = range -160 to +70 degrees Celsius
JP6 closed = range +/- 30 degrees relative to potmeter P1 on print

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Switch position 9 == FLOW control by external signal (no sensors)
"deliver cold N2 gas as controlled by external analog 0-5V signal"

Button on pump allows operator to toggle between Standby and Sleep
Standby = pumping with flow as set by external 0-5 volt signal (0 volt = stop pumping)(*1)
Sleep = stop Standby, set internal freeze protector ON to prevent ice clogging in risepipe
pump can be put in STANDBY mode with TTL signal or +24V signal on 25D connector
pump can be put in SLEEP mode with TTL signal or +24V signal on other pin of 25D connector
Maximum FLOWRATE is set by potmeter on pump

(*1) external analog signal on pin 10 of 25 p D connector delivers a flow depending on the setting of the flow potmeter on the pump
0 - 5 Volt delivers 0 - 100% of the adjustment of the flow potmeter on the pump.

Switch position A == remote temperature control (1 sensor)
"deliver cold N2 gas as controlled by external analog 0-5V signal(s)"

Button on pump allows operator to toggle between Standby and Sleep
Standby = pumping as long as sensor is above- , not- or soft-pumping when sensor is below temperature setpoint(*1)
pumping flow is depending of the speed of the temperature changes. (P.I.D.)
Standby = when pumping, use maximum flow as set by external 0-5 volt signal (0 volt = stop pumping)(*3)
Sleep = stop Standby, set internal freeze protector ON to prevent ice clogging in risepipe
pump can be put in STANDBY mode with TTL signal or +24V signal on 25D connector
pump can be put in SLEEP mode with TTL signal or +24V signal on other pin of 25D connector
Maximum FLOWRATE is set by potmeter on pump
adjust flowrate so, that in stable situation the squeezing is ab. 30-50%
read also appendix H for mode 6, because mode A uses a similar PID

(*1)temperature setpoint is depending on jumper setting JP7
1 as set by potmeter on pump front(*2)
2 as set by external 0-5 analogue signal on pin 11 of 25p D connector(*4)
(*2)range is depending on jumper setting JP6
JP6 open = range -160 to +70 degrees Celsius
JP6 closed = range +/- 30 degrees relative to potmeter P1 on print

(*3) external analog signal on pin 10 of 25 p D connector delivers a flow depending on the setting of the flow potmeter on the pump
0 - 5 Volt delivers 0 - 100% of the adjustment of the flow9otmeter on the pump.
(*4) external analog signal for temperature setpoint 0 - 5 Volt gives a setpoint from -200 to +70 degrees Celsius according PT100 characteristics

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Switch position B == FLOW control by external signal (and 1 sensor)
"deliver cold N2 gas as controlled by external analog 0-5V signal and 1 sensor for STOP"

Button on pump allows operator to toggle between Standby and Sleep
Standby = pumping with flow as set by external 0-5 volt signal (0 volt = stop pumping)(*1)
pumping as long as sensor is warm, not pumping when sensor is cold
Sleep = stop Standby, set internal freeze protector ON to prevent ice clogging in risepipe
pump can be put in STANDBY mode with TTL signal or +24V signal on 25D connector
pump can be put in SLEEP mode with TTL signal or +24V signal on other pin of 25D connector
Maximum FLOWRATE is set by potmeter on pump

(*1) external analog signal on pin 10 of 25 p D connector delivers a flow depending on the setting of the flow potmeter on the pump
0 - 5 Volt delivers 0 - 100% of the adjustment of the flow potmeter on the pump.

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10 Appendix C : Remote control

All the #855 models can be remotely switched OFF and ON (= in SLEEP or STANDBY), in 4 ways:

1 With a 5 volt signal on pin 4 of the 25p subDconnector, the pump can be switched to SLEEP.
(Pin 4 is connected with 5 Volt in the standard setup, connecting it to 0 Volt will switch the pump in SLEEP)
With a 5 volt signal on pin 5 of the 25p subDconnector, the pump can be switched to STANDBY.
Pin 5 is connected with 5 Volt in the standard setup, connecting it to 0 Volt will switch the pump in STANDBY
Where SLEEP overrides the STANDBY.

