



Tech Note

GA-300 Gas Analyzer and GAK-300 Accessory Kit

Overview

The GA-300 CO₂ and O₂ Gas Analyzer is easy-to-use, robust, and adaptable to human, animal and plant applications. The GA-300 has two analog outputs to allow connection to iWorx computer interfaces to allow recording and display of O₂ and CO₂ signals. In addition, the GA-300 incorporates an input for connection of a Polar Heart Rate Receiver.



Figure 1: The GA-300 Gas Analyzer

The GAK-300 is an accessory kit for use with iWorx kits, like the MC-214, that are capable of measuring basal and resting metabolic rates using the GA-300 gas analyzer and the SP-304 spirometer.

The GAK-300 contains the necessary components to measure the volumes of oxygen consumed (VO₂) and carbon dioxide produced (VCO₂) during the segments of light, moderate, and strenuous exercise that are part of an aerobic fitness test. The components include: a mixing chamber, a 1000 Liter/min capacity flow head, a non-rebreathing valve, a mouthpiece, head gear, smooth interior tubing, and nose clips (Figure 2).

How It Works

The GAK-300 contains components that permit the measurement of VO₂, VCO₂, and other metabolic parameters during exercise without the need for expensive heated flow heads and heater controllers.

When using the GAK-100 with a spirometer, the subject breaths directly through a non-rebreathing valve, and not a flow head. The non-rebreathing valve permits the subject to inhale fresh air from environment, as it prevents the rebreathing of exhaled air. When the subject exhales, the valve directs the expired air through the outlet of the valve and down a large tube to a mixing chamber.

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As the capacity of the mixing chamber fills with the expired air, air is pushed out of the mixing chamber as the expired air from new breaths enters the chamber. The volume of air that moves out of the mixing chamber is measured by the flow head and spirometer attached to the outlet of the mixing chamber. The volume of air expelled from the mixing chamber is equal to the volume of expired air entering the chamber from each new breath.

Since the mixing chamber has a capacity that is 5 to 10 times larger than the tidal volume of the subject, the concentrations of oxygen and carbon dioxide in the mixing chamber are the averages of the concentrations of those gases in the last 5 to 10 breaths exhaled into the chamber. When these concentrations are joined in an algorithm with the volumes of air expired by the subject, accurate values for the subject's rate of oxygen consumption and carbon dioxide production can be calculated.



Figure 2: The GAK-300 gas analyzer accessory kit.

Equipment Set-up

1. Connect the airflow tubes from the SP-304 Spirometer in the iWorx kit to the inlets of the A-FH-1000 Flow Head that comes with the GAK-300 kit (Figure 3).



Figure 3: The A-FH-1000 flow head from the GAK-100 kit connected to the SP-304 spirometer with a pair of airflow tubes..

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2. Connect the inlet of the A-FH-1000 Flow Head to the outlet of the mixing chamber (Figure 4).



Figure 4: The inlet of the A-FH-1000 Flow Head attached to the outlet of the mixing chamber.

3. Connect the 35mm I.D. Smooth interior tubing from the GAK-300 kit to the inlet of the mixing chamber (Figure 5).



Figure 5: The spirometer circuit used to measure the volume of air exhaled by the subject, and provide oxygen and carbon dioxide samples from the exhaled air to the gas analyzer.

4. Connect the other end of the smooth interior tubing to the outlet of the non-rebreathing valve (Figure 5).
5. Connect the mouthpiece in the GAK-300 kit to the side port of the non-rebreathing valve (Figure 5).
6. Connect the one of the lengths of gas sampling tubing to the Luer-Lock sample port on the side of the mixing chamber (Figure 5).

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7. Connect the other end of the gas sampling tubing to the filter on the inlet of the GA-300 gas analyzer (Figure 6).



Figure 6: The rear panel of the GA-300 gas analyzer showing the inlet and outlet ports for the gas sampling tubing.

8. Connect the other length of gas sampling tubing to the other Luer-Lock sample port on the side of the mixing chamber.
9. Connect the other end of the gas sampling tubing to the outlet of the GA-300 gas analyzer. (Figure 6).
10. Connect the SP-304 spirometer to the channel 4 DIN8 input of an iWorx 214 recorder.
11. Connect the outputs of the GA-300 gas analyzer to the inputs of an iWorx recorder (Figure 1).
 - (a) Connect the CO₂ output using the BNC-BNC cable to channel 2 of the IX-214.
 - (b) Connect the O₂ output using the DIN8-DIN8 cable to channel 3 of the IX-214.

Experiments

Experiments using the GA-300 and GAK-300, with the iWorx metabolic cart, can be found in the iWorx Software installer and in the iWorx Newsletter archive which is available from the iWorx website: <http://www.iworx.com/newsletter/default.htm>.

Directions for programming the LabScribe2 software to complete exercises with the GA-300 and GAK-300 and the metabolic cart are included in each experiment.

Components of the GAK-300

- (1) 5 liter mixing chamber
- (1) Non-rebreathing valve with 35mm O.D. openings
- (1) Headgear for supporting the non-rebreathing valve and mouthpiece
- (1) 6 ft section of smooth interior tubing with 35mm I.D. openings
- (1) Reusable mouthpiece with saliva trap
- (1) 1000 Liter/min flow head
- (5) Noseclips

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Performance specifications of the GA-300 are valid under the following conditions:

Performance Conditions:	
Ambient Temperature	5-40°C Operation;
Atmospheric Pressure	600mmHg - 912mmHg
Warm-Up Time	5 minutes
Altitude	Two point calibration required.
Humidity	10-95%, non-condensing

Performance Specifications:	
Range	1-25% O ₂ ; 0-10% CO ₂
Resolution	+/- 0.25% : Oxygen +/-0.1% in 0-10% range
Flow with Pump	~250 ml/min
Response Time	15s@ 250ml/min flow

Other Specifications:	
Power	5VDC, 2.5A
Dimensions	4.15x 2 x 5.5 inch

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