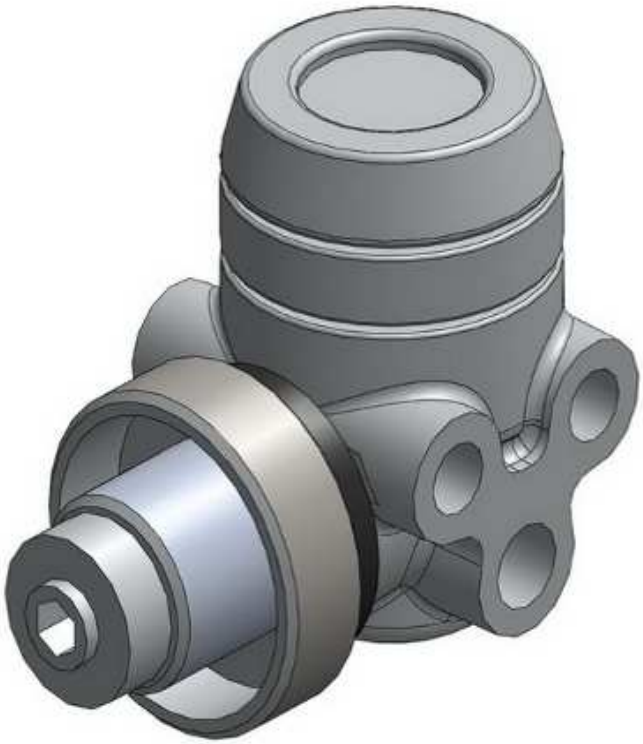
# Apollo A-320 NITROX and A-320 CMF First Stage Regulators

## USER MANUAL



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## 1. Introducing your Apollo A-320 first-stage regulator

Open Safety Limited have chosen Apollo A-320 first-stage regulators to supply with their rebreather products. The Apollo A-320 is one of the most expensive first-stage regulators available: it is a top class, high performance valve, with a long history, made with Japanese attention to quality. It provides high flows with excellent pressure control, even in the most demanding applications.

We are confident that Open Safety customers will find that the performance of the Apollo A-320 first-stage regulators exceeds their every expectation.

Apollo have been little known in Europe until recently, but are well known in Asia, and known for quality. All Apollo regulators have been designed and manufactured with pride, according to standards which meet or surpass all requirements for the BS EN ISO 9001:2000 quality control system. The A-320 Nitrox and CMF models comply in full with every EU requirement for respiratory equipment and are CE certified.

The A-320 has excellent oxygen compatibility, withstanding oxygen surge tests at the German Materials Institute, BAM, to 360 bar. The valve seat is a PTFE film with very low mass, on a bronze seat, within a nickel plated bronze housing. Bronze, Nickel and PTFE are highly oxygen compatible. The lubricant is Gleitmo 599, which has the highest oxygen compatibility of any lubricant, passing surge tests at four times the pressure of other lubricants in common use with oxygen regulators. All O-rings are Viton.

As well as the general quality of its design and manufacture, the A-320 stands out for its the ideal hose routing it offers and for being the lightest regulator valve available on the market.

There is one model for Open Circuit use, and for general use, such as on the rebreather make-up-gas cylinder: the **A-320 Nitrox**. This is a compensated balanced regulator.

There is another model for Constant Mass Flow rebreather use only: the **A-320 CMF**. This must not be used for Open Circuit or general use: it is an absolute pressure (non-pressure compensated) balanced regulator specialty for use with rebreather oxygen dosing units that use a constant mass flow principle. The A-320 CMF must not be dived deeper than 80m, and should be set to provide at least 11.5 bar intermediate pressure on the surface.

This Operating Manual gives you essential information you on how to fit your A-320 regulators, how to use them safely and care for them correctly.

Please take time to read and understand this entire Operating Manual. Should you have any difficulties or questions that cannot be solved with the help of the Manual, please contact us at

## 2. Get your regulators serviced at least annually

All mechanical items wear, and this is especially so for items exposed to a marine environment.

However well you have cared for your regulators, it is essential that you have them professionally cleaned and serviced by an Apollo-approved service centre at least once a year, and more frequently if they have had more than average use.

As well as knowing what you can and must do to care for your regulators, it is also important to know what you must not attempt to do yourself. The Apollo A-320 regulator is a highly delicate, precision instrument and it is vital that it is not tampered with by anyone who is not a highly-trained, Apollo-approved technician. All assembly, maintenance or repair tasks must be performed by such a technician. Do not ever attempt to service or repair your regulators yourself. This is NOT the A-320 Service Manual.

