

Universal Design Specs

Implantable Portion

1. Net minimum flow rate must be 5 L/min [3,6]
2. Overall size must be implantable in an average male's chest, fitting within a max cube of 6 cm x 15 cm x 10 cm [1,4]
 - Furthermore, the shape of the internal portion must be suitable for implantation in the body. Every exposed surface must have a minimum fillet radius of 1 cm to avoid sharp edges.
3. The assembled heart cannot leak [Given]
4. Each ventricle must have at least 2 ports (1 inlet and one outlet for blood), and 100% of the blood must flow through both ventricles in series. The left side must have an exit and entrance oriented upwards and to the right, and the right side must have an exit and entrance oriented upwards to the left. [1]
5. Must be pressurizable 120 mmHg (16 kPa) for 30 seconds without breaking (burst pressure) [2,13]
6. Must be purely mechanical (no electricity) [Given]
7. The blood must remain in the body [Given]
8. Assembled product must not incur damage from a drop test of 1 foot onto a rubber/padded surface
9. Must not incur damage during drop, impact, compression, and vibration tests when the product is packaged for shipping [12]
10. The product must be biocompatible, or at least biologically inert [9]
11. The product must be able to be sterilized. Heat/steam sterilization may be used on metal (titanium) parts and on polyimide (high temperature) plastics [7,8,11]

External Driver

12. Must be packable to backpack size of 45 cm x 43 cm x 22 cm
13. Does not exceed 20 lb [5]
14. Takes less than or equal to 90 seconds to set up for someone familiar with the system, as 4-6 minutes without a heartbeat (blood flow) causes permanent damage to the body. We want a safety factor of >2, making our setup time less than 2 minutes [10]
15. A healthy adult between 18-40 years old, and of moderate to average strength, must be capable of performing 5 minutes of continuous operation
16. Must be purely mechanical (no electricity) [Given]
17. Disassembled parts must not incur damage from a drop test of 1 foot onto a rubber/padded surface
18. Must not incur damage during drop, impact, compression, and vibration tests when the product is packaged for shipping [12]

Design-Specific Design Specs*

1. The volume which can be possibly displaced by the driver must be equal to (or within 90% of) the volume possibly displaced by the internal portion:

$$(.9)\Delta V_{\text{internal capable}} < \Delta V_{\text{external capable}} < \Delta V_{\text{internal capable}}$$

2. The driver and implantable portion must use an incompressible fluid

External Driver

3. The flywheel must complete at least one full revolution every 2 seconds (Universal Spec 1)
4. The period of the flywheel must be synced with the period of the piston
5. The rim of the flywheel must be filleted to a radius of 1 cm on both edges to allow convenience for gripping and spinning manually

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6. The internal portion must propel greater than or equal to 167 cc/stroke (Universal Spec 1, Design Specific 3)

*These specifications are not based on research, but rather on the minimum performance requirements that we wish to achieve with our specific design

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