MicroCO Meter
Operating Manual

Federal (USA) law restricts this device to sale by or on the order of a physician or licensed practitioner.

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Overview

The MicroCO is a hand held battery operated device used to measure the concentration of carbon monoxide, CO, on the breath and calculates the percentage of carboxyhemoglobin, %COHb, in the blood.

It is accurate, easy to use, and has many features designed to simplify its operation.

These include: Auto zero function
                 Smoking level color light indicators
                 Poison level alarm
                 Simple calibration
                 Serial interface to PC

Please note: It is recommended that this unit be calibrated upon receipt.

This device should only be used by trained and qualified personnel.

Introduction

The MicroCO is based on an electrochemical fuel cell sensor, which works through the reaction of carbon monoxide (CO) with an electrolyte at one electrode, and oxygen (from ambient air) at the other. This reaction generates an electrical current proportional to CO concentration. Output from the sensor is monitored by a microprocessor, which detects peak expired concentrations of alveolar gas. This is then converted to % carboxyhemoglobin (%COHb) using the mathematical relationships described by Jarvis et al\textsuperscript{1}, for concentrations below 90 ppm, and by Stewart et al\textsuperscript{2} for higher levels.
Raised levels of carboxyhemoglobin are most commonly caused by accidental smoke inhalation/CO poisoning or cigarette smoking. The MicroCO includes a countdown timer as an aid to timing the breath holding period prior to exhalation.

The results are displayed on a clear LCD display. Warning lights are provided to give an instant indication of the smoking level.

The countdown timer, warning light levels, and the alarm level are user adjustable when the unit is connected to a PC running COBRA software.

Note: the countdown timer, warning light levels, and the alarm level used throughout this manual are the factory settings and may have been changed.

References

   Low cost carbon monoxide monitors in smoking assessment
   Thorax 1986; 41: 886-887

2. Stewart RD, Stewart RS, Stamm W, Seleen RP
   Rapid estimation of carboxyhemoglobin levels in fire fighters
   JAMA 1976; 235, 390-392

Smoke Inhalation/CO Poisoning

CO poisoning usually occurs as a result of smoke inhalation from fires or exposure to CO from car exhausts or faulty heating systems. CO binds with hemoglobin to form carboxyhemoglobin (COHb) which reduces the capacity of the blood to carry oxygen. Acute poisoning may cause symptoms ranging from headache and breathlessness (at COHb levels of 10% to 30%) through confusion to coma and
death (COHb usually greater than 60%). A particularly insidious feature of CO poisoning is the development of neurological problems such as movement disorders (often resembling Parkinson’s disease), memory loss and altered personality. Such problems may develop weeks after apparent recovery from acute poisoning.

Chronic exposure to relatively low levels of CO may result in a variety of symptoms including headache, fatigue, poor concentration, dizziness, palpitations, chest pain, visual disturbance, nausea, diarrhea and abdominal pain.

Chronic CO poisoning as a cause of such symptoms is often missed.

The MicroCO allows immediate assessment of patients at risk of CO poisoning who can then be rapidly referred for expert assessment. Prompt treatment with oxygen (in a hyperbaric chamber, if severe) is often life saving. Screening for CO exposure may also reveal the cause of non-specific symptoms relating to low level CO exposure (usually as the result of faulty gas appliances).

References

Meredith T, Vale A, Carbon monoxide poisoning
British Medical Journal, 1988; 296, 77-78

Cigarette Consumption

The MicroCO provides a simple screening test for cigarette consumption for use in all smoking cessation programs.

Measurement of carboxyhemoglobin has been well validated as an indirect measure of cigarette consumption and is widely used in smoking cessation programs.
Typical values for carboxyhemoglobin and expired CO in smokers and poisoning victims, together with the alarm light status, are given below:

<table>
<thead>
<tr>
<th>CO(ppm)</th>
<th>%COHb</th>
<th>Cigarette consumption</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 6</td>
<td>0 – 1</td>
<td>Non smoker</td>
<td>Green</td>
</tr>
<tr>
<td>7 – 10</td>
<td>1.1 – 1.6</td>
<td>Light smoker</td>
<td>Amber</td>
</tr>
<tr>
<td>11 – 72</td>
<td>1.8 – 12</td>
<td>Heavy smoker</td>
<td>Red</td>
</tr>
<tr>
<td>&gt;72</td>
<td>&gt;12</td>
<td>Suspected poisoning</td>
<td>Red + alarm</td>
</tr>
</tbody>
</table>

Please note that some urban areas may have high environmental levels of CO. This can cause a rise in exhaled CO of a few ppm above that which is normally present on the breath. In these cases it is possible for a non-smoker to appear at the bottom of the ‘light smoker’ range (7 – 10 ppm).

