SERVICE MANUAL

eAdvantage®

Analgesic Gas Mixing and Delivering System

Electronic Nitrous Oxide/Oxygen Analgesic Gas Mixing and Delivering System

01EQ3000

Made in Canada by O-Two™ Medical Technologies Inc.
Part Number: 15PL1033 Rev. 3, July 2024

o_two controlled™ ventilation

TABLE OF CONTENTS

1. SAFETY

⚠ WARNINGS ⚠

- Federal Law restricts this device to sale by or on the order of a physician.
- The eAdvantage® shall only be used by qualified healthcare professionals trained in its use for the purposes specified under “Intended Use”.
- The eAdvantage® system is designed for patient self-administration.
- Never attach the face mask to the patient using a head harness.
- The eAdvantage® shall not be used in oxygen rich nor flammable gases or anaesthetic agents environments. Keep away from open flames, sparks and grease/oil.
- It is recommended to use cylinders that are at least 1/4 full. Always turn ON the cylinder valve slowly and fully.
- The nitrous oxide cylinder should be operated in an upright position. If the nitrous oxide cylinder is in a valve-down position while the post valve is open, liquid may be expelled through the vent passages. This liquid, Nitrous Oxide, can cause burns by freezing on exposed skin.
- Never allow oil or grease to come into contact with any part of the cylinders, regulators or eAdvantage® system.
- Always use the checklist to ensure that all components are reassembled correctly and that all disposable items are replaced.
- Before use on a patient, the settings of the delivered gas should be checked to ensure they are in accordance with the intended use.
- It is recommended to use an oxygen monitor complying with ISO 80601-2-55 whenever the gas mixer is in use by connecting it to the gas outlet on the device between the device and the circuit.
- This device must be used with the O-Two™ Breathing Circuit, 01CV8037. It is recommended to connect the expiratory tubing of the circuit to an Anaesthetic Gas Scavenging System complying with ISO 80601-2-13
- If the alarm sounds continuously, immediately discontinue use and shut OFF the gas supply.
- After use, always turn OFF the cylinders to ensure that gas cylinders with sufficient volume are attached before returning the unit to its normal storage position.
- After use always turn OFF the device.
- Do not disassemble any part of the unit except where described in this manual as any unauthorized disassembly will invalidate the warranty.
- NEVER obstruct the output port nor the scavenging connector outlet.
- DO NOT use the Oxygen Flush function to provide positive pressure ventilation to a non-breathing patient.

℞ Only

- Medical gases must be dry and free from dust and oil. A malfunction in the medical gas pipeline will cause this device to stop working.
- This device and its associated breathing system are compatible for use with N_2O and O_2.
- The patient shall be constantly monitored by trained healthcare professionals while using the eAdvantage.

2. TEST EQUIPMENT

A) Oxygen / Nitrous Oxide Analyzer (VIASENSOR G210 or equivalent)

B) Timeter RT200 or equivalent

C) Pneuview Adult Test Lung set to 0.05 L/cmH_2O & Rp20.

A cycling Test Fixture (O-Two e700 with Patient Circuit) it is used in the factory as a dual lung with triggering capabilities.

Alternatively, other patient simulating devices could be used, as long as a steady rate and volume above 900 ml is maintained, such as a 1L syringe.

D) O-Two Patient Circuit (01CV8037) with 3-Way Tee Connector

E) AGSS (Anesthetic Gas Scavenging System) transfers, receives, and dispose of exhaust gas from the eAdvantage and Inhalation Resistance Test Fixture

F) Oxygen cylinder and N_2O cylinder

NOTE

Do not use cylinders with a reserve pressure lower than 500 PSI.

G) Adjustable output Oxygen regulator with a minimum 60 PSI (4.1 Bar) peak output pressure and a 9/16 DISS outlet. The regulator must be able to output a minimum flow of 100L/min at no less than 40.6 PSI (2.8 Bar).

