

Client Needs

Client Need Statement

To investigate the relation between cartilage redox balance and disease state, the Henak Lab requires a method of applying physiologically relevant mechanical stimuli (which is known to influence said redox state) to articular cartilage samples over the long-term; to meet this need, Dr. Henak has requested the fabrication of an incubator-housed device capable of replicating in vivo compressive stimuli profiles over the desired timescales.

List of client needs (in their words)

Low-to-no friction on contacting pillar surface

Linear actuation applying ~20% strain to 6mm x 2mm (diameter x height) cartilage samples

Constant force, not necessarily constant strain, applied across all samples

Device must be capable of providing a variety of force profiles

Incubator-compatible

Engineering Specifications

Specification description	Target	Unit	Test method	Rank	Met
Category 1: Device Function					
Device to apply & control linear actuation with controlled force capable of actuating compression mechanism	>25	N	Validate manufacturer specifications with testing	Must	
Induces 20% strain in (idealized) cartilage samples via uniaxial tensile stress	20%	mm/mm	Use in-device load cell to determine deformation	Must	
Sufficient device actuation to allow for removal of sample dish	50	mm	attempt removal of sample dish	Must	
Low-friction compression/interface with cartilage sample	0.1	-- (coefficient of friction)		Must	
Category 2: Incubator and environment					
Fit within incubator	(20 x 21 x 25)	inch	place fully fabricated box into incubator / measure	Must	
Able to withstand laboratory-grade sanitation procedures	---	---	Review of individual electronic technical specifications prior to use	Must	
Electronic components of actuator withstand incubator's simulated in-vivo environment	---	---	Review of individual electronic technical specifications prior to use	Must	
Cords of electronic components may be wired to external power sources	---	---	review of cord diameter and quantity	Must	
Category 3: Additional Functions					
Modular compressive pillar attachment (i.e., to allow for 6, 12, 24, etc. well plates to be used)	---	---	N/A	Nice-to-have	
Modular compressive pillars that are different shapes (e.g., indentors)	---	---	validate that the actuator applies the same force to the samples	Nice-to-have	
Re-feeding mechanism (i.e., to change sample media automatically within incubator)	---	---	N/A	Nice-to-have	
Category 4					