

AQMS-100
Zero Air Generator
User Manual

Preface

User Information

We are grateful for your choice of zero air generator, AQMS-100. Prior to using the AQMS-100, please read the user manual carefully. This manual contains all important information and data explaining how to operate the instrument, and the user must strictly comply with them to ensure a normal operation of AQMS-100.

Overview

This manual elaborates on the operation and maintenance of AQMS-100; meanwhile, it describes the working principle, structural composition and performance feature of AQMS-100. This manual is a guide book for trained technicians or any users who have knowledge of instrument operation (for example, automation technology).

Main contents of this manual are shown as follows:

Chapters	Contents
1. AQMS-100 Overview	It mainly describes the working principle, technical indices and precautions for use of AQMS-100.
2. AQMS-100 Construction	It mainly describes the structure and appearance of AQMS-100.
3. AQMS-100 Installation	It mainly describes the process and precautions for installation of AQMS-100.
4. Daily Maintenance and Storage	It mainly describes the work for maintenance of AQMS-100.
5. FAQ and Troubleshooting	It mainly describes frequently asked questions (FAQ) and diagnostic methods in operation of AQMS-100.

It is impossible for this manual to provide detailed description for each product model due to many practical reasons; please contact with Customer Service Department for help if you want to acquire further relevant information or solve questions that are not involved in this manual.

Executive Standard

The generator is compliant with the Enterprise Standard for Zero Air Generator Q/ 38-2012.

Warnings, Cautions and Notes

Safety standard is always put as top priority in every procedure all through the development,

manufacture, test, and archiving. In order to ensure personal safety and avoid property loss in using and maintaining the product, this manual incorporates relevant notes, cautions and warnings, which are shown by specific icons together with corresponding explanatory text. The meaning of Warning, Cautions and Notes signs is clarified as below.

Sign	Clarification
	NOTES: Alert the user to pertinent facts and conditions.
	CAUTIONS: Hazards which will result in equipment or property damage.
	WARNINGS: Hazards which will result in personal injury or death.

Warranty and Maintenance

Specific warranty and maintenance terms please refer to the clauses on the contract.

Within the warranty period, we will provide free maintenance services including product maintenance, maintenance and replacement of spare parts, technical supports and routine field services, etc.

Some malfunctions, if when they occur within the warranty period, would be charged. These malfunctions include but are not limited to:

- 1.) Misoperation (leading to water immersion, corrosion, fire, connecting in series with strong current, etc.);
- 2.) Damage caused by force majeure (earthquake, lightning strike, flood, etc.);
- 3.) Unauthorized internal product modification;
- 4.) Operation against the user manual or training instructions, leading to product damage.

Products developed and manufactures by shall be disposed in strict accordance with national stipulations with respect to disposal of waste products.

Legal Statement:

bears no legal liability for users in regard to the contents of this manual. Please refer to the legal clauses in corresponding contract.

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1 AQMS-100 Overview

1.1 Introduction

The air monitor of automatic air quality monitoring system shall be calibrated periodically to keep accuracy and precision, and the calibration is implemented by injecting standard into the instrument. When calibrating instruments with standard, zero is essential for calibrating the zero point.

Zero air generator AQMS-100 developed are mainly used for calibrating zero point of urban ambient air quality monitor and indoor ambient air quality. AQMS-100 has such advantages as stable flow, low dew point, dry and clean of zero, as well as easy to operate.



Figure 1-1 Zero Air Generator AQMS-100

1.2 Working Principle

AQMS-100 consists of air compressing and cooling system, water removal system, HC/CO removal system, NO reaction system, NO₂, O₃, SO₂, H₂S and NH₃ removal system, and final particle removal and zero output system; its circuit is shown as Figure 1-2.

