Powered Litter

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Project Description

The goal of the Powered Litter project is to design, create, and test a device that attaches to the litter's base making the litter self-propelled. This powered litter device will be used in emergency rescue situations where a person is stuck out in a difficult region of nature and has suffered a serious injury not allowing them to walk. The purpose of the device is to improve upon the safety of the injured patient and the rescue crew. The device will not negatively impact any functionality of a typical litter used to transport the injured. The device is to be battery operated, provide appropriate controls, and braking. It is expected that the device be able to operate at a normal walking speed of 1.4 [m/s].

Currently, stretchers are the go-to device in these rescue situations due to their portability, ruggedness, and affordable cost. However, they have not changed very much from their original design (refer to Figure 1.1). The powered litter project is proposing a fresh and improved version of this device by innovating its design to be self-propelled, which makes the rescue crews job much less taxing and improves the efficiency by preventing the crew from unnecessary fatigue. This device will also provide better care for the patient by allowing for better stability. See Figures 1.2-1.4.

Table 1: Powered litter functional requirements.

Functional Requirements	Corresponding Values
Factor of Safety	3.6
Has to travel at the average walking speed.	1.4 m/s
*Durable and able to hold the weight of an average sized person.	Max weight: 250 lbs
*Lightweight and Detachable	Max weight of each section: 30 lbs
*Weather Resistant	Insulated motor, battery, and electrical components

secondary

To determine the success for this project the above requirements in Table 1 are expected to be met. A factor of safety value of 3.6 was chosen for the static load applied to the litter, ensuring the structure would not buckle in the dynamic conditions of its use. The powered litter should be able to maintain the average walking speed of a rescuer (1.4[m/s]), ensuring the work required by the rescue team is as minimal as possible. The litter should be able to carry and support a 250[lb] patient in the event of a rescue. The American Society of Testing and Materials (ASTM) F2821-15 engineering standard outlines the testing methods for basket type rescue litters. This engineering standard was used when reviewing the structural integrity, stability, and safety of the litter. The litter has been designed to be easily assembled and disassembled for ease of transportation in vehicles with each section designed to weigh less than 30[lb]. This will allow rescuers to carry the disassembled litter in parts until the assembly is desired. The weather proofing process would follow the ASTM electronics standard F2865-13, which classifies the degree of ingress of dust and water. The powered litter was planned to be tested for the F2865-13 under an IP54 standard, ensuring that the dust ingress does not interfere with the operation of the equipment. It would also protect the product against water ingress from sprays and splashes in all directions.

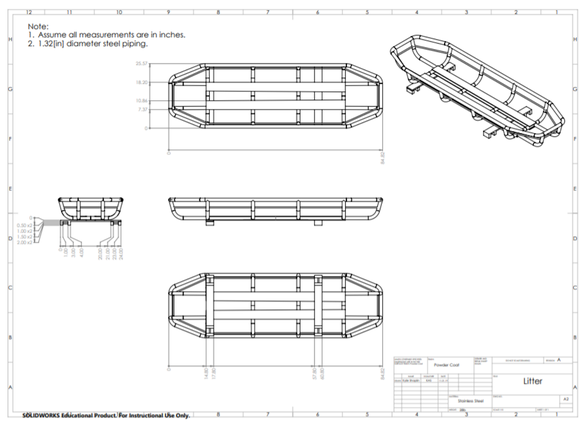

Figure 1.1: Pre-Fabricated litter mechanical drawing.

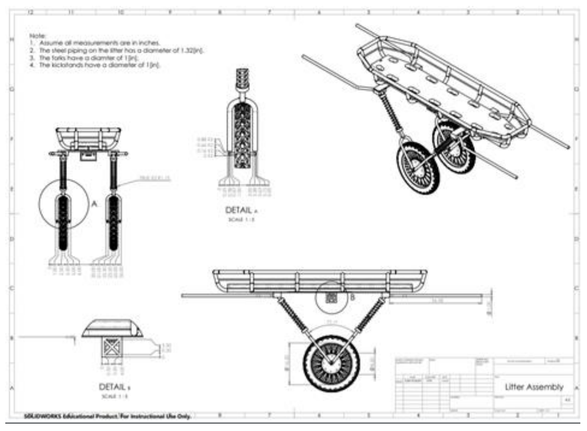

Figure 1.2: Powered litter final design mechanical drawing.

Figure 1.3: Powered litter final design SolidWorks assembly model.

Figure 1.4: Powered litter alpha prototype build.

Design Process

There were multiple factors that had to be taken into consideration when developing the design of the powered rescue litter. Those factors were, being able to disassemble the litter for portability, having each of the disassembled components weigh less than 30[lb], and also to be able to carry a maximum weight of 250[lb]. Taking these factors into consideration, the structure of the litter was design based on triangles, which is the strongest geometric shape that can be used on a structure. This not only would help to properly distribute the weight of the person, but it would also emphasis the weight in the part that was the most convenient such as the shocks. Having this shape would also make it essentially portable by reducing its volume when disassembled. The two wheel design was also implemented to ensure the stability of the powered litter (refer to Figures 1.2-1.4). A pre-fabricated litter was used in the design of the product, to ensure that it would be compatible with any litter (refer to Figure 1.1). As seen in Figure 1.4, the wheel assembly was design to be offset from the center of the rescue basket, which anticipates for the weight distribution relative to the center of mass of the patient.

Test Data

If all of the prototype testing were to have been completed, there would have been data to verify each of the functional requirements and engineering standards. An electrical system test would have been completed to determine if the electrical system could provide enough power to move the litter. A speed test was able to be completed on the alpha prototype (refer to Figure 1.4) to ensure that the litter could travel at 1.4[m/s]. The data obtained from this test provided the results seen in Table 2. Due to this test being the first attempt on the alpha prototype, the results do not make logical sense for the powered litter product, which calls for more testing. The weather resistant test would be completed to verify that the litter can withstand water and dust ingress from all different angles according the IP54 standard. Another test would be done to verify that the litter could bear the different weights from 0[lb] – 250[lb], with 250[lb] being the maximum weight that it could carry. A test to verify the ability for the litter to propel up different inclines would be completed as well, with a maximum incline of 12 degrees. The modularity of the litter would have also been tested to determine how well the product would disassemble and reassemble. The final test that would have been completed is a mock simulation test to verify that the powered litter would work in a real-life search and rescue mission. Each of these tests would help to verify that the litter meets necessary the requirements.

Table 2: Speed test results for the powered litter alpha prototype.

Speed Rating	Speed[m/s]
Low	38.65
Medium	59.20
High	99.86