[Immersed heater isothermal humidifier: heaterSteam titanium]

1. **GENERAL**
    a. **DESCRIPTION**
        i. Air humidification apparatus for the production of aseptic steam, with immersed heater technology, supplied with mains drinking water, demineralised or softened water.
    b. **WORK REQUIRED**
        i. Installation according to the manufacturer's specifications, performed by technical personnel validated by the manufacturer [selected by the customer]
        ii. System commissioning performed by [manufacturer's technical personnel, or technical personnel authorised by the manufacturer, chosen by the customer]
    c. **DOCUMENTATION**
        i. Technical manual for installation, configuration and use, complete with dimensions, technical specifications, operating principles and performance, water circuit and wiring diagrams, standards and specifications for safe installation, guide for commissioning and operation, diagnostics, list and identification of spare parts.
        ii. User manual with safety and operating instructions.
    d. **QUALITY:**
        i. CE
        ii. $_{C}ETL_{US}$ (UL standards)
        iii. TÜV PRODUCT SERVICE
        iv. EAC
        v. WaterMark
        vi. ISO 9001:2015 - ISO 14001:2015 - ISO 45001:2018 (manufacturer)

2. **PRODUCT**
    a. **[definition of the apparatus, technology]**
        i. Stand-alone isothermal humidifier with immersed heaters for the production of steam using mains drinking water, demineralised or softened water.
        ii. The water is heated by immersed heaters, producing sterile steam at atmospheric pressure
        iii. steam production, water drain and refill must be managed by the control program completely automatically according to actual feedwater conductivity, without the need for prior analysis or settings.
    b. **[general features and construction]**
        i. Painted steel supporting structure with separate sections for the water circuit and the electrical parts, front panel that can be removed for maintenance
        ii. electrical section separated by a metal partition, with electrical panel including electrical components and electronic control
        iii. steam production cylinder must be built using AISI 304 stainless steel.
        iv. The heaters must be made from titanium for better resistance to corrosion and longer working life.
        v. The quantity of steam produced must be modulated by applying power over variable intervals (duty cycle) via solid state relays without mechanical contacts
        vi. The water level must be controlled by a three-level sensor
        vii. any excess foam on the surface of the water must be detected and managed by a suitable device inside the cylinder. SOLUTIONS WITHOUT PROTECTION AGAINST EMISSION OF

BOILING WATER ARE NOT PERMITTED. The same device must also act as an additional safety level sensor

viii. for models from 2 to 13 kg/h: Kevlar sack (reusable) inside the cylinder for quick and easy cleaning; no additional gaskets required;

c. [model capacities and variants]

i. minimum model capacities:
   - 2, 4, 6 kg/h (single-phase power supply); THE MINIMUM CAPACITY OF 2 kg/h or 4 kg/h MUST BE AVAILABLE AS A SPECIFIC MODEL AND NOT BY REDUCING THE CAPACITY OF LARGER MODELS, so as to minimise peak power consumption and not need to oversize the power supply system
   - 6, 10, 13, 20, 27, 40, 53, 60, 80 kg/h (three-phase power supply)

ii. Higher capacities must be achievable by connecting several units in an intelligent arrangement, with automatic backup function in the event of shutdown due to maintenance or an alarm. Rotation must be available to balance wear across multiple apparatuses.

iii. the steam cylinder must be
   - removable, with the head that can be opened for cleaning, for models up to 13 kg/h
   - parallelepiped-shaped with a front cover that can be opened for removing scale
   - the cylinder must be thermally insulated

d. [feedwater and drain water]

i. The apparatus must be able to use the following types of feedwater:
   - mains drinking water with a conductivity up to 1500 µS/cm
   - demineralised water (reverse osmosis)
   - softened water

ii. the water inlet must be via solenoid valve with air gap greater than 25 mm (1”) or via double-check valve to prevent backward contamination

iii. water must be drained by means of a pump; on request, a drain tempering device must be available to limit the drain water temperature to 60°C

e. [power supply specifications]

i. The following voltages shall be available:
   - (single phase): 208 V, 230 V
   - (three-phase): 230 V, 380-400 V, 460 V, 575 V

ii. The power supply for the electronic controller must be taken internally from the main power supply: SOLUTIONS THAT REQUIRE A POWER SUPPLY IN ADDITION TO THE MAIN POWER SUPPLY ARE NOT PERMITTED.

iii. for three-phase power supplies NEUTRAL MUST NOT BE REQUIRED IN ADDITION TO THE PHASES

iv. the power consumption is specified according to the model in the instruction manual

f. [control, characteristics]

i. The apparatus must be managed completely automatically by an electronic microprocessor controller. Steam production must be modulated continuously according to the input signal.

