
Medclair

# DU2000

# Technical brief

## Revision: A2

2023-02-15

# Content

# 1. General

During nitrous treatment, the exhaled air will contain high levels of nitrous which leads to a bad working environment and possible harms for the personnel.

Our Central Destruction unit (CDU) purifies a degree of minimum 96 % of the collected nitrous from the exhaled air. The elimination is performed using a catalytic process where the collected nitrous is decomposed into nitrogen and oxygen, the most common components in the surrounding air.

## 1.1. Energy saving gas purification with unique technology

Medclair has designed its own unique technology for heat exchange and isolation of the CDU. The implemented technique enables reuse of the energy fed to the unit which minimises the energy consumption.

Our technique is based upon a high degree of energy recycling, few moving parts and a stable catalytic process. Altogether this gives an effective purification process and stable operation at a low operating cost.

## 1.2. Process Supervision

The process in the CDU may be supervised using a standardised web based interface. Continuous measurement is performed of the nitrous concentration, gas flow, energy consumption and the measurement data is presented as average values per hour, day and month.

## 1.3. Easy installation

Medclair delivers a turnkey product which facilitates an easy and quick installation.

The unit only needs to be connected to the extraction system (from the wards), ventilation (for the processed gas), power and the operations centre.

## 1.4. No daily attention

The CDU does not need any daily attention, the destruction unit can be compared with a normal ventilation unit.

## 1.5. Long lifetime

All components used are carefully selected to deliver a unit that can be operated continuously for several years without the need for repair.

# 2. Destruction unit DU2000

## 2.1. Overview

Medclair have continuously refined the design of the destruction unit and can today demonstrate a climate smart product that to a very high degree recycles the energy fed to the process which results in a significantly reduced energy consumption.

Our design is based upon few moving parts and a reliable catalytic process. The result is a product that exhibits an effective purification of nitrous combined with a safe operation to a low operational cost.

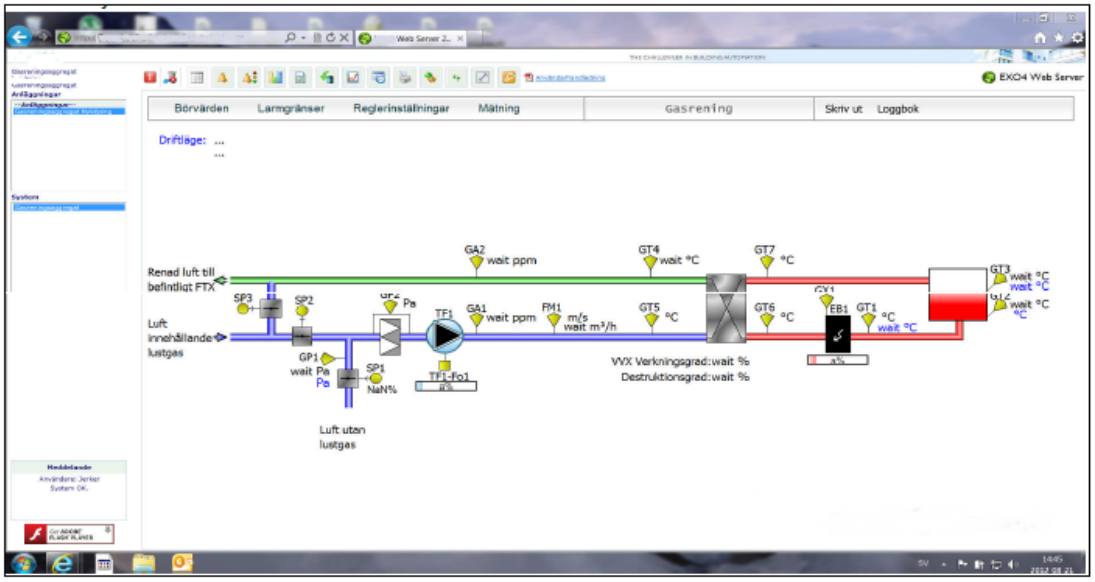
Since the unit is operating at a “low flow” the piping installation can be realised with pipes having small diameters and therefore being less costly, this when there is no existing piping.
The outlet from the unit is normally connected to the installed ventilation pipes leading out from the site.