References

The relationship between alveolar and blood carbon monoxide concentrations during breath holding
Jones RH, Ellicott MF, Cadigan JB, Gaensler EA
Journal of Laboratory and Clinical Medicine 1958; 51, 553 – 564

Carbon monoxide in breath in relation to smoking and carboxyhaemoglobin levels
Wald NJ, Idle M, Boreham J, Baily A
Thorax 1981; 36, 366-369

Definition of a reliable threshold value for detecting current smokers by CO measurement
Marino Luigi; Latini Roberto; Barbano Gina; Bazzerla Giorgio; De Luca Anita, Nardini Stefano Respiratory and TB Unit-General Hospital- Via forlanini, 71-I-31029-Vittorio Veneto (TV-ITALY).
**Correlation between exhaled CO measurements and carboxyhaemaglobin percentage in smokers**

Marino Luigi; Latini Roberto; Barbano Gina; Bazzerla; Zanette Antonia; Nardini Stefano Respiratory and TB Unit- General Hospital- Via Forlanini, 71- I-31029-Vittorio Veneto (TV- ITALY).

**Package Contents**

The MicroCO is supplied with a carrying case containing the following items:

1. MicroCO meter (Cat No. MC02)
2. 22 mm mouthpiece adapter (Cat No. PSA1800)
3. 22 mm reducing connector for calibration (Cat No.MEC1007)
4. 9-Volt Battery
5. 4 Disposable mouthpieces (Bag 100 Cat No. 3301)
6. Calibration tool (Cat No. MEC1184)
Contraindications

There are no known contraindications for using the MicroCO.

Warnings and Cautions

The following terms are used as follows in this manual

Caution: Possibility of injury or serious damage

Warning: Conditions or practices that could result in personal injury

Please Note: Important information for avoiding damage to the instrument or facilitating operation of the instrument.

Note: The device should be used by trained and qualified personnel.

<table>
<thead>
<tr>
<th>CAUTION: Read the manual before use.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION: Do not attempt to charge the batteries, connect improperly or dispose of in a fire as there is a possibility of leakage or explosion. Follow manufacturer’s recommendations for proper disposal.</td>
</tr>
<tr>
<td>WARNING: The instrument is not suitable for use in the presence of explosive or flammable gases, flammable anesthetic mixtures or in oxygen rich environments.</td>
</tr>
</tbody>
</table>
**CAUTION:** Mouthpieces are single patient use. If used on more than one patient, there is a risk of cross-infection. Repeat use may increase air resistance and lead to an incorrect measurement.

**PLEASE NOTE:** The product you have purchased should not be disposed of as unsorted waste. Please utilize your local recycling facility for the disposal of this product.

**PLEASE NOTE:** Degree of protection against Ingress of Water is IPX0.

**CAUTION:** When you connect the MicroCO to other equipment, always make sure the whole combination complies with the international safety standard IEC 60601-1 for medical electrical systems. During measurements, connect the MicroCO only to computers that comply with IEC 60601-1 / ANSI/AAMI ES60601-1:2005 / CAN/CSA-C22.2 No. 60601-1:14

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**Intended Use**

The MicroCO is intended to measure the amount of Carbon Monoxide (CO) that can be expired from the breath. The expired CO is measured in parts per million (ppm) and is used to calculate the percentage of carboxyhemoglobin (%COHb) in the blood.

The MicroCO is used in smoking cessation clinics, physician offices, emergency departments and by the fire-fighting services. In smoking cessation clinics, it is used for instructional purposes to check on the client’s progress and compliance. General practitioners, emergency room personnel and the fire-fighting services can use the
instrument to quickly assess the level of suspected CO poisoning.

