Humidification and Adiabatic Cooling with Danfoss Nessie®

DANFOSS HIGH-PRESSURE
WATER SOLUTIONS

Design Guide

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Basics

The high-pressure atomization principle:
High-pressure humidification and adiabatic cooling is based on the principle of atomizing water into the finest droplets. With a Danfoss high-pressure pump, water is pressurized to 70-100 bar (1000-1450 psi) and atomized through special nozzles. The water droplets (aerosols) – reduced to a diameter of only 10-20 µm – evaporate within extremely short time without supplying further energy (heat). Thus the required absorption heat of 2300 kJ/kg water is drawn out of the air to be humidified, and the so called adiabatic cooling effect is generated. The change of condition of the air proceeds at constant enthalpy in Hx-diagram (adiabatic).

To control the humidification load, the Danfoss Nessie System is equipped with a multiple-stage controller switching nozzle groups on and off by solenoid valves when required. Standard systems with three valves are equipped with a 6-step controller ensuring a sufficient fine tuning of the humidification load.

Specific properties of the Nessie® high-pressure humidification system:

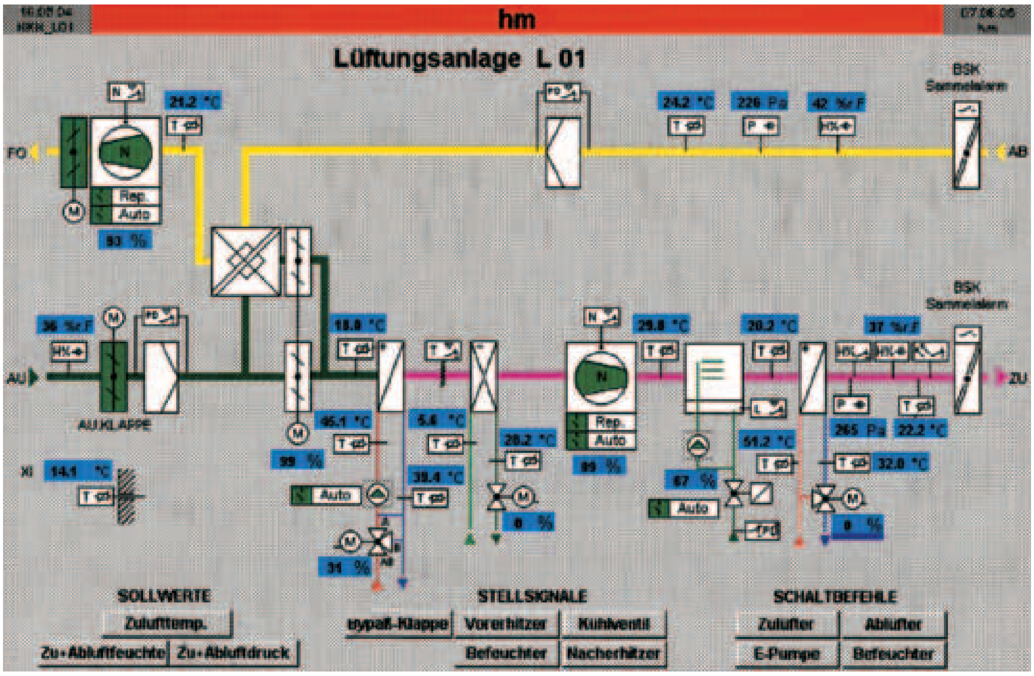
- ❑ *8000 hours* service-free operation (on reverse osmosis water, softened water or water with hardness degree <4°dH (= German Hardness)
- ❑ *Pump is oil-free* (no regularly oil change and/or change of seals or valve plates).
- ❑ VDI 6022 certified (for offices and hospitals).
- ❑ Constantly homogeneous optimal spray pattern of the nozzle and thus *the best possible evaporation (humidification capacity or adiabatic cooling)* all over the load range by a 6-step control system with constant pressure control.
- ❑ Efficiency of min. 80% all over the load range and the inlet conditions.
- ❑ The anti-drip nozzles allow for using tap water (within the tolerated limits according to VDI 6022 VDI 3803) *without calcification of nozzle orifices* and thus without involving increase in maintenance costs.
- ❑ No use of chemical additives (silver ions, biocides or hydrogen peroxide).
- ❑ All components in contact with the media are *made of non-corroding materials*, like stainless steel or plastics.
- ❑ The constant pressure control system enables a *cost-efficient* connection of several air handling units or DEC systems to a common pump unit. The control systems for the individual air handling units are connected to each other according to the Master-Slave principle.

