# 3500 / 3500HL Series
# Air / Oxygen Mixer

## USER'S MANUAL

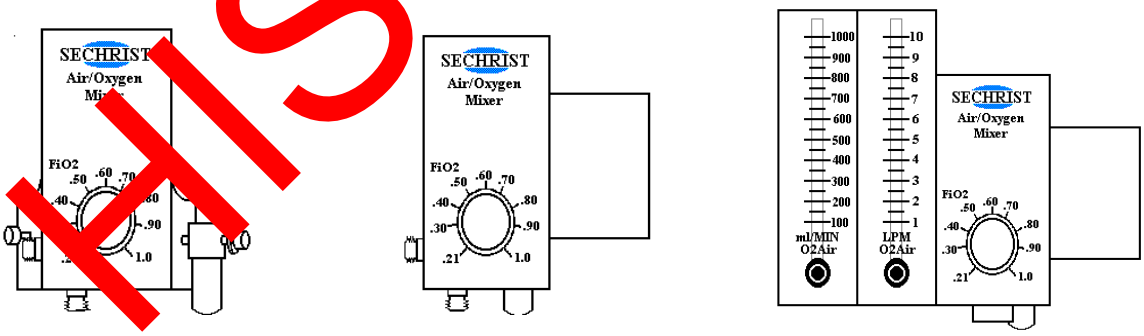
## Low Flow Models:

20099, 3500CP-G2045 7, 20459 &
20090 (Not Offered in US/Europe Markets)

## High Flow Models:

3600 & 3601



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℞ Only

**FEDERAL LAW (USA) RESTRICTS THIS DEVICE TO SALE BY OR ON THE ORDER OF A PHYSICIAN.**

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## INTRODUCTION

We at Sechrist Industries, Inc. thank you for choosing a Sechrist air/oxygen mixer. We also caution you that before attempting to use the mixer in a patient care setting, you must make yourself thoroughly familiar with the instructions in this manual and any product labeling. Throughout this manual, warnings, cautions, and notes will be utilized to bring your attention to particularly important matters.

## USER/OWNER RESPONSIBILITY

**WARNING: It is the responsibility of the procuring organization to assure they have the tooling, equipment and training necessary to perform the tasks they are procuring components or kits for.**

**WARNING: Hospitals or users who perform certain repairs and/or periodic service without undergoing training by Sechrist Industries assumes sole responsibility for any malfunction, which results from improper usage, faulty maintenance, improper or unauthorized repairs, damage or alteration performed.**

The Sechrist mixer will perform in accordance with the specifications and descriptions contained within this manual and accompanying labeling when the mixer is operated and maintained in accordance with the instructions contained within this manual and other accompanying documentation. Do not attempt to operate this equipment before reading and thoroughly understanding these instructions. The mixer should be checked periodically as specified within this manual (see Routine Maintenance section). A defective product should never be used in a clinical setting. Any necessary repair should be provided at the Sechrist home offices in Anaheim, CA or by an individual trained and authorized by Sechrist Industries. However, Sechrist recognizes that some hospitals and other users maintain their own service groups (biomedical engineers and technicians) who perform certain repairs and/or periodic service. Given this, Sechrist does provide spare components and kits for such effort.

## WARNINGS & CAUTIONS

**WARNING:** indicate the possibility of personal injury or death to the patient and/or operator of the device.

**CAUTION:** indicate the potential of damage to equipment and/or other property if the caution is ignored.

**Notes:** call attention to statements that are intended to supplement or emphasize basic instructions contained within this manual.

**WARNING: It is the responsibility of the procuring organization to assure they have the tooling, equipment and training necessary to perform the tasks they are procuring components or kits for.**

**WARNING: No modification of this equipment is allowed. Do not modify this equipment without authorization from the manufacturer. If this equipment is modified, appropriate inspection and testing must be conducted to ensure continued safe use of the equipment.**

**WARNING: Hospitals or users who perform certain repairs and/or periodic service without undergoing training by Sechrist Industries assumes sole responsibility for any malfunction, which results from improper usage, faulty maintenance, improper or unauthorized repairs, damage or alteration performed.**

**WARNING: The user of the Sechrist Air/Oxygen Mixer shall have sole responsibility for any malfunction, which results from improper usage, faulty maintenance, improper and/or unauthorized repairs, damage or alteration performed by anyone other than Sechrist Industries.**

**WARNING: Alarm/bypass conditions must be corrected swiftly, as the selected oxygen concentration, will not be delivered during a bypass situation.**