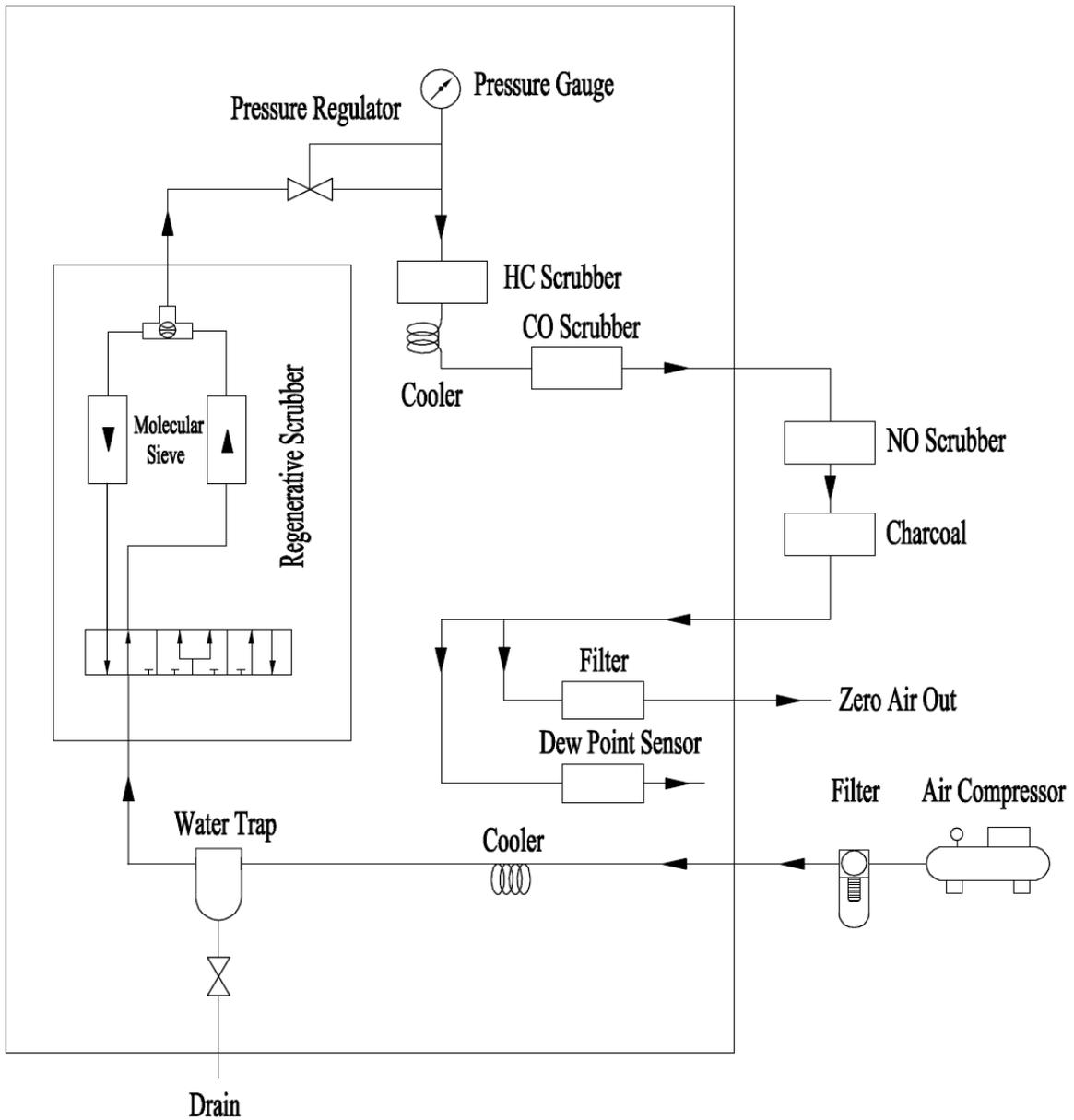


Figure 1-2 Circuit of AQMS-100

1.) Air compressing and cooling system

Air coming from air compressor has relative high pressure and humidity. When the air with high humidity passes through copper pipes of the cooler, the heat is taken away by the cooling wind, resulting in the air temperature decrease. Under such conditions as high pressure and low temperature, the relative humidity of air will reach the highest value, which meets the oversaturated state under normal atmosphere conditions.

