BME Design-Spring 2026 - BRYAN HEATON
Complete Notebook

PDF Version generated by

Dhruv Nadkarni

on

Apr 29, 2026 @07:40 PM CDT

Table of Contents

Team contact Information

Dhruv Nadkarni - Jan 23, 2026, 11:17 AM CST

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
Johnson	Russ	Advisor	russ.johnson@wisc.edu	N/A	M1073 Engineering Centers Building
Botros Cho	Ms. Nada Dr. Daniel	Client Alternate client	nbotros@wisc.edu chod@surgery.wisc.edu	414-687-9117	UW School of Medicine and Public Health - Division of Plastic Surgery
Heaton	Bryan	Leader	bmheaton@wisc.edu	952-367-6597	N/A
Kaminski	Meghan	Communicator	mfkaminski@wisc.edu	630-549-4521	N/A
Evers	Serena	BSAC	skevers@wisc.edu	262-665-4562	N/A
Nadkarni	Dhruv	BWIG	dnadkarni@wisc.edu	978-793-5560	N/A
Gunasekar	Harshad	BPAG	hgunasekar@wisc.edu	630-730-6531	N/A

Project description

SERENA EVERS - Apr 29, 2026, 2:56 PM CDT

Course Number: B M E 402

Project Name: EarVac: Negative pressure wound therapy device for improved microtia reconstruction healing

Short Name: EarVac

Project description/problem statement:

Newly reconstructed ears after microtia reconstruction surgery are fragile, prone to destructive fluid buildup, and difficult to dress securely. Clinicians need a conformal negative-pressure wound therapy device that holds a foam dressing over the ear, maintains consistent negative pressure over complex 3D geometry, and safely collects drainage from existing drains to reduce complications and support consistent healing. Current temporary drains often lose suction and dressings fail to seal around the ear's contours which increases a burden on clinical staff. A device specifically shaped for postoperative ear anatomy would provide a more stable seal, more reliable pressure delivery, more reliable wound drainage, and greater protection during the critical early healing period.

About the client:

Dr. Daniel Cho is a pediatric plastic surgeon at UW Health. He specializes in the treatment of infants and children with craniofacial differences. Ms. Nada Botros is a medical student at the Medical College of Wisconsin doing a dedicated research year with Dr. Cho in the CRANILab.

2026-02-06: Client Meeting Notes

Dhruv Nadkarni - Mar 12, 2026, 10:38 PM CDT

Title: Client Meeting Notes 1

Date: 2026/02/06

Content by: Dhruv Nadkarni

Present: Entire Team

Goals: Upload meeting notes to labarchives

Content:

Questions for client:

- What journals do you usually like to publish in?
- What are your goals for the project by the end of the semester?
    - Patent mention
- Do you have any design concerns?
- Do you have any concerns with our testing plan?
- Can we shadow the procedure?
    - How many procedures do you think you do on average at the UW Hospital
    - HOPEFULLY, whole reconstruction surgery
    - If not, we're cool with any part of the process
        - NPWT application
- Can we have a wound drain?
    - And some connections?
    - To your knowledge, are there any tube adaptors that you think we would need to successfully connect everything together?
- Do you know of any tight connectors for tubes that can be used to connect to the vacuum? Or any other methods that are approved in medicine?

CLIENT MEETING NOTES

- Journals - (3000ish words)
    - Journal of Craniofacial Surgery
    - PRS - biggest journal
    - Check BMES Journal
        - Annals of Biomedical Engineering – this one probably
    - Clinical journals tough to publish because clinical trials are necessary
- Patenting - Long Term Goal
    - Can atleast start with an Invention Disclosure (do an initial patent search to see feasibility)

    - WARF disclosure
- Design Comments
    - Looks good!
- EAKIN PUTTY - to ensure seal with tube going into adhesive
    - Build opening to stick tube through hole while maintaining seal
        - Straw type opening that tube can stick into and hold seal
    - Cable management adaptor????
    - IV hub + Double sided tape (IV tegaderm)
- Eakin cohesive seals large 4” 98mm 10 pack
    - Could be used to attach to skin and then attach to headphone on the other side.
- Double sided skin tape stuff on ear muff padding to eliminate the device-skin interface
- TEST SOON
    - Collect all testing data by the end of february
- TEST ON PERSON (comfort)
    - Silicone putty to close up ear drum
- 3D print the y connector?
- Jvac drain adaptor
    - Male female
    - Hypodermic needle (idk how to spell this) L

GOALS

- Sketch Out Updated Model
- End of February - Finish Testing
    - Hopefully by meeting on 2/18
- March - Patent stuff / Invention Disclosure & Research Paper (Annal of Biomedical Engineering)
    - Meet with WARF to discuss?
- April - Research Paper Revision by Dr. Cho, etc., & final presentation
    - Have a draft of the paper by early april once they get back from vietnam

Notes from OTHER Doctor

- Drain on the inside well suctioned HOWEVER, little pressure on the surface
    - 25-50 mmHg
    - 50 for both
- Concern with moving around, getting knocked around in the first week when the ear is fragile
    - She's cool with it after the first week tho, lit

- Wide range of head sizes, but we have to
- Also could be implemented as a week 2 dressing just to protect the reconstructed ear
    - Replace earmuff part after week 1
- Glasscock dressing
- Adaptability is KEY! You hear that brice spice
- TEST WITH FLAT PART
- 2 Stage surgery

Conclusions/action items:

Prepare for next client meeting

2026-02-26: Client Meeting

BRYAN HEATON - Apr 29, 2026, 12:01 PM CDT

Title: Client Meeting

Date: 2/26

Content by: All

Present: Meghan, Harshad, Bryan

Goals: Demonstrate the current state of the design

Content:

Everything went well! Nada loves the design and the direction of the device

Conclusions/action items:

- Put it on a person, dressing and headphone / headband
- Meeting in three weeks

2026-02-27: Advisor Meeting

BRYAN HEATON - Apr 29, 2026, 12:02 PM CDT

Title: Advisor Meeting

Date: 2/27

Content by: All

Present: All

Goals:

Content:

- Hair issue?
- Door seal in for muff cushion protection
    - Hardware store □

Conclusions/action items:

- Print the 3D Earmuff prototype to determine the final material
- Replace the Hydrocoloid Dressing with a rubber stopper for a seal

2026-03-06: Advisor Meeting

BRYAN HEATON - Apr 29, 2026, 12:03 PM CDT

Title: Advisor Meeting

Date: 2/27

Content by: All

Present: All

Goals:

Content:

- Begin fluid flow testing
    - Proof of concept that fluid will be reabsorbed
        - NO BACKFLOW

Conclusions/action items:

- Use red dye for backflow testing

2026-03-13: Advisor Meeting

BRYAN HEATON - Apr 29, 2026, 12:05 PM CDT

Title: Advisor Meeting

Date: 2/27

Content by: All

Present: All

Goals:

Content:

- We would like to do an invention disclosure with WARF/ speak with someone at WARF to understand the possible routes.
    - see if russ has anything to say about that
        - Include a Hazard analysis type section in our final manuscript
        - We need something to hold the tube in so it doesn't come out if the tube snags on something (lock mechanism maybe?)
        - Hard plastic around tube connection

Russ suggestions/comments:

- Decide who inventors are and who provided material input
    - 5 of us + 2 clients
- Talk to client first
-

  Wharf Invention Disclosure:

Conclusions/action items:

DO INVENTION DISCLOSURE

2026-04-10: Advisor Meeting

BRYAN HEATON - Apr 29, 2026, 12:06 PM CDT

Title: Advisor Meeting

Date: 2/27

Content by: All

Present: All

Goals:

Content:

Invention Disclosure

Design vs Utility Patent

- BOTH (Utility is stronger)
    - Highlight functionality
        - Dual Drain
        - Holding Vacuum
        - Airtight Seat
        - Headphone connection part type shi
        - Hotdog Foam / Flat Disc Foam design
        - Two phase approach

Conclusions/action items:

DO INVENTION DISCLOSURE

3/2/2026 - Y-connector size determination (copy)

