



FACE MASK DIFFERENTIAL PRESSURE TESTER

according to EN 14683+AC

MDO-25

User Manual

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1. Introduction

The device is used for measurement of air flow resistance of medical face masks using differential pressure measurement according to the ČSN EN 14683 + AC standard.

The device works on the principle of sucking air through the facemask and measuring its flow and differential pressure between both sides of the facemask. The measured values are clearly displayed on a LCD display, including the possibility of averaging the values. The device is also equipped with automatic air flow speed control.

Before using the device, familiarize yourself in detail with the basics of its operation through this manual and the general principles for observing work safety.

2. Device Description

Block diagram of the device is shown on fig. 2.1. A high-power air pump 7 sucks in air thru the whole system. The device includes medical air flow sensors SFM3000-200-C, one at the air inlet (2) and the second sensor between the specimen and the pump (6). Furthermore, the device contains a differential pressure sensor SDP810-500Pa, which senses the pressure on the flanges between which the tested veil is inserted.

The flange for inserting and fixing the drape consists of two rings, which are made of aluminum; the construction is self-sealing. The precise displacement of the flange for attaching the drape is realized by a precise single axis manipulator table.

The device is controlled by four buttons (see chapter 3.3). The heart of the control electronics is the ATmega328PA microcontroller. The measurement results (especially the differential pressure) are recalculated with respect to the mechanical construction of the device and displayed on a graphic LCD display.

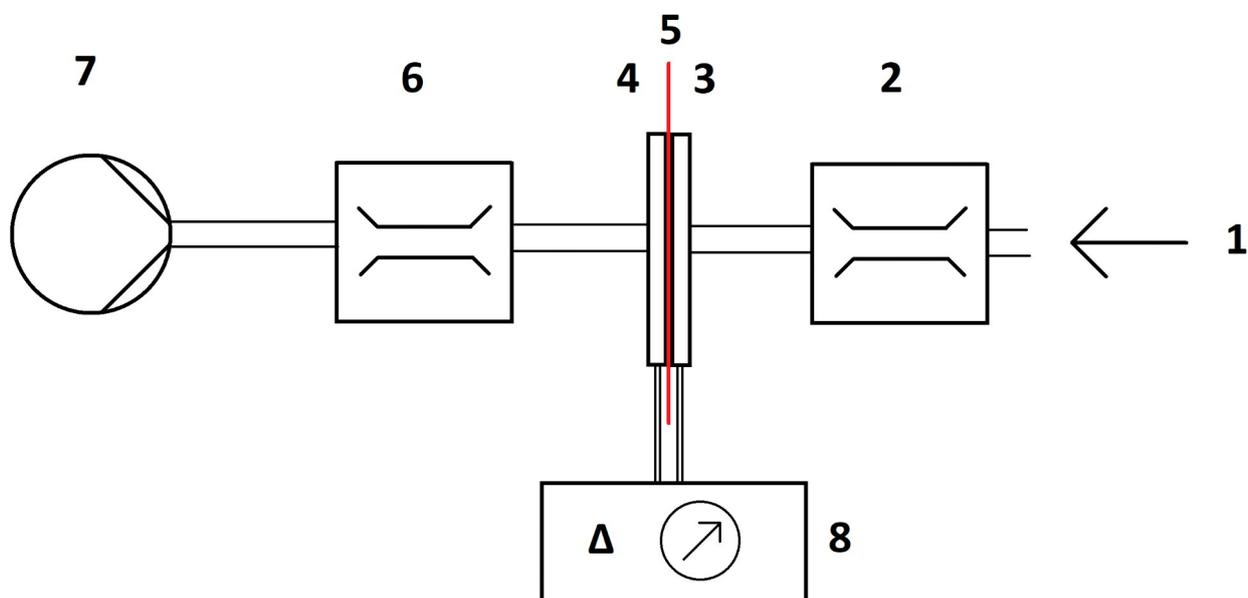


fig. 2.1: Block diagram of the device (1 - suction, 2 - air flow meter, 3 and 4 - metal ring, 5 - tested sample, 6 - air flow meter, 7 - fan, 8 - differential pressure gauge)

The device is powered by an external switching power supply with an output voltage of 48 V.