Connecting these pins to ground (pin 17=18=19=20), is also enough to make the signals switch. So two pushbuttons could do the job also. (pull up resistor is 1 kohm, with 100nF capacitor)

2 With the optocoupler signals (see chapter 12)

For programmers:
3 If NO monitor sofware is standby, so the serial port is free for your own application software, the serial port can be opened at 19200,N,8,1
is Baudrate 19200, No parity, 8 databits, 1 stopbit.
Sending a "pon" command (PumpingON) will set the pump in STANDBY, sending a "pof" command (PumpingOFf) will set the pump to SLEEP.
Sending "rm 19" will give back the pump status register. result and 2 = pumping, result and 16 = standby, result and 32 = sleep, result and 64 = Dewar level lower than 5 liters, result and 128 = alarm

4 If the monitorsoftware is running, so the port is occupied, there is a way to tell the monitor software to switch the pump. This is not a very gentle solution, but the only easy way.
The monitor software will check continuously in his working directory (c:\Program Files\NorhofPumpMonitor as default) for a (empty) file "PON.txt" or "POF.txt" (or "pon.txt" or "pof.txt") . If found, the pump will switch ON or OFF, and delete the file.
creating a "RM19.txt" file gives back a "RM19.dat" file with the pumpstatus result.

11 Appendix D : Password protection

In the monitor software all the editable functions can be password protected.
In the Main screen - service screen - calibration screen - extended setup is a button "password protection". Here you can set a password of maximum 4 characters or numbers, which will be asked before entering all the editable functions.
Also here you can delete the password protection. (=NO password).
If you have forgotten the password, you can simply delete the file "NORpassword.sys" in the working directory of the PumpMonitor. (probably c:\Program Files\NorhofPumpMonitor\NORpassword.sys"

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12 Appendix E: pin connections 25p subD connector

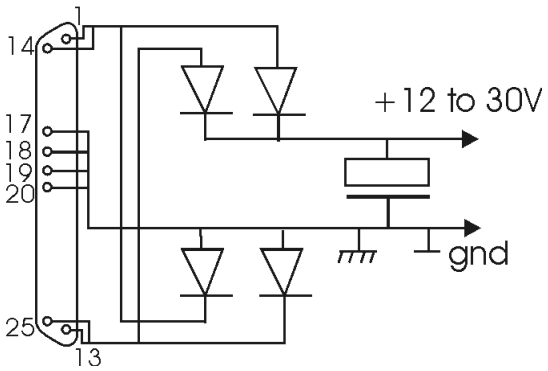
Pinconnections 25p subD connector on pump(male)

25p Dconn pins #800 and #855 models, and 600 models from after Jan. 2011:

1=14 AC1 AC or DC 12 to 24 Volts Power supply (min. 4 A.)
13=25 AC2 AC or DC 12 to 24 Volts Power supply (min. 4 A.)

17=18=19=20 system ground

** If you want to use an other power supply than
we supplied, and if it is a DC power supply of 12 to 30 Volt:
connect - (minus) of the DC power supply to 17,18,19 and 20
connect + (plus) of the DC power supply to 1,14,13 and 25
Power supply must be DC12V, 4 amps, or 24 Volt, 2 amps.



