

Heating Pad for a microPET/CT scanner

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Problem Statement:

During anesthesia, metabolism slows down, which can lead to hypothermia and eventual death. For prolonged μ PET/CT scans, where animals are kept for an extended period of time under anesthesia, it is important to keep the animals at steady temperature. Currently heating lights are used to provide that; however they often lead to non-uniform and poorly controlled temperature regulation. Therefore, it has been proposed to design a heating device that could be used to provide a controllable and steady temperature during prolonged scans. Because of the imaging requirements, the heating device should not contain metal parts.

Client Requirements:

- Temperature should be near the body temperature of a mouse
- Temperature should be controllable and constant
- Heating should be able to be provided for roughly one hour
- The device should be cleanable

Design Requirements:

- No metal parts within the scanning region of the μ PET/CT machine
- Liquid may be used but device must be completely sealed (no leaking)
- Limit the use of moving parts. Slight motion may be acceptable, but significant motion may affect imaging capabilities
- The portion of the device that the mouse is sitting on should be somewhat firm so the mouse does not sink into the device
- The heat delivery portion of the device must fit in a 4 $\frac{3}{4}$ inch diameter opening

1. Physical and Operational Characteristics

a. Performance Requirement: The device will need to produce temperatures near the body temperature of a mouse. However, the main concern is that the device can maintain a constant temperature.

b. Safety: The device will likely operate at high temperatures; therefore the user should use care when operating the device. The device will require a label warning of this high operating temperature. We should use a temperature fuse to automatically turn off the device if the temperature becomes extremely high. The device may also employ a DC power supply. Standard safety precautions should be followed regarding this electrical unit.

c. Accuracy and Reliability: The device should provide controllable heat accurate within roughly 3-5 degrees Celsius of the temperature desired by the operator. Temperatures should

be repeatable to ensure that temperature is a controlled variable across a number of scans spanning an amount of time determined by the researcher.

d. Life in Service: The device should be capable of providing heat for at least one hour, the typical length of a μ PET/CT scan. The device should be able to withstand multiple uses within one day. The product life of the device depends on the working parts used in the design.

e. Shelf Life: Shelf life will not likely be an issue with this device

f. Operating Environment: The device will be used at the UW hospital in the room where the μ PET/CT scan machine is located. The temperature of this room is approximately 80 degrees Fahrenheit.

g. Ergonomics: The temperature control of the device should be straightforward so that a user can easily shift the temperature up and down without extensive training. Also, the body temperature of the mouse should be highly visible.

h. Size and Shape: The device used to deliver heat to the mouse within the scanning chamber of the μ PET/CT machine must fit into a cylindrical space with a circular diameter of approximately 10 cm. The length of this device will likely not be constrained by the length of the μ PET/CT scanning chamber. There are no size constraints on any device outside of the scanning chamber.

i. Weight: The weight of this device is not constrained.

j. Materials: The part of the device that goes inside the imaging chamber cannot contain any metal parts. Metal parts may be used on portions of the design that are located outside of the imaging chamber. Also, this device should be cleanable because mice tend to urinate during scans.

k. Aesthetics, Appearance, and Finish: The device should clearly indicate a warning about the high temperatures that the device will be running at. Aesthetics are not a large concern at this point.

2. Product Characteristics:

a. Quantity: One device is required.

b. Target Product Cost: The budget for this project is not concrete. Our goal is to construct a prototype for under \$200.

3. Miscellaneous:

a. Standards and Specifications: The device should comply with all regulations established by the FDA for medical instruments. More information can be found on the FDA website.

b. Customer: The customers for this device will be researchers who would like to keep the body temperature of a small animal constant during imaging processes.

c. Patient-related concerns: There are no patient-related concerns at this time.

d. Competition: There is currently no device available that adheres to the requirements set forth by the client.