
Medclair

# DU2100-M21
# Technical Brief
## Revision: C0

2022-11-14

# Content

# 1. General

## 1.1. Purpose

This document is a Technical Brief of the mobile destruction unit (MDU) DU2100-M21 which is used for nitrous oxide destruction.

## 1.2. Definitions

| | |
|---|---|
| MDU | Mobile Destruction Unit |
| DU | Destruction Unit |

## 1.3. Generally

The mobile unit is a smart solution that easily can be moved between different treatment rooms. The unit is a solution for collecting residual Nitrous Oxide from exhaled air and decomposing it. The MDU is a self supporting system with low noise level and minimum energy consumption.

The mobile unit purifies more than 99 % of the nitrous oxide entering the unit. This facilitates a healthy work environment for healthcare professionals and a minimal impact on the external environment.

The MDU is specially adapted to suit the mobile needs of healthcare professionals allowing them to use it in an easy and reliable manner. The unit has room for a nitrous oxide cylinder (either pre-mixed or concentrated) as well as an oxygen tube, and if needed an associated mixing unit (titration unit.)

Both inhalation and exhalation equipment can be placed on the mobile unit together with gas cylinders. Inhalation devices such as demand valves or mixers can easily be placed on the MDU. Exhalation tubes for scavenging (collect and remove) are connected to the outlet of the MDU making it a complete closed system for removal of nitrous oxide from ambient air.

The MDU is constructed with few moving parts and components, which all have a high degree of reliability and long product lifespan.

The MDU has an integrated control system that continuously monitors several parameters, including temperature and gas flows, and stops automatically when overloaded. On delivery, the device is already set up for remote monitoring, and it is easy to connect the unit to Medclair's technician for remote monitoring.

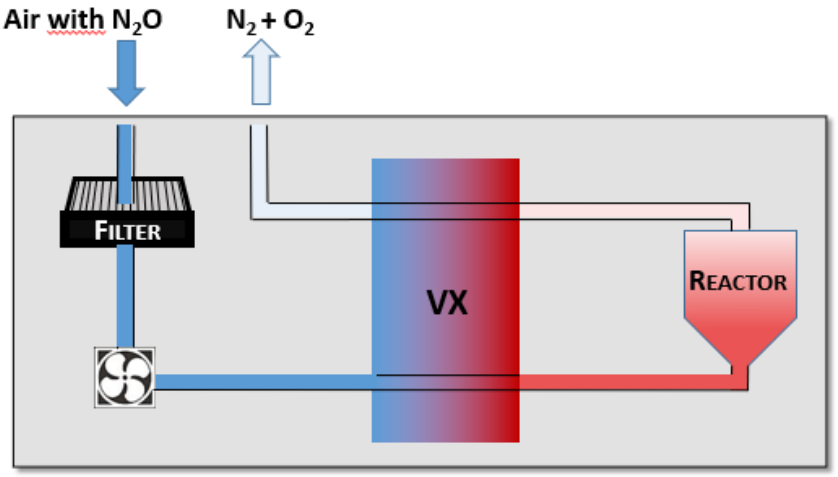
# 2. General functioning principle

The MDU uses a catalytic process for decomposing nitrous oxide to nitrogen and oxygen, which are the main components of air.

Inside the MDU, the cleavage process is performed by a built-in reactor which works with a high temperature for the cleavage to happen. We use a unique technique with heat exchange and isolation that results in a high degree of energy recycling which significantly reduces the energy consumption.

Nitrous oxide in the exhaled air entering the MDU is purified to a degree >99% with the use of a catalytic process in the reactor that breaks down the environmental aggressive nitrous oxide into nitrogen ($N_2$) and oxygen ($O_2$) which are the main constituents of air and can therefore be returned to the environment.

The figure below shows the general functioning principle of MDU.

