

Spider Cage to Support Cerebral Palsy Patient

Product Design Specifications | September 23, 2016

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Function:

A spider cage is a structure that is used by therapists to help develop muscles of patients with muscle disorders, specifically, cerebral palsy. Patients develop muscle strength through the use of therapy bands that can be attached to various points on the spider cage. Commercial spider cages are available, but are expensive. This spider cage needs to be made with the materials already purchased by the client, transportable, able to be set up by the client and also support the any patient.

Client Requirements:

- The cage shall be able to be transported by trailer
 - The structure will need to fit through a doorway.
- The client cannot offer any budget.
 - The client has already supplied the previous Spider Cage team with money, with which steel for the structure was purchased. These members must make up the Spider Cage.
- The cage shall be able to be assembled by the client (2-4 assemblers), must include instructions.
- Locations of where bungees can be attached to the cage
 - The Spider Cage shall have members on the three walls and the ceiling of the cage that are moveable. This will allow the client to attach therapy bands to any location on each wall and the ceiling of the cage.
- The cage shall be able to hold 350 lbs. of weight from any point on the cage.
- Therapists shall be able to reach any point on the cage to attach a therapy band. A maximum height shall be set between 6ft. and 7ft.
- The cage shall be able to fit any size patient.

Design Requirements:

1. Physical and Operational Characteristics

- a. **Performance Requirements:** The cage must be able to hold 350 lbs from any structural component/frame member or resistance band connection point. The cage must have at least four adjustable/movable resistance band connection points on each section of the cage (top, back, left side, right side). The maximum height of the cage must not exceed 7ft. Any portion of the cage used for resistance band connections or adjustments may not exceed a maximum height of 6ft. There must be enough room within the cage for patient and physician to work comfortably and simultaneously. The cage must be modular for transportation and installation using a maximum of four persons and a generic towable trailer. Modular sections must be able to fit through a standard 32" X 80" doorway.
- b. **Safety:** Ensure the cage can perform as expected with a safety factor of 3 when a load is applied in a "worst-case" loading scenario. Mark, protect, or remove all possible pinch points. Use non-corrosive and non-toxic materials. Remove all sharp edges. Develop an instruction manual informing users of proper lifting and handling techniques to avoid injury when transporting. Develop a maintenance plan for maintaining and cleaning intricate/detailed portions of the cage to avoid dust/dirt build up.
- c. **Accuracy and Reliability:** Resistance band connection points must have fixed adjustment locations or position references for tracking patient progress. Connection points for the modular sections must have appropriate tolerances for proper rigidity while in use, yet must they must have enough clearance for assembly/disassembly.
- d. **Life in Service:** The cage is expected to remain functional for as long as possible without replacing structural/critical components and while being used an average of 6 times a day.
- e. **Shelf Life:** Cage and its components should be stored in a dry, temperature controlled area.
- f. **Operating Environment:** The cage will be used in a clinical setting such as a physical therapist's office as well as in the patient's home. Not meant for climbing, only to support body weight via bungee cords.
- g. **Ergonomics:** Cage must be easy and relatively quick to assemble and disassemble; instructions for doing so should be included with cage.

- h. Size:** Large enough for a therapist and patient to stand up comfortably and perform exercises but small enough to fit in a trailer. The height must not exceed 7 ft.
- i. Weight:** There is currently no minimum weight, however, the weight should not compromise the stability of the cage. If it is designed as a kit to be assembled, each piece of the kit must have a low enough weight to allow it to be transported to and from a trailer and must be small enough to fit through a door.
- j. Materials:** The material should be as lightweight as possible while still retaining its structural integrity. An ideal material may be rigid plastic, as opposed to steel, however, this may exceed the project's budget. Overall, the heavier the material, the more pieces the cage must be disassembled into to allow for easy transportation of the cage.
- k. Aesthetics, Appearance, and Finish:** The cage should be free of sharp corners or places that could snag on clothing or the harnessing itself. If the cage folds, the folded structure must also not pinch the customer while it is being transported. The functionality of the cage is more important than the appearance, but the cage should appear clean, with no points of concern such as material defects visible. Harnessing for the patient should look or be professionally sewn with sturdy attachments to the bungee cords.

2. Production Characteristics

- a. Quantity:** Only one spider cage needs to be created and tested, there will be no mass manufacturing of the design. An instruction manual on how to assemble the cage and a fabrication manual on how to build the cage should be included.
- b. Target Product Cost:** Spider cages go for ~\$5000, therefore, a final cost that is less than half of this is the desired target.

3. Miscellaneous

- a. Standards and Specifications:** None required as of now.
- b. Customer:** The cage is being designed for a patient with cerebral palsy. There is no specific customer that this product is being built for so the only customer requirements are that the cage support the height and weight of a given patient.

- c. *Patient-related Concerns:*** The cage will need to be used with a patient under the supervision of an occupational therapist.
- d. *Competition:*** There are a few cages available online for purchase but they are not as similar to the design that the client, Mr. Jahnke is looking for.