User Manual

EK76>R15 LP
28.5 hp Diesel

Nitrox System

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

Nuvair
1600 Beacon Place
Oxnard, CA 93033

Phone: +1 805 815 4044
FAX: +1 805 486 0900
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. Nuvair, however, retains the right to modify its contents without notice. If you have problems or questions after reading the manual, stop and call Nuvair at 1-805-815-4044 for information.

Table of Contents

Introduction

Setup, Operation, and Maintenance

Separate Manuals Included:

Champion R15 Compressor Operation & Maintenance Instructions
EK76 Rotary Screw manual
Kohler 9LD626-2 28.5hp Manual

1.0 Introduction

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.

This manual will assist you in the proper set-up, operation and maintenance of the Nuvair EK76>R15 LP. nitrox System. 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:

⚠ Danger

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

⚠ Warning

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

⚠ Caution

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.

⚠ Notice

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

⚠ Warning

Rotary screw compressors are continuous duty rated workhorses that that are not made to run for short intervals or sit without use for long periods of time. The rotary screw compressor must be run for a minimum of one continuous hour per week in tropical settings to insure moisture does not build up in the compressor. The oil filter and oil/air separator must be changed every 2000 hours or a minimum of once per year. In tropical conditions the oil should be checked every month for moisture by draining a small amount off the bottom of the compressor into a clear glass. If moisture is found it can be drained off and a visual inspection should be done on all filters checking for rust or corrosion.

Safety Warnings

⚠ 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 HP Compressor manufacturer's rating, and never above 3600 psi (250 bar). The system is not rated for pressures above 3600 psi (250 bar). Higher pressures may lead to explosions which may cause serious personal injury or death.

⚠ 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.

2.0 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, or direct air stream at body, this can cause injuries.
21) Compressed air from this machine absolutely must not be used for food processing or breathing air without the properly maintained downstream filters, purifiers, 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.

3.0 Legal Precautions

It is highly recommended that a nitrox log be maintained when using nitrox on a job site to document the following information. This log must be of permanent binding style with no loose pages.

- Date and time of day
- Job Name & Number
- Supplier's check of oxygen content (%O_2) plus signature and date
- User's check of oxygen content (%O_2) plus signature and date
- MOD (Maximum Operating Depth) in user's handwriting

Proper air/nitrox gas analysis tested on a quarterly basis and comprehensive maintenance is the best way to assure proper, safe, and economical nitrox production.

4.0 System Overview

The EK76>R15 LP nitrox package is designed to be portable yet rugged and open with good access to components, yet good moving part protection while it is running. This package is for use to supply low pressure surface supplied nitrox or air direct to divers.
The operator should be able to produce nitrox with a minimum of start-up hassles.

LP>LP nitrox:

- 1 x 250 Semi-permeable Membrane
- (2) O_2 Analyzers
- Air Supply and Regulated Air Input Gauges
- BP Regulator for adjusting O_2% and air volume pumped by the EK76 compressor
- Air Intake Filter & Static Mixing Tube
- Hankison Series 20 LP Filtration to .003 PPM Oil Vapor and a 2nd set for divers
- NUVAIR 455 FDA Approved Food Grade Compressor Lubricant in R15 and Nuvair 546 in EK76 Rotary Screw compressor
- Aluminum Frame with Stainless Steel Compressor Plate
- Vibration Isolation Mounts
- 1 x Low-pressure Two Stage Compressor
- 1 x Low-pressure Rotary Screw Compressor
- 2 x 30 Gallon ASME LP Volume Tank with Drain & Gauges (Optional 2 x 60 gallon tanks)
- 2 x Air Cooler, 1x Oil Cooler
- Kohler Diesel 28.5hp

Specifications:

- Produces 24% -40% nitrox @ 16cfm
- Upgraded Purification
- Mix Accurate To 1/10th Percent

Low Pressure Feed Air Compressor Technical Data:

- LP Screw Compressor – using 18hp–34 cfm@175psi

Maximum Block Output Pressure:	193 psi
Maximum Block Rated Output	58cfm
Final System Discharge Pressure:	80-185 psi
Modulation Intake device	
Rotary Screw Compressor	
Lubricant:	NUVAIR 546
Condensate Drain	Manual
Supplying Grade D Air to Membrane	

Final Low Pressure nitrox/Air Compressor Technical Data:

- LP Compressor – 10hp–16 cfm@175psi

Maximum Block Output Pressure:	200 psi
Maximum Block Rated Output	23.5 cfm
Final System Discharge Pressure:	155-175 psi
Dual Control Head unloaders	
Number of Stages:	2
Number of Cylinders:	2
Package Free Air Delivered Max:	16 SCFM @ 40%O_2
Lubricant:	NUVAIR 455
Condensate Drain	Manual

- Weight: 1400 lbs.
- Dimensions: 67″H X 76″L X 35″D

Suggested Maintenance Intervals:

Replace NUVAIR 455* Lubricant: in R15	200 Hours or yearly
Replace Nuvair 546* Lubricant in EK76 Rotary Screw	2000 Hours or yearly
LP Filtration Elements	100 Hours or yearly

** Proprietary high-pressure FDA approved synthetic Lubricant.*

Typical Specification For Grade-D Air:

- O2 Percentage: 20-22
- CO2: 1000 PPM
- CO: 10 PPM
- Hydrocarbons: 25 PPM
- Odor: None

Membrane Technical Data:

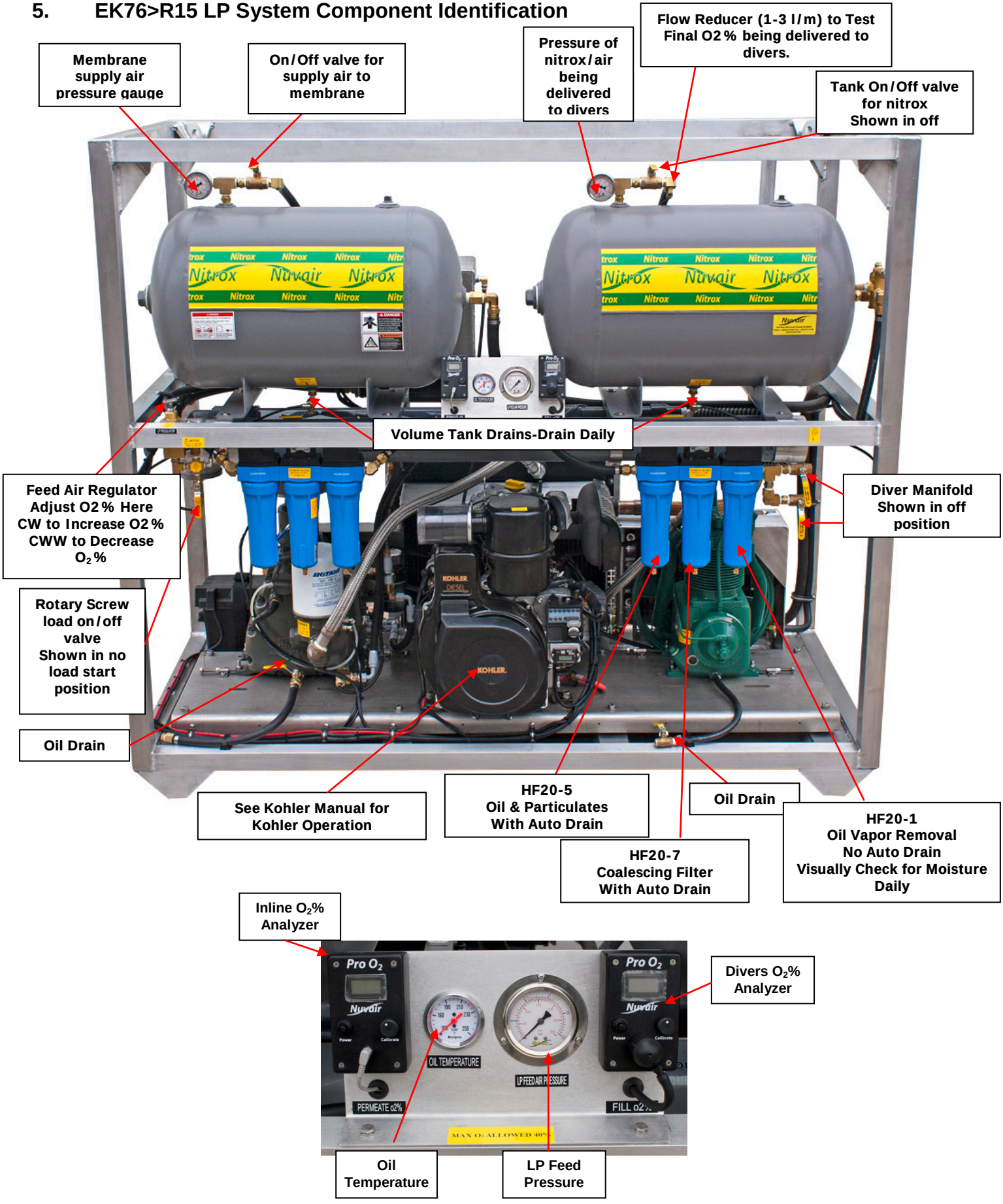
- Membrane Operating Temperature Range: 90-120 Fahrenheit
- Input Operating Pressure Range: 100 - 300 psi
- Input Gas Composition: Grade-D Air
- Input Gas Consumption: 20-34 SCFM
- Output Gas Delivery to nitrox Compressor: nitrox: 24% - 40%
- Lubricant: NUVAIR 455 & 546

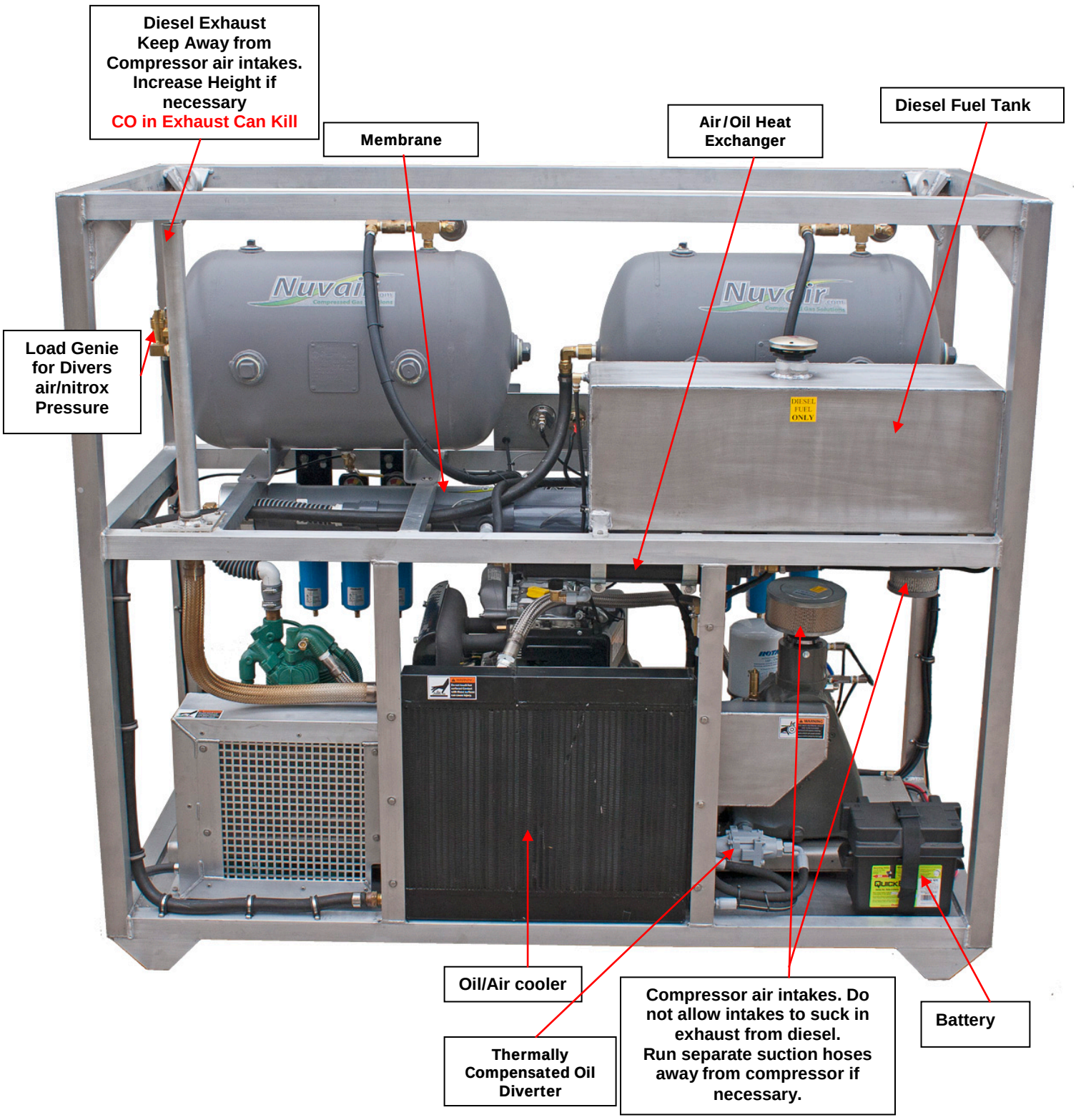
System Overview:

The **EK76>R15 LP** nitrox production system is a self-contained, portable, low pressure delivery package capable of supplying nitrox in oxygen percentages between 24% and 40% to the intake of the R15 compressor. The R15 compressor compresses this nitrox for the divers use.