In terms of size the unit can be compared to a normal fridge (80x90x190).

## 2.2. Supervision

The process in DU2000-M1 is continuously supervised by the control unit and data can be read from the built in Led screen, through the internet from an operations centre connected via the Modbus interface.

Measurement data is gathered continuously and can be read as average values per hour, day or month. Specific data that can be read directly from the Led screen or via the web is gas in/out and energy consumption.
All information concerning the process can be read in real time from the built in Led screen or remotely via the web interface which is shown in the picture below.




In addition to this, statistics can be extracted from all measured parameters (from the start) which then can be presented in diagrams or exported Excel.

## 2.3. Reactor/Disintegration

Within the reactor a catalytic process is active for destruction of the nitrous. Incoming gas flow is passing a preheated catalytic bed where $N_2O$ is disintegrated into $O_2$ (oxygen) and $N_2$ (nitrogen).

The purification rate of incoming nitrous in the destructor is a degree of minimum 96 %.

Disintegration of the incoming nitrous is ongoing as long as the destructor holds the correct reactor temperature in the reactor, which is controlled by the built-in supervision of its temperature and heat exchanger.

The catalyst bed is made by an inert material that is not consumed during the process which enables a long durability.

## 2.4. Control system

The process is controlled and supervised by a built-in control system. Informationen is gathered from a number of measuring sensors (temperature, gas flow, pressure and gas concentration).
Analysis of gathered information is used for control of valves and heaters.

The system controls the process, saves measurement values and calculates average values e.g. nitrous purification, nitrous in and out and energy consumption.

Measurement values for nitrous in/out and energy consumption is presented by hour, day and month via the interface shown on the web page and Led screen.

Statistics can be accessed for all measured parameters and be presented in diagram or exported in Excel format.

## 2.5. Alarm handling

Several parameters are supervised during operation and when their value isn't within specified intervals an alarm is generated.

All generated alarms are logged to facilitate backtracking of the processing history.

Generated alarms are divided into three groups: A-alarm, B-alarm and C-alarm.

| | |
|---|---|
| A-alarm | A serious problem has occurred, the destruction unit will be halted and the by- pass valve will be opened.<br>Inform Medclair as soon as possible for initial troubleshooting. The problem will either be corrected remotely or by a visit at the site and the problem has to be acknowledged in order to cancel the alarm and enable the unit to start up again. |
| B-alarm | Less serious problem that doesn't affect the operation and its safety i.e. communication error. This is not an acute problem but Medclair must be informed to monitor the unit.<br>The alarm doesn't need any intervention and will be cancelled automatically when restored to normal operation. |
| C-alarm | Alarms in this group do not affect the unit operation or its safety and may be considered as user information. These alarms do not need to be acknowledged. |

## 2.6. Installation and operation

Medclair delivers a turnkey product with all functionality in one single unit that only needs to be connected to power (circuit breakers) and pipes for gas in and out.
After connection to power and piping the unit is ready for operation in a matter of hours, the start up time depends on the time it takes to reach correct processing temperature for normal operation.

Medclair takes responsibility for installation and commissioning of the unit. The customer is responsible for necessary piping between wards and exhaust system, circuit breaker and ventilation for connection to the destructor.
The CDU must be located in a space that is designed with ventilation so that the temperature in the room never exceeds +35°C.

After installation, the unit does not need daily supervision and can be compared to a normal ventilation unit.