2.) Water removal system

Liquid air in the oversaturated air is separated from the air by the water removal filter. The water separated is drained out from a solenoid valve, which is opened for 5s of water discharge once every 30 min. Passed through the water removal filter, the air enters into the regenerable scrubber, which is used for further removing excess water in the air. The regenerable scrubber consists of two paratactic cartridges with molecular sieves, one three-position five-way valve and one shuttle valve. The two cartridges with molecular sieves are working alternatively; specifically, when one is washing the air, the other is regenerating to get ready for next air washing.

When AQMS-100 is started up, the three-position five-way valve will guide the high-pressure air through one of the two cartridges, while the other cartridge is connected with atmosphere. After passing through the first cartridge, the molecular sieves can remove almost all excess water to export dry air. A part of the dry air passes through the shuttle valve into the second cartridge. Since the second cartridge is connected with atmosphere, the dry air entering into the cartridge will expand immediately to become a very large volume, leading to the quick decrease of relative humidity; as the air is blown into atmosphere immediately, the water in the cartridge is taken away by the air, thus the molecular sieves are regenerated. The two cartridges with molecular sieves work alternatively, taking a turn every two minutes.

Because the two cartridges with molecular sieves are working alternatively, namely, when one is removing water and the other is regenerating, it is not necessary to replace molecular sieves.

3.) Reaction system for removing HC/CO

The system can change slight hydrocarbons in air into CO₂ and H₂O and change CO into CO₂ under the action of catalyst at the reaction temperature of 360°C. The system consists of an outer cover, in which there is a high-temperature reaction chamber with granular noble-metal catalyst in the reaction chamber is heated by a heater with thermocouples and filled with heat insulation material externally.

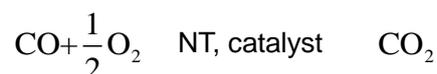
Its reaction principle is as follows:



4.) Reaction system for removing CO

The system can change slight CO into CO₂ under the action of catalyst at normal temperature.

Its reaction principle is as follows:



5.) Reaction system for removing NO

The system can change NO in air into NO₂ under the action of Purafil oxidizing agent at room temperature. Purafil oxidizing agent is exclusively used to change NO into NO₂. Purafil oxidizing agent has a limit service life; normally, it is purple and it should be replaced when it becomes yellow-brown.

Its reaction principle is as follows:



6.) System for removing NO₂, O₃, SO₂, H₂S and NH₃

The system uses activated carbon to remove NO₂, O₃, SO₂, H₂S and NH₃. The activated carbon must be replaced once every 6 months. When the contents of these gases are high in air, the service life of activated carbon will be shortened. The first consideration shall be to replace the activated carbon if the signal measured is changing obviously when zero is used to calibrate the instrument.

7.) Particulate matter removing and zero output system at final stage

The particulate matter removing system at final stage is used to filter off fine particles in zero and the accuracy of the filter is 5 μm.

1.3 Technical Index

Table 1-1 Technical index of AQMS-100

Item	Index
Output	20 SLPM, under 30 psig
Dew point	< -30 °C
SO ₂	< 0.025ppb
NO	< 0.025ppb
NO ₂	< 0.025ppb
O ₃	< 0.3ppb
CO	< 0.01ppm
CH ₄	< 5ppb
NMHC	< 0.25ppb
Air compressor	Externally installed
Installation	Desk type
Working temperature	(0~40) °C
Power supply	220~240 V AC/50 Hz
Dimensions	222mm(H) x 482mm(W) x 561mm(D)

1.4 Precautions for Use

- Power supply shall be safe and stable; the instrument shall be well grounded. Under severe thunderstorms, the instrument should be shut down with plug disconnected off.
- Working pressure and temperature of all parts of equipment shall be inspected to find out and eliminate its faults.
- The inlet of the pump must keep unobstructed.
- The air compressor in working produces lots of heat on its surface, thus the compressor surface

shall not be covered by any objects, so as not to effect heat dissipation and lead to instrument damage.