Possibilities

Humidification:

The humidifier is normally installed after the pre-heater of a ventilation and air conditioning system to obtain optimum input conditions for a speedy evaporation of the extremely small water droplets. As a result of the adiabatic cooling effect of the high-pressure atomization, a decline in air temperature in the humidifier of 5-10°C may be observed – depending on the degree of humidification. At optimum operation of the humidity controller, the desired supply air temperature should be reached after the humidifier. If required, the temperature will be adjusted by a secondary heater. It should, however, be noticed that the relative humidity will decrease when using secondary heating.

Depending on the design of the ventilation and air conditioning system, the humidifier can be placed before or after the supply air fan. Arranged before the fan (suction side), the rise in temperature owing to the fan power loss as well as a correct design/adaptation of the drain should be considered. Arranged after the fan (overpressure), no special requests as to drain should be considered.



Adiabatic cooling:

Cooling systems exploiting the adiabatic cooling effect work analogously of humidifiers but are instead installed in the exhaust duct, as an increased relative humidity in the supply air during the summer season is undesirable. After the temperature reduction, the outlet air is sent through a cross heat exchanger or „heat"-recovery wheels and is thus transferring its "cooling effect" to the supply air.

The required humidification degree (Δx) is normally lower, as the condition of the air at the humidifier corresponds to the condition of the return air, and temperatures around 22-24°C and a humidity of 40-60% rH are to be expected.

Design of complete system

Pump units

Danfoss offers a series of different pump units covering ventilation systems in the area from 5.000-200.000 m^3/h (special sizes on request).

❏ Nessie 300 HVAC:	10-300 l/h
❏ Nessie 450 HVAC:	20-450 l/h
❏ Nessie 600 HVAC	30-600 l/h
❏ Nessie 1000 HVAC:	50-1000 l/h

The pump units are available in two versions:

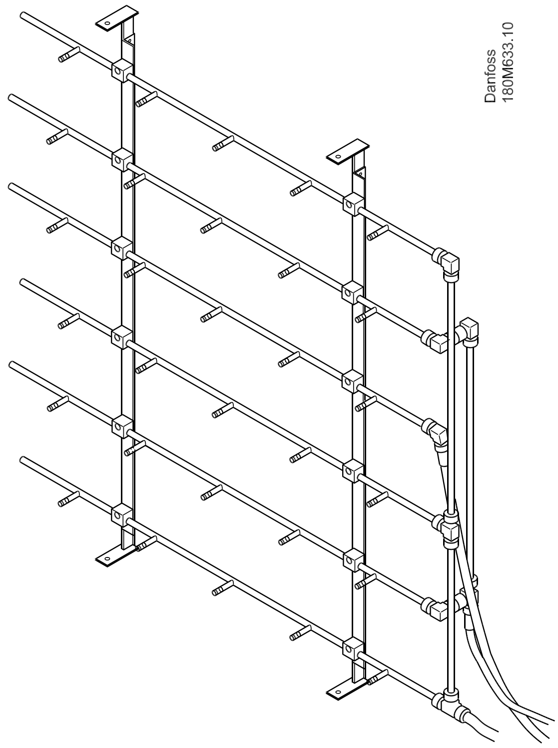
1. Basic: With connecting box (power supply and control connections).
2. Complete: With complete control system (humidity control).

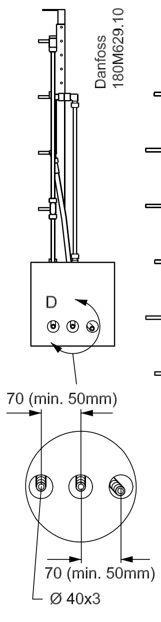
The pump units are equipped with the unique Danfoss water-lubricated high-pressure pump. The system is ready-to-connect (please also see the last pages of this Design Guide) and simple to operate.

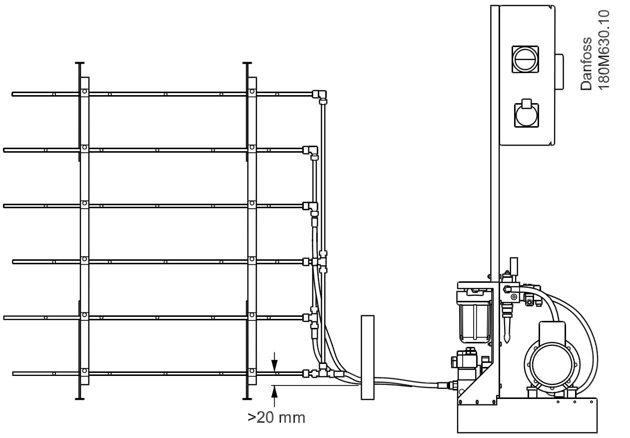
Design of complete system (continued)

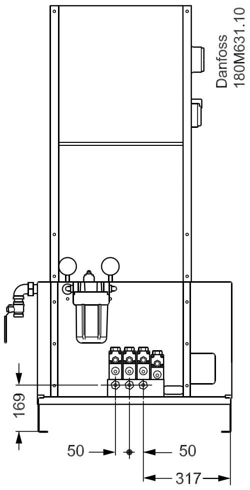
The Danfoss Nessie high-pressure humidification system consists of horizontally arranged nozzle branches placed in air ducts and equipped with high-pressure spraying nozzles at a spacing of 200 mm. The nozzle branches are vertically oriented and fixed on angle bar supports with plastic clamps. Mounting plates are fixed at either end of the supports.