## 3. General and Special Purpose Models

Once again, there are two models of the A-320 that are CE certified: The A-320 Nitrox and the A-320 CMF.

### 3.1 The A-320 Nitrox regulator

The A-320 Nitrox is a general purpose open circuit first stage regulator for use with approved second stages DSVs (Diver Supply Valves), and is suitable for use with Nitrox, Heliox and Trimix, or even with up to 100% Oxygen. **The Nitrox model is suitable for open circuit diving and for general rebreather use, but NOT for rebreather constant mass flow oxygen dosing.**

The A-320 Nitrox is suitable for use with rebreathers for connection to the Make-Up gas or Bail-Out gas cylinders. Their purpose in these applications is to ensure that the pressure of gas delivered from these cylinders remains constant relative to the diver's environment, while increasing relative to the surface as the diver's depth increases. The A-320 Nitrox has a clever Adaptive Compensation feature to get the most out of your second stage regulator, your DSV,

The A-320 Nitrox regulator is available in G5/8 and M26 DIN type fittings, depending on application.

### 3.2 The A-320 CMF regulator

**The A-320 CMF regulator is for use ONLY for connecting the oxygen cylinder to the rebreather oxygen injector on rebreathers that work using a Constant Mass Flow principle.**

The purpose of the CMF model is to ensure that the same outlet pressure of oxygen is always provided, regardless of the ambient pressure. This means that it provides a pressure that reduces with respect to the diver's environment, as the diver goes deeper. The A-320 CMF, like any other absolute pressure regulator, must not be stored in a saturation diving environment.

The only application of an Absolute Pressure diving regulator is for fixed or variable orifice injectors. The A-320 CMF regulator is only supplied with rebreathers.

**As it is imperative that the two types of regulator do not get mixed up, the A-320 CMF absolute pressure regulator always has an M26x2 300 bar inlet thread, which is incompatible with most Open Circuit gas cylinders, but in Europe Nitrox cylinders may also be M26 so take care.**

## 4. Pressure and temperature limits

Both the A-320 Nitrox and A-320 CMF regulators are limited to use in water from 4C to 40C, and in air up to 60ºC. They are limited to 300bar supply pressures. If you plan to dive in water below 10ºC, you must have undergone specialised cold water diving training from a recognised agency before using these regulators. Please contact Open Safety if you require more information.

## 4. Environmental sealing system

The Apollo A-320 regulators feature an environmental sealing system. In the A-320 Nitrox an external diaphragm seals the ambient chamber from the surrounding water when submerged, while an adjustable piston transfers ambient water pressure to the internal diaphragm. In the A-320 CMF model, the chamber is sealed. This sealing allows the regulators to be used down to at least 4C. Do not use the regulator if the seal is broken, for example, if there is water or condensate inside the compensating diaphragm visible from outside the regulator.

## 5. General Safety

**Always inspect dive equipment before use and never dive with any equipment you suspect to be damaged or faulty!**

The A-320 Nitrox and CMF regulators are labelled with the necessary information according to the respiratory equipment standard EN 250:200/A1:2006. This standard is for one diver breathing from a regulator: it does not cover use where two divers share one regulator (Octopus use).

Four LP 3/8UNF and 2 HP 7/16 ports are provided.

The A-320 regulators are for use only by divers that have completed a recognised diver training course, commensurate with the type of diving planned. Diving is an inherently dangerous activity, and the diver must plan and train for conditions that include failure of the regulator to supply gas, or over-supply of gas by the regulator: all mechanical systems are guaranteed to fail eventually and the diver has sole responsibility to check the regulator before each use, have it serviced at appropriate intervals, to practice bail out procedures.

Install and operate the Apollo A-320 1st stage regulator as well as the accessories only in perfect condition taking into account this entire Operating Manual.

Ignoring these instructions or good practice such as by use of incompatible lubrication, or exceeding the limit values for pressure or temperature, or applying additional mechanical loads can result in failure of the regulator to supply sufficient gas flow or pressure, or may provide excessive flow or pressure, it may cause an oxygen fire or expose the user and those in the vicinity of the regulator to these and other potentially fatal and destructive hazards.

## 4.0 Inspection

When you unpack your A-320 first-stage regulator, inspect the components carefully to ensure that you have received all the parts listed in the assembly instructions. Make sure that no component has been damaged in transit.