H) Two separate Air supplies 35-87 PSI

I) Pressure Supply Atmospheric Bleed-Off Needle Valve Control

J) 3-Way Tee Supply Hose with Quick Disconnect Valve

K) Stop Watch

3. OPERATION AND MAIN DISPLAYS

3.1 Controls, Connections and Indicators

A	Green LED for battery operation indicator	I	Output Connection
B	N_2O Input Connection	J	LED Confirmation Indicator
C	Power Input Connection	K	Control Knob
D	USB Connection	L	Cancel Key
E	Alarm Buzzer	M	Audio Paused Key
F	Green LED indicator for AC power	N	Oxygen Flush Key
G	Orange LED indicator for battery charging	O	Oxygen Input Connection
H	Airway pressure monitoring port	P	LCD Screen

3.2 Main displays

• Calibration process
Calibration is conducted when the unit starts up. Operation screen - Main Page: displays the % concentration of each gas, time, battery status, settings, and lock status.

• Setting Mode - Set date & time, change passcode, display and transfer stored information, or perform software upgrade.

• Testing Mode

Check and test function of Sensors and Proportional Valves.

3.3 Main Operation

A) To start the eAdvantage®, press the Control Knob (K) for 1 second, the associated green LED (J) will commence flashes at a high frequency. After 1 second, the eAdvantage® will turn ON and begin the calibration process.

B) Enter Setting Mode - On Operation Screen, select “Setting Mode” by rotating control knob and confirm by pressing control knob.

C) Enter Testing Mode - On Setting Mode, select “Data Transfer” and press “Flush” for 9 seconds.

D) Exit Testing Mode - Press “Cancel Key” (L) for 4 seconds.

4. TESTING PROCEDURES

4.1 Check the function of control knob and each key as shown below. (Refer to Figure 1)

Control Knob (K):

Rotating the Control Knob will start the selection, change settings and parameters.

Pressing the Control Knob will activate the selection, confirm the selection, turn ON/OFF the unit.

Oxygen Flush key (N)

Pressing the Oxygen Flush key will deliver a constant flow of 40 +/-5 L/min of pure oxygen as long as this key is pressed.

Cancel key (L)

Pressing the Cancel key will cancel the current stage and return to the previous stage until the main screen with no selection is reached.

Silence key (M)

Pressing Silence key will mute the audible alarm for 2 minutes. The Silence function will be activated at any time when Silence key is pressed even without an active alarm.

4.2 Check LED indicators and Battery Status Indicator on screen as shown below, ensure all are in working conditions. (Refer to Figure 1)

LED indicators

	Green LED – Continuous when unit is ON and flashing when unit is OFF. Blinking at a high Frequency during the unit being turned ON/OFF or Enter/ Exit Test Mode.
	Green LED – Continuous when unit is connected to an external power source during both ON and OFF phases.
	Orange LED – Continuous when unit is charging and off when battery is fully charged during both ON and OFF phases. During the OFF phase, this light will start flashing when the battery capacity drops to around 60%.
	Green LED – Continuous when unit is ON and operated using internal battery.

Battery Status Indicator

Battery status will be displayed on the screen. There are two different status indicators, one showing discharge status and the other showing the charging status.

Battery discharge status

The battery discharge status indicator on screen should be around 50% of full

capacity, showing 2 or 3 bars on the indicator. Charge the battery if needed.

Battery charging status

The battery charging status indicator should display on the screen when the unit is connected to an external power source. Check the charging function.

4.3 Check Lock Feature

When activated, the unit will not permit changes to mixture concentration and will disable the Setting Mode and Oxygen Flush.

4.4 Input Pressure Alarms Check & Input System Leak Test

Input Pressure Alarms

a) Connect 60 PSI Air to O_2 input of unit and Timeter high pressure test port by using the T supply hose. Connect another separate 60 PSI Air supply to N_2O input of unit.

b) Decrease Air input pressure on O_2 side to 45 +/-1 PSI by using an adjustable regulator. The Low O_2 Input Pressure Alarm should activate and remain on until the pressure reaches 21 PSI.

c) Further decrease the pressure to 20 +/-1 PSI, the "No" O_2 Input Pressure Alarm should activate and remain on until the pressure drops to zero.

d) Increase the pressure to 80 +/-1 PSI, the High O_2 Input Pressure Alarm should activate and will terminate once the pressure drops below 79 PSI.

e) Repeat steps (a) to (d) to test the N_2O Input Pressure Alarms.

f) Adjust both input pressures to 60 PSI.

Input System Leak Test

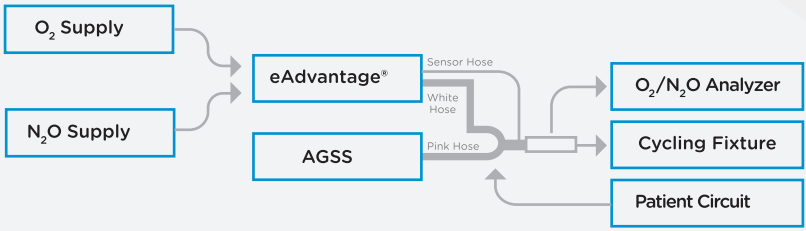
a) Disconnect the quick disconnect adapter on the O_2 supply line, start the stopwatch when pressure values have stabilized on the Timeter. The trapped pressures as indicated on the High Pressure Gauge must not drop more than 0.5 PSI in 30 sec.

b) Disconnect the quick disconnect adapter on the N_2O supply line, sstart the stopwatch when pressure values have stabilized on the Timeter. The trapped pressures as indicated on the High Pressure Gauge must not drop more than 0.5 PSI in 30 sec.

4.5 Oxygen And Nitrous Oxide Concentration (O_2 %, N_2O %)

a) Having connected the supply hose to the regulators, ensure that the eAdvantage is in the OFF condition, then turn on the oxygen and nitrous oxide supply. Using a mild soap solution, spray the input connections to the eAdvantage to check for leaks. If any leak is detected, tighten the connection and re-test.

b) Once no leaks are found, connect the Patient Circuit to the output of the eAdvantage (I). Then, connect the output port of the patient circuit to the Cycling Test Fixture and O_2/N_2O Analyzer using the 3-way Tee. Connect the exhaust port of the patient circuit to the Anesthetic Gas Scavenging System, and connect the sensor port of the patient circuit to the pressure sensor port of eAdvantage (H) as shown below.



c) Supply the unit with 60 PSI O_2 and 60 PSI N_2O. Turn ON the unit and set O_2% to 50%.

d) Set the Cycling Test Fixture (O-Two e700) as follows: Vt=900 ml (Flow=20 L/min (minimum)), Rate=15 BPM, I:E Ratio =1:1, TRI=disabled, Pmax=80 cmH_2O, or simulate according to these parameters:

f) After several cycles, or until the readings on Analyzer become stable, record the O_2%. The nominal value is 50%, with an accepted range of 45-55%.

NOTE: the unit should not exhibit any noticeable vibrations during testing.

Oxygen And Nitrous Oxide Concentration Chart

O_2 % Setting	30	40	50	60	70	75	90	100
O_2% Acceptable Range (%)	27-35	35-45	45-55	55-65	65-75	70-80	85-95	95-100
N_2O % Setting	70	60	50	40	30	25	10	0
N_2O% Acceptable Range (%)	75-65		55-45			30-20		0

5. ALARMS, WARNINGS AND NOTIFICATIONS

5.1 Functional Alarms

Note: Both visual and audible alarms will persist until the underlying cause of the alarm has been addressed and resolved.

If an alarm is activated, the user can press the Silence Key to temporarily silence the audible alarm for 2 minutes. However, the visual alarm will continue flashing until the problem causing the alarm is resolved.

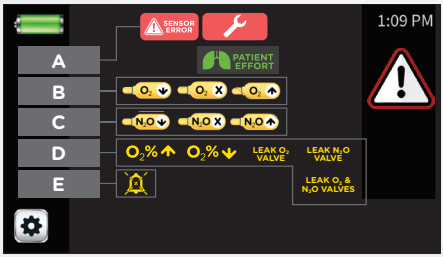
If the alarm is muted and a new alarm situation arises, the mute function will remain in effect. Only the visual indication for the new alarm will appear on the screen.

Alarms are displayed in sub-sections A-D. High-priority alarms are indicated with a red 'Warning' symbol, while Medium and Low-priority alarms have a yellow symbol.

The eAdvantage® device can display multiple alarm symbols simultaneously if several failures are occurring at the same time. In such cases, the audible alarm will correspond to the highest-priority alarm.

The patient effort cell is located at the center of the screen above the mixture dials as shown below. This symbol will be displayed during the whole phase of patient-demanded breaths.

Note: The dark grey cells shown below are not visible on the actual device screen. They are included in the following illustration for demonstration purposes.



Alarm/Warning priorities with corresponding visual/ audible alarms

Symbol	Name	Cell #	Priority	Alarm delay	On Screen Visual Alarm	Audible Alarm
	Sensor error (U13 and/or U14 sensors failure)	A	High	Directly	Solid symbol with flashing red warning symbol	1 Burst with 10 pulses each, repeat every 7.5 seconds
	No O_2 gas input ≤ 20 PSI	B	High	Directly	Solid symbol with flashing red warning symbol	1 Burst with 10 pulses each, repeat every 7.5 seconds
	Low O_2 input pressure (35-21 PSI)	B	Medium	Directly	Solid symbol flashing down with yellow warning symbol	1 Burst with 3 pulses each, repeat every 20 seconds
	High O_2 input pressure ≥ 80 PSI	B	High	Directly	Solid symbol with flashing red warning symbol	1 Burst with 10 pulses each, repeat every 7.5 seconds
	No N_2O gas input ≤ 20 PSI	C	High	Directly	Solid symbol with flashing red warning symbol	1 Burst with 10 pulses each, repeat every 7.5 seconds
	Low N_2O input pressure (35-21 PSI)	C	Medium	Directly	Solid symbol flashing down with yellow warning symbol	1 Burst with 3 pulses each, repeat every 20 seconds
	High N_2O input pressure ≥ 80 PSI	C	High	Directly	Solid symbol with flashing red warning symbol	1 Burst with 10 pulses each, repeat every 7.5 seconds
	Empty Battery		High	Directly	Solid symbol with a flashing red warning symbol	1 Burst with 10 pulses each, repeat every 7.5 seconds
	Low Battery		Low	N/A	The solid yellow symbol with a fixed yellow warning symbol	N/A

5.2 Preventive Alarms

The eAdvantage® will not switch ON if any of the problems listed below are detected:

1. O_2 Valve Failure.
2. N_2O Valve Failure.
3. O_2 Flow Sensor Failure.
4. N_2O Flow Sensor Failure.
5. U12 (Paw) Sensor Failure.
6. U13 (O_2 input pressure) Sensor Failure.
7. U14 (N_2O input pressure) Sensor Failure.

Instead, a new screen will display the cause of the malfunction and request the mixer to be checked or returned for service. At the same time, a continuous Audible Alarm will sound.

The above failures will be saved in the events log under specific failure as listed in the "Stored History" section.

If multiple failures are detected, the mixer will switch between the messages related to the failures.

Symbol	Name	Cell #	Priority	Alarm delay	On-Screen Visual Alarm	Audible Alarm
$O_2\%\downarrow$	Low O_2% @ 6% volume lower than setting	D	Medium or high below 27% of O_2%	After 3 consecutive breaths	Follow the visual alarm logic depending on the alarm priority	(Medium) 1 Burst with 3 pulses each, repeat every 20 seconds (high) 1 Burst with 10 pulses each, repeat every 7.5 seconds
$O_2\%\uparrow$	High O_2% @ 6% volume higher than setting	D	Medium	After 3 consecutive breaths	Solid symbol flashing down with yellow warning symbol at 0.7 Hz with 50% usage	1 Burst with 3 pulses each, repeat every 20 seconds

LEAK O_2 VALVE	O_2 valve leak during standby	D	High	10 seconds after turning the device ON or the last demanded breath	A solid symbol with a flashing red Warning symbol at 1.4 Ghz with 50% usage	1 Burst with 10 pulses each, repeat every 7.5 seconds
LEAK N_2O VALVE	N_2O valve leak during standby					
LEAK O_2 & N_2O VALVES	O_2 & N_2O valves leak during standby					

5.3 Flow Valve Leak Alarm

The eAdvantage® system includes a flow valve leak detection feature that functions when the unit is supplied with gas.

While the device is ON, it continually monitors the outputs from both flow sensors. This monitoring occurs during the standby mode or for 10 seconds following the last patient-demanded breath.

If either of the flow sensors detects any unexpected flow (suggestive of a leak), the device will promptly display leak alarms on the screen, alerting the user to the issue.

Note: The leak detection feature is inactive when both input gases are turned OFF (0 PSI). Therefore, the detection feature operates only when gas pressure is present in the system.

5.4 Battery Indicators

The eAdvantage® system provides visual indications of the battery status on the screen. There are two distinct types of battery status indicators:

- Discharge Status Indicator: Displays the current battery level during normal operation, indicating the remaining charge.
- Charging Status Indicator: Shows the battery status while it is being charged.

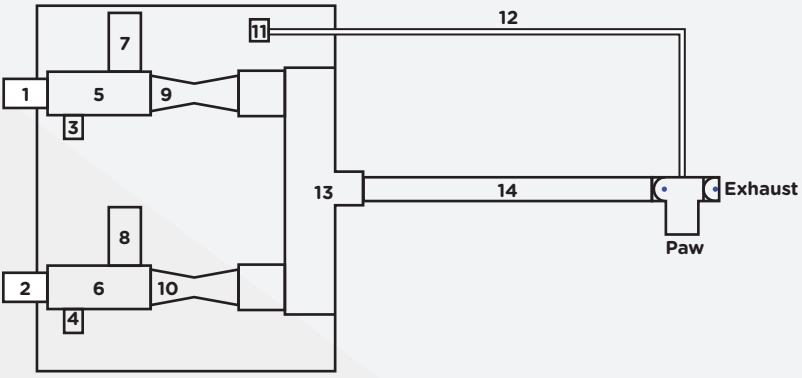
Battery discharge status on-screen indicators:			
1		Full capacity	No alarm
2		75% at full capacity	No alarm
3		50% at full capacity	No alarm
4		25% at full capacity	A solid yellow symbol with solid a yellow WARNING symbol
5		5% at full capacity	Corrected symbol with flashing red warning symbol at 1.4 Hz with 50% usage

Battery charging status on-screen indicators			
1		Full capacity	No alarm
2		75% at full capacity	No alarm
3		50% at full capacity	No alarm
4		25% at full capacity	No alarm
5		5% at full capacity	No alarm

Note: When the battery reaches approximately 2% of its full capacity, the device will not turn ON if it is currently OFF. Conversely, if the device is already ON and operating, it will automatically shut down to preserve the remaining battery life.

Battery levels are detected based on measured voltages, and the capacities shown above reflect results from tests using new batteries at room and low temperatures. Please note that battery levels are subject to change when using older batteries.

6 CIRCUIT DIAGRAM



1. O_2 Input Connector
2. N_2O Input Connector
3. O_2 Input The Pressure Sensor
4. N_2O Input The Pressure Sensor
5. O_2 Inlet Manifold
6. N_2O Inlet Manifold
7. O_2 Flow Control Valve
8. N_2O Flow Control Valve
9. O_2 Flow Sensor
10. N_2O Flow Sensor
11. Respiratory Pressure Sensor
12. Sensor Hose
13. Removal Kit
14. Patient Circuit
15. 3-Bypass Valve

7. TROUBLESHOOTING

⚠ WARNING ⚠

Please contact the manufacturer if a problem cannot be rectified. For the safety of the patient and the health care providers, DO NOT continue using the mixer.

Message/fault	Cause	Remedy
High inhalation resistance	Disconnected sensing hose or no input gas	Check input gas valves or sensing hose connection
External leak	Input hoses are not tightened	Tighten input hoses
Extremely high inhalation resistance	Device is OFF	Remove the mask from the face and ensure the device is ON
No input gas	No gas or input gas pressure below 20 PSI	Change the gas cylinder
Low input gas	Low gas below 40 PSI	Change the gas cylinder
Battery discharges quickly	No proper charging/faulty battery	Charge battery as per instructions/replace battery
eAdvantage® cannot be switched ON	Battery empty/no power supply connected/defective	Change battery/connect power supply/ send to O-Two™ for repair or service

8. REPLACEMENT PARTS AND ACCESSORIES

PART #	DESCRIPTION	UNIT
01CV8037-CS	O-Two Medical Single-Use Breathing circuit with Scavenger Hose, Monitoring line, and Adapter with Mouthpiece	Case/10
01FM4999-CS	Universal Face Mask	Case/12
01CV0106*	Power supply cord (Canada and the US)	Each
01CV0104	External power supply	Each
01CV7040-1	eAdvantage® Mounting Bracket w/ C-Clamp	Each
01CV7040-2	eAdvantage® Mounting Bracket w/ Medirail clamp	Each
01CV9200	Li-Ion Smart Battery	Each
02RT1303	Disposable Mouthpiece (Individually Wrapped)	Case/50

OXYGEN HOSES		
PART #	**DESCRIPTION**	**UNIT**
01FV4303-AFNR	O-Two™ 6 Foot (1.85 Meter) O_2 supply hose with AFNOR probe and 9/16" DISS nut device connection	Each
01FV4303-AGA	O-Two™ 6 Foot (1.85 Meter) O_2 supply hose with AGA probe and 9/16" DISS nut device connection	Each
01FV4303-CZCH	O-Two™ 6 Foot (1.85 Meter) O_2 supply hose with CZECH probe and 9/16" DISS nut device connection	Each
01FV4303-DIN	O-Two™ 6 Foot (1.85 Meter) O_2 supply hose with DIN probe and 9/16" DISS nut device connection	Each
01FV4303-DISS	O-Two™ 6 Foot (1.85 Meter) O_2 supply hose with 9/16 DISS nut and 9/16" DISS nut device connection	Each
01FV4303-UNFR	O-Two™ 6 Foot (1.85 Meter) O_2 supply hose with UNIFOR probe and 9/16" DISS nut device connection	Each
01FV4303-BM	O-Two™ 6 Foot (1.85 Meter) O_2 supply hose with BRITISH probe and 9/16" DISS nut mixer connection	Each

NITROUS OXIDE HOSES		
PART #	**DESCRIPTION**	**UNIT**
01FV4303-AFN-N_2O	O-Two™ 6 Foot (1.85 Meter) N_2O supply Hose with AFNOR Gas supply fitting and N2O DISS nut Device Connection	Each
01FV4303-AGA-N_2O	O-Two™ 6 Foot (1.85 Meter) N_2O supply Hose with AGA Gas supply fitting and DISS nut Device Connection	Each
01FV4303-CZCH-N_2O	O-Two™ 6 Foot (1.85 Meter) N_2O supply Hose with Czech Gas supply fitting and DISS nut Mixer Connection	Each
01FV4303-DIN-N_2O	O-Two™ 6 Foot (1.85 Meter) N_2O supply Hose with DIN nut and DISS nut Device Connection	Each
01FV4310	O-Two™ 6 Foot (1.85 Meter) N_2O supply Hose with DISS Gas supply fitting and DISS nut Device Connection	Each
01FV4303-UNF-N_2O	O-Two™ 6 Foot (1.85 Meter) N_2O supply Hose with UNIFOR gas supply fitting and DISS nut device connection	Each
01FV4303-BM-N_2O	O-Two™ 6 Foot (1.85 Meter) N_2O supply Hose with British gas supply fitting and DISS nut device connection	Each

9. SPECIFICATIONS

Gas Source	Compressed Oxygen + Nitrous Oxide
Circuit Control Source	Electronic
Pneumatic circuit Gas consumption (L/min)	0.00
Maximum Flow Rate (L/min)	>260 combined or 160 from oxygen input only
Oxygen concentration (O_2 %)	30-100 % continuous adjustment with 5% incremental changes
Trigger sensitivity (cm H_2O)	~ -1.0 (non-adjustable)
Input Pressure range (PSI)	50-70
Inhalation resistance (cm H_2O)	0 to -6
Exhalation resistance (cm H_2O)	0 to 6
Purge Flow rate (L/min)	40 (Oxygen)
Operating temperature (°C)	5 to 40
Storage temperature (°C)	-20 to 60
Device emergency shut off	below 35 PSI O_2 input
Battery	Li-Ion (01CV9200) | Operating time 15-24 hrs
A/C power adapter	100-250V / 4.74A
Display	4.3" Color TFT
Data Storage and Transfer	Yes
USB	Yes (for Data Transfer & Software Update)
Live Monitoring	Alarms and setting only
Parameter Settings	Control Knob
Lock Key Function	Yes w/ passcode
Dimensions (mm)	305 x 210 x 130
Weight With & W/O Battery (KG)	2.80 & 2.20

Your Representative is:

O-TWO MEDICAL TECHNOLOGIES INC.

For your nearest Authorized O-Two™ Distributor
In North America call Toll Free 1-800-387-3405

SERIAL Nº:	

CE 1639

EC	REP

MedNet EC-REP IIb GmbH
Borkstrasse, 10
48163 Münster, Germany

o_two controlled™ ventilation

www.otwo.com
45A Armthorpe Road, Brampton, ON, Canada, L6T 5M4
Telephone: **+1 905 792-OTWO (6896)** N.A. Toll Free: **+1 800 387 3405**
Facsimile: **+1 905 799 1339** Email: **resuscitation@otwo.com**