8 RXD serial connection (use 1 K resistor in serial on pump side), 3n3 to grnd on computer side
9 TXD serial connection (use 1 K resistor in serial on computer side, and 3n3 to grnd on computer side
4 TTL_1 input, 0 or 5 Volt, 0 Volt = switch pump to SLEEP
(pull up resistor is 1 kohm, with 100nF capacitor)
5 TTL_2 input, 0 or 5 Volt, 0 Volt = switch pump to STANDBY
(pull up resistor is 1 kohm, with 100nF capacitor)

10 external flow input, analog 0-5 Volt
11 external. temp setpoint input, analog 0-5 Volt

6 external. EXTRA sensor input (PT100 element) to ground
7 external. MAIN sensor input (PT100 element) to ground

15 opt1C* optocoupler input 1 neg.
2 opt1A* optocoupler input 1 pos. : 0 or 5-24 Volt input. 5-24 V. to switch pump to STANDBY
(use 1 Kohm resistor for 5 Volt, 5K for 24 Volt)

16 opt2C* optocoupler input 2 neg.
3 opt2A* optocoupler input 2 pos. : 0 or 5-24 Volt input. 5-24 V. to switch pump to SLEEP
(use 1 Kohm resistor for 5 Volt, 5K for 24 Volt)
(*) connect C to ground and supply positive signal with resistor to A to switch
(*) OR, connect A to ground to use negative signal on C .

12 output TTL 5 Volt external heater LOW = Heating ON, 5V = Off

23 optEXH1E optocoupler output emitter for external heater (*)
24 optEXH1C optocoupler output collector for external heater (*)

21 optAL2E optocoupler output emitter ALARM (*)
22 optAL2C optocoupler output collector ALARM (*)
conductive = Alarm, OPEN is no alarm

(*) connect E = emitter to ground to switch a positive signal,
then connect C=collector with 10K to +5V to switch the signal, or with 33k to +24V
(*) OR, connect C = collector to ground to switch a negative signal,
then connect E=emiter with 10K to -5V or with 23k to -24 V.

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13 Appendix F: calibration

Usually the system will work as mentioned above and you do not have to do any adjustments.
If the system is recently delivered, all calibration is already done at the factory.
However, if you change the setup, or have the feeling that the sensors may not give the accurate temperature, you may calibrate the internal pressure sensor and internal and external sensor(s).
This procedure is very simple.

In the monitor program, there a button to go to the 'service' screen. There in the bottom is a button to go to the 'calibrate' screen.
On the left are some buttons to make a 'rough' calibration, to select what type of external sensors are connected. In the right part is the fine calibration.

SELECTION OF EXTERNAL SENSOR TYPE
Standard one external sensor is supplied with each system. This sensor is a PT100 element. The sensor itself is a 1.6 mm glass sensor, in a blue Teflon tubing of 2,8 mm. (the tip is very fragile). You also could use other sensors yourself, as long as it is a PT100 element.
If the sensors are used for temperature-measurement, the sensors can be switched with a much lower current (1 mA), so that the sensor will not be heated up by the current, to make the temperature accurate over all the range.
To select this current, some jumpers should be set corresponding the choice of sensor working.
On this screen a little drawing gives the position of the jumpers corresponding the wanted working.
Once the jumpers are set, you may press a corresponding button to enter the 'rough' calibration values into the pump. This is enough for good working, but the real temperature may vary one ore two degrees for small manufacturing differences in the sensors and electronics. (default for 33mA. = 137 and 470, for 1mA. = 90 and 478)

Also it is possible to connect a dual sensor (two PT100 sensor serial on only two wires). This could be convenient for using mode 4 (one point level control) and with this dual sensor having in fact a two point level control, and having only one cable to connect. If so, use the rough calibration to let the pump know that this type of sensor is connected.

FINE CALIBRATION
After the rough calibration is entered into the pump, you may use the fine calibration to calibrate the sensor more accurate. In the right side of this screen you see the fine calibration buttons.

External sensor
For the external sensor, you can read the actual temperature in the middle.
When the sensor is at room temperature, after switching the mains power on the pump, of after connecting the sensor, the sensor would be at ambient temperature (about 20 degrees). If the value is much lower ore higher, you may press the '20 degrees' button to enter this value into the pump. If you want a very accurate calibration, you may put the sensor in a glass of water, and heat the water up to 30 degrees (with a hairdryer?) and then press the '30 degrees' button. (default calibration for the 1mA sensor is 478)

What is important, is the calibration for the 'cold' value. Here for the sensor must be put into LN2. Make sure that the sensor is deep into the LN2, and look at the temperature on screen that it is not dropping any longer (one or two minutes). If the reading is not exactly –196, press the '-196' button to enter this value into the pump. Now the reading should be –196 exactly. (default calibration for the 1 mA sensor 90)
Calibration is now ready, but before use, the pump should be reset (power off and on) to work with the new values.