The system utilizes two low-pressure compressors that are mounted together with 28.5 hp Kohler Diesel Engine and a permeable membrane in a rigid, aluminum frame. The system components include: BP pressure regulator, low pressure air filtration, gas stream temperature stabilizer (heater), permeable membrane, mixing tube, air intake filter, in line sensor/o2 analyzer, compressor intake porting and two low-pressure compressors. All of the component assemblies and parts are mounted to facilitate easy set-up, operation, and transport.

5. EK76>R15 LP System Component Identification




Diesel Exhaust
Keep Away from
Compressor air intakes.
Increase Height if
necessary
CO in Exhaust Can Kill
Membrane
Air/Oil Heat
Exchanger
Diesel Fuel Tank
Load Genie
for Divers
air/nitrox
Pressure
Oil/Air cooler
Thermally
Compensated Oil
Diverter
Compressor air intakes. Do
not allow intakes to suck in
exhaust from diesel.
Run separate suction hoses
away from compressor if
necessary.
Battery

Supply Air Pressure to Membrane

On/Off valve for supply air to membrane

Feed Air Regulator Adjust o2% Here CW to Increase o2% CCW to Decrease o2%

Rotary Screw load on/off valve Shown in no load start position

HF20-7 Coalescing Filter With Auto Drain

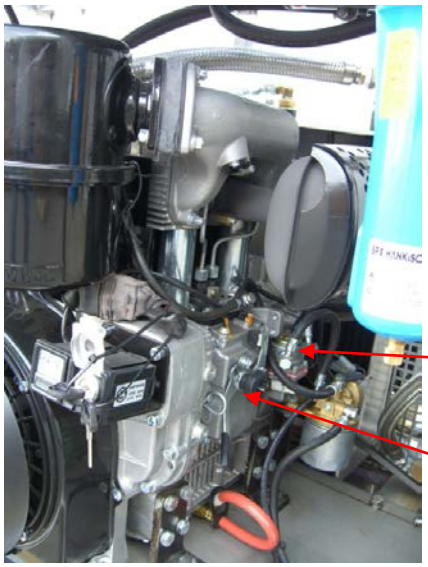
HF20-5 Oil & Particulates With Auto Drain

HF20-1 Oil Vapor Removal No Auto Drain Visually Check for Moisture Every 10 Hours

Divers air/nitrox supply Load Genie

Fuel Tank

Fuel Tank Sight Gauge



Diesel Throttle Control

Oil Level Dip Stick

6.0 Theory of Operation:

The EK76>R15 LP is a turnkey package that produces oxygen-rich air (nitrox) at low pressure of up to 200 psi for surface supply use to divers.

The nitrox System allows for efficient and cost effective nitrox production without the hazards or expense of blending with stored high-pressure oxygen (O_2). 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.

The nitrox System uses 2 x Low Pressure Compressors, 2 x Air Aftercoolers, 1 x oil cooler, 2 x Volume Tanks, 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. It is then compressed for surface supply to divers.

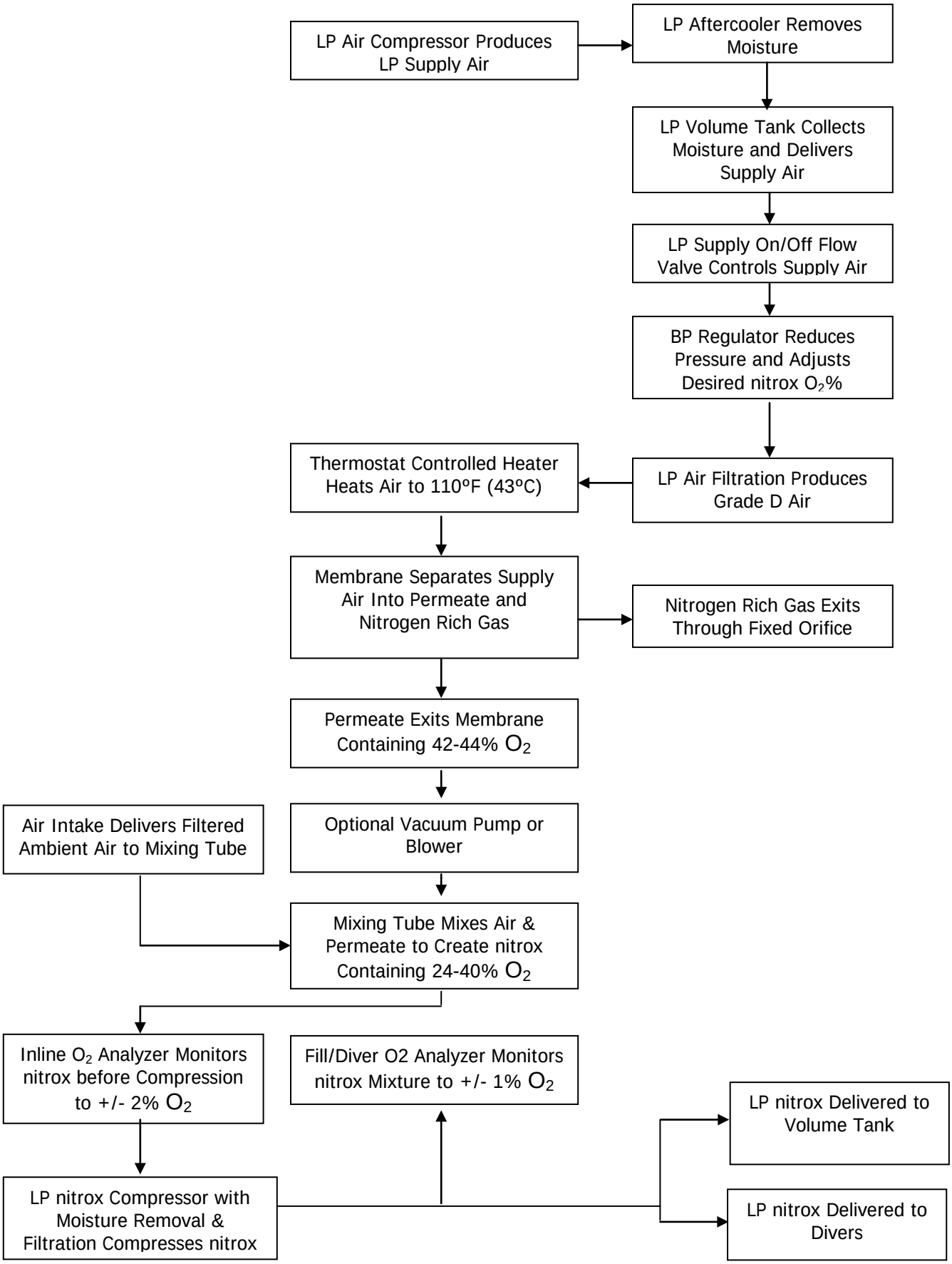
The Membrane System is rated for a maximum supply pressure of 300 psi (20 bar) and works well with the 185psi (13 bar) maximum pressure from the LP Supply Compressor. A Back Pressure Regulator controls the amount of air and therefore the pressure that is pumped by the EK76 Rotary Screw Compressor. The air is cooled, filtered and then 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.

