



Operation Manual

LP 280

Nitrox GeneratorTM

With **Nitrox Manager**

Rotair RVG Version

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WARNING

This Operation Manual contains important safety information and should always be available to those personnel operating this equipment. Read, understand, and retain all instructions before operating this equipment to prevent injury or equipment damage.

Every effort was made to ensure the accuracy of the information contained within. Nuvair, however, retains the right to modify its contents without notice. If you have problems or questions after reading the manual, stop and call for information.

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1.0 Introduction

This manual will assist you in the proper set-up, operation and maintenance of the Nuvair LP 280 Nitrox Generator™. Be sure to read the entire manual.

Throughout this manual we will use certain words to call your attention to conditions, practices or techniques that may directly affect your safety. Pay particular attention to information introduced by the following signal words:



Indicates an imminently hazardous situation, which if not avoided, will result in serious personal injury or death.



Indicates a potentially hazardous situation, which if not avoided, could result in serious personal injury or death.



Indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.



Notifies people of installation, operation or maintenance information which is important but not hazard-related.

2.0 Safety Warnings

Nuvair has taken extreme care in providing you with the information you will need to operate this system. However, it is up to you to carefully read this manual and make the appropriate decisions about system safety.



WARNING

This equipment is used to provide breathing gas for the purpose of underwater life support. Read this manual in its entirety. Failure to heed the warnings and cautions contained in this document may result in severe injury or death.



WARNING

The equipment you will be using to manufacture nitrox (oxygen rich air) will expose you to both low and high-pressure gas. Gas, even under moderate pressures, can cause extreme bodily harm. Never allow any gas stream to be directed at any part of your body.



WARNING

Any pressurized hose can cause extreme harm if it comes loose or separates from its restraint (or termination) while under pressure and strikes any part of your body. Use appropriate care in making and handling all gas connections.



DANGER

Pure nitrogen is a colorless, odorless, tasteless gas that will not support life. Breathing gas mixtures containing more than 84% nitrogen at surface pressures will lead to unconsciousness and may cause death.



WARNING

The nitrogen discharge from the Membrane System must be vented to the exterior of any closed building, boat, or similar enclosed space. Breathing gas mixtures containing more than 84% nitrogen at surface pressure will lead to unconsciousness and may cause death.



WARNING

Do not use any form of mineral oil or synthetic lubricant not rated for nitrox in any compressor in this system. Use only the recommended Nitrox Compressor Lubricant. Never mix the Nitrox Compressor Lubricant with other lubricants. Remove all existing lubricant and replace with the proper Nitrox Compressor Lubricant prior to installing the Membrane System. The use of improper lubricants can lead to fire or explosions, which may cause serious personal injury or death.



WARNING

Do not use this system to produce nitrox mixtures containing more than 40% oxygen. Pumping nitrox mixtures with higher concentrations of oxygen may lead to fires or explosions, which can cause serious personal injury or death.



WARNING

The use of enriched air nitrox does not eliminate the risk of decompression sickness (DCS) in diving. Decompression sickness can lead to permanent disability or death.



WARNING

Do not pump nitrox mixtures at pressures above the compressor manufacturer's rating, and never above 3600 P.S.I. (250 bar). The system is not rated for pressures above 3600 P.S.I. (250 bar). Higher pressures may lead to explosions which may cause serious personal injury or death.



WARNING

Some compressors are not suitable for compressing oxygen-rich air, i.e., nitrox. Use of an unsuitable compressor may lead to possible compressor damage and/or fires or explosion. This can lead to serious personal injury or death. If there is any doubt regarding the use of an existing compressor, contact Nuvair or the compressor manufacturer before you connect your Membrane System to your machinery.



CAUTION

Ambient room temperature should never exceed 100°F (38°C) during operation of the Nitrox System. Operation at higher temperatures may lead to system damage and malfunction. A damaged membrane will not produce the correct nitrox mixture which can lead to severe personal injury if the gas is used for diving purposes without proper analysis.

3.0 Safety And Operation Precautions

Because a Compressor is a piece of machinery with moving and rotating parts, the same precautions should be observed as with any piece of machinery of this type where carelessness in operations or maintenance is hazardous to personnel. In addition to the many obvious safety precautions, those listed below must also be observed:

- 1) Read all instructions completely before operating any compressor or Nitrox System.
- 2) For installation, follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Administration (OSHA) standards.
- 3) Electric motors must be securely and adequately grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system to the compressor starter; by using a separate ground wire connected to the bare metal of the motor frame; or other suitable means.

- 4) Protect all power cables from coming in contact with sharp objects. Do not kink power cables and never allow the cables to come in contact with oil, grease, hot surfaces, or chemicals.
- 5) Make certain that power source conforms to the requirements of your equipment.
- 6) Pull main electrical disconnect switch and disconnect any separate control lines, if used, before attempting to work or perform maintenance. "Tag Out" or "Lock Out" all power sources.
- 7) Do not attempt to remove any parts without first relieving the entire system of pressure.
- 8) Do not attempt to service any part while System is in an operational mode.
- 9) Do not operate the System at pressures in excess of its rating.
- 10) Do not operate compressor at speeds in excess of its rating.
- 11) Periodically check all safety devices for proper operation. Do not change pressure setting or restrict operation in any way.
- 12) Be sure no tools, rags or loose parts are left on the Nitrox System.
- 13) Do not use flammable solvents for cleaning the Air Inlet Filters or elements and other parts.
- 14) Exercise cleanliness during maintenance and when making repairs. Keep dirt away from parts by covering parts and exposed openings with clean cloth or Kraft paper.
- 15) Do not operate the compressor without guards, shields, and screens in place.
- 16) Do not install a shut-off valve in the compressor discharge line, unless a pressure relief valve, of proper design and size, is installed in the line between the compressor unit and shut-off valve.
- 17) Do not operate in areas where there is a possibility of inhaling carbon monoxide, carbon dioxide, nitrogen, or flammable or toxic fumes.
- 18) Be careful when touching the exterior of a recently run electric, gasoline, or diesel motor - it may be hot enough to be painful or cause injury. With modern motors this condition is normal if operated at rated load - modern motors are built to operate at higher temperatures.
- 19) Inspect unit daily to observe and correct any unsafe operating conditions found.
- 20) Do not "play around" with compressed air, nor direct air stream at body, because this can cause injuries.
- 21) Compressed air from this machine absolutely must not be used for food processing or breathing air without adequate downstream filters, purifiers and controls and periodic air quality testing.
- 22) Always use an air pressure-regulating device at the point of use, and do not use air pressure greater than marked maximum pressure.
- 23) Check hoses for weak or worn conditions before each use and make certain that all connections are secure.

The user of any Compressor or Membrane System manufactured by Nuvair is hereby warned that failure to follow the preceding Safety and Operation Precautions can result in injuries or equipment damage. However, Nuvair does not state as fact or does not mean to imply that the preceding list of Safety and Operation Precautions is all-inclusive, and further that the observance of this list will prevent all injuries or equipment damage.

4.0 Legal Precautions

It is highly recommended that a Nitrox fill log be maintained when filling Scuba cylinders to document the following information. This log must be of permanent binding style with no loose pages.

- ◆ Fill date and time of day
- ◆ Tank Number
- ◆ Supplier's check of oxygen content (%O₂) plus signature and date
- ◆ User's check of oxygen content (%O₂) plus signature and date
- ◆ Fill Pressure
- ◆ MOD (Maximum Operating Depth) in user's handwriting
- ◆ Nitrox certifying agency and card number

5.0 Theory of Operation

The LP 280 Nitrox Generator™ is a turnkey package that produces oxygen-rich air (Nitrox) for delivery to the intake of a separate High Pressure (HP) Compressor. This HP Compressor then compresses the Nitrox to fill Scuba Cylinders or Storage Tanks. Although it is described as the “Nitrox Compressor”, it is also can be used to pump air.

The Nitrox System allows for efficient and cost effective Nitrox production without the hazards or expense of blending with stored high-pressure oxygen (O₂). Instead, the system uses a Semi-Permeable Membrane to produce Nitrox from air. A portion of the nitrogen in air is separated out, leaving an oxygen rich Nitrox mixture. This Nitrox mixture can be pumped up to a maximum pressure of 3600 P.S.I. (250 bar) when filling Scuba Cylinders or Storage Tank.

The Nitrox System uses an LP Rotary Screw Compressor, Air Aftercooler, Refrigerated Air Dryer and Filtration to provide the Membrane System with a source of clean, pressurized air for separation. The air is filtered to CGA Grade D air quality prior to entering the Membrane System so it will not damage or plug the Membrane fibers. Specifications for Grade D air are provided in the Appendix.

The LP280 Membrane System is rated for a maximum supply pressure of 300 P.S.I. (20 bar) and works well with the 175 PSI (12 bar) maximum pressure from the Rotary Screw Compressor. The Nitrox Manager sends power to a electronically controlled valve that operates the modulation device located on the intake of the compressor. This device determines the amount of air the compressor pumps. The compressor output determines Nitrox production. The air can then be heated to a temperature that provides stability over a wide range of ambient conditions, is optimal for membrane permeation and provides protection to the membrane from condensate. This heating process is not required on our “Nitrox Generators” that have the “Nitrox Manager”.

The heated air enters the Membrane, which is made up of thousands of miniature hollow fibers. The walls of these fibers are semi-permeable and designed for different gases to move through them (or permeate) at different speeds. The resulting gas mixture is known as the “permeate”. As air flows through the hollow fibers, both oxygen and nitrogen permeate through the fiber walls. The oxygen permeates faster than the nitrogen, which produces permeate with an oxygen content greater than air. The gas that reaches the end of the hollow fibers without permeating is almost entirely nitrogen and is discharged. The flow rate of this discharge is set by the factory via a fixed orifice, which controls the permeate to contain a constant 44% O₂ under normal operating conditions.

The permeate is a concentrated mixture that must be diluted with additional air prior to entering the Nitrox Compressor. It exits the Membrane at ambient to slightly negative pressure and travels to the Mixing Tube. An optional co2 scrubber can be used at this point to lower co2 concentrations in the the permeate. The permeate then mixes homogeneously with filtered outside air. This new mix is then pumped by the high pressure compressor.

6.0 Low Pressure Rotary Screw Compressor Technical Data

Capacity and Power Consumption:

- ◆ Normal working pressure – 80-175 P.S.I. (5.5-12 bar)
- ◆ Capacity at normal working pressure – 33.3 cfm (950 l/min)
- ◆ Shaft power at normal working pressure – 10.2 hp (7.65 kW)
- ◆ Maximum working pressure – 175 P.S.I. (12 bar)
- ◆ Minimum working pressure – 44 P.S.I. (3 bar)
- ◆ Idling shaft power consumption – 2.3 hp (1.7 kW)
- ◆ Transmission – Belt drive

Cooling:

- ◆ Allowed ambient temperature – 32-104°F (0-40°C)
- ◆ Compressed air temperature above cooling medium temperature – 50°F (10°C)
- ◆ Cooling air flow – 635 cfm (0.3 m³/s)
- ◆ Maximum cooling air pressure drop – 0.12 in H₂O (30 Pa)
- ◆ Cooling air temperature rise – 64°F (18°C)
- ◆ Oil cooler heat rejection – 324 BTU/min (5.7 kW)
- ◆ Aftercooler heat rejection – 40 BTU/min (0.7 kW)

Motor and Electrical Values:

- ◆ Motor - F class, IP55, 10hp (7.5 kW)
- ◆ Speed of rotation – 3480 rpm
- ◆ Fuse (max) – 25 A
- ◆ Compressor current – 16 A at 380 V / 50 Hz 220/440 volt 60Hz
- ◆ Control voltage – 230 V

General Technical Data:

- ◆ Oil Capacity 4 liters
- ◆ Maximum Oil Content in Air– 3 mg/m³
- ◆ Noise level (Cagi Pneurop) - 69dB
- ◆ Compressor weight – 792 lb (360 kg)

7.0 System Components

- Low Pressure Rotary Screw Compressor
- Nuvair 546™ Food Grade Rotary Screw Compressor Lubricant
- Refrigerated Air Dryer
- On/Off Flow Valve
- Nitrox Manager with Modulation Control for Compressor Output
- Low Pressure Filtration, Grade D Breathing Air, including three stages:
 - ◆ Coalescing & Particle Removal to 1 micron, auto drain, differential pressure indicator
 - ◆ Water & Oil Vapor Removal to 0.01 micron, auto drain, differential pressure indicator
 - ◆ Oil Vapor Removal to 0.003 PPM, manual drain
- Heater including:
 - ◆ Thermostat Control
 - ◆ Digital Temperature Gauge
 - ◆ Pressure Switch
- Semi-Permeable Membrane – compatible with HP Compressors rated up to 10 cfm (283 L/min)
- Mixing Tube & Air Intake Filter
- Panel Mount Inline Oxygen Analyzer with Nitrox Manager
- Compressor Intake Hose for Nitrox Compressor
- Nitrogen Discharge Hose (optional)
- Nuvair Pro O₂™ Fill Oxygen Analyzer, including:
 - ◆ High Pressure>Low Pressure Regulator
 - ◆ Flow Restrictor, 1 - 5 L/min
- Nitrox Compressor Lubricant:
 - ◆ Nuvair 455™ Food Grade Lubricant (standard)
 - ◆ Nuvair 751™ Diester Based Lubricant (optional)
- Air/Nitrox Quality Analysis Kit

