EDS Model D1a

INSTRUCTION MANUAL

Electronic Digital Pulse-Demand Oxygen Delivery System

Patent # 6,220,244
Revision: 1.8
EDS-013a

MOUNTAIN HIGH
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Aviation Oxygen Systems

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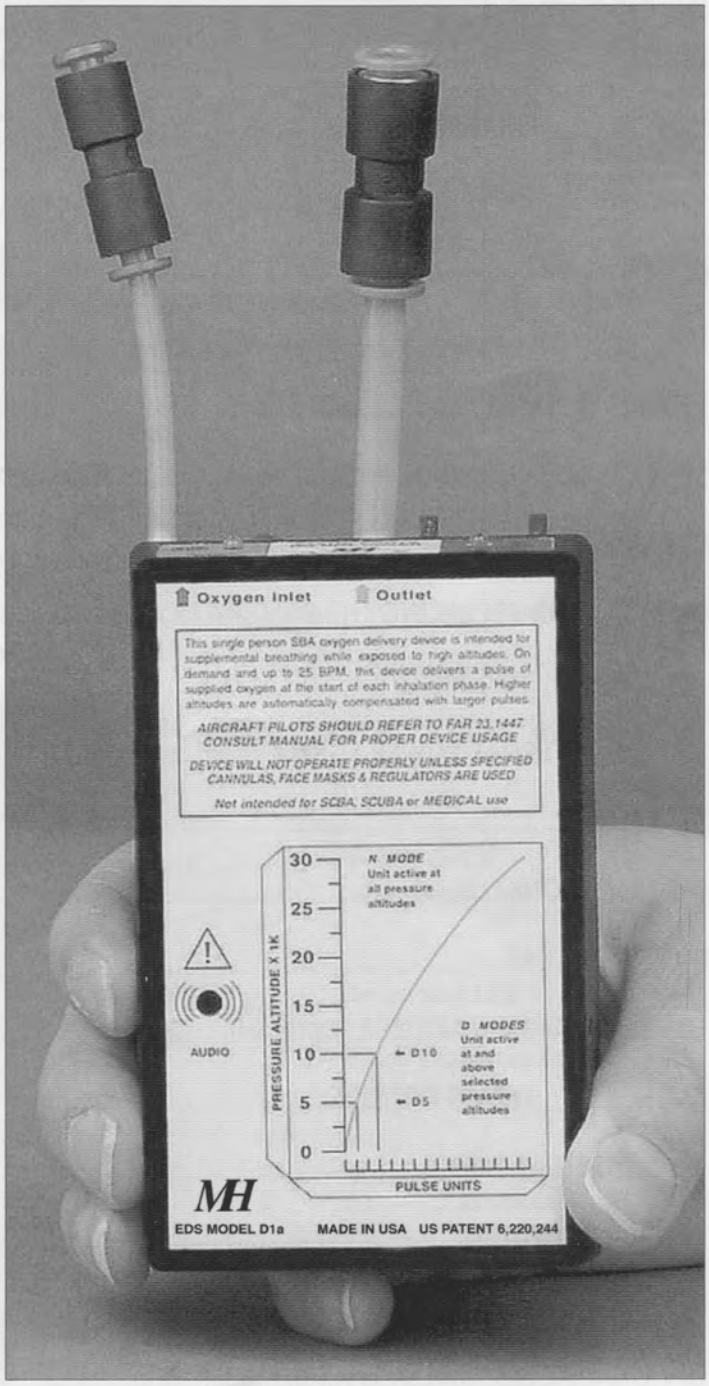

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INTRODUCTION

The human lungs are relatively inefficient compared to the other life-supporting organs, and are easily stressed at altitudes above 5600 feet, resulting in reduced efficiency, which can, within seconds, debilitate a pilot .

The patented MH EDS-D1a is a single person aviation oxygen delivery system. It is designed to deliver aviation oxygen into the human body in the most efficient, comfortable and convenient way possible. With user-selectable settings, apnea alarm and small size, the MH EDS-D1a provides the most portable and flexible electronic digital oxygen delivery system in the world.

The MH EDS-D1a operates using well known physiological facts about healthy, non-smoking persons. A person spends 1/4 to 1/3 of every breath inhaling and 2/3 to 3/4 of every breath exhaling and pausing. In addition, between 2/3 and 3/4 of the volume of air inhaled is exhaled without getting to the oxygen exchange areas of the lungs. Only about 25% to 30% of the oxygen inhaled in a given volume of air is actually absorbed into the bloodstream. The rest is simply exhaled. *Studies have shown that oxygen delivered at the very beginning of inhalation cycles is more efficient than a constant flow oxygen delivery method. The MH EDS-D1a provides oxygen at a slightly higher pressure than ambient, allowing optimum oxygen absorption. This is especially crucial during high altitude flights where oxygen partial pressure with absolute (atmospheric) pressure is low.