When you connect your regulator to a gas cylinder, make sure that you do not over-tighten it and that the thread has engaged correctly.

## 5. Oxygen Lubricants

All O-rings should be lightly lubricated. The ONLY lubricant approved for use with high pressure oxygen for the A-320 is: Gleitmo 599 high intensity lubricant for oxygen service, manufactured by Fuchs Lubritech GmbH, Hans-Reiner-Straße 7-13, D-67685 Weilerbach. Tel +49 (0) 6374 / 924-800 OSEL can supply this lubricant on request. All O-rings should be lightly lubricated with Gleitmo 599.

Gleitmo 599 is a innovative special lubricant based on a special perfluoropolyether base oil which is concentrated with a special combination of white solid lubricants. The special feature of gleitmo 599 is an oxygen surge tolerance up to 450 bar.

**Note: Do not mix Gleitmo 599 with other lubricants!**

Gleitmo 599 Features:

- BAM (German Federal Inst. for Materials Testing) approval for gaseous oxygen up to 450 bar at 60℃
- BAM approval for use with liquid oxygen
- temperature range for use: -40 / +250 ℃
- highest resistance to oxygen of any lubricant tested
- excellent lubricating performance
- exceptional thermal resistance and non-flammable
- very good compatibility with plastics, elastomers and rubber

- largely resistant to aggressive gases and chemicals
- expert´s report about physiological harmlessness in respiratory equipment available
- registered under NSF-H1

## 6. O-RINGS

Only VITON O-rings and original spare parts are to be used in the servicing of the Apollo A-320 1st stage regulator. Low pressure ports use 70 durometer O-rings, and high pressure ports use 90 durometer O-rings

Inspect O-rings for any nicks, cuts, sets (flattening), or other damage, every time a port is opened.

To protect the regulator from exposure to contaminants in non-oxygen clean conditions, keep the A-320 in a sealed bag unless all ports are plugged with hoses or port plugs.

## 7. Maintenance and Cleaning

Prior to any work on the regulator, read and observe the safety instructions.

Ensure prior to work that the regulator is completely free of pressure.

**WARNING: Working on valves under pressure can be fatal !**

All components brought into contact with gases have to be kept free of oil and grease.

As soon as possible after diving, especially if exposed to a maritime or chlorine environment the regulator should be rinsed thoroughly with fresh water while attached to a cylinder and pressurised with gas, then dry it.

## 8. Removing the Regulator from the Cylinder Valve (DIN and M26 thread)

1.) Turn off the cylinder gas supply by turning the cylinder valve handle clockwise until it stops.

2.) While observing the submersible pressure gauge, depress the purge button of the ALVBOV, second stage or 1st stage pressure relief valve. When the gauge reads zero and airflow cannot be heard exhausting, release the purge button.

3.) Turn the 1st stage handwheel anti-clockwise to loosen and remove the 1st stage from the cylinder valve.

4.) Ensure that the threads are clean, o-ring is still located. Screw on a cap to protect the 1st stage threads and insert a plug to protect the cylinder valve threads.

## 9. Attaching the Regulator to a Cylinder Valve (DIN or M26 thread)

To attach the Apollo A-320 regulator to a cylinder valve, follow these steps:

1.) Remove the threaded protector cap and plug from regulator and cylinder valve.

2.) Position the 1st stage so that the hose routing is correct. If required, the cylinder may need to be secured correctly first. Thread the 1st stage connector into the cylinder valve and tighten the handwheel by hand. Do not use tool to tighten this to the cylinder valve.

3.) If a submersible pressure gauge is attached to the 1st stage, ensure the gauge is facing away from you. Protect your eyes. Pressurise the regulator by slowly opening the cylinder valve handwheel. Continue to turn the cylinder valve handwheel until fully open, and then turn back half a turn to prevent the valve locking fully open due to thermal contraction as the valve cools.

4.) Check for leaks by listening to the thread connection. If required use a spray bottle of soapy water or by submerging in water to localise the location of the leak. Once location detected replace the faulty o-ring if required with the correct Apollo O-ring.

Always open the cylinder valves slowly and let the 1st stage pressurise slowly. Rapid pressurisation causes adiabatic compression of the breathing gas, which generates heat inside the 1st stage. Heat, along with oxygen and an ignition source (from contamination) are the ingredients that can cause combustion.

## 10. Relief valves

Safety valves serve as a system protection against exceeding the maximum service pressure through high pressure seat failure. Therefore, they have to be treated and installed very carefully.