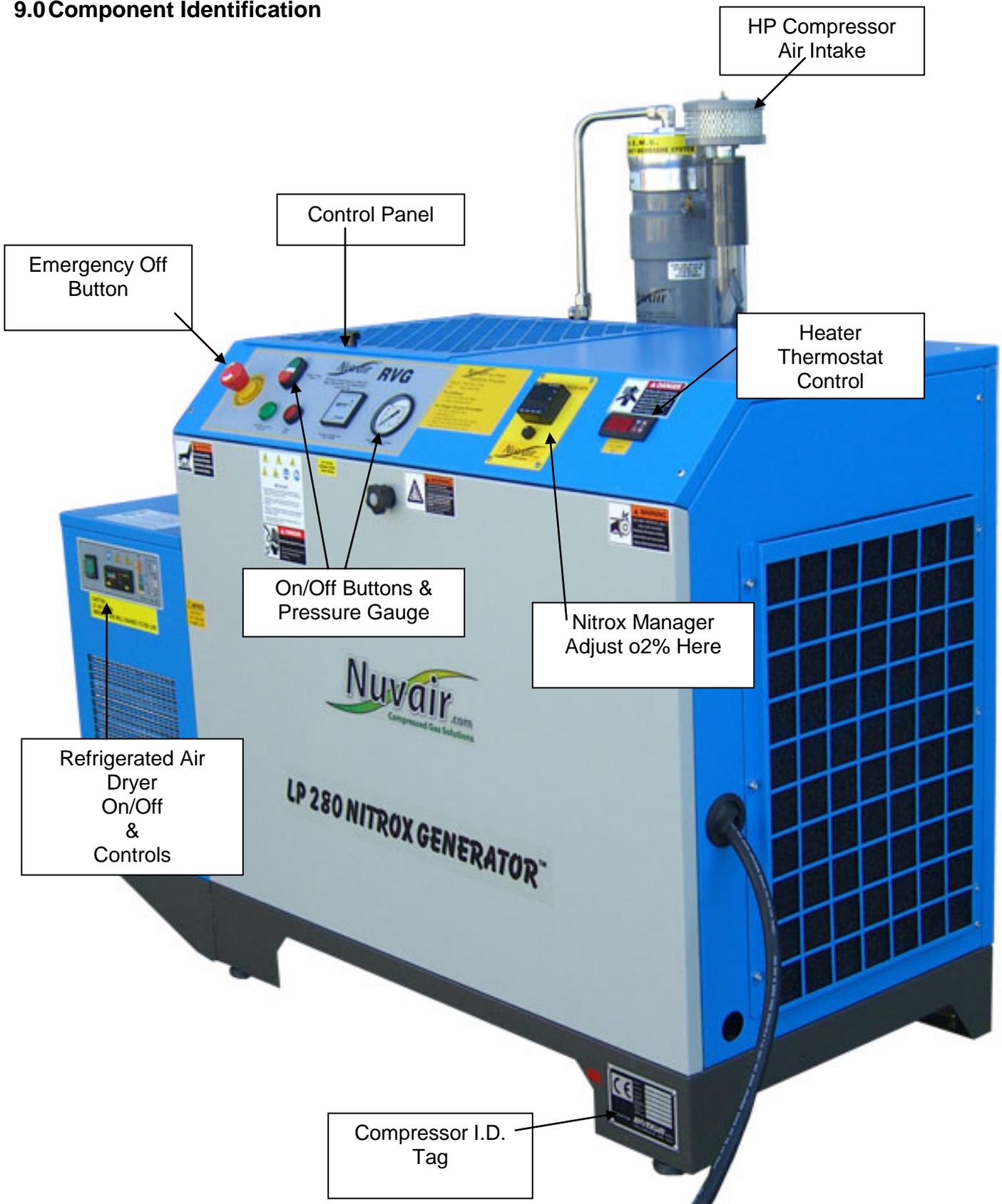
8.0 Nitrox System Specifications

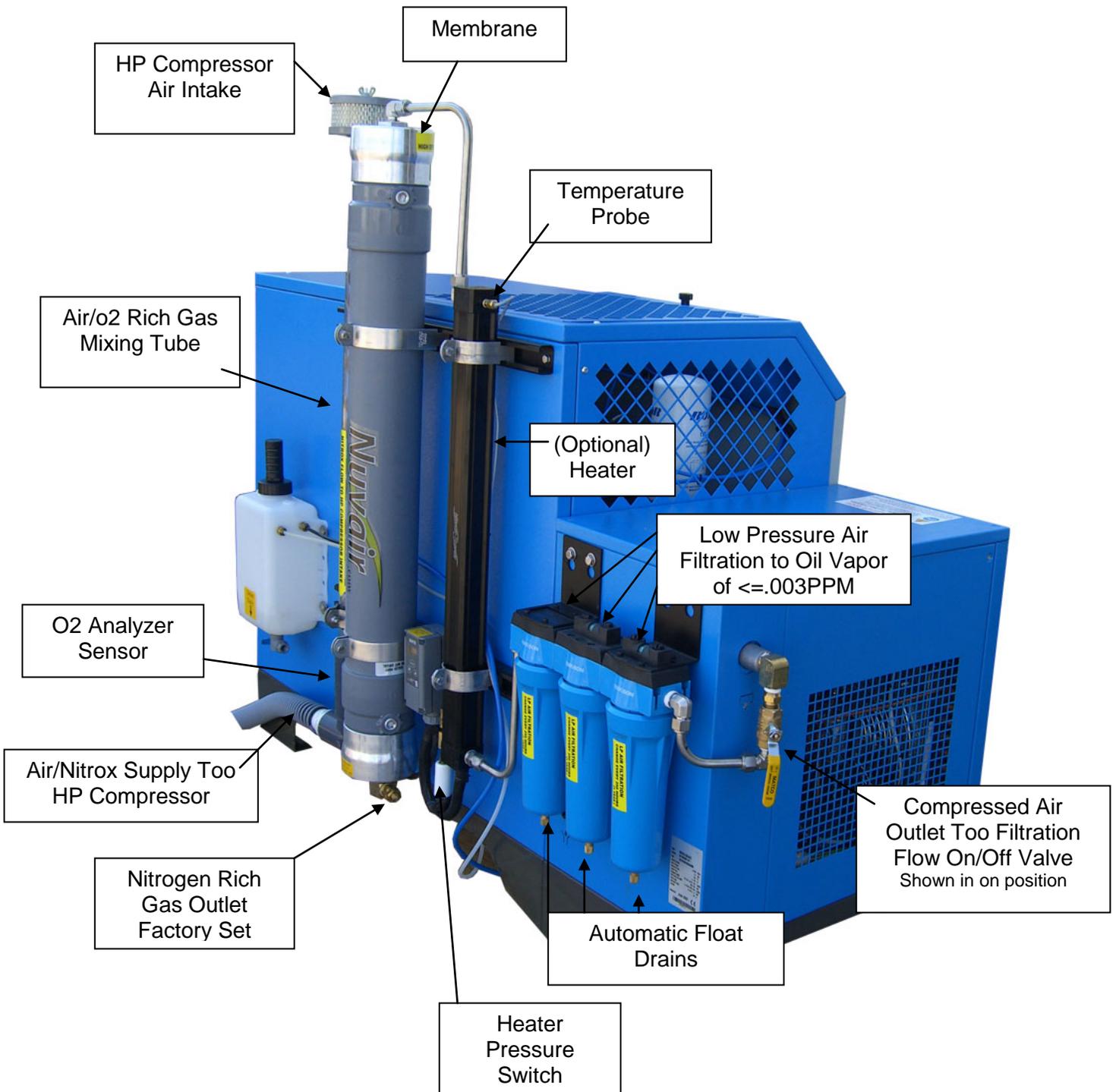
Nuvair Nitrox Generator Model		LP 280 50 Hz	LP 280 60 Hz
Physical Specifications	Height	48 in (1219 mm)	48 in (1219 mm)
	Width	59 in (1500 mm)	59 in (1500 mm)
	Depth	30 in (762 mm)	30 in (762 mm)
	Weight	635 lb (288 kg)	635 lb (288 kg)
Full Load Amps	Total Requirement for LP Compressor & Membrane Heater	21 A @ 380 VAC, 37 A @ 220 VAC, 50 Hz	37 A @ 220 VAC, 60 Hz
Membrane Input	Operating Pressure Range	80-175 psi (6-11 bar)	80-175 psi (6-11 bar)
	Maximum Input Pressure	300 psi (21 bar)	300 psi (21 bar)
	Supply Air Volume Range	8-32 scfm (212-736 L/min)	8-32 scfm (212-736 L/min)
	LP Supply Air Quality	Grade D	Grade D
	Optimum Temperature	110 +/- 5°F (43 +/- 3°C)	110 +/- 5°F (43 +/- 3°C)
	Nitrox %O ₂ Range	24 - 40%	24 - 40%

Nitrox Compressor Recommendations

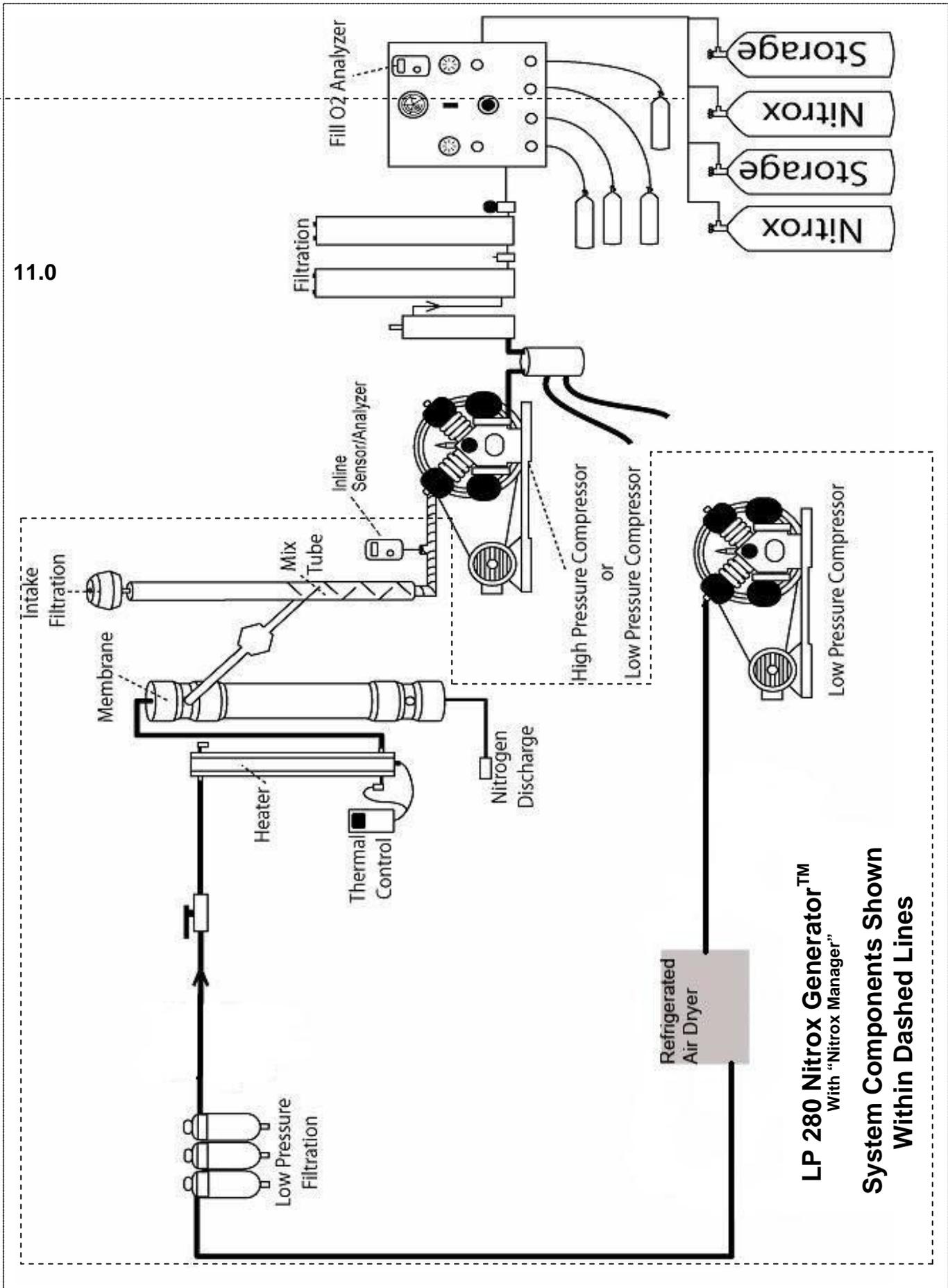
		To Pump Nitrox up to 40%O ₂	To Pump Nitrox up to 36%O ₂	To Pump Nitrox up to 32%O ₂
HP Nitrox Compressors	Charging Rate	6-10 scfm (170-280 L/min)	6-14 scfm (170-400 L/min)	6-18 scfm (170-510 L/min)
	Horsepower – Electric	5-7.5 hp (3.8-5.5 kW)	5-15 hp (3.8-7.5 kW)	5-20 hp (3.8-15 kW)
	Horsepower – Gas	6.5-11 hp (4.9-8.3 kW)	6.5-18 hp (4.9-14 kW)	6.5-24 hp (4.9-16 kW)
	Horsepower – Diesel	9-10 hp (6.8-7.5 kW)	9-18 hp (6.8-14 kW)	9-27 hp (6.8-20 kW)

9.0 Component Identification





10.0 System Drawing / Schematic

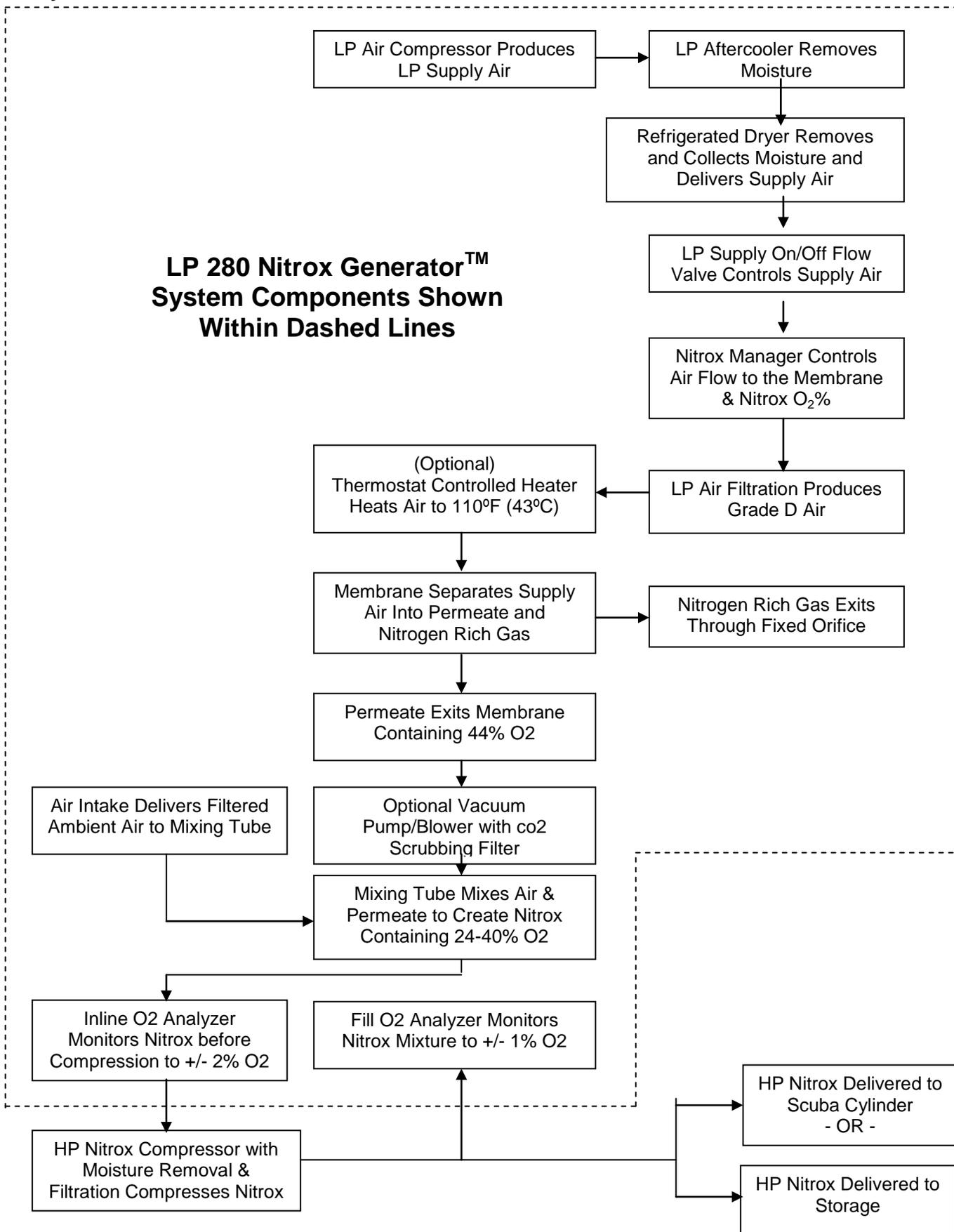


11.0

LP 280 Nitrox Generator™
 With "Nitrox Manager"
System Components Shown
Within Dashed Lines

System Flow Chart

LP 280 Nitrox Generator™ System Components Shown Within Dashed Lines



12.0 Preparing Existing HP Compressors



WARNING

Some compressors are not suitable for compressing oxygen-rich air, i.e., nitrox. Use of an unsuitable compressor may lead to possible compressor damage and/or fires or explosion. This can lead to serious personal injury or death. If there is any doubt regarding the use of an existing compressor, contact Nuvair or the compressor manufacturer before you connect your Nitrox System to your machinery.