A New Oxygen-Conserving Delivery Device, American Review of Respiratory Disease 1983; 127:86
Clinical Assessment of Oxygen Conserving Devices in Chronic Bronchitis & Emphysema, Thorax 1985; 40:820-824

FEATURES

- **Easy to use two-button control, small size and light weight.**
- **Automatically adjusts oxygen flow for different altitudes.**
- **Allows operation for different oxygen delivery protocols and variable flow regulators.**
- **Push-button control switch allows automatic altitude enable, Night & Day operations and high flow settings for special or emergency purposes.**
- **Green/Red LED indicators for oxygen FLOW and ALARM or STATUS.**
- **Audible and visual Apnea alarm to inform user of kinked, pinched, disconnected lines or obstructed cannula**
- **Reduced oxygen consumption compared to standard constant-flow systems.**
- **Reduces dry-mouth as well as associated discomfort over standard constant-flow delivery systems.**
- **The EDS pulse-demand technology has been recognized by the FAA as having the equivalent level of safety per FAR. 23.1447 operating with a cannula or face mask.**

HOW THE EDS WORKS

The EDS-D1a monitors the slight drop in pressure induced from inspiration efforts. In turn it delivers a precisely metered pulse of oxygen at the instant inspiration is detected. Tests indicate that 90% of the oxygen the MH EDS D1a provides to the lungs goes directly into the blood. The patented MH EDS D1a "synchronous inhalation pulse-demand technique" is currently the most efficient way known to saturate the blood to over 90% while using as little oxygen as possible. Actual oxygen usage will be determined by breathing rate and your physiological needs at altitude. Your oxygen usage may vary.

Because oxygen is wasted using the constant-flow method, many pilots wait until some indication of hypoxia is detected before they begin to use their limited supply. This could leave a person well behind the oxygen saturation curve before realizing the onset of hypoxia. The MH EDS D1a allows one to use oxygen when it is needed without the worry of running out before reaching the destination.

The MH EDS D1a is intended to be used with regulators provided by Mt. High. Any other regulator with a near-compatible oxygen regulator may be used. Pilots who intend to fly with the MH EDS D1a are advised to become familiar with the system. The cannula can be used for flight operations up to 18,000 ft. MSL. Above 18,000 ft., a face mask should be worn. This is because at higher altitudes where oxygen is needed it is important that the pilot get the proper amount either through the mouth or nose. A cannula alone can't provide this assurance. A cannula and face mask are included with the MH EDS D1a unit. A face mask with a microphone that is compatible with the MH EDS D1a is available from Mountain High.

LIMITED LIFETIME WARRANTY

Mountain High Equipment & Supply Company warrants your **MH EDS EDS-D1a** unit or system against defects from materials and workmanship for as long as you own it. The conditions are simple; should any part of the D1a become defective, ship it to us and we will repair or replace it free of charge (you pay only shipping). This warranty is only valid if Mountain High Equipment & Supply Company has determined that the system or any of its components have not been damaged from improper use, submerged in fluids, dismantled or abused. Mountain High Equipment & Supply Company reserves the right to determine if repairs are to be done under warranty or at a nominal charge. Before this warranty can be valid Mountain High Equipment & Supply Company must have the owner's guarantee & registration form properly filled out and in our files.

Mountain High Equipment & Supply Company is not liable for any property or personal damage caused by misuse of the system or cylinder. Operating conditions including, but not limited to, system pressure and ambient conditions must be considered. When using the system improperly, it could possibly cause failure and lead to possible property damage and personal injury.

NOTICE OF NON-LIABILITY

This device is classified as, and is only suitable for use as, a supplementary breathing apparatus (SBA) for aviation use. It is intended to help supply the needed amount of oxygen for persons during excursions at flight altitudes where supplemental oxygen is needed. This device is not suitable for any type of life support operations. This device is not suitable for SCBA (Self Contained Breathing Apparatus) or SCUBA (Self Contained Underwater Breathing Apparatus) or any Medical operations.

Before it is put to use, it is the responsibility of any user who will use this device to become familiar with the operation and safety aspects of this device.

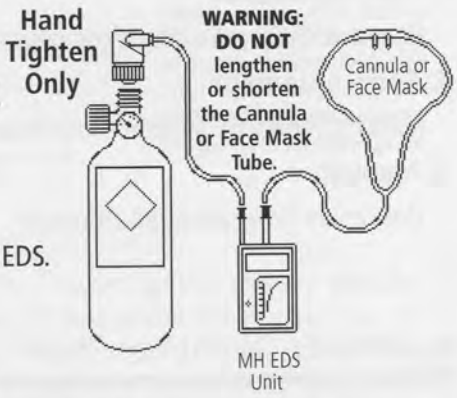
Mountain High Equipment & Supply Company assumes no responsibility for any accidents, injury or death that may result from the misuse of this device/equipment. This includes any usage of this device/ equipment outside the scope of common sense and detailed in the operations and safety manuals,