- The air compressor is a device working with pressure, the pressure must be decreased to normal pressure when maintaining; the condensate water in filter must be emptied before disassembling. Maintaining with pressure is not allowed.
- The cabinet cover shall not be opened at will. When maintaining the instrument, power must be cut off with the plug disconnected. Hot-line operating is not allowed; attention shall be paid to prevent various foreign matters from entering the instrument interior and pipeline system.
- The catalytic oxidizer in the zero air generator has rather high working temperature, so it should be sufficiently cooled down before maintaining.
- When the instrument is out of use for a long time, the pressure in the compressor shall be decreased down to normal pressure and the condensate water in the holder shall be emptied.

2 AQMS-100 Construction

AQMS-100 zero air generator is designed through the methods of integration and modularization, with modules mainly integrated inside the instrument cabinet. Its appearance is shown in Figure 1-1 and its size is shown in Figure 2-1.

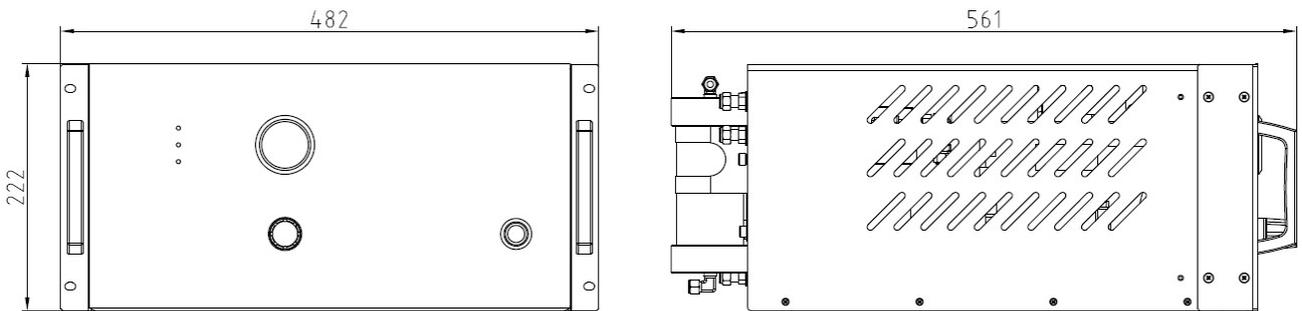


Figure 2-1 Size of AQMS-100

2.1 AQMS-100 Front View

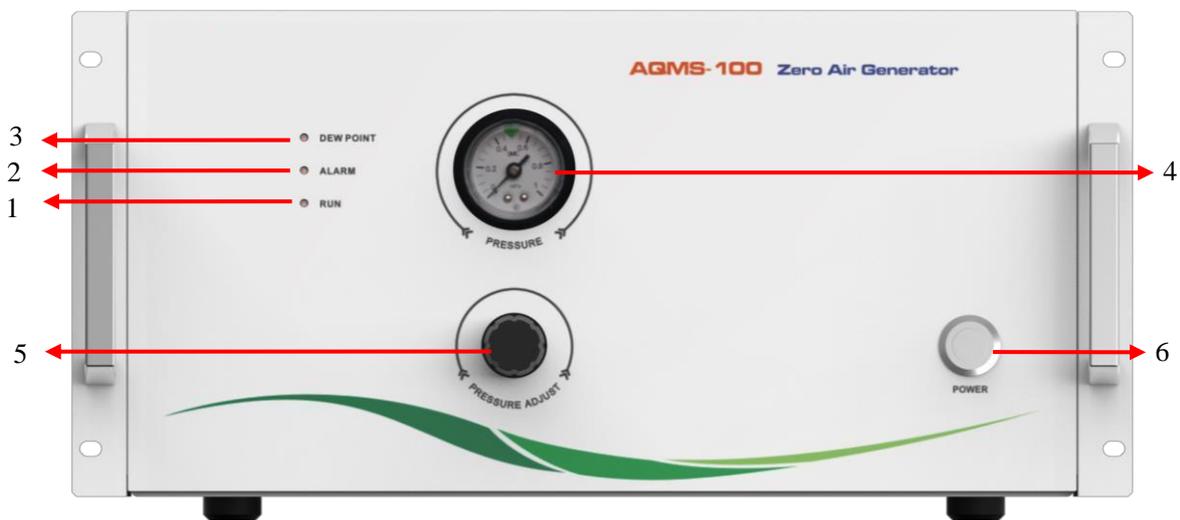


Figure 2-2 AQMS-100 Front View

Table 2-1 Name and Function of All Parts in Front View

No.	Name	Function
1	Power indicator	When the indicator is green, the power is connected. When the indicator is off, the power is not connected.
2	Fault alarm indicator	When the instrument faults, the indicator is on.
3	Dew point alarm indicator	When the indicator is red, the alarm about dew point is given, informing the dew point of zero exported is higher than -16°C. When the indicator is green, the dew point is proper and the dew point of zero exported is lower than -16°C.
4	Pressure gauge	It shows the pressure of zero exported.
5	Pressure regulating valve	It is used to regulate the pressure of zero exported.
6	Power switch	-

2.2 AQMS-100 Rear View

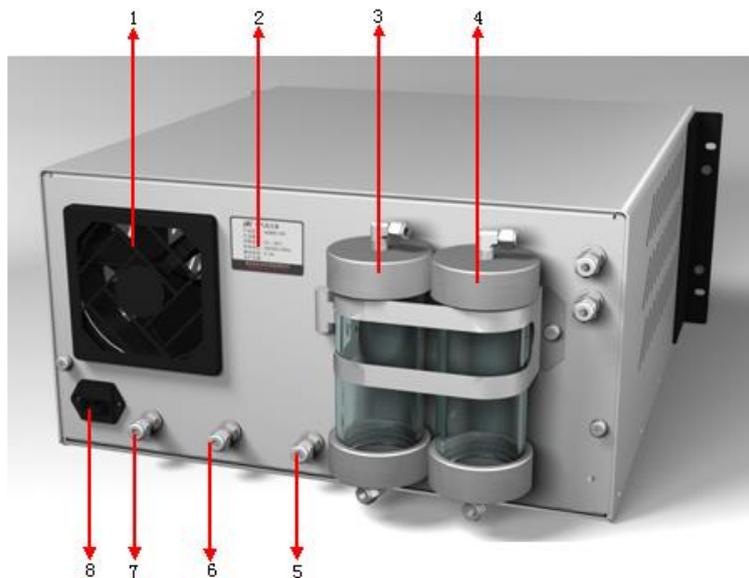