12.1 Purification System

The purification system on the existing HP Compressor to which the Nitrox System will be installed must produce Grade E breathing air appropriate for diving use. This is the same standard applied to all breathing air compressors. Please make sure you place extra caution on timely replacement of the filters in the purification system to ensure these standards at all times. Specifications for Grade E air are provided in the Appendix.

A recent air quality test from your existing Compressor is highly recommended prior to installing the Nitrox System. After installation, test a Nitrox sample using the Air/Nitrox Quality Analysis Kit provided. Quarterly testing is mandatory once the System is operational.



CAUTION

Breathing air compressors must produce breathing air appropriate for diving use in accordance with the appropriate CGA Grade. Periodic air quality testing is mandatory to assure compliance.

12.2 Replacement of Compressor Lubricant

For an existing Compressor to be used with the Membrane System, all traces of old Lubricant must be removed and replaced with Nitrox Compressor Lubricant. Nitrox Compressor Lubricant is compatible with both air and Nitrox.

- 1) Start Compressor and run for 10 minutes to warm Compressor Lubricant. Shut off Compressor, remove Lubricant, and replace Lubricant Filter if any.
- 2) Refill Compressor with the Nuvair Air/Nitrox Compressor Lubricant supplied. Do not overfill.
- 3) After 10 hours, repeat Steps 1 and 2.



Nuvair™ 455
Food Grade Air &
Nitrox Compressor
Lubricant (Standard)



Nuvair™ 751
Diester Based Air &
Nitrox Compressor
Lubricant (Optional)



CAUTION

After running the compressor, the lubricant will be very hot. Take care when removing the drain plug and draining the lubricant to avoid burns.



NOTICE

Recommended Nitrox Compressor Lubricant change intervals after the 10-hour flush are at 25, 50, and 100 hours. After reaching 100 hrs, change lubricant in 100 hour cycles.



CAUTION

Wear gloves when handling compressor lubricant. If contact with skin is made, wash the skin surface with soap and water.



CAUTION

Always wear goggles when handling compressor lubricant. These materials can cause eye irritation. If you accidentally get lubricant into your eyes, flush with fresh water for 15 minutes and contact a physician if irritation develops.



CAUTION

Compressor lubricant should be incinerated after use in a licensed facility in accordance with Federal, State, and local regulations.

12.3 Installation of Fill Oxygen Analyzer

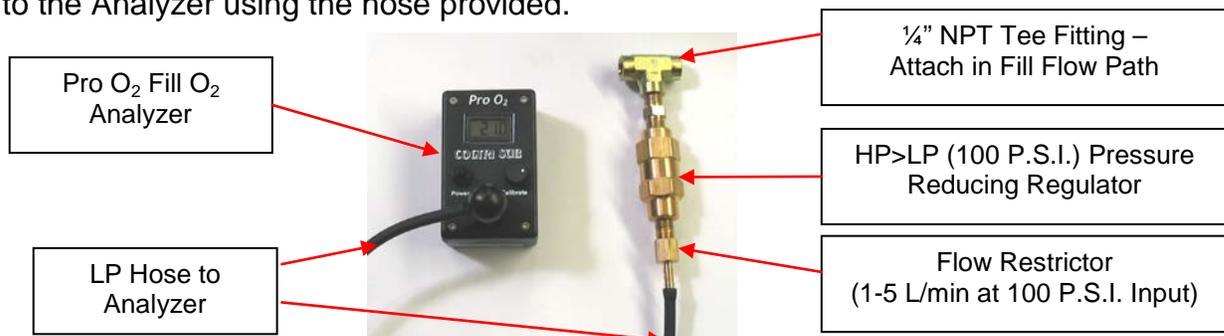
The Fill Oxygen Analyzer is installed at the final nitrox outlet (compressor fill whip, Fill Panel, etc.) to monitor oxygen content. A sample stream of nitrox is delivered to the analyzer to provide accurate results and prevent damage to the analyzer. A regulator and flow restrictor are used to control the pressure and flow of the sample stream. After installation, always use the Fill Oxygen Analyzer when pumping either nitrox or air to ensure proper oxygen content.



WARNING

Never expose the Oxygen Analyzer Sensor to pressure or you may cause damage and/or false readings. Damaged sensors will not provide accurate gas analysis. Inaccurate gas analysis can lead to serious personal injury or death.

The Nitrox sample stream is obtained at the Fill Whip location on the Compressor or Fill Panel. Tap into the Fill Whip manifold or install a HP "T" fitting, then attach the inlet of the Regulator/Flow Restrictor Assembly using HP hose and fittings as required (hose and fittings not included). Mount the Fill Oxygen Analyzer in a secure location, then attach the outlet of the Regulator/Flow Restrictor Assembly to the Analyzer using the hose provided.



13.0 Installing the Nitrox System



NOTICE

If any information in this manual conflicts with any of the other manuals call Nuvair before proceeding.



CAUTION

Ambient room temperature should never exceed 100°F (38°C) during operation of the Nitrox System. Operation at higher temperatures may lead to system damage and malfunction. A damaged membrane will not produce the correct nitrox mixture which can lead to severe personal injury if the gas is used for diving purposes without proper analysis.

13.1 Precautions

- 1) Please read all information supplied before physically installing the Nitrox System.
- 2) Unpack the system and remove from the pallet. Visually inspect the system to make sure there has been no damage during shipping. If damaged, please call Nuvair to file a damage report. Please take photos and supply detailed information about the damage.
- 3) Place the system in a permanent location near the existing HP Compressor. Allow a minimum spacing of 18" from adjacent walls. Select a location where ambient room temperature will never exceed 100°F (38°C).
- 4) The Heater Thermostat has been set in the factory. Do not adjust.
- 5) A 13 foot corrugated Compressor Intake Hose has been provided to connect the Nitrox System to the HP Compressor intake. If a longer hose is required, the diameter must also be increased. Contact Nuvair for assistance.

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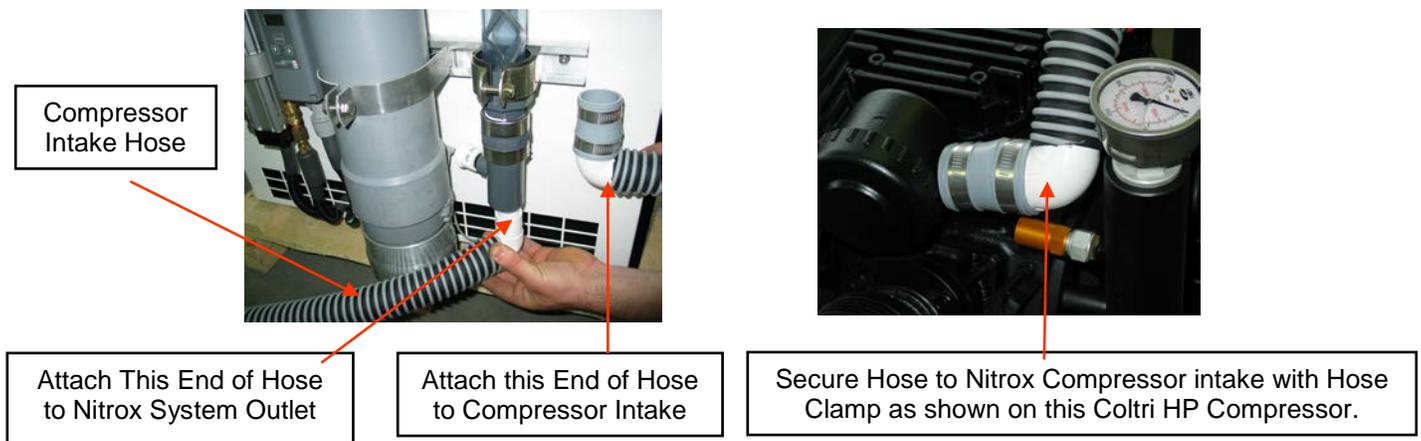
13.2 Attaching Compressor Intake Hose



WARNING

Do not substitute a compressor intake hose of a smaller diameter or longer length than that supplied. This will increase the amount of suction the compressor must generate which can cause overheating and damage to the compressor. Damaged compressors can pump impurities into the diver's breathing gas. This may cause serious injury or death.

- 1) Cut the Intake Hose to proper length to reach between the Nitrox System and HP Compressor. Reattach end fittings
- 2) Attach the Intake Hose to the Nitrox System outlet.
- 3) Attach the other end of the Intake Hose to the intake of the Nitrox Compressor and secure with the hose clamp provided.



13.3 Attaching Nitrogen Discharge Hose (Optional)

The nitrogen discharge from the Membrane must be isolated from the air intakes of the Membrane System and LP Compressor. This requirement will be met if the Nitrox System is installed in a well-ventilated room that meets industry standards for Compressor installations. If the Nitrox System is installed in a closed building, boat, or similar enclosed space, the nitrogen discharge must be vented to the outside. An optional Nitrogen Discharge Hose may be needed. If your installation requires the use of a Nitrogen Discharge Hose, please contact Nuair for assistance.



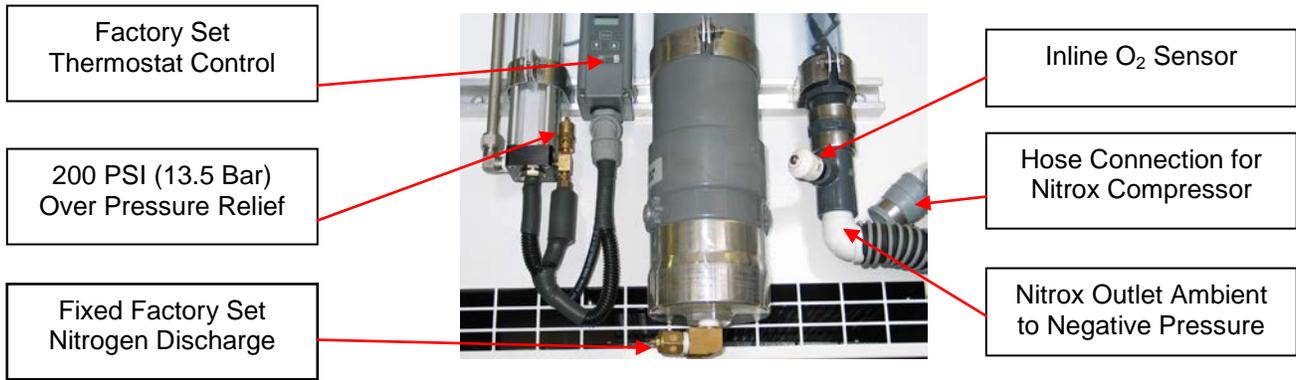
DANGER

Pure nitrogen is a colorless, odorless, tasteless gas that will not support life. Breathing gas mixtures containing more than 84% nitrogen at surface pressures will lead to unconsciousness and may cause death.



WARNING

The nitrogen discharge from the Membrane should be vented to a well-ventilated room or to open air with good circulation. Failure to isolate the discharge from the air intake of the Membrane System or LP compressor could lead to incorrect nitrox mixtures, resulting in serious personal injury or death. If you allow this pure nitrogen to accumulate in an enclosed space, anyone entering this space will quickly lose consciousness and will die if not immediately resuscitated.



13.4 Output Pressure Adjustments

The LP Compressor maximum pressure has been factory set to pump up to 175 P.S.I. (12 bar). At 175 PSI the Modulation Device will unload the compressor.

This output setting allows the system to be used with a HP Compressor having a rated capacity up to 10 cfm (283 l/m) and produce 40%.

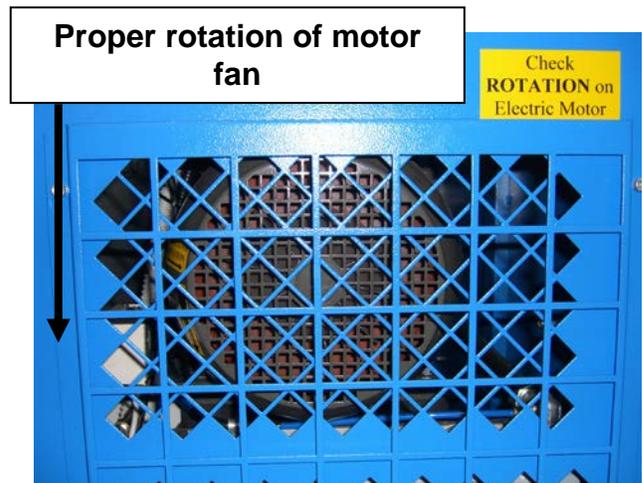
13.5 Electrical Power Connection



WARNING

Never use extension cords to provide power to your Nitrox System. The system must be properly wired according to national and local electrical codes by a qualified electrician. Improper wiring may lead to fires, which can cause serious personal injury or death.

Prior to making the electrical power connection, check all system specifications provided in this manual. When working on the Nitrox System the main breaker at the power source must be “locked out” in the Off position.



Amperage Load for System

- ◆ Approximately 37 A for 220 V three phase service
- ◆ Approximately 21 A for 380 V three phase service

LP Compressor Rotation Check

Always turn on (bump) starter and run motor very briefly to check for proper direction of rotation (see arrow above pulley).

Proper Rotation will force exhaust air out the top and raise the test paper.



CAUTION

Operation in reverse direction for even a short period of time will damage a Rotary Screw Compressor.

The Cabinet Power Switch must be in the Off position to remove the front panel of the Compressor. This Switch terminates power to the Compressor and electrical panel. Store the compressor with this switch in the Off position. **When working on the Compressor the main breaker at the power source must also be “locked out” in the Off position.** The Nitrox System has circuit breaker protection for the Compressor Motor and Membrane System Heater located behind the right side panel.



13.6 Air/Nitrox Quality Testing

Before using your Nitrox System to pump nitrox, test a sample of the nitrox produced using the Air/Nitrox Quality Analysis Kit provided to verify compliance with CGA standards. Quarterly testing is mandatory once the System is operational.

Air/Nitrox Quality
Analysis Kit



14.0 Pre-Operation Instructions



WARNING

Do not allow nitrox to be discharged into the air storage system. Nitrox introduced into the air storage system could cause a diver to suffer from oxygen poisoning at depth. Oxygen poisoning is extremely dangerous and can lead to drowning.



WARNING

Do not allow air to be discharged into the Nitrox storage system. Air introduced into the nitrox storage system could cause a diver to suffer from decompression sickness if the nitrox mixture is not analyzed properly and is used underwater under the assumption it is a different mix.

14.1 Compressor Lubricant Levels

Check lubricant levels before starting the LP and HP Compressors, and add lubricant as required. Use only the lubricants specified.

Check LP
Compressor Oil Level



14.2 Nitrox Manager %O₂ Calibration

The “Nitrox Manager” controls the volume of air that the compressor pumps and therefore determines the final o2%.

With the High Pressure Compressor and LP Nitrox Generator running.

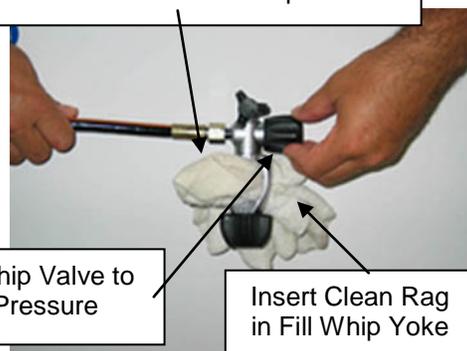
Gas production is monitored with the Inline Oxygen Analyzer (Nitrox Manager) before entering the Nitrox Compressor to obtain an estimate of %O₂ (+/- 1%); however, do not rely completely on this reading as an indication of %O₂ at the Nitrox Compressor outlet. Prior to pumping nitrox into a Scuba cylinder or Surface Supply System, it must be monitored with the Fill Oxygen Analyzer to obtain a precise measurement of %O₂ (+/- 1%). Both Oxygen Analyzers must be calibrated prior to each use.