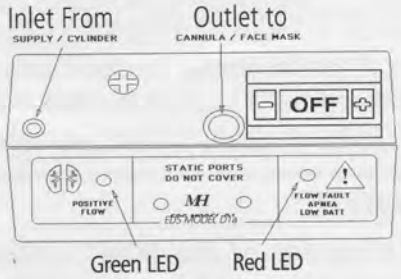
BASIC SAFETY

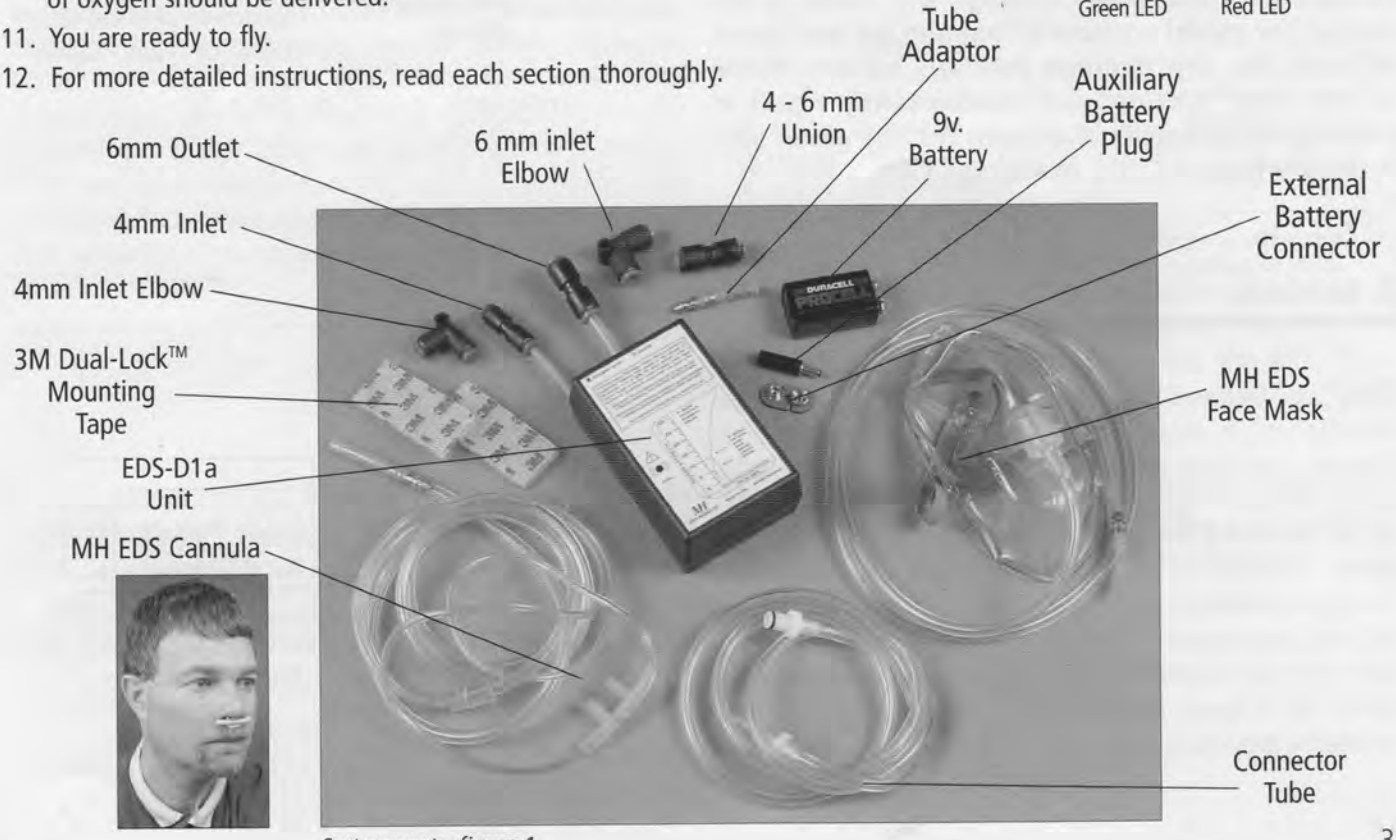
The EDS Oxygen system is designed to deliver pure oxygen for the purpose of supplemental breathing and is not intended for medical use. Pure oxygen is a highly oxidizing gas and can vigorously accelerate combustion. It can provide a catalyst for spontaneous combustion and may cause personal injury or death if not used properly and with caution. ***DO NOT use any type of oil or grease on any of the fittings, valves or cylinders. DO NOT smoke while in use. DO NOT operate near an open flame.***

QUICK START

1. Open the shipping carton and inventory your system *(see figure 1)*
2. Fill the cylinder with Aviation oxygen. Many FBOs offer this service.
3. Attach the regulator to the cylinder and hand tighten only ***(DO NOT use a wrench, the "O" ring seals the regulator to the cylinder, not the threads).***
4. Read the operational and precautionary front face plate.
5. Install the 9 volt battery. *(see page 7)*
6. Attach the **Red** tube or **Clear** tube with quick disconnect to the outlet on the regulator and the other **Red** end to the 4mm RED Quick-Connector inlet on the EDS.
7. Attach the cannula or face mask tubing (**Blue End)** to the 6mm **Blue** Quick-Connector outlet on the EDS. ***(CAUTION: Use only the supplied MH EDS cannula. Other cannulas may not work properly with the MH EDS D1a. DO NOT lengthen or shorten the cannula tube)***
8. Turn the cylinder valve on.
9. Turn on the EDS using the power on/off and control switch. Set to "N" mode. A start-up pulse of oxygen and Beeper test will verify battery power.
10. Don cannula or face mask (make sure the face mask seals against the skin) and take a breath. The bright green LED light should illuminate, and a pulse of oxygen should be delivered.
11. You are ready to fly.
12. For more detailed instructions, read each section thoroughly.







System parts, figure 1

CONTROL SWITCH SETTINGS AND MODES OF OPERATIONS

The EDS-D1a unit is controlled by two push button control switches. A stop is provided inside the selector switch at the extreme travel positions, to prevent inadvertently turning the D1a off in flight.

The EDS-D1a has three main modes of user controlled operation as seen and described in the text and figures.