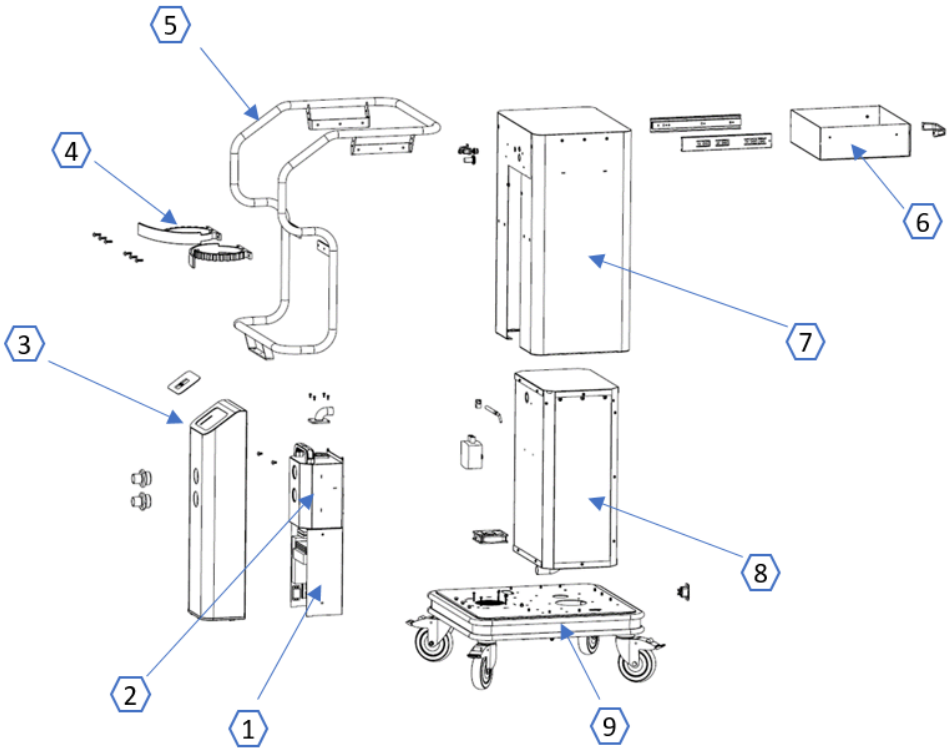



- The exhaled air containing nitrous oxide is sucked into the system with a fan.
- A catalytic process in the reactor breaks down nitrous oxide (N2O) at high reaction temperatures into oxygen (O2) and nitrogen (N2) + excess heat from the process.
- The hot purified air is led into the heat exchanger, where the heat is recycled to warm up the incoming exhaled breath. The cooled purified air is released into the atmosphere after passing a particle filter.
- An integrated robust control system monitors the process and the unit is prepared for remote connection to the Medclair support center for off-site monitoring.

# 3. Construction

DU2100-M21 is designed to be robust and heavy-duty both regarding the physical construction as well as the technical. The unit is built using robust components that have shown its stability and function in operation.

The figure below shows an overall sketch of the different components used. Some of the modules are further described in following sections.




1 Electronic box
2 Intake box
3 Front house with operator panel and intake connection
4 Brackets for fixing the gas tubes
5 Combined handle and protection rim
6 Box for accessories
7 Main house
8 Reactor package
9 Bottom

## 3.1. Electronic box

The electronic box contains components for control and regulation of the unit function based on measurement data gathered from sensors placed within the unit.
The internal software is using the measurement data to control fans and heaters within the unit to get an effective process as possible.

The construction is made by using certified standard modules to keep a robust, stable and flexible product.

Electronic modules are gathered in the electronic box which can be quickly changed if needed to keep a high degree of operation.

## 3.2. Intake box

In the intake box the fan that sucks the exhaled gas into the unit is found, here is also an integrated filter that evens out the gas before it is sent to the reactor package for destruction.

## 3.3. Reactor package

In the reactor package there is a specially designed heat exchanger, heater with sensors and the actual reactor. These components ensure that the temperature needed for the purification (splitting $N_2O$ into $O_2$ and $N_2$) is kept on a stable level in an energy effective way.

## 3.4. Bottom

In the bottom of the unit components for cooling and filtering of outgoing air is placed (filtering to ensure that no particles from the process comes out in the surrounding air).

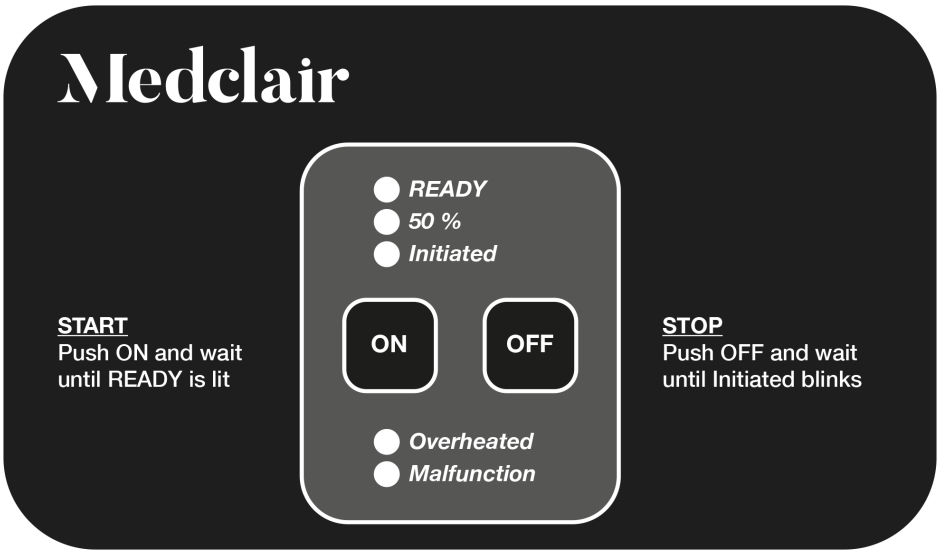
Here, the gas meter (IR) is measuring nitrous oxide concentration after purification placed and the CO2 filter attached (the filter separates CO2 from the gas before going to the gas meter).
The CO2 filter changes color when saturated, becomes purple, and shall then be changed. Additional filters are delivered with the unit and saturated filters are changed at service.