Typically the connection of a downstream second stage will serve as a pressure relief, but if one is not fitted then a dedicated relief valve is to be fitted to a LP port.

## 11. Pre-Dive Inspection Checklist

1.) Carefully inspect all hoses at termination to ensure they are sealed into their respective ports on the 1st stage with no o-rings protruding.

2.) Visually inspect the 1st stage regulator for signs of any damage.

3.) Closely inspect the external sealing diaphragm for any signs of damage or deterioration that may cause creep or flooding. Check to ensure that the retainer which holds the external diaphragm in place is tightly secured. If this is loose then use the correct Apollo tool to securely tighten. If damaged, then the 1st stage requires servicing as the regulators performance may be compromised and 1st stage freeze-up or change in the quantity of gas supplied with depth could vary.

4.) Connect the 1st stage regulator to a fully charged gas cylinder G5/8 or M26 threaded as applicable. SLOWLY open the cylinder valve to pressurise the regulator. Continue turning the valve anti-clockwise until it stops and then turn half a turn back to confirm open, but prevent the valve jamming open.

5.) Listen near the 1st stage to check for any leakage. If leakage is suspected, use a spray of soapy water or submerge in water to localise the leak.

6.) If leakage is detected, depressurise regulator and replace the o-ring identified as the point of the leakage prior to re-pressurising.

7) If leakage continues, then the regulator and the second stage DSV must be serviced by a certified technician before use.

8) If difficulty in breathing from the regulator is experienced, then the regulator and the second stage DSV must be serviced by a certified technician before further use. Mark the regulator to prevent use.

## 12 Repair

Where repair is required, following failure this is to be communicated to support@opensafety.eu at the earliest opportunity, inclusive of disclosure of the serial number of the HP seat and the batch codes on the medium pressure diaphragm.

## 13 Storage

Clean the regulator before storage.

During storage, protect the regulator from external effects and dirt. Protect the connection openings to prevent entry of dirt.

The storage room should be dry and dust-free. Storage temperature must be frost-free up to +25℃. Store spare parts so that they are not expos ed to sunlight or UV light from other sources.

## 14 Packaging and Transport

Pack the regulators so that any accessories such as threads or o-rings cannot be damaged through subsequent transport. Protect connection opening to prevent the entry of dirt.

Protect the regulators against external force such as shock, impact, vibration etc. during transport.

Protect existing sealing surfaces on the connections from damage.

## 15. Disposal

Observe the valid legal regulations for appropriate disposal protecting the environment. Recycle metals where facilities exist. There are no toxic metals in the A-320.

## 16. Warnings

**WARNING:**: this regulator, like all EN 250 regulators, are not intended for more than one user to breathe from at the same time.

**WARNING:**: if SCUBA is configured and used by more than one diver at the same time, then the cold water and breathing performance may not fulfil the requirements of EN 250.

**WARNING:** IF THE REGULATOR HAS A GREEN DIAPHRAGM CAP, THEN IT IS AN A-320 CMF MODEL WHICH IS AN ABSOLUTE PRESSURE REGULATOR. ABSOLUTE PRESSURE REGULATORS MUST NOT BE USED FOR OPEN CIRCUIT DIVING. ONLY COMPENSATED REGULATORS HAVING A CLEAR OR BLACK DIAPHRAGM CAP SHOULD BE USED FOR OPEN CIRCUIT DIVING, NAMELY THE A-320 NITROX model.

**WARNING:**: The whole of this manual must be read before use, and use of this regulator is subject to the limits indicated in this manual. The A-320 regulator is for use by trained divers only, having a current diver medical.

**WARNING:**: Diving is inherently hazardous. The user is responsible for inspecting, servicing and using the regulator with appropriate hazard management, and planning to cover risks of insufficiency of gas supply, over provision of gas supply and other risks as set down herein.

## 17. Information supplied by the manufacturer

The following information is supplied for trained and qualified users:

Application: Diving by trained divers who are medically fit, in open circuit diving (A-320 Nitrox model only) and rebreather oxygen dosing systems using the Constant Mass Flow principle (A-320 CMF model only).

Maximum depth of equipment certification: For EN250 maximum depth is 50m on Air, and for use in EN 14143:2003 certified rebreathers to 40m on Air and 100m on Heliox.

Breathable air supply through the A-320 1st stage regulator shall meet the requirements for breathable air according to EN 12021. It is particularly important to ensure that gas is dry and has a dew point below -54C if it is to be used in temperatures below 10C. Protect all hoses and ports from water ingress.



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