They are:

1. Fully-Automatic

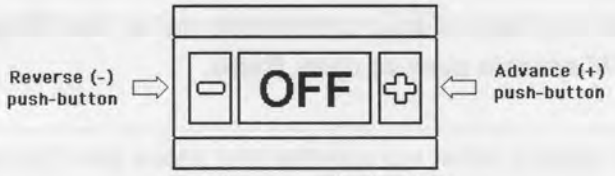
(Standard Protocol, altitude compensating)

2. Semi-Automatic

(Enriched Protocol, altitude compensating)

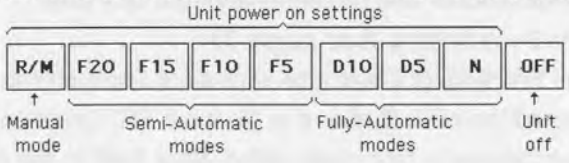
3. Manual

(Maximum flow rate at all altitudes)



Switch as seen in the full Reverse (-). "OFF" setting

Control switch settings (windows) for each of the positions

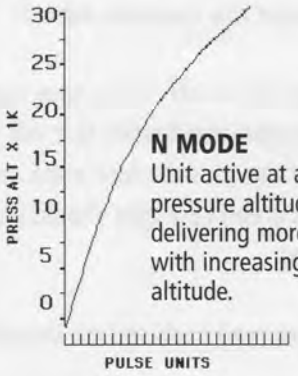


N MODE: "Night" or "Now"

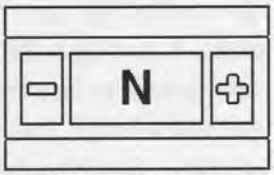
The first power **ON** mode is the **N** for **"Night"** or **"Now"** mode. At this setting the EDS-D1a will respond to breathing actions at all altitudes with the standard delivery protocol. The EDS-D1a will deliver pulses of oxygen at the effective flow rate of 1.0 liter/min. per 10,000 ft. for pressure altitudes up to about 33,000 ft.

NOTE:

Using any of the "ON" settings will result in the correct (or more) amount of oxygen for any given altitude for the average healthy person. None of the "ON" settings will inadvertently result in inadequate amounts of oxygen for any given altitude in which the EDS operates.



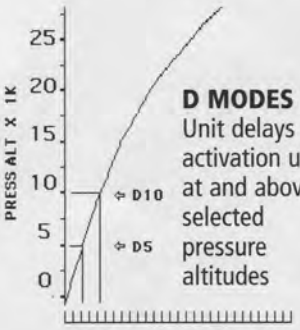
N MODE
Unit active at all pressure altitudes delivering more with increasing altitude.



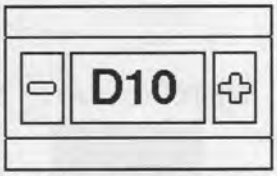
Switch as seen set to "Night" or "Now" mode.

D MODES: "Day" or "Delayed"

The next two settings are the **D** modes. These are the "**Day**" or "**Delayed**" modes. The **D5** setting will cause the EDS-D1a unit to delay responding to breathing actions until it senses a pressure altitude of 5,000 ft. and above. The **D10** setting will cause the D1a unit to delay responding to breathing actions until it senses a pressure altitude of 10,000 ft. and above. Because the **D1a** unit has no user adjustments for changes in barometric pressure, it simply operates from pressure altitudes such as your body does. Therefore, if the unit is being used while the barometric pressure is low, it will start operation sooner *(at a lower MSL flight altitude)* than it will if the barometric pressure is high.



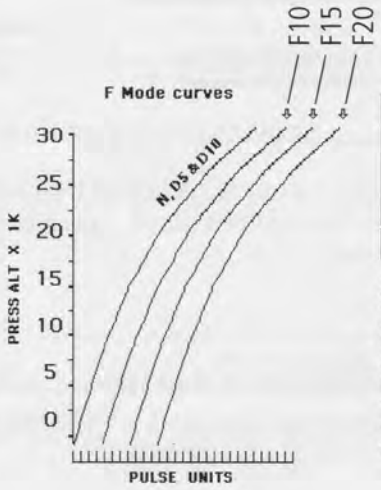
D MODES
Unit delays activation until at and above selected pressure altitudes

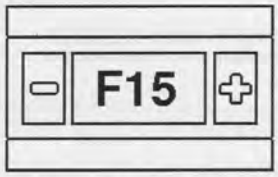


Switch as seen in one of the "Day" or "Delay" settings.

F MODES: "Floor & Face Mask"

The **F Mode"** settings **(F5, F10, F15, and F20)** are called the "**Floor or Face mask"** settings. These settings cause the EDS-D1a unit to add additional oxygen to the standard protocol equivalent to the indicated setting, in thousands of feet. For instance, if you are at a pressure altitude of 10,000 ft, and you set the unit to the F10 setting you will get an additional 10,000 ft. worth of oxygen added to your current pressure altitude. This results in an effective flow rate equivalent to 20,000 ft. worth of oxygen. Thus the settings will add in the effective flow rate of 0.5 liter/min. for the **F5**, 1.0 liter/min. for the **F10**, 1.5 liter/min. for the **F15**, and 2.0 liter/min. for the **F20** . The **F10** or **F15** settings are suitable for use with most face masks.



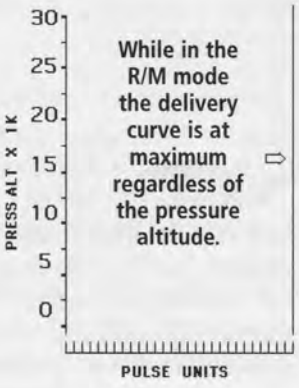


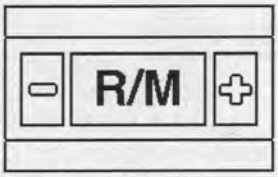
Switch as seen in the F15 Mode. The F15 setting provides 15,000 ft. amount of oxygen referenced to sea level or that respective additional amount throughout the pressure altitude curve.