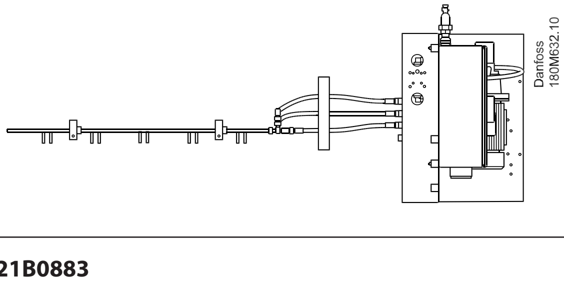
Depending on the internal cross section of the air duct, the mounting plates can be up to 230 mm lengthwise infinitely variable. In line with the step control, the nozzle branches are connected below each other by vertical pipes. The high-pressure hoses included in the consignment must be used for connecting the pump unit and the valves, respectively.











Design of complete system (continued)

Design:

Number and length of the nozzle branches are aimed at the standard dimension of the filter cartridges most frequently used in the ventilation business, 612 mm × 612 mm. At a medium air velocity of approx. 2.5 m/s, the number of nozzles required for obtaining an average humidification output of Δx 5 g/kg will appear. A fine-tuning of the required humidification output is obtainable by changing the system pressure, e.g. between 60 and 100 bar.

Basis for installing half or intermediate-sized filter cartridges will only be the number of whole filter cartridges.

Number of whole filter cartridges, height × width:
↓

2×2	6 branches of 5 nozzles (30 × 3,3 = 99 l/h)	2 supports 1100-1560 mm high
2×3	6 branches of 8 nozzles (48 × 3,3 = 158 l/h)	2 supports 1100-1560 mm high
2×4	6 branches of 10 nozzles (60 × 3,3 = 198 l/h)	3 supports 1100-1560 mm high
2×5	6 branches of 13 nozzles (78 × 3,3 = 257 l/h)	3 supports 1100-1560 mm high
2×6	6 branches of 16 nozzles (96 × 3,3 = 317 l/h)	4 supports 1100-1560 mm high
3×2	7 branches of 5 nozzles (35 × 3,3 = 116 l/h)	2 supports 1700-2160 mm high
3×3	7 branches of 8 nozzles (56 × 3,3 = 185 l/h)	2 supports 1700-2160 mm high
3×4	7 branches of 10 nozzles (70 × 3,3 = 231 l/h)	3 supports 1700-2160 mm high
3×5	7 branches of 13 nozzles (91 × 3,3 = 300 l/h)	3 supports 1700-2160 mm high
3×6	7 branches of 16 nozzles (112 × 3,3 = 370 l/h)	4 supports 1700-2160 mm high
4×2	9 branches of 5 nozzles (45 × 3,3 = 149 l/h)	2 supports 2300-2760 mm high
4×3	9 branches of 8 nozzles (72 × 3,3 = 238 l/h)	2 supports 2300-2760 mm high
4×4	9 branches of 10 nozzles (90 × 3,3 = 297 l/h)	3 supports 2300-2760 mm high
4×5	9 branches of 13 nozzles (117 × 3,3 = 386 l/h)	3 supports 2300-2760 mm high
4×6	9 branches of 16 nozzles (144 × 3,3 = 475 l/h)	4 supports 2300-2760 mm high

Special dimensions on request.

Configuration of pump unit and nozzle system:

- ❏ Nessie 300: 2×2, 2×3, 2×4, 2×5, 3×2, 3×3, 3×4, 4×2, 4×3
- ❏ Nessie 450: 3×5, 3×6, 4×4, 4×5
- ❏ Nessie 600: 4×6
- ❏ Nessie 1000: For larger systems

Design of complete system (continued)

Humidity control:

The Danfoss Nessie humidification system is based on a 6-stage control system for switching nozzle groups on and off by 3 solenoid valves.

The principle is based on a simple step control system. A humidity sensor measures the humidity after the humidifier (room humidity, respectively) (feedback). The set point humidity can be programmed on the control panel or variably set externally over a 0-10 V signal input (e.g. over the building management system).