**WARNING: Liquid water or other contaminants in either supply gas, particularly in the air supply, will cause malfunction of this equipment and any attached equipment. Supply gases should meet gas dryness of .0045 mg water per cubic centimeter of gas.**

**WARNING: Oxygen concentration must be monitored downstream from the mixer with a suitable, calibrated oxygen analyzer, equipped with alarms that can be set for high and low FIO2's. FIO2's should then be adjusted to maintain appropriate blood gas concentrations.**

**WARNING: The mixer is designed to mix air and O2 only; do not modify the inlets to accommodate any other source gases.**

**WARNING: Oxygen vigorously accelerates combustion. To avoid explosion hazard, do not expose the mixer to any instruments or other equipment that may have been contaminated by oil or grease. Gas supplied to the mixer must be extremely clean (no more than 25 parts per million (ppm) of gaseous hydrocarbons is allowed.) A high concentration of hydrocarbons in the gas supply is a fire hazard.**

**WARNING: The mixer audible alarm may not function when both air and O2 supply pressures are less than the minimum specified inlet pressure.**

**WARNING: The outlets have the capability of providing gas pressures equal to the inlet pressures. Therefore, any attached equipment must provide safety relief protection in order to prevent excessive pressures from being delivered to patients.**

**WARNING: Whenever a patient is attached to respiratory care equipment, constant attendance is required by qualified personnel. The use of alarm or monitoring systems does not provide absolute assurance of a warning for every possible system malfunction. In addition, some problems may require immediate attention.**

**WARNING: Excessive supply pressures (> 70 psi, 482 kPa) may result in mixer damage or malfunction. Use of a suitable supply gas regulation system is necessary.**

**WARNING: A Sechrist air/oxygen gas mixer is a sophisticated medical device designed for use by qualified personnel under the direction of a qualified physician.**

**WARNING: This product should only be maintained and repaired by a Sechrist Industries factory-trained technician or by written instructions from Sechrist Industries. This product should not be modified in any way, except with prior written approval of Sechrist Industries. Unapproved modifications can result in death or serious injury.**

**WARNING: The mixer does not contain gas-sterilizing filters and will supply the same quality of gas supplied from the gas sources. Use of appropriate gas purity and gas line filters is the responsibility of the user.**

**WARNING: When the Sechrist mixer is used to supplement respiratory equipment, the user must refer to and follow the instructions provided by the manufacturer of the respiratory equipment.**

**CAUTION: Do not immerse the mixer in any solution. Do not sterilize.**

**CAUTION: This precision gas-mixing device may become nonfunctional or damaged if used without the watertrap assembly and filters provided.**

**CAUTION: Before using this mixer, verify that the performance verification procedure has been performed by a qualified individual.**

SUMMARY OF SYMBOLS

| SYMBOL | MEANING |
|---|---|
|  | Caution |
|  | Manufacturer |
|  | Date of Manufacture |
|  | The symbol indicates to user/operator to refer to instruction manual/ booklet |
|  | Warning, prohibition or mandatory action |

| | |
|---|---|
| Rx Only | Caution: Federal law restricts this device to sale by or on the order of a physician. |

## INDICATIONS FOR USE

***Intended Use***

The purpose of the device is to enable qualified personnel to mix medical-grade air and medical-grade oxygen, at operator selected ratios, for delivery to patients through various types of respiratory care equipment.

The Sechrist air/oxygen mixer is a precision pressure regulation and proportioning device, which is designed to accurately mix medical grade air and medical grade oxygen ($O_2$). The mixer can provide for $FIO_2$'s of .21 to 1.0 for delivery to a variety of respiratory devices. The mixer receives air and oxygen via diameter index safety system (D.I.S.S.) inlet connections at a nominal pressure of 50 psi. (344 kPa). The unit will operate satisfactorily with inlet pressures of 30 – 70 psi (207 - 482 kPa) providing that the pressures are within 20 psi (138 kPa) of one another. The Sechrist air/oxygen mixers may be indicated whenever precise concentrations of oxygen are required for clinical applications. Use of the mixer in its appropriate configuration, may be found throughout the healthcare environment. Uses include but may not be limited to bedside delivery of precise oxygen concentrations directly to the patient or delivery of precise $FIO_2$'s to other equipment, such as a ventilator, isollettes, or resuscitation equipment.

## CONTRAINDICATIONS

While supplemental oxygen therapy is not without possible side effects, such as absorption atelectasis, and oxygen toxicity, the detrimental effects of oxygen should never prevent its use when indicated [1].