Optional Sound Muffler for HP Nitrox Compressor

- 1) Slightly open fill whip valve on HP Nitrox Compressor to relieve any residual pressure, and then, if desired, insert clean rag in yoke to act as sound muffler.
- 2) Turn on HP Nitrox Compressor according to manufacturer's instructions.
- 3) Adjust fill whip valve so the running Compressor maintains 1500-2000 P.S.I. outlet pressure. Air will now be flowing past both Oxygen Analyzers for calibration purposes.

Adjust Fill Whip Valve to
Maintain Pressure

Insert Clean Rag
in Fill Whip Yoke



- 4) Put LP280 in Stand-by mode by pushing Enter twice. The “Stby” will show in the SV position and the current air o2% will show in the PV position.
- 5) Adjust the Calibration Knob so 20.90% (see O2 analyzer manual) is displayed in the PV position.
- 6) To Run press Enter once. The SV position will flash “Run” and then start to display the current o2%



- 7) Press the enter button twice until the Stby (SV second row) flashes. The reading on PV is now indicating the o2% in the air intake to the “Nitrox” compressor.
- 8) Adjust the Calibration Knob so PV reads 20.9%. (Read calibration instructions in the Pro o2 manual)
- 9) Press “Enter” one more time to put in run mode

Calibration Knob



14.3 Oxygen Analyzer Calibration

Fill Oxygen Analyzer Provides Precise Reading

Inline Oxygen Analyzer “Nitrox Manager” Provides A Reading Before The HP Compressor



WARNING

Oxygen Analyzers must be calibrated before each use. See Oxygen Analyzer manuals for correct calibration procedures. Improper calibration of the Fill Oxygen Analyzer may result in the use of incorrect nitrox mixtures, which may cause serious injury or death to the diver using the gas mixture.



WARNING

At altitudes above sea level, a correction factor must be used when calibrating the Fill Oxygen Analyzer may not be achievable. See Fill Oxygen Analyzer manual for correcting analyzer readings at various altitudes. Improper calibration of the Fill Oxygen Analyzer may result in the use of incorrect nitrox mixtures, which may cause serious injury or death to the diver using the gas mixture.



WARNING

The Inline Oxygen Analyzer (Nitrox Manager) supplies oxygen readings that can vary +/- 1% O₂ due to heat, humidity, and pressure changes experienced in the nitrox flow and therefore should only be used for estimates of %O₂. The Fill Oxygen Analyzer supplies more accurate oxygen readings, within +/- 1% O₂. For Scuba cylinder nitrox fills, the user must always verify the final fill with a third independent Oxygen Analyzer.

- 10) Monitor all gauges for proper operating range and check all connections for leaks.
- 11) Calibrate Oxygen Analyzers while the Nitrox Compressor is pumping air. Refer to the Oxygen Analyzer manual included with the Nitrox System for details. Note that special calibration procedures may be required when operating at altitudes above sea level.

- ◆ Inline Oxygen Analyzer - Calibrate Analyzer so Display reads 20.9%.
- ◆ Fill Oxygen Analyzer - Calibrate Analyzer so Display reads 20.9% to correlate with the Grade E breathing air present at the Sensor. Different settings may be used depending on location, so verify your actual ambient conditions and refer to the Oxygen Analyzer manual for details.

Fill Oxygen Analyzer - Alternate Calibration Method

The Fill Oxygen Analyzer can also be calibrated in ambient air as an alternative. This is especially useful during routine re-calibration while the system is operating. Different settings may be used depending on location, so verify your actual ambient conditions and refer to the Oxygen Analyzer manual for details.

- 1) Remove the Flow Adapter Cap covering the Sensor.
- 2) Expose the Sensor to ambient air for approximately 15 seconds.
- 3) Adjust Calibration Knob until Display reading stabilizes at 20.9%.
- 4) Reinstall the Flow Adapter Cap to the Analyzer.
- 5) The Fill Oxygen Analyzer is now ready for use.



Sensor Cap Removed

Calibration Knob

14.4 Attaching Scuba Cylinder



Only one fill whip is attached to a Scuba Cylinder at this point. The second whip will continue to be used to control HP compressor outlet pressure.

Attach one HP compressor Fill Whip to a Scuba Cylinder. Leave Cylinder Valve closed.

Additional cylinders or storage tanks can be attached after the system is ready to pump Nitrox.

Fill Whip Attached to Scuba Cylinder



15.0 Producing Nitrox

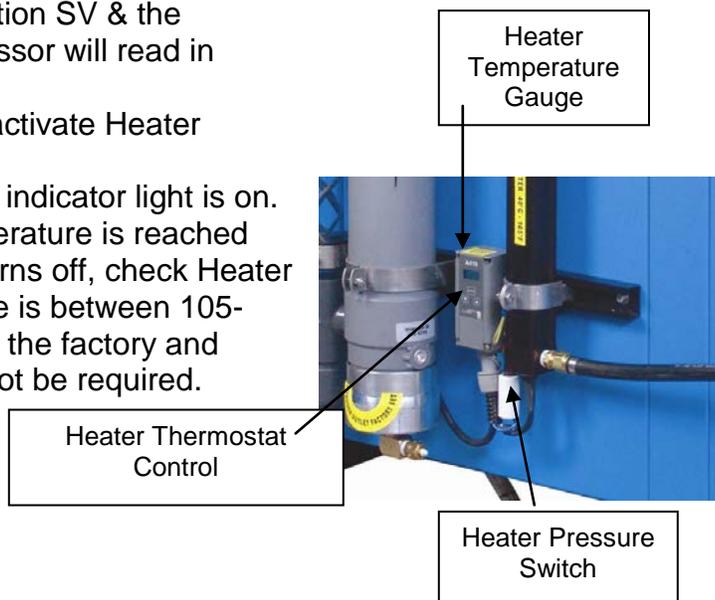


WARNING

The equipment you will be using to manufacture nitrox (oxygen rich air) will expose you to both low and high-pressure gas. Gas, even under moderate pressures, can cause extreme bodily harm. Never allow any gas stream to be directed at any part of your body.

15.1 Flow to Membrane

- 1) Verify that Oxygen Analyzer calibration is complete.
- 2) Turn on LP Compressor using On/Off Switch.
- 3) Turn on your HP Compressor. Allow outlet pressure to build up to approximately 2300 P.S.I., then crack open the unconnected fill whip to maintain 1500-2300 P.S.I.
- 4) Verify that Inline Oxygen Analyzer (Nitrox Manager) reads 20.9%.
- 5) Set desired o2% in Nitrox Manager position SV by
 - a. Put unit in Stand-by Mode by pressing Enter twice
 - b. Push Menu once
 - c. Change the flashing digit with Max button
 - d. Move to the next digit with Min button and set
 - e. Push Enter to run with new setting
 - f. The desired o2% setting will read in position SV & the current o2% flowing to the nitrox compressor will read in position PV
- 6) Note the pressure must exceed 80 P.S.I to activate Heater Pressure Switch.
- 7) Verify that Heater Thermostat Control green indicator light is on. The light will remain on until operating temperature is reached and will then cycle on and off. When light turns off, check Heater Temperature Gauge to verify air temperature is between 105-120 °F (40-49 °C). Temperature is preset at the factory and changes to the Thermostat Control should not be required.



CAUTION

The On/Off Flow Valve on the Membrane System must be opened slowly. A sudden rush of gas can damage the Membrane and other system components. A damaged membrane will not produce the correct nitrox mixture which can lead to severe personal injury if the gas is used for diving purposes without proper analysis.



NOTICE

The Heater Thermostat Control green indicator light will stay on until operating temperature is reached.



CAUTION

Do not change the temperature setting on the Thermostat Control without contacting Nuair. Changes in temperature settings may cause Membrane damage. A damaged membrane will not produce the correct nitrox mixture which can lead to severe personal injury if the gas is used for diving purposes without proper analysis.



NOTICE

15.2 Final Adjustments Before Pumping Nitrox

- 1) As the Nitrox initially makes its way through the running Nitrox Compressor, the %O₂ reading on the Fill Oxygen Analyzer will slowly increase to read approximately the same %O₂ as the Inline Oxygen Analyzer. This should happen within 3-5 minutes.
- 2) When the two Analyzers read within +/- 1%, make any final adjustments to the Membrane System input pressure necessary to obtain the exact Nitrox %O₂ desired as indicated on the Fill Oxygen Analyzer.
- 3) The system is now ready to pump Nitrox.



Fill Oxygen Analyzer

15.3 Refrigerated Air Drier

1. It is best to leave the drier on at all times. If your application requires turning the drier off when not in use. Turn the drier on at least 1 hour before use.

2. Check that during operation the temperature gauge is operating in the green.

3. Listen for the solenoid valve opening and draining condensate every 5 minutes or less.

Temperature Gauge

On/Off Switch



15.4 Pumping Nitrox



WARNING

The use of enriched air nitrox does not eliminate the risk of decompression sickness (DCS) in diving. Decompression sickness can lead to permanent disability or death.



WARNING

The Inline O₂ Analyzer supplies oxygen readings that can vary +/- 2% O₂ due to heat, humidity, and pressure changes in the nitrox flow and should only be used for rough estimates of %O₂. The Fill O₂ Analyzer supplies more accurate readings, within +/- 1% O₂. For Scuba cylinder nitrox fills, the user must always verify the fill with a third independent O₂ analyzer.



WARNING

Do not use this system to produce nitrox mixtures containing more than 40% oxygen. Pumping nitrox mixtures with higher concentrations of oxygen may lead to fires or explosions, which can cause serious personal injury or death.



WARNING

Do not pump nitrox mixtures at pressures above the compressor rating, and never above 3600 P.S.I. (250 bar). The system is not rated for pressures above 3600 P.S.I. (250 bar). Higher pressures may lead to explosions which may cause serious personal injury or death.



NOTICE

No oxygen cleaning of standard cylinders or plumbing is mandatory when using the Nitrox System to produce nitrox containing a maximum of 40% oxygen. When filling oxygen clean cylinders, hyper-purification of the nitrox is required using an optional Oxygen Compatible Air purification system available from Nuair.



DANGER

This Nitrox System does not produce nitrox mixtures acceptable for 100% oxygen service.



DANGER

Never fill a cylinder that is marked, "For Oxygen Service," with nitrox that has been produced by anything other than 100% oxygen clean system. Filling an oxygen clean cylinder with breathing gas containing hydrocarbons can lead to explosions if the cylinder is subsequently filled with gas mixtures containing gas mixtures containing greater than 40% oxygen.



WARNING

Only provide Scuba cylinder nitrox fills to customers who have proof of nitrox training and certification. Improper use of nitrox can be fatal.



DANGER

This system is not cleaned for oxygen service and not all components are compatible with gas mixtures containing greater than 40% oxygen. Pumping gas mixtures containing greater than 40% oxygen will lead to explosions which may cause severe personal injury or death.



WARNING

Each Scuba cylinder belonging to a customer must be analyzed by that customer at the nitrox filling facility, using an oxygen analyzer independent of those used with the Nitrox System. An employee must witness that the customer has properly analyzed the gas in each cylinder, noted the maximum operating depth for that mixture, and signed and dated the fill log. The time of day must also be included with the date, since some customers may fill the same cylinder more than once a day.

Fill Scuba Cylinders or HP Storage tanks as follows:

- 1) When filling a Nitrox Scuba cylinder, follow all industry standards. Do not exceed rated pressure of cylinder, and do not exceed 3600 P.S.I. under any condition.
- 2) With fill whip bleed valve open and Nitrox flowing, verify that Fill Oxygen Analyzer %O₂ reading equals the desired Nitrox %O₂.
- 3) Close bleed valve, open cylinder valve, and fill cylinder. While filling, monitor system for proper operation:
 - a) Monitor Oxygen Analyzers and recalibrate as required
 - b) Manually drain all Compressor condensate periodically or listen for proper operation of auto-drains if equipped.
 - c) Monitor all system gauges as shown in the table below.



NOTICE

The Oxygen Analyzers may require re-calibration after 20-30 minutes of operation due to humidity and temperature change effects on the Sensors. To recalibrate, put the “Nitrox Manager” in “Stby” and follow the calibration instructions.



NOTICE

When the HP compressor auto drain engages and dumps condensate, the Fill Oxygen Analyzer reading will decrease momentarily due to the pressure drop in the system. It will return to its previous reading within seconds after the auto drain sequence stops.

<i>GAUGE</i>	<i>RECOMMENDED SETTING</i>
Compressor Gauges	According to manufacturers recommendations
Heater Temperature	105-120° F (40-49° C)
Cabinet Temperature	Less than 100 ° F (38 °C)
Compressor Outlet Pressure	0-175 PSI (12 bar)
Fill Oxygen Analyzers	Showing the proper reading for intended fill
Nitrox Storage Pressure	DO NOT exceed rating of tank or 3600PSI (250Bar)

- 4) After filling is complete, close cylinder valve, vent the bleed valve, and remove the cylinder.

- 5) Test the nitrox %O₂ in the cylinder using an independent Oxygen Analyzer such as the Nuair O₂ Quickstick™. Calibrate analyzer before use in accordance with manufacturer's instructions.
- 6) Repeat steps 1-5 until you have filled all Scuba cylinders.
- 7) Mark each tank with fill date, %O₂, fill pressure, and MOD (Maximum Operating Depth).
- 8) Log every Nitrox fill to document the following information:
 - ◆ Fill date and time of day
 - ◆ Tank Number
 - ◆ Supplier's check of oxygen content (%O₂) plus signature and date
 - ◆ User's check of oxygen content (%O₂) plus signature and date
 - ◆ Fill Pressure
 - ◆ MOD (Maximum Operating Depth) in user's handwriting
 - ◆ Nitrox certifying agency and card number
- ◆ When filling a HP Nitrox storage tank, verify that Fill Oxygen Analyzer %O₂ reading equals the desired nitrox %O₂. Open applicable line valves and tank valve, and fill with nitrox. Do not exceed rated pressure of cylinder, and do not exceed 3600 P.S.I. (250 bar) under any condition. After filling is complete, close all valves and turn off compressor or relieve pressure.



Use Independent Oxygen Analyzer for Verification

15.5 Pumping Air

To use the System to pump air, put the “Nitrox Manager” into “Stby” mode and shut down the LP compressor. No Nitrox will be supplied to the HP Compressor, and it will pump air only. Both the Inline Oxygen Analyzer and Fill Oxygen Analyzer should read 20.9% when the HP Compressor is pumping air.



NOTICE

Always use Oxygen Analyzers to monitor oxygen content of any gas flowing through the System. Both air and Nitrox are subject to variations in oxygen content.



LP280 On/Off Buttons

15.6 Shutting Down

- 1) Shut off the Membrane System putting the Nitrox Manager into Stby mode.
- 2) Manually drain all filters and condensate drains.
- 3) Turn off LP Compressor On/Off Switch. The Compressor will go into shut down mode and shut off.
- 4) Turn off HP Compressor when it has returned to pumping air, as determined by a Fill Oxygen Analyzer reading close to 20.9% O₂.

16.0 Nitrox Operation Notes



NOTICE

Use the Fill Oxygen Analyzer to verify the nitrox oxygen percentage prior to pumping. When using the input pressure reading to obtain specific oxygen percentage, minor adjustments of the input pressure regulator may be required to obtain the exact percentage desired.