Figure 2-3 AQMS-100 Rear View

Table 2-2 Name and Function of All Parts in Rear View

No.	Name	Spec.
1	Fan	-
2	Product nameplate	-
3	Activated carbon scrubber	-
4	NO scrubber	-
5	Air inlet	1/4"
6	Zero outlet	1/4"
7	Drainage outlet	1/4"
8	Power interface	220 V AC, 50 Hz

3 AQMS-100 Installation

3.1 Basic Requirements for Installation Site

3.1.1 Installation Site

AQMS-100 shall be installed at a site with no magnetic field interference, no corrosive , and no intensive or sustained vibration; there should be no obstructions around the instrument; the room shall have some atmospheric conditions. The operating floor for the instrument shall be firm, stable and reliable.

3.1.2 Installation Conditions

The basic requirements in installing and using AQMS-100 for environment are as follows:

- Environment temperature: (0~40) °C
- Relative humidity: (0~95)% RH

CAUTION:

The stability and service life of the instrument may be influenced if the basic conditions can't be met by actual conditions of the user.

According to accuracy requirements, it is recommended that the laboratory temperature shall keep steady to avoid sharp and frequent changes, so as to ensure stable results.

3.2 Basic Requirements for Operators

AQMS-100 is an instrument of high precision. In order to ensure proper use and reliable operation and to reach particular measurement standards, the operator shall have a certain degree of professional knowledge or meet the following conditions through training:

- 1.) Possessing certain knowledge about instrument operation and some operating skills;
- 2.) Preliminary understanding of fundamental principles and maintenance of the instrument.

3.3 Instrument Installation

3.3.1 Unpacking and Checking

When the instrument is received, the user shall firstly check the goods against the packing list of instrument. In checking, special attention shall be paid to whether the goods name, model and quantity are consistent with the packing list or not; if so, the packages of each part shall be unpacked for further checking.