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 42-44% O_2 under normal operating conditions.

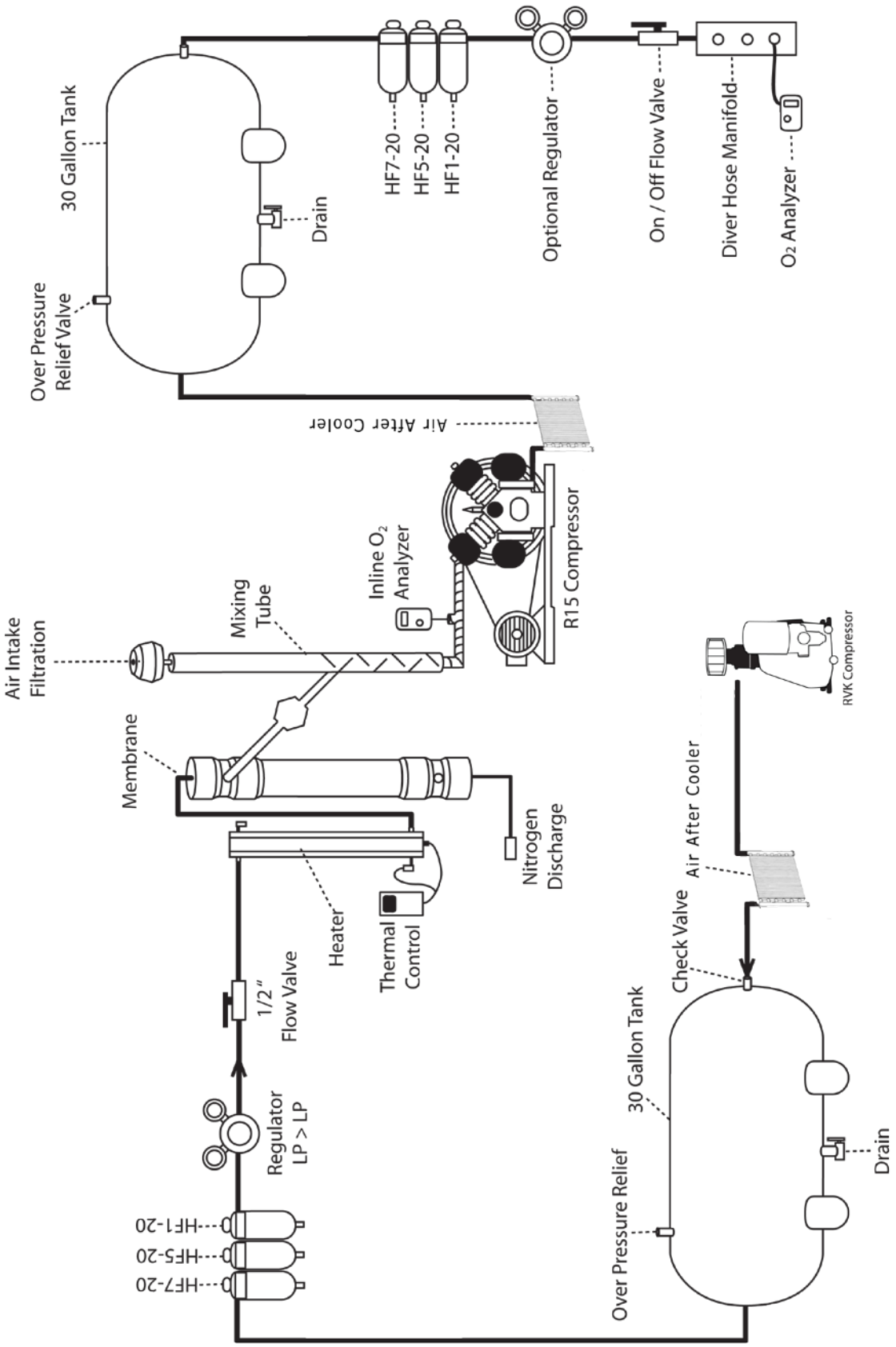
The permeate is a concentrated mixture that must be diluted with additional air prior to entering the nitrox Compressor. It exits the Membrane at ambient to slightly negative pressure and travels into the Mixing Tube, where it mixes homogeneously with filtered outside air. The amount of dilution, and thus final $\%O_2$, is obtained by adjusting the Back Pressure Regulator. As pressure is increased, permeate flow increases, air flow decreases, and a higher $\%O_2$ nitrox is produced. As pressure is decreased, permeate flow decreases, air intake flow increases, and a lower $\%O_2$ nitrox is produced. This relationship between permeate flow and air intake flow exists because the total of these two flow rates will always equal the intake flow rate demanded by the nitrox Compressor. The resulting nitrox mixture is analyzed for $\%O_2$ before entering the nitrox Compressor for approximate content and again when pumping nitrox for precise content.