16.1 Hot Fills

While in the process of filling HP Nitrox Storage Tanks, you may have a need to supply a walk-in customer with a Scuba Cylinder fill of a different nitrox mix. You can change mixes as follows:

- 1) With the Nitrox System and HP compressor operating, isolate the HP Nitrox Storage Tanks from the HP compressor by closing appropriate valves.
- 2) Record the Membrane System input pressure reading
- 3) Slightly open fill whip valve on the HP compressor, and adjust so the running compressor maintains 1500-2000 P.S.I. (100-140 bar) outlet pressure.
- 4) Adjust the input regulator to the pressure corresponding to the desired nitrox %O₂ for the Scuba Cylinder fill.
- 5) Allow the Fill Oxygen Analyzer reading to stabilize, make any minor adjustments necessary to achieve the desired %O₂, and then fill cylinder in normal manner.
- 6) When finished return regulator to previous setting, and allow the Fill Oxygen Analyzer reading to stabilize. Make any minor adjustments necessary to achieve the desired %O₂, and then resume filling Storage Tanks.

17.0 Maintenance

The following list of daily and routine maintenance items is intended as a guide. Refer to LP and HP Compressor manuals for complete maintenance requirements.

17.1 Daily Maintenance



CAUTION

Be sure to check compressor lubricant level prior to each day of operation. Failure to ensure the proper lubricant level will lead to system damage.

- 1) Check Lubricant levels of both LP and HP Compressors and add proper Lubricants as required. See Section 14.1 and Compressor manuals for details.
- 2) Check HP Compressor Filtration for condensate and proper operation of condensate drains. Refer to HP Compressor manual for details.
- 3) Check LP Filtration for condensate and proper operation of condensate drains.

17.2 Routine Maintenance



WARNING

Use only the specified Nuvair Lubricants in this system. The use of incompatible lubricants presents a risk of fire and/or explosion, and may result in system damage. This can lead to severe personal injury and death.



WARNING

Be sure that all pressure has been relieved from the system prior to opening any filtration canister. Failure to vent pressure from the system prior to opening the canister can lead to serious personal injury or death.



CAUTION

If the LP280 refrigerated air drier is not on or working properly the LP filter life will be drastically reduced. Check inside the final filter element weekly for excessive moisture.

- 1) LP Compressor Lubricant: Change Rotary Screw Compressor Lubricant and Lubricant Filter after the first 100 hour break in period and every 1500 hours thereafter. Only use Lubricants rated for use with Rotary Screw Compressors, such as Nuvair 546™. Never mix Compressor Lubricants. See Section 17.3 and LP Compressor manual for details.
- 2) LP Filtration Inspection: On a weekly basis, inspect each Filter Bowl for the presence of moisture and each Element for any unusual degradation or wetness. See Section 17.4 for details.
- 3) LP Filtration Elements: Change LP Filter Elements every 250 hours to maintain CGA Grade D air standards. Visual differential pressure (DP) indicators on the HF7 and HF5 filters assist with monitoring replacement intervals. See Section 17.4 for details. If the Nitrox System is operated in high humidity and/or high temperature, Filter Elements must be changed more often. See Appendix for details on Filter Element Life Factors.

- 4) Semi-Permeable Membrane: No maintenance required. Service life exceeds 20 years if LP Filtration is properly serviced to maintain Grade D standards.
- 5) Membrane System Air Intake Filter: Inspect filter element every 3 months for visible particles. Change every 12 months or sooner if particles are visible.
- 6) Oxygen Analyzers: Replace Oxygen Sensor and Battery as required. See manual included with Nitrox System.



DANGER

Do not swallow (ingest) either the electrolyte from the Oxygen Sensor or the Sensor itself. The Potassium Hydroxide chemical contained in the Sensor can cause severe injury or death. If electrolyte or the Sensor is swallowed, seek medical attention immediately.



DANGER

If after handling the Oxygen Analyzer or Sensor, you find that your fingers or other parts of your body feel “slippery” or the skin or eyes sting, immediately flush affected area with clean, fresh water for at least 15 minutes. The stinging or slippery sensation is an indication of a leaking Sensor. The Potassium Hydroxide chemical contained in the Sensor can cause severe injury or death. Seek immediate medical attention if eye contact is made or skin stinging persists.

The following items are not integral parts of the Nitrox System, but proper maintenance is required to assure optimum performance.

- 1) HP Compressor Lubricant: Change HP Compressor Lubricant every 100 hours of operation in accordance with manufacturer’s guidelines. Only use Lubricants rated for use with Nitrox, such as Nuvair 455™ or 751™. Never mix Compressor Lubricants. Refer to HP Compressor manual for details.
- 2) Breathing Air Filters: Change HP Compressor Filter Elements in accordance with manufacturer’s guidelines to maintain CGA Grade E breathing air standards.
- 3) Air/Nitrox Quality Analysis: Take breathing air/Nitrox samples quarterly for analysis to assure compliance with CGA Grade E breathing air standards.

17.3 Compressor Lubricant

The LP Rotary Screw Compressor in your Nitrox System uses Nuvair 546™ Food Grade Synthetic Rotary Screw Compressor Lubricant. This lubricant is thinner than the lubricants that are used in reciprocating HP Compressors and should not be mixed with other Compressor Lubricants.

Access to the oil filter, oil/air separator and oil drains is through the front cabinet door. See appendix page 38

NUVAIR™ 546

FOOD GRADE ROTARY SCREW COMPRESSOR OIL

Application

Nuvair™ 546 is designed for 2,000 hours of use in rotary screw compressors where a food grade lubricant is needed. USDA H-1 rated Nuvair™ 546 meets all requirements under FDA Regulation 21 CFR 172.878 and 178.3570.



Characteristics:

- Available in quart, gallon, and five-gallon containers
- Improved thermal and oxidative stability over mineral oil
- Compatible with most seals, plastics, rubbers
- Wide operating temperature range
- Non-detergent
- Extended drain intervals reduces oil disposal, thus increasing cost effectiveness

Typical Properties

SAE Grade
 ISO Viscosity Grade
 Viscosity, cSt @ 100°F
 cSt @ 210°F
 Viscosity Index
 Pour Point °C
 °F
 Flash Point °C
 °F
 Evaporation
 Foaming Sequence I, II, III
 Copper Corrosion
 Specific Gravity
 USDA Authorization
 Demulsibility

ASTM Test Method

D-2422
 D-445
 D-445
 D-2270
 D-97
 D-97
 D-92
 D-92
 D-972
 D-892
 D-130
 D-1298
 H1 or H2
 D-1401

Nuvair™ 546

20
 46
 49.9
 7.9
 145
 -54
 -65
 246
 475
 1.0%
 Nil
 1A
 0.84
 H-1
 Excellent

17.4 LP Filtration

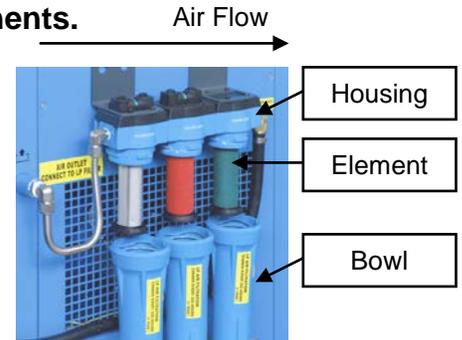


CAUTION

Special attention needs to be given to the arrangement of the four LP Supply Air Filtration Elements and Bowls. Properly reinstall each Element and Bowl to the correct Housing. Improper sequence can cause damage to downstream components.

The use of Grade D or better supply air is critical to prevent the passing of any residual oil vapor into the Membrane System. Three stages of Hankison LP filtration are used to produce Grade D air:

- 1) Particle Removal to 1 micron
- 2) Coalescing & Water/Oil Vapor Removal to 0.01 micron
- 3) Oil Vapor Removal to 0.003 PPM



Filtration Inspection

Open each Filter and inspect as follows:

1. Inspect Bowl for the presence of moisture. A high level of moisture build-up in the HF7 or HF5 Filter indicates improper operation of auto-drain floats. Any evidence of moisture in the HF1 Filter indicates the air is not cooling properly and moisture is not properly being removed. Excess moisture will prevent the final filter from operating properly.
2. Inspect Elements for any unusual degradation or wetness. Element degradation can indicate more serious problems. Contact Nuair for assistance,

Changing Filtration Elements

Change Filter Elements every 100 hours. If the Nitrox System is operated in high humidity and/or high temperature, Filter Elements must be changed more often. See Appendix for details on Filter Element Life Factors. Visual DP indicators on the HF7 and HF5 filters assist with monitoring replacement intervals.

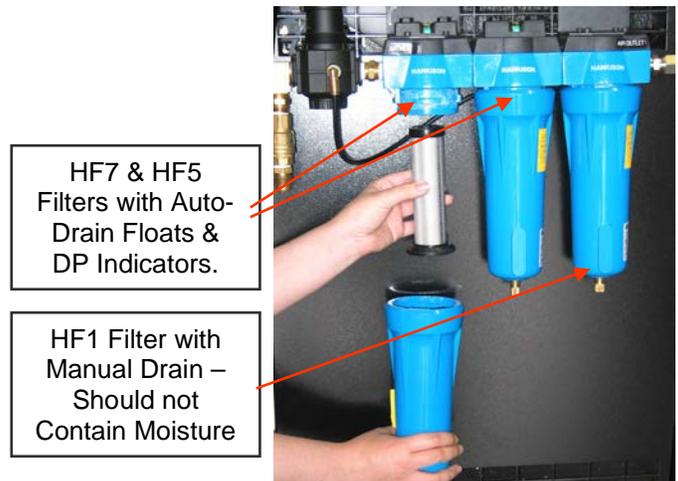
- 1) Push up on the Bowl, rotate CCW, and lower to remove.
- 2) Gently rotate Filter Element and pull down off mounting post.
- 3) Replace Element and reassemble in reverse order.



NOTICE

The interior of the Filter Bowls can be cleaned with a diluted solution of Simple Green™ (a citrus based cleaner) and flushed thoroughly with clean water. This will assist to prolong the life of the element, bowl, and auto drain.

HF7-20 Particle Removal	HF5-20 Coalescing & Water/ Oil Vapor Removal	HF1-20 Oil Vapor Removal
-------------------------------	--	--------------------------------



DP Indicator
Changes from
Green to Red as
Filter Ages. Do
Not Use When
Red.



17.5 Spare Parts List

See Rotary Screw Compressor manual for LP Compressor parts list. Other Nitrox System components and related items are listed below.

Nitrox System Components	Type	Part Number
Rotary Screw Compressor Lubricant, Food Grade	Nuvair 546, 1 Gal (Other Sizes Available)	9409
LP Filtration Element	Hankison HF 7-20	E7-20
	Hankison HF 5-20	E5-20
	Hankison HF 1-20	E1-20
Heater Assembly	1200 Watt, 28" Length	H1200
Heater Thermostat Control	110V/220V	A419
Heater Pressure Switch		3100-052
Membrane	230 Series	NUV230
Air Intake Filter Element	LP280	16CP
Mixing Tube Assembly	1.5 inch diameter, specify length	
Oxygen Analyzer	Pro O2	9450
	Pro O2 Remote Panel Mount	9460
Oxygen Sensor	See Analyzer Owners Manual	
Compressor Hose Coupler	1-1/4"-1-1/2" to 1-1/4"-1-1/2" 1-1/4"-1-1/2" to 1-1/2"	PTC-150 RDTC40X32
Permeate Hose	1.5" Suction Hose sold by the foot	ARH15050
Related Equipment Components		
Air/Nitrox Quality Analysis Kit	Specify: (1) CGA Grade Required (2) Single Use or Program Use	
Air/Nitrox Compressor Lubricant		
Reciprocating Compressor, Food Grade	Nuvair 455, 1 Gal	9406
Reciprocating Compressor, Diester Based	Nuvair 751, 1 Gal (Other Sizes Available)	9403

Appendix

Supply and Breathing Air Specifications

All supply and breathing air must meet the following requirements of CGA G-7.1-1997. Supply air delivered to the Nitrox Membrane System must be purified to meet Grade D or E quality, and periodic air quality testing to assure compliance is recommended. All breathing air for diving produced by the downstream Compressor must be purified to meet Grade E quality, and periodic air quality testing to assure compliance is mandatory.

Item	Grade D	Grade E
◆ Oxygen	◆ 19.5-23.5%	◆ 20-22%
◆ Carbon Dioxide (maximum)	◆ 1000 PPM	◆ 1000 PPM
◆ Carbon Monoxide (maximum)	◆ 10 PPM	◆ 10 PPM
◆ Hydrocarbons (maximum)	◆ Not specified	◆ 25 PPM
◆ Water Vapor (maximum)	◆ Not specified	◆ Not specified
◆ Dew Point (maximum) (1)	◆ Not specified	◆ Not specified
◆ Oil & Particles (maximum) (2)	◆ 5 mg/m ³	◆ 5 mg/m ³
◆ Odor	◆ None	◆ None

Notes: (1) Dew Point of supply air must be >10°F (6°C) colder than coldest ambient air expected
(2) Supply air delivered to the Membrane System must contain <0.003 PPM Oil Vapor

All breathing Nitrox produced for diving must be purified to meet these same requirements, except for oxygen content. Nitrox oxygen content must measure within +/- 1% O₂ of the specified value of the mixture using a properly calibrated Oxygen Analyzer (i.e. Nitrox produced with a target content of 32% O₂ must measure in the range of 31-33% O₂). Periodic air quality testing to assure compliance is mandatory.

Filter Element Life Factors

Breathing air filter element life is typically rated by manufacturer based on an air temperature of 80°F at the filter inlet. Under normal operation this temperature is 12°F (5°C) warmer than the ambient air, resulting in an equivalent ambient temperature rating at 68°F (20°C).

To determine element life at a different ambient temperature, multiply the rated life by the life factor listed below:

Filter Temperature	Ambient Temperature	Filter Element Life Factor
53°F (12°C)	41°F (5°C)	2.6 x Life
62°F (17°C)	50°F (10°C)	1.8 x Life
71°F (23°C)	59°F (16°C)	1.35 x Life
80°F (27°C)	68°F (20°C)	1 x Life
89°F (32°C)	77°F (25°C)	0.8 x Life
96°F (36°C)	84°F (29°C)	0.55 x Life
105°F (41°C)	93°F (34°C)	0.45 x Life
114°F (46°C)	102°F (39°C)	0.35 x Life

Material Safety Data Sheet

Nuvair™ 546 Premium Synthetic Food Grade Air/Nitrox Compressor Lubricant

Effective Date: 03/19/2010

Supersedes:

I. Product Identification:

Trade Name: Nuvair 546
Chemical Name: Polyalphaolefin
Chemical Family: Synthetic hydrocarbon

II. Components & Hazard Statement:

This product is non-hazardous. This material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)

III. Physical Data:

Viscosity: 46 cSt. @ 40°C
Specific Gravity (Water = 1.0): 0.84
Boiling Point: Not Determined
Vapor Pressure: Negligible
Appearance & Odor: Clear & odor Mild
Solubility in Water: Negligible
Other Data: Non-Toxic USDA H-1 Approved

IV. Fire & Explosion Hazard Data:

Flash point: 500°F / 260°C
Autoignition Temperature: Not Determined
Flammability Limits: Not Determined
Extinguishing Media: Dry Chemical; CO2 Foam; Water Spray
Special Fire Fighting Procedure: Burning may produce irritating/noxious fumes. Firefighters should use NIOSH/MNSA approved self-contained breathing apparatus. Use water to cool fire-exposed containers to prevent pressure build-up.

V. Reactivity Data:

Stability: Stable under normal conditions.
Materials to Avoid: Incompatible with oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide

VI. Health Information:

Eye Contact: Flush eyes with water for 15 minutes. Call physician if irritation develops.
Skin Contact: Wash skin with soap and water.
Inhalation: Remove to fresh air.
Ingestion: First aid not normally required. If uncomfortable, call physician.

VII. Health Hazard Data:

Exposure Limit: Not Applicable
Effects of Overexposure: Low oral and dermal toxicity. Prolonged or repeated exposure may cause irritation, nausea, and vomiting.