BRYAN HEATON - Mar 13, 2026, 12:10 PM CDT

Title: Y-connector size determination

Date: 3/2/2026

Content by: Bryan

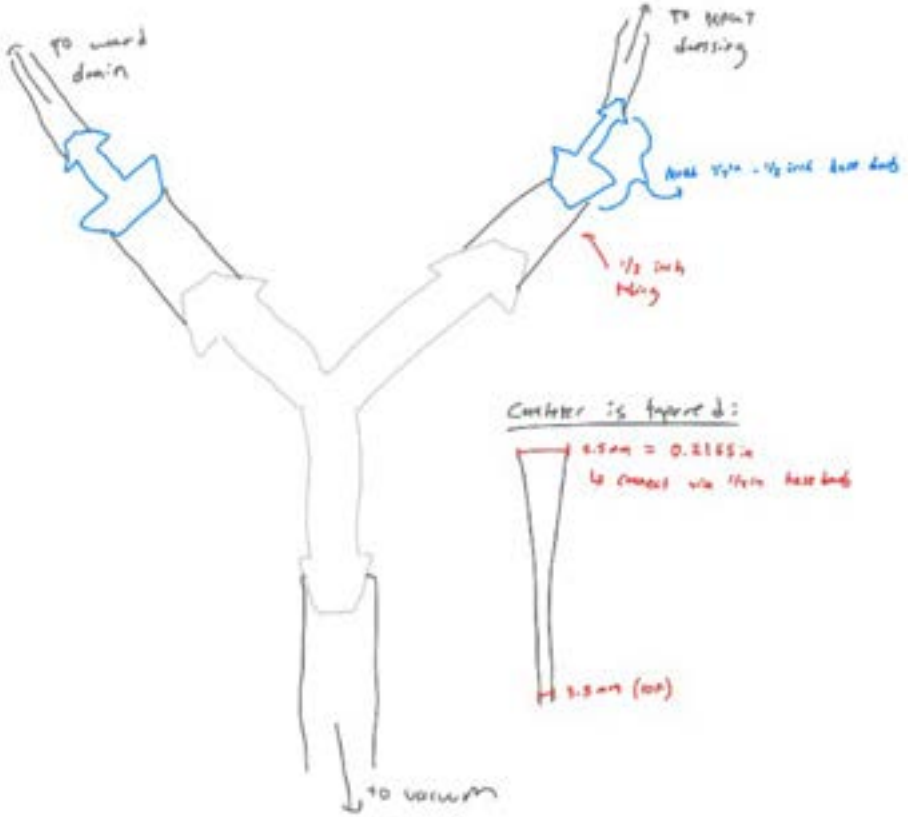
Present: Bryan, Harshad

Goals:

1. Find a commercially available y-connector suited for our design

Content:

This system allows for equal diameter tubing between wound drain and dressing while using commonly commercially available hose barb adaptors. It also only uses a 1/2 inch all around y-connector which is easy to find



Conclusions/action items:

- Continue to test with this setup

3/2/2026 - Dressing Evolution (copy)

BRYAN HEATON - Mar 13, 2026, 12:10 PM CDT

Title: Dressing Evolution

Date: 3/2/2026

Content by: Bryan Heaton

Present: Bryan

Goals:

1. Show the evolution of the NPWT dressing over time

Content:

The first version (v0) of the dressing was applied to a flat surface (table). It implemented

- Hot dog foam design
- Integrated tube / adhesive layer combination
    - Incorrect tubing diameter for y-connector compatibility

The first test-ready (v1) dressing implemented some changes:

- Correct tube diameter (10F) into dressing
- Tube - seal interface secured with hydrocolloid dressing

The second test-ready dressing (v2) only changed the location of the tube-adhesive interface to be towards the bottom of the ear to be more compatible with the earmuff piece.

Future improvements include:

- A more secure and modular tube-adhesive interface

- A more accurate diameter of adhesive layer around the foam to better approximate patient dressing security

Conclusions/action items:

- See above for improvements

3/2/2026 - First Vacuum Test (copy)

BRYAN HEATON - Mar 13, 2026, 12:10 PM CDT

Title: First Vacuum Test

Date: 3/2/2026

Content by: Bryan

Present: Bryan Heaton, Harshad

Goals:

1. Show the v1 dressing before and during vacuum
2. Evaluate seal viability for v1 seal

Content:

The v1 dressing worked as planned even with the hydrocolloid dressing security of the vacuum interface. This will be tested with future iterations of the dressing.

Conclusions/action items:

- Investigate other dressing improvements

3/11/2026 - Upgraded Vacuum Interface (copy)

BRYAN HEATON - Mar 13, 2026, 12:10 PM CDT

Title: Upgraded Vacuum Interface

Date: 3/11/2026

Content by: Bryan

Present: Bryan & Dhruv

Goals:

- Implement new interface into dressing for improved accessibility into NPWT dressing

Content:

Below displays the new dressing both under suction and without suction.

- The dressing still appears to distribute negative pressure evenly throughout the entire dressing
- Only one part had to be externally sealed with hydrocolloid dressing around the interface
    - Due to method of punching hole for stopper insertion
- All necessary hydrocolloid dressing shown is underneath the adhesive layer and will be replaced with a less volume-taking alternative in the future
- All concerns with the dressing will be resolved if the dressing is manufactured in a high-quality, high reproducibility facility.

Conclusions/action items:

- Re-do testing related to transmission of negative pressure with new seal
- Investigate repeatability of tube insertion through interface: any issues?

2/24/26: SolidWorks Update: Headband (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:33 PM CDT

Title: SolidWorks Update

Date: 2/24/26

Content by: Meghan

Present: N/A

Goals: Update dimensions

Content:

Conclusions/action items: Edit the earmuff portion in relation to the new dimension of the headband. 3D print the designs in PLA.

3/12/26: SolidWorks Assembly (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:34 PM CDT

Title: SolidWorks Assembly

Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Assembly to ensure components fit

Content:

Conclusions/action items: 3D print components in PLA.

3/12/26: SolidWorks Assembly 2 (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:34 PM CDT

Title: SolidWorks Assembly 2

Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Create assembly with protective ring

Content:

Conclusions/action items: 3D print all components.

3/12/26: Protective Ring (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:34 PM CDT

Title: Protective Ring

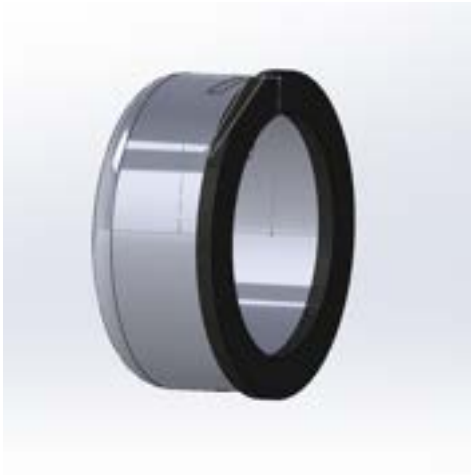
Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Create protective ring for earmuff and dressing interface

Content:



Conclusions/action items: 3D print protective ring in softer material.

3/12/26: SoldiWorks Update: Earmuff (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:34 PM CDT

Title: SolidWorks Update: Earmuff

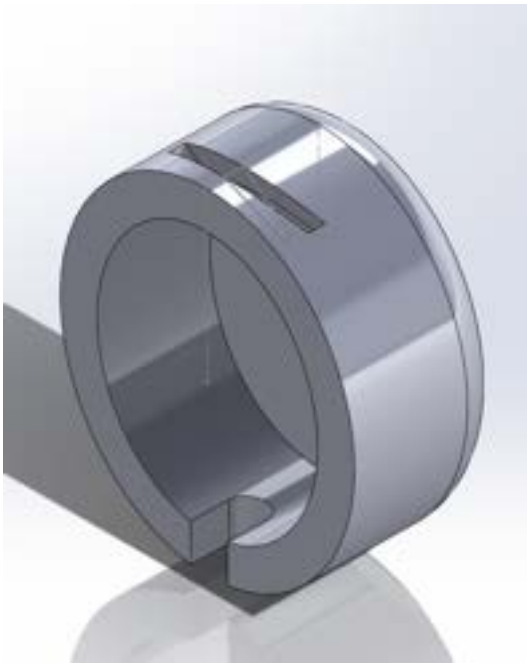
Date: 3/12/26

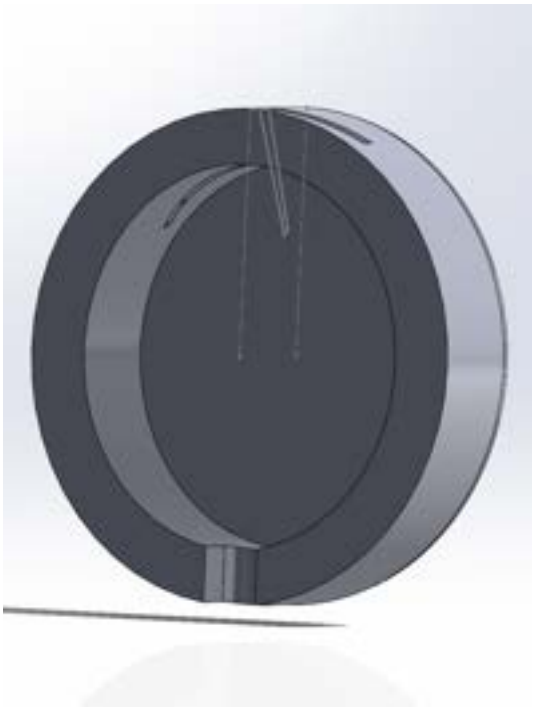
Content by: Meghan

Present: N/A

Goals: Update dimensions

Content:





Conclusions/action items: 3D print both components in PLA to test connection site.