Another duct humidity sensor installed right after the humidifier serves as an overspray protection to prevent condensation in the subsequent duct system. At more than 85% rH, a nozzle group will be switched off.

The following control signals must be preset in the system by a superior building control system:

- ❏ Humidifier start/stop, potential free switch
- ❏ Feedback-humidity, 0-10 V equal to 0-100% rH
- ❏ Set point-humidity (optional), 0-10 V equal to 0-100% rH
- ❏ Overspray protection (optional), 0-10 V equal to 0-100% rH

The control system is equipped with a fault relay.

Dimensioning guidelines

Dimensioning guidelines

For correct dimensioning of the high-pressure spray system, the following data are required from the air handling unit manufacturer:

- ❏ Nominal max. volume flow in m^3/h at full fan speed
- ❏ Worst case air condition before the humidifier (cooler), i.e. inlet temperature and relative humidity
- ❏ Required target humidification in % rH
- ❏ Dimensions of the duct (clear height, clear width, absorption distance (length) (please also see chapter on absorption distance)
- ❏ Target humidity control accuracy (e.g. +/3% rH)

Absorption distance:

Available length for the absorption distance (clear duct length) is decisive for the humidifier efficiency and thus the water consumption to be expected. Consequently the following interaction occurs:

The longer the available length, the higher the humidifier efficiency! Owing to physical limits, it is basically only possible to achieve a max. humidity of 80-85% rH. At correspondingly high saturation of the air, the natural evaporation process is decelerated.

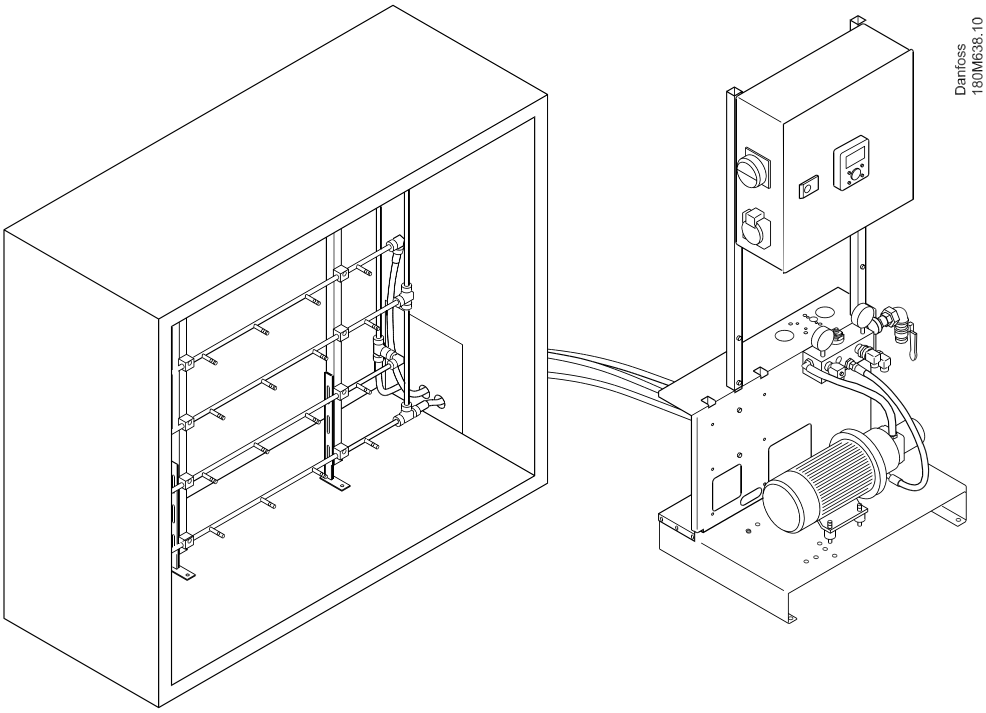
Danfoss recommends for supply air humidification a minimum distance of 2 metres between nozzle branch and droplet separator. The distance for adiabatic cooling in outlet ducts depends on design chosen and specific function of the high-pressure humidification system, but shorter distances are definitely possible due to secondary evaporation through the heat recovery system.

(Other lengths, particularly for supply air humidification, should be co-ordinated with Danfoss Nessie.)