ii. input signal from probe or external controller: 0-1 V, 0-10 V, 0-20 mA, 4-20 mA, ON/OFF contact, 0-135 Ohms, 135-10,000 Ohms, NTC.

iii. An external enabling input and at least 4 programmable relays are required for remote signalling of alarm status, production status, activation of the steam blower

iv. An input for a second “limit” humidity probe is required to CONTINUOUSLY MODULATE PRODUCTION based on the humidity downstream in the duct, in order to prevent

condensation during temperature transients. A SIMPLE ON/OFF ENABLING INPUT IS NOT ACCEPTABLE FOR THIS PURPOSE.

v. The minimum required control algorithms, which can be selected during installation, must be: stand-alone with room probe, stand-alone with main probe + modulating limit probe, stand-alone with two probes (average); secondary with external proportional signal, with external signal + local limit probe, ON/OFF, with NTC temperature probe for steam baths.
vi. It must feature a colour graphic display with buttons for programming and monitoring unit status, the set and measured humidity level, steam production, current draw, water conductivity, parameters and alarms using text and icons;
vii. The web server function must be available for connectivity to the local Ethernet network
viii. It must be connectable to other similar units in *main-secondary* i.e. “mirror” mode so as to extend capacity, including the “automatic backup” and “rotation” functions to distribute wear equally across several humidifiers operating in the system
ix. It must be connectable to multiple wireless probes to avoid wiring in critical installations; the probes can be assigned a weight for average measurements.
x. Initial configuration must be guided via wizard
xi. The following must be included: complete diagnostics, alarm log downloadable via USB port for diagnosis; messages for preventive maintenance
xii. It must include daily and weekly programming of operation with differentiated set points.
xiii. Water pre-heating function to reduce time to reach production (programmable pre-heating set point);
xiv. Thermal shock function to remove scale from the heaters, so as to reduce cleaning and simplify maintenance;

g. [performance data]

i. relative humidity control accuracy must be up to +/- 1%.
ii. the maximum flow-rate must be settable by parameter, with continuous production control between 0% and 100% of the maximum set capacity

h. [safety, savings and hygiene]

i. The heaters must be individually protected against overheating by embedded temperature sensors, so as to avoid damage due to overheating as a result of insufficient maintenance (scale removal) or other faults. SOLUTIONS WITHOUT PROTECTION OF THE HEATERS AGAINST OVERHEATING ARE NOT PERMITTED.
ii. Additional protection against overheating by thermal circuit breaker fitted on the cylinder head (20 kg/h and larger models)
iii. The formation of foam in the cylinder must be detected by a suitable sensor and automatically managed to prevent the emission of boiling water together with the steam. SOLUTIONS WITHOUT PROTECTION AGAINST EMISSION OF BOILING WATER ARE NOT PERMITTED.
iv. the apparatus must be equipped with a conductivity meter in the feedwater supply circuit and a suitable software algorithm to optimise water change and prevent corrosion based on actual water quality, allowing significant savings in water consumption. SOLUTIONS THAT ONLY ALLOW MANUAL SETTING OF WATER HARDNESS DURING INSTALLATION ARE NOT ACCEPTABLE, THE SYSTEM MUST BE SELF-ADAPTIVE.
v. automatic water draining due to inactivity must be factory-set every 3 days by parameter, however can be modified in the field to comply with any local regulations, so as to avoid hygiene problems due to stagnant water.

i. [interfaces]

i. BACnet, Modbus, CAREL protocols for BMS and remote control via RS485 serial; BACnet and Modbus protocols over Ethernet. Without requiring external devices.
ii. USB for programming, updating, parameter duplication, diagnostic logs
iii. Ethernet port

iv. RS485 serial port

j. [accessories]: the following must be available:

i. steam delivery hoses, food safety certified quality, with embedded steel spiral to prevent choking, diameters 22, 30 and 40 mm
ii. stainless steel duct steam distributors with diameters 22, 30 and 40 mm, lengths between 35 and 205 cm, flow-rates from 1 to 40 kg/h, with separate condensate drain
iii. in-room steam blowers
iv. 10 mm drain pipes for condensate and 40 mm for humidifier water
v. wide range of relative humidity and temperature sensors, duct and room models, ranges 10-90% rH or 0-100% rH, with current or voltage signal
vi. range of wireless sensors for installation in critical locations

k. The type of apparatus shall be the CAREL heaterSteam

l. Approved manufacturers: Carel Industries SpA

3. EXECUTION

a. Installation in compliance with the manufacturer's specifications

b. Installation in compliance with applicable local laws and regulations

c. Water quality as per manufacturer's specifications, under the responsibility of the user