3/18/26:3D printed earmuff with elastic ring (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:35 PM CDT

Title: 3D printed earmuff with elastic ring

Date: 3/18/26

Content by: Meghan

Present: N/A

Goals: 3D Print pictures

Content:

Conclusions/action items: Reprint with more flexible material

3/18/26:3D printed Headband (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:34 PM CDT

Title: 3D printed Headband

Date: 3/18/26

Content by: Meghan

Present: N/A

Goals: 3D Print pictures

Content:

Conclusions/action items: Reprint with more flexible material

3/18/26:3D printed earmuff with elastic ring (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:34 PM CDT

Title: 3D printed earmuff with elastic ring

Date: 3/18/26

Content by: Meghan

Present: N/A

Goals: 3D Print pictures

Content:

Conclusions/action items: Reprint with more flexible material

3/2/2026 - Y-connector size determination (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:36 PM CDT

Title: Y-connector size determination

Date: 3/2/2026

Content by: Bryan

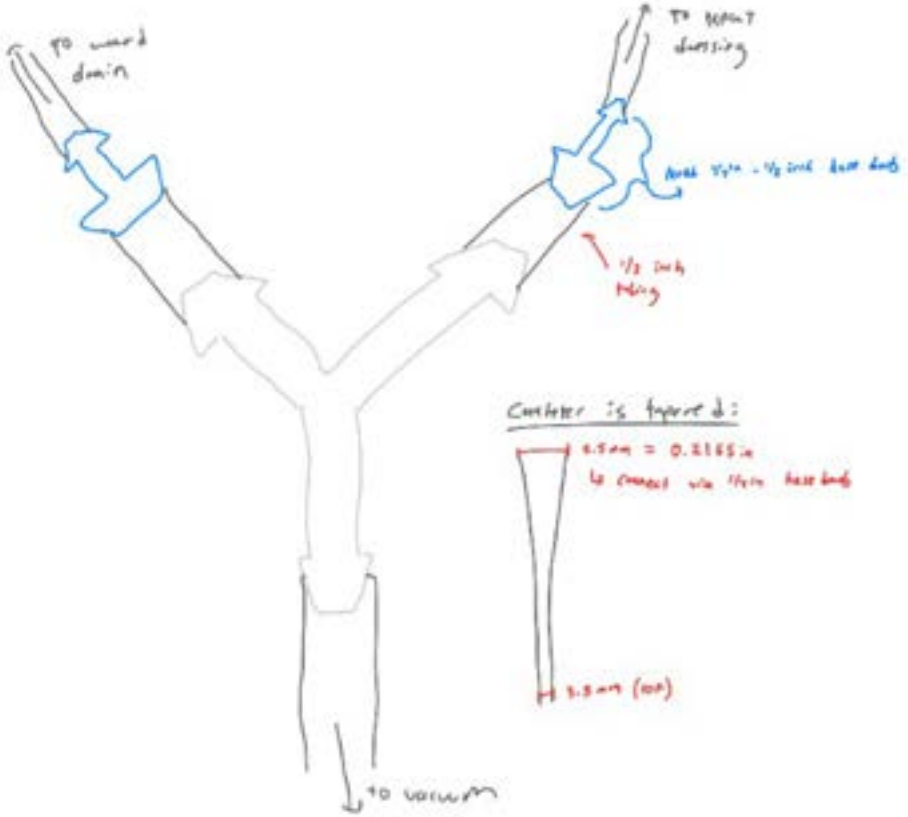
Present: Bryan, Harshad

Goals:

1. Find a commercially available y-connector suited for our design

Content:

This system allows for equal diameter tubing between wound drain and dressing while using commonly commercially available hose barb adaptors. It also only uses a 1/2 inch all around y-connector which is easy to find



Conclusions/action items:

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Future improvements include:

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Conclusions/action items:

- See above for improvements

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MEGHAN KAMINSKI - Apr 29, 2026, 2:36 PM CDT

Title: First Vacuum Test

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Content by: Bryan

Present: Bryan Heaton, Harshad

Goals:

1. Show the v1 dressing before and during vacuum
2. Evaluate seal viability for v1 seal

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3/11/2026 - Upgraded Vacuum Interface (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:36 PM CDT

Title: Upgraded Vacuum Interface

Date: 3/11/2026

Content by: Bryan

Present: Bryan & Dhruv

Goals:

- Implement new interface into dressing for improved accessibility into NPWT dressing

Content:

Below displays the new dressing both under suction and without suction.

- The dressing still appears to distribute negative pressure evenly throughout the entire dressing
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    - Due to method of punching hole for stopper insertion
- All necessary hydrocolloid dressing shown is underneath the adhesive layer and will be replaced with a less volume-taking alternative in the future
- All concerns with the dressing will be resolved if the dressing is manufactured in a high-quality, high reproducibility facility.

Conclusions/action items:

- Re-do testing related to transmission of negative pressure with new seal
- Investigate repeatability of tube insertion through interface: any issues?

3/11/2026 - Reproducibility of Tube Through New Interface Testing (copy) (copy)

MEGHAN KAMINSKI - Apr 29, 2026, 2:37 PM CDT

Title: Reproducibility of Tube Through New Interface Testing

Date: 3/11/2026

Content by: Bryan

Present: Bryan and Dhruv

Goals:

1. See if the seal is maintained after several insertion / removal cycles of the tube through the interface

Content:

Trial	Success?
1	Y
2	Y
3	Y
4	Y
5	Y
6	Y
7	Y
8	Y
9	Y
10	Y

Conclusions/action items:

- The seal demonstrated successful a vacuum pull after several insertions and removal of the tube from the dressing. This implies the dressing is viable even if tubing must be removed and replaced several times during treatment.

3/10/24: Biosafety and Chemical Safety

MEGHAN KAMINSKI - Mar 19, 2024, 10:30 PM CDT

Title: Bio safety and Chemical Safety training

Date: 3/10/24

Content by: Meghan

Present: Meghan

Goals: Complete all canvas modules and tasks to pass the bio safety and chemical safety training necessary for the labs in coming weeks.

Content:

Conclusions/action items: The image above shows the completion of my biosafety and chemical safety training. The training is necessary to understand the processes and potential dangers that come with unsafe practices in the lab. The next step is to use the skills in the biomaterial fabrication.

