



# Mechanical Testing of Hydrogels



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## Abstract

Interpenetrating networks (IPNs) and hydrogels have many biomedical applications, which require varying mechanical properties. The mechanical properties of IPNs and hydrogels are dependent on their chemical composition, temperature, and pH of their surroundings. At present, there is limited published work to describe these properties and conditions. The goal of this project is to design a testing system(s), which will allow our client to identify the dynamic stress-strain relationship, creep, and ultimate stress and strain. This semester, an environmental chamber to be used for tensile testing with the Instron 1000 system was modified and tested. A creep testing system was designed and a prototype was built. Future work includes testing of the creep system.

## Final Design Tensile

### Tensile Testing Modifications

- Top plate of environmental chamber was removed because it interfered with travel of Instron 1000 crosshead
- Machined and tested a new aluminum grip adaptor to prevent contact between Instron 1000 and solution
- Developed chamber filling/draining mechanism

### Tensile Testing System Validation

- No leak
- Temperature is maintained over duration of tensile test.
- Instron 2700 Series grips are sensitive enough for soft biomaterials, like gels
- Does not interfere with tensile test



Figure 1 - Instron 1000 Mechanical Testing System with Environmental Chamber.

## Creep

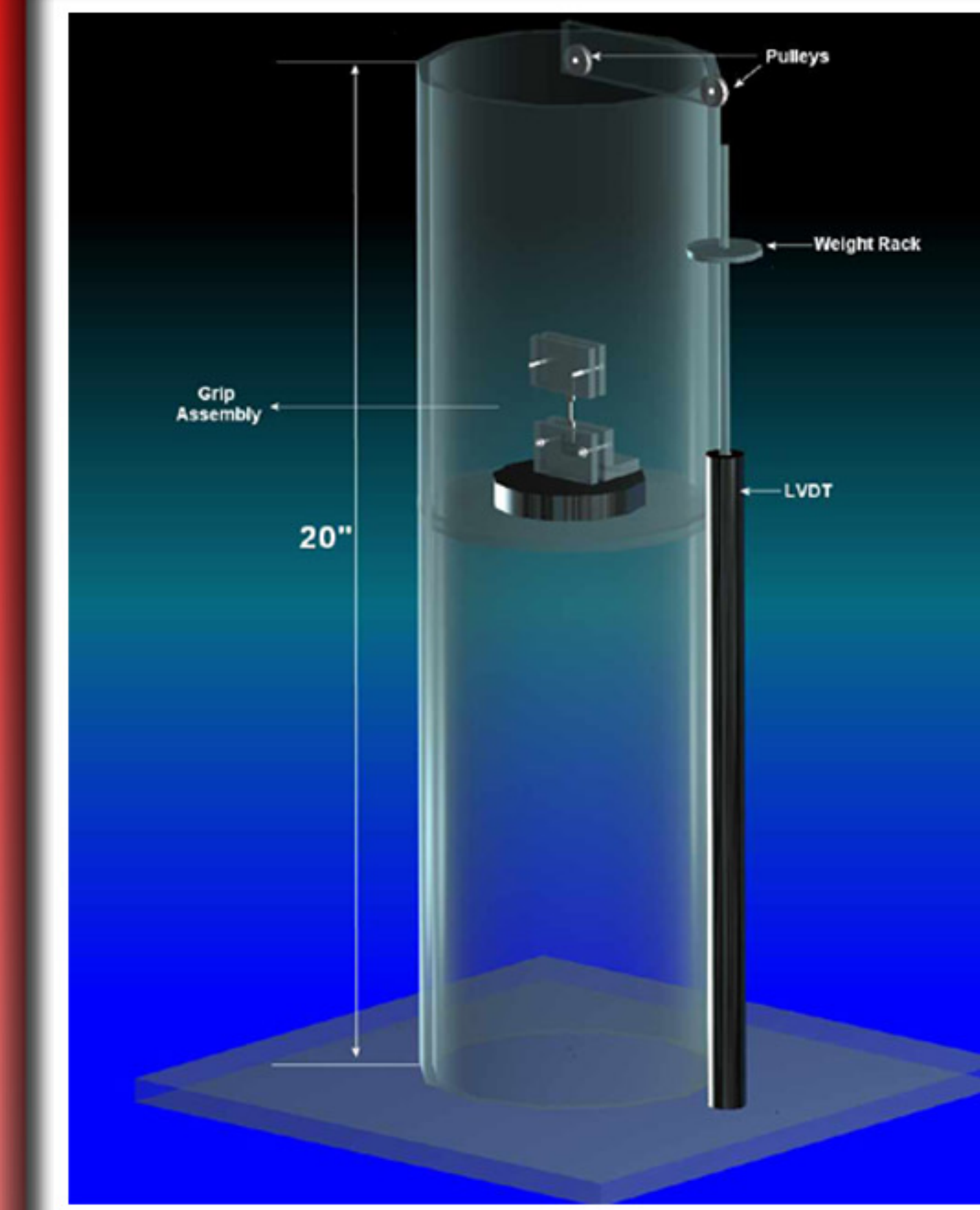


Figure 2 - 3D rendering of creep testing system.

### Features:

- LVDT displacement transducer measures elongation of gel specimen
- 10-bit ADC allows for computerized data logging with 0.1 mm precision
- Transparent Acrylic body allows for clear viewing of specimen during testing
- Weight rack allows adjustable load

## Background

IPNs and hydrogels are gelatin-based biomaterials. They are used for many biomedical applications, including drug delivery matrices, tissue engineering scaffolds, and wound dressings.

## Problem Definition

There is limited published data on the mechanical properties of IPNs and hydrogels. Tensile and creep properties need to be characterized in physiological conditions ( $37\pm 3^\circ\text{C}$  and pH 4.5-8) before these biomaterials can be further developed for clinical use. To investigate these properties, the following is needed.

- Tensile Testing System
- Creep Testing System

## Design Criteria

Study the Tensile and Creep Properties of IPNs and hydrogels under controlled environmental conditions:

- pH range (4-8)
- Temperature  $37\pm 3^\circ\text{C}$

Sample preparation will include using the PDMS-Stencil procedure, which follows standards established by American Society for Testing Materials (ASTM)

## Future Work

### Tensile Testing

- Discuss alternative solutions for sensitivity with Instron1000

### Creep Testing System

- Prototype Testing
- Heater and/or circulating water bath for temperature control
- Data logging system

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