

Product Design Specification

Indirect Calorimeter

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Team Members:

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Problem Statement:

All components of an indirect calorimetric are available in my lab. We look for student(s) who are interested in assembling the pieces into a functioning unit and computerizing the system with the existing software. This unit will be used to continuously collect the real-time (24~48 hours) data on mouse oxygen consumption, CO₂ production, activity and food intake. This will be very useful instrument for us to study the genetic and pharmacological effects of our targets on the treatment and prevention of obesity-diabetes. We have all components of an indirect calorimeter, mainly including oxygen sensors, CO₂ sensors, air flow controls, mouse chambers, pipes, wires, computer, all types of switches and controls, software, manual instruction.

The commercial instrument that is similar to this unit is the CLAM system (costing \$150,000), the principle and working mechanism of which can be found at the web site of Columbus Instruments.

Client Requirements:

- Use materials provided by Professor Cai to construct a calorimeter. These include oxygen sensors, CO₂ sensors, air flow controls, mouse chambers, pipes, wires, a computer, all types of switches and controls, software, and instruction manual.
- Obtain measurements for water and food intake and urine produced.
- Be able to record and quantify the animals' movements.

Design Requirements:

1. Physical and Operational Characteristics

a. Performance Requirement: Must be able to record data for CO₂, O₂, and movement about every five minutes for a continuous period of 24-48 hours. The data should be recorded in units of mL/hr. Food, water, and waste must be measured every day.

b. Safety: Animal safety.

c. Accuracy and Reliability: CO₂ and O₂ measurements must be able to be measured to at least 5%.

d. Life in Service: For the duration of client's project, probably 2 to 5 years.

e. Operating Environment: The current environment is the animal testing room, two floors above Dr. Cai's lab. Dr. Cai is interested in moving to an environment that can withstand longer durations of testing. This could be satisfied by obtaining a self contained environment or tank which has its own ventilation and environment control. Environment is room temperature. Moisture must also be recorded.

f. Ergonomics: Easy use by researchers that requires minimal training. A cart to push the cages and set-up around should be considered. The cart should be tall enough that minimal bending is necessary to make repairs or move equipment.

g. Size and Shape: Small enough to fit on a rolling cart which can be moved from the animal room in the basement to the lab. This includes standard doorway size.

h. Weight: Not so heavy that transfer on a cart is undoable.

i. Materials: Must stand up to long testing cycles.

j. Aesthetics, Appearance, and Finish: Spatially efficient. It would be nice to have the system set up in an easy to follow order for easier trouble shooting.

2. Product Characteristics:

a. Quantity: One device is required.

b. Target Product Cost: The prototype should cost less than \$2000 to build. Additional costs are acceptable if new sensors and/or analyzers are needed.

3. Miscellaneous:

a. Standards and Specifications: The device should comply with all applicable laws, regulations, and policies governing animal testing. It should be accepted by the scientific community as a legitimate indirect calorimeter which gives reliable data.

b. Customer: The typical customer would be physiologists researching metabolism in small animals. We are designing it for Professor Cai's specific study, as opposed to producing it for mass production.

c. Patient-related concerns: No potential harm caused to animals subjects.

d. Competition: The CLAM system produced by Columbus Instruments.