[1] Donald F. Eagan, MD, Eagan's Fundamentals of Respiratory Care, Fifth Edition 1999

## OPERATING INSTRUCTIONS

- Before using the mixer, verify that performance verification has been completed.
- If applicable, connect the mixer outlet to the inlet device that will be delivering the oxygen concentration to the patient.
- From reliable, pressure regulated gas sources, connect both medical grade air and medical grade oxygen to the mixer inlets utilizing appropriate gas hoses (P/N IV 308 air supply hose and P/N IV 309 oxygen supply hose).

**NOTE: The alarm/bypass will activate when the first gas is connected. The alarm will reset upon the connection to the second gas supply.**

- Using the calibrated control knob, select the desired oxygen concentration ($FIO_2$) from .21 to 1.0.
- If the configuration includes a flowmeter/s, initiate gas flow through the flowmeter(s) by tuning the knob(s) on the flowmeter(s) counter clockwise to the desired flow setting.
- Begin the operation of the attached delivery unit, if applicable.
- After the selected gas mixture has washed out the room air from the delivery unit, analyze and monitor the delivered gas concentration with a calibrated oxygen analyzer. Appropriately set the high and low alarm limits on the analyzer.
- Periodically observe the watertrap assembly for the accumulation of moisture. Moisture should be removed from the water trap assembly by depressing the valve at the bottom of the watertrap bowl.
- Periodically observe the oxygen analyzer and evaluate the delivered $FIO_2$.

## SPECIFICATIONS

Multiple configurations are available, with and without attached flowmeter(s). All models utilize the same gas mixer and therefore the following specifications apply to all configurations.

**$FIO_2$** .....0.21 +.01 to 1.0 – 0.1

**Accuracy** .....± 3%

High flow configurations.....at least 100 lpm @ an $FIO_2$ of .60 with inlet pressures of 50 psi (344 kPa). Supply range of 30-70 psi produces an output flow within a range of 70-150 lpm
Low flow configurations .....at least 40 lpm @ an $FIO_2$ of .60 with inlet pressures of 50 psi (344 kPa). Supply range of 30-70 psi produces an output flow within a range of 29-60 lpm

**Supply Pressures ****

Nominal .....50 psi (344 kPa)± 10 psi (68 kPa) (@ 4.0 standard cubic feet per minute (SCFM) min. flow)
Minimum.....30 psi (207 kPa)
Maximum .....70 psi (482 kPa)

**Bleed Flow*****

High flow configurations.....8.0 to 10.0 lpm @ 16 lpm flow setting
Low flow configurations .....2.5 to 4.5 lpm @ 8 lpm flow setting

**Dimensions (without flow meters)**

Height .....6 inches (15.24 cm)
Width .....6 inches (15.24 cm) (pole mount) / 6 ½ inches (16.51 cm) (wall mount)
Depth .....6 inches (15.24 cm) (pole mount) / 5 ½ inches (13.97 cm) (wall mount)
Weight .....6 lbs. (2.73 kg)

**Service Life** .....2 years

**Lifetime of Device**.....The lifetime of Sechrist mixers is 20 years provided they are overhauled using Sechrist supplied components and Sechrist certified technicians once every 2 years.

**Optional flowmeters**

1 – 10 lpm.....± 3% of full scale
1 – 15 lpm.....± 3% of full scale
0 – 16 lpm.....± 3% of full scale
2 - 20 lpm.....± 3% of full scale
2 – 32 lpm.....± 3% of full scale
3 – 30 lpm.....± 3% of full scale
100 - 1000 ml/min.....± 3% of full scale

*NOTE: The mixer will maintain the delivered $FIO_2$ within ± 1% of the selected concentration with small fluctuations of the supply pressure. The additional 2% error results from the readability of the set point and scale error.

**NOTE: The outlet pressure of the mixer will always be slightly lower than the lower of the two supply pressures. Some respiratory equipment attached to the mixer may require closer tolerances; if so, consult with the manufacturer of the equipment.

***NOTE: The bleed flow is located on the bottom of the proportioning module and is necessary in order to maintain $FIO_2$ accuracy at very low flow settings.