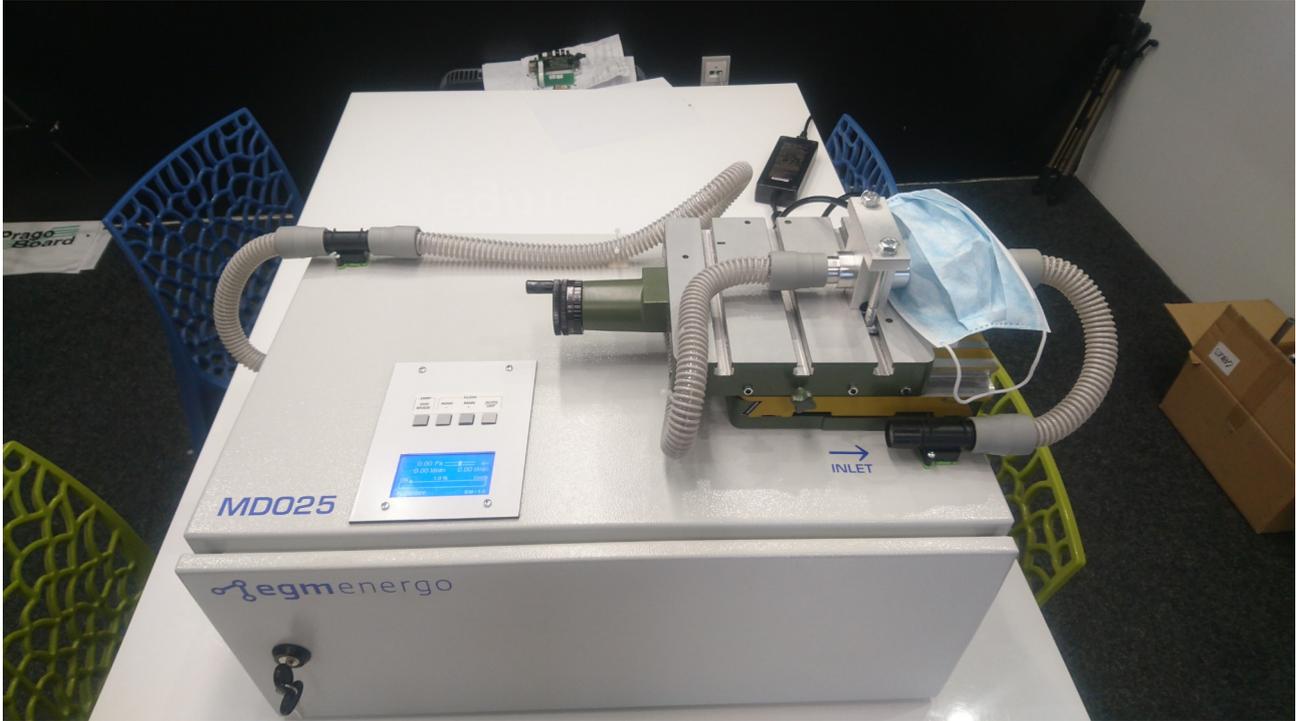


fig. 2.2: Device in Operation

3. Device Operation

3.1. Power On

The device does not contain a main switch. The device is switched on by plugging in the power supply. Immediately after connection, the display backlight lights up, the measuring screen is displayed (see fig. 3.1) and the device is ready for measurement. Switching off is done in a similar way - the power supply is unplugged again.



fig. 3.1: Measurement Screen

3.2. Measurement Screen Description

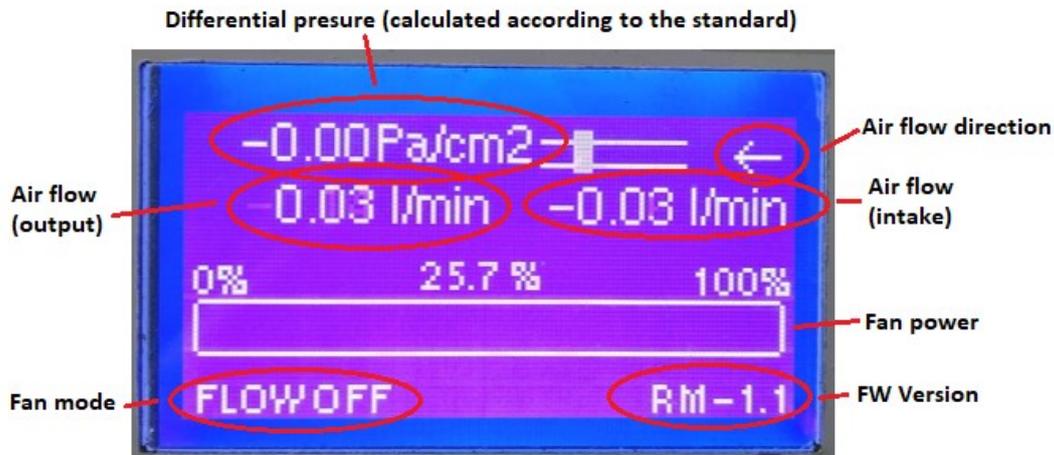


fig. 3.2: Screen Description

3.3. Controls

The device contains four buttons located above the display (see fig. 3.3). Meaning of individual buttons:

- **AVG MODE** – pressing the button turns on averaging. This function is used to obtain a constant value during the measurement. After switching on the function, the number of samples of differential pressure from which the average is calculated is shown in the lower right corner of the display (see fig. 3.4). When one million samples are reached, the function is automatically switched off. The function can be switched off at any time during the measurement by pressing the button again.
- **MAN- / MAN +** - by pressing the button the fan (air pump) speed is reduced/increased, the device automatically switches to manual control mode. Use AUTO / OFF button to switch off the fan or switch to the automatic control mode. The current value of the fan power is displayed on LCD (see fig. 3.2).
- **AUTO/OFF** - by pressing the button the device switches between fan control modes „off“ and „automatic mode“ (see chapter 3.4). Switch to manual mode by pressing one of the MAN buttons.



fig. 3.3: Control Panel Buttons



Number of averaged samples

fig. 3.4: Averaging ON

3.4. Air Pump Automatic Control Mode

The device supports automatic control mode, which can be activated with the AUTO / OFF button (see chapter 3.3). Automatic regulation controls power of the air pump, so that just 8 l of air per minute flows through the apparatus (as required by the standard).

fig. 3.5: Automatic air flow regulation mode

When the mode without the veil is switched on, the controller can oscillate around 8l / min. Therefore, it

is recommended to activate the automatic mode for veil measurements and then possibly switch to the manual control mode and fine-tune the fan speed manually or use the averaging mode to smooth values.