A unique feature of Nuvair nitrox Systems is that the input pressure that correlates to a specific nitrox $\%O_2$ is repeatable. For example, if your nitrox Compressor pumps 36% O_2 when the input pressure is at 125 psi (9 bar), then adjusting the Regulator to 125 psi (9 bar) during the next use will produce the same mixture.

7.0 Membrane System Flow Chart



8.0 System Drawing/Schematic



⚠ Notice

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

9.0 Assembly Preparation:

1. First familiarize yourself with the components of the system in the first section of the LP>LP nitrox manual.
2. Please read and follow instructions in compressor manual.
3. Unpack the LP>LP nitrox System and remove from the pallet.
4. Visually inspect the system to make sure there has been no damage* during shipping.
5. Follow the remaining step by step instructions for initial set up and operation.

*If damaged, please call Nuvair to file a damage report. Please take photos and supply detailed information about the damage.

10.0 Set-up and Assembly

10.1 Power Connection

This package comes with a 12 volt battery for the Kohler electric start to function properly**.**
Red Is Positive! Connecting the wrong leads may damage circuitry.

A. Kohler Engine Operation:
See engine Manual.

10.2 Air Intake and Mixing Tube:

1) The LP>LP membrane system is supplied with two air intake locations. They are all female pipe thread to allow for remote intake locations.
2) The nitrox compressor air intake allows air to mix with the O_2 rich gas exiting the membrane permeate port.
3) The O_2 rich mix then passes by the inline sensor/analyzer where it is analyzed and an O_2% reading is supplied to the operator on the inline O_2 analyzer.
4) The gas then enters into the intake of the nitrox low-pressure compressor.
5) The O_2 % is determined by adjusting the BP regulator. Increasing the input air volume and pressure will increase the O_2%. Decreasing the input will lower the O_2 %. With no input pressure the compressor will be pumping air.

⚠ 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.

10.3 Oxygen Analyzer Mounting and Connections:

Two oxygen analyzers have been provided with your system. The analyzers are used to determine the oxygen percentages that you are producing.

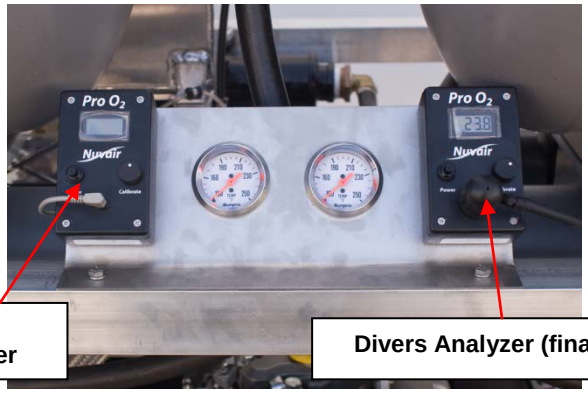
For more information see Pro O_2 manual in appendix.

A. The divers (final) analyzer is installed to supply a reading just before the divers air/nitrox manifold.

B. Calibrate the fill or divers air/nitrox (final) analyzer to 20.9% as follows:

Remove the fitting (cap) covering the sensor.

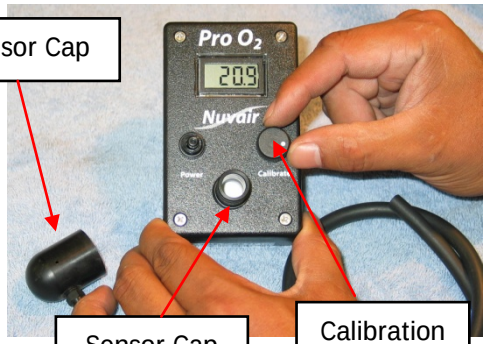
- Expose the sensor to ambient air for approximately (15) seconds.
- Adjust the potentiometer until the reading stabilizes to 20.9%.
- Reinstall the flow adapter cap to the analyzer.



The Final Analyzer Supplies the IMPORTANT READING.

C. Calibrate the inline sensor/analyzer while both compressors are running, pumping air and pulling fresh air across the sensor. (This is when the feed air On/Off ball valve is closed)

Adjust the potentiometer until the reading stabilizes to 20.9%. See O_2 manual.



⚠ Warning

Oxygen Analyzers must be calibrated before each use. See Oxygen Analyzer manuals for correct calibration procedures. Improper calibration of the Divers Supply (Final) 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. 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

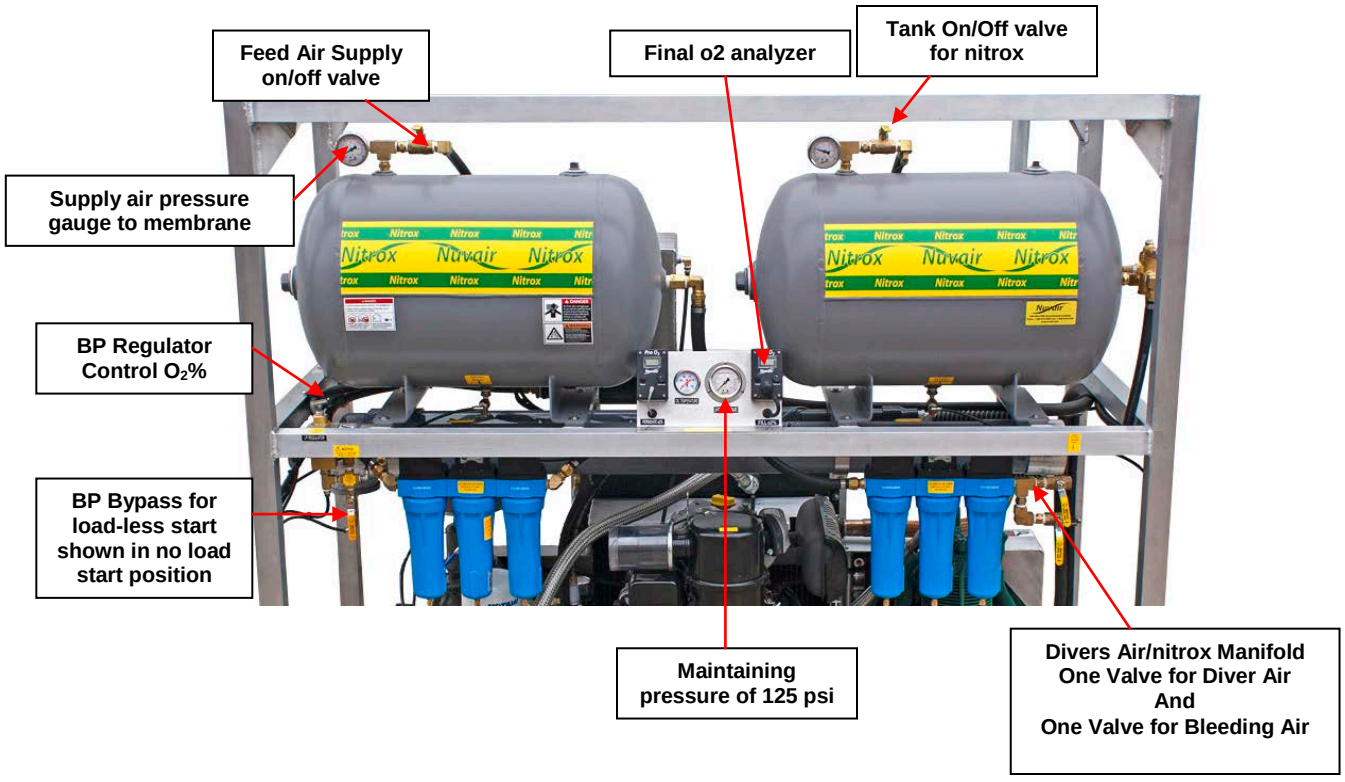
The Inline Oxygen Analyzer supplies oxygen readings that can vary +/- 2% O_2 due to heat, humidity, and pressure changes experienced in the nitrox flow and therefore should only be used for rough estimates of %O_2. The Inline O_2 analyzer could read 43% O_2 +/-2 when the nitrox compressor is unloading and not pumping nitrox. The Divers Supply (Final) Oxygen Analyzer supplies more accurate oxygen readings, within +/- 1% O_2