CAUTION:

External conditions of instrument packing shall be checked before unpacking for checking internal goods. If damage is found, the damaged goods must be well kept and then the manufacturer shall be contacted for a solution.

3.3.2 Installation of Air Filter

- 1.) Take out the packing box of air filter from the instrument packing container;
- 2.) There is 1 air filter, 1 thread seal tape and 1 stainless steel end connector in the packing box;
- 3.) Connect the stainless steel end connector with the air filter through the outlet thread, with thread seal tape used for sealing.

3.3.3 Installation of Air Compressor

- 1.) Take out the air compressor from the packing container;
- 2.) Connect the thread air inlet of air filter with the outlet of air compressor, with thread seal tape used at the thread to prevent air leakage.

3.3.4 Connection of Circuit

- 1.) Take out the $\Phi 1/4$ " fluoro-plastic pipes from the unpacking container of zero air generator;
- 2.) Use a $\Phi 1/4$ " fluoro-plastic pipe to connect the outlet of air filter with the "air inlet" at the rear panel of zero air generator;
- 3.) Connect one end of a $\Phi 1/4$ " fluoro-plastic pipe with the "drainage outlet" at the rear panel of zero generator, and fix the other end of the pipe at a fixed object to facilitate draining;
- 4.) Connect a $\Phi 1/4$ " fluoro-plastic pipe to the "zero outlet" at the rear panel of zero air generator.

3.3.5 Electrical Connection

Use a special cable to connect AQMS-100 with a power socket firmly and reliably.

3.4 Instrument Starting

Check whether the power supply is (100~240) V/(45~55) Hz AC; if it meets the requirement of instrument for power supply, then the power can be connected up; 1 min later, the instrument shall be started as per the following steps.



3.4.1 Start Air Compressor

- 1.) Close the valve at the outlet of air compressor;
- 2.) Power on the air compressor and run it;
- 3.) When the pressure in the holder of air compressor reaches 0.7MPa, the air compressor will stop working automatically; when the pressure is lower than 0.5MPa, the compressor will start working automatically.

3.4.2 Regulate Pressure at Outlet of Air Compressor

- 1.) Open the outlet valve of air compressor;
- 2.) Use the pressure regulating valve at the outlet of air compressor to regulate the pressure to 0.5MPa.

3.4.3 Start Instrument

Turn on the power switch at the front panel of AQMS-100.



CAUTION:

Every time before starting AQMS-100, there are 5s of automatic drainage for the "drainage outlet" at the rear panel of instrument.

3.4.4 Regulate Pressure Regulating Valve

- 1.) Use the pressure regulating valve at the front panel of AQMS-100 to keep the reading of pressure gauge at 0.2MPa;
- 2.) About 30 min later, dry and clean zero will be exported.

3.5 Shut Down Instrument

- 1.) Cut off the power supply of air compressor;

2.) Close the outlet valve of air compressor;

3.) When the pressure gauge at the front panel of zero generator shows that the pressure has decreased to 0 MPa, the zero generator shall be shut down.

 **CAUTION:**

If zero will be out of use for a long time, the power supply shall be cut off, and the outlet valve of air compressor shall be shut down after the pressure in the holder decreases to normal pressure (pressure gauge shows 0).

4 Daily Maintenance and Storage

In order to ensure AQMS-100 can work steadily and reliably for a long time, it should be maintained regularly. This chapter describes the important steps in daily maintenance.

The maintainability of AQMS-100 has been sufficiently considered in designing, and users can carry out daily maintenance to the instrument by themselves.

This section will describe the following maintaining processes in detail:

- Clean the main part of instrument;
- Empty the water of air compressor;
- Empty the water of air filter;
- Replace the particulate filter;
- Replace the activated carbon scrubber;
- Replace NO scrubber;
- Replace HC/CO scrubber;
- Replace the regenerable scrubber.

4.1 Clean the Main Part of Instrument

Wet cloth or dry cloth dipped in 99% alcohol can be used to scrub the main part of the instrument. It is not allowed to use organic solvent or acidic cleanser to clean the instrument.

