

Ergonomic Automated Bioanalytical Sample Tube Uncapping and Capping Device

Product Design Specification (PDS)

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Function: A device that can, with or without automation, efficiently cap and uncap twist-top sample tubes to save our client from finger joint damage and avoid wasting valuable time manually capping around 500-700 sample tubes each day.

Client Requirements: The device must be stand alone, easy to use, and equally efficient to or more efficient than manually capping and uncapping sample tubes. It must also be compatible with multiple sizes of sample tubes. It should be a simple design that is easy to use, reliable, and fits into a lab setting where bench space is limited. The device must average the capping and uncapping of 10,000 sample tubes per month, making this a fairly robust design. It must work every time, and the design needs to be low cost and low maintenance.

Design Requirements:

1. Physical and Operational Characteristics

a. Performance Requirements:

Device has to be able to withstand high use without failure; must work every time with an average of 10,000 samples uncapped per month. Efficiency is also of great interest, as minimizing down-time while the device is in use is important.

b. Safety:

Must pass all sterility standards of the lab. It should not pose a risk of injury for anyone using or near the device.

c. Accuracy and Reliability:

Must have a 95% success rate when capping/uncapping 1,000 sample tubes. The device should be able to uncap at least 3 different varieties of sample tubes.

d. Life in Service:

Design should be able to be used for many years of heavy use. To test, no wear should be visible after uncapping 1,000 sample tubes. If the product has an element that is prone to wear or breaking down, there should be a simple procedure for replacement/correction of that part.

e. Shelf Life:

This design is being made for a specific client, so as of right now, no shelf life is expected for the first product. However, the device should be able to sit on a shelf indefinitely and still be functional should it be grabbed off the shelf.

f. Operating Environment:

A laboratory where bench space is limited. For that reason, the device should take up as little workspace as possible. Sterility is of great importance in a setting like this, so the product must be able to be cleaned and then used again.

- g. Ergonomics:*
Must be capable of withstanding heavy use from multiple technicians. The device should be easy to use and require a very small learning curve, as technicians should be able to teach other technicians how to use it.
- h. Size:*
Should fit into a lab setting with limited bench space; a size that fits into a 65 cubic cm space is desired.
- i. Weight:*
Must be light enough to be placed on a laboratory station (< 75lbs).
- j. Materials:*
Must be able to be cleaned without risking the integrity of the device.
- k. Aesthetics, Appearance, and Finish:*
Device should not stick out from other devices and machines of the lab. As this product is centered around efficiency, aesthetics are a lower priority as compared to functionality.

2. Production Characteristics

- a. Quantity:*
Two devices should be created: one that uncaps and another that uncaps. If possible, it is desirable to consolidate these two devices into one single device that can do both operations.
- b. Target Product Cost:*
Cost will be decided based on materials/parts used in construction as well as the client's allotted budget.

3. Miscellaneous

- a. Standards and Specifications:*
Being able to cap and uncaps multiple sample tubes simultaneously is desirable. The device also should not break any of the sterility standards of the laboratory. The device must ensure that there is no cross contamination between the samples during the process, as that would greatly compromise the sample tubes samples.
- b. Customer:*
Professor Robert G. Radwin and a local research and testing lab near Madison.
- c. Patient-related Concerns:*
The device must reduce the strain on the lab technician's hands. To measure this, a pinch test measuring the pinch strength of a lab technician before and after a standard day of working with sample tubes will be taken. Then, the pinch strength will be taken before and after a day using our day, and the results will be compared.
- d. Competition:*
There are several products already on the market that serve the role of capping and uncapping sample tubes. That which is most similar to our product is the Capit-All™ Screw Cap Tube Capper/Decapper, which is capable of quickly capping and decapping up to 96 sample tubes at once. This product has several sub-designs specialized for the

number of sample tubes to be capped at once as well as the types of caps on the sample tubes (matrix screw top, nunc screw top, nalgene external thread cryostorage tubes, etc.)