The MicroCO is designed for use by clinicians and health care professionals.

**Operation**

For accurate results, the CO meter should be used at room temperature. If the instrument has been stored in cool or hot conditions, allow time to reach room temperature prior to use.

Install the 9-volt battery by sliding open the battery cover, clipping the battery in place and replacing the cover. Insert the mouthpiece adapter into the MicroCO and then insert a disposable mouthpiece into the adapter. Turn the unit on by selecting the upper or middle position on the central slide switch and the display will show software version number (ex. 3.03).

The version number will appear momentarily while correction for ambient levels is executed. During this time the unit must not be exposed to concentrations of CO. The display will change to:

![Display showing 20](image)

Upon seeing the number 20, instruct the subject to inspire fully and hold their breath for 20 seconds. The display will count down from 20 to 0 as an aid to timing the breath
holding period. The green indicator will then illuminate and the display will change to:

At this time, the subject should seal their lips around the mouthpiece and exhale slowly and fully. The 20 second breath holding period is recommended to allow time for equilibration of alveolar gas.

If, however, the subject is unable to hold their breath for this period, the unit may still be used before 20 seconds have elapsed.

The unit must not be used, however, for one (1) second after the unit is first switched on i.e. before the countdown commences. Expired alveolar gas is then entrapped between sensor and mouthpiece valve. The display reading will rise to a plateau over the course of a several seconds. The final value will be held until the unit is turned off and represents parts per million CO or %COHb depending on the slide switch position.

The lights will come on according to the table on page 4 and the red light will flash and an alarm will sound if the measurement rises above 72 ppm (12%COHb).

If this occurs then the possibility of CO poisoning should be investigated as this level of CO is unlikely to be produced by cigarette smoking.
Important note: Before repeating a measurement the unit must be turned off, and the mouthpiece and adapter removed for at least one (1) minute. This is to allow re-equilibration with ambient air and to dry the surface of the sensor. Visually inspect that all moisture has evaporated from the surface of the sensor before reuse.

If the unit is switched on again too quickly after use there may be a response to residual expired carbon monoxide from the previous test.

In this case the display will show:

![Image of display showing 'GAS'](image)

If this is displayed then turn the unit off, remove the mouthpiece adapter, and expose to ambient air for two (2) minutes before repeating the test.

**Note:** If this warning appears again after following the above procedure then turn off and leave the sensor exposed to ambient air for a further three (3) minutes. If the same message appears again then this indicates possible contamination of the sensor with a solvent.

In this case remove all sources of solvent from the vicinity of the sensor and expose to ambient air for 24 hours before switching on again.
PC Connection

The MicroCO may be connected to the serial port of a PC running COBRA (CO BReath Analysis) software.

This software allows the measurements to be read by a PC and automatically entered onto a pre-defined report for subsequent printing and filing. It also allows the CO level indicators and the breath holding countdown timer to be configured to individual requirements.

**Note:** The MicroCO should only be connected to a computer that is manufactured in accordance with EN 60601-1.

**Note:** Keep the PC out of reach of the patient at all times.

Calibration

Calibration will remain stable to within 2% over one (1) month and typically to within 10% over six (6) months. Micro Direct supplies calibration gas (20ppm CO in air) and recommends that the unit is recalibrated every six (6) months. See page 27 for calibration accessories.

The gas is supplied in convenient, disposable cans containing 17 liters of gas (Cat No. MC10).

To carry out the calibration locate the calibration button on the right-hand side of the instrument as shown on the next page.
Screw the control valve firmly onto the cylinder and connect the gas supply as shown below:

Push the slide switch to the CO - PPM position and wait for the unit to display zero.
The plastic tubing supplied with the gas should be pushed firmly over the reducing connector.

Turn the control knob fully counter-clockwise until knob will not turn any further. Apply gas for 25 seconds. If the meter does not read 20 ppm, use the calibration tool to push the calibration button.

The unit will beep three (3) times, store new calibration value and the display will show:

![CAL](image)

The gas supply should then be turned off.

If the signal from the CO sensor is too low a new calibration value will not be stored and the display will show:

![CEL](image)

The most likely cause for this is an expired cell but may also be caused by depressing the calibration switch with no gas applied. Ensure that the concentration of calibration gas is correct (20ppm) that the connections to the gas cylinder are secure, that the gas cylinder is not empty, and then repeat the calibration procedure.

