Webinar Q&A Report:
Recording High-Quality Metabolic Data in Humans

1. **What happens if the RER is >1 or < 0.7?**

   When recording BMR or RMR and following the correct protocol, RER should be between 0.7 and 1. During exercise, RER can go higher than 1 for reasons described in answer 2. I have not seen RER go lower than 0.7 and if it does, something is wrong.

2. **Why does the recorded RER go significantly above 1 during moderate exercise?**

   The GASSYS3 uses sensors that have a response time of approximately 20 seconds. Although we correct for most of the response time differences in software, it is hard to get a perfect, linear, match between sensors. So, the reading for RER is only going to be accurate during steady-state conditions such as BMR or RMR or, during exercise, after the subject has been exercising for a while. For the Webinar, we only recorded a few minutes of the Subject in a resting state, and then had him perform a quick ramp up to moderate exercise. Since the Subject only held the moderate level for a short while, no meaningful RER value was obtained.

3. **What texts or references do you recommend on metabolic measurement?**

   There are guideline papers available from different societies, but a good starting point is The American College of Sport Medicine's "Metabolic Calculations Handbook"

4. **How do you tell if the calibration has "gone bad" and needs to be refreshed? If the system fails this test, how quickly can it be calibrated for use?**

   The calibration consists of a zero-airflow baseline and an ambient air flush, after which the measured O2 value is reported. There are three things to check after calibration:

a. Is the measured O2 value close to 20.95%?
b. Is the airflow baseline at zero?
c. By using the Integral measurement tool and selecting one airflow pulse (1 syringe cycle) does the measured volume equal the syringe size?

   If the answer to any of these is "no", then the air calibration should be repeated.

5. **How long can the analysis be prolonged? is there a time limit that would affect accuracy?**

   The maximum recording duration is limited only by the amount of computer disk space. The accuracy of the sensors should not change during a long recording. Wearing a facemask or mouthpiece, however, is a very unnatural act, and wearing them for long periods of time is very fatiguing.

6. **Why does the system need to warm up?**

   All of the sensors have a warm-up time. The O2 sensor has an internal heater that takes at least 3 minutes to reach the desired temperature.

7. **What are the errors of measurement in terms of O2 and CO2?**

   +-1%

8. **Could you please provide a price for the system, including the software also?**

   Please contact our Sales Department for system level pricing. (info@biopac.com)

9. **Are these gas analysis systems compatible with all BSL versions?**

   No, there are new script commands that had to be added to the software. The first version that will be compatible with the GASSYS3 will be BSL 4.1.3. It is possible to upgrade your software to the latest version though. The following link will provide you with additional information:

   https://www.biopac.com/product/software-upgrade-to-bsl-4/

10. **Will data be recorded in the journal by default? Or this an added setting that must be first turned on?**

    The software template and script will automatically push the values to the Journal by default, but there is a preference setting to turn this feature off.

11. **Do we have to allow constant air flow as these affects the volume of oxygen used and CO2 expired?**

    The system does not require a constant flow of air to operate. The sensors are located in the mixing chamber and will measure the flow of expired air that comes from the subject and will constantly analyze the air in the chamber, but it does not have to presented in a constant flow.

12. **Is there is a choice of format for data output (.csv, .txt, etc).**

    Yes, the raw data and measurements are available in a number of formats, including exporting the measurements direct to Excel.

13. Is it possible to add an analogue or digital input channel (e.g. treadmill speed, bike resistance)?

Yes. If Heart Rate from ECG is not required, there is one additional analog channel on the MP36. There are also 8 digital input channels that can be utilized.

14. What types of analyses can be done? (other than extracting the mean)

Assuming the question refers to the Epoch analysis that was shown during the demonstration, the following image to the right shows the list from the menu. The Epoch analysis will allow you to use any of the measurements that are available in the BSL AcqKnowledge software.

15. Is the open time limit the same for GASSYS2?

I'm not sure if I understand the question. The recording length is determined by the amount of memory in the computer. The amount of time the GASSYS3 can remain accurate between gas calibrations is much longer than the GASSYS2.

16. What is the top row measuring?

I assume that you mean the measurements boxes that appear above the graph window. These measurements are user selectable and can be used manually with the I-beam selection tool, or automatically over specified time periods with the Epoch analysis. See the answer to question 13 for the list of available measurements.

17. How often would airflow calibration need to be performed during an intervention?

Just once, prior to each Subject recording.

18. When performing on multiple subjects, what calibration must be performed in between subjects for best results?

Only the airflow baseline and ambient flush which takes about 2 minutes.

19. What type of O2 sensor is used?

The new GASSYS3 device uses a Zirconia Solid-Electrolyte sensor.

20. Is this a system limited for use with humans, or do you have other adaptations for use with other animals?

Currently the system is designed to work with humans. We do intend to expand the system in the future to work with small animals that will be contained within the mixing chamber. For this to work, we must provide constant airflow through the system.

21. How does this system differ from GASSYS2?

Although it looks similar, the GASSYS3 is a total redesign. This new system has an expanded CO2 range of 1 to 10%, and a heater which allows it to measure under strenuous exercise conditions. It also has built in ambient pressure, temperature and humidity sensors as well as chamber temperature and humidity sensors. This allows the software to automatically correct for altitude, water vapor pressure and to convert air volume to Standard Temperature Pressure Dry (STPD). The software runs a script that removes a most of the setup steps you must perform with the GASSYS2.

22. How often must the gas system be calibrated in order to ensure accurate results?

There are two types of calibration; gas calibration and ambient air calibration. Gas calibration requires precision gas references. We have minimized the need for gas calibrations. We have been testing a system here that has held its O2 and CO2 accuracy to within 1% for over 8 months. We believe they can hold their accuracy for one year, depending on usage. The temperature, humidity and barometric sensors integrated into the system allow the software to compensate for changes in ambient and expired air.

We do require an ambient air calibration. The airflow transducer needs to establish a zero airflow baseline. In addition, we must establish an ambient O2 reading. This is accomplished by reading the O2 value after flushing the mixing chamber with ambient air for 1 minute.

23. What is the limit to the duration of recording if any? (i.e. marathon running)

There is no real limit, other than the capacity of the computer to store the data.

24. Can the airflow transducer and/or gas chamber be moved after calibration?

The gas calibration is performed at the factory which is at sea level. It can be shipped to a location at higher altitude (i.e. Denver) and it should not require re-calibration using reference gasses. You should always perform the airflow baseline and ambient air flush calibration, which takes about 2 minutes, prior to the recording.

25. Why would you place the airflow transducer on the inspired side?

The airflow transducer is a screen pneumotach design. During moderate to high exercise intensity, condensation can form on the screen which will affect its accuracy. For BMR or RMR and even moderate exercise measurements, the airflow transducer can be attached to the expired side.

26. How is gas flow calibration performed?

I assume that you mean airflow, which is measured by the SS11LB Airflow Transducer. The transducer is factory calibrated and can be tested with a calibration syringe. The important thing is to make sure that the offset is accounted for and this is handled automatically by the script during the first part of the calibration.

27. What is the smallest/youngest subject that you can study with this system?

The system will work for children as young at 10, and possibly younger, but we have not run tests on young children. The flow rates and gas analyzers should work fine.

28. Are their best practices for combining measurements of EMG and HRV with metabolic function?

I'm not aware of any published best practices but I imagine there are some guideline papers out there. There are certainly guidelines for HRV and EMG. The following links may help to address your question.

https://www.biopac.com/knowledge-base/guidelines-for-psychophysiological-recordings/

https://www.biopac.com/wp-content/uploads/354.full_.pdf

If you have additional questions for BIOPAC Systems regarding content from their webinar or wish to receive additional information about their products and laboratory services, please contact them by phone or email:

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