VIII. Employee Protection:

For general personal hygiene, wash hands thoroughly after handling material. Avoid contact with skin and eyes. Chemical impervious gloves are not required, but may be recommended for prolonged exposure. Use in a well ventilated area.

IX. Storage, Spill, & Disposal Procedures:

Storage: Store in clean, dry area.
Spills: Use absorbent materials to soak up fluid.
Disposal: Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

X. Hazard Rating Information:

NFPA Health: 0
Flammability: 1
Reactivity: 0
Personal Protection: B

This information contained herein is based on the data available to us and is believed to be true and accurate. Nuvair makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained from the use thereof. Nuvair assumes no responsibility for injury from the use of this product.

Material Safety Data Sheets

Nuvair™ 455 Premium Synthetic Food Grade Air/Nitrox Compressor Lubricant

Effective Date: 03/19/2010

I. Product Identification:

Trade Name: Nuvair 455
Chemical Name: Polyalphaolefin
Chemical Family: Synthetic hydrocarbons/Esters

II. Components & Hazard Statement:

This product is non-hazardous. This material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

III. Physical Data:

Viscosity: 100 cst. @40°C
Specific Gravity (Water = 1.0): 0.85
Boiling Point: N.A.
Vapor Pressure: Negligible
Appearance & Odor: Clear – with Mild odor
Solubility in Water: Negligible

IV. Fire & Explosion Hazard Data:

Flash point: 464°F / 240°C/ COC
Autoignition Temperature: Not Established
Flammability Limits: Not Established
Extinguishing Media: Dry Chemical; CO2 Foam; Water Spray
Special Fire Fighting Procedure: Burning may produce irritating/noxious fumes. Firefighters should use NIOSH/MNSA approved self-contained breathing apparatus. Use water to cool fire-exposed containers to prevent pressure build-up.

V. Reactivity Data:

Stability: This product is stable and will not react with water.
Materials to Avoid: Avoid strong oxidizers
Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide

VI. Health Information:

Eye Contact: Flush eyes with water for 15 minutes. Call physician if irritation develops.
Skin Contact: Wash skin with soap and water.
Inhalation: Remove to fresh air.
Ingestion: First aid not normally required. If uncomfortable, call physician.

VII. Health Hazard Data:

Exposure Limit: Not Applicable
Effects of Overexposure: Low oral and dermal toxicity. Prolonged or repeated exposure may cause irritation, nausea, and vomiting.

VIII. Employee Protection:

For general personal hygiene, wash hands thoroughly after handling material. Avoid contact with skin and eyes. Chemical impervious gloves are not required, but may be recommended for prolonged exposure. Use in a well ventilated area.

IX. Storage, Spill, & Disposal Procedures:

Storage: Store in clean, dry area.
Spills: Use absorbent materials to soak up fluid.
Disposal: Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

X. Hazard Rating Information:

NFPA Health: 0
Flammability: 1
Reactivity: 0
Personal Protection: B

This information contained herein is based on the data available to us and is believed to be true and accurate. Nuvair makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained from the use thereof. Nuvair assumes no responsibility for injury from the use of this product.

Material Safety Data Sheet

Nuvair™ 751 Premium Synthetic Diester Based Air/Nitrox Compressor Lubricant

Effective Date: 3/10/2010

Supersedes:

I. Product Identification:

Trade Name: Nuvair 751
Chemical Name: Diester
Chemical Family: Diester

II. Components & Hazard Statement:

This product is non-hazardous. This material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

III. Physical Data:

Viscosity: 146 cst. @40°C
Specific Gravity (Water = 1.0): 0.94
Boiling Point: Not determined
Vapor Pressure: Negligible
Appearance & Odor: Amber / Mild odor
Solubility in Water: Negligible
Other Data: Non-toxic USDA H-2 approved

IV. Fire & Explosion Hazard Data:

Flash point: 520°F / 271°C COC ASTM D-92
Autoignition Temperature: 765°F ASTM D-2155
Flammability Limits: Not Established
Extinguishing Media: Dry Chemical; CO2 Foam; Water Spray
Special Fire Fighting Procedure: Burning may produce irritating/noxious fumes. Firefighters should use NIOSH/MNSA approved self-contained breathing apparatus. Use water to cool fire-exposed containers to prevent pressure build-up.

V. Reactivity Data:

Stability: Stable under normal conditions.
Materials to Avoid: Incompatible with oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide

VI. Health Information:

Eye Contact: Flush eyes with water for 15 minutes. Call physician if irritation develops.
Skin Contact: Wash skin with soap and water.
Inhalation: Remove to fresh air.
Ingestion: First aid not normally required. If uncomfortable, call physician.

VII. Health Hazard Data:

Exposure Limit: Not Applicable
Effects of Overexposure: Low oral and dermal toxicity. Prolonged or repeated exposure may cause irritation, nausea, and vomiting.

VIII. Employee Protection:

For general personal hygiene, wash hands thoroughly after handling material. Avoid contact with skin and eyes. Chemical impervious gloves are not required, but may be recommended for prolonged exposure. Use in a well ventilated area.

IX. Storage, Spill, & Disposal Procedures:

Storage: Store in clean, dry area.
Spills: Use absorbent materials to soak up fluid.
Disposal: Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.

X. Hazard Rating Information:

NFPA Health: 0
 Flammability: 1
 Reactivity: 0
 Personal Protection: B

This information contained herein is based on the data available to us and is believed to be true and accurate. Nuvair makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained from the use thereof. Nuvair assumes no responsibility for injury from the use of this product.

OWNER'S WARRANTY RESPONSIBILITIES

Failure of the owner to prevent equipment damage by complying with the procedures outlined below and in the Operation Manual will void the Nitrox System warranty.

Installation:

- All set up requirements and procedures provided in the Nitrox System Operation Manual must be followed in their entirety including supply air cleanliness, Compressor preparation, and installation of the Nitrox System.
- Supply air to the Membrane must be properly filtered to CGA Grade D air quality or better to prevent damage to the Membrane. Air quality testing of the supply air should be performed periodically and documented to assure compliance.
- If there is any doubt regarding the suitability of a HP Compressor for compressing Nitrox, contact Nuvair or the Compressor manufacturer before you connect your Nitrox System.
- If an existing HP Compressor is to be used for compressing Nitrox, all traces of the old Lubricant must be removed and replaced with a Nitrox Compressor Lubricant approved by Nuvair.
- Electrical wiring and connections should be made by a qualified electrician in accordance with all national and local electrical codes.
- Do not change the temperature setting on the Heater Thermostat Control. Changes in temperature settings may cause Membrane damage.
- To prevent Compressor damage, only use the Compressor Intake Hose provided. If a longer hose is required, contact Nuvair for assistance.

Operation:

- Do not use the Nitrox System to supply a HP Compressor with Nitrox mixtures containing more than 40% oxygen. Compressing higher concentrations of oxygen may cause severe Compressor damage.
- Do not pump Nitrox mixtures at pressures above the compressor manufacturer's rating, and never above 3600 P.S.I. Compressing Nitrox at higher pressures may cause severe HP Compressor damage.
- To prevent Membrane damage, drain all low pressure filter and volume tank condensate on a daily basis.

Maintenance:

- Change low pressure filter elements on a schedule determined by filter capacity and ambient temperature and humidity. Contact Nuvair if you need assistance establishing a schedule for your equipment and location.
- Replace Membrane System Air Intake Filter on a regular basis to prevent flow obstruction.
- Keep all nuts, bolts, fittings, connectors, and clamps tight.
- Keep a service record book showing that regular maintenance work has been carried out. If a warranty claim becomes necessary, it will aid in demonstrating that damage has not been caused by insufficient maintenance. Proof of maintenance may be required prior to determining the validity of a warranty request.

NUVAIR NITROX SYSTEM WARRANTY

NUVAIR extends a limited warranty, which warrants the Nitrox System to be free from defects in materials and workmanship under normal use and service for a limited period. The specific Membrane Component of the Nitrox System is warranted according to the pro-rated terms as set forth below. All other Original Equipment Manufacturer (OEM) components used in the system are warranted only to the extent of the OEM's warranty to NUVAIR. NUVAIR makes no warranty with respect to these OEM components, and only warrants the workmanship that NUVAIR has employed in the installation or use of any OEM component. This warranty is not transferable.

NUVAIR will, at its discretion and according to the terms as set forth within, replace or repair any materials which fail under normal use and service and do not exhibit any signs of improper maintenance, misuse, accident, alteration, weather damage, tampering, or use for any other than the intended purpose. Determination of failure is the responsibility of NUVAIR, which will work together with the customer to adequately address warranty issues. When any materials are repaired or replaced during the warranty period, they are warranted only for the remainder of the original warranty period. This warranty shall be void and NUVAIR shall have no responsibility to repair or replace damaged materials resulting directly or indirectly from the use of repair or replacement parts not approved by NUVAIR.

Pro-Rated Terms:

NUVAIR warrants the Membrane Component of the Nitrox System to be free from defects in material and workmanship for a period of thirty-six (36) months from date of installation or forty-two (42) months from date of shipment by NUVAIR, whichever may occur first. The warranty covers parts only and is prorated as follows:

- First Year Repair or replacement free of charge
- Second Year Warranty allowance of 70% of the current Membrane Component list price
- Third Year Warranty allowance of 40% of the current Membrane Component list price

A warranty registration card, supplied with system documentation, must be filled out and submitted to NUVAIR for the warranty to be in full effect. If the warranty registration card is not received within thirty (30) days of installation, the thirty-six (36) month warranty will begin with the date of shipment from NUVAIR.

Maintenance Items:

Any materials which are consumed, or otherwise rendered not warrantable due to processes applied to them, are considered expendable and are not covered under the terms of this policy. This includes maintenance and consumable items listed as part of a suggested maintenance program included with system documentation.

Return Policy:

Application for warranty service can be made by contacting NUVAIR during regular business hours and requesting a Return Material Authorization number. Materials that are found to be defective must be shipped, freight pre-paid, to the NUVAIR office in Oxnard, California. Upon inspection and determination of failure, NUVAIR shall exercise its options under the terms of this policy. Warranty serviced materials will be returned to the customer via NUVAIR's preferred shipping method, at NUVAIR's expense. Any expedited return shipping arrangements to be made at customer's expense must be specified in advance.

Limitation of Warranty and Liability:

Repair, replacement or refund in the manner and within the time provided shall constitute NUVAIR'S sole liability and the Purchaser's exclusive remedy resulting from any nonconformity or defect. NUVAIR shall not in any event be liable for any damages, whether based on contract, warranty, negligence, strict liability or otherwise, including without limitation any consequential, incidental or special damages, arising with respect to the equipment or its failure to operate, even if NUVAIR has been advised of the possibility thereof. NUVAIR makes no other warranty or representation of any kind, except that of title, and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, are hereby expressly disclaimed. No salesman or other representative of NUVAIR has authority to make any warranties.



Operation Manual

Pro O₂TM
Pro O₂ RemoteTM

Oxygen Analyzers

If you have any questions on this equipment please contact Technical Support at:

Nuvair
2949 West 5th St.
Oxnard, CA 93030

Phone: 805-815-4044
FAX: 805-815-4196
Email: info@nuvair.com

Hours: Monday through Friday
8:00 AM to 5:00 PM PST USA



WARNING

This Operation Manual contains important safety information and should always be available to those personnel operating this equipment. Read, understand, and retain all instructions before operating this equipment to prevent injury or equipment damage.

Every effort was made to ensure the accuracy of the information contained within this manual; however, we retain the right to modify its contents without notice. If you have problems or questions after reading the manual, stop and call for information.

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1.0 Introduction

This manual will assist you in the proper set-up, operation and maintenance of the Pro O₂[™] and Pro O₂ Remote[™] Oxygen Analyzers. Be sure to read the entire manual.

Throughout this manual we will use certain words to call your attention to conditions, practices or techniques that may directly affect your safety. Pay particular attention to information introduced by the following signal words:



Indicates an imminently hazardous situation, which if not avoided, will result in serious personal injury or death.



Indicates a potentially hazardous situation, which if not avoided, could result in serious personal injury or death.



Indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

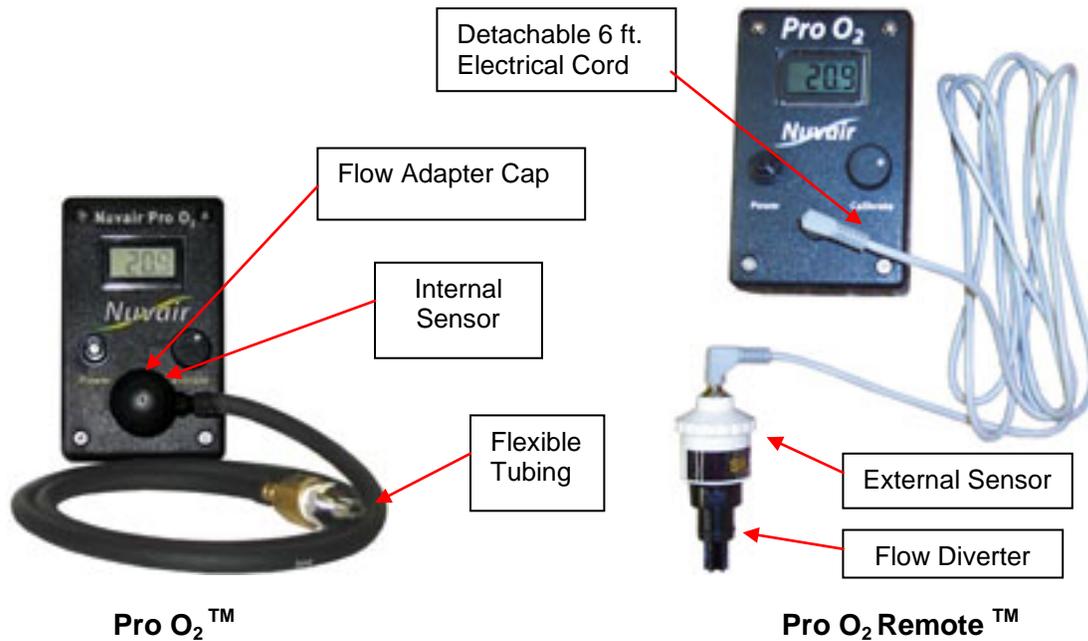


Notifies people of installation, operation or maintenance information which is important but not hazard-related.

2.0 System Description

The Pro O₂TM and Pro O₂ RemoteTM Oxygen Analyzers (“the Analyzer”) measure oxygen (O₂) levels in gases in the range of 0.1 - 100.0% O₂. The choice of Analyzer depends on the application:

- Pro O₂TM – where pressurized gas must be analyzed and the pressure and flow of the sample flow can be regulated
- Pro O₂ RemoteTM - where non-pressurized gas must be analyzed or for pressurized gas applications where the Analyzer must be located remote to the sensor



The Analyzer is a water and impact resistant unit compatible with outdoor and marine environments. Pressurized gases must be regulated to one atmosphere absolute (0 P.S.I.) prior to analyzing.

When used in breathing gas applications, redundant Analyzers must be used for verification. In diving, for example, one Analyzer must be used to monitor oxygen during breathing gas production and a second independent Analyzer must be used to verify the oxygen content of the breathing gas prior to diver use.



WARNING

When using the Analyzer for diving applications with mixed gases other than air, you must first obtain proper instruction from a certified diving instructor with a nationally recognized training agency qualified in mixed gas diving. Improper use of this analyzer may result in incorrect gas analysis which can lead to serious personal injury or death.



WARNING

Although the Analyzer is a rugged instrument, careless handling or abuse may result in damage to the Analyzer resulting in inaccurate gas analysis. Inaccurate gas analysis can lead to serious personal injury or death.