11.0 Operation

Once you have read through this manual, the compressor manuals, the diesel manual, the O_2 analyzer manual, made the necessary set-up connections, and you understand how the system functions; follow the steps below to operate the system:

1. Always check fluid levels before starting compressor and engine.
2. Close feed air supply on/off ball valve.
3. Set BP bypass for load-less start.
4. Open tank on/off valve for nitrox.
5. Start diesel as per instructions.
6. Warm for a few minutes.
7. Adjust throttle to run position.
8. Set BP bypass to run (load) position and turn off Feed Air Supply Valve**.**
9. Slightly open the ball valve on the diver Air/nitrox manifold, maintaining a pressure of 125 psi or more in the divers Air/nitrox volume tank and venting the remainder to the atmosphere.
10. While the compressor is pumping air through the divers manifold valve, calibrate both O_2 analyzers as per instructions in the Pro O_2 manual and on page 18.
11. Slowly open the feed air supply valve and then slowly turn the BP regulator control handle clockwise to increase O_2%. Watch the inline sensor/O_2 analyzer (page 18). Increase supply air pressure until the analyzer reads the O_2% desired. The air pressure must exceed 80 psi to activate the heater for the membrane.
12. The nitrox will slowly make its way through the compressor, volume tank, and filtration. Allow the O_2% to stabilize for 5-8 minutes.

Step 13 *Continued on next page*



⚠ 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 Nuvair. 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.

13. When both O_2 analyzers are within 1% of each other and O_2 analyzer is reading desired O_2 %.
14. Close the bleed manifold valve and open the divers manifold valve.

⚠ Warning

OSHA Regulations require an emergency backup source of breathing gas for the diver in case of an emergency or compressor malfunction.

15. Monitor compressor operation at all times. Note tank pressure on the first compressor; feed air input pressure on air going to the membrane, divers Air/nitrox tank pressure and O_2%.
16. During the dive, monitor both analyzers to ensure they stay within 1% of each other. Lightly fine tune the input pressure to get the exact desire O_2% on the final analyzer. The final analyzer indicates the O_2% going to the diver.This is the important reading. During the operation the analyzer sensor may warm slightly and require recalibration. Remove the cap and recalibrate as per the manual. The inline sensor will also warm and start to supply a reading that is higher than the actual O_2%. This sensor can only be recalibrated by turning off the air flow to the membrane while the compressor is running. This should never be done while divers are breathing the nitrox. During this period rely on the final O_2 analyzer reading. A third analyzer can be used to check the final analyzer's accuracy at any time by removing the cap from the final analyzer and attaching it to another analyzer.
17. After completion (shut down), close feed air ball valve.
18. Turn the bypass valve to the unloaded position.
19. Lower the throttle and allow for a cool down on the diesel engine before shutting down.

12.0 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 O_2 Analyzer supplies oxygen readings that can vary +/- 2% O_2 due to heat, humidity, and pressure changes in the nitrox flow and should only be used for rough estimates of %O_2. The Fill O_2 Analyzer supplies the accurate reading, within +/- 1% O_2. Use an additional o2 analyzer at the divers manifold.

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.

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 Nuvair.

Warning

Only provide nitrox to divers 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.

Notice

The Oxygen Analyzers may require re-calibration after 10-20 minutes of operation due to humidity and temperature change effects on the Sensor. To recalibrate, turn off the Membrane System On/Off Flow Valve and follow calibration instructions.

GAUGE	*RECOMMENDED SETTING*
Compressor Gauges	According to manufacturers recommendations
Heater Temperature	105-120^{o} F (40-49^{o} C)
Ambient Temperature	Less than 105 ^{o} F (40 °C)
Volume Tank Pressure	155-175 PSI (11-13 Bar)
Regulated Pressure to Membrane	80-185 PSI (6-12.75bar) depending on Nitrox O2%.
Fill Oxygen Analyzers	Showing the proper reading for intended fill
Nitrox Delivery Pressure	**DO NOT** exceed rating of tank or 175 psi

13.0 Operation Notes:

- Utilizes standard Hankison series 20 filtration

  Do NOT use any substitute.
- Bleed condensate drain on the volume tanks daily.
- Do NOT use this system to produce greater than 40% oxygen concentration.
- Use only NUVAIR 455 compressor lubricant in R15 piston compressor and Nuvair 546 in the EK76 Rotary Screw compressor. Do NOT substitute.
- Final discharge pressure is factory set. Do NOT alter setting.