**Optional Accessories**

The following operator detachable inlet pressure hoses comply with Compressed Gas Association (CGA) V-1, V-5, and G-4.1:
Ref. IV 308 14 foot (4.27 m) Air Supply Hose Ref. IV 309 14 foot (4.27 m) Oxygen Supply Hose



## PERFORMANCE VERIFICATION

Prior to each clinical usage, the user should perform an alarm test and analyze the full $FIO_2$ range. With an accurately calibrated oxygen analyzer, the user should analyze the $FIO_2$ at the following settings; 21%, 40%, 60%, 80%, and 100%. Additionally, the user should briefly disconnect one supply gas to assure that the bypass/alarm system is functioning. With a single supply gas disconnected, the audible alarm should sound and the analyzed $FIO_2$ should indicate the $FIO_2$ of the single supply gas; i.e. 21% if the oxygen was disconnected and 100% if the air supply was disconnected.

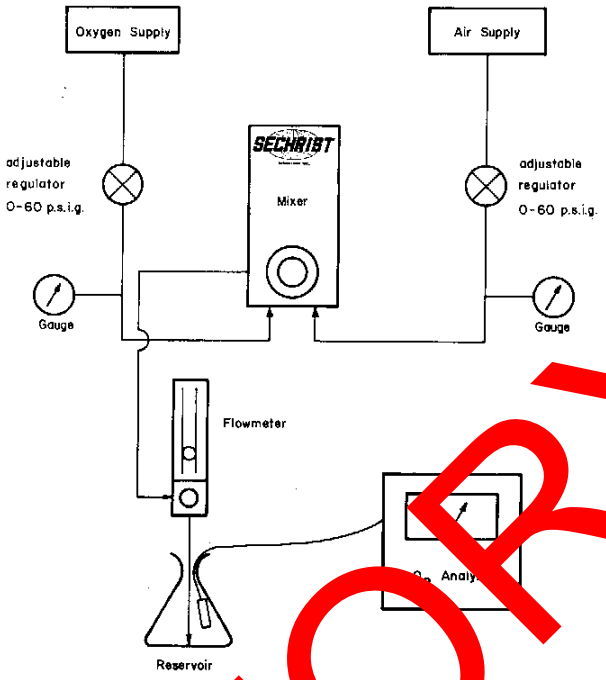
The following more extensive procedure should be performed at least once a month, or more frequently as indicated or desired.

This procedure provides a means of determining if the mixer is functioning in accordance with the design specifications. This verification is intended to be performed in the health care setting by qualified personnel. The procedure should be followed exactly as outlined. If the mixer fails to meet the established standards, it should be removed from clinical application until calibration and/or service is accomplished (see troubleshooting section or service manual)

NOTE: It is strongly recommended that personnel responsible for performance verification testing keep accurate records of testing activities.

The performance verification process requires a simple configuration as diagramed below.

Figure 2




- Connect the mixer to the supply gases with independently adjustable pressure regulators.
- Connect a flowmeter to the mixer outlet.
- Direct the flow from the flowmeter to a reservoir (e.g. a bag or tube) making sure that no room air is being entrained to dilute the mixture.
- Place a calibrated $O_2$ analyzer probe within the reservoir.

**Test for overall accuracy**

- Set both supply pressures to 50 psi (344 kPa).
- Set the flowmeter to 8 lpm for configurations with the following flowmeters; 0 – 10 lpm, 1 –15 lpm, 0 – 16 lpm, and 100 – 1000 ml/min.
- Set the flowmeter to 15 lpm for configurations with the following flowmeters; 2 – 20 lpm, 2 – 32 lpm, and 3 – 30 lpm.
- Compare the $O_2$ analyzer reading at the following settings. Since the mixer has an overall accuracy of ± 3% and if the analyzer accuracy is within ± 1%, the following comparisons should agree within ± points.
  - .2
  - .40
  - .60
  - .80
  - 1.0

**Test for accuracy with varying inlet pressures.**

- Set the $FIO_2$ to .60 with the inlet pressures at 50 psi (344 kPa).
- Verify the setting accuracy comparing the setting with the analyzed value.
- Set the $O_2$ pressure to 40 psi (276 kPa) leaving the air supply at 60 psi (414 kPa).
- Note the analyzer reading.
- Set the $O_2$ pressure to 60 psi (414 kPa) and the air supply to 40 psi (276 kPa)
- Note the analyzer reading.
- Analyzed $O_2$ concentrations should vary by no more that 2% with the above pressure changes.