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Internal pressure sensor
Inside the pump is an internal pressure sensor which measures the pressure in the Dewar, 2cm from the bottom, so UNDER the LN2. Calibration of this is very simple. The pump should be out of the LN2, so in open air.

If the reading on screen is not 0 mBar (+_ 0.5 mBar), you may click the '0 mBar' button to enter this value. Now the reading should give 0 mBar +- 0,5 mBar. After the pump is placed back in the LN2, the LN2 level should correspond with the actual LN2 level. (default may vary between 32 and 52, was factory calibrated)

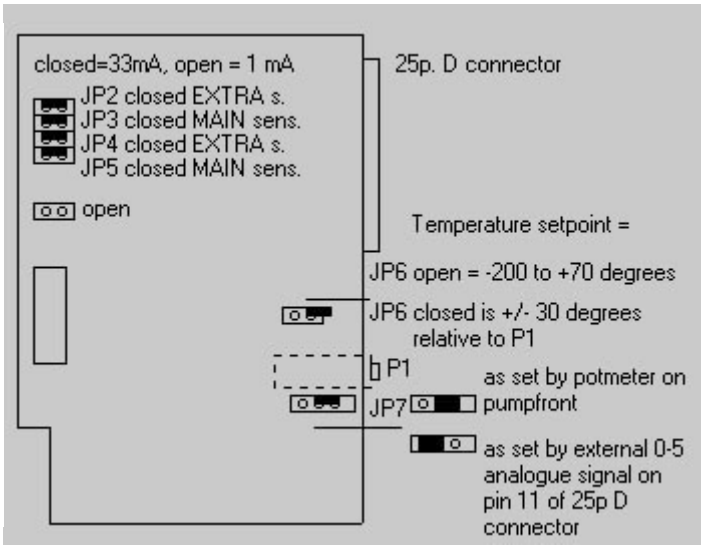
Internal vessel sensor. (in service screen)
Inside the pump , down in the Dewar, there is a set of sensors to measure the level in the Dewar. If the pump is in room temperature, the reading should be around +30 degrees (due to heating because of 33 mA through these sensors also)
When the pump is in the LN2, and there is more than 10 cm LN2 in the Dewar, the reading should be –196 degrees. If not, you may click the '-196 button' to calibrate this value. (default = 237 and 637)

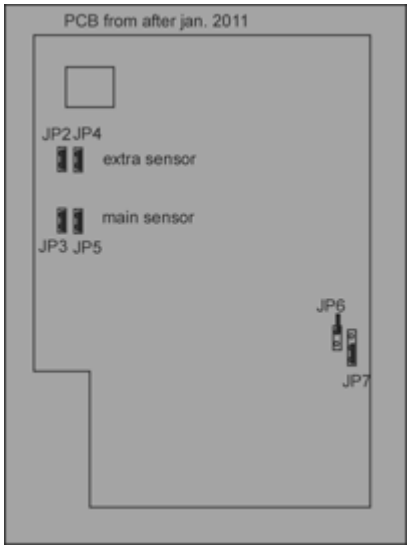
FLOWPOTMETER RANGE
On the side of the pump is the thumbwheel to set the wanted pressure in the Dewar to reach a corresponding flow. It is scaled from 0 to 7, working is a logarithmic way. For most applications, a middle range flow setting of about 3 should be sufficient, which is about 50 mBar, when the pump is delivered. The standard range at delivery is 0 to 270 mBar for this thumbwheel. (for the #905, #910 and #915 liquid pumps).
However, if you want, you may rescale this range, to adjust it more for your application.
In the middle of the calibration screen, on the bottom, there is a selection box in which you may select an other range.
If you select an other range, and write it into the pump, you may prevent the user in setting a too high flow for your application.
NB. For most filling applications a pressure of ab. 50 mBar is sufficient. Start with the thumbwheel on 3 (= ab. 50 mBar) and allow the fill-line to cool down and observe the flow after 3 minutes.