13.1 Correlation of Input Pressure to Oxygen Content

After the 10 hour break-in period for your nitrox system, you will notice that specific nitrox O_2 percentages always match specific input pressures once the system has warmed up. These pressures will be repeatable. If you find that the fill oxygen analyzer reads 36% O_2 when the input pressure is at 125 psi (9 bar), record this pressure or make a mark on the input pressure gauge indicating the %O_2. Do this for each %O_2 that you normally make, making sure system has warmed up first. The next time nitrox with 36% O_2 is needed, adjust the regulator to 125 psi (9 bar) and wait for the oxygen analyzer reading to stabilize. You will find the analyzer reading to be very close to 36% O_2, requiring only minor adjustments of the regulator to achieve the exact desired %O_2.

⚠ Notice

Use the Diver Supply (Final) Oxygen Analyzer to verify the nitrox oxygen percentage prior to delivery to divers. 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.

14. Maintenance

14.1 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 system is located in an area where there is high humidity and high heat, the life of all Filtration Elements may be as little as 35% of rated operating capacity. Check the compressor manual and Appendix for details on Filter Element Life Factors.

1) R15 Compressor Lubricant: Change compressor lubricant after the first 100 hour break in period and every 200 hours thereafter on the R15. Only use lubricants rated for use with breathing Air/nitrox systems such as NUVAIR 455. Never mix Compressor Lubricants. See LP Compressor manual for details.
2) EK76 Rotary Screw Compressor Lubricant: Change after the first 100 hours and then every 2000 hours. Use only Nuvair 546 lubricant. The 546 lubricant is much thinner than the 455. Never mix.
3) 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.
4) LP Filtration Elements: Change LP Filter Elements every 100 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 14.3 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.
5) Semi-Permeable Membrane: No maintenance required. Service life exceeds 20 years if LP Filtration is properly serviced to maintain Grade D standards.
6) Membrane System Air Intake Filter: Inspect filter element every 3 months for visible particles. Change every 12 months or sooner if particles are visible.
7) 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.

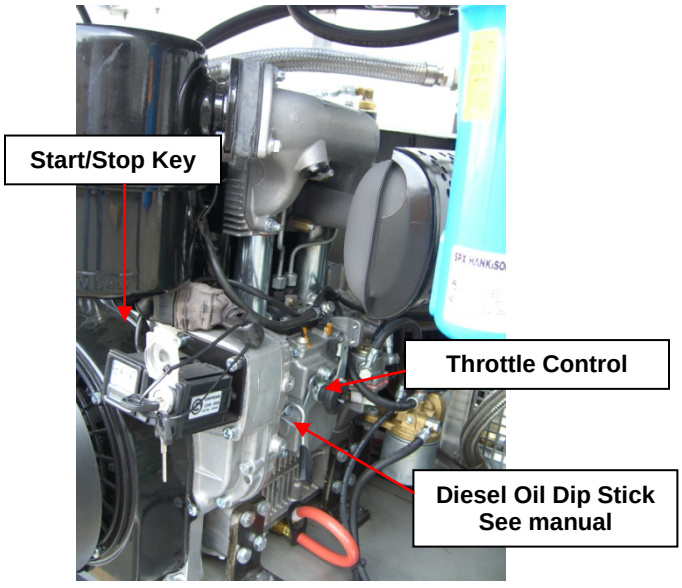
⚠ Danger

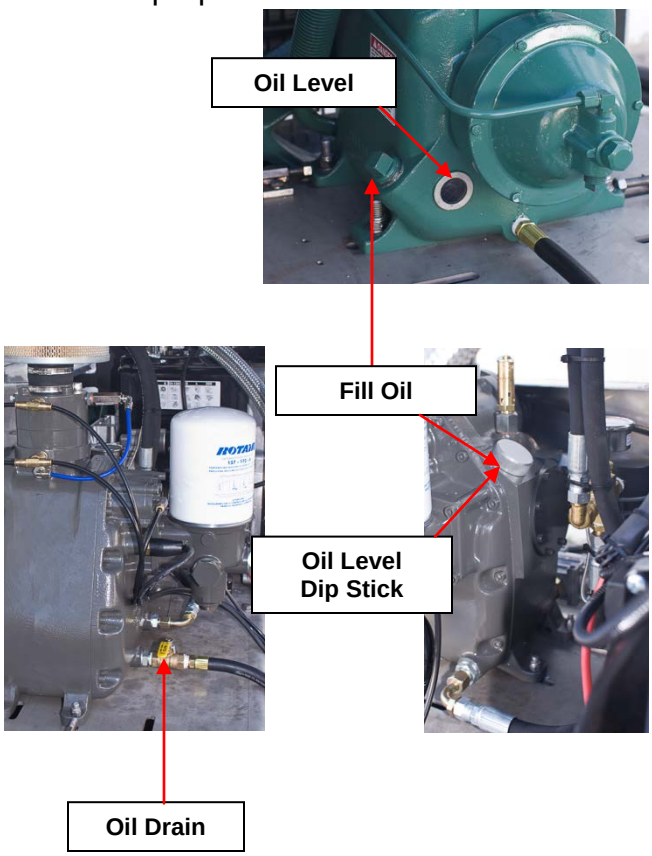
If after handling the Oxygen Analyzer or Sensor, you find that your fingers or other parts of your body feel "slippery" or the skin or eyes sting, immediately flush affected area with clean, fresh water for at least 15 minutes. The stinging or slippery sensation is an indication of a leaking Sensor. 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.

14.2 Compressor Lubricant:

Change R15 with NUVAIR 455 nitrox rated lubricant every 200 hours or minimum once per year.
Change EK76 oil with Nuvair 546 every 2000 hours or once per year.
Do not mix brands.

1) Check oil and diesel levels before operation.
2) Drain Volume tanks daily. Check filters for moisture daily.
3) Start and warm to operating temperature before nitrox preparation.





Refer to Supplied Engine manual for proper oil and maintenance.