3/13/24: TeamLab training

MEGHAN KAMINSKI - Mar 19, 2024, 10:28 PM CDT

Title: TeamLab training

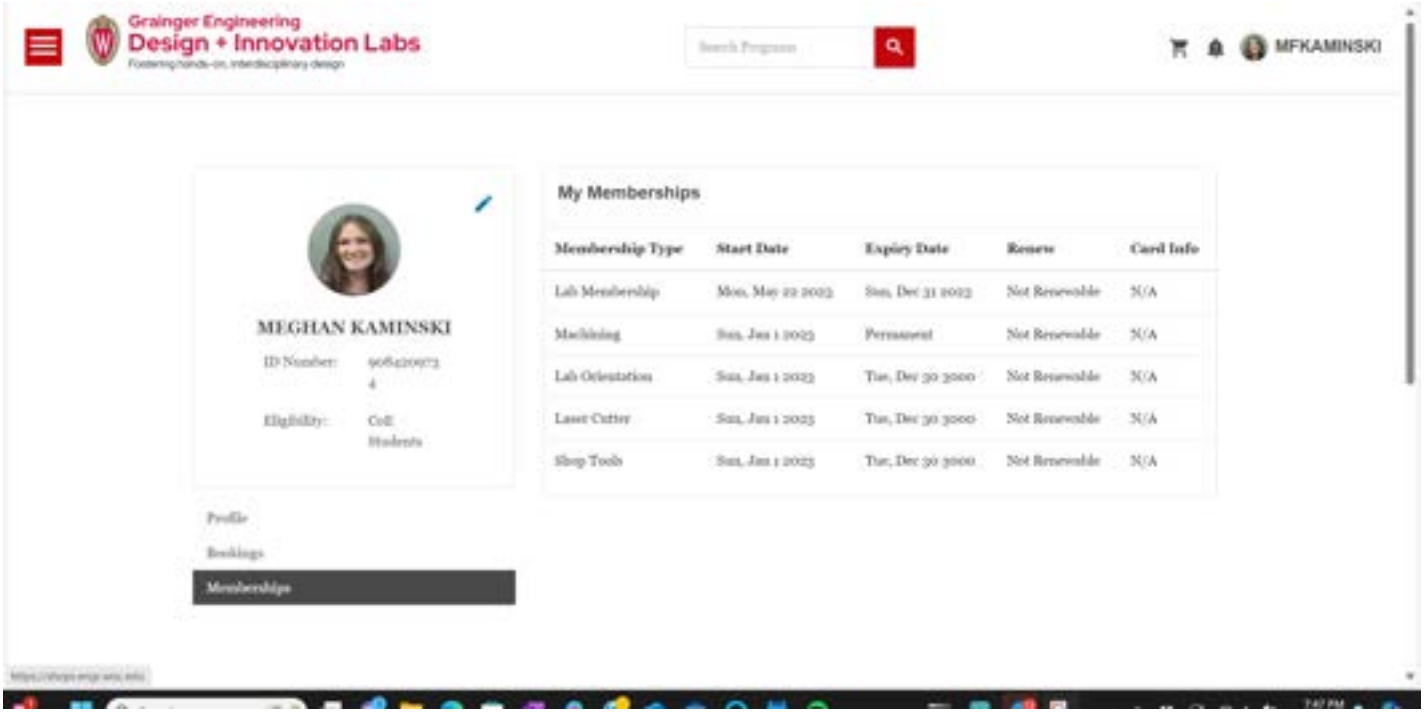
Date: 3/13/24

Content by: Meghan

Present: Meghan

Goals: Complete mill and lathe training to pass the intro to machining training necessary for fabrication of the sample holder.

Content:



Conclusions/action items: The screenshot above contains proof of my completion of the intro to machining in the Team Lab. It is necessary to continue to practice these new skills to improve my techniques. The next steps will be to use the certificate in the team lab with fabrication of the sample holder.

10/28/25- Animal user orientation training

MEGHAN KAMINSKI - Oct 28, 2025, 11:51 AM CDT

Title: Animal user orientation training

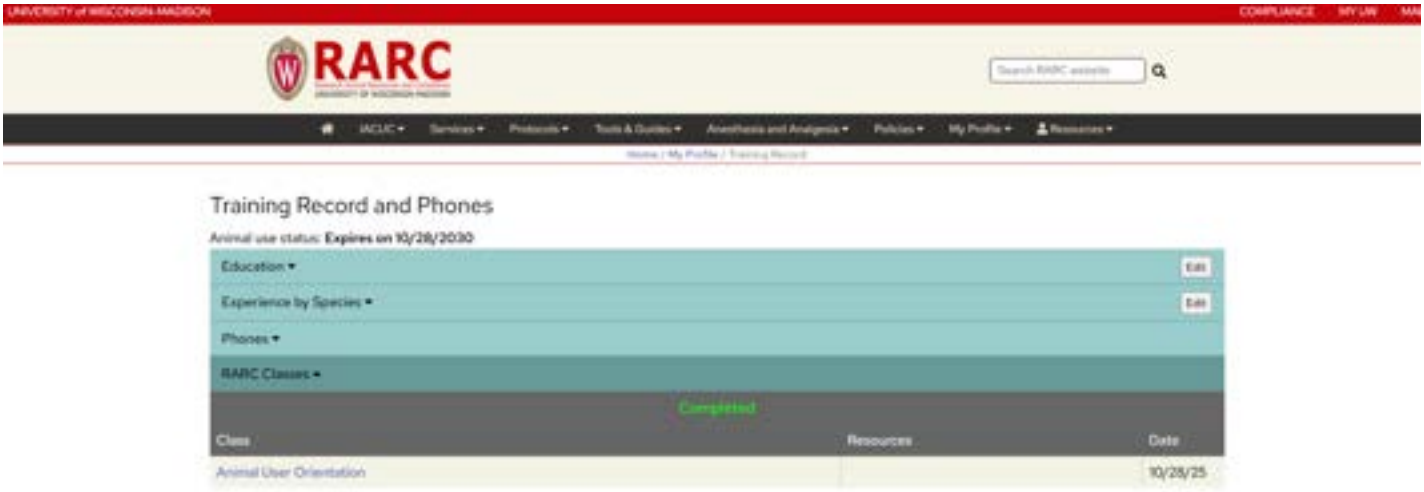
Date: 10/28/25

Content by: Meghan

Present: N/A

Goals: Required training

Content:



Conclusions/action items: N/A

3/16/26: Six Sigma Foundations: Applying Design for Six Sigma

MEGHAN KAMINSKI - Mar 16, 2026, 6:33 PM CDT

Title: Six Sigma Foundations: Applying Design for Six Sigma

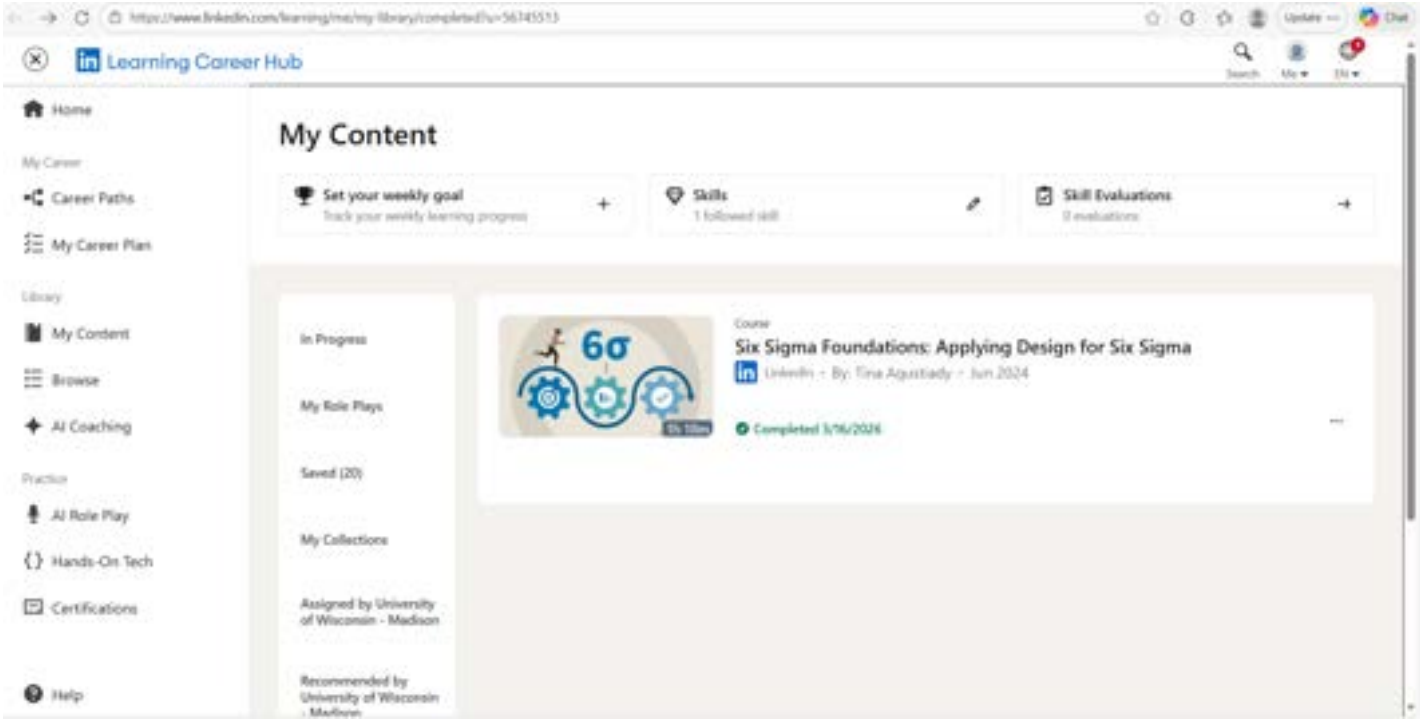
Date: 3/16/26

Content by: Meghan

Present: N/A

Goals: Complete training for the semester

Content:



Conclusions/action items: Apply knowledge to project/future industry experience

MEGHAN KAMINSKI - Mar 16, 2026, 6:33 PM CDT

Download

CertificateOfCompletion_Six_Sigma_Foundations_Applying_Design_for_Six_Sigma.pdf (63.8 kB)

4/29/26 Final Expense spreadsheet

SERENA EVERS - Apr 29, 2026, 2:58 PM CDT

Title: Expense spreadsheet

Date: 4/29/26

Content by: Serena

Present: n/a

Goals: n/a

Content:

attached

Conclusions/action items:

n/a

SERENA EVERS - Apr 29, 2026, 3:01 PM CDT

Download

BPAG_Expense_Spreadsheet_-_Sheet1.pdf (118 kB)

4/29/26 Materials description

SERENA EVERS - Apr 29, 2026, 3:04 PM CDT

Title: Materials description

Date: 4/29/26

Content by: Serena

Present: n/a

Goals: n/a

Content:

The materials used to fabricate the EarVac are separated into two categories. The first category is the dressing. The dressing contains all necessary elements to successfully dress and apply negative pressure to the closed incision. The second category is the protective layer, which will encase the dressing and secure it to the user's head. The protective layer includes the headband and protective ear muff.