Pressing the button again switches off the control and stops the fan. At the same time, the sensors are restarted, which is signaled by the flashing of the message "ERROR" in place of air flow and differential pressure measurements.

4. Measurement Procedure

4.1. Apparatus Testing

1. According to chap. 3.1 we turn on the device.
2. If there is any test sample from the previous measurement between the measuring rings, remove it and move the rings close together so that the joint between them is tight.
3. According to chap. 3.4 start the automatic regulation of the fan (or adjust the air flow to 8 l / min in manual mode).
4. **On the display after stabilizing the values, we must observe a differential pressure of 0 Pa and both values of the air flow must be identical.**
5. Further according to chap. 3.3 switch the device to manual mode with an air flow of 8 l / min.
6. Clog the suction opening of the first flow meter well (use your palm).
7. **On the display after stabilizing the values, we must observe a differential pressure of 0 Pa and both values of air flow must be close to 0 l / min.**

4.2. Face Mask Differential Pressure Measurement

1. According to chap. 3.1 we turn on the device.
2. Insert the tested face mask (see the standard for details) between the measuring rings and move the rings close together so that the connection between them is tight.
3. According to chap. 3.4 start the automatic regulation of the fan (or adjust the air flow to 8 l / min in manual mode).
4. Start averaging, see chap. 3.3
5. After stabilizing the values on the display, the display shows the measured differential pressure. Check that the air flow is near 8 l / min.

5. Calibration

All sensors in the device are factory calibrated. In the case of measurement control, eg in a metrological institute, the device contains a menu for manual calibration. The calibration menu is entered by long pressing the **AUTO / OFF** button from the main measuring screen. It is possible to move in the menu with the **+** and **-** buttons, the values are confirmed by pressing the **AUTO / OFF** button and the **AVG / MODE** button is used to return back. The entered setting parameters are immediately applied to the measurement even without saving, however, after disconnecting the power supply, the last saved setting is used. To save the values to the calibration memory, it is necessary to save the calibration by selecting "**Save calibration**". The calibration menu contains the following items:

- **Auto flow ml/min** - setting the value of air flow in automatic mode. It is possible to set 5-15 l / min.
- **Flow left offs x0.001** - setting the offset of the flow meter to the left (ie closer to the motor). It is possible to set values 0-2000 (in l/min x 0.001). The program does not use negative numbers, so offset 0 is at 1000. This means that +/- 1 l/min can be set.
- **Flow left gain x1000** - setting the gain of the flow meter to the left (ie closer to the motor). It is possible to set values of 500-1500. The program does not use decimal numbers, so gain 1 is at 1000. This means that the gain can be set from 0.5 – 1.5.
- **Flow right offs x0.001** - setting the offset of the flow meter to the right (ie the one at the beginning of the measuring system). It is possible to set values 0-2000 (in l/min x 0.001). The program does not use negative numbers, so offset 0 is at 1000. This means that +/- 1 l/min can be set.
- **Flow right gain x1000** - setting the gain of the flow meter on the right (ie the one at the beginning of the measuring system). It is possible to set values of 500-1500. The program does not use decimal numbers, so gain 1 is at 1000. This means that the gain can be set from 0.5 – 1.5.
- **Pressure offs x0.001** - differential pressure gauge offset setting (in Pa x 0.001). It is possible to set values 0-2000. The program does not use negative numbers, so offset 0 is at 1000. This means that +/- 1 Pa can be set.
- **Pressure gain x1000** - differential pressure gauge setting. It is possible to set values of 500-1500. The program does not use decimal numbers, so gain 1 is at 1000. This means that the gain can be set from 0.5 – 1.5.
- **Save calibration** - saves settings even after switching off the device. To save, you must enter the code **00042**.

6. Technical Parameters

Parameter	Value
Input Voltage (for external PSU)	100 až 240 V AC / 50 Hz
Current Consumption	max. 2 A
Electrical Protection	SELV
External PSU Output Voltage	48 V DC
Max. PSU Output Current	3,38 A
Operating Temperature	15 - 35 °C
Max. measured air flow Sensor used: SFM3000-200-C	±220 l/min
Max. measured differential pressure Sensor used: SDP810-500Pa	±102 Pa (calculated) ±500 Pa (raw)
Air Flow Measurement Error	Max. ±2,5 % of value
Air Flow Offset	Max. ±0,1% of range
Differential Pressure Error	±0,6 % of value
Differential Pressure Offset	±0,02 % of range
External Size (excl. PSU)	1000 x 500 x 500 mm
IP Rating	IP20