Dimensioning guidelines (continued)

Design of humidifier and relevant components: The duct section to be provided by the air handling unit manufacturer (system builder) is to be laid out as follows:

- ❏ Duct section in corrosion proof design acc. to VDI 3803 (stainless steel, Epoxy coated or glass fibre reinforced plastic)
- ❏ Water tight on all sides
- ❏ Drain pan with drain and siphon (special design for negative pressure)
- ❏ Two-sided slope in drain pan to ensure complete discharge of excess water (acc. to VDI 6022).
- ❏ Droplet separator to be placed at the end of the absorption area. Please note! The net or fin separator to be applied must be dimensioned for aerosols up to 10 µm and comply with the VDI 6022 requirements!
- ❏ Air velocity in the humidifier should not exceed the standard speed of 2.5 m/s used in the ventilation business.



Dimensioning guidelines (continued)

Calculation example – humidification performance

System data:

- ❏ Volume flow Q = 36.000 m³/h
- ❏ Dimensions: Clear height 2000 mm, clear width 2600 mm
- ❏ Inlet air conditions 0˚C at 80% rH
- ❏ Inlet temperature after pre-heater T_1 = 32°C
- ❏ Inlet humidity after pre-heater rH_1 = 10% rH
- ❏ Required target humidity after the secondary heater min. rH_2 = 50% rH rH
- ❏ Required temperature after the secondary heater T_3 = 22°C
- ❏ Air density ρL = 1.2 kg/m³

Calculation of air mass flow:

- ❏ M = Q × ρL = 36.000 m³/h × 1.2 kg/m³ = 43.200 kg/h

Data according to Hx-diagram (or calculation program for ventilation and air conditioning systems):

- ❏ Water content (absolute humidity) at humidifier inlet ×1 = 3 g/kg
- ❏ Water content (absolute humidity) at humidifier outlet ×2 = 8,2 g/kg
- ❏ Humidification degree Δ× = ×2 - ×1 = 5,2 g/kg
- ❏ Relative humidity at humidifier outlet RH_2 = 60% rH
- ❏ Temperature after humidifier t_2 = 19°C
- ❏ Reheating $\Delta t = t_3 - t_2$ = 3°C

Calculation of humidification performance:

B = M × Δ× = 43.200 kg/h × 5,2 g/kg = 225 kg/h equal to 225 litres of water/hour.

At an assumed humidification efficiency of min. 80%, the performance will be:

B_{pump} = B/0.8 = 281 l/h

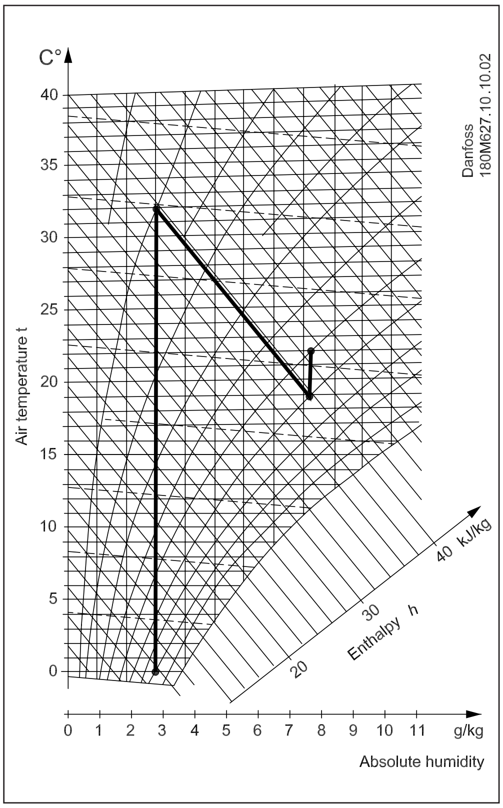
→ Pump unit and nozzle system to be dimensioned to 281 l/h.

Change of condition according to Hx-diagram:

After the humidifier, the air temperature is brought to the required room temperature by the secondary heater. Thus the relative humidity is reduced from 60% rH to 50% rH.

Selecting pump unit and nozzle system

- Nessie 300 HVAC
- Nozzle system 3×4



Dimensioning guidelines (continued)

Calculation example – adiabatic cooling:

System data:

- ❏ Volume flow Q = 36.000 m^3/h
- ❏ Dimensions: Clear height 2000 mm, clear width 2600 mm
- ❏ Inlet temperature before the humidifier T_1 = 22°C
- ❏ Inlet humidity after the pre-heaterrH_1 = 40% rH
- ❏ Max. obtainable target humidity after the humidifier rH_2 = 85% rH
- ❏ Air density ρL = 1.2 kg/m^3

Calculation of air mass flow:

- ❏ M = Q × ρL = 36.000 m^3/h × 1,2 kg/m^3 = 43.200 kg/h

Data according to Hx-diagram (or calculation program for ventilation and air conditioning systems):