⚠ 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

14.3 LP Filtration

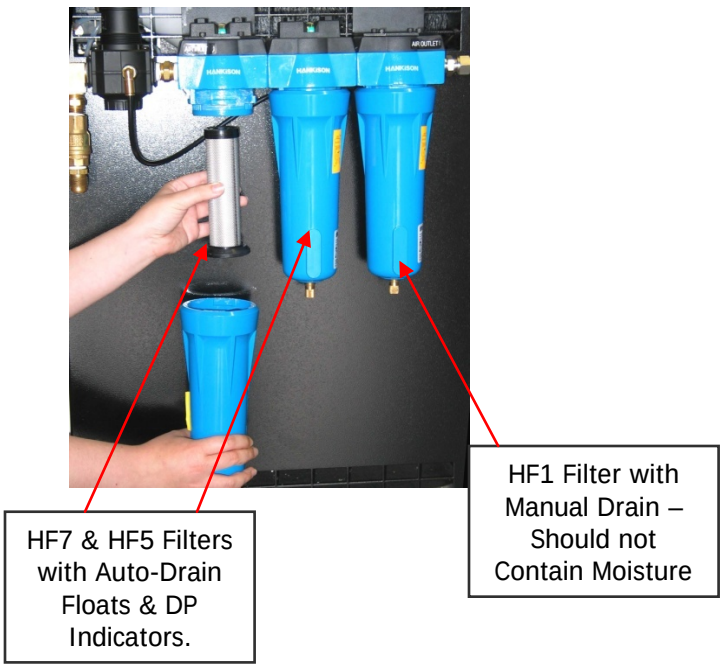
The use of Grade D or better supply air is critical to prevent the passing of any residual oil vapor into the Membrane System. Three stages of Hankison LP filtration are used to produce Grade D air:

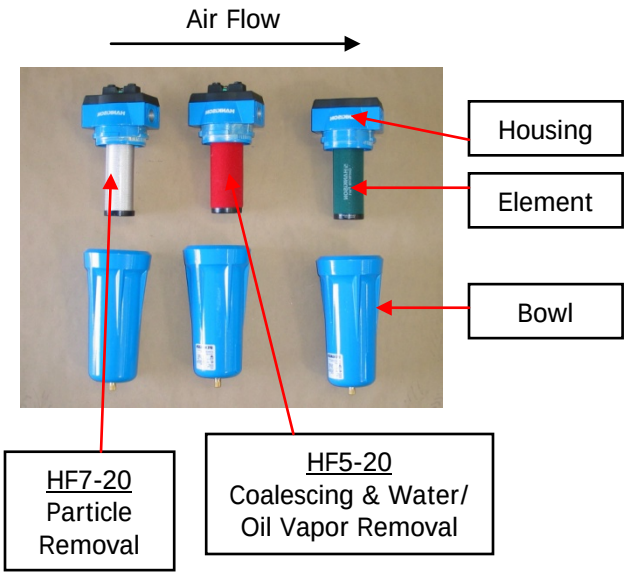
1) Particle Removal to 1 micron
2) Coalescing & Water/Oil Vapor Removal to 0.01 micron
3) Oil Vapor Removal to 0.003 PPM

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 Nuvair for assistance.



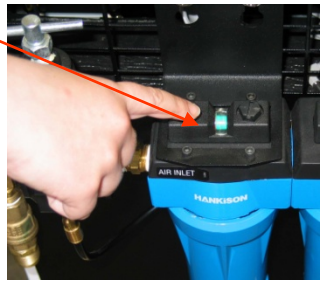


Changing Filtration Elements

Change Filter Elements every 100 hours or once per year. 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.

DP Indicator Changes from Green to Red. Yellow indicates filter needs to be replaced. Do Not Use When Red.



⚠ Notice

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

14.4 Spare Parts List

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

nitrox System Components	Type	Part Number
Compressor Lubricant, Food Grade	Nuvair 455, 1 Gal (Other Sizes Available) Nuvair 546, 1 Gal	9406 9409
LP Filtration Element	Hankison HF 7-20	E7-20
	Hankison HF 5-20	E5-20
	Hankison HF 1-20	E1-20
Heater Thermostat Control		
Heater Pressure Switch		B16-947
Membrane	1 x 250 Series	
Air Intake Filter Element		FT-14-100
Mixing Tube Assembly	2 inch diameter, specify length	
Oxygen Analyzer	Pro O_2	9450
	Pro O_2 Remote Panel Mount	9452
Oxygen Sensor	See Analyzer Owner's Manual	
Compressor Hose Coupler	1-1/4"-1-1/2" to 1-1/4"-1-1/2"	018578000476
	1-1/4"-1-1/2" to 1-1/2"	RDTC40X32
	Related Equipment Components	
Air/nitrox Quality Analysis Kit	Specify: (1) CGA Grade Required	
	(2) Single Use or Program Use	

14.5 Service Record Log

Date	Technician Name	Service Performed
Date	Technician Name	Service Performed

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/m3	5 mg/m3
Odor	None	None

Notes: (1) Dew Point of supply air must be >10^{o}F (6^{o}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% O_2 of the specified value of the mixture using a properly calibrated Oxygen Analyzer (i.e. nitrox produced with a target content of 32% O_2 must measure in the range of 31-33% O_2). 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 80ºF at the filter inlet. Under normal operation this temperature is 12ºF (5ºC) warmer than the ambient air, resulting in an equivalent ambient temperature rating at 68ºF (20ºC).

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
53ºF (12ºC)	41ºF (5ºC)	2.6 x Life
62ºF (17ºC)	50ºF (10ºC)	1.8 x Life
71ºF (23ºC)	59ºF (16ºC)	1.35 x Life
80ºF (27ºC)	**68ºF (20ºC)**	**1 x Life**
89ºF (32ºC)	77ºF (25ºC)	0.8 x Life
96ºF (36ºC)	84ºF (29ºC)	0.55 x Life
105ºF (41ºC)	93ºF (34ºC)	0.45 x Life
114ºF (46ºC)	102ºF (39ºC)	0.35 x Life

OWNER'S WARRANTY RESPONSIBILITIES

Failure of the owner to prevent equipment damage by complying with the procedures outlined below and in the User 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 psi 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 service record books 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.

Additional Record of Changes

It is the responsibility of the owner of this product to register their ownership with Nuvair by sending the warranty card provided to Nuvair. This card is to establish registration for any necessary warranty work and as a means of communication that allows Nuvair to contact the user regarding this product.

The user must notify Nuvair of any change of address by the user or sale of the product. All changes or revisions to this manual must be recorded in this document to ensure that the manual is up to date.

Change Date	Description of Change
09012012	**Replaced half frame pictures with full frame pictures**
07/18	**Revised with EK76**

Nuvair
Phone +1 805 815 4044
Fax +1 805 486 0900
1600 Beacon Place
Oxnard, CA 93033 USA
info@nuvair.com
www.nuvair.com
REV: 07.18