

The Twister

Product Design Specification (PDS)

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Function: A device that can, with or without automation, efficiently cap and uncapping test tubes with twist tops and save our client from finger joint damage and from wasting valuable time manually capping 500-700 test tubes each day.

Client Requirements: The device must be stand alone, easy to use, and more efficient than manually capping and uncapping test tubes. It must also be compatible with multiple sizes of test 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 test 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 fit into a regulated work environment and pass all of its sterility checks. It should not pose a risk of injury for anyone using or near the device.

c. *Accuracy and Reliability:*

Must work every time with an average of 10,000 samples uncapped per month.

d. *Life in Service:*

Design should be able to be used for many years of heavy use. If the product has an element that is prone to 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 used by laboratories across the world.

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 ideally the product will be able to be cleaned after previous usage.

g. *Ergonomics:*

Must be capable of withstanding heavy use from multiple technicians. The device should be easy to use and have 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; no larger than a desktop printer.
- i. Weight:*
No restriction on weight for the design.
- j. Materials:*
Must be able to be cleaned and sterilized without the risk of damaging the device.
- k. Aesthetics, Appearance, and Finish:*
Device should not stick out from the other devices and machines of the lab, so a look similar to those devices is desired. As this product is centered around efficiency, aesthetics are a lower priority as compared to functionality.

2. Production Characteristics

- a. Quantity:*
One device for our client for now, however its construction would ideally be easy enough to mass produce the product.
- b. Target Product Cost:*
Cost will be decided based on materials/parts used in construction as well as the client's thoughts on the usefulness of the design.

3. Miscellaneous

- a. Standards and Specifications:*
Being able to cap and uncap multiple test tubes simultaneously is preferred. The device also should not break any of the sterility standards of the laboratory. We must be sure that there is no cross contamination between the samples during the process, as that would greatly interfere with the technicians' results.
- b. Customer:*
Professor Robert G. Radwin and the Covance Research Lab of Madison.
- c. Patient-related Concerns:*
Unknown at this point in time; will learn much more about specifics of project after speaking with technicians at the Covance Research Lab.
- d. Competition:*
There are several products already on the market that serve the role of capping and uncapping test 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 test tubes at once. This product has several subdesigns specialized for the number of test tubes to be capped at once as well as the types of caps on the test tubes (matrix screw top, nunc screw top, nalgene external thread cryostorage tubes, etc.)