*BME 200/300: BIOMEDICAL ENGINEERING DESIGN*

# PRODUCT DESIGN SPECIFICATIONS

– THE NEUROCHEMICAL TEAM –

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**Project Title:** Development of a Device for Neurochemical Sample Collection from Freely Moving Monkeys

*(Project Number: 26 / Code: neurochemical_sampling)*

## Initial Problem Statement

The purpose of the project is to develop a device allowing monkeys to be free from chairing while experiments are conducted. Direct measurements of neurochemical substances in the brain from free moving non-human primates is significantly important for understanding complex brain function and developing treatment strategies for brain disorders in humans. During the last semester four BME students worked hard to design and built a device. However, this device still needs further refinement for actual application. The development of the device for microdialysis experiments may require creativity and intellectual exercise.

## Revised Problem Statement

To improve on the device created last semester that protects the microdialysis apparatus used during cranial experiments on non-human primates. This involves making the device lighter, more secure around the monkey's head, and better able to cushion the microdrive unit.

## Client Requirements

- Material must be lightweight so as not to impose too much weight on the monkey's head.
- Material must be strong enough to withstand forces that the monkey may apply.
- The device must not interfere with the data collection process.
- The device must be able to be easily integrated with the current microdialysis apparatus being used.
- The monkey must be able to move freely with the device attached to it.
- There should be limited space between the device and the microdialysis apparatus.
- The device must be detachable from the apparatus after use.

[1] Denotes the Biomedical Student Advisory Committee.
[2] Denotes the Biomedical Web Implementation Group.

- The device should be sterile and reusable.

## Design Requirements

*1. Physical & Operational Characteristics:*

a. **Performance Requirements:** The device must be strong enough to withstand 100 N (based on human arm strength estimate) to protect the microdrive unit from any forces that the monkey may apply.

b. **Safety:** The device must not contain sharp edges or other protrusions that may injure the monkey or researcher. The materials that are used must not be toxic.

c. **Accuracy & Reliability:** The device must provide reliable protection for the microdrive unit by being able to withstand a force of 100 N for 10 consecutive hits within a time period of 10 s.

d. **Life in Service:** The device must be able to withstand at least 12 hours of use at a time, and must be sterile so that it can be reused.

e. **Shelf Life:** At least 5 years.

f. **Operating Environment:** Normal laboratory environment for non-human primate research.

g. **Ergonomics:** The device must not restrict the monkey's motion except for the head and neck.

h. **Size:** The base of the device should have a diameter of 82.55 mm and a maximum height of 73.025 mm (height differs due to the shaping of the base to provide a custom fit for the Rhesus monkey's head). The cylindrical top should have a diameter of 50.8 mm (with a 3.175 mm lip around the bottom), a height of 152.4 mm, and a thickness of 2.38 mm.

i. **Weight:** Not more than 0.5 kg so as not to impose too much weight on the monkey's head (as determined by client). However, this weight is subject to modification based on live testing scheduled for November.

j. **Materials:** Aluminum alloy 5052 for the outer casing and RTV silicone rubber for the form-fitted interior.

k. **Aesthetics, Appearance & Finish:** The device must be aesthetically pleasing and look "humane" so as not to create a public outcry.

*2. Production Characteristics:*

a. **Quantity:** 1 reproducible device.

b. **Target Product Cost:** Not more than USD1000.

*3. Miscellaneous:*

a. **Standards & Specifications:** The design and construction of the device must comply with USDA regulations and NIH guidelines, subject to approval from the attending veterinarian.

b. **Customers:** Primarily the client, but can be potentially extended to any research institution that is involved with cranial microdialysis studies on non-human primates.

c. **Patient-Related Concerns:** The device must be sterilized before use with a different primate. It should not cause more discomfort to the monkey than the current experimental apparatus (i.e. the primate chair) does.

d. **Competition:** No currently known products specifically address the need to protect the microdrive unit during cranial microdialysis studies on non-human primates.