- ❏ Water content (absolute humidity) at humidifier inlet x_1 = 6.5 g/kg
- ❏ Water content (absolute humidity) at humidifier outlet x_2 = 9,2 g/kg
- ❏ Humidification degree $\Delta x = x_2 - x_1$ = 2.7 g/kg
- ❏ Relative humidity at humidifier outlet rH_2 = 85% rH
- ❏ Temperature after humidifier t_2 = 15,3°C

Calculation of humidification performance:

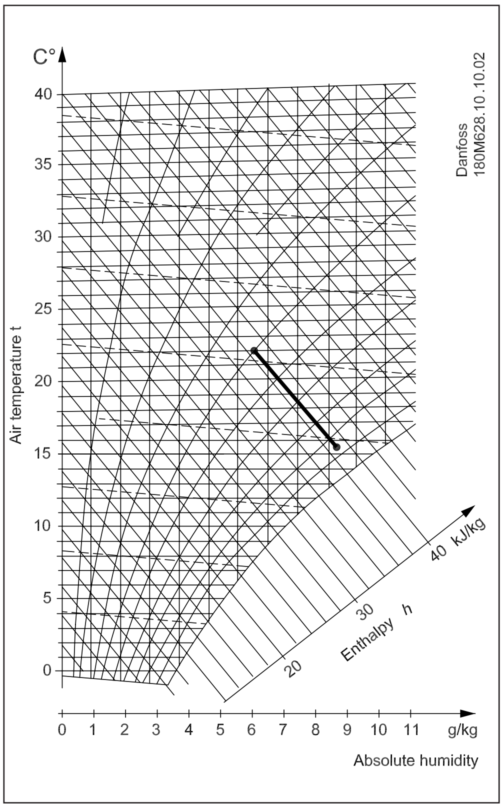
B = M × Δx = 43.200 kg/h × 2.7 g/kg = 117 kg/h equal to 117 litres of water/h.

At an assumed humidification efficiency of min. 80%, the performance will be:

B_{pump} = B/0.8 = 146 l/h

→ Supply from pump unit should be 146 l/h.

Change of condition according to Hx-diagram:



Selecting pump unit and nozzle system

- ❏ Nessie 300 HVAC
- ❏ Nozzle system 3x4

Hygiene requirements and water quality

The hygiene issue in humidification systems is subject to lively discussion in the ventilation business, and the so called Legionnaires' disease is given special attention.

At this stage, the following facts can be stated:

Bacteria of the type Legionella Pneumophilia require the following environment for propagation:

- ❑ A water temperature in the area between 25 and 55˚C
- ❑ Stagnant water for 72 hours

Bacteria propagation in a humidification system is very unlikely, since a combination of these conditions can not occur in a system in running operation. When operating at a high recirculation rate (bypass) it is, however, possible to heat the water in the pump unit up to 40°C while keeping the water in constant circulation. A freshwater temperature of more than 25°C is also very unlikely, as the water is supplied directly from the public water supply.

When supplied from an intermediate tank, e.g. in connection with a reverse osmosis system it must, however, be ensured that a heating of more than 25°C along with a 72-hour standstill of the system is not possible.

The Nessie HVAC control unit is equipped with a flushing function. If the system has been out of operation for more than 24 hours (or the power supply has been disconnected), a flushing sequence is automatically activated in order to replace the water in the pump unit with freshwater for restarting the unit. The replaced water is discharged through a special flush valve into the drain.

For standstill of the system, the pipes are drained through the 3/2-way valves of the step control to drain. When, after some time, the nozzle system has been drained of water, basis for bacteria propagation has been eliminated. Please note: The draining may take several hours and is also only required for longer standstills.

The Danfoss Nessie High-Pressure humidification system is certified according to the Hygiene Directive of the HVAC business and fulfils the German Guidelines VDI 6022 and 3803.

Responsibility of the operator

When developing the system, Danfoss paid special attention to making the system hygienically safe and took many crucial details into consideration to ensure unproblematic operation.

In this connection it is once again pointed out that the responsibility for a hygienically unproblematic operation of the system exclusively rests with the system operator!

Danfoss accepts no responsibility whatsoever if these instructions are neglected.

Water supply, power supply and I / O's

The following connections are required for operating the Danfoss Nessie system:

Water supply:

- ❏ Water supply – optional:
  - Tap water according to the EU-Drinking water Directive, if used, pre-filtered.
  - Demineralized water (reverse osmosis)
  - Softened water (softener)

- ❏ Min. inlet pressure 2 bar (29 psi)
- ❏ Max. inlet pressure 4 bar (58 psi), if so, pressure reduction valve must be used
- ❏ Max. inlet temperature – water 20°C (68°F)
- ❏ G ¾" female thread or ∅19mm hose connection
- ❏ Water outlet for flushing and draining the system G ½" female thread or ∅19mm hose connection (the outlet may preferably be combined with the duct drain tub discharge).