TEMPERATURE POTMETER RANGE (optional)
On the front of the pump is the potentiometer for setting the wanted temperature, in case of a temperature regulation mode.
Standard the range is from –190 to ab. +70 degrees Celsius.
On the PCB in the pump housing is a jumper JP6, which is normally open. If this jumper is put ON (closed), the range of the temperature can be set by the blue potentiometer P1, and with the potentiometer on the front of the pump, this can be varied plus or minus about 30 degrees.
Here for is an other scale needed on the pump. You may request an other scale from us, or make it yourself.

NB. There is a drawing of the jumpers in the monitorsoftware, in the 'view all modes' button, with a separate button.

NB. There is a pinconnection diagram in the monitorsoftware, in the 'view all modes' button, at the bottom of mode 15





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14 Appendix G: detailed working of the pumping

When the pump is not standby, there is NO overpressure in the Dewar and the small release valve is open. This release valve is a small hole to connect the Dewar to the outside. It is closed when overpressure is needed.
When the pump is switched to 'STANDBY' , the pump uses a heater element in the bottom of the Dewar to create gas to build a small overpressure. When the pressure is enough, the cold N2 gas will flow out of the fill hose. You can imagine, that how higher the pressure is, the higher the flowrate is. Note that there is NO valve in the fill hose, Cold N2 gas is just coming from the Dewar, going to the application.
So, when switched to STANDBY, the release valve will close and the heater will build some pressure to create some cold N2 flow.

There can be 3 situations of the pump:

1 SLEEP	the pump is doing nothing, except keeping an internal small heater warm to prevent the pumphead from freezing
2 STANDBY	a small overpressure is used to keep the pump standby for the next pumping action (most working modes)
3 PUMPING	a pressure is used to realize the requested flow of cold N2

SLEEP mode:
When the pump is connected to the power, 9 beeps sounds, and the pump will begin in SLEEP mode (yellow LED flashing slowly every 5 seconds)

STANDBY / PUMPING mode:
When the green button is pushed, the pump switches ON, depending of what working mode and sensor temperature(s).
When in a mode with no sensors, or when sensor(s) are not yet cold enough, the pump will go into PUMPING mode. (Yellow LED burning)
When the sensor(s) are cold, or the temperature is reached, the pump will go into STANDBY mode. (yellow LED flashing every 1 sec.)

STANDBY mode:
In the standby mode, a small overpressure is used to make it as fast as possible to respond on a pumping request later. This is kept until the pump goes into PUMPING mode.

PUMPING mode:
When starting pumping, the pump starts to build up pressure. You can see this in the monitor program at the HEATER. It will start at 5% and increases every 3 seconds, up to 100%. It will increase pressure until the pressure is equal to the pumping pressure (set by the thumbwheel on the side of the pump)

In working modes which just switches ON and OFF the pumping, this total pressure will be kept during PUMPING.
In working modes which regulates flow or temperature, the percentage of the pressure may depend on temperature changes and/or level sensor temperatures. If more cold seems needed, the pressure will be higher, but when a temperature is almost reached, the pressure will be lower.

If this pressure is reached, the heater shuts OFF, until the pressure is too low again. It will then be switched ON with a little lower capacity (95%) each time. In the end this will be a stable situation and the heater will switch ON and OFF at 30% to 50 %, depending on how much cold N2 is really pumped.
(On the screen the visibility is slower than it is in real. This value is sampled on screen every 1 second only, to limit data transfer. This is also for many other values on the screen, because the monitor is just for indication)

After the pump has finished pumping (depending on what mode the pump is in) and the pump is in STANDBY, the Dewar pressure is released.