The dressing utilized in negative pressure wound therapy devices can be assembled layer by layer, which allows flexibility in size range applications. Companies, such as Solventum, have created preassembled dressings for negative pressure wound therapy devices. For the application of the EarVac, a preassembled dressing will be fabricated for convenience, made possible by the limited variation in the size of incisions. The segment of the dressing in contact with skin is often a hydrocolloid dressing, which is desirable due to its gentle texture. Hydrocolloid dressings induce a moist wound-healing environment, which improves healing rate, reduces infection, and enhances collagen synthesis. DuoDERM dressings utilize modern hydrocolloid dressings for the management of exuding wounds. DuoDERM is utilized as the contact layer with the ear in the EarVac's dressing. The next layer contains polyurethane foam. Polyurethane foam ensures an evenly distributed negative pressure across the wound surface while absorbing exudate, reducing infection risks. DuoDERM and polyurethane foam are encapsulated in a layer of acrylic adhesive. The acrylic adhesive layer is waterproof, skin-friendly, and creates a strong seal to encapsulate the wound. The dressing is connected to an automated vacuum unit via medical-grade tubing. Medical-grade tubing utilized in NPWT devices is typically made from phthalate-free PVC. These elements constitute the dressing sticker.

The protective layer consists of two major components, the headband structure and ear muff protective layer. Both components are fabricated out of thermoplastic polyurethane. Thermoplastic polyurethane (TPU) is a thermoplastic elastomer that combines the elasticity of rubber with the processability of plastic. TPU can withstand bodily fluids, sterilization processes, and degradation. In future iterations, both the headband structure and ear muff protective layer will be lined with a layer of closed-cell polyethylene foam. Polyethylene foam is commonly used in wearable medical devices. Polyethylene foam will provide comfort to the user during long-term wear. In addition, the headband will be constructed of Nylon PA12. Nylon PA12 has high tensile strength and fatigue resistance, making it commonly used in devices such as prosthetics, orthotic braces, and wearable medical supports. Nylon is durable and lightweight which ensures reliability in outpatient environments.

To create the EarVac device entirely, the dressing sticker is connected to the ear muff protective layer via 3M Super 77 Multipurpose Spray Adhesive. 3M Super 77 Multipurpose Spray Adhesive is utilized in industrial applications with a variety of suitable materials, such as plastic, paper, and foam. In addition to a single, modular device, adjustability was an important factor used to evaluate different designs. In the future, to incorporate an adjustable aspect of the headband, medical-grade Velcro will be utilized. Medical-grade velcro is skin-friendly, breathable, and durable.

The final portion of the design involves the integration of the NPWT device tubing and a wound drain, which is inserted in the lower neck. A single-use Y-Connector is used to integrate the two tubes. This will supply constant negative pressure to both pathways, allowing efficient healing.

Conclusions/action items:

n/a

2026/02/20 - Negative Pressure Transmission Test Protocol

Dhruv Nadkarni - Apr 29, 2026, 2:55 PM CDT

Title: Negative Pressure Transmission Test Protocol

Date: 02/20/2026 (Updated 04/29/2026)

Content by: Dhruv Nadkarni

Present: Meghan, Serena, Harshad, and Bryan

Goals: Write the complete protocol for the test

Content:

Overview: The purpose of the continuous negative pressure transmission test is to assess the vacuum's ability to apply pressures of -50 to -130 mmHg within a 10 minute interval whilst remaining accurate to the intended value. Additionally, the mm deviation of the adhesive seal from original value (pre-vaccum) will be noted on each run to determine efficacy of adhesive and seal stickiness. The tests will have the vacuum apply pressures of 50, 90, and 130 mmHg below atmospheric pressure. Each pressure value will be tested for 10 minutes, 2 times. During each trial, the measured pressure values must not exceed +/- 5mmHg of the applied pressure values, as monitored on the pressure gauge. Additionally, we will note down the seal stretch length of the adhesive seal quadrants.

Procedure:

1. Prior to testing, the tester must measure the seal stretch at the 4 quadrants of the seal. Quadrant 1 is the top, quadrant 2 is the left, quadrant 3 is the bottom, quadrant 4 is the right. The Seal stretch is the pull off from the sponge and the skin.
2. Turn the vacuum on and set the pressure applied to 50mmHg below atmospheric pressure.
3. Let the vacuum run for 10 minutes. Monitor the pressure value via the pressure gauge.
    1. Should the displayed pressure and measured pressure exceed +/- 5mmHg of the intended pressure at any point, the test will be considered a fail. Additionally, if the vacuum does not continuously suction for 10 minutes (ripping or else wise), the test will be considered a fail.
4. During the test, the adhesive pull will be measured on all 4 sides of the seal. This can be measured anytime between 2-5 minutes in suction. Following the test, the adhesive stretch will be measured again.
5. Repeat the test for 50, 90, and 130 mmHg below atmospheric pressure. Take 3 minute breaks in between runs to ensure the sponge returns to equilibrium.

Conclusions/action items:

Results posted in Experimentation tab

2026/03/01 - Vacuum Validation

Dhruv Nadkarni - Mar 01, 2026, 4:26 PM CST

Title: Vacuum Validation Part 1

Date: 03/01/2026

Content by: Dhruv Nadkarni

Present: N/A

Goals: Validate Vacuum Works

Content:

The purpose of the test was to verify that the vacuum pressure is as expected. The test setup included an addition of a vacuum transducer to measure the pressure emitted.

5, 10, 15, 20, and 25 mmHg sub atmospheric were measured. Only visual observations were done for the pressure gauge to ensure a +/- 1mmHg deviation was applicable.

Conclusions/action items:

The visual observations indicated lower pressure was consistent between measured and observed. Official testing needs to be conducted to ensure all pressures within the -25 to -150 mmHg range work.

2026/04/29 - Tensile Testing Protocol

Dhruv Nadkarni - Apr 29, 2026, 3:07 PM CDT

Title: Mechanical Strength / Tensile Testing Protocol

Date: 04/29/2026

Content by: Dhruv Nadkarni

Present: Meghan, Serena, Harshad, and Bryan

Goals: Write the complete protocol for the test

Content:

Overview: The purpose of the test is to validate the failsafe design of the connection. The failsafe design ensures that if tension is applied to the tubing, then the tube will pull out of the connection sight rather than rip the seal. A 15mm by 70mm sample will be cut from the entire seal. The tubing will be gripped on the top claw of the MTS machine, while the skin material will be gripped to the bottom claw. The machine will pull the tube seal connection apart. The force required to break the seal must not be above 10N, as that is the strength required to rip off a Band-Aid. The test will be run a minimum of 3 times at 2 strain rates (5mm/min and 50 mm/min) Should the average force be greater than 10N, the test will be considered a fail.

Procedure:

1. Prior to testing, prepare a sample of 15mm x 70mm that consists of duoderm, sponge, adhesive seal, and the tubing and stopper connection.
2. Grip the duoderm, sponge, and adhesive seal portion to the bottom claw. Grip the tubing to the top claw.
3. Open the tensile testing method. Zero the force display on the MTS machine screen. Slowly increase the distance between the the two claws until the force display reads a value just above 0.1N.
4. Zero the force display and displacement display and then set the strain rate to 5mm/min. Begin the test.
5. Once the test finishes, note down visual observations around the seal tube connections. This can be rips or stretches or any other damage. Also save the data to a folder.
6. Repeat the test for 50mm/min strain rate.

Conclusions/action items:

Results posted in Experimentation tab

2026/02/20 - Negative Pressure Transmission Test Protocol Results Day 1

Dhruv Nadkarni - Feb 20, 2026, 1:59 PM CST

Title: NPWT Test Result Day 1

Date: 02/20/2026

Content by: Dhruv Nadkarni

Present: Bryan, Harshad, Meghan, and Serena

Goals: Record test results for the vaccum seal tests.