Changes in pressure altitudes cause the unit to deliver the additional amount of oxygen for that pressure altitude. For example, if you are at a pressure altitude of 5,000 ft. and you select the F10 setting you will then receive the effective flow rate of 5,000 + 10,000 = 15,000 ft. or 1.5 liters/min. The unit will be active at all altitudes (like "N" mode) while in any of the "F mode" settings. The "F" modes are very useful in situations where you may wish to pre-charge yourself with oxygen before an ascent or as needed for losses associated with a face mask. The "F" modes enable you to ensure proper oxygenation after you have descended from long-term high altitude flights, even after having descended to flight levels not requiring oxygen.

R/M: "Reserve/Manual Mode"

This last switch setting causes the EDS-D1a unit to respond to breathing actions with a fixed 1/2 second long pulse regardless of the actual cabin pressure altitude. This would equate to a 100% oxygen flow setting for a conventional delivery oxygen device. The effective (or equivalent) flow rate at this setting is about 10 liters per min. This setting is intended to be used as an emergency setting while still providing some conserving. This setting should provide the user a better than 90% utilization of the oxygen supplied during most inspiration cycles.





Switch as seen in the Reserve/Manual Mode. Maximum delivery rate.

The R/M setting is intended for times when you may desire to receive oxygen during the (near) full reserve inspiration cycle to manage possible acute dyspnea (shortness of breath) and/or anxiety while under stressful and/or demanding flying conditions. In addition, this setting can be used as a "full-on" mode to pre-charge yourself with oxygen or for emergency purposes.

DISPLAY INFORMATION

There are two bright LEDs on the EDS-D1a. The **Green LED** indicates positive oxygen flow for every breath. A rapidly flashing **Red LED** indicates flow fault or apnea conditions and a slow flashing **Red LED** indicates low battery voltage.

FLOW FAULT ALARM

The EDS-D1a will produce a two second visible **Red LED** and an audible beeping **Flow Fault** alarm if the oxygen supply is depleted; the supply line has been pinched closed, is plugged up or has come off; the battery no longer has the power to energize the valve, or the valve has failed to open.

APNEA ALARM

The EDS-D1a will produce a visible **Red LED** and audible **Apnea** alarm for the following reasons: **(1)** The user has quit breathing for 45 seconds or the cannula/face mask is improperly worn. **(2)** The outlet tube has become disconnected. **(3)** The outlet tubing has become pinched closed or is plugged off.

LOW BATTERY

The EDS-D1a uses a standard 9 volt alkaline battery *(DURACELL type MN1604 or equivalent).* The EDS-D1a unit continuously monitors the condition of the battery during operation. The unit flashes the **Red LED** once every two seconds to warn that the battery has dropped to about 6 volts. The unit will, however, continue to operate properly for about four hours @ 25° C after the indicator starts to flash. It will flash the **Red LED** once every second to warn that the battery has dropped to about 5 volts and should then be replaced **as soon as possible.** The EDS-D1a will operate for 40 to 60 hours with a fresh alkaline battery under normal operation.

EXTERNAL POWER

The EDS-D1a unit has an external power connector. It allows the unit to operate from an external power supply such as the EDS-EPS (External Power Supply) or a power supply that provides 7 to 10 volts with less than 150 mV. ripple. The inside conductor "tip" is negative (-) and the outside ring is positive (+). The MH EDS D1a power input is reverse polarity protected.

MISC. NOTES

The EDS unit will only produce the apnea alarm if it has not detected any respiration actions for a period of 45 seconds. Any respiration events within this time will reset the 45 second "time-out" apnea detector. This type of apnea detection is usually sufficient for aviation applications. The apnea alarm can be used as a "put-your-oxygen-on" alarm once you get to the preset D mode altitude. The apnea alarm will not sound if you already have the cannula or face mask on properly.

MH regulators are designed to produce the correct flow rates at the correct pressure.

WARNING:

DO NOT exceed 30 psig on the inlet or the valve may free flow. Do not store the EDS unit while the inlet is under pressure. Remove all sources of oxygen pressure and secure the unit to ensure it will not become damaged. If the lines are disconnected they must be covered so that debris, dust or dirt can't get in. If the supply line is left attached to the system, make sure that it is first purged with clean dry air or oxygen before the EDS unit is connected.

LIFE EXPECTANCY OF THE UNIT

The EDS-D1a unit does not require any regular or periodical maintenance or calibration.

The electromechanical valve has a service life of well over 150 million pulsing cycles. The respiration sensor has a service life of well over 500 million pulsing cycles.

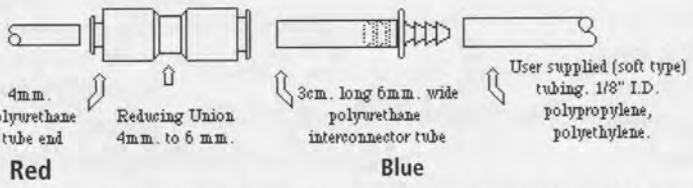
CLEARING A CLOGGED VALVE

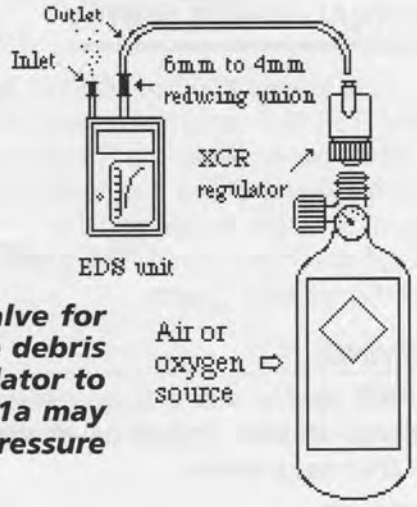
If the unit is used in an application where dirt and dust are present, the valve may become clogged with debris or leak. If this happens you can usually clear a clogged valve by back-flushing. This is done by supplying a small amount of air or oxygen pressure into the large (6mm) outlet line while the valve is on.