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FREEZE PROTECTION:
If the pump is OFF (in sleep mode), a small heater element in the top of the system will be heated up to 50 degrees, to block the water vapor which could go into the pump and freeze the system.
Therefore, the pump should not be IN the LN2 and disconnected from the mains power in the same time.
If mains power is disconnected, the pump should NOT be in the Dewar. (for some hours it is no problem, but for a night long, it can be too long and the pump could freeze) This also depends on the humidity of that moment, and on the length of the fill hose. If the fill hose is long, it takes more time for the water vapor to go into the tube and reach the pumphead.

BLOCKED (frozen) alarm:
The pump looks if the cold N2 is really going out of the system, counting on that the exhaust of the N2 is in the free air. When the pressure in the Dewar is higher than 60 mBar, and the temperature measured in the exhaust of the pump is still higher than -20 C., the "exhaust blocked" alarm is set.
If the application is too much airtight, thus the exhaust is blocked too much, this could also cause a ‘blocked exhaust’ alarm. This is the same as a frozen exhaust. The application should have an opening wide enough to let expand all the gas. If the pump gives this alarm often, the value for the length of the fill hose could be set some longer, to prevent this alarm. This value only sets the sensitivity of the alarm. It has further NO influence on any pumping behavior.
The frozen alarm will also be set when the (blank) pressure measuring tube (tube going down in the LN2) is frozen. Only solution then is to warm up the pump and make sure all water is out of this tube.

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15 Alarm list

Almost empty alarm:
Warning LED ON + double beep every 30 seconds = less than 4 liters LN2 left
- This is measured with a sensor 4 cm from the bottom of the Dewar.

Other alarms:
When warning LED flashes, the number of beeps indicate the problem:
beeps
1 pump is not cold (empty?)
- this is measured with a sensor close to the bottom of the Dewar
2 Dewar level sensor not OK
- empty or almost empty internal sensor is broken?
3 pump flow sensor not OK
- internal TMB sensor is broken?
4 no pressure building (leak?)
- pump not airtight on Dewar, or orange overpressure valve is not tight

8 main external sensor not OK
- main sensor on the application is loose or broken
9 extra external sensor not OK
- second application sensor is loose or broken
10 exhaust blocked (frozen?)
- flow tube inside the pump is frozen, or fill tube on application is frozen, or
- application is too much airtight
11 pressure measuring tube frozen
- internal pressure measuring tube is frozen (or has water in)
- then also the LN2 level indication of the Dewar will be wrong
12 pumping was too long
- pumping time has reached the adjusted time for pumping too long alarm

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16 Warming up and drying the pump

Notice: when cleaning the pump, <u>always remove the pump from mains</u> during cleaning procedure

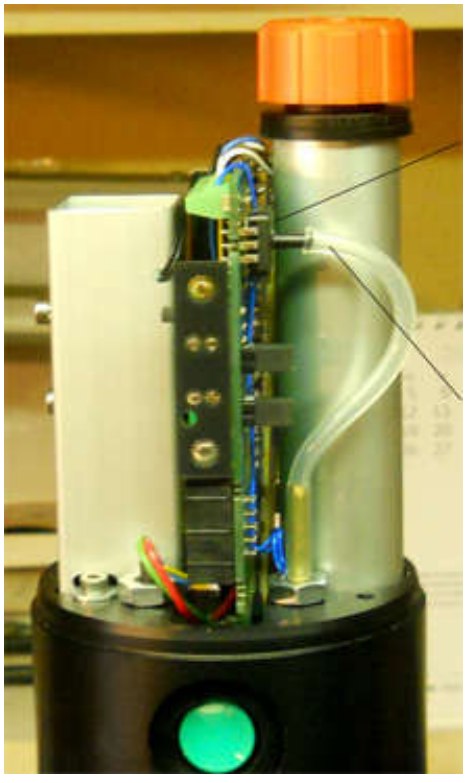
If you have the feeling that the risepipe or the pressure measuring tube is frozen, you need to warm the pump up to room temperature, and maybe dry the rise pipe and measuring tube.
Please put the pump in its floorstand, or lay the pump on a table and wait for all ice and condense water has disappeared. You may help a little by warming it with an electrical hairdryer. But be careful. The protection pipe, around the heater and rise pipe, is made of PVC, and will deform at temperatures above 70 C.