**Test the alarm module function.**

- Set supply pressures to 50 psi (344 kPa).
- Set the $FIO_2$ to .60.
- Reduce the air supply pressure to 24 psi. (166 kPa).
- The audible alarm should sound within the following pressure range of 24-28 psig, and the $O_2$ analyzer should read 100%.
- Slowly increase the air supply pressure to 50 psi (344 kPa). The alarm should cease and reset prior to obtaining a supply pressure of 40 p.s.i. (276 kPa).
- Reduce the $O_2$ supply pressure to 24 psi (166 kPa).
- The audible alarm should sound within the following pressure range of 24-28 psig, and the $O_2$ analyzer should read 21%.
- Slowly increase the $O_2$ supply pressure to 50 psi (344 kPa). The alarm should cease and reset prior to obtaining a supply pressure of 40 psi (276 kPa)

**Check the inlet filters.**

- To test the flow through the water trap filter and air inlet filter assemblies, a small test port has been provided on the rear of the mixer just above the air inlet.
- Turn both supply gases off and allow the gases to cease flowing. With a ¼ inch hex nut driver, remove the plug from the test port and install a 10-32 threaded nipple.
- Connect an accurate pressure gauge (0-60 psi) (0-414 kPa) to the nipple.
- Turn the supply gases on and set the flow to 16 lpm.
- Set the mixer $FIO_2$ control to .21.
- Observe the pressure registered by the gauge connected to the test port.
  - The difference between the test gauge pressure and the supply pressure should vary by no more than 5 psi (34 kPa).
  - If the pressure differential is > 5 psi (34 kPa) replace the inlet filters as outlined in the routine maintenance section.

## ROUTINE MAINTENANCE

**NOTE: The manufacturer will make available on request circuit diagrams, component parts lists, descriptions, calibration instructions, or other information that will assist trained service personnel to repair those parts of medical equipment that are designated by the manufacturer as repairable by service personnel.**

Routine maintenance of the mixer is limited to periodic performance verification, replacement of the inlet filters and cleaning of the exterior surfaces. A mixer in need of calibration or service should not be used until the necessary repairs are performed and the equipment has been tested to determine that it is functioning properly. Calibration and servicing may only be accomplished by personnel trained and authorized to do so by Sechrist Industries. Routine maintenance, as defined in this manual, may be performed by a competent individual having experience in the maintenance of devices of this nature. Parts designated within this manual should be replaced only with parts manufactured or sold by Sechrist Industries.

Routine maintenance procedure

- Inlet filters
  - Periodically replace the air water trap/inlet filter (P/N 3529E in Figure 4) at least every 6 months or as needed.
  - Replace the internal sintered stainless steel filters (P/N 3522K in Figure 3) at least every 6 months or as needed.

| **CAUTION** |
| --- |
| Do not immerse the mixer in any solution. Do not attempt to sterilize. |

- Cleaning
  - Exterior surfaces of the mixer may be wiped clean with a mild soap solution or a liquid disinfectant solution. Do not use cleaning agents that contain abrasives.

