Heart Pump Impeller – Executive Summary

Heart pumps need precision impellers optimised for high RPM, flow rate and multi-decade longevity. This design is a scaled-up prototype impeller optimised to run at 2700RPM across a 0.8 bar pressure difference and achieve a 75 litres/min flow rate.

Data Sheet:

Dimensions	
Inlet blade height, $\mathbf{b_1}$	0.01m
Outlet blade height, $\mathbf{b_2}$	0.008m
Number of blades, **n**	6
Inlet & outlet blade thickness, **t**	0.001m

Efficiency Factor Values	
Velocity misalignment, $\mathbf{|v_2| - v_d}$	1.82
Outflow angle misalignment, $\boldsymbol{\alpha_s - \alpha'_2}$	0.367°
Inlet blockage factor, $\mathbf{B_{f1}}$	0.861
Outlet blockage factor, $\mathbf{B_{f2}}$	0.832
Slip factor, $\boldsymbol{\sigma}$	0.903
Leading edge angle, $\boldsymbol{\beta_1}$	23.9°

Where the efficiency parameters that are defined as such:

- A small *velocity misalignment* ($\mathbf{|v_2| - v_d}$) – meaning an impeller where there is a small difference between the *absolute velocity of flow at the exit of impeller* ($\mathbf{|v_2|}$) and the *velocity of flow at entry to the diffuser* ($\mathbf{v_d}$). This is because the larger difference the more energy is lost to vortex formation

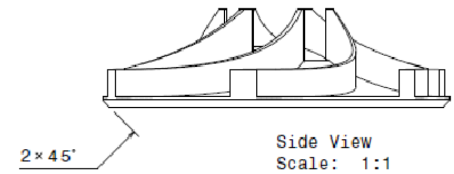
- A small *outflow angle misalignment* ($\boldsymbol{\alpha_s - \alpha'_2}$) – meaning an impeller where is a small difference between the *volute spiral angle* ($\boldsymbol{\alpha_s}$) and the *outlet flow angle* ($\boldsymbol{\alpha'_2}$). This is because a large difference means more flow hits the casing of the pump and causes energy loss in the flow due to turbulence.

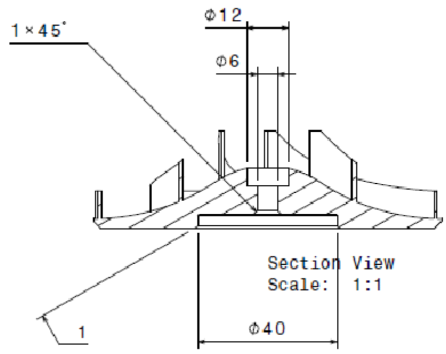
- An *inlet and outlet blockage factor* ($\mathbf{B_{f1}}$, $\mathbf{B_{f2}}$) as close as possible to 1. This is because a high factor means a low blockage in the flow. Devices where more energy is used to accelerate the flow rather than overcoming blockage/friction in the flow are more efficient.

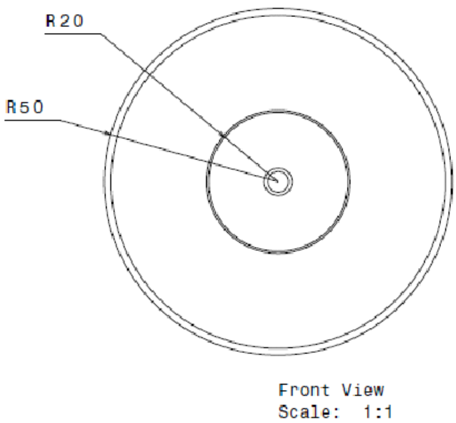
- A *slip factor* (**σ**) as close as possible to 1. This is because a high slippage means a larger difference between the actual and ideal tangential velocity of the flow as it leaves the impeller, meaning the impeller increases the velocity of the flow less efficiently. The closer to 1 the lower the slippage.

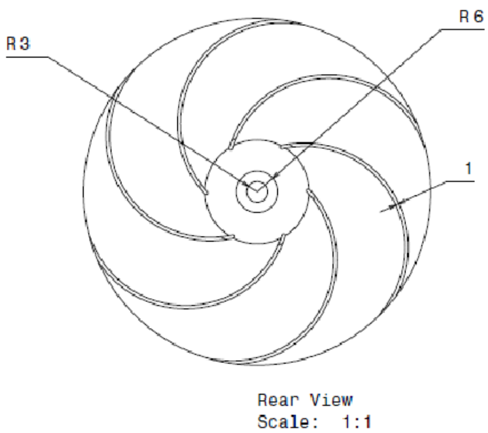
- Small *leading edge angle* (**β_1**). This is because a large angle results in laminar separation and cavitation as fluid passes through the impeller, thus causing inefficiencies in the pump.

2D Drawings









CAD Model (CATIA):