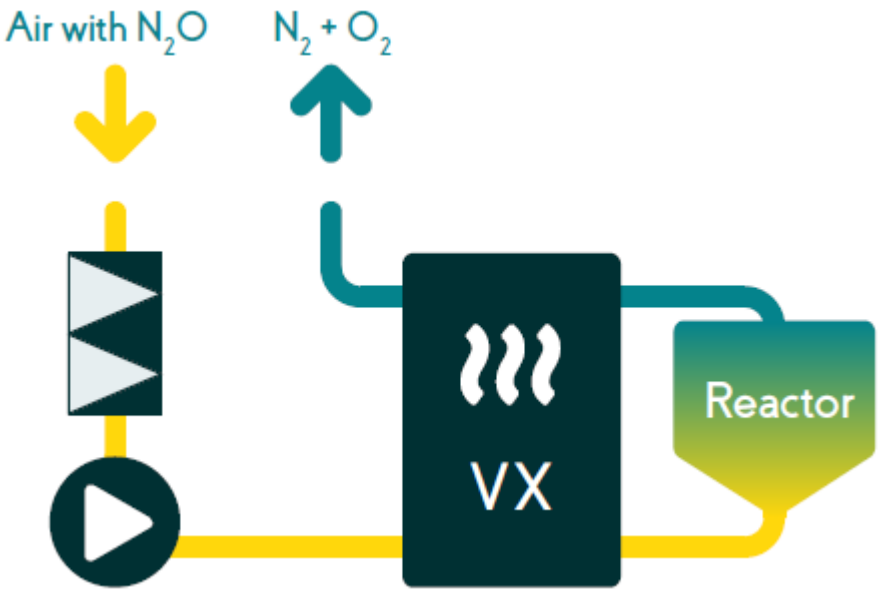
All components used have been carefully selected in order to keep the unit running in continuous operation over several years.

# 3. Process description

The nitrous input to the system is via a particle filter. The air is then pushed through the system by means of a fan to a heat exchanger (pre heated) where it is heated to the operational temperature by a radiator.

The purified air is then passed through the heat exchanger where it is cooled down before it is let out to the atmosphere.

The catalytic process decomposes the nitrous ($N_2O$) into oxygen ($O_2$) and nitrogen ($N_2$). Normal air contains more than 99% of these gases.



# 4. Daily use

## 4.1. Operation

Medclair AB will train the customer staff in operating the CDU and take care of its daily use and alarm handling.

All setpoints such as temperature, flow and pressure as well as alarm handling (acknowledgement, levels, priorities) can be performed from the Medclair service centre.

Operation information can be read by the customer via the built-in LED screen or via a modbus connection to an operation centre.
Questions and error reporting is done to the Medclair technical support: support@medclair.com .

No special tools, test equipment or simulators are needed for daily operation and are therefore not included in the delivery.

## 4.2. User interface

The internal process of the CDU can be supervised via the built-in LED screen where the process data is displayed in real time. The data is also distributed to an external server where both the customer and Medclair can log in via the internet to read data. Medclair support can also adjust parameters and handle alarms via the internet connection.

The same data that can be obtained from the server can also be made available to an operation centre via the modbus interface.

# 5. Delivery, installation, and commissioning

DU2000-M1 is delivered to site as one pretested module. At site, the unit is put in place and connected to power, extraction system, alarm or operation centre and internet. After this a functionality check is performed before the unit is ready for final inspection and operation.

Below is the required action and responsible party (Medclair/customer) listed:

## 5.1. Preparations

Before delivery to the installation site, the following must be performed:

| Step/Activity | Medclair | Customer |
|---|---|---|
| Function and performance testing before delivery | X | |
| Delivery to installation site | X | |
| Installation of safety switch with the specified rated power is installed close to the installation place (max 5m away). | | X |
| Inform Medclair if there are specific requirements regarding the connection of gas in/out | | X |
| Inform Medclair about the placement of the destructor | | X |
| If connection to the operation or alarm centre is required, make sure that cables are available at the destructor.<br>Possible connections to the destructor is a discrete alarm connection and modbus. As an option the modbus connection via TCP/IP can be provided (if TCP/IP interface is desired, contact Medclair prior to installation). | | X |
| Enable mobile connection (3G/4G) at the site for connection to external server | | X |

## 5.2. Installation

| Step/Activity | Medclair | Customer |
|---|---|---|
| Placement of destruction unit as instructed | X | |
| Make sure that there is an electrician available for connection between the destructor and the security switch. | | X |
| Connection to operation or alarm centre | | X |
| Connection of destruction unit to extraction system and ventilation according to customer instructions | X | |

Following is to be performed during installation:

## 5.3. Commissioning

| Step/Activity | Medclair | Customer |
|---|---|---|
| Verify that all connections are made correctly | X | |

| | | |
|---|---|---|
| Perform functional check. | X | |
| Verify that connection to external server works as expected | X | |
| Verify that the unit heats up and operating temperatures is reached within intended time frame | X | |
| Perform a final check of the destructor including:<br>▪ Performance control using calibrated $N_2O$<br>▪ Verification of by-pass function<br>▪ Verification of UPS function by simulating a short power failure<br>▪ Verification of the alarm function by simulation of fault situations (if connected to an alarm centre verify that correct information is transferred) | X | |

# 6. Maintenance (service & repair)

Service and support is only to be performed by Medclair AB:s personnel, or by personnel educated by Medclair AB.