4.2 Empty the Water of Air Compressor

After the air compressor is used for a period, some water will be stored in the holder. The electronic drainage valve of the air compressor can realize automatic water drainage. It will have a 2s of drainage for every 45 min operation.

Every time when the air compressor is powered on, the electronic drainage valve will carry out drainage automatically.

Generally, a patrol inspection shall be done every week; specifically, the power supply of air compressor shall be cut off and then restored to observe whether the electronic drainage valve can carry out drainage properly or not.

 **CAUTION:**

If there is high pressure in the holder of air compressor, there will be strong air flow to run out when the electronic drainage valve is implementing water drainage.

4.3 Empty the Water of Air Filter

The air compressor is provided with an air filter at the outlet for filtering particulates and liquid water. The drainage of air filter will be carried out automatically. When the water stored in the air filter reaches a certain level, the floater will rise up to carry out drainage automatically.

Generally, patrol inspection shall be carried out once every week through the outlet of air compressor to observe whether there is any water retained in the filter. If the water is full but can't be drained, it indicates the drainage outlet is blocked by particulates, thus the corresponding air filter shall be washed. The washing steps are as follows:

- 1.) Close the outlet valve of air compressor;
- 2.) Take down the air filter and disassemble the external cover of air filter to wash the automatic drainage outlet with clean water;
- 3.) Reinstall the external cover of the air filter and reinstall the air filter at the outlet of air compressor.

4.4 Replace the Particulate Filter

The final particulate filter is installed inside the instrument to remove fine particulates; the filter has a filtering accuracy of 5 μ m. Generally, the filter shall be replaced once every year to ensure efficient operation. The steps for replacing are as follows:

- 1.) Close the outlet valve of air compressor;
- 2.) When the pressure shown by the gauge at the front panel decreases to 0 MPa, the power shall be cut off, with plug disconnected;
- 3.) Open the rear panel;
- 4.) Remove the particulate filter at the rear panel and replace with a new one;
- 5.) Close the rear panel.

4.5 Replace the Activated Carbon Scrubber

The first consideration shall be to replace the activated carbon if the signal measured is changing obviously when zero is used to calibrate the instrument; the period of replacing is 6 months in general.

The activated scrubber is located at the rear panel of instrument and the steps for replacing are as follows:

- 1.) Close the outlet valve of air compressor;
- 2.) When the pressure shown by the gauge at the front panel decreases to 0 MPa, the power shall be cut off;
- 3.) Dismount the screws that fix the activated carbon scrubber at the rear panel, take out the scrubber, replace with new activated carbon, and reinstall it.

4.6 Replace NO Scrubber

The NO scrubber contains NO oxidizing agent, which shall be replaced if its 80% has become into yellow-brown from purple. As recommended, it should be replaced once every 6 months in general. If NO content in air is high, its service life will be shortened.

The NO scrubber is located at the rear panel of instrument, and the steps for replacing it is as follows:

- 1.) Close the outlet valve of air compressor;
- 2.) When the pressure shown by the gauge at the front panel decreases to 0 MPa, the power shall be cut off;
- 3.) Dismount the screws that fix the NO scrubber at the rear panel, take out the NO scrubber, replace with new NO oxidizing agent, and reinstall it.

4.7 Replace HC/CO Scrubber

The HC/CO scrubber can change hydrocarbons into CO₂ and H₂O and change CO into CO₂ under the action of catalyst. Theoretically, it is not necessary to replace catalyst; however, it will inevitably be contaminated or poisoned, thus it shall be changed once every 1~2 years as recommended. The steps for replacing are as follows:

- 1.) Close the outlet valve of air compressor;
- 2.) When the pressure shown by the gauge at the front panel decreases to 0 MPa, the power shall be cut off, with plug disconnected;
- 3.) Open the top panel of instrument to find out the HC/CO scrubber module.

CAUTION:

Attention should be paid to the scrubber surface and copper cooling coil which are at high temperature, to avoid scalding.