TO CLEAR A CLOGGED VALVE, FOLLOW THESE STEPS:
(WARNING...Use only the Mountain High supplied regulator to perform this procedure).

1. Remove the 6mm blue union from the outlet side of the EDS-D1a unit (see page 11) and replace it with the 4mm to 6mm reducing union that is included in your MH EDS system.
2. Connect the 4mm line from the regulator (source) to the reducing union.
3. With the EDS-D1a unit off, turn on the cylinder valve slowly to charge the outlet side of the EDS-D1a. Next turn the EDS-D1a unit on, wait about one second, then turn the unit off. Repeat this several times if needed to clear the clogged valve.

4 mm to 6 mm Reducing Union





Each time the EDS-D1a unit is turned on it will open the valve for about one second. Do this as many times as needed to free debris that may be clogging the valve. Do not use any other regulator to perform the "clearing a clogged valve" procedure as the D1a may be damaged. Do not leave the outlet side charged with pressure more than one minute or the D1a may be damaged.

WARNING:

DO NOT apply pressure over 15 psig into the outlet of the MH EDS D1a or the unit may be damaged.

NOTE:

If following the above steps do not correct the described problem, and the EDS-D1a unit is still not functioning correctly, the unit should be sent to Mountain High Equipment & Supply Company for diagnosis, repair and calibration. The REPAIR FORM, address and telephone information is on page 13 of this instruction manual.

The MH D1a is covered under a limited lifetime warranty.

INLET PRESSURE NOTICE

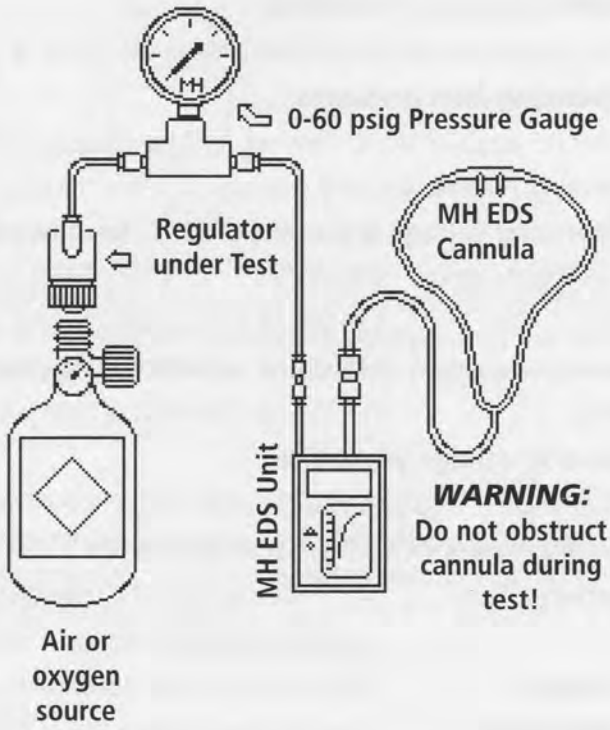
IMPORTANT NOTICE FOR MH EDS D1a INLET PRESSURE

If the EDS-D1a will not be used with a MH Regulator, the alternate regulator must be able to deliver a dynamic (flowing) pressure of 1 bar (15 psig. ±2.5 psig.) and a static, no flow, pressure between 1 and 2 bars (15 and 30 psig.) measured at the inlet of an EDS unit while the valve is open and an EDS cannula is connected to the outlet. If the above listed pressure specifications are not met, it may compromise the operation and ability of the EDS-D1a to deliver the correct amount of oxygen at altitudes. Lower than specified inlet dynamic pressures will result in lower than needed volume of oxygen pulses. Higher pressures will result in higher than needed volume of oxygen pulses. Undesirable operation of and/or damage to the EDS may result from operating with inlet pressures above 30 psig. Inlet pressures above 30 psig may cause the valve to automatically relieve inlet pressures through the outlet, not allowing the EDS unit to detect any inspiration efforts.

WARNING:

Inlet pressure above 25 psi will not damage the unit, but may cause the valve to leak.

Acceptance testing the dynamic (flowing) and static (not flowing) outlet pressure performance of a regulator for use with an EDS unit. Maximum pressure (no flow) 30 psi. Recommended no flow pressure is 15 - 20 psi.



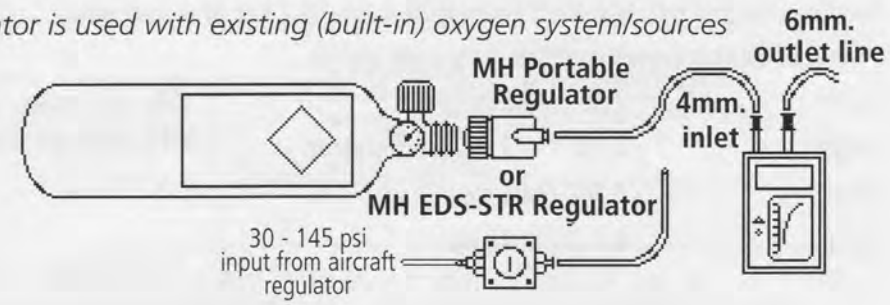
OPTIONAL EDS REGULATOR STABILIZER

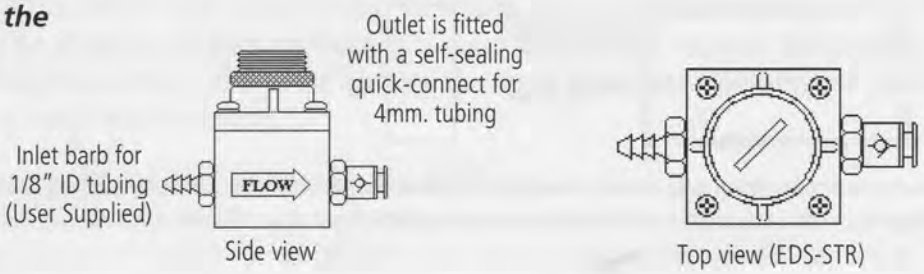
The EDS Regulator has a self-sealing 4mm outlet for connecting the EDS using a 4mm service line.

