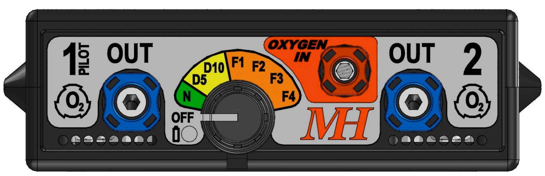
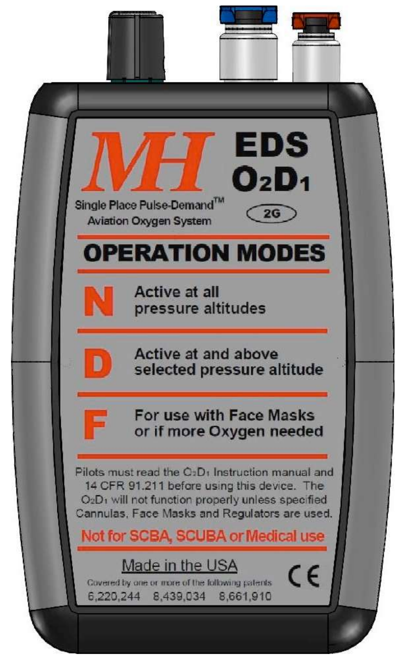
O2D2-2G

1 or 2 Person



O2D1-2G

Single Person



MH EDS 2G USER MANUAL

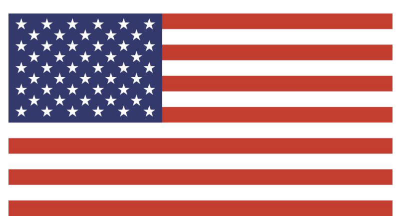
Digital Electronic Pulse-Demand™ Aviation Oxygen Delivery System

Thank you for purchasing the MH EDS Pulse-Demand™ Oxygen Controller.

Pulse-Demand™ is a patented innovative oxygen control technology that allows you to fly with safety and comfort, knowing that you will automatically receive the precise amount of oxygen required at altitude.

READ THIS MANUAL CAREFULLY BEFORE USE.

MH
Aviation Oxygen Systems
MOUNTAIN HIGH
Equipment & Supply Company



Proudly Made in the USA

Covered by one or more of the following patents
6,220,244 8,439,034 8,661,910
Other Patents Pending

800-468-8185 • 541-923-4100 • Fax: 541-923-4141 • www.MHoxygen.com • 2244 SE Airport Way, Suite 100 • Redmond OR 97756-7537

CONTENTS

The patented MH Pulse-Demand™ Electronic Delivery System (**EDS**) is designed to deliver aviation oxygen in the most efficient and convenient manner possible. With its user-selectable settings, **APNEA** Alarm and small size, the EDS is the most flexible portable digital electronic oxygen delivery system in the world.

Two EDS models fit most common needs for a portable oxygen system. The flagship **EDS O2D2** device provides oxygen for either one or two users in a single compact unit, while the **EDS O2D1** is the single-user "little brother" of the O2D2. The primary difference between the two models is the second-user capability of the O2D2, but otherwise the performance, features, operation and limitations of the O2D1 and O2D2 are essentially identical. This manual describes both models in generic terms, only referring to the O2D1 or O2D2 models when a notable difference exists. For example …

O2D2: When the O2D2 is used in single-place mode it has basically the same oxygen consumption and battery duration as the O2D1. Since oxygen consumption and battery duration information in this manual is presented on a "per person" basis, this means that when the O2D2 is used with 2 people oxygen consumption will be roughly double, and battery duration roughly half the indicated values.

O2D2: The O2D2 has 2 unique features distinct from the O2D1 which are described in separate sections:

- **O2D2 EXTERNAL AUDIO OUTPUT**, page 22.
- **O2D2 EXTERNAL POWER**, page 23.

The EDS unit supplies the oxygen you need to stay alert and comfortable while flying by providing a measured pulse of oxygen at the beginning of each inhalation. In contrast to constant flow systems that deliver more oxygen than the body needs, the MH EDS provides oxygen *only* when you inhale. This patented delivery technology ensures that you stay safe and comfortable by delivering the proper amount of oxygen based on your pressure altitude and breathing rate. The efficiency of this method provides a dramatic increase in cylinder duration, which enables you to enjoy the benefits of oxygen use below the mandated altitude. This means fewer headaches, less fatigue and increased alertness when flying at night or for long distances. It also enables you to save weight and space with a smaller cylinder, and fly longer between refills!

Unlike constant-flow oxygen systems, the MH EDS features “set and forget” operation and can be set to begin providing oxygen either immediately, or above a specified altitude. Oxygen flow is automatically adjusted according to your pressure altitude.

When you’re flying, you have more important things to do than adjust your oxygen flow during altitude changes.

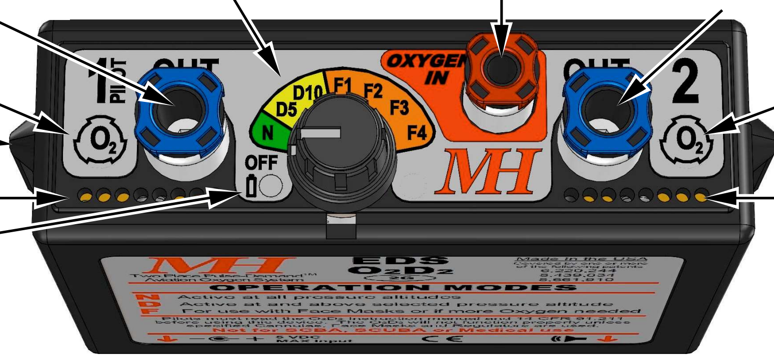
FEATURES

- Compact, light-weight, easy-to-use.
- Automatically adjusts oxygen flow for pressure altitude.
- Reduced oxygen consumption through more efficient oxygen delivery compared to constant-flow systems.
- Rugged MIL-spec control switch for improved reliability. Positive position-detents provide excellent tactile feedback and resistance to inadvertent changes.
- Rotary mode-switch selects the EDS operating mode: **N**ight, **D**elay or high-flow **F**acemask settings.
- Large easy-to-grip indicator knob for ease of use and good visibility.
- Red/Yellow/Green LEDs indicate oxygen flow status and alarm conditions.
- Audible and visible **FLOW-FAULT** Alarm informs user of kinked, pinched or disconnected oxygen lines.
- Reduced dry mouth and sinus discomfort compared to constant-flow oxygen systems.

Always connect to **Station #1 (Pilot)** when only one person is using the O2D2

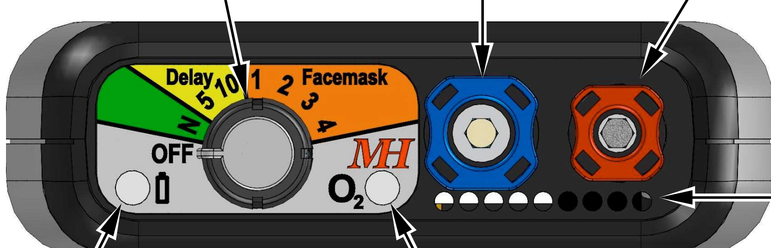
O2D2-2G

1 or 2 Person



O2D1-2G

Single Person



Typical EDS O2D2 Portable Oxygen System

(including oxygen cylinder, regulator and Full-Pack™ carry-on cylinder harness)

EDS O2D2 Kit
MH p/n: 00EDS-2200-00

O2D2 portable system stowed in Full-Pack™

A "handy" way to transport your oxygen system

Full-Pack™ secures to seat-back in aircraft

GETTING STARTED

Pilots who intend to fly with the EDS should familiarize themselves and their passengers with the system prior to use.

Cannulas and facemasks are included with the EDS unit. A cannula may be used for flight operations up to 18,000 ft., but above 18,000 ft., a facemask should be worn. A compatible facemask with a built-in microphone is available from MH (see page 29).

1. **Fill** your cylinder with Aviation Oxygen if you have not already done so. Many FBOs offer this service (see **FILLING YOUR PORTABLE CYLINDER**, page 20).

2. **Inventory** your system (see table/photo) and read the front label on the EDS unit

Item	O2D2 Qty	O2D1 Qty
(a) EDS User Manual	1	1
(b) EDS unit	O2D2	O2D1
(c) AA Batteries	3	2
(d) 3M Dual-Lock	2	2
(e) Anti-Bacterial Facemask Wipes	✓	✓
(f) Oxygen Inlet Tube	1	1
(g) EDS Facemask	2	1
(h) Cannula, Standard	2	1
(i) Cannula, Flare-tip	2	1
(j) Tote-bag	2	1
(k) Warranty Registration Card	1	1

3. **Attach** the Regulator to your cylinder per the instructions provided with your cylinder and pressure regulator (REG-1032 illustrated).
   - The EDS is designed for use with MH Pressure Regulators only (see pages 16, 18).
   - ***Hand-tighten only!*** The regulator seals to the cylinder with an “O” ring and only needs to be installed hand-tight to achieve a proper seal.
   - ***DO NOT use a wrench or pliers. Over-tightening will damage the regulator.***
   - *Pressure in the Regulator* ***must be relieved*** *before the Regulator can be removed from the cylinder* (see **BLEEDING THE REGULATOR**, *p. 8*).

4. **Open** the battery cover on the back of the EDS unit, install the AA batteries (2x for O2D1, 3x for O2D2) and replace the battery cover.

   NOTE: Batteries fit tightly, handle with care.

   See page 8 for detailed instructions.

5. **Connect** the oxygen inlet tubing between the Regulator and the EDS (see **CONNECTING TO YOUR REGULATOR**, p. 16).

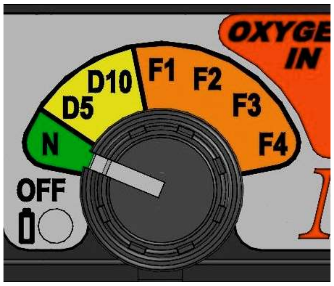
   If you are using an MH **XCP** or **FPR** Regulator with CPC type connectors:
   - Locate the inlet tubing included with your EDS (clear tube with a short Red tube on one end).
   - Insert the Red end of the tubing into the Red "OXYGEN IN" connector on the EDS unit until it stops (see page 8),
   - Insert the CPC male fitting on the other end of the tubing into the Regulator.

   If you are using an MH **XCR** Regulator with a "One-Touch" fitting (e.g., REG-1032):
   - Use the Red 4mm inlet tubing that came with the Regulator in place of the tubing that came with your EDS.
   - Insert one end of the tubing into the Red "OXYGEN IN" connector on the EDS unit until it stops (page 8).
   - Insert the other end of the tubing into the "One-Touch" fitting on the Regulator.

6. **Insert** the Blue end of the cannula or facemask tubing into the BLUE "OUT" connector on the EDS unit (page 8).
   - *Use only the supplied MH EDS cannula, as other cannulas may not work properly with the EDS.*
   - **O2D2:** Always use the #1 connector when only one (1) person will be using the system. For a second user, insert the BLUE end of the cannula or facemask tubing into the BLUE #2 connector. The **APNEA ALARM** for the User #2 outlet is enabled only after several successive initial inhalations are detected.

   CAUTION: DO NOT pinch *the Cannula or Facemask tubing when inserting into the BLUE "OUT" connectors.*

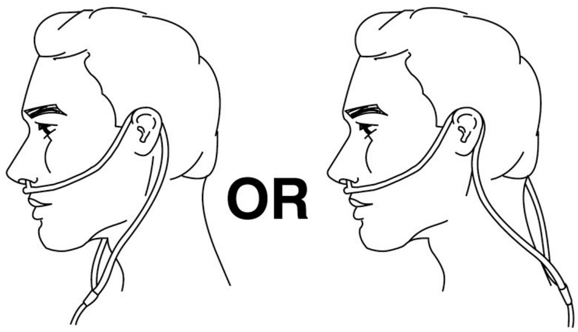
   DO NOT lengthen or shorten the cannula tubing.



7. **Open** the oxygen cylinder valve ***SLOWLY*** (~ 2 turns).

8. **Turn** the EDS unit on by rotating the Mode-Selector knob one position to the right (clockwise) which sets it to "**N**" mode (page 9). The **POWER-UP TEST** sequence will verify battery power (page 10), and a start-up pulse of oxygen will be delivered.

9. **Don** the cannula (with the tab pointing down) or facemask (making sure it seals against the skin). Refer to the card that comes with the cannula or facemask for donning information.



Comfortable Cannula Position

Looped over ears with TAB pointed down

10. **Take** a breath. The station indicator LED should illuminate bright green, and a pulse of oxygen should be delivered. A positive inhalation (with some effort) is required to trigger the unit. Very soft or shallow breathing may not be detected.

11. **Test** the EDS unit on the ground for proper operation and check your oxygen cylinder for adequate pressure (page 12).

You are ready to fly.

INSTALLING & REPLACING BATTERIES

__O2D2:__ The O2D2 uses three (3) AA alkaline batteries. Remove the battery door by gently pressing down on the battery cover tab, then tip the door out and away from the unit. Insert the batteries with ***proper polarity*** as shown. Replace the door by setting the bottom of the door in place and tipping the top in until it snaps into place.

__O2D1:__ The O2D1 uses two (2) AA alkaline batteries. Remove the battery door by gently pressing down on the battery cover tab, then slide the door out and away from the unit. Insert the batteries with ***proper polarity*** as shown on the label inside the battery compartment. Replace the door by sliding it back in until it snaps into place.

NOTES:

- Batteries will be a tight fit. Take care not to damage the batteries and/or connectors when inserting or removing the batteries. Do not short the battery terminals.
- Install the batteries with the proper polarity as shown.
- ***Use good quality <u>alkaline</u> batteries <u>only</u>*** (DURACELL ULTRA or equivalent).
- ***<u>DO NOT</u> USE LITHIUM BATTERIES!*** No damage will result, but the **LOW BATTERY** Alerts <u>WILL NOT</u> function correctly as they are calibrated for alkaline batteries.
- ***<u>DO NOT</u> mix old and new batteries!*** Replace all batteries at the same time.
- ***Remove the batteries during long periods of non-use*** (see **STORING THE EDS**, page 20). Battery leakage and corrosion can damage the EDS.
- ***Batteries should be replaced annually*** or whenever a **LOW BATTERY** Alert is indicated. Remove exhausted batteries from the EDS.
- ***Dispose of batteries properly.*** Do not burn. Use collection points when available.
- __O2D1:__ The O2D1 will operate for ~ 100 hours with fresh alkaline batteries under normal conditions.
- __O2D2:__ The O2D2 will operate for ~ 50 hours with 2 people (~ 100 hours for one person) with fresh alkaline batteries under normal conditions.
- __O2D2:__ See page 23 for **O2D2 EXTERNAL POWER** information.

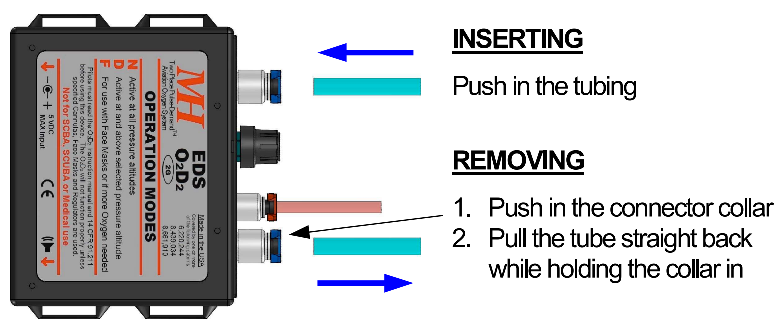
TUBING & CONNECTORS

The O2D1 and O2D2 have the same tubing fittings. The O2D2 is depicted here, but the instructions for inserting and removing the tubing are exactly the same for both models.

To INSERT TUBING: push the tubing into the connector until resistance is felt, then push a little further, about 1/8 inch. Gently tug on the tubing to make sure it is captured.

To REMOVE TUBING: push the tubing in slightly, then push in the connector collar while pulling gently on the tubing.

When removing tubing, ***<u>DO NOT</u> pull on the tubing without pushing in the collar,*** as this will likely damage the connector.



BLEEDING THE REGULATOR

Bleed the regulator between uses. Leaving the regulator pressurized when not in use will shorten its service life.

1. Make sure the oxygen cylinder valve is closed.
2. Remove the regulator outlet tubing from the <u>EDS inlet fitting</u>. Merely removing the tubing from the <u>regulator outlet fitting</u> of an XCP or FPR type regulator will not actually bleed the regulator as the check-valves incorporated into the CPC outlet fittings will retain pressure in the regulator (also applies to the 6mm Split-Kit, see **CONNECTING TO YOUR REGULATOR**, p. 16). You may hear the gas escaping as you do this.
3. Stow the regulator outlet (EDS inlet) tubing properly in order to prevent contamination (STORING THE EDS, p 20).
4. If you wish to remove the regulator from the cylinder, merely loosen the regulator nut by hand. **<u>USE NO TOOLS!</u>** If the regulator has been properly bled, it will loosen easily by hand.

The Rotary Mode-Selector knob controls operation of the MH EDS.

Available options encompass three main modes of operation:

N Mode:	**Standard Flow**	**Immediate onset**
D Modes:	**Standard Flow**	**"Delayed" onset** (altitude threshold)
F Modes:	**Enriched Flow**	**Immediate onset**

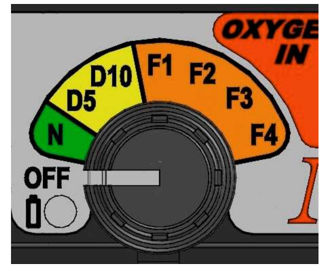
Notes:

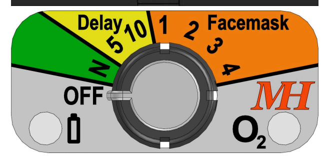
- The **N** and **D** modes are calibrated to provide the oxygen normally required by a healthy average-size person using a cannula at a given altitude. Your needs may be different.
- The **F** modes are provided for use with a Facemask, but may also be used with a cannula if more oxygen is required than is otherwise provided by the **N** or **D** modes.
- In all modes, the EDS delivers more oxygen as altitude increases (altitude compensating).
- Mode setting changes produce an audible "beep" and the Battery LED flashes Green.
- **O2D2:** The selected mode applies to both users and should be set to accommodate the user with the highest oxygen need.
- You may use a Pulse Oximeter to help monitor your blood oxygen saturation level, but keep in mind that due to certain physiological effects at higher altitudes, these devices tend to indicate a saturation level *lower than actual.*

MODE SETTINGS

Mode Selector Knob in "OFF" position

O2D2 *(upper image)*
O2D1 *(lower image)*

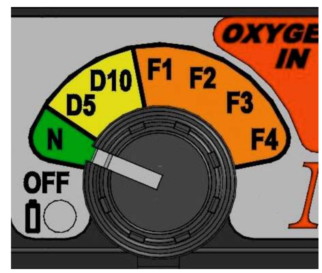




N MODE: "Night" or "Now"

The **N** setting causes the MH EDS to immediately begin providing the standard oxygen flow appropriate for an average healthy person using a cannula. Operation commences (and continues) regardless of pressure altitude, so **N** mode assures that you will continue to receive supplemental oxygen all the way through final approach and landing. This is useful when flying at night since night vision is especially affected by hypoxia.

Flow amount:	Standard	**Altitude Compensating:**	Yes
Flow start:	All altitudes	**Use with:**	Cannula

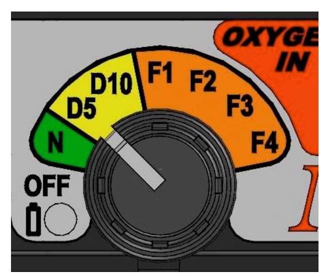


D MODES: "Delayed" or "Day"

The **D** settings "delay" operation until a minimum pressure altitude threshold is reached: 5,000 ft. in **D5** mode; 10,000 ft. in **D10** mode.

Flow amount:	Standard	**Altitude Compensating:**	Yes
Flow start (D5):	5,000 ft.	**Use with:**	Cannula
Flow start (D10):	10,000 ft.		

NOTE: When the barometric pressure is low, operation will begin at a slightly *lower* flight altitude than when the barometric pressure is high.



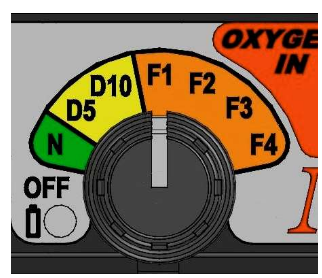
F MODES: "Facemask" or "Fat"

The **F** settings are for use with a Facemask or when more oxygen is required with a cannula.

Flow amount:	Enriched	**Altitude Compensating:**	Yes
Flow start:	All altitudes	**Use with:**	Facemask or Cannula

Notes:

- **F** settings augment the amount of oxygen otherwise provided at a given pressure altitude in order to compensate for the additional plenum volume associated a facemask.
- Each successive **F**-setting provides a progressively larger dose of oxygen.
- **F**-Mode settings are calibrated for use with the various sizes of the MH EDS or ALPS facemasks as indicated in the table below. Use *only* approved MH EDS or ALPS facemasks.



ALPS Facemask	F1	F2	F3	F4
Small	●	●		
Medium		●	●	
Large			●	●

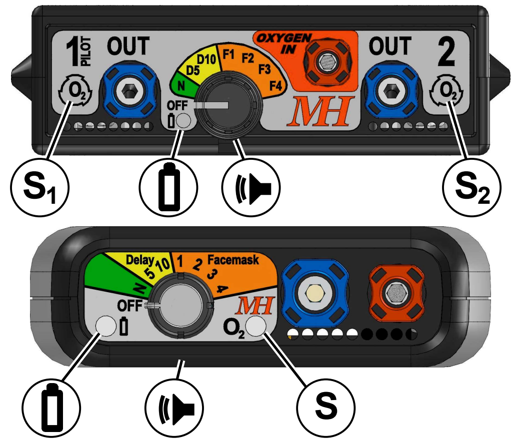
ALARMS & ALERTS

The MH EDS provides a continuous indication of operational STATUS, and also generates audible and visual ALARMS and ALERTS designed to call the user's attention to critical warnings or error conditions.

System STATUS, ALARM and ALERT conditions are conveyed by front-panel LEDs and an on-board tone generator. The pattern of flashing LEDs and tones associated with each condition is intended to be suggestive of the severity of the condition indicated and otherwise as obvious as possible. You should nevertheless familiarize yourself with the various ALARMS and ALERTS before using your EDS for the first time, and review periodically.

The Station Indicator LED (**S**) displays conditions related to the breathing station, while the Battery Warning LED displays battery-related conditions. LEDs may flash Red (**R**), Green (**G**), or Amber (**A**). The Tone Generator emits high/low tones in conjunction with ALARM conditions. An initial oxygen pulse (**O_2**) is delivered as part of the Power-Up Test sequence. Oxygen pulses are subsequently delivered with each inhalation during normal operation.

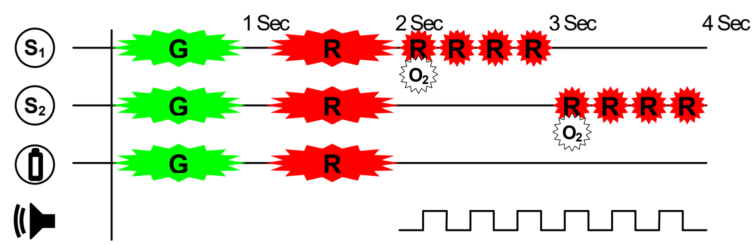
<u>**O2D2:**</u> The O2D2 has 2 Station LEDs (**S_1 S_2**) which are depicted separately when their behavior is distinct.



Battery LED	S	Station LED	Tone Generator
Red	R	A Amber	Beep/Chirp
Green	G	O_2 Oxygen Pulse	Warble Tone

POWER-UP TEST

LEDs flash **Green** then **Red**. An oxygen pulse (~ ½ second) is then delivered to the Station outlet and the Station LED **(S)** emits 4 rapid **Red** flashes accompanied by a High-Low warble tone. <u>**O2D2:**</u> the oxygen pulse, flashing **Red** LED and warble tone is repeated for Station #2 **(S_2)**. The **POWER-UP TEST** checks the battery voltage and verifies valve operation and the continuity of the oxygen supply, as well as exercising the LEDs and tone generator.

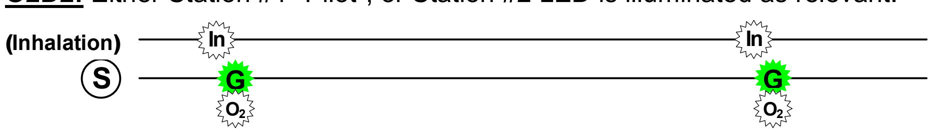


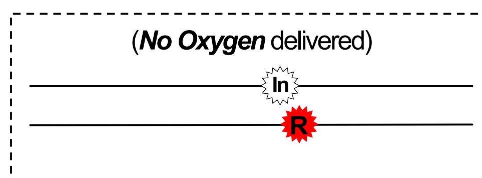
The oxygen pulse will be evident from the sound of the valve opening, or if you have donned your cannula, you will be able to feel the pulse in your nostrils. See **OXYGEN SYSTEM PRE-FLIGHT**, page 12.

INHALATION EVENT & OXYGEN DELIVERY NOTIFICATION

Station LED flashes (~ ¼ second minimum) with each valid inhalation event detected. A **Green** flash indicates that oxygen was delivered, a **Red** flash indicates that ***no oxygen*** was delivered.

<u>**O2D2:**</u> Either Station #1 "Pilot", or Station #2 LED is illuminated as relevant.



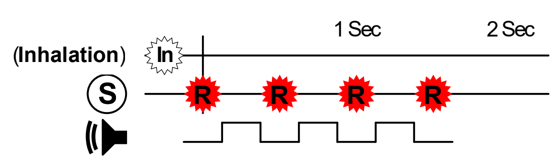


No oxygen will be delivered under the following circumstances:

- If operating in **D** mode but below the selected threshold altitude.
- If the detected breathing rate exceeds 30 bpm (breaths-per-minute), the EDS unit delivers oxygen only on every other breath (which provides a behavior more to the expectations of the user).

FLOW-FAULT ALARM

Station LED emits 4 **Red** flashes accompanied by a High-Low warble tone. A **FLOW FAULT ALARM** indicates that an inhalation has been detected, but that an adequate amount of oxygen ***has not been delivered.***

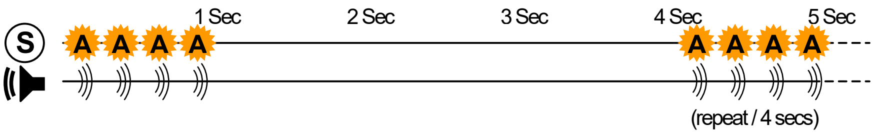


A **FLOW FAULT ALARM** typically means that either:

1. The oxygen cylinder valve is not open.
2. The oxygen supply line is pinched or disconnected.
3. The valve in the EDS unit has failed to operate.

A **FLOW FAULT ALARM** is <u>not</u> necessarily a low oxygen pressure warning.

APNEA ALARM



Station LED emits 4 rapid **Amber** flashes with audio beeps when no valid inhalation event has been detected recently.

An **APNEA ALARM** is generated if the time since the last inhalation event exceeds an interval that is dependant on the pressure altitude. This interval is ~30 seconds at lower altitudes, but much less at higher altitudes where the onset of hypoxia is more rapid and its effects are more pronounced (see page 31).

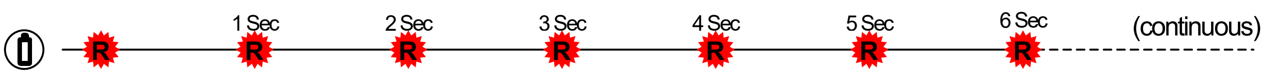
An **APNEA ALARM** typically occurs for one of the following reasons:

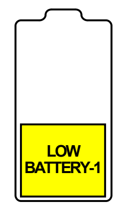
1. The cannula or facemask has been removed or is not being worn properly.
2. The outlet tube from the EDS unit to the cannula or facemask has become pinched or disconnected.
3. The user is breathing primarily through their mouth while using a cannula or otherwise too softly for inhalation to be detected.

The **APNEA ALARM** does not respond below the selected pressure altitude when operating in **D** mode (see page 9).

<u>**O2D2:**</u> Apnea monitoring is <u>always</u> active for Station #1 (Pilot). Apnea monitoring for Station #2 only becomes active after ~ 30 seconds of continuous use. If Station #2 is unused, the O2D2 will <u>not</u> spontaneously generate **APNEA** Alarms for Station #2. Apnea monitoring will reset when the O2D2 is turned off then on again.

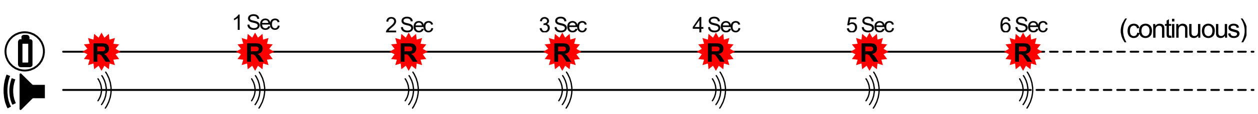
LOW BATTERY-1 ALERT (First Warning)

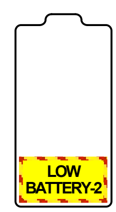




Battery Warning LED displays continuous slow **Red** flashes with no sound.
From the time a **LOW BATTERY-1 ALERT** is first issued, the EDS should continue to operate properly for about another eight (8) man-hours (@ 77°F/25°C, and depending on battery quality).

LOW BATTERY-2 ALARM (Second Warning)

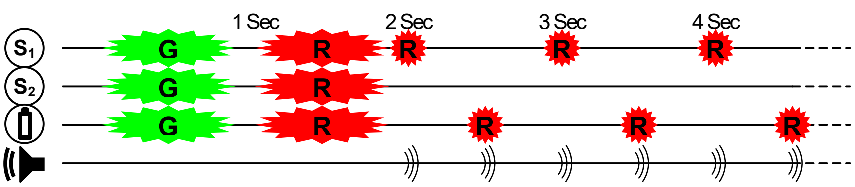




Battery Warning LED displays continuous slow **Red** flashes together with a high chirping sound.
From the time a **LOW BATTERY-2 ALARM** is first issued, the EDS may continue to operate for about another two (2) man-hours.

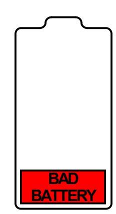
- <u>**REPLACE THE BATTERIES IMMEDIATELY**</u> if you receive either of the **LOW BATTERY** Warnings during your **OXYGEN SYSTEM PRE-FLIGHT** check (page 12).
- If you receive the <u>Second Warning</u> while in the air, you may wish to descend to a lower altitude in order to minimize the consequences of a sudden failure of your oxygen system.
- If you continue *beyond* the <u>Second Warning</u>, the batteries will ultimately deplete to the point where the valves cease firing. At this point, you will <u>no longer be receiving oxygen</u> (see **BATTERY LIFE AND DEPLETION,** page 13).

BAD BATTERY ALARM



(Red flashing repeats continuously)

Battery Warning LED and Station LED alternately flash **Red** accompanied by a high chirping tone. The batteries are too low to operate the EDS unit and it will not dispense oxygen.



BATTERIES <u>MUST</u> BE REPLACED!

This test is performed at **POWER-UP** only. The EDS may or may not complete the full **POWER-UP TEST** sequence (initial oxygen pulses, etc.) before generating a **BAD BATTERY ALARM.** If a **BAD BATTERY ALARM** <u>is</u> generated, the EDS will enter "lock-out" mode and will not function other than to display the **BAD BATTERY ALARM**.

<u>**O2D2:**</u> see **O2D2 EXTERNAL POWER** information on page 23.

OXYGEN SYSTEM PRE-FLIGHT

The following procedures should be performed prior to every flight.

1. **ESTIMATE OXYGEN DURATION**

   Prior to flight, check the pressure gauge on your oxygen system and estimate the duration of your oxygen supply based on your anticipated flight profile (see **ESTIMATING OXYGEN DURATION**, p. 14). Take into account that you or your passenger(s) may need *more* oxygen than "normal". Consider all the legs of your flight if you may not be able to refill your oxygen cylinder along the way.

   Make sure that your estimated oxygen duration exceeds your anticipated oxygen needs. Be conservative in your estimate in order to leave some "breathing room" in the event of delays.

   Cylinder pressures below 300 psi will compromise the operation of the regulator and affect the amount of oxygen delivered. Below 300 psi, you may be receiving less oxygen than prescribed, but with no indication of a problem.

2. **CONNECT OXYGEN SYSTEM**

   A portable oxygen system needs to be carefully configured prior to each use. Secure your oxygen cylinder as required, and connect the oxygen inlet line (see **CONNECTING TO YOUR REGULATOR**, p. 16) and cannula/facemask outlet lines to the EDS. Verify all connections.

3. **OPEN OXYGEN CYLINDER VALVE**

   The oxygen cylinder valve should always be closed when not in use. Open the valve ***SLOWLY***.

4. **EDS BATTERY TEST**

   Turn the Mode-Selector knob to the **N** position to **POWER-UP** the EDS (see **POWER-UP TEST**, page 10). The Battery Monitoring function will require several seconds to properly assess the condition of the batteries. Continue to observe the unit for several seconds after **POWER-UP** to watch for indication of a **LOW BATTERY** or **BAD BATTERY** condition. If you receive any of these **LOW BATTERY** Alerts, **REPLACE THE BATTERIES IMMEDIATELY** *before* your flight! (page 13)

   O2D2: Test and verify battery operation even if you intend to operate the O2D2 with external power (page 23).

   You should always have a spare set of fresh batteries with you.

5. **EDS FUNCTIONAL TEST**

   Don your cannula/facemask and have your passenger(s) do the same. Familiarize passenger(s) with the system as required. Make sure that the outlet tubing is properly connected to the EDS and not kinked or pinched. Take a breath (inhale) and verify that oxygen is being delivered (the Station LED on the EDS will flash Green, you should feel a puff of oxygen in your nostrils, and you may even hear the valve open inside the EDS unit). You have now verified that your entire oxygen system is functioning properly.

6. **CHECK SPARES KIT**

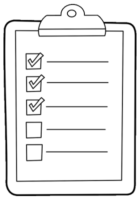
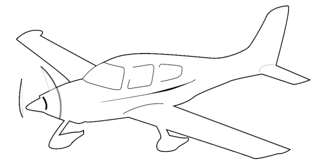
   - Spare set of fresh, quality AA alkaline batteries. ***You should always have a spare set of fresh batteries with you at all times.***
   - You may also wish to keep some Anti-Bacterial Facemask Wipes on hand (page 29).

It is recommended that you wear your cannula for the entire flight if a need for supplemental oxygen is anticipated. Consider the MH E-Z Breathe Boom Cannula (page 29) as a convenient way of keeping your oxygen system ready to use. At the point when the onset of hypoxia is a possibility, it is better to not have to deal with the otherwise unnecessary task of donning your cannula. Facemask users may also want to consider this. If you choose to remove your cannula/facemask at any point, stow it in such a manner that the outlet tubing will not become kinked or pinched when re-donning it.

Even if you do not anticipate an immediate need for oxygen, it is recommended that the EDS be set to **D5 or D10** mode as a default. This way, you will automatically begin receiving oxygen when you exceed 10,000 ft (pressure altitude). You may switch the EDS to **N** or **F** mode at any time to begin receiving oxygen "**Now**". If using the **D** Modes (page 9), it is recommended that you don your cannula or facemask before you reach the **D5** or **D10** preset altitude, rather than using the **APNEA Alarm** (page 11) as a “put-on-your-cannula/facemask” reminder.

OXYGEN SYSTEM POST-FLIGHT

1. **Turn off the EDS unit.**
2. **Close the oxygen cylinder valve** (leaving the regulator pressurized when not in use can shorten service life).
3. **Bleed the regulator** and EDS inlet line (see **BLEEDING THE REGULATOR**, page 8).
4. **Stow cannulas/facemasks/tubing** to prevent contamination (see **STORING THE EDS**, page 20).

PRE-FLIGHT			IN-FLIGHT
 EDS POWER-UP TEST	(Nominal)	(Nominal)	
REPLACE BATTERIES <u>IMMEDIATELY</u> (prior to flight)	**LOW BATTERY-1**	**LOW BATTERY-1**	less than 8 man-hrs remaining **REPLACE BATTERIES AT <u>FIRST OPPORTUNITY</u>**
REPLACE BATTERIES <u>IMMEDIATELY</u> (prior to flight)	**LOW BATTERY-2**	**LOW BATTERY-2**	less than 2 man-hrs remaining **DESCEND AT <u>FIRST OPPORTUNITY</u> & REPLACE BATTERIES**
REPLACE BATTERIES <u>IMMEDIATELY</u> (Inoperable "Lock-Out" Mode)	**BAD BATTERY**	**LOW BATTERY-2 with FLOW-FAULT**	No Longer Dispensing Oxygen **<u>OXYGEN SYSTEM SHUTDOWN</u>**

Notes:

- **Replace the batteries *<u>immediately</u>*** if you receive <u>any</u> of the **LOW BATTERY** Alerts during your **OXYGEN SYSTEM PRE-FLIGHT** check (page 12). DO NOT embark on a flight with weak batteries. You should always carry a set of fresh AA alkaline batteries as part of your "spares" kit.
- If you begin a flight with a **LOW BATTERY-1** Alert (page 11), you may have no more than 2 man-hours of remaining operation.
- If you begin a flight with a **LOW BATTERY-2** Alarm (page 11), you may be on the verge of imminent shut down.
- If you receive a **LOW BATTERY-2** Alarm in flight, descend at your first opportunity and replace the batteries.
- If you continue to operate with a **LOW BATTERY-2** Alarm, and subsequently begin receiving **FLOW-FAULT** Alarms, this likely indicates that the oxygen-dispensing valves have ceased operating, and you are <u>no longer receiving oxygen.</u> Descend as soon possible! (see **BATTERY LIFE AND DEPLETION** discussion below)
- It is particularly important to heed **BATTERY ALERTS** if you are to be conducing flight operations in the flight levels.
- The times for remaining operation ("Time-to-Failure") are approximations only, based on nominal conditions (see below).

BATTERY LIFE AND DEPLETION

Battery life depends on many variables. First of all, not all batteries are created equal, so use "good quality" (Name-Brand) <u>alkaline</u> batteries. Batteries (even if <u>unused</u>) have a limited shelf life, so make sure you have "fresh" ones. Even so, "brand new" batteries may be faulty or partially depleted.

In addition, the rate at which the batteries are depleted is influenced by several factors. The power consumed by the valves varies individually. Your altitude and respiration rate (as well as temperature, humidity, etc.) also affects the rate of battery depletion.

Once the EDS has successfully powered-up (without issuing a **BAD BATTERY** Alarm), it will continue to operate as long as possible until the batteries are completely exhausted. As the batteries deplete, the EDS will first issue a **LOW BATTERY-1** Alert (page 11) informing you that you have no more than 8 man-hours of operation remaining. With further depletion, the EDS will issue a **LOW BATTERY-2** Alarm warning you that you have, at best, about 2 man-hours of operation remaining.

Ultimately, the batteries will deplete to the point where the EDS will no longer be able to operate the oxygen-dispensing valves. When the valves cease operating, you will <u>no longer be receiving oxygen!</u> This is typically heralded by the onset of **FLOW-FAULT** alarms for each breath.

Note that alkaline batteries will sometimes "rejuvenate" if allowed to "rest". So although you may have received a **LOW BATTERY** Alert at the end of your previous flight, you may not get a warning when powering-up the EDS the next day. This is misleading, and you should not let this situation lull you into postponing battery replacement. Once a **LOW BATTERY** Alert has been issued, the batteries are unreliable and should be ***replaced immediately.***

ESTIMATING OXYGEN DURATION

You can *estimate* whether your oxygen supply will be sufficient for your flight if you have a good idea of the maximum altitude that you will be flying at while using oxygen. The table below indicates the amount of time that a given **FULL** cylinder will last **for one person**. Multiply that value by the proportion of *usable* oxygen in your cylinder, and *divide by the number of people* who will be using oxygen. Compare the result to the amount of time that you anticipate that you will be using oxygen. Just like your fuel calculations, make sure you always have more oxygen than your calculations indicate (see ***Notes on Estimating Oxygen Duration** below).*

Usable Oxygen

The amount of oxygen in your cylinder is determined by its capacity (size) and pressure. However, not all of the oxygen in your cylinder is "usable". Below 300 psi, regulator performance degrades to the point where the EDS will not be able to deliver the full prescribed dose of oxygen and ***hypoxia could result***. Therefore, the last bit of oxygen in your cylinder must be discounted as "unusable".

The ***Simple*** way to estimate oxygen duration merely divides your current indicated cylinder pressure by its Rated (MAX) pressure and assumes that this proportion represents your usable oxygen. In other words, if your cylinder is half full, then just divide the FULL cylinder duration by 2. This is reasonably close when your cylinder is nearly full, but departs considerably and gives an *overly optimistic* approximation as your cylinder approaches empty.

The ***Proper*** way accounts for the "unusable" portion of oxygen in your cylinder and provides a *true* correction to the FULL cylinder duration. This becomes extremely important as your cylinder approaches "empty".

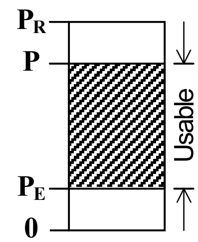
Oxygen Duration (***Simple*** method)

$$T = \frac{T_R}{N}\left(\frac{P}{P_R}\right)$$

Oxygen Duration (***Proper*** method)

$$T = \frac{T_R}{N}\left(\frac{P - P_E}{P_R - P_E}\right)$$

T = Estimated Oxygen Duration Time
T_R = FULL Cylinder Duration Time
N = Number of users
P = Cylinder Pressure (indicated)
P_E = "Empty" Cylinder Pressure = 300 psi
P_R = Rated (MAX) Cylinder Pressure



Cylinder Duration Table

Look-up the FULL Cylinder Duration Time (T_R) for your cylinder in the following table and calculate your estimated oxygen duration (T) as above. As needed, determine the value for a specific altitude by interpolating between adjacent values.

Cylinder Model Number	Rated MAX Cylinder Pressure P_R		Rated MAX Cylinder Capacity V_R		T_R = FULL Cylinder Duration (hours ***per person***)				
					EDS Modes **"N", "D"**			EDS Mode **"F"** Class A Airspace	
	psi	bar	Cu Ft	Liters	10000 ft	15000 ft	18000 ft	20000 ft	25000 ft
AL-113	2216	153	4.0	113	6.9	3.4	2.6	1.8	1.2
AL-180	2216	153	5.8	165	10.1	4.9	3.8	2.6	1.7
AL-248	2015	139	8.8	248	15.2	7.4	5.7	3.9	2.6
AL-415	2015	139	14.7	415	25.4	12.3	9.6	6.6	4.3
AL-647	2216	153	22.8	647	39.6	19.2	14.9	10.3	6.7
AL-682	2015	139	24.1	682	41.8	20.2	15.7	10.8	7.0
CFF-480	3000	207	18.2	515	31.6	15.3	11.9	8.2	5.3
CFFC-048	2216	153	48.2	1365	83.6	40.5	31.5	21.6	14.1
CFFC-022	1850	128	22.0	623	38.2	18.5	14.4	9.9	6.4
KF-011	1850	128	11.0	311	19.1	9.2	7.2	4.9	3.2
KF-077	1850	128	77.0	2180	133.6	64.7	50.3	34.5	22.5
KF-115	1850	128	115.0	3257	199.6	96.6	75.2	51.6	33.6

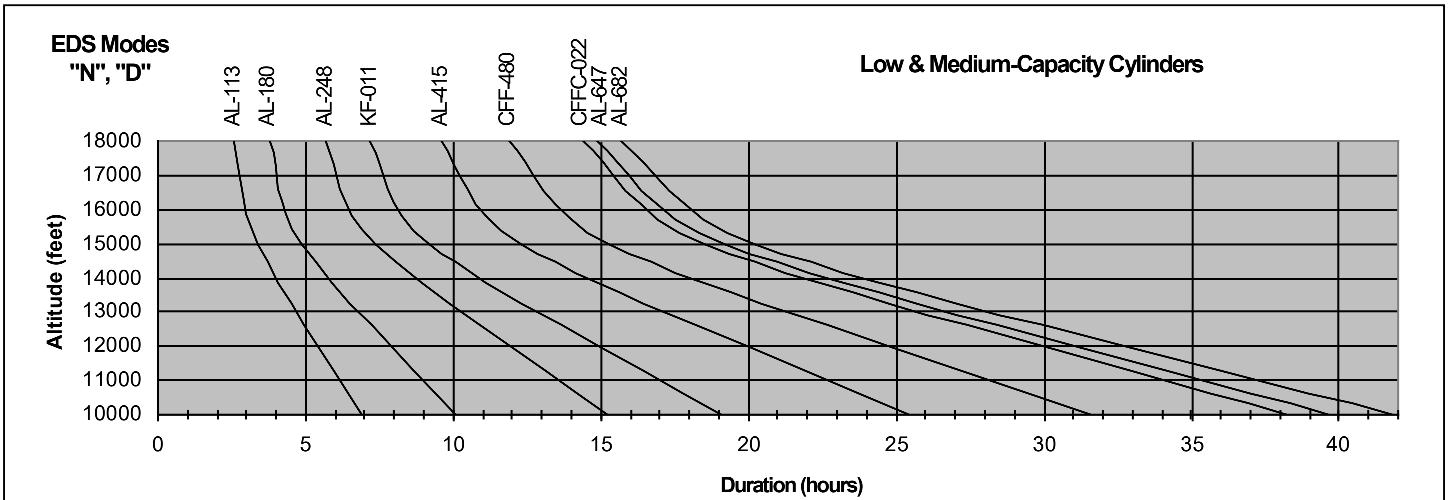
Example: "Simple" vs "Proper" Oxygen Duration Calculations

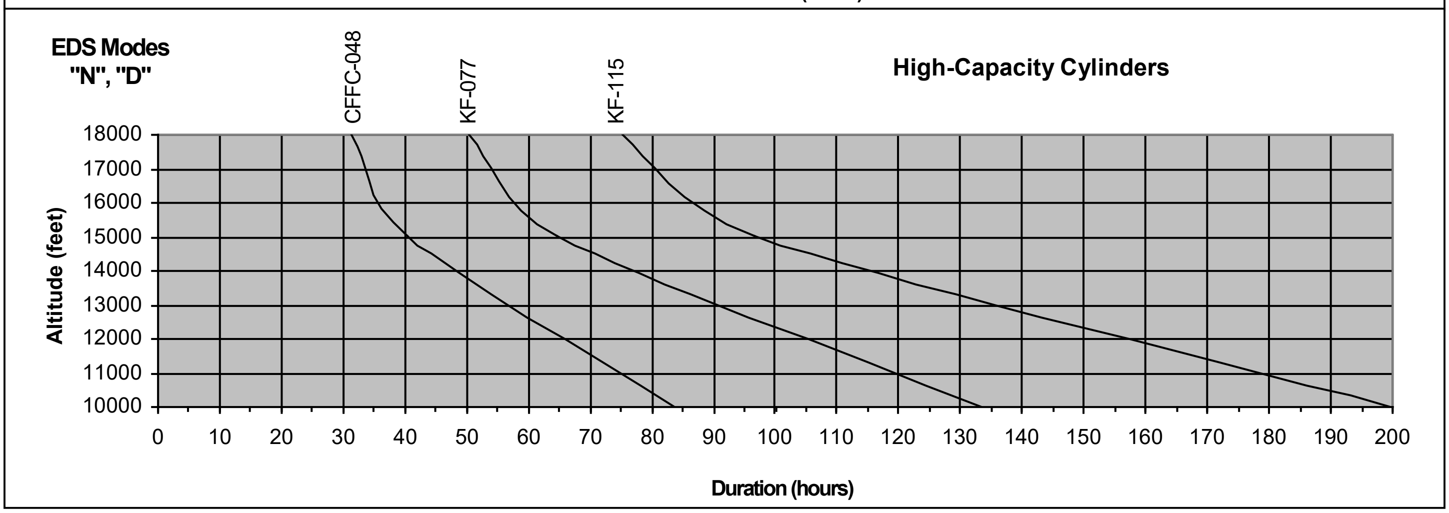
Cylinder: AL-415
Altitude = 10000 ft
P_E = 300 psi
P_R = 2015 psi
T_R = 25.4 hrs
T = Oxygen Duration (hrs)

Cylinder Pressure (psi)		2015	1750	1511	1250	1008	750	504	400	300
Simple Method	**T (hrs)**	25.4	22.1	19.1	15.8	12.7	9.5	6.4	5.0	3.8
	(Apparent)	100%	87%	75%	62%	50%	37%	25%	20%	15%
Proper Method	**T (hrs)**	25.4	21.5	17.9	14.1	10.5	6.7	3.0	1.5	0.0
	(Corrected)	100%	85%	71%	55%	41%	26%	12%	6%	0%

The example table displays oxygen duration values for an AL-415 cylinder. At 300 psi, it might *seem* (by the **Simple** method) that you have almost 4 hours of oxygen left, but that is misleading. Below 300 psi, regulator performance begins to degrade and consequently your EDS will not be able to perform to specifications. In reality, your EDS *will* continue to provide *some* oxygen beyond this point, but you will not be receiving the full prescribed amount that you would otherwise, which creates an ***increased risk of hypoxia.***

The following graphs may alternatively be used to interpolate a FULL Cylinder Duration time for a given altitude for EDS modes "**N**" and "**D**" (use the table above for EDS mode "**F**"). Use the curve as indicated for your particular cylinder.





Notes on Estimating Oxygen Duration

- The value that you calculate for an estimate of your oxygen duration is ***only an estimate***. Be conservative.
- You will use *more* oxygen if you fly higher or longer with oxygen than you anticipated (weather, headwind, etc.).
- You will use *more* oxygen if you change delivery modes in-flight from what you anticipated (e.g., switch to **F** modes) because you (or your passengers) feel a need for more oxygen.
- Keep in mind that in **N** mode, you will be consuming oxygen continuously at all altitudes, as opposed to the **D** modes which only deliver oxygen when at or above the selected threshold altitude.
- Since the EDS uses an adaptive algorithm, different people will receive different amounts of oxygen *by design.* Consider the indicated duration to be merely *nominal*, and that "your results may vary". This makes it difficult to accurately determine oxygen duration since conditions vary not only from person to person, but from moment to moment. You will use *more* oxygen if the flight is more stressful than you anticipated (and this point may be even more relevant for your passengers). Be conservative.
- These guidelines only apply to EDS usage, not constant-flow or "mixed" configurations.
- To estimate oxygen duration for flights with multiple-segments (at different altitudes), or multiple successive flights, you should use the worst-case (highest altitude) duration numbers.
- The usable oxygen proportion may also be calculated using other units of pressure, so long as all pressure values are in the same units (P_E = 300 psi = 20.7 bar, etc.)
- Consider that most FBOs will be unable to fill your cylinder to its rated maximum pressure. A typical capability that you will encounter is about 1800 psi (124 bar), and due to the vagaries of the trans-filling process, any given FBO (at any given time) may not be able to supply even that. Therefore, even if you have sufficient oxygen for the next leg of your flight and plan to fill your cylinder at the next stop, you may want to check the capabilities of the local FBO first. It may be that the local FBO would be able to fill your cylinder to an extent such that the pressure remaining at your next stop might be greater than what the next FBO could provide.
- ***When in doubt, fill it up!*** Oxygen is arguably as important as fuel. Make sure you have more than you'll need for any contingency. See also **FILLING YOUR PORTABLE CYLINDER**, page 20.

CONNECTING TO YOUR REGULATOR

The method for connecting an EDS unit to your regulator depends on which regulator you have as well as other details of your particular configuration. The accompanying illustrations generally depict connection of an EDS O2D2, but the same principles also apply to the EDS O2D1 (with some important exceptions which are discussed below as relevant).

Single EDS unit

Connection to ***XCR*** regulator ***[Figure 1]***

Use the 4mm tubing (`19600-0002-00`) that came with your ***XCR*** regulator.

Connection to ***XCP*** regulator ***[Figure 2]***
Connection to ***FPR*** regulator ***[not shown]***

Use the XCP-to-EDS Supply Adapter tubing (`00EDS-1070-00`) that came with your EDS unit.

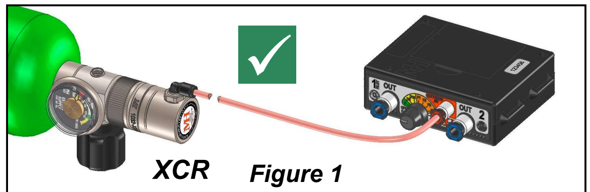


Figure 1

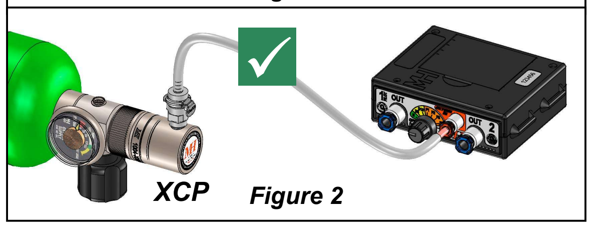


Figure 2

Dual EDS units

Dual Connection to ***FPR*** regulator ***[Figure 3]***

The ***FPR*** (Four-Port) Regulator makes it easy to connect more than one oxygen-dispensing unit. Use the XCP-to-EDS Supply Adapter tubing (`00EDS-1070-00`) that came with your EDS units. The check-valves incorporated into the FPR outlet ports make it a simple matter to reconfigure for more or fewer users as needed.

Dual Connection to ***XCP*** regulator ***[Figure 4]***

Use a 6mm Split Kit (`00XCP-1048-00`) and the XCP-to-EDS Supply Adapter tubing (`00EDS-1070-00`) that came with your EDS units.

Although the single-leg tubing may be extended, it is best if the wye (Y) fitting is located close to the regulator.

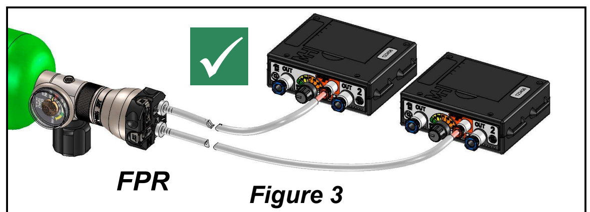


Figure 3

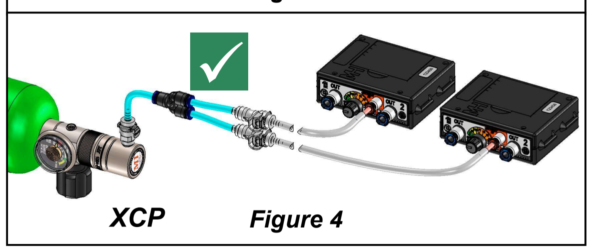


Figure 4

Dual Connection to ***XCR*** regulator, 4mm tubing (stock)

The stock ***XCR*** regulator incorporates a 4mm outlet fitting. However, 4mm tubing does not generally provide adequate oxygen flow for more than 2 users. Therefore, the (stock) XCR regulator should only be used to supply up to 2 EDS O2D1 units, or a single EDS O2D2 unit. Any other application is not recommended.

[Figure 5] A 4mm Split-Kit (`00XCR-1044-00`) can be used to supply a pair of EDS O2D1 (single place) units. It is best if the wye fitting is located close to the regulator.

[Figure 6] While it is <u>much</u> better to modify your ***XCR*** regulator for 6mm tubing (see instructions below), the 4mm Split-Kit configuration <u>can</u> be used with a pair of EDS O2D2 units with the following *important caveats*:

- The single-leg side of the wye-fitting connecting to the XCR regulator <u>must</u> be of minimal length (less than 4 inches).
- Each of the 4mm tubing legs between the wye-fitting and the O2D2 units <u>must</u> be less than 1.5m [5 feet].
- Such usage creates an ***increased risk of hypoxia*** since oxygen flow will be unavoidably constrained at higher altitudes or higher respiration rates and the EDS units may not be able to deliver the full prescribed amount of oxygen.

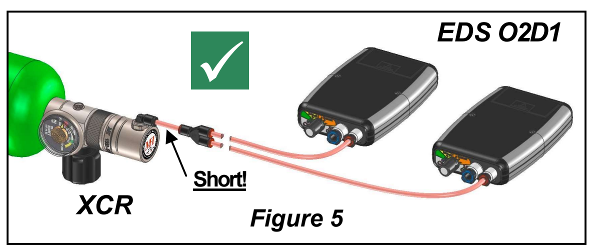


Figure 5

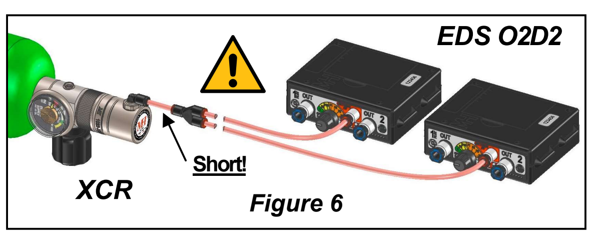


Figure 6

Dual Connection to ***XCR*** regulator, 6mm tubing (modified) ***[Figure 7]***

If your XCR regulator will need to supply more than 2 users, it should be modified for 6mm tubing. You can easily do this modification yourself, or you may choose to send in your XCR regulator and have MH perform the modification (perhaps in conjunction with your biennial inspection and service – see **MAINTENANCE FAQ**, page 27).

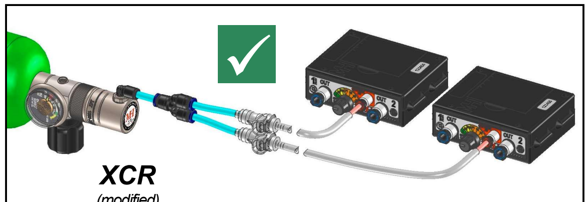


Figure 7

Modifications for 6mm connection to ***XCR*** regulator ***[Figure 7]***:

1. Contact MH Sales and order a 6mm outlet fitting (`19056-0604-00`) and a 6mm Split-Kit (`00XCP-1048-00`).
2. Remove the 4mm outlet fitting from the XCR regulator and replace it with the 6mm fitting (all you need is a 13mm wrench). Be careful to keep everything clean, and do not over-tighten the fitting – it only needs to be "snug".
3. Remove the male CPC fitting from the tubing as supplied with the Split-Kit (or cut the tubing if necessary). Assemble the Split-Kit without the male fitting and insert the single-leg tubing into the 6mm fitting on the XCR.
4. Use the XCP-to-EDS Supply Adapter tubing (`00EDS-1070-00`) that came with your EDS unit. Plug the male CPC fitting into the female fitting of the Split-Kit, and the 4mm tube-end into the inlet fitting of the EDS.

Notes:

- It is best to place the wye-fitting (Split-Kit) close to the regulator, but the single-leg tubing can be extended if necessary. Order 6mm PolyUrethane tubing (`19600-0003-00`) from MH.
- The female CPC fittings included with the Split-Kit incorporate a one-way check-valve. One line may then be disconnected for single-unit operation without creating a leak.
- *[**Figure 8**]* The same effect may be obtained by incorporating a 6mm-4mm Unequal Wye (`00HDW-1332-00`). However, if one of the devices is removed, that leg of the wye-fitting must be plugged with a 4mm Tubing Plug (`19056-0498-00`), otherwise a severe leak will result. Alternatively, the Unequal Wye may be replaced with a 6mm-4mm Unequal Union (`00HDW-1314-00`).

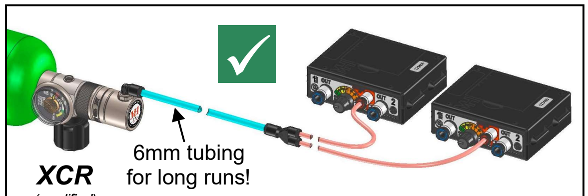


Figure 8

Mixed Devices (EDS and Constant-Flow)

Multiple Connections to ***FPR*** regulator ***[Figure 9]***

Using constant-flow devices in conjunction with your EDS unit is an economical way to provide oxygen to the "back seat" on an occasional-use basis, and is extremely easy to do if you already have an ***FPR*** regulator. Just remember that constant-flow devices will use *more oxygen* per-person than your EDS and will thus significantly impact the effective duration of your oxygen supply! (see **ESTIMATING OXYGEN DURATION**, page 14).

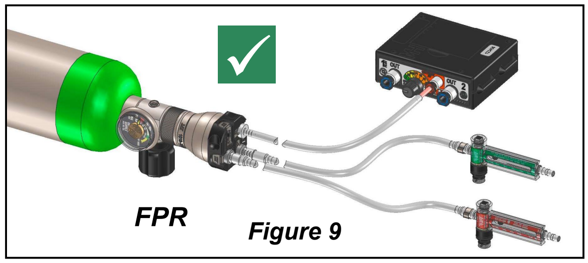


Figure 9

Use the XCP-to-EDS Supply Adapter tubing (`00EDS-1070-00`) that came with your EDS unit to connect the EDS to the FPR. MH3 and MH4 constant-flow devices connect directly to the CPC connector ports on the FPR regulator.

General Dos & Don'ts

- Avoid 4mm tubing. If 4mm tubing is used, its length must be less than 1.5m [5 ft]. ***[Figure 10]***
- Avoid Tee-fittings (Wye-fittings preferred). ***<u>DO NOT USE</u>*** Tee-fittings with 4mm tubing. A 4mm Tee-configuration is inadequate for distributing oxygen to multiple devices. If necessary, Tee-fittings should only be used with 6mm or larger tubing.
- If using a wye-configuration (Split-Kit or Reducing Wye), the single-leg tubing connecting to the regulator should be as short as possible.
- Tubing connecting directly to the EDS unit inlet port should be no longer than necessary (maximum 1.5m [5 ft]).
- Tubing runs longer than 1.5m [5 ft] should be 6mm or larger tubing. 8mm tubing and fittings are also available from MH.

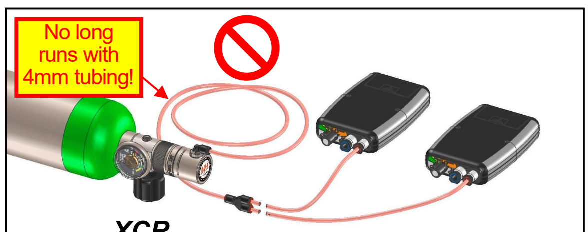


Figure 10

Notes

- An FPR regulator is the best and most convenient method for supplying oxygen to multiple oxygen-delivery devices, especially when constant-flow devices are used in conjunction with EDS units.
- An extended-length (84") version of the XCP-to-EDS Supply Adapter tubing is available from MH (`00EDS-1070-01`).
- Contact MH Customer Service for help with your unique requirements.

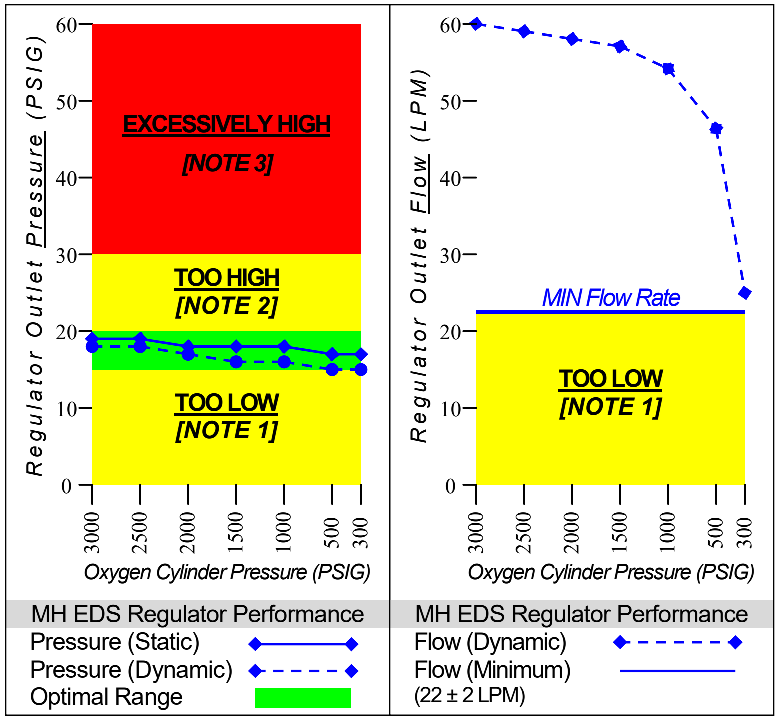
THIRD-PARTY REGULATORS

It is *strongly* recommended that you use an approved MH Regulator with your MH EDS unit. The outlet pressure and flow characteristics of the MH Regulators have been carefully matched to the requirements of the EDS in order to assure optimal performance of your portable oxygen system. A third-party regulator may be used with the EDS but you are cautioned that it must meet the following specifications in order for the EDS to perform properly:

Regulated Pressure: **16-20 PSI (NOM 1 Bar)**
Minimum Flow Rate: **22 L/min MIN (≥ 300 PSI)**

Notes:

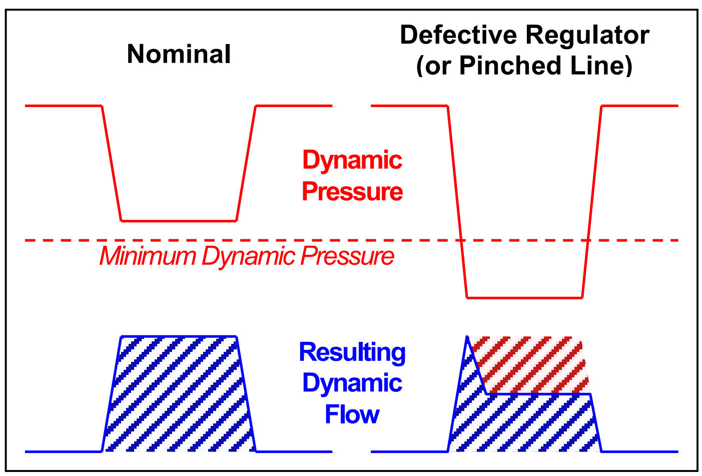
1. ***Lower*** outlet pressure or flow than specified above will result in an inadequate volume of oxygen being delivered, and you will consequently receive less oxygen than prescribed for your pressure altitude which creates a ***risk of hypoxia***.
2. ***Higher*** outlet pressures will result in an unnecessarily high volume of oxygen being delivered, which is wasteful and negates one of the primary advantages of the EDS system.
3. ***Excessively high*** pressures will cause the internal control valve to open spontaneously and leak oxygen (very wasteful), and can even damage the EDS breathing sensor and render your EDS unit inoperable.



Regulator Pressure/Flow Dynamics

The dynamic outlet-pressure response of the regulator affects the flow (volume of oxygen) that can be instantaneously provided to the EDS unit. So long as an adequate outlet pressure is maintained throughout the duration of the oxygen delivery pulse, the bolus of oxygen delivered will provide the prescribed volume of oxygen.

In the example graphs at right, the horizontal scale represents time, the red curves represent the dynamic *pressure* response of the regulator (vertical scale = pressure), and the blue curves represent the dynamic *flow* output of the regulator (vertical scale = flow rate). The total volume of oxygen delivered in a pulse is the area under the flow curve (blue hatched area).



The left-hand pair of curves illustrate that when the regulator is able to maintain a minimum dynamic pressure throughout the oxygen delivery pulse, then it will also be able to maintain the requisite flow required by the EDS unit, and the full complement of oxygen as prescribed will be delivered.

The right-hand pair of curves illustrate what can happen if the regulator is NOT able to maintain a minimum dynamic pressure (a defective regulator or pinched oxygen supply line can also produce the same result). The effect is that the flow is constrained and the total volume of oxygen delivered will be *less* than prescribed (the red hatched area represents the amount of oxygen that you are "shorted"). This results in a ***risk of hypoxia***. Therefore, while the *static* performance of your regulator is important, the *dynamic* performance is ultimately critical to the proper operation of your EDS unit.

While the efficiency of the EDS design allows you to fly farther between refills, there is much more to it than that. Anyone can "conserve" oxygen very simply by just using less than they need, but that carries a significant ***risk of hypoxia*** and is therefore a recipe for disaster. The EDS system conserves oxygen by delivering it in the most *efficient* manner possible so that you are *fully* able to utilize *all* the oxygen thus delivered. Furthermore, by monitoring your pressure altitude and respiration rate, it is able to automatically adjust the amount of oxygen delivered to assure that you are receiving *all* the oxygen that you *need*.

Your EDS unit depends on the capability of your regulator to ultimately deliver the performance you expect. That is why MH *strongly* recommends that you use an approved MH EDS Regulator with your EDS unit.

Built-in aircraft oxygen systems typically provide a much higher outlet pressure than can be tolerated by the EDS. The higher outlet pressure will not only compromise the performance of the EDS, but is likely to damage the internal breathing sensor, rendering your EDS unit inoperable. Another issue is that built-in systems will sometimes incorporate a flow-restrictor which will severely compromise EDS performance. Before using a built-in system as the oxygen source for your EDS, make sure that any flow-restrictors are removed or circumvented.

DO NOT connect your EDS directly to the outlet fittings of an existing built-in oxygen system without first verifying that the system outlet ***pressure*** and ***flow*** are compatible with the EDS (see **THIRD-PARTY REGULATORS**, page 18)

To safely use the MH EDS with an existing built-in oxygen system, or with a third-party regulator with an outlet pressure greater than 20 PSI, it is mandatory that you use the MH EDS In-Line Reducing Regulator (EDS-ILR) to ensure a compatible inlet pressure. The EDS-ILR is connected between the built-in system or third-party regulator and the EDS unit to reduce the inlet pressure to the appropriate level.

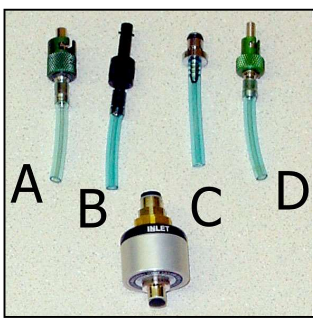
MH EDS In-Line Reducing Regulator

MH EDS Pulse-Demand™ units require an oxygen inlet pressure of between 16 and 20 psig. The light-weight MH EDS-ILR Regulator (full description: In-Line Low-Pressure Stabilizing Reducing Regulator) enables you to use your MH EDS unit with an existing built-in aircraft oxygen system.

The MH EDS-ILR Regulator is available with connector options to connect directly to most built-in aircraft oxygen systems.

EDS-ILR
Regulator only

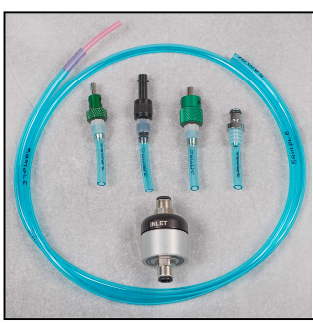
MH Part Number:
00REG-1048-00



EDS-ILR Regulator w/ Connector

MH Part Number	Connector	
00REG-1048-03	PB566	(A)
00REG-1048-01	Scott	(B)
00REG-1048-04	XCP/CPC	(C)
00REG-1048-02	BP750	(D)

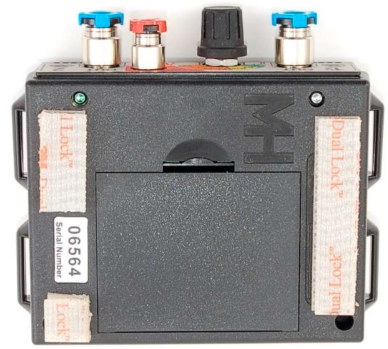
(see website for details)



CFI Regulator Kit includes
EDS-ILR Regulator and
all four available connectors

MH Part Number:
00REG-1048-05

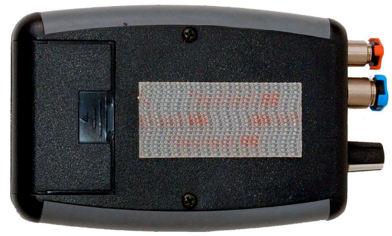
MOUNTING THE EDS



You may mount the EDS unit to a panel or other suitable place where it is visible by the pilot to allow for the monitoring of operational status as well as Alarms and Alerts.

One method uses the 3M DUAL LOCK tape that is supplied with your EDS. Cut the DUAL LOCK tape in half-lengthwise, creating two long rectangles. Do not separate the 2 locking halves of the tape prior to mounting. Test-fit the tape pieces to the EDS unit and trim as required. Examples of suggested locations for EDS **<u>O2D2</u>** and **<u>O2D1</u>** applications are shown below (note that **<u>O2D2</u>** mounting requires additional trimming to avoid obscuring the serial number).

Clean the area on the EDS where you wish to apply the tape. Peel the adhesive liner off of the rectangles and press the exposed adhesive to the back of the EDS. **DO NOT COVER ANY PART OF THE BATTERY DOOR** (**<u>O2D2</u>**: Do not obscure the Serial Number). Other arrangements are possible so long as the battery door is not covered.



Clean the mounting area in your aircraft then remove the remaining adhesive liner from the tape strips. Press the exposed adhesive to the panel with the EDS in position as desired. The pressure-sensitive adhesive bonds on contact but should be left in place for 24 hours for full strength. Pull the EDS unit away, separating the 2 locking halves of the tape. Simply press the EDS up against the fixed tape strips to re-mount it for use.

<u>O2D2:</u> Alternatively, you may also mount the O2D2 by feeding 3/4"-wide straps (not included) through the mounting-loops molded into the unit.

STORING THE EDS

Close the cylinder valve, bleed the regulator (see **BLEEDING THE REGULATOR**, page 8), and disconnect all tubing (inlet and cannula/facemask) when the EDS unit is not being used. <u>Do not</u> store the EDS unit with the inlet under pressure.

Stow oxygen tubing and cannulas/masks in a manner that ensures that they will not be contaminated with dirt or debris. The supplied tote bags or a recloseable plastic bag is a good storage container. <u>Anytime</u> oxygen lines are disconnected, they must be protected to prevent contamination. Improperly stowed oxygen lines can lead to the following problems:

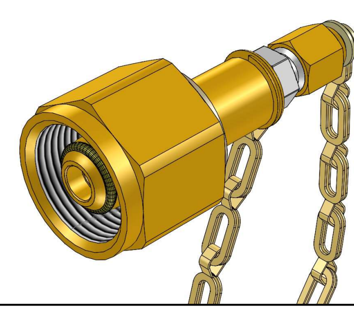
- Moisture can enter the system. When it evaporates it can then leave a precipitate (scum) on the breathing sensor or valve seat which can compromise the operation of the EDS.
- Foreign Objects or Debris (FOD) can enter the system (including insects). When the EDS is reconnected and gas applied, the debris is pushed into the unit and comes to rest at a constriction. This will most often trigger a FLOW FAULT, but partial obstructions can sufficiently reduce the flow enough to affect the amount of oxygen delivered at higher altitudes and create a ***risk of hypoxia***.

Remove the batteries to prevent lelakage and corrosion if the unit is not going to be used for an extended period (30 days or more). When using the unit for the first time after extended storage, verify battery function via the usual **POWER-UP** procedure. Replace the batteries if in doubt or if a **LOW BATTERY** Alert is received (see pages 11, 13). A fresh set of spare alkaline batteries should be part of your pre-flight inventory.

Replace batteries <u>annually</u> regardless of use.

FILLING YOUR PORTABLE CYLINDER

Sometimes an FBO cannot quickly or easily adapt to the standard CGA-540 regime. For this reason you may find it useful to carry an MH GSE-1029-01 Transfill Adapter (`00GSE-1029-01`). This accessory adapts your CGA-540 portable cylinder to the AN-800 (MS22035/66) equipment that is commonly found at FBO oxygen transfilling stations. Don't leave home without this!



CGA-540 to AN-800 Transfill Adapter
(`00GSE-1029-01`)

EDS unit emits no sound or start-up oxygen pulse when turned on:

1. Check batteries. Install fresh, quality **alkaline** batteries as required.
2. Make sure the batteries are installed with the correct polarity (page 8).
3. Check for corrosion. Clean contacts or replace batteries as required.
4. **O2D2:** Verify external power if using external power connection. Remove connector to test with battery power.

Start-up sound is heard, but no start-up oxygen pulse delivered:

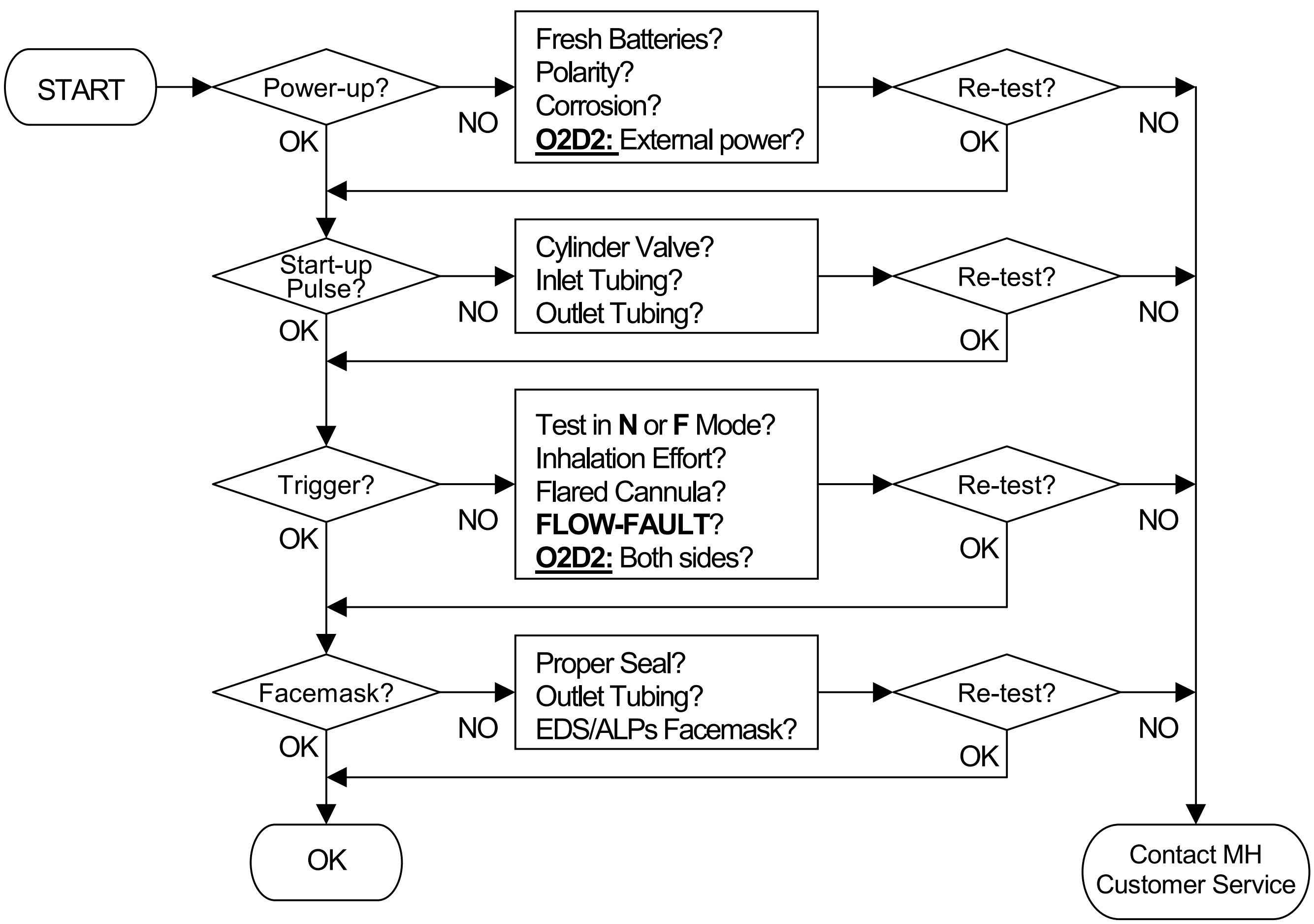
1. Make sure the oxygen cylinder valve is open.
2. Check that oxygen *inlet* tube is properly connected and not kinked, pinched, or otherwise obstructed.
3. Check that oxygen *outlet* tube is properly connected and not kinked, pinched, or otherwise obstructed.

EDS does not trigger on inhalation:

1. Use **N** or **F** modes for test (EDS may not respond in **D** mode if below threshold altitude).
2. Some inhalation effort is required. Avoid breathing through your mouth. Shallow breathing may not trigger the EDS.
3. Try using the Flared-Tip cannula included with the EDS kit (MH part number `00EDS-1084-01`).
4. If a **FLOW-FAULT** Alert is received, re-check the oxygen cylinder and inlet/outlet tubing as above.
5. **O2D2:** Test *both* outlets (#1/Pilot and User #2).

When using the facemask, no oxygen pulse on inhalation:

1. Make sure the facemask seals properly against the skin.
2. Check oxygen outlet tubing for proper connection, no obstructions.
3. Use only approved EDS or ALPS facemasks provided by Mountain High Equipment & Supply.
   DO NOT use conserving cannulas ("Oxymizer") or facemasks with a dilution bag.
   EDS facemasks DO NOT have a dilution bag attached.



O2D2 EXTERNAL AUDIO OUTPUT

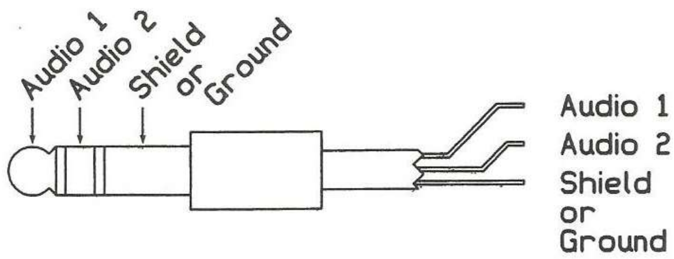
Audio **Alarms** generated by the O2D2 may be difficult if not impossible to hear when wearing a headset. The External Audio Port may be used to inject the audio output from the O2D2 into the cabin intercom/ICS system so that important error conditions and status alerts are not missed.

Signal Assignments for 3.5mm Stereo Plug Connector (not provided):

Tip	First Audio Output
Ring	Second Audio Output
Barrel	Shield or Ground

There is no need to differentiate Left or Right as both audio outputs provide the same signal.

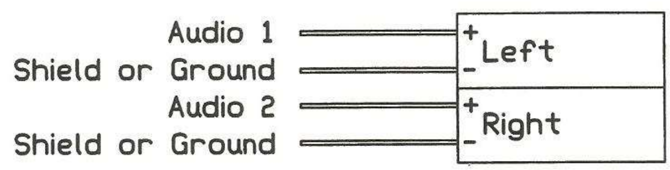
OPTIONAL 3.5mm STEREO AUDIO PLUG AND CABLE



To O2D2 Audio Jack **To Aircraft**

The standard wiring option has one audio output wired to the Left Input and the other audio output wired to the Right Input.

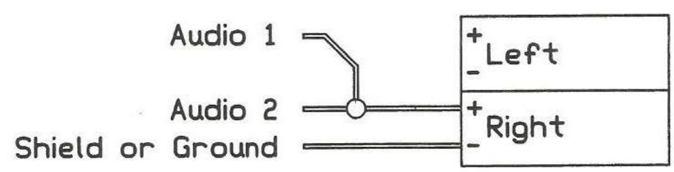
TYPICAL COMMUNICATIONS WIRING



EDS Audio Cable **Aircraft Input**

The audio outputs of the O2D2 are designed to drive standard audio inputs with impedance from 1000Ω to 10,0000Ω. To accommodate lower impedance inputs, parallel both audio outputs.

DRIVING A LOW IMPEDANCE INPUT



EDS Audio Cable **Aircraft Input**

DO NOT tie the outputs from two separate O2D2 units together. If installing two O2D2 units in an aircraft, each should be given its own input to the communications system. If this is not an option, then wire the audio output of one O2D2 to the Left Input and the audio output of the other O2D2 to the Right Input.

TWO O2D2 UNITS DRIVING ONE INPUT

EDS Audio Cables **Aircraft Input**

The O2D2 External Power Jack (page 4) provides the option of operating your O2D2 from an external power source rather than from battery power, which can free you from constant concerns about the state of your batteries. The most convenient arrangement is if your aircraft has a DC power jack ("lighter" socket), in which case a suitable voltage adapter can be plugged in to the existing socket and the O2D2 powered from that.

However, the O2D2 requires a 4.5 VDC source with fairly narrow tolerances. DO NOT wire the O2D2 directly to your aircraft power bus (which is typically either 12 or 24 Volts). Furthermore, most commonly available power adapters are *not compatible* with the O2D2 and could potentially damage your O2D2 unit. Mountain High recommends the **MyGoFlight DualMicro** Power Adapter.

You should still keep a fresh set of batteries installed in your O2D2 in the event of failure of the power adapter and/or cable.

WARNING: EDS O2D2 units can be ***severely damaged*** and rendered inoperable if the external voltage applied is not within tolerances. Also, the power jack is an internally-switched type and inserting an external power connector disconnects the internal batteries. The O2D2 unit will *not* automatically switch over to battery power if the external power fails. Likewise, it will *not* automatically switch over to external power if the batteries fail. When there is a connector installed in the external power jack, then external power is selected. If the batteries fail, the O2D2 *can* be switched to external power (if available) by manually inserting the external power cable connector. Likewise, if the external power fails, the O2D2 *can* be switched to battery power by manually removing the external power cable connector (assuming good batteries are already installed in the O2D2).

FUTURE O2D2s (release date TBD) will help prevent damage from incompatible external power sources (anything over 5.5 VDC, or reversed polarity). The incompatible external voltage will be ignored and the O2D2 will continue to run off battery power, if able. Newer O2D2s *will* automatically switch between battery and external power (if one or the other fails, or when the external power connector is inserted or removed). External power will be selected whenever it is greater than the current battery voltage, and less than 5.5 VDC. There may be ***NO WARNING*** of this switchover, so **Battery Alerts** would need to be heeded even if the O2D2 is configured to run off external power. If both battery and external power are available, the switchover will happen seamlessly without the O2D2 powering down. Otherwise (if external power is not connected, or if no batteries are installed), the O2D2 will power-down, and will necessarily need to power-up again when a power source is restored.

RETRO-FIT: Some "newer" older O2D2s can be retro-fitted with the new power-protection circuitry to add the more-robust external power features. If you have an "older" O2D2 and use the external power feature, or anticipate doing so in the future, contact MH Customer Service to see if your O2D2 unit can be retro-fitted.

MyGoFlight DualMicro Power Adapter

The **MyGoFlight DualMicro** Power Adapter is the top-of-the-line DC charging adapter for 12-28 volt systems (including 24-volt aircraft systems that typically output 28 volts) and provides an output voltage that is safe for your O2D2. The special 1m [39 inch] USB adapter cable connects the DualMicro to your O2D2. The DualMicro has been tested to not interfere with on-board radios and navigation equipment.

The **DualMicro** is also a versatile USB charging adapter. Dual 2.4A USB ports enable the charging of any combination of iPhones, smartphones, tablets, ADS-B receivers, GPS units, or other USB powered devices. *Rapid Charge* technology allows you to fully charge 2 full-size tablet devices in no time at all. Handles 12-28 volts input, so it may also be used in your car, truck or RV, as well as your aircraft. Keep the **DualMicro** in your flight bag and you will always have all the power you need, when you need it.

12-28V DC USB Power Adapter only MH Part Number: 39399-1250-00	USB-O2D2 Adapter Cable only MH Part Number: 36990-0USB-03
EDS O2D2 12-28V DC External Power Kit (Power Adapter + USB Cable) MH Part Number: 39300-1250-00	

WARNING: Use ONLY this approved MH External Power Adapter and Cable with the MH EDS O2D2

Over-voltage damage is not covered under warranty

What Is Air?

The air surrounding us is a mixture of gases consisting of 78% nitrogen and 21% oxygen. The remaining 1% is made up of argon, carbon dioxide, and traces of rare gases.

What Is Oxygen?

Pure oxygen is a colorless, tasteless, odorless gas and is non-combustible under normal conditions.

Why Is Oxygen So Important?

Although oxygen itself is nonflammable, it vigorously supports combustion, and in fact, without oxygen there can be no fire. Oxygen is also absolutely essential to support the process of “vital combustion” which maintains human life. Although a person can live for weeks without food or for days without water, they will die in minutes if deprived of oxygen. The human body maintains life by taking in fuel (the carbohydrates, fats, and proteins in our diet) and using oxygen to convert it to heat and energy in a process known as “metabolism". Metabolism is thus similar to combustion in that it utilizes the oxygen in the air to "burn" a "fuel" to produce heat and energy.

Where And How Do We Normally Obtain Our Oxygen?

With each breath, we fill our lungs with air containing 21% oxygen, inflating millions of tiny air sacs (known as “alveoli”) like tiny balloons. Microscopic capillaries in the thin walls enclosing each sac transport oxygen from the lungs to every cell in the body. Because the body has no way to store oxygen, it leads a breath-to-breath existence.

How Much Oxygen Does the Human Body Need?

The rate of metabolism, which determines the need for oxygen, depends on the degree of physical and mental activity of the individual. Walking at a brisk pace will consume about four times as much oxygen as sitting quietly. Under severe exertion or stress, a person might consume eight times as much oxygen as when resting.

What Happens If The Body Does Not Receive Enough Oxygen?

When the body is deprived of an adequate supply of oxygen, even for a short period, various organs and processes in the body begin to suffer impairment. This condition is known as “hypoxia" and affects every cell in the body, but especially the brain and nervous system. This makes hypoxia extremely insidious and difficult to recognize, and a serious hazard for pilots.

What Are The Effects Of Hypoxia?

Hypoxia causes impairment of vision (especially at night), lassitude, drowsiness, fatigue, headache, euphoria (a false sense of exhilaration), and temporary psychological disturbance. These effects do not necessarily occur in the same sequence nor to the same extent in all individuals, but are typical in average persons affected by hypoxia.

When And Why Must We Use Extra Oxygen?

Supplementary oxygen must be used to compensate for either a deficiency on the part of an individual or a deficiency in the atmosphere. A person with a respiratory or circulatory impairment may not be able to fully utilize the 21% of oxygen in the air, so supplementary oxygen must be administered (by oxygen tent or mask) to enrich the inhaled air. The total volume of oxygen in each inhalation is then greater than normal and compensates for the individual’s inability to utilize the normal atmospheric oxygen. When we ascend in altitude, a different condition is encountered wherein the atmosphere itself is deficient, and even an otherwise "normal" person will require supplemental oxygen.

Does The Percentage Of Oxygen In The Air Change With Altitude?

No. The ratio of oxygen to nitrogen in the composition of air does not change. The 21% of oxygen in the air remains relatively constant at altitudes of up to one hundred thousand feet.

Why Must We Use Extra Oxygen When We Ascend In Altitude?

The blanket of air surrounding our planet is several hundred miles thick. Air has weight and is compressible, so the air closest to the earth (supporting the weight of all the air above it) is denser and its molecules packed closer together. At higher altitudes, the air is less dense. At 10,000 feet the atmospheric pressure is only two-thirds of that at ground level, and although the *percentage* of oxygen is still the same, each lung-full of air consequently contains only two thirds as many molecules of oxygen. At 18,000 feet, there is only *half* the amount of oxygen. Therefore, as we ascend, there is a progressive reduction in the amount of oxygen taken into the lungs with each breath, and a corresponding decrease in the amount of oxygen available for the bloodstream to transport to every cell in the body. To compensate for this, we must supplement the air we breathe with additional oxygen in order to supply enough oxygen molecules for the metabolic needs of the body.

At What Altitudes Should Oxygen Be Used?

In general, a normal, healthy individual is unlikely to need supplemental oxygen at altitudes below 8,000 feet. An exception is night flying. The retina of the eye is affected by even *extremely mild* hypoxia, and night vision deteriorates significantly above 5,000 feet. Between 8,000 and 12,000 feet, hypoxia may cause the first signs of fatigue, drowsiness, sluggishness, headache, and slower reaction times. At 15,000 feet, hypoxia becomes increasingly apparent in terms of impaired efficiency, increased drowsiness, errors in judgment, and difficulty with simple tasks requiring mental alertness or muscular coordination. Symptoms become more intense with progressively higher ascent or with prolonged exposure. At 20,000 feet, a pilot may scarcely be able to see, much less read, the instruments. Hearing, perception, judgment, comprehension, and general mental and physical faculties are all severely compromised and the pilot may be on the verge of *complete collapse*.

Therefore, the availability and use of supplemental oxygen is recommended on night flights where altitudes above 5,000 feet are contemplated, and for altitudes above 8,000 feet for daytime flights.

How Can You Tell When You Need Oxygen?

You can't. Therefore, oxygen should be used *before* it is needed. The most dangerous aspect of hypoxia is the insidious, "sneaky" nature of its onset. Hypoxia primarily affects the brain and nervous system with a gradual loss of mental faculties and impairment of judgment and coordination, but these changes are so gradual that they are completely unnoticed by the affected individual. The effects of hypoxia are very much like those of alcohol or other drugs that produce a false sense of well being. There is a complete loss of ability for self-criticism or self-analysis, and in fact, a person suffering from mild or moderate hypoxia is apt to feel a sense of exhilaration or security, and may be confident in their proficiency and performance even while on the verge of complete incompetence. Some people believe that a pilot can detect the need for oxygen by noting an increase in breathing rate, an accelerated heartbeat, and a slight bluish discoloration (cyanosis) of the fingernails. However, by the time these symptoms develop, the individual is likely to be mentally incapable of recognizing these signs.

Are All Individuals Equally Affected By Hypoxia?

NO. Just as there is a variation among individuals in the ability to tolerate heat or cold, some people can tolerate some degree of hypoxia without apparent effect, while others who are more sensitive to a lack of oxygen cannot. There is no way to measure or predict susceptibility to hypoxia because it can be affected by physical condition, fatigue, emotion, use of tobacco alcohol or drugs, diet and other factors. The individual who has flown at 14,000, 16,000, or even 18,000 feet without oxygen and survived, has no idea how close they may have been to disaster, and may believe that all this talk about oxygen need, if true at all, does not apply to them. Such a belief could some day prove fatal.

Is It True That Oxygen Is Toxic Or Harmful?

NO. Oxygen therapy is often used for prolonged periods in hospitals and homes with beneficial effects. It is generally agreed that a 60% oxygen concentration on the ground (equivalent to 100% at ~ 12,000 feet), will not cause any harmful effects.

Why Not Use Oxygen Intermittently For Short Periods?

Intermittent use of oxygen, at an altitude where there is an oxygen deficiency, would only temporarily alleviate the effects of hypoxia while the oxygen is being used. Because of the insidious nature of hypoxia, a person already mildly hypoxic is extremely unlikely to even *think* of using oxygen equipment, intermittently or otherwise. Nevertheless, the occasional use of oxygen for five or ten minutes (even at altitudes below 8,000 feet) can act as a "refresher" to relieve the effects of *mild* hypoxia, cigarette smoke, apprehension, or other factors. Such a "refresher" prior to the termination of a flight can help improve the pilot's mental and physical condition for the approach procedures and landing maneuvers.

How Can Oxygen Equipment Improve The Utility Of An Aircraft?

Higher altitudes often have the benefits of a smoother flight, more favorable winds, better performance from the Omni and other radio navigation equipment, higher speed, longer range, and better engine performance. With oxygen equipment aboard, a pilot can safely take advantage of these benefits knowing that their *own* performance will not be affected by hypoxia and that they will be just as efficient and capable as at lower altitudes or even on the ground. With oxygen equipment in use, pilot and passengers will arrive at their destination fresh and fit, without the headache, lassitude, and fatigue which often result from prolonged exposure to even mild hypoxia.

What Types Of Oxygen Equipment Are Available For Private And Executive Aircraft?

For general aviation small aircraft, the most practical option is often a portable system, which can be carried along when flight is anticipated at altitudes where hypoxia would be an issue. If flights at such altitudes are frequent, then a "built-in" oxygen system offers some advantages, especially for larger aircraft. For either portable or built-in systems, there is then a choice between "Continuous Flow" or "Pulse-Demand" type equipment. Continuous flow systems deliver oxygen at a fixed rate that the user must adjust when changing altitude. "Pulse-Demand" (MH EDS) equipment automatically delivers a prescribed amount of oxygen to the user during each inhalation in response to pressure altitude and their own breathing pattern. Pulse-Demand is significantly more efficient and requires no user adjustment when changing altitude.

How Should An Oxygen System Or Equipment Be Selected?

Contact Mountain High Equipment & Supply at 800-468-8185. An MH Sales Engineer will assist you in selecting the proper equipment best suited to your aircraft and specific needs.

WARNINGS:

- **Improper use or maintenance of aviation oxygen equipment may result in *serious injury or death.***
- **Aviation oxygen equipment is intended to be used only for aviation applications and is to be used only by, or under the supervision of, a pilot or crew member trained and qualified in its use.**
- **Aviation oxygen equipment is to be serviced only in accordance with the applicable component maintenance manuals from MH Oxygen Systems and only by technicians knowledgeable of the equipment and trained in the inherent hazards of high pressure aviation oxygen.**
- **Aviation oxygen equipment is to be used only with oxygen meeting the requirements of MIL-PRF-27210.**

BREATHING SENSOR ALTITUDE COMPENSATION

As absolute atmospheric pressure decreases with altitude, breathing efforts consequently assert less pressure on breathing sensors to the point where inhalation may not be properly detected at higher altitudes. Additionally, breathing *effort* tends to diminish as the partial pressure of CO_2 also decreases with altitude. The EDS must compensate for these physical and physiological effects when ascending to higher altitudes.

The EDS employs an active algorithm that constantly and automatically adjusts the sensitivity of the breathing sensors based on pressure altitude and detected breathing effort. It also filters out false-triggers due to pneumatic artifacts. This helps ensure that all breaths are correctly detected so that the EDS can respond reliably and deliver the proper amount of oxygen. This function is entirely automatic and involves no user settings.

AUTOMATIC RESPIRE-METRIC COMPENSATION

An average size adult, with no compromising pulmonary conditions or illnesses, will have an average respiration rate of 12 to 18 breaths per minute. Persons between 60 and 75 years of age will generally have a rate between 12 and 28 breaths per minute. The respiration effort at rest generally becomes less as the rate increases. Shallow breathing with an elevated respiration rate is typical with exposure to altitude and/or anxiety.

Respiration is primarily controlled by chemoreceptors that detect dissolved CO_2 in the blood. Higher CO_2 levels (e.g., from physical work) trigger higher respiration until CO_2 is re-normalized. Higher respiration consequently increases oxygen levels. As the amount of dissolved CO_2 in the blood decreases, so does the urge to respirate. Therefore, as the partial pressure of CO_2 drops during excursions to higher altitudes, breathing effort will generally decrease, as the body is not compelled to respirate to expel any more CO_2. Unfortunately, this exacerbates hypoxia as less oxygen is inhaled and admitted into the blood.

One way to encourage respiration at higher altitudes would be to actually deliver a small amount of CO_2 with each inhalation. The EDS instead augments the amount of oxygen delivered to help ensure that each individual receives the full amount of oxygen that they require in spite of reduced respiration. The EDS uses a poly-metric method of dynamically adjusting the amount of oxygen delivered on a breath-by-breath basis as a function of pressure altitude, respiration rate and (in some cases) breathing effort. If the EDS is unable to establish meaningful respire-metrics for the current user (due to pneumatic artifacts or an improperly worn cannula or facemask), it will revert to default parameters to cover a known mean pulmonary profile.

FACEMASK PLENUM VOLUME COMPENSATION

A facemask, unavoidably, has a volume of space (plenum) that does not directly contribute to the admission of oxygen. This plenum volume can compromise the initial admission of oxygen by allowing the user to re-breathe CO_2 at the most important point of the inhalation phase and consequently displace a portion of the delivered pulse of oxygen. While a small amount of re-inhaled CO_2 can actually be beneficial at higher altitudes as it encourages respiration, missing the full complement of the prescribed amount of oxygen is not.

The EDS has four manually selected F-Mode settings (F1 through F4) that help mitigate this effect by providing an additional bolus of oxygen with each breath to compensate for the plenum volume associated with the facemask. Each F-setting provides a progressively larger bolus. Modes F1 and F2 are intended for small sized masks, F2 and F3 for medium sized masks, and F3 and F4 for large sized masks. These F-Mode settings can also be used if the user determines that they may need more oxygen than is automatically prescribed.

Q: I have one of your portable MH-EDS Pulse Demand™ units. It seems to be operating just fine. Should I send it in for any type of routine service or testing?

Yes. Even though your pulse-demand unit will generally let you know if there is a problem and has been designed to be relatively maintenance free (except for battery replacement), it should be sent in on a regular basis for performance inspection and service (service fee will apply). This should include the in-line or screw-on regulator you use with the EDS unit. Think of it like performing an annual inspection on your aircraft.

Q: How often does MH recommend doing this?

Routine service should be accomplished once every two years (biennially). This program has been developed from service data acquired during the past 20+ years that this technology has been in the field.

Q: What is done to my EDS unit and regulator when I send them in for service?

From time to time we make engineering improvements that may include changes to hardware or firmware or both. This is our way of passing on our latest improvements to you. Routine service parts such as seats, seals, O-rings and filters are inspected and replaced as needed. Any other parts replaced due to damage or wear would be subject to additional charges. Your upgraded EDS unit(s) and regulator(s) are then thoroughly inspected and tested. This helps ensure that your system is operating at peak performance.

Q: How long should I expect this service to take?

Once we receive your unit, in-house turn-around time is generally five to ten working days.

Q: I have sent my EDS unit back once before for a problem with leaking or not responding at certain altitudes, but it came back with the same problem. Why?

Some problems perceived to be with the EDS unit turn out to be related to the pressure regulator. This is often the case if you are not using the regulator designed for the EDS, and is why you must include the primary reducing regulator that you are using (whether or not it's ours) when you return your EDS for service.

- Other regulators may not provide the proper inlet pressure required for the EDS unit to deliver the correct amount of oxygen.
- The breathing sensor in the EDS units can be damaged if the inlet pressure is too high. DO NOT connect an EDS unit directly to your aircraft's built-in system without our inline reducing regulator. We have seen many instances where customers connect the EDS unit to the connectors and tubing that came with their aircraft, then plug them into the high-pressure oxygen outlets. This has caused a lot of confusing problems because these connectors generally have flow restriction orifices. In many cases the EDS unit will check-out OK at ground level when the pulse response is low, but then complain with FLOW-FAULT Alarms at higher cruising altitudes.

LIMITED WARRANTY

Mountain High Equipment & Supply Company warrants your MH EDS unit against defects in materials and workmanship for two (2) years from the invoiced date of purchase. This warranty is non-transferable. Should any part of the MH EDS unit become defective within the warranty period, return the EDS Unit with a description of the problem and we will repair or replace it, at our discretion, free of charge (you pay only shipping to MH).

Contact MH for RMA # and Return Form: service@MHoxygen.com

Return to:

Mountain High Equipment and Supply Company
Service Department
2244 SE Airport Way, Suite 100
Redmond OR 97756-7537

This warranty is only valid if Mountain High Equipment & Supply Company determines that the system and its components have not been damaged due to improper use, dismantled, submerged or otherwise abused. Mountain High Equipment & Supply Company reserves the right to determine if repairs are to be done under warranty or at a nominal charge.

To activate warranty coverage, you must complete and return your enclosed EDS Owner's Registration Card.

NOTICE OF NON-LIABILITY

This device is classified as, and is *only* suitable for use as, a Supplemental Breathing Apparatus (SBA) for aviation use. It is intended to help supply the needed amount of oxygen for persons at flight altitudes where supplemental oxygen is needed. This device is not suitable for SCBA (Self Contained Breathing Apparatus), SCUBA (Self Contained Underwater Breathing Apparatus), medical use, or any other types of life support applications.

It is the responsibility of the user to become familiar with the operational and safety aspects of this device before using it. Improper use of the system could cause failure and lead to possible ***property damage, personal injury or death!***

OXYGEN SYSTEM BACKUP

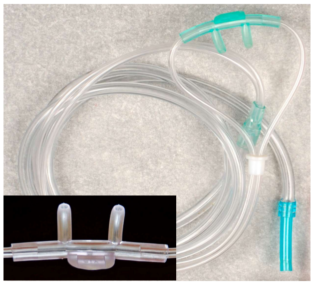
If a pilot consistently flies above 18,000 feet, the aircraft should have a supplementary gauge that is visible by the pilot during flight in order to monitor the oxygen cylinder pressure. You should also carry an Emergency Oxygen System (EOS) such as the **MH Co-Pilot** as a back-up safety feature in case your primary oxygen system stops working. It is the absolute responsibility of the pilot to determine that there is adequate pressure in the oxygen cylinder prior to flight, as well as assuring that an adequate emergency back-up is in place in the event of a system failure.

BASIC OXYGEN SAFETY

Observe all cautions and use proper procedures when handling oxygen. Pure oxygen vigorously accelerates combustion. Some materials such as oil will burn in oxygen with explosive violence, which could result in ***severe damage, personal injury or death***.

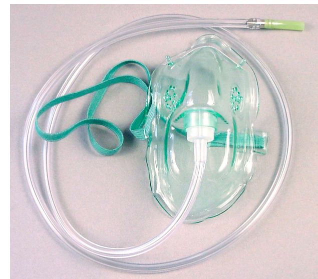
- ***Relieve pressure in the Regulator before removing it from the Cylinder***
- **DO NOT** use any type of oil or grease on any oxygen fittings or components.
- **DO NOT** operate near an open flame.
- **DO NOT** smoke while in use.

EDS REPLACEMENT ITEMS



EDS Standard Cannula
(00EDS-1084-00)

EDS Flair-Tip Cannula
(00EDS-1084-01)



EDS Facemask
(00EDS-1078-01)

XCP Adapter Tube
(00EDS-1070-00)

Anti-Bacterial Facemask Wipes
(00VEN-0077-00)

3M Dual Lock Reclosable Fastener (2 pk)
(00OEM-0008-00)

EDS ACCESSORIES

E-Z Breathe Boom Cannula for EDS
(00EDS-1092-00)

ALPS Facemasks, w/o Mic
(see website for p/n's)

ALPS Facemasks, w/ Mic
(see website for p/n's)

E-Z Breathe Quick Disconnect
(19053-0009-00)

MyGoFlight USB Power Adapter
(39300-1250-00)

O2D2 USB Power Cable
(36990-0USB-03)

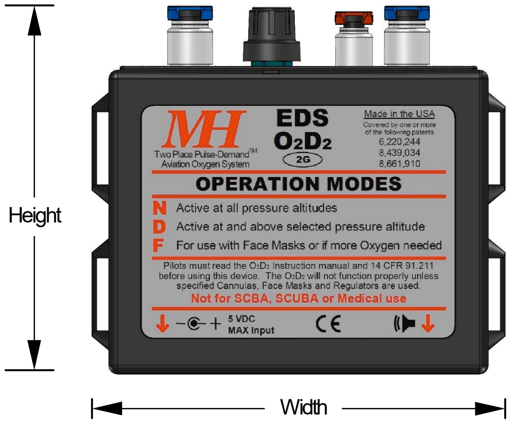
EDS O2Dx-2G SPECIFICATIONS

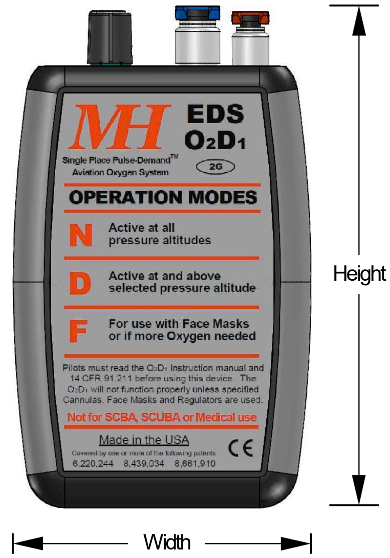
Specifications are subject to change without notice.
Altitude references infer *pressure altitude.*

The O2D2, when used in single-place mode, will have essentially the same oxygen consumption and battery duration as the single-place O2D1

When the O2D2 is used with 2 people, oxygen consumption will be approximately double, and battery life half, compared to the O2D1

Think in terms of man-hours.





Physical Characteristics	EDS O2D2-2G	EDS O2D1-2G
Width (widest point)	4.3” [109 mm]	3.1” [79 mm]
Height (with connectors)	3.85” [98 mm]	5.23” [130 mm]
Depth (front to rear)	1.25” [32 mm]	0.95” [24 mm]
Weight (with batteries)	12.1 oz [343 g]	7.5 oz [213 g]

Battery Operation	EDS O2D2-2G		EDS O2D1-2G
Battery Type	1.5 Volt AA alkaline (3 ea.)		1.5 Volt AA alkaline (2 ea.)
Battery Voltage			
NOM	~ 4.25 VDC		~ 2.875 VDC
Low Battery-1 Level	~ 3.3 VDC ± 0.1 VDC		~ 2.40 VDC ± 0.04 VDC
Low Battery-2 Level	~ 3.0 VDC ± 0.1 VDC		~ 2.25 VDC ± 0.04 VDC
MIN Start-Up Voltage	~ 2.8 VDC ± 0.1 VDC		~ 2.00 VDC ± 0.04 VDC
Battery Current			
Average	~3.75 mA		~3.25 ma
Peak (~500 ms max)	~220 mA		~100 ma
Battery Life	2 people	1 person	
NOM (fresh batteries, normal operating conditions)	~ 50 Hrs	~ 100 Hrs	~ 100 Hrs
Low Battery-1 Alert (time remaining at onset)	~ 4 Hours	~ 8 Hours	~ 8 Hours
Low Battery-2 Alarm (time remaining at onset)	~ 1 Hours	~ 2 Hours	~ 2 Hours
Test conditions	25° C, ~25% RH		25° C, ~25% RH

External Connectors (O2D2 only)

External Audio Output (see page 22 for wiring schematics)

- 3.5 mm stereo audio jack
- ~40 mV RMS into 5KΩ L/R independent
- Suitable for most aircraft Integrated Communication Systems [ICS]

External Power Input (see page 23 for important additional information)

- DC power jack for 4.5 ± 0.5 VDC external power source
- Over-voltage protection
- Reverse-polarity protection

Specifications common to EDS O2D2-2G, O2D1-2G

Operating Ranges

Inlet pressure, MIN	15 psig [1 bar] **Dynamic** (cannula w/ 1.5m [5ft] of 4 mm inlet tubing)
Inlet pressure, MAX	25 psig [1.72 bar] **Static**
Temp range (~10% RH)	-40° to +60°C (Storage, complete unit less batteries)
Temp range (~25% RH)	0° to +60°C (Operating, standard valve)
Temp range (~100% RH NC)	+5° to +60°C (Operating, standard valve)
Altitude range:	-100 to +30 K ft, ~100% RH, +5° to +60°C (standard valve)
Vibration:	5 to 500 Hz random, 2.5 g RMS Sin wave, 15 minutes per axis

EDS Auto-Compensation

Respiration rate limits

Adaptive: ~ 5 - 30 bpm (see note below)
<u>**O2D2:**</u> both users independently

For respiration rates over 30 bpm, the EDS unit delivers oxygen only on every other breath, which provides a behavior more to the expectations of the user (see **INHALATION EVENT & OXYGEN DELIVERY NOTIFICATION**, page 10).

Apnea Time-to-Alert

Adaptive (continuous as function of pressure altitude):

Altitude	Time-to-Alert
(any)	32 sec (MAX)
~10 K ft	~25 sec
~15 K ft	~22 sec
~26 K ft	~16 sec

The EDS units will now ensue with an apnea alert if the unit does not detect breathing after ~16 minutes in any setting to help inform you that the unit has been left on.

Note: In **D** modes, **APNEA ALARM** does not respond below the selected threshold altitude

NOTES

- Specifications and Limits characterized from test results, or derived from underlying specifications.
- Nominal Battery Voltage/Current values measured in **N** mode setting @ 15 bpm typical
- Battery-life values assume fresh alkaline batteries and normal operating conditions.
- ***Unit is not water-proof!*** Keep away from rain and spray.
- ***Batteries should be replaced at least once a year.***
- ***Use good quality <u>alkaline</u> batteries <u>only</u>.*** <u>**DO NOT**</u> use Lithium batteries (page 8).
- ***<u>DO NOT</u> mix old and new batteries!*** Replace all batteries at the same time. (page 8).
- Remove batteries during long-term storage to prevent battery leakage and corrosion (page 20).
- The **Battery Minimum 'Start-Up'** voltage is the level at which the EDS unit will initiate the **POWER-UP TEST**. If the battery level is too low, the EDS will immediately generate a **BAD BATTERY ALARM.** Otherwise the EDS will proceed to issue the initial oxygen pulse(s). This not only exercises the valve(s) and verifies the integrity of the entire oxygen system, but also serves as a stress-test for the batteries. If the battery level is too low following the initial pulse(s), the EDS will generate a **BAD BATTERY ALARM** then. Only when the EDS successfully passes all of these tests will it then commence operating (with or without a **LOW BATTERY** Warning). This behavior should help the operator in determining if the EDS unit is bad or if the batteries are just too low.
- If a **BAD BATTERY ALARM** is generated, the EDS unit will enter "lock-out" mode and will not function other than to display the **BAD BATTERY ALARM**. Batteries ***must be replaced*** at this point for the EDS unit to resume proper functioning. However, once the EDS is running, it will continue to operate as long as possible until the batteries are completely exhausted (see **BATTERY LIFE AND DEPLETION**, page 13).

Mountain High E&S Co. USA

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