Content:

Test on 2/20/2026

50 mmHg

[redacted] Deviation (mm)

Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
50 mmHg (pre)	7.55	3.94	7.40	3.87
50 mmHg (2 - 5 min)	4.09	2.36	3.72	0
50 mmHg (post 10min)	7.08	3.66	7.47	3.88

No tears, no suction deviation

90 mmHg

[redacted] Deviation (mm)

Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
90 mmHg (pre)	7.29	3.66	7.88	3.97
90 mmHg (2 - 5 min)	3.04	2.16	4.01	0
90 mmHg (post 10min)	6.58	2.90	7.21	3.90

No tears, no suction deviation

130mmHg

[redacted] Deviation (mm)

Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
130 mmHg (pre)	6.92	3.50	6.98	4.21

130 mmHg (2 - 5 min)	2.95	1.63	3.07	0
130 mmHg (post 10min)	4.58	3.21	5.88	4.27

No tears, no suction deviation

Conclusions/action items:

Re-do test on another day to get averages

3/11/2026 - Reproducibility of Tube Through New Interface Testing

BRYAN HEATON - Mar 11, 2026, 3:41 PM CDT

Title: Reproducibility of Tube Through New Interface Testing

Date: 3/11/2026

Content by: Bryan

Present: Bryan and Dhruv

Goals:

1. See if the seal is maintained after several insertion / removal cycles of the tube through the interface

Content:

Trial	Success?
1	Y
2	Y
3	Y
4	Y
5	Y
6	Y
7	Y
8	Y
9	Y
10	Y

Conclusions/action items:

- The seal demonstrated successful a vacuum pull after several insertions and removal of the tube from the dressing. This implies the dressing is viable even if tubing must be removed and replaced several times during treatment.

2026/04/11 - Negative Pressure Transmission Test Protocol Results Day 2

Dhruv Nadkarni - Apr 29, 2026, 3:08 PM CDT

Title: NPWT Test Result Day 1

Date: 04/11/2026

Content by: Dhruv Nadkarni

Present: N/A

Goals: Record test results for the vaccum seal tests.

Content:

Test on 4/11/2026 - Test on OG Design (No Insertable Tube)

50 mmHg

[redacted] Deviation (mm)

Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
50 mmHg (pre)	5.6	2.3	4.5	2.8
50 mmHg (2 - 5 min)	0	0	0	0
50 mmHg (post 10min)	5.3	1.4	4.2	1.8

No tears, no suction deviation

90 mmHg

[redacted] Deviation (mm)

Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
90 mmHg (pre)	5.3	2.6	4.8	2.4
90 mmHg (2 - 5 min)	0	0	0	0
90 mmHg (post 10min)	3.7	1.3	3.8	1.6

No tears, no suction deviation

130mmHg

[redacted] Deviation (mm)

Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)

130 mmHg (pre)	4.5	2.3	4.0	2.2
130 mmHg (2 - 5 min)	0	0	0	0
130 mmHg (post 10min)	3.8	2.6	4.5	1.8

Slight tear in the seal, most likely due to repeated pull (almost 35 times)

NEW DESIGN EXTRA NOTES:

Values following INITIAL application: Once suction is ran for the first time, than the number go down to what we see

15.228.222.417.5

Test on 4/11/2026 - Test on New Design (Insertable Tube)

50 mmHg

[redacted]	Deviation (mm)			
Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
50 mmHg (pre)	6.8	7.7	9.4	7.8
50 mmHg (2 - 5 min)	0	0.4	7.1	0
50 mmHg (post 10min)	6.2	6.8	7.8	3.3

No tears, no suction deviation

90 mmHg

[redacted]	Deviation (mm)			
Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
90 mmHg (pre)	7.2	6.9	8.8	4.8
90 mmHg (2 - 5 min)	0	0.3	5.1	0
90 mmHg (post 10min)	5.6	6.6	6.8	3.3

No tears, no suction deviation

130mmHg

[redacted]

Pressure Applied	Deviation (mm)			
	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
130 mmHg (pre)	7.2	7.0	8.4	3.9
130 mmHg (2 - 5 min)	0	0.4	5.2	0
130 mmHg (post 10min)	5.9	6.6	8.4	4.5

No tears, no such deviation

Test on 4/11/2026 - Test on New Design (Insertable Tube)

[redacted]

Pressure Applied	Deviation (mm)			
	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
50 mmHg (pre)	7.4	6.6	11.1	4.6
50 mmHg (2 - 5 min)	0	0.4	8.2	0
50 mmHg (post 10min)	4.2	6.2	7.2	2.0

No tears, no suction deviation

90 mmHg

[redacted]

Pressure Applied	Deviation (mm)			
	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
90 mmHg (pre)	7.8	6.4	9.8	4.3
90 mmHg (2 - 5 min)	0	0.3	7.8	0
90 mmHg (post 10min)	4.5	6.0	7.2	1.8

No tears, no suction deviation

130mmHg

[redacted]	Deviation (mm)			
Pressure Applied	Quadrant 1 (Top)	Quadrant 2 (Left)	Quadrant 3 (Bottom)	Quadrant 4 (Right)
130 mmHg (pre)	7.8	6.5	8.2	4.3
130 mmHg (2 - 5 min)	0	0.3	7.7	0
130 mmHg (post 10min)	4.7	6.0	8.2	2.0

No tears, no such deviation

Conclusions/action items:

No further testing needed.