The EDS Regulator is used with existing (built-in) oxygen system/sources

NOTE:

If a MH Portable Regulator will not or can not be used, the MH EDS-STR Regulator should be used. The EDS-STR is designed to allow up to six EDS units to be operated from a built-in oxygen system where the pressure is 30 to 145 psig.

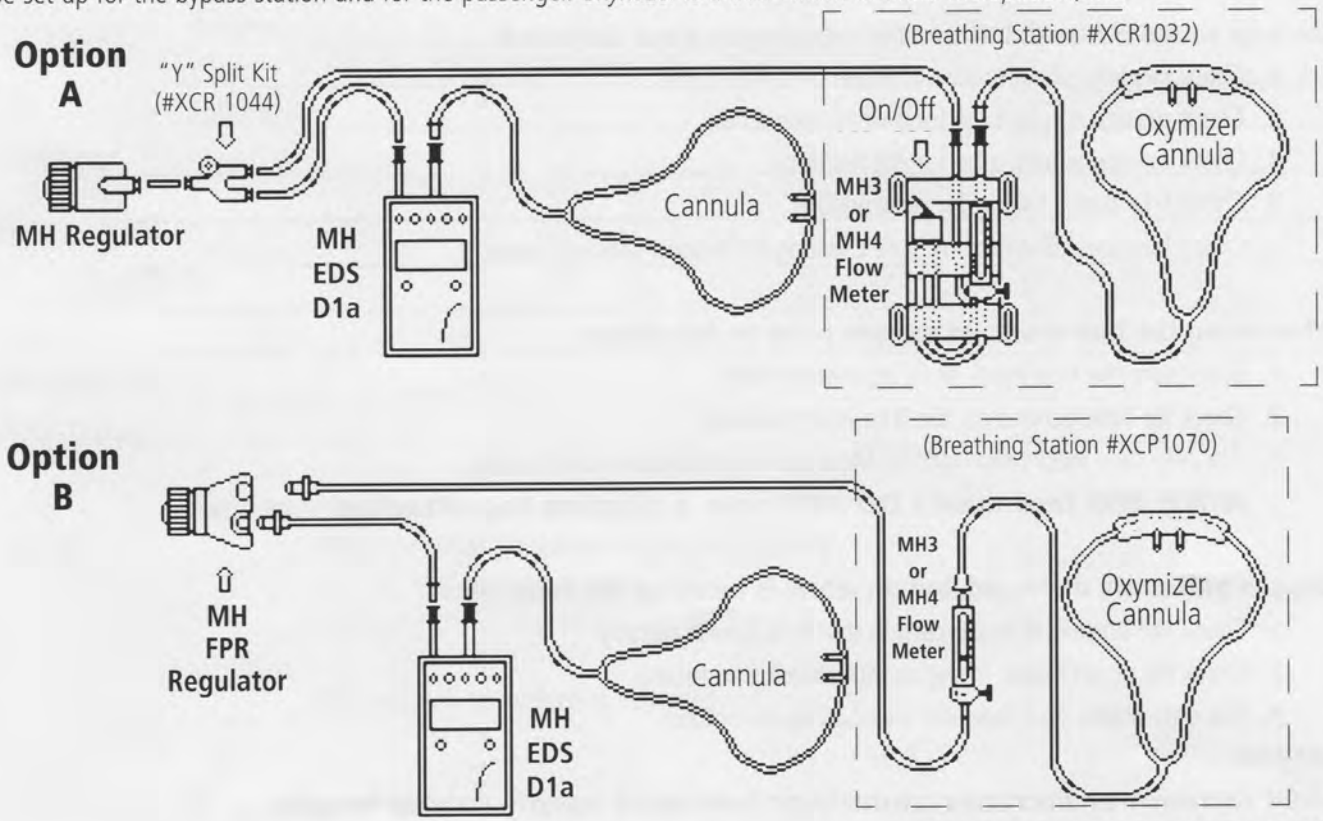




EMERGENCY BYPASS OPTIONS

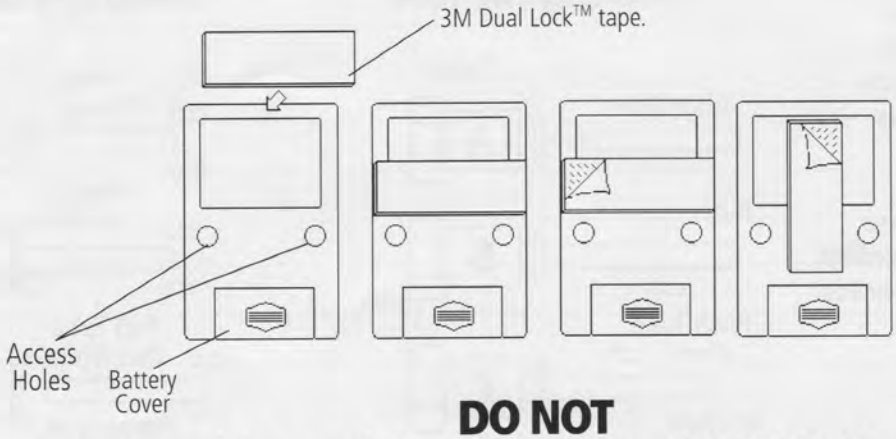
The EDS-D1a has proven to be very reliable and has been used by pilots for several years. The MH EDS-D1a unit has no means to provide a bypass of oxygen in the event of a total failure. If this should become necessary, here are two methods you can implement with optional equipment, for altitudes up to 18,000 feet.