If the above message is repeated, the CO meter must be returned to Micro Direct, Inc. for sensor replacement.
Sensor life is greater than 2 years and depends upon both the amount of exposure to CO and other gases, particularly solvents such as alcohol and cleaning fluids.

If the signal from the CO sensor is too high, a new calibration value will not be stored and the following will be displayed when calibration is attempted:

![Error Symbol]

The most likely cause for this is using an incorrect concentration of calibration gas. Ensure that the concentration of calibration gas is correct (20 ppm) that the connections to the gas cylinder are secure and then repeat the calibration procedure.

In order to stop any gas leak from the can after calibration, ensure that the control knob is tightened firmly.

**Important Notes:**

- Only certified calibration gas from a reputable source should be used.
- Ensure no CO is present on the sensor for three (3) minutes before starting the calibration procedure.
- Ensure the instrument and gas cylinder has stabilized at room temperature before calibrating.
- In order to stop any gas leaks from the can after calibration, ensure the control knob is tightened firmly.
**Battery Life**

Battery life is approximately 30 hours of continuous use. When the battery has approximately one (1) hour of useful life left, the alarm will sound momentarily after the unit is first switched on and the following message will be displayed:

![Battery Icon]

When the battery has completely expired the above will be displayed continuously and the battery must be replaced.

**Battery Replacement**

Locate the sliding cover situated on the rear of the unit, toward the bottom of the device.

Place your thumb over the round thumb indent, press gently and slide the cover to the right to remove it from the unit.

Lift the old battery out and holding the battery terminal by the plastic body, pull it off the old battery.

Plug the new battery into the battery terminal taking care that the correct polarity is observed.

Push the battery back into the battery holder and replace the battery cover onto the guides. Slide the battery cover to the left until it is fully home.

**Note:** Please remove the battery if the meter is likely to be unused for some time.
**CAUTION**: Do not open the battery cover when the device is turn on.

**CAUTION**: The operator should not touch the contacts of the battery and the patient at the same time.

**Please Note**: Dispose of the waste battery in accordance with your waste management regulations.

**Internal Battery Expiry**

The MicroCO has an internal battery with a life of approximately three years. This battery supplies the sensor signal conditioning circuit continuously to ensure instant start up.

When the battery has expired, the following warning message will be displayed:

![Battery Expiry Message](image)

and the alarm will sound when the unit is first turned on.

When this occurs, the CO meter must be returned to Micro Direct, Inc. for battery replacement.

**Sensor Expiry**

Sensor life is greater than 2 years and depends upon both the amount of exposure to CO and other gases and solvents such as alcohol and cleaning fluids.
When the sensor has expired, it will become impossible to obtain a correct calibration. When this occurs, the MicroCO must be returned to Micro Direct for sensor replacement.

**Product Lifetime**

The MicroCO meter is designed for a product lifetime of seven (7) years.

**Cleaning**

Disinfection of contaminated parts is only effective after having them carefully pre-cleaned. Micro Direct recommends using any cold germicidal disinfectant that does **NOT** contain chlorine or alcohol. Please follow the solutions manufacturer’s instructions.

**CAUTION:** Switch off the device and always unplug your MicroCO meter from the computer before cleaning.

When using the disposable cardboard mouthpiece with one-way valve under the prerequisite that the patient was instructed only to exhale, the mouthpiece adapter and the CO meter surface have to be cleaned.

The mouthpiece adapter may be cleaned and sterilized by immersion in any cold sterilizing solution that does **NOT** contain chlorine or alcohol. We recommend wiping exposed surfaces of the meter with the Protex disinfectant wipe (order #48-70). It is recommended that this procedure is performed after each use and all used cardboard mouthpieces discarded.
**Important note**: The sensor surface must not be wiped with any aqueous solutions and **must not** be exposed to solvents e.g. alcohol or permanent damage may result.

**CAUTION**: Do not attempt to wash or immerse the MicroCO meter in water or cleaning fluid, as there are electronic components inside that will be permanently damaged.

Important Note: Cardboard mouthpieces must be disposed of immediately after use. If there are changes on the material surfaces of either the unit or mouthpiece adapter (cracks, brittleness) the respective parts must be disposed of.

**Servicing**

If your unit requires service or repair, please see page 29 for contact details. A full-service manual including circuit diagram and parts list is available upon request.

**Trouble Shooting Information**

Should you encounter problems operating your MicroCO, please consult the table below:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>MicroCO cannot be switched on or “bat” is displayed</td>
<td>Batteries are flat</td>
<td>Change the battery</td>
</tr>
<tr>
<td>Battery life is shorter than expected</td>
<td>Unit not being switched off</td>
<td>Turn the unit off after use</td>
</tr>
<tr>
<td>Displayed Message</td>
<td>Description</td>
<td>Action / Replacement Details</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>“CEL” is displayed</td>
<td>Fuel cell is depleted</td>
<td>Return unit for cell replacement</td>
</tr>
<tr>
<td>“Err” is displayed</td>
<td>Gas cylinder empty</td>
<td>Check valve on cylinder for contents and replace cylinder if necessary. Check calibration value</td>
</tr>
<tr>
<td>“bt2” is displayed</td>
<td>Internal battery has expired</td>
<td>Return unit for battery replacement</td>
</tr>
<tr>
<td>“gAS” is displayed</td>
<td>Fuel cell is depleted</td>
<td>Return unit for cell replacement</td>
</tr>
</tbody>
</table>
|                   | Fuel cell is contaminated by residual gas or solvents| Allow unit to be exposed to clean air. Turn unit ON and await message to disappear, if not return unit for cell replacement |}

**Safety Designation per IEC 60601-1**

- **Type of protection against electrical shock**: Internally powered Equipment
- **Degree of protection against electrical shock**: Type B applied part
- **Power Equipment**: Battery type: 9 volt battery, Alkaline Manganese Dioxide
Battery Life: 9.0V, 550mAh

Degree of Electrical connection between equipment and patient: Equipment designed as non-electrical connection to the patient

Degree of mobility: Transportable

Mode of operation: Continuous

Classifications according to IEC 60601-1: MicroCO - Applied part, type B

**WARNING:** No modification of this equipment is allowed.

**WARNING:** Do not connect devices that are not specified as part of the system.

**NOTE:** When you connect other equipment to the unit, always make sure the whole combination complies with the international safety standard IEC 60601-1-1 for medical electrical systems. When connecting to a PC with the supplied serial cable, the PC must be IEC 60601-1 / ANSI/AAMI ES60601-1:2005 / CAN/CSA-C22.2 No. 60601-1:14 compliant.

**WARNING:** The user must not touch any voltage carrying parts and the patient at the same time.

**Electromagnetic Compatibility (EMC) to EN60601-1-2:2007**

**WARNING:** use of portable phones or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation.

The MicroCO has been test to EN 60601-1-2:2007, regarding the ability to operate in an environment containing other electrical/electronic equipment (including other medical devices).

The purpose of this testing is to ensure that the MicroCO is not likely to adversely affect the normal operation of other such equipment and that
other such equipment is not likely to adversely affect the normal operation of the MicroCO.

Despite the testing of the MicroCO that has been undertaken, normal operation of the MicroCO can be affected by other electrical/electronic equipment and portable and mobile RF communications equipment.

As the MicroCO is medical equipment, special precautions are needed regarding EMC (electromagnetic compatibility).

It is important that the MicroCO is configured and installed /put into service, in accordance with the instructions/guidance provided herein and is used only in the configuration as supplied.

Changes or modifications to the MicroCO may result in increased emissions or decreased immunity of the MicroCO in relation to EMC performance.

The MicroCO should be used only with the PC serial cable provided by Micro Direct, Inc. (Cat No. ASS3803, Description: Interface cable for COBRA software). This cable should not be extended by the user. This cable should not be used with devices other than the MicroCO. If the cable is extended by the user, this may result in an increased level of emissions or decreased level of immunity, in relation to the MicroCO’s EMC. Use of the cable with devices other than the MicroCO, may result in an increased level of emissions or decreased level of immunity, in relation to the other devices’ EMC.