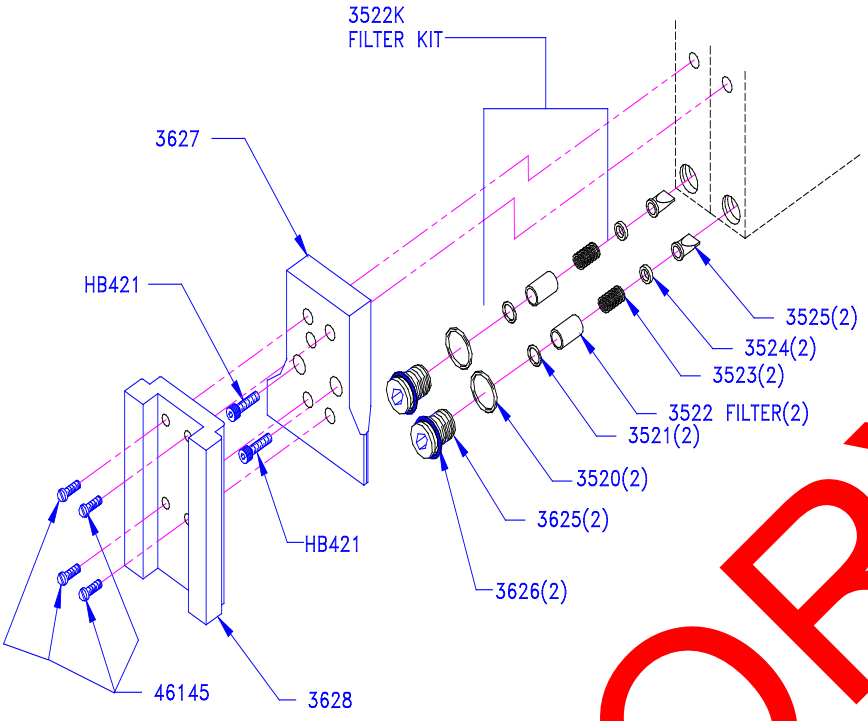



Figure 3

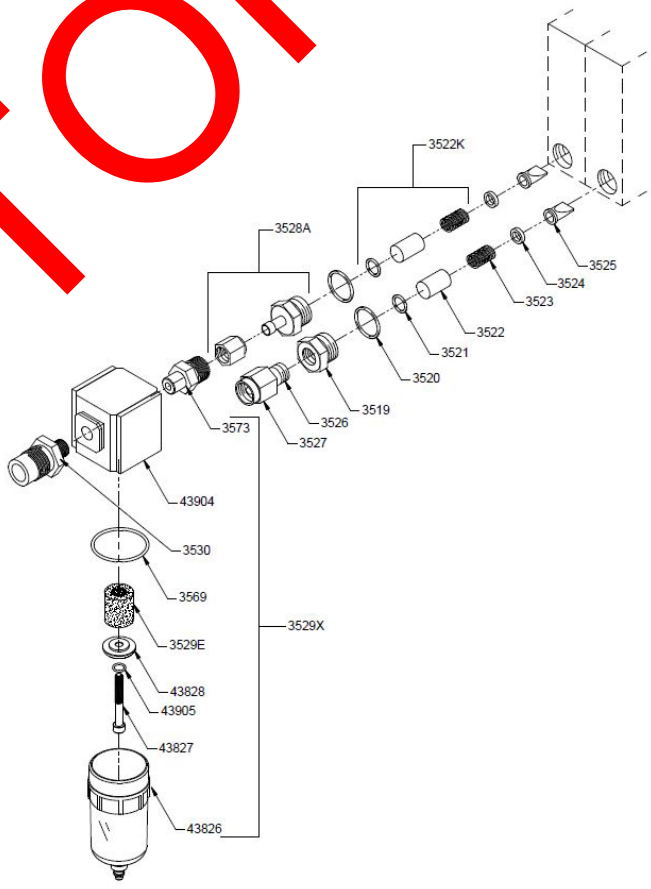



Figure 4

## FACTORY OVERHAUL

In order to assure proper function and accuracy, the Sechrist air/oxygen mixers must be thoroughly overhauled every two- (2) years. To maintain the product warranty, this overhaul must be performed by Sechrist Industries or by Sechrist authorized personnel.

## LIFETIME OF DEVICE

The lifetime of Sechrist air/oxygen mixers is 20 years provided they are overhauled using Sechrist supplied components and Sechrist certified technicians once every 2 years.

## TROUBLESHOOTING

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| **Inaccurate $FIO_2$** | $O_2$ analyzer out of calibration (most common problem). | Recalibrate $O_2$ analyzer. |
| | Improper purity of supply gases. | Check/verify supply g |
| | Incorrect gas supplied to inlet. | Assure t out and hoses are c nected correctly. |
| | Front and rear seats are worn. | |
| | Incorrect calibration of proportioning module. | **Recal te mixer as outlined in the service manual. |
| | Malfunctioning balancing module. | **R librate balancing module as outlined in the servic anual. |
| **$FIO_2$ control knob is difficult to turn.** | Faceplate has shifted. | Reposi n faceplate. |
| | Bent adjustment shaft. | ** place shaft and recalibrate as outlined in the service manual. |
| **$FIO_2$ change > 1% when testing.** | Air or $O_2$ inlet filter may be dirty causing > 20 psi (138 kPa) difference. | Replace inlet filter. |
| | Regulator needle ut of calibration. | **Recalibrate mixer as outlined in the service manual. |
| **Continuous alarm with both inlet pressures equal.** | Dirty inlet filter(s) | Replace filter(s). |
| | By ss check ll leaki | **Clean check ball and seat. |
| | Alarm m ule out c libration. | **Recalibrate as outlined in the service manual. |
| **Alarm not sounding with the loss of pressure from one source gas.** | D ctive alarm ed. | **Replace alarm reed. |
| | A m module out of calibration. | **Recalibrate as outlined in the service manual. |
| | Alarm poppets stuck. | **Clean, lubricate poppets and recalibrate as outlined in the service manual. |



If the problem or concern continues after taking the appropriate corrective action, consult an authorized Sechrist service representative or contact Sechrist Industries Technical Support.

**** To be performed only by authorized personnel.**