Because many pilots fly with passengers only part of the time, the MH3 or MH4 flowmeter and an Oxymizer® cannula can be set up for the bypass station and for the passenger. *Oxymizer is a trade mark of Chad Therapeutics, inc.*



USING 3M DUAL LOCK™ TAPE

After a suitable place for the unit has been found, peel off the protective adhesive backing and press the adhesive side to the chosen mounting area.



DO NOT

cover any of the access holes or battery cover with the 3M Dual Lock™ tape.

TROUBLESHOOTING

- **The D1a unit emits no sound or start-up oxygen pulse when turned on:**
  1. Check the battery to make certain that it is a fresh battery.
  2. Check the battery connection leads, making certain they have good clean connections.

- **Start-up sound is heard, but no start-up oxygen pulse delivered:**
  1. Check oxygen cylinder valve to make certain it is on.
  2. Check oxygen supply tube for proper connection.
  3. Check oxygen supply tube for obstructions.
  4. Check D1a outlet tubing for obstructions.
  5. Check for valve obstructions. (see Clearing A Clogged Valve on page 8)

- **When using the face mask, no oxygen pulse on inhalation:**
  1. Make sure the face mask seals against the skin.
  2. Check for obstructions on the **D1a** outlet tubing.
  3. Use only face masks provided by Mountain High Equipment & Supply.

     NOTE: EDS face masks DO NOT have a dilution bag attached

- **Oxygen pulses are delivered, but an alarm is heard at the same time:**
  1. Check the battery to make certain that it is a fresh battery.
  2. Check for obstructions in the cannula/mask and tubing.
  3. Use only masks and cannulas supplied by Mountain.

WARNING:

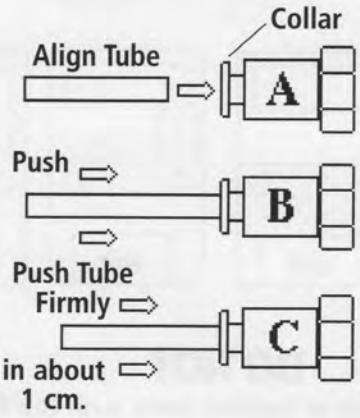
DO NOT increase or decrease cannula or face mask supply tubing length.

INSERTING AND REMOVING THE POLYURETHANE TUBING

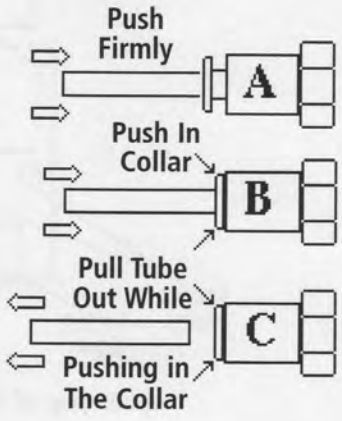
To remove the polyurethane service line you must push in the connector collar while you pull on the polyurethane line.

DO NOT
pull the polyurethane line without pushing in the collar. It will damage the connector.

Inserting the Tube



Removing the Tube



MH REPAIR/RETURN ORDER

In the highly unlikely possibility of MH equipment failure, please fill out this Repair/Return Form, package up the non-functioning unit and send to MH via UPS or another carrier of your choice.

Date :_____ Product:_____

Product ID/Serial Number: _____

Customer: Name: _____

Address: _____

City: _____ State:_____ Zip:_____

Telephone: _____ E-mail_____

Problem: _____

_____

_____

_____

_____

Returned Via: _____

Return Date: _____

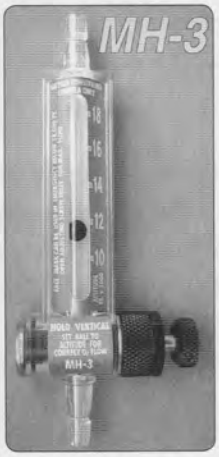
Send to: Equipment Repair Department
Mountain High Equipment & Supply Company
625 SE Salmon Avenue Suite 2
Redmond OR 97756-8696

Your unit will be evaluated, repaired and returned

NOTES

Complete single and multi-place carry-on **MH EDS *FADOC™** system packages are available along with padded fabric carry/strap-down harnesses for our kevlar-fiber and aluminum cylinders. *(Full Authority Digital Oxygen Control)

For critical size and weight applications, the MH Micro-lite valve and regulator system with our new light-weight and small 'S' series cylinders, offer compactness and capability never offered before.



The **MH EDS D1a** operates with any of THE MH regulators. It can be used with our new **FPR** (Four Port Regulator) along with **MH-3** & **MH-4** flowmeters. Please request our catalog or visit our web site (mhoxygen.com) for our a complete selection of our aviation oxygen accessories.

MH
MOUNTAIN HIGH
Equipment & Supply Company
Aviation Oxygen Systems

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541-923-4100
Fax: 541-923-4141
www.MHoxygen.com
625 SE Salmon Avenue, Redmond, OR. 97756-8696 USA
(next to the Redmond Airport, stop by and say hello)