The MicroCO has an essential performance – the product should continue to operate as intended to an accuracy of +/- 5% of reading or 1 ppm (whichever is greater).

WARNING: The MicroCO should not be used adjacent to or stacked with other equipment. If adjacent or stacked use with other equipment is necessary, the MicroCO and the other equipment should be observed / monitored, to verify normal operation in the configuration in which it will be used.

<table>
<thead>
<tr>
<th>Guidance and Manufacturer’s Declaration – Electromagnetic Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The MicroCO is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or the user of the MicroCO to ensure that is used in such an environment.</td>
</tr>
<tr>
<td><strong>Emission Test</strong></td>
</tr>
</tbody>
</table>

Guidance

| RF emissions | CISPR 11 | Group 1 | The MicroCO uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. |
| RF emissions | CISPR 11 | Group B | The MicroCO is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes. |
| Harmonic emissions | IEC61000-3-2 | Not Applicable (battery powered) |
| Voltage fluctuations / flicker emissions | IEC61000-3-3 | Not Applicable (battery powered) |

Guidance and Manufacturer’s Declaration – Electromagnetic Immunity

The MicroCO is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or the user of the MicroCO to ensure that is used in such an environment.

<table>
<thead>
<tr>
<th>Immunity Test</th>
<th>IEC 60601 Test Level</th>
<th>Compliance Level</th>
<th>Electromagnetic Environment - Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic discharge (ESD)</td>
<td>IEC61000-4-2</td>
<td>+/- 6 kV contact +/- 8 kV air</td>
<td>+/- 6 kV contact +/- 8 kV air</td>
</tr>
<tr>
<td>Electrical fast transient / burst</td>
<td>IEC61000-4-4</td>
<td>+/- 2 kV for power supply lines +/- 1 kV for input / output lines</td>
<td>Not Applicable (Battery powered and serial cable &lt;3m)</td>
</tr>
<tr>
<td>Surge</td>
<td>IEC61000-4-5</td>
<td>+/- 1 kV line(s) to line(s) +/- 2 kV line(s) to earth</td>
<td>Not Applicable (Battery powered)</td>
</tr>
<tr>
<td>Voltage dips, short interruptions and voltage variations on power supply input lines</td>
<td>IEC61000-4-11</td>
<td>&lt; 5% U_T (&gt; 95% dip in U_T) For 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles &lt;5% U_T (&gt; 95% dip in U_T) for 5 s</td>
<td>Not Applicable (Battery powered)</td>
</tr>
</tbody>
</table>
Guidance and Manufacturer’s Declaration – Electromagnetic Immunity

The MicroCO is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or the user of the MicroCO to ensure that it is used in such an environment.

<table>
<thead>
<tr>
<th>Immunity Test</th>
<th>IEC 60601 Test Level</th>
<th>Compliance Level</th>
<th>Electromagnetic Environment - Guidance</th>
</tr>
</thead>
</table>
| Conducted RF  | 3 Vrms 150 kHz to 80 MHz | 3 Vrms | Portable and mobile RF communications equipment should be used no closer to any part of the MicroCO, including any cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance (d)**

\[ d = 1.2\sqrt{P} \]

| Radiated RF   | 3 V/m 80 MHz to 2.5 Ghz | 3 V/m | \( d = 1.2\sqrt{P} \) for 80 MHz to 800 MHz

\( d = 2.3\sqrt{P} \) for 800 MHz to 2.5 GHz

Where \( P \) is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and \( d \) is the recommended separation distance in meters (m).
Fields strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range. Interference may occur in the vicinity of equipment marked with the following symbol:

\[ \text{Symbol} \]

**NOTE 1** At 80 MHz and 800 MHz, the higher frequency range applies.

**NOTE 2** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radios, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the MicroCO is used exceeds the applicable RF compliance level above, the MicroCO should be observed to verify normal operation. Abnormal performance is observed, additional measures may be necessary, such as re-orientating or relocating the MicroCO.

Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V / m.

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**Recommended separation distances between portable and mobile RF communications equipment and the MicroCO**

The MicroCO is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the MicroCO can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the MicroCO as recommended below, according to the maximum output power of the communications equipment.