The IR sensor is measuring $N_2O$ concentration (ppm) in the purified gas. An average value is calculated with 5 minutes intervals and alarm is given in two levels if a decrease of purification is seen.
Alarm level 1: Indication is given that the purification level has decreased, the purification is still within acceptable levels, but the unit shall be checked by a Medclair service person. *(If the decrease was just temporarily the indication will be removed when normal average values are received from the gas measuring)*.
Alarm level 2: Purification has decreased to a level where the unit should not be used and therefore the MDU will stop operating.

# 4. User interface

The user interface is designed with ease-of-use in mind. Mostly the unit is controlled by pressing one button for start (ON) and another for stop (OFF) of the unit.

Besides the buttons there are indications to show the process when the unit is heated up.




Two LED's are used to indicate potential error states as follows:

- Temperature fault, i.e. over temperature in the unit is indicated by a yellow LED (Overheated) as long as the error state applies. The unit will attempt to correct this itself and the LED will turn off when the temperature is normal again.
- At decreased purification this is indicated in two steps.
  1. Malfunction blinks indicate that the purification has dropped but is still within an acceptable level. Medclair shall be contacted for service of the unit.
  2. Malfunction lights, purification has dropped below acceptable values. The MDU will stop operating and needs repair.

If a serious functional fault is discovered this is indicated by a red LED (Malfunction). If a user forced restart of the unit doesn't clear the problem Medclair service center shall be contacted.

See the User Manual for more detailed information about the use of DU2100-M21.

# 5. Technical data & Certification

## 5.1. Technical data

| | |
|---|---|
| Power supply: | 230 VAC, 50Hz |
| Energy consumption, heating up: | 750 W |
| Energy consumption, operation: | < 100 W |

Operational conditions:

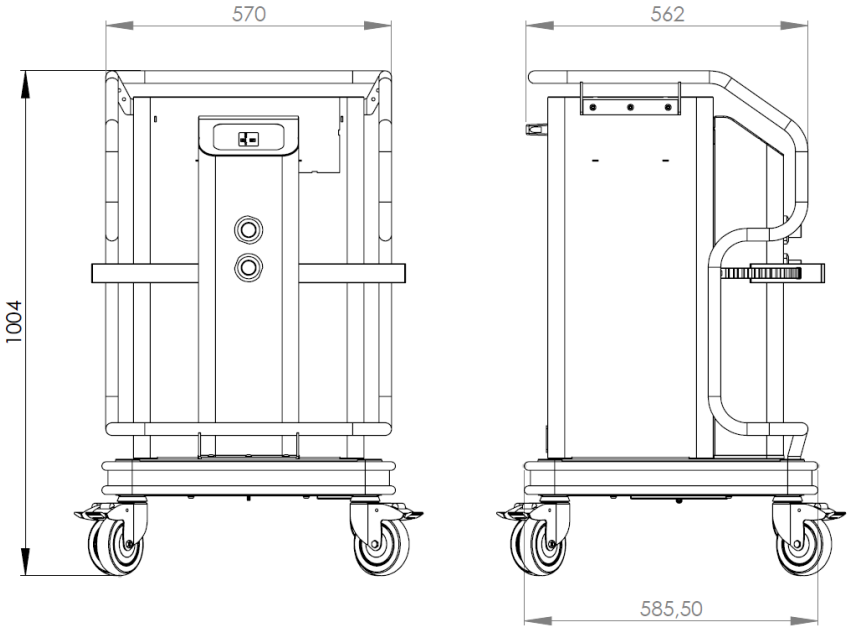
| | |
|---|---|
| Temperature, storage: | -25°C to 50°C |
| Temperature, operation | 10°C to 30°C |
| Relative humidity: | 10 – 80 % |
| Above sea level: | < 2000 meters |
| Surrounding environment | No flammable environment, no combustion gases or presence of halogenated anesthesia gases |

Max value for incoming gas

| | |
|---|---|
| Nitrous oxide: | 16 grams of nitrous oxide per minute |
| Oxygen: | Max 100 % |
| Temperature: | Max 35°C |
| Relative humidity: | Max 100 % |
| Total flow: | 40-50 l/min (configurable) |

| | |
|---|---|
| Start-up time | < 40 min |
| Purifying degree (nitrous) | > 99 % |

| | |
|---|---|
| Weight: | ca: 70 kg (without gas tubes) |
| Noise, operation: | < 35 dB |



## 5.2. Certification

DU2100 is CE certified and fulfills the following directives and standards:

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|---|---|
| EU directives: | |
| 2006/42/EG | Machinery Directive |
| 2014/30/EU | Electromagnetic compatibility, EMC |
| 2014/35/EU | Low Voltage directive |
| 2011/65/EU (RoHS) | Restriction of the use of certain hazardous substances |
| Regulations: | |
| SS EN 12100:2010 | Safety of machinery – General principles for design – Risk assessment and risk reduction: |
| SS EN 60204-1 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements: |
| SS EN 60601-1-2, utg. 4:2015 | Medical electrical equipment – General requirements for basic safety and essential performance – Part 1-2 |
| 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.



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