## 6.1. Preventive maintenance (service)

The preventive maintenance consists of regular check of operation parameters, calibration and change of filter when needed. All to ensure a stable operation over time.

Service is normally performed once a year at site and time for service is planned together with the customer.

The service is performed without disturbing daily activities at the customer since the destructor does not need to be shut down during the visit.

The service will be performed according to actual checklist containing the main action points listed below:

- Print out of operational data from last service
- Visual inspection of the equipment
- If needed upgrade of the software
- Control of particle filter (change of filter if needed)
- Control of zero-point calibration
- Control of damper/valves
- Calibration of $N_2O$ measurement sensors using calibrated gas
- Performance measurement using calibrated gas
- Control of efficiency
- Solve customer reported problems
- Writing of service report with measurement data and delivering it to customer

## 6.2. Remedial maintenance (repair)

If the destruction unit for whatever reason stops functioning, contact Medclair as soon as possible. Medclair will then check the unit to see if the problem can be sorted out remotely or if a repair is needed.

If, at a preventive service, a potential problem is discovered which most likely will need a repair this will be forwarded to the customer for discussion/decision.

## 6.3. Software update

Software update is performed by Medclair or appointed partner and is normally made remotely via the internet connection.

After a software upgrade following shall be checked.

- No changes of the unit configuration have been made
- All measurement equipment operates correct and shows values as expected
- Transfer of data to external server can be carried out
- Alarm function has not been affected (performed by simulations)
- Inform operating staff about the software upgrade

## 6.4. Commissioning

If the unit has been shut down after a repair situation, the following shall be checked before the unit is put back into operation:

- Repaired or changed module/part is functioning correctly
- The unit starts up and reaches the processing temperature correctly.
- Operation information displayed by the unit is correct

Note: Time for start-up and reaching the correct processing temperature depends on the initial temperature (i.e. how much it has cooled down since last shutdown)

# 7. Technical data & Certification

## 7.1. Technical data

| | |
|---|---|
| Power supply: | 400 VAC, 50Hz |
| Power consumption: | 10 A max |
| Rated power: | 3 kW |
| Energy consumption, warming up: | 2,4 kW |
| Energy consumption, operation: | Ca: 800 – 1 100 W (depending of load) |
| Normal system pressure: | Ca: 2500 Pa |

**Operational conditions:**

| | |
|---|---|
| Temperature: | Max 35°C |
| Relative humidity: | 10 - 80 % |
| Above sea level: | < 2000 metre |
| Surrounding environment: | No flammable environment, no combustion gases or presence of halogenated anaesthetic gases |
| Purification degree (nitrous): | > 96 % |
| Normal outlet temperature: | Ca: 80 - 120°C |

| | |
|---|---|
| Weight: | Ca: 300 kg |
| Size (WxDxH): | 900 x 800 x 1900 mm |
| Pipe connection gas in/out: | Ø35 mm |

## 7.2. Certification

DU2000-M1 is CE certified according to the following:

**EU directive:**

2006/42/EG Machinery Directive
2014/108/EC Electromagnetic compatibility, EMC
2014/35/EU Low Voltage directive
2011/65/EU Restriction of the use of certain hazardous substances (RoHS)

**Swedish directive:**

AFS 2008:3 Arbetsmiljöverkets föreskrifter om maskiner
SS EN 12100:2010 Riskbedömning och riskreducering
SS EN 60204-1 Maskinsäkerhet – Maskiners elutrustning – Del 1: Allmänna fordringar
SS EN 50581:2012 RoHS

Medclair, founded in 2013, is a Swedish research and development company with leading-edge expertise in process gas purification, gas measurement, ventilation and control. We solve healthcare and environmental challanges through innovation.



Medclair