Power supply:

- ❏ Three-phase supply 3×400 V 16A with ground conductor
- ❏ Control signals – incoming:
  - Potential free switch for system start/stop
  - 0-10 V (0-100% rH) for measured humidity value (feedback)
  - 0-10 V (0-100% rH) for overspray protection; optional: hygrostat.
- ❏ Control signals – outgoing:
  - Potential free fault relay contact

Nessie® high-pressure humidification system

Short description:

- ❏ *8000 hours* service-free operation (on reverse osmosis water, softened water or water with hardness degree <4° dH (= German Hardness)
- ❏ *Pump is oil-free* (no regularly oil change and/or change of seals or valve plates).
- ❏ VDI 6022 certified (for offices and hospitals).
- ❏ Constantly homogeneous optimal spray pattern of the nozzle and thus the *best possible evaporation (humidification capacity or adiabatic cooling)* all over the load range by a 6-step control system with constant pressure control.
- ❏ Efficiency of min. 80% all over the load range and the inlet conditions.
- ❏ The antidrip nozzles allow for using tap water (within the tolerated limits according to VDI 6022 VDI 3803) *without calcification of nozzle orifices* and thus without involving increase in maintenance costs.
- ❏ No use of chemical additives (silver ions, biocides or hydrogen peroxide).
- ❏ All components in contact with the media are *made of non-corroding materials*, like stainless steel or plastics.
- ❏ The constant pressure control system enables a *low-cost connection* of several air handling units or DEC systems to a common pump unit. The control systems for the individual air handling units are connected to each other according to the Master-Slave principle.

Pump unit:

- ❏ *Hydrostatic lubrication (oil free)*
- ❏ *Min. 8000 hours maintenance free operation*
- ❏ Power consumption below 4 W at 70 bar per litre water.
- ❏ Water quality:
  - *tap water of drinking water quality*
  - *reverse osmosis water*
  - *de-ionized or de-mineralized water (Conductivity of <1µS possible)*
- ❏ Noise level between 73-80 dB(A).
- ❏ Nominal system pressure of 70 bar, (max. 100 bar)
- ❏ Speed range between 1000-3000 rpm
- ❏ Constant pressure control by
  - frequency converter motor, VLT®-FCM 300
  - pressure transducer, MBS 3050.
- ❏ Up to 90% re-circulation at supply water and ambient temperature of max. 20°C.
- ❏ Low pressure side/connecting water supply: Supply pressure:
  - Min. 2 bar absolute
  - Max. 4 bar absolute
- ❏ Filter: 10 µm absolute with a ß value >5000.
- ❏ Temperatures:
  - ambient temperature: 0 - +40°C
  - storage temperature (with frost protection): -25 - +6°C
  - humidity, storage and operation: 5-95% rH non-condensing.

Nozzle system:

- ❏ Nessie *anti-drip nozzles* (2.5 l/h, 3.3 l/h, 4.9 l/h, 8.5 l/h or 11 l/h)
- ❏ Humidity control by switching nozzle groups on and off by means of a 6-step control system.
- ❏ Size and number of nozzles depend on the humidity performance of the ventilation and air conditioning system; dimensioning by factory or factory authorized distributor / partner.
- ❏ Nessie *stainless steel high-pressure valves with 3/2-way principle in easy-to-maintain Cetop version.* In order to prevent dripping, pressure on the nozzle groups is reduced when switched off (calcification of nozzles when using tap water is clearly reduced).
- ❏ Absorption distance: min. *1.5 m* (other distances to be agreed with Danfoss Nessie or cooperation partners).
- ❏ No so called turbolators installed, and thus *no additional pressure loss*. The total cross section is used for placing the nozzles in the humidification unit. The nozzles can also be placed facing the upstream airflow without considerable expense on site.

Control:

- ❏ Consists essentially of a Möller EASY 819 PLC with display. Possible to choose German, English or French display texts.
- ❏ The humidity is controlled by means of a *6-stage control system and 3 high-pressure valves* at an interval of ±3%.
- ❏ At a standstill of the system an automatic flushing sequence will be activated every 24 hours in order to replace the water in the system.
- ❏ The system operates at an externally set point (0-10 V) and also – as a decentralized solution – at an internally set point. Humidity feedback and overspray protection sensor (0-10 V) can be connected directly.

Appendix
Specification texts
Humidification system –
Nessie®
(continued)

❏ Monitoring:
- Dry-running safety switch (opening switch at 1.6 bar: 250 V a.c./24 V d.c., max. 0,5 A)
- Excess temperature safety switch (opening switch at 50°C: 250 V a.c./ 24 V d.c., max. 0,5 A)
- Monitoring of system pressure by means of an electronic pressure transducer
- Automatic disconnection at system pressure below 50 bar (pipe break protection).