WARNING

Breathing gas must always be analyzed by two separate Analyzers, with one used for production and one used for analysis after production. Never depend on a single Analyzer during both gas production and delivery. If the Analyzer readings do not agree, both units must be recalibrated. Inaccurate gas analysis can lead to serious personal injury or death.

2.1. Controls



2.2. Display

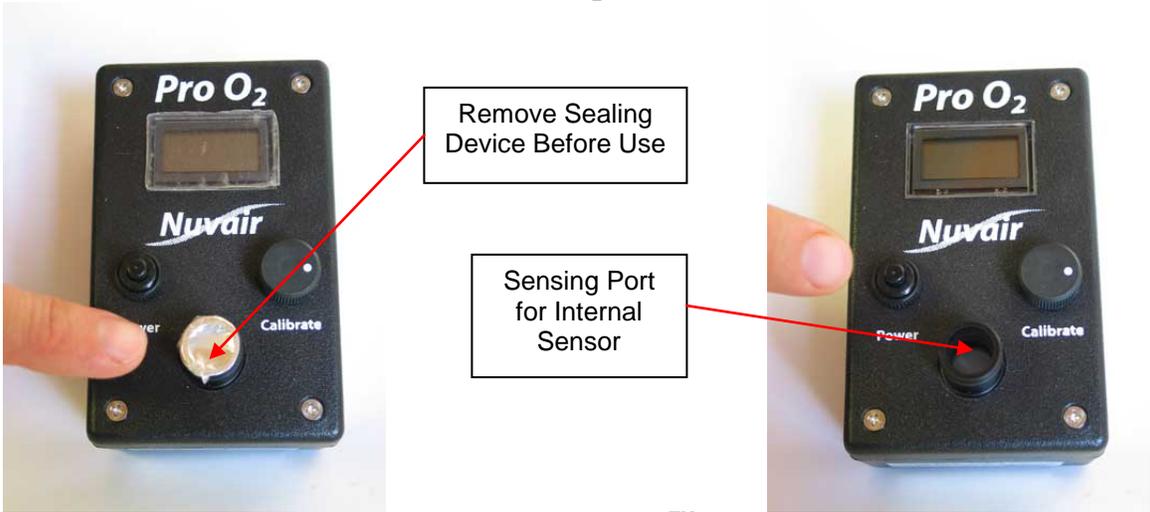


2.3. Oxygen Sensor

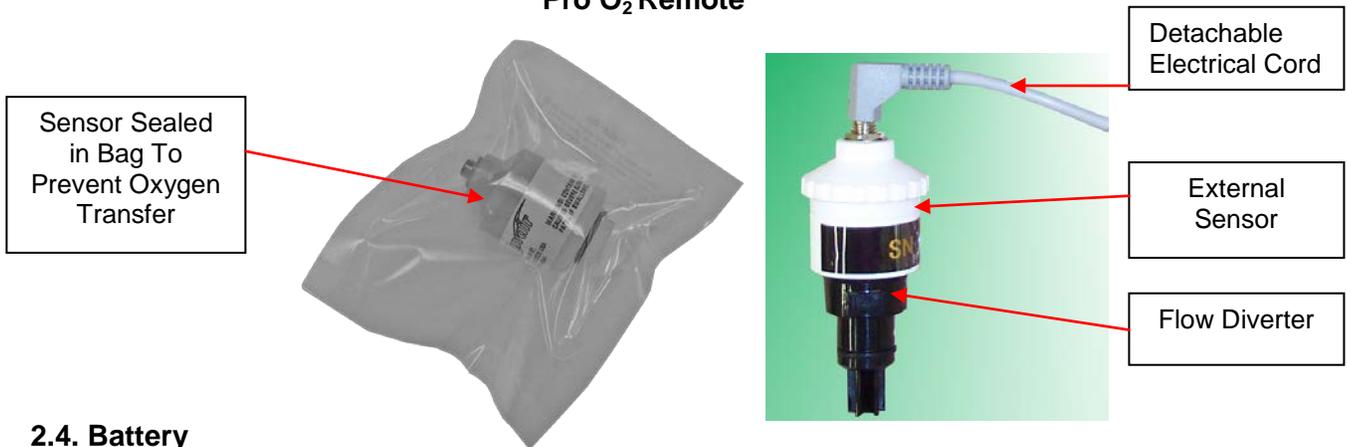
The Analyzer uses an electrochemical O₂ Sensor to measure O₂ content in gases. The Sensor is disposable and user-replaceable, with a life expectancy of up to 36 months depending on usage. The Sensor is designed for use at one atmosphere absolute (0 P.S.I.) pressure. The gas mixture to be analyzed must be regulated accordingly, and any potential for pressure or vacuum must be avoided.

To extend sensor life, the Analyzer is supplied with the Sensor in a sealed condition. When first received, please verify that sealing device is intact. If the sealing device is torn or missing, contact your supplier for assistance. The sealing device must be removed prior to initial use and is not necessary to reuse.

Pro O₂™



Pro O₂ Remote™

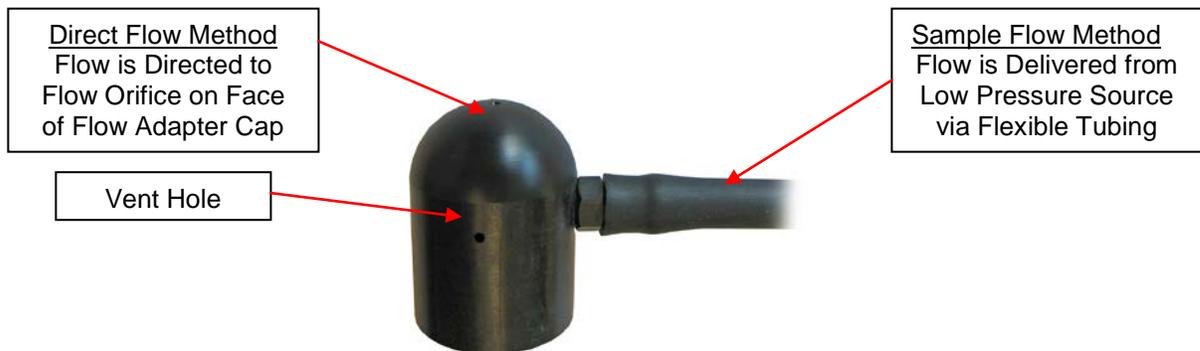


2.4. Battery

Power is provided by a standard alkaline 9-volt battery. It is located inside the Analyzer and is user-replaceable.

2.5. Flow Adapter Cap (Pro O₂™)

The Flow Adapter Cap with flexible tubing and flow orifice attaches to the Pro O₂™ Sensor port and is sealed by an o-ring. It can be used to direct the gas sample flow to the Sensor via one of two methods:



2.6. Flow Diverter (Pro O₂ Remote™)



The Flow Diverter is installed to the user's non-pressurized device to direct gas flow to the Sensor:

- Slip Fit Method – Install optional Tee Adapter (see Spares and Accessories section) in-line with gas flow path. Insert Flow Diverter with o-ring into small bore of Adapter.
- Press Fit Method – Remove the Flow Diverter o-ring and press fit the Diverter into a 9/16 inch diameter cylindrical bore in gas flow path.

3.0 Calibration



WARNING

Oxygen Analyzers must be calibrated before each use. Improper calibration may result in the use of incorrect breathing gas mixtures, which may cause serious injury or death to the person using the gas mixture.



WARNING

Calibration or use of the Analyzer with a low battery may result in inaccurate readings. Inaccurate gas analysis can lead to serious personal injury or death.



NOTICE

If the Analyzer has been subjected to a recent change in ambient temperature, allow it to stabilize for one hour before calibration.



WARNING

When Analyzer calibration is performed at different atmospheric conditions than the gas being measured, a calibration correction value may be required. Improper calibration may result in the use of incorrect breathing gas mixtures, which may cause serious injury or death to the person using the gas mixture.

3.1. Calibration Methods

Calibration should always be performed at the same temperature and humidity conditions as the gas being measured. This is not always possible, for example, in a tropical environment where dry breathing gas from a high-pressure Scuba cylinder will be measured after Analyzer calibration has been performed in the warm, humid ambient air. Under these conditions a calibration correction value may be required, as detailed in the Appendix, or dry air must be used for calibration.



WARNING

Obtain proper training before attempting special calibration procedures. Improper calibration may result in the use of incorrect breathing gas mixtures, which may cause serious injury or death to the person using the gas mixture.

Calibration in air at sea level is suitable for many applications; however, the closer the oxygen content of the calibration gas is to the gas being tested, the more accurate the measurement results. The following special applications require methods and training beyond the scope of this manual:

- Analysis of gases containing greater than 50% oxygen requiring calibration with pure oxygen or certified calibration gas
- Analysis of gases at altitudes above sea level requiring correction for reduced atmospheric pressure

3.2. Calibration in Air

The following pictures illustrate the steps required to calibrate the Pro O₂™ Analyzer.

Pro O₂™

Turn Analyzer On

Monitor Display for Low Battery Warning



Step 1

Remove Flow Adapter Cap

Expose Sensor Port to Still Air Until Display Stabilizes



Step 2

Adjust Calibrate Knob Until Display Reads 20.9%



Step 3

Replace Flow Adapter Cap

Do Not Disturb Calibrate Knob



Step 4

The following pictures illustrate the steps required to calibrate the Pro O₂ Remote™ Analyzer.

Pro O₂ Remote™

Turn Analyzer On

Monitor Display For Low Battery Warning



Step 1



Unscrew Sensor From Flow Diverter

Expose Sensor Port to Still Air Until Display Stabilizes

Step 2

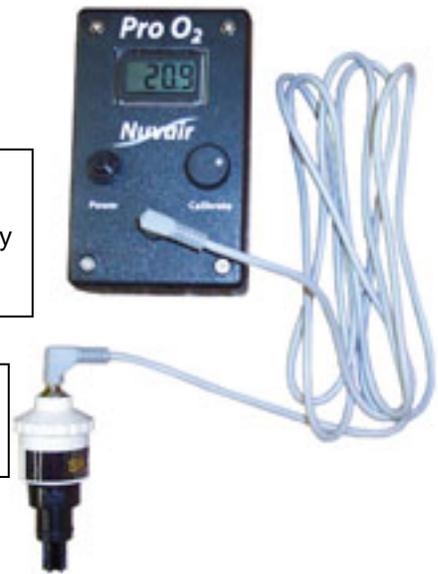
Adjust Calibrate Knob Until Display Reads 20.9% O₂



Step 3

Verify Electrical Cord is Firmly Attached at Both Ends

Reinstall Sensor to Diverter



Step 4

4.0 Operation

Prior to each Analyzer use:

- 1) Verify that Sensor sealing device is removed
- 2) Turn unit on and monitor Display for low battery warning
- 3) Calibrate Analyzer as required.



WARNING

Never expose the Oxygen Sensor to pressure or you may cause damage and/or false readings. Damaged Sensors will not provide accurate gas analysis. Inaccurate gas analysis can lead to serious personal injury or death.

4.1. Pro O₂™

The Pro O₂™ can be used to analyze a regulated gas sample flow, the contents of a gas cylinder, or the flow from a regulator. The flow rate of gas must equal 1 – 5 L/min. To produce this flow, a Flow Restrictor and Regulator may be required. See Spares and Accessories section.



WARNING

Gas, even under moderate pressures, can cause extreme bodily harm. Never allow any gas stream to be directed at any part of your body.

Sample Flow Method

Attach Flexible Tubing to Gas Sample Flow of 1-5 L/min



Step 1

Verify that Gas is Flowing Out Holes in Flow Adapter Cap



Step 2

Allow 15 Seconds for Display Reading to Stabilize

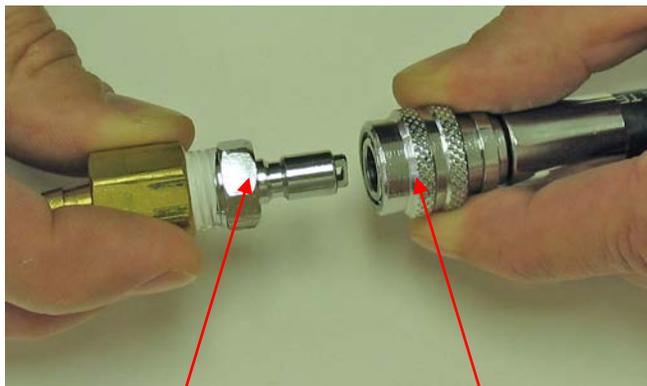
Record Reading while Gas is Flowing



Step 3

When analyzing Scuba Cylinder gases, it is convenient to obtain the sample gas directly from the Buoyancy Compensator (BC) inflator hose attached to the Regulator first stage.

A special Flow Restrictor is attached to the inflator hose quick-disconnect (QD) fitting. The fitting on the other end of the Restrictor is then inserted into the tubing supplied with the Analyzer. A variety of Flow Restrictors are available to fit different types of inflator hose QD fittings. See Spares and Accessories section.



Flow Restrictor

BC Inflator Hose QD Fitting

Direct Flow Method – Gas Cylinder

Slowly Open Cylinder Valve until Slight Hiss of Gas is Heard



Hold Flow Adapter Cap Flow Orifice up to Gas Flow

Verify that Gas is Flowing Out Tubing



Step 1

Allow 15 Seconds for Display Reading to Stabilize

Record Reading While Gas is Flowing



Close Cylinder Valve & Remove Analyzer

Verify that Gas Continues to Flow from Valve. If Not, Repeat Procedure



Step 3

Direct Flow Method – Scuba Regulator

Attach Scuba
Regulator to
Cylinder Valve

Open Cylinder
Valve



Step 1

Lightly Press
Regulator Purge
Button to Get Very
Low Flow of Gas

Hold Flow Adapter
Cap Flow Orifice
Up to Gas Flow



Step 2

Allow 15
Seconds for
Display Reading
to Stabilize

Record Reading
while Gas is
Flowing



Step 3

4.2. Pro O₂ Remote™

The Pro O₂ Remote™ is used where non-pressurized gas must be analyzed or for pressurized gas applications where the Analyzer must be located remote to the sensor:

Begin Flow of
Gas Stream
Past Sensor

Gas Flow



Allow 15
Seconds for
Display Reading
to Stabilize

Record Reading
while Gas is
Flowing



Step 2

5.0 Maintenance

5.1. Analyzer Care

- Do not clean Analyzer with anything other than a damp soft cloth.
- Do not immerse Analyzer in liquid, leave unprotected outside, or store in a wet environment.
- Protect Analyzer from excessive shock and impact.
- Protect Analyzer from excessive exposure to sunlight and extreme temperatures.

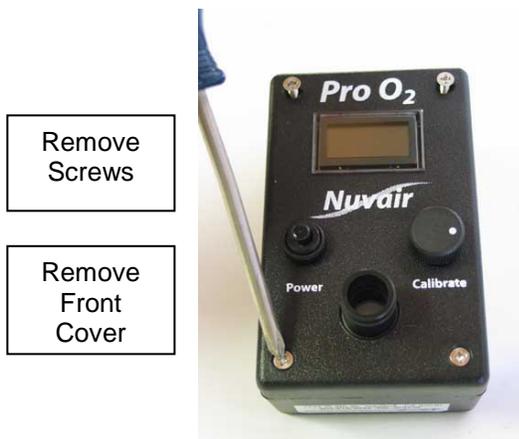
5.2. Battery Replacement



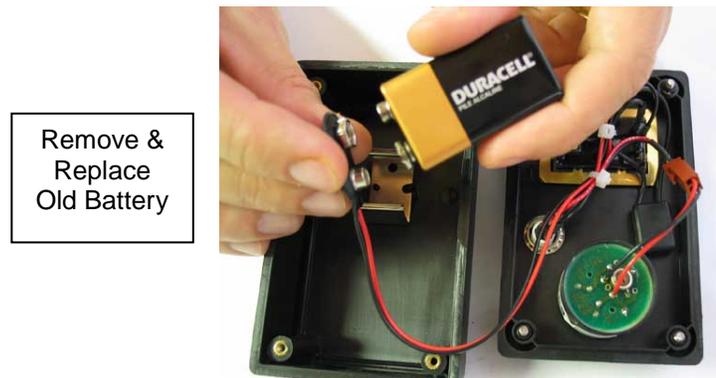
NOTICE

Be sure to dispose of spent, leaking, or damaged Batteries properly, according to local regulations.