-
- 4.) When the scrubber has cooled about 30 min, the top cover of scrubber shall be opened to take out the insulation cotton;
 - 5.) Take out the HC/CO reactor and replace with a new HC/CO reactor;
 - 6.) Reinstall the insulation cotton;

- 7.) Recover the top cover of HC/CO scrubber;
- 8.) Recover the top cover of zero generator.

4.8 Replace the Regenerable Scrubber

The regenerable scrubber needs no maintenance, but if the molecular screen is contaminated by oil or other external pollutants, the scrubber shall be cleaned and changed. The steps for replacing are as follows:

- 1.) Close the outlet valve of air compressor;
- 2.) When the pressure shown by the gauge at the front panel decreases to 0 MPa, the power shall be cut off, with plug disconnected;
- 3.) Open the top panel of instrument to find out the regenerable scrubber module;
- 4.) Use a wrench to unscrew the connector installed at the scrubber;
- 5.) Unscrew the set screws in the base plate to remove the scrubber;
- 6.) Unscrew the top cover of scrubber;
- 7.) Empty the molecular screen in the scrubber to load with new molecular screen;
- 8.) Screw down the top cover of scrubber and reinstall the connector with a wrench;
- 9.) Reinstall the regenerable scrubber module;
- 10.) Recover the top cover of zero generator.

4.9 Long-time Storage

For long-time storage, the instrument shall be kept in its packing container. Attention shall be paid to the environmental conditions as humidity, temperature and corrosivity for long-time storage of instrument; no pressing, no raining and no sun exposure.

Avoid placing the instrument at any environment with potential electricity interruption (such as pumps and microwave oven), high-energy magnetic field or radio interference.

5 FAQ and Troubleshooting

Attention should be paid to following aspects in troubleshooting:

- People other than professionals are not allowed to open the cover or carry out maintenance to the internal parts;
- Power supply must be cut off before opening the cover;
- The alarm information given by the instrument shall be sufficiently used for troubleshooting;
- The self-contained correcting features shall be used to correct the instrument, so as to avoid resulting in error exceeding rated value; and
- Electrostatic protection measures shall be taken in implementing operation to internal structure.

Figure 5-1 FAQ and Troubleshooting

No.	FAQ	Troubleshooting
1	Power indicator is off	Check whether the power cable is effectively connected; Check whether the power voltage and frequency meet the requirements; Check whether the power switch is turned on; and Check whether the fuse is burned out.
2	Compressor is not started (after the instrument is started up for 10s)	Check whether the pressure in holder is above the starting pressure because the pressure will decrease with the use of ; Check whether the voltage and current of AC power can meet the requirements; Check whether the air inlet of pump is blocked; Check whether there are objects that mechanically disturbed the operation of pump; and Check whether the pressure switch is intact.
3	Equipment shows abnormal vibration and high noise	Check whether the silencer at pump inlet becomes loosened or falls off; Check whether the compressor is fixed on the base plate; and Check whether the pipelines of compressor contact with other objects.
4	pressure at outlet can't reach 30 PSIG	Check whether flow at outlet exceeds 20 SLPM; Check whether the air inlet of pump is blocked; Check whether the pressure regulator is set at a value lower than 0.2 MPa; and Check whether there is any leakage inside the instrument.
5	Air compressor can't be restarted after stopped	Check whether the pressure in holder has decreased to the pressure value set by the pressure switch.
6	When flow reaches 5 SLPM, the compressor keeps working all the time	Check whether the pressure switch is set at a too high value; and Check whether there is internal leakage.

No.	FAQ	Troubleshooting
7	outlet pressure drops sharply	Check whether the outlet flow is too high; and Check whether the pressure regulator is fixed at a too high value.
8	exported is not pure, having pollutants	Replace corresponding catalyst.
9	exported is not dry	The 3-position 5-way valve is blocked; Check which outlet of the valve is blocked; Replace the 3-position 5-way valve; The shuttle valve is blocked; Replace the shuttle valve; The molecular screen for water removing is contaminated; Replace the molecular screen for water removing; The dew point alarm faults; The dew point sensor gives incorrect measurements; replace or calibrate the dew point sensor.