❏ MASTER/SLAVE systems / DEC systems
- MASTER control (integrated monitoring and control of pump unit)
- SLAVE control(s) (only controlling the nozzle systems).

❏ Installed in IP 54 control box.

Installation:

❏ Individual systems/DEC systems
- The pump unit is connected to the nozzle system with the high-pressure hoses included in the supply (including leading-in protection for the hoses).
- No authorized factory contracting partner required, trained staff is sufficient.

❏ MASTER/SLAVE systems
- Materials for connecting pump unit to the nozzle system are not included in the supply.
- Connection of nozzle system to pump unit to be made by trained staff.
- Installation of high-pressure pipe to be made with 12 mm stainless steel pipes and stainless steel compression ring fittings.

Air handling unit/aerosol separator (mist eliminator)

❏ New installations
- Air handling unit including aerosol separator (mist eliminator) according to VDI 6022 must be available. Installation of nozzle system can be made on site or in factory.

❏ Retrofit
- Air handling unit including aerosol separator (mist eliminator) according to VDI 6022 must be available. Installation of nozzle system can be made on site or in factory.

Humidification performance:
(to be made for every HVAC system)

❏ Volume flow:
❏ Inlet condition;
❏ Outlet condition:
❏ Humidification degree Δx:
❏ Humidification performance (litres/hour):
❏ Utilization degree of water (min. 80%):
❏ Amount of water for dimensioning of pump:

Appendix
Specification texts
Humidification system – Nessie®
(continued)

Technical data
for the individual pump units:

10-300 l/h

Min. pump capacity (at 70 bar):	10 l/h
Max. pump capacity (at 70 bar):	300 l/h
Pump size:	**PAH 2 Tech**
Motor:	1.5 kW/FCM 315
RPM:	max. 3000 rpm
Supply:	3×400 V, 50 Hz, 16 A
Power (incl. of coils/PLC):	approx. 2500 W
Dimensions (HxWxD):	approx. 75×70×60 cm
Weight:	100 kg
Design/type:	Mounting frame to be placed on floor
Type:	**Nessie 300 HVAC Complete**

30-600 l/h

Min. pump capacity (at 70 bar):	30 l/h
Max. pump capacity (at 70 bar):	600 l/h
Pump size:	**PAH 4 Tech**
Motor:	2.2 kW/VLT - FCM 322
RPM:	max. 3300 rpm
Supply:	3×400 V, 50 Hz, 16 A
Power (incl. of coils/PLC):	approx. 2500 W
Dimensions (HxWxD):	approx. 75×70×60 cm
Weight:	110 kg
Design/type:	Mounting frame to be placed on floor
Type:	**Nessie 600 HVAC Complete**

20-450 l/h

Min. pump capacity (at 70 bar):	30 l/h
Max. pump capacity (at 70 bar):	600 l/h
Pump size:	**PAH 3.2 Tech**
Motor:	2.2 kW/FCM 322
RPM:	max. 3000 rpm
Supply:	3×400 V, 50 Hz, 16 A
Power (incl. of coils/PLC):	approx. 2500 W
Dimensions (HxWxD):	approx. 75×70×60 cm
Weight:	110 kg
Design/type:	Mounting frame to be placed on floor
Type:	**Nessie 450 HVAC Complete**

50-1000 l/h

Min. pump capacity (at 70 bar):	50 l/h
Max. pump capacity (at 70 bar):	1000 l/h
Pump size:	**PAH 6.3 Tech**
Motor:	4 kW/FCM 340
RPM:	max. 3000 rpm
Supply:	3×400 V, 50 Hz, 16 A
Power (incl. of coils/PLC):	approx. 5700 W
Dimensions (HxWxD):	approx. 75×70×60 cm
Weight:	120 kg
Design/type:	Mounting frame to be placed on floor
Type:	**Nessie 1000 HVAC Complete**

Danfoss Nessie®
Your Source to Knowledge and New Solutions

Danfoss A/S is one of the largest industrial companies in Denmark, with net sales of around EURO 2 billion.
We employ more than 18,000 people, and 6,000 of them work in Denmark in 12 different locations.

www.nessie.danfoss.com

Danfoss is an international group and a leader in research, development and production for a wide spectrum of different industries. We produce about 250,000 components each day at our 53 factories in 21 countries. The Group's primary aim is to create quality of life for our stakeholders and to be a leader in refrigeration, heating and motion controls.

Our work is based on our Core Values: Trust, Passion for Technology, Reliability, Global Perspective with Local Commitment and Environmental and Social Responsibility.

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