The following pictures illustrate the steps required to replace the battery in the Analyzer.



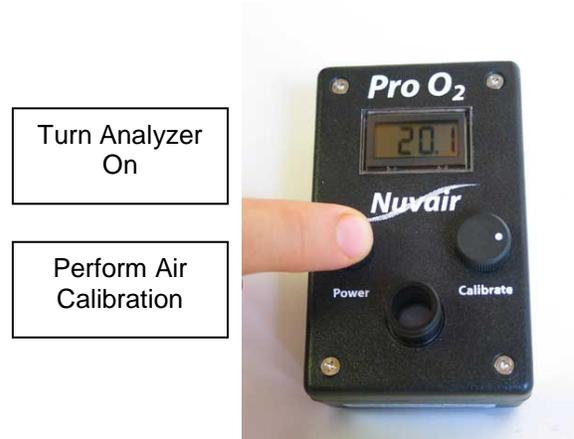
Step 1



Step 2



Step 3



Step 4

5.3. Oxygen Sensor Replacement



CAUTION

Be sure to dispose of spent, leaking, or damaged Oxygen Sensors properly, according to local regulations.



DANGER

Do not swallow (ingest) either the electrolyte from the Oxygen Sensor or the Sensor itself. The Potassium Hydroxide chemical contained in the Sensor can cause severe injury or death. If electrolyte or the Sensor is swallowed, seek medical attention immediately.



WARNING

If after handling the Oxygen Analyzer or Sensor, you find that your fingers or other parts of your body feel “slippery” or the skin or eyes sting, immediately flush affected area with clean, fresh water for at least 15 minutes. The stinging or slippery sensation is an indication of a leaking Sensor. The Potassium Hydroxide chemical contained in the Sensor can cause severe injury or death. Seek immediate medical attention if eye contact is made or skin stinging persists.

Handling Sensors

Replacement Sensors are supplied in sealed bags. Normally Sensors do not present a health hazard. Before opening the bag, check that the electrolyte has not leaked. However, if electrolyte leakage has occurred, do not open bag. Dispose of Sensor properly or return for replacement.

If electrolyte leakage occurs while the Sensor is in service, use rubber gloves and chemical splash goggles for handling. Rinse contaminated surfaces thoroughly with water.

Electrolyte First Aid Procedures

- Ingestion - Drink a large volume of fresh water. Do not induce vomiting. Get immediate medical attention.
- Eye Contact - Flush eyes with clean, fresh water for at least 15 minutes and get medical help immediately.
- Skin Contact - Flush the affected area with clean, fresh water for at least 15 minutes and removed contaminated clothing. If stinging persists get medical attention.

The following pictures illustrate the steps required to replace the Sensor in the Pro O₂™.

Pro O₂™

Remove Flow Adapter Cap



Step 1

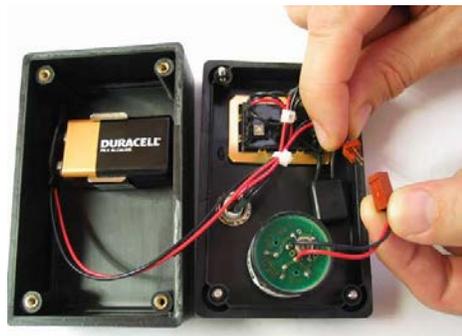
Remove Screws

Remove Front Cover



Step 2

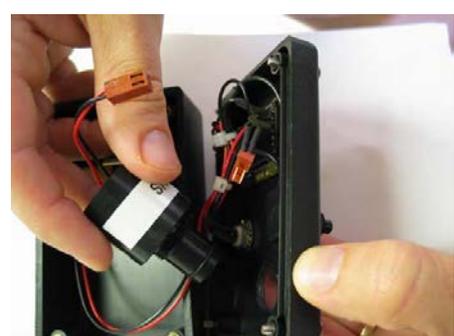
Disconnect Electrical Connector



Step 3

Remove Old Sensor from Cover by Unscrewing CCW

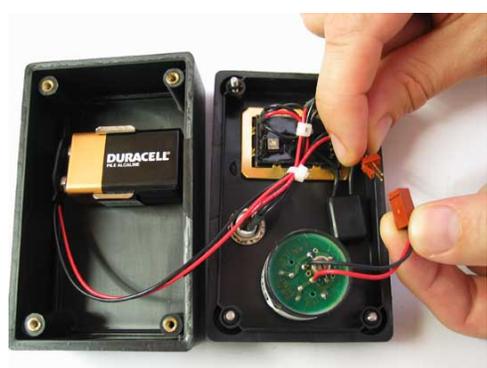
Replace with New Sensor



Step 4

Reconnect Electrical Connector

Note: Reversing Polarity Will Cause Display to Read Negative



Step 5

Replace Front Cover - Do Not Pinch Wires

Reinstall Screws



Step 6

Turn Analyzer On

Perform Air Calibration



Step 7

The following pictures illustrate the steps required to replace the Sensor in the Pro O₂ Remote.

Pro O₂ Remote™

Disconnect
Electrical
Cord from
Sensor



Step 1

Remove and
Replace Old
Sensor



Step 2

Reconnect
Electrical
Cord to
Sensor



Step 3

Turn
Analyzer On

Perform Air
Calibration



Step 4

6.0 Spares and Accessories

6.1. Oxygen Sensors

Order the replacement Sensor closest in appearance to your existing Sensor.

Pro O₂™



Part No. D-15



Part No. R-33D

Pro O₂ Remote™



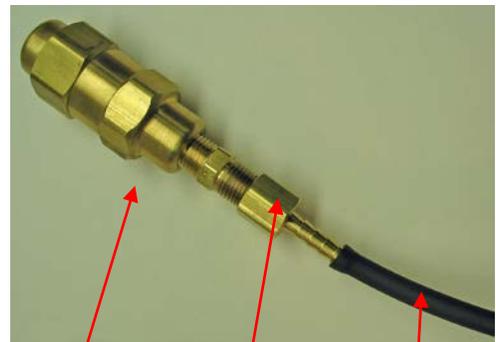
Part No. R-17DNUV

6.2. Flow Restrictors and Regulators (Pro O₂™)

A variety of Flow Restrictors and Pressure Regulators for the Sample Flow Method are available from Nuvaair, all calibrated to produce a flow rate of 1 – 5 L/min with a Regulator output of 100 – 160 P.S.I.

Universal Flow Restrictors are used for most applications and are typically provided complete with Regulator.

When analyzing Scuba Cylinder gases, special Flow Restrictors can be used to obtain the sample gas directly from the BC inflator hose. A variety of BC Flow Restrictors are available to fit the different types of inflator hose QD fittings used.



Pressure Reducing Regulator

Universal Flow Restrictor

LP Hose to Analyzer



Standard Flow Restrictor
Part No. AA04



Mares™ Flow Restrictor
Part No. A167

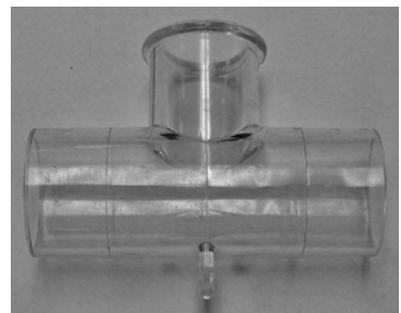


ScubaPro™ Flow Restrictor
Part No. AA05

6.3. Tee Adapter (Pro O₂ Remote™)

When using the Pro O₂ Remote™ to analyze in-line gas flow, the Tee Adapter is used to install the Sensor and Flow Diverter in the gas path.

Tee Adaptor
Part No. 6024



7.0 Troubleshooting

SYMPTOM	REASON	SOLUTION
Battery symbol	Low Battery	Change the battery
No display	Switched off Bad connection	Switch on Check display connection Check battery connection
Zero reading	Sensor disconnected Sensor expired	Check connection Change sensor
Reading erratic	Pressure on sensor Radio transmission Sensor old or faulty Condensation on sensor.	Check flow Move unit away Change sensor Dry in air
Reading does not change when calibration knob is turned	Faulty connections Sensor failure	Check connections Change sensor
Display segments missing	Display faulty	Return to dealer
Will not calibrate	Sensor faulty Sensor not in air High altitude	Change sensor Check flow adapter Use altitude calibration procedure
Reading drifts	Rapid temperature change	Stabilize temperature & recalibrate

Appendix

Calibration Correction Values for Temperature and Humidity

Oxygen Analyzer calibration should always be performed at the same temperature and humidity conditions as the gas being measured. Where this is not possible, a calibration correction value may be required. A common example is a tropical environment where dry breathing gas from a high-pressure Scuba cylinder will be measured after Analyzer calibration has been performed in the warm, humid ambient air.

To determine if a calibration correction value is required, you must first know the temperature and relative humidity of the air in which calibration will be performed. Using the chart below, find the atmospheric oxygen percent value corresponding to these values. If the oxygen percent value falls in the shaded portion of the chart, calibrate the Analyzer to the corrected chart value.

OXYGEN COMPENSATION CHART FOR MOISTURE IN THE ATMOSPHERE

ATMOSPHERE OXYGEN PERCENT IN RELATION TO TEMPERATURE AND RELATIVE HUMIDITY										
TEMPERATURE (°F) -->	32	40	50	60	70	80	90	100	110	120
TEMPERATURE (°C) -->	0	4	10	16	21	27	32	38	43	49
RELATIVE HUMIDITY (%)	ATMOSPHERIC OXYGEN PERCENT (% O ₂)									
10	20.9	20.9	20.9	20.9	20.8	20.8	20.8	20.8	20.7	20.7
20	20.9	20.9	20.8	20.8	20.8	20.8	20.7	20.6	20.5	20.4
30	20.9	20.8	20.8	20.8	20.7	20.7	20.6	20.5	20.4	20.2
40	20.8	20.8	20.8	20.7	20.7	20.6	20.5	20.4	20.2	19.9
50	20.8	20.8	20.8	20.7	20.6	20.5	20.4	20.2	20.0	19.7
60	20.8	20.8	20.7	20.7	20.6	20.5	20.3	20.1	19.8	19.5
70	20.8	20.8	20.7	20.6	20.5	20.4	20.2	19.9	19.6	19.2
80	20.8	20.8	20.7	20.6	20.5	20.3	20.1	19.8	19.5	19.0
90	20.8	20.7	20.7	20.6	20.4	20.3	20.0	19.7	19.3	18.7
100	20.8	20.7	20.6	20.5	20.4	20.2	19.9	19.5	19.1	18.5
H ₂ O at 100% RH	0.6	0.8	1.2	1.8	2.5	3.4	4.7	6.5	8.6	11.5

If the Temperature and Relative Humidity axis meet in the shaded part of the chart, calibrate to the chart O₂ level or with dry air to maintain 0.5% O₂ accuracy in NITROX.

To use the correction value, follow the standard Calibration in Air procedure with the following exceptions:

- Make sure Oxygen Sensor port is exposed to the ambient temperature and humidity corresponding to the correction value.
- Adjust the Calibrate Knob to achieve a Display reading equal to the correction value.
- Once you have calibrated the Analyzer for temperature and humidity using the, your readings for gas analysis should be correct with no further adjustment.
- Re-calibrate Analyzer for any changes in temperature or humidity of the ambient environment or the gas being analyzed.

Note that the calibration correction value is never used when the temperature and humidity conditions of the gas being measured are the same as the conditions during calibration.

Analyzer Specifications

Range:	0.1-100.0% Oxygen (0-1 ATA PPO ₂)
Display Accuracy:	+/- 0.1%
Sensor Type:	Electrochemical
Expected Sensor Life, Room Air:	36 Months
Power:	9V Alkaline Battery
Response Time:	Less Than 6 Seconds to 90% of Final Value
Operating Temperature:	32-104°F (0-40°C)
Storage Temperature:	32-122°F (0-50°C)
Pressure:	Sensitive to Partial Pressure
Humidity:	0-99% RH (Non-Condensing)
Warranty:	36 Months Pro-Rated

Note: All specifications are at ambient / sea level, 25°C

NUVAIR Pro O₂™ and Pro O₂ Remote™ Warranty

NUVAIR extends a limited warranty, which warrants the Pro O₂™ and Pro O₂ Remote™ (Pro O₂) to be free from defects in materials and workmanship under normal use and service for a limited period. The Pro O₂ is warranted according to the pro-rated terms as set forth below. This warranty is not transferable.

NUVAIR will, at its discretion and according to the terms as set forth within, replace or repair any materials which fail under normal use and service and do not exhibit any signs of improper maintenance, misuse, accident, alteration, weather damage, tampering, or use for any other than the intended purpose. Determination of failure is the responsibility of NUVAIR, which will work together with the customer to adequately address warranty issues. When any materials are repaired or replaced during the warranty period, they are warranted only for the remainder of the original warranty period. This warranty shall be void and NUVAIR shall have no responsibility to repair or replace damaged materials resulting directly or indirectly from the use of repair or replacement parts not approved by NUVAIR.

Pro-Rated Terms:

NUVAIR warrants the Pro O₂ to be free from defects in material and workmanship for a period of thirty-six (36) months from date of purchase. The warranty covers parts and labor and is prorated as follows:

- 0 – 12 Months Repair or replacement free of charge
- 13 – 18 Months Warranty allowance of 75% of purchase price
- 19 – 24 Months Warranty allowance of 50% of purchase price
- 25 – 36 Months Warranty allowance of 25% of purchase price

A warranty registration card, supplied with system documentation, must be filled out and submitted to NUVAIR for the warranty to be registered. If the warranty registration card is not received within ten (10) days of purchase, the warranty will begin with the date of manufacture by NUVAIR.

Maintenance Items:

Any materials which are consumed, or otherwise rendered not warrantable due to processes applied to them, are considered expendable and are not covered under the terms of this policy. This includes the 9-volt battery used in the Pro O₂.

Return Policy:

Application for warranty service can be made by contacting NUVAIR during regular business hours and requesting a Return Material Authorization number. Materials that are found to be defective must be shipped, freight pre-paid, to the NUVAIR office in Oxnard, California. Upon inspection and determination of failure, NUVAIR shall exercise its options under the terms of this policy. Warranty serviced materials will be returned to the customer via NUVAIR's preferred shipping method, at NUVAIR's expense. Any expedited return shipping arrangements to be made at customer's expense must be specified in advance.

Limitation of Warranty and Liability:

Repair, replacement or refund in the manner and within the time provided shall constitute NUVAIR'S sole liability and the Purchaser's exclusive remedy resulting from any nonconformity or defect. NUVAIR shall not in any event be liable for any damages, whether based on contract, warranty, negligence, strict liability or otherwise, including without limitation any consequential, incidental or special damages, arising with respect to the equipment or its failure to operate, even if NUVAIR has been advised of the possibility thereof. NUVAIR makes no other warranty or representation of any kind, except that of title, and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, are hereby expressly disclaimed. No salesman or other representative of NUVAIR has authority to make any warranties.



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