2026/04/14 - Cath-Seal Testing Results

Dhruv Nadkarni - Apr 29, 2026, 3:11 PM CDT

Title: Cath-Seal Tensile Testing Results

Date: 04/14/2026

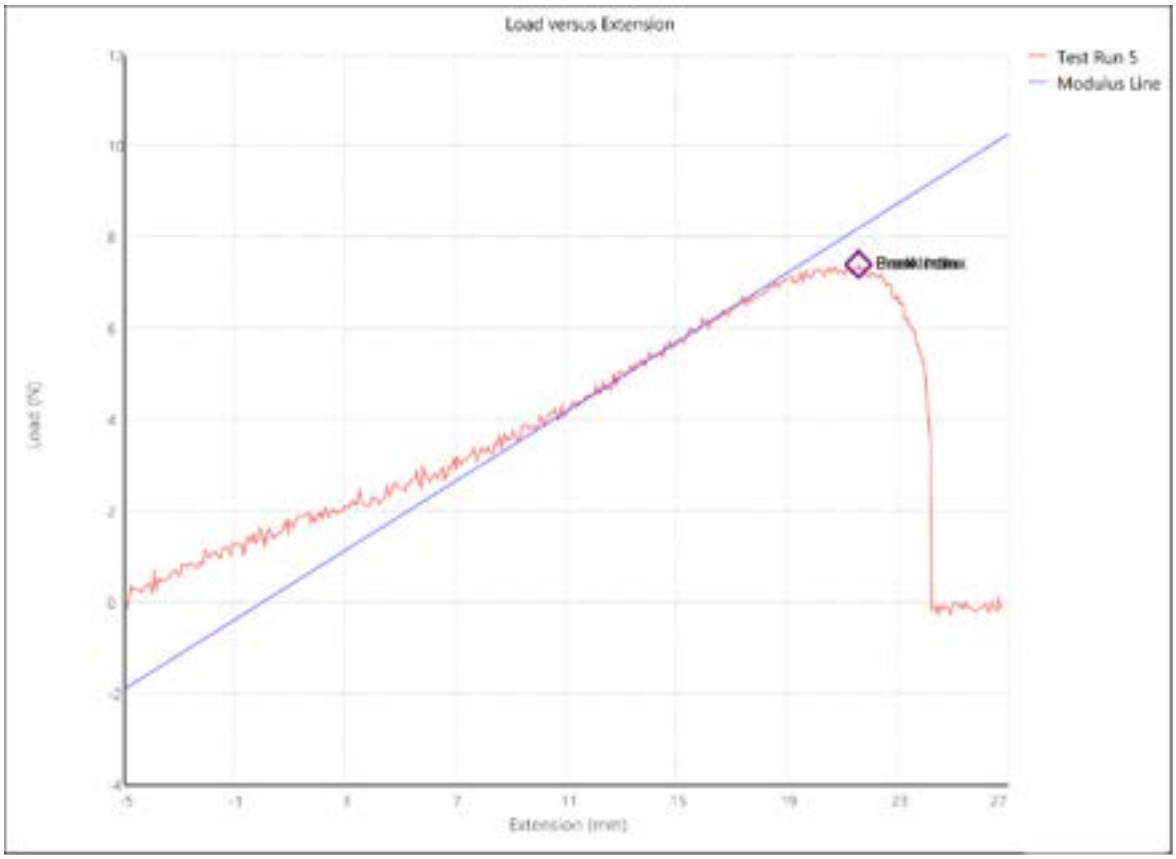
Content by: Dhruv Nadkarni

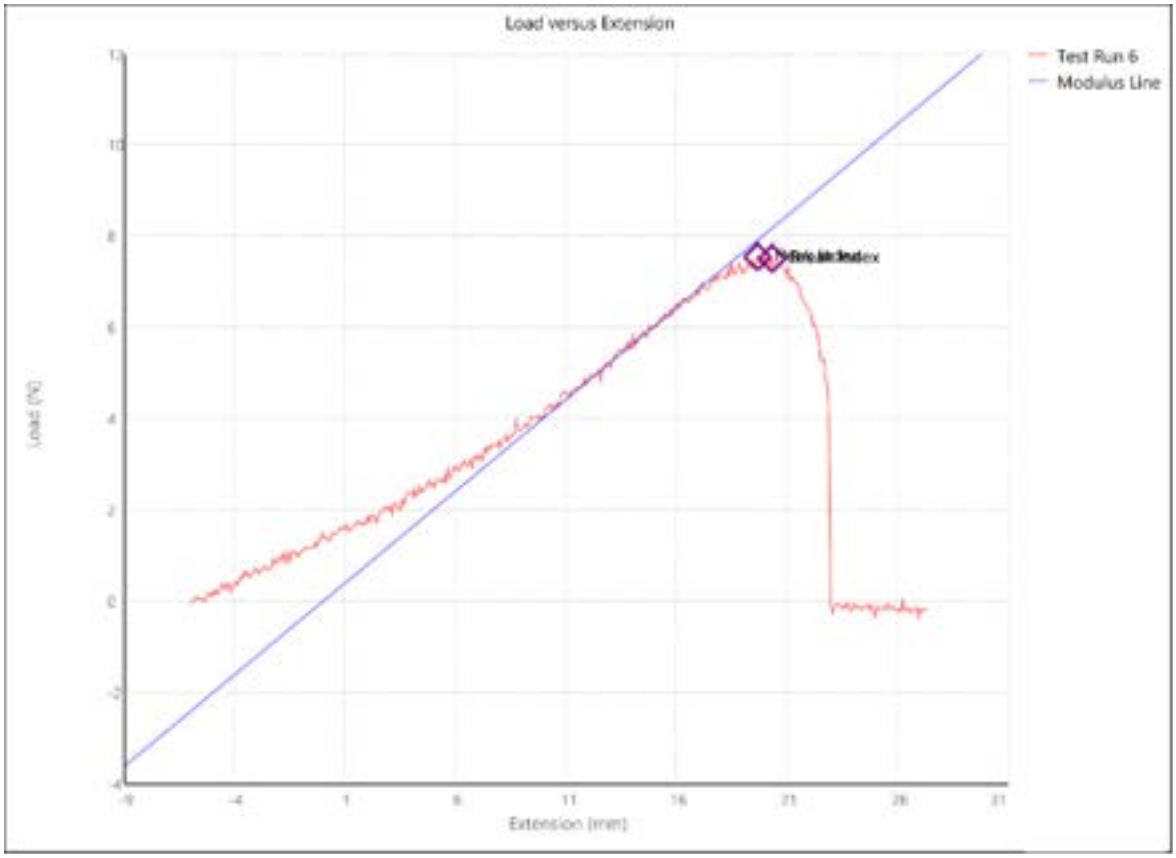
Present: Serena Evers

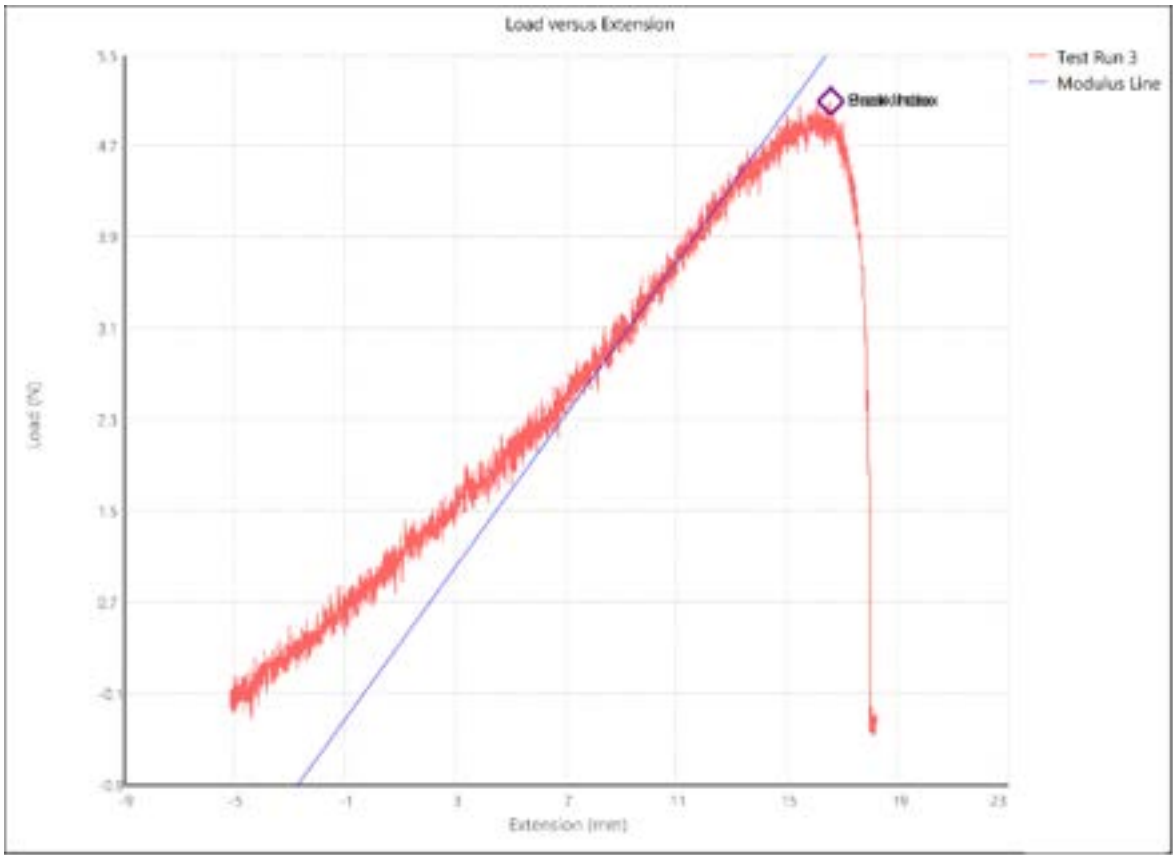
Goals: Post results of tensile testing here.

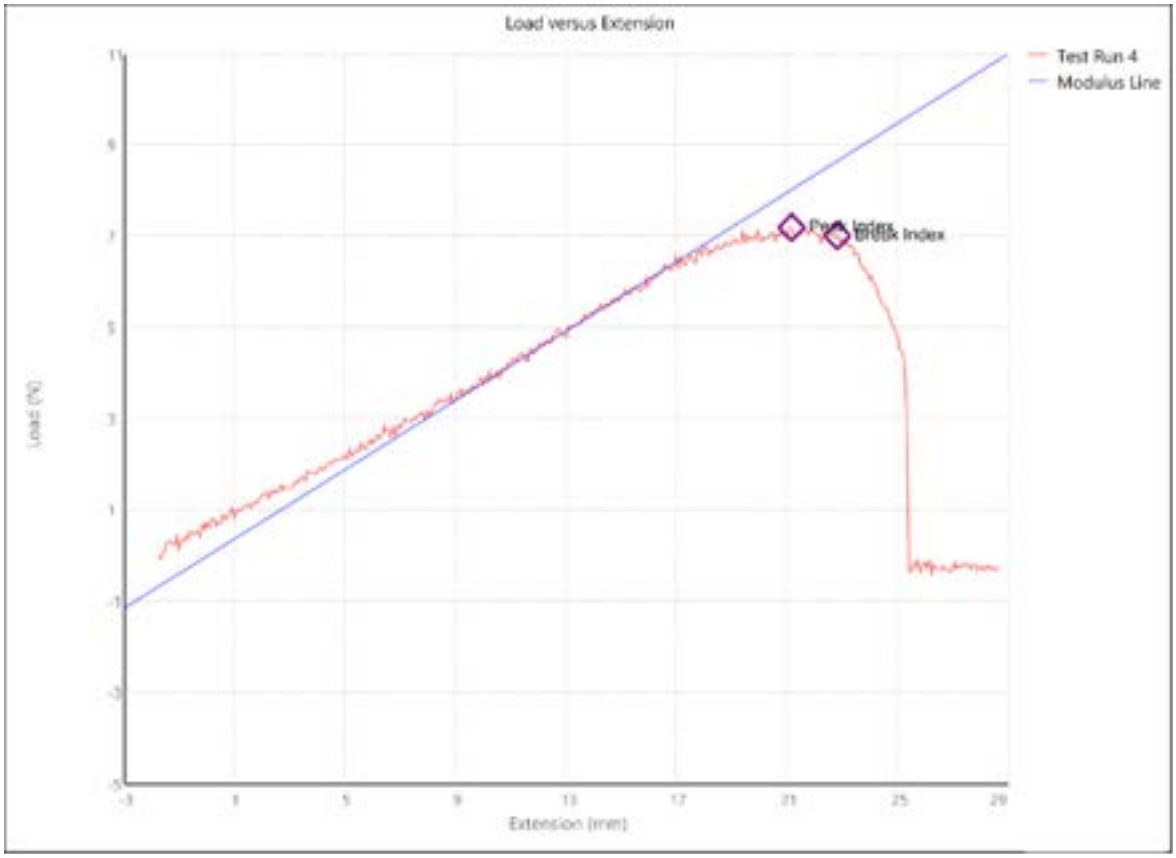
Content:

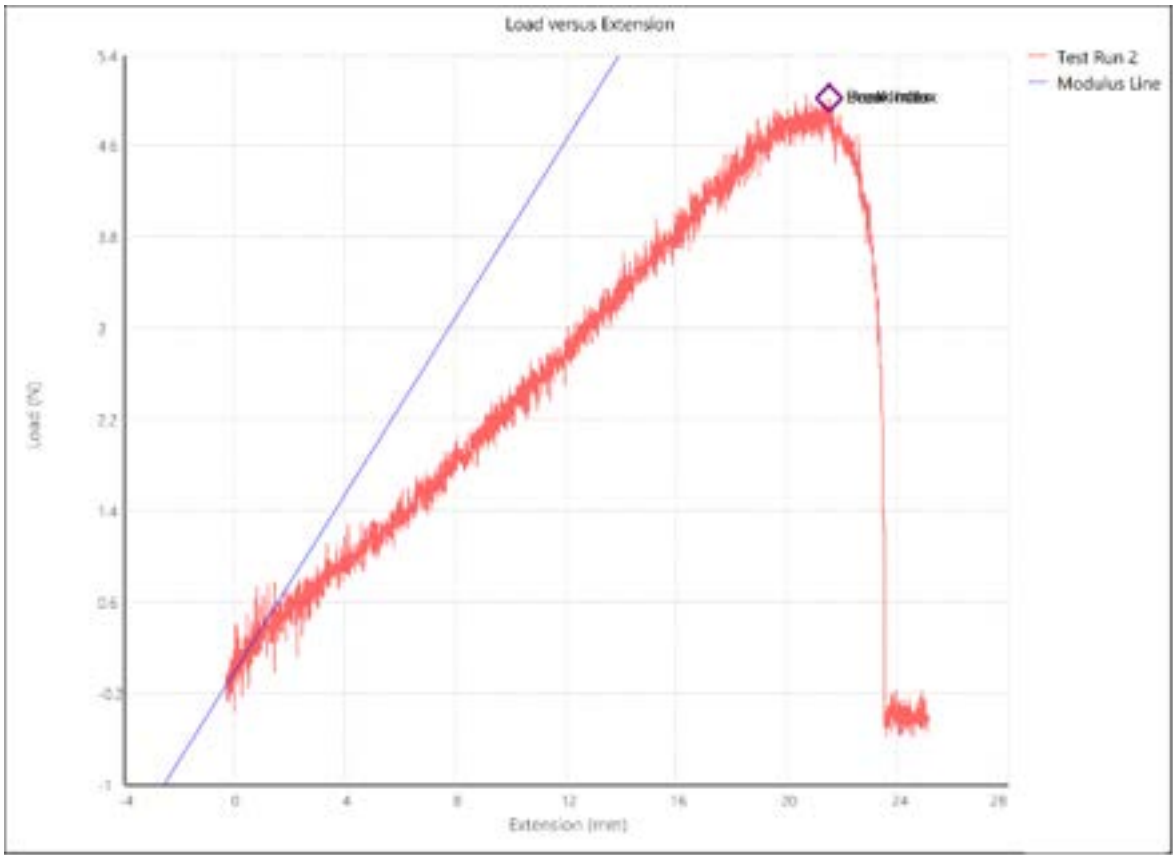
Files also attached.

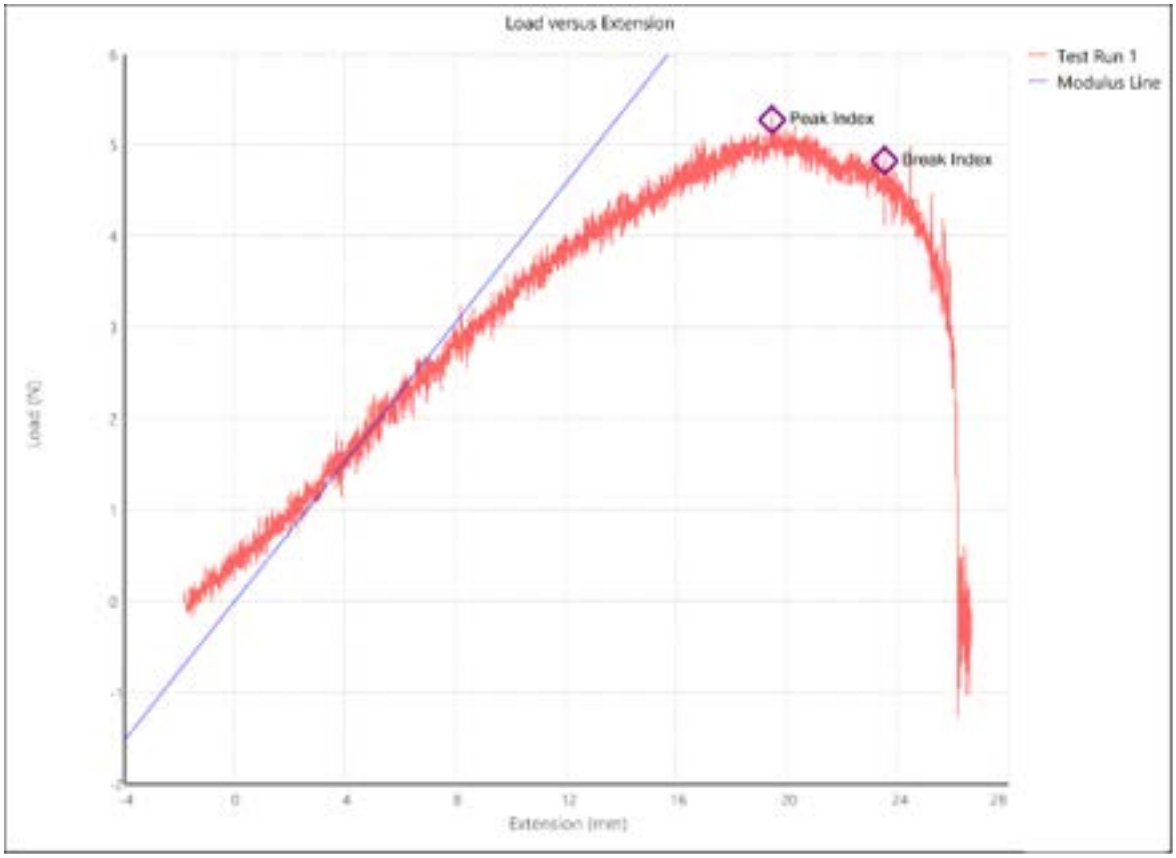

Load versus Extension
Test Run 5
Modulus Line
Load (%)
Extension (mm)


Load versus Extension
Test Run 6
Modulus Line
Load (%)
Extension (mm)


Load versus Extension
Test Run 3
Modulus Line
Load (%)
Extension (mm)


Load versus Extension
Test Run 4
Modulus Line
Load (%)
Extension (mm)





Conclusions/action items:

Analysis of data required.

Dhruv Nadkarni - Apr 29, 2026, 3:12 PM CDT

Download

All_Test_Runs.zip (208 kB)

2026/04/29 - Data Analysis for Tensile Testing for 5mm/min

Dhruv Nadkarni - Apr 29, 2026, 3:26 PM CDT

Title: Data Analysis for Tensile Testing - 5mm/min strain rate

Date: 04/29/2026

Content by: Dhruv Nadkarni

Present: N/A

Goals: Create a stress strain and force displacement curