Metabolic calculations

A practical system will continuously measure the flow and gas values and feed these values to a ***data acquisition system*** for computation and analysis. Below are the basic equations using the directly measured as well as derived variables. These equations are typically programmed into the data acquisition software as channel calculations. The main variables are:

Vi = fresh air flow into chamber, lpm (measured directly)

Vo = effluent flow from chamber, lpm (derived)

FiO2 = oxygen fraction at input of chamber (measured directly)

FoO2 = oxygen fraction at outlet of chamber (measured directly)

FiCO2 = carbon dioxide fraction at input of chamber (measured directly)

FoCO2 = carbon dioxide fraction of effluent from chamber (measured directly)

The output flow from the chamber, Vo, needs special consideration because the ratio of CO_2 produced to O_2 consumed (RER) will affect this output flow. To derive Vo, the *Haldane equation* is used, which exploits the assumption that the amount of nitrogen does not change from chamber input to output:

Vo = Vi (FiN2 / FoN2)

where FiN2 and FoN2 are nitrogen fractions at chamber input and output, respectively.

The inlet N2 fraction is thus calculated as:

FiN2 = 1 – (FiO2 – FiCO2)

and the outlet N2 fraction as:

FoN2 = 1 – (FoO2 – FoCO2)

With these derived values, the main equations may be used:

VO2 = (Vi x FiO2) – (Vo x FoO2) for oxygen consumption in liters/min, and:

VCO2 = (Vo x FoCO2) – (Vi x FiCO2) for carbon dioxide production

Once you have the basic VO2 values, there are a number of approaches to calculate an estimated heat or energy production. One such measure is Energy Expenditure (EE) in kcals/min that can be derived from VO2:

EE = (3.581 VO2 + 1.448 VCO2) – 1.773

Another derived measurement, the Respiratory Exchange Ratio (RER) may be computed:

RER = VCO2 / VO2 (this is a dimensionless measure, and is independent of body weight)

These are the basic measurements, which can then be standardized to animal body weight if desired:

VO2 / M and **VCO2 / M** (M=body weight in kg)