Blocked exhaust:

After all condense water is disappeared, it could be possible to see if there is an ice block in the rise pipe. The most obvious place is high in the risepipe, almost at the pumphead. So this may not be easy to see.
You may blow with dry air from the fill line into the pump, to blow the last water downwards out of the rise pipe. Of course the air should flow freely through this when the ice block is removed.

Frozen pressure measuring tube:

Second place of freezing is the pressure measuring tube. (red tube of 3,3 mm for pumps from before 2011, or transparent tube for pumps after 2011)
At the bottom, next to the heater, there is a set of two small resistors mounted in this pressure tube. These resistors evaporate LN2 during pumping, to make sure this pressure tube is fully filled with N2 gas all the time.
If the pump is out of the LN2, condense water may occur here, which will turn into ice when the pump is replaced in the LN2 before it was dried. If done many times, some ice may appear here, and even some water can go upwards in this tube. To make really sure that all water is out, you may careful blow with dry air from above trough this tube. Here for, the silicon tube in the pumphead could be removed from the pressure sensor on the PCB. Then you can blow in the silicone tube downwards through this pressure tube. Watch if any water comes out, and blow until there is no water left.



pressure sensor

pressure tube, make loose

pressure measuring tube

. protection pipe

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17 Declaration of Conformity

EU DECLARATION OF CONFORMITY

This declaration of conformity is issued under the sole responsibility of the manufacturer

MANUFACTURER

Business name:	Norhof B.V.
Address:	Galileilaan 33U
Postal code:	6716 BP
Place:	Ede
Country:	The Netherlands

DESCRIPTION AND IDENTIFICATION OF THE ELECTRICAL EQUIPMENT

Denomination:	LN2 Microdosing Systems
Function:	Transfer of liquid nitrogen
Type:	Serie #400 Manual LN2 dosing systems Serie #600 Automatic LN2 microdosing systems Serie #800 Automatic N2 gasstream systems Serie #900 Advanced Automatic LN2 microdosing systems
Serial number:	400-XXXX-XX-XX-XX-XX 600-XXXX-XX-XX-XX-XX 800-XXXX-XX-XX-XX-XX 900-XXXX-XX-XX-XX-XX
Year in which the CE marking was affixed:	2017

COMPLIANCE

The manufacturer declares that the above mentioned electrical equipment fulfills all relevant provisions of

Low Voltage Directive (2014/35/EU)
EMC Directive (2014/30/EU)
RoHS Directive (2011/65/EU)
General Product Safety (2001/95/EC)

In conjunction with the following harmonised standards or technical specifications for the design and manufacture

EN 12300:1998; EN 61010-1:2010; EN 61000-6-1:2007; EN 61000-6-3:2007

SIGNED FOR AND ON BEHALF OF NORHOF B.V.

Place:	Ede	Identity:	Mr. Emile Bisschop
		Position:	General Manager
Date:	3 July 2017	Signature:	

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18 P.E.D. 99/36/EC compatibility

According to P.E.D. 99/36/EC (Pressure European Directive) for pressurized vessels, systems which are working with a pressure of 0.5 Bar and higher are affected by this directive, and are not allowed in a laboratory. The Norhof system can produce maximum 300 mBar, and therefor this directive does not apply for this system.

19 Country of Origin

All the Norhof LN2 dispensers and pump models #400, #600, #800 and #855 are manufactured in the Netherlands.

20 RoHS compliance

RoHS COMPLIANT

This product does not contain any of the restricted substances referred to in Article 4(1) of the RoHS Directive at concentrations in excess of those permitted under the RoHS Directive EC directive 2002/95/EC and 2002/96/EC

- Original instructions -
Norhof B.V., Ede 2025