<table>
<thead>
<tr>
<th>Rated Maximum Output Power of Transmitter in Watts (W)</th>
<th>Separation Distance in Meters (m) according to Frequency of Transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 KHz to 80 MHz</td>
<td>80 MHz to 800 MHz</td>
</tr>
<tr>
<td>( d = 1.2 \sqrt{P} )</td>
<td>( d = 1.2 \sqrt{P} )</td>
</tr>
<tr>
<td>0.01</td>
<td>0.12</td>
</tr>
<tr>
<td>0.1</td>
<td>0.38</td>
</tr>
<tr>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>10</td>
<td>3.8</td>
</tr>
<tr>
<td>100</td>
<td>12</td>
</tr>
</tbody>
</table>

For transmitters rated at a maximum output power not listed above, the recommended separation distance \( d \) in meters (m) can be estimated using the...
equation applicable to the frequency of the transmitter, where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1  At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2  These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.
Symbols

Type B device

Consult the instructions for use

Manufacturer

Date of Manufacture

Serial Number

Single Patient Use

Federal U.S. law restricts this device to sale by or on the order of a physician (Rx only)
Consumables / Accessories

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3301</td>
<td>Mouthpieces (Bag of 100)</td>
</tr>
<tr>
<td>PSA1800</td>
<td>CO Connector with Valve</td>
</tr>
<tr>
<td>MC10</td>
<td>CO Calibration Gas (17 Liters)</td>
</tr>
<tr>
<td>MC15</td>
<td>CO Calibration Kit</td>
</tr>
<tr>
<td>MC22</td>
<td>Regulator for Calibrating Gas</td>
</tr>
<tr>
<td>MEC1184</td>
<td>Calibration Tool</td>
</tr>
<tr>
<td>MEC1007</td>
<td>Reducing Connector for Calibration</td>
</tr>
<tr>
<td>ASS3803</td>
<td>Interface cable for COBRA Software</td>
</tr>
<tr>
<td>48-70</td>
<td>Protex Disinfectant Wipes (100/canister)</td>
</tr>
</tbody>
</table>

For further information or to place an order for disposables or supporting products, please contact Micro Direct, your local distributor or view our website www.mdspiro.com

For Customer Care: Toll Free 1-800-588-3381, phone 207-786-7808

Please Note: Information in this manual is subject to change without notice and does not represent commitment on the part of Micro Direct, Inc.
Specifications

Sensor type: Electro-chemical fuel cell
Range: 0 - 300 ppm
Resolution: 1 ppm
Detected levels:
- Green indicator light: 0 to 6 ppm (0 to 1 %COHb)
- Amber indicator light: 7 to 10 ppm (1.1 to 1.6 %COHb)
- Red indicator light: 11 to 72 ppm (1.8 to 12 %COHb)
- Flashing red light + alarm: > 72 ppm (> 12 %COHb)
Accuracy: +/-5% of full scale or 1ppm whichever is the greater

Sensitivity drift: 0.5%/°C
Sensor life: >2 years
Response time: < 15 sec (to 90% of reading)
Hydrogen cross sensitivity: <15%
Operating temperature: 32 - 104 °F
Operating pressure: Atmospheric +/- 10%
Pressure coefficient: 0.02% signal per mBar
Relative humidity: 15 - 90% continuous
(Non condensing): (0 - 99% intermittent)
Baseline drift: 0 ppm (auto-zero)
Long term drift: < 2% signal loss per month
Power source: Single Alkaline 9 volt battery
Main battery life: 30 hours of continuous use
Internal battery: Lithium 1/2AA 3.6 volt
Internal battery life: 10 years
Weight: 6.3 ounces with battery
Dimensions: 6.5” x 2.5” x 1”
Display: Custom LCD
Storage temperature: -4° to +158° F
Storage humidity: 30% to 75%
Customer Contact Information

For all sales order processing for products, training and spare parts, service and technical support inquiries, please contact the following:

Micro Direct, Inc.
803 Webster Street
Lewiston, ME 04240

Customer Service and Sales

Toll Free: 800-588-3381  
Telephone: 207-786-7808  
Email: sales@mdspiro.com

Factory Repair and Technical Support

Toll Free: 800-588-3381  
Telephone: 207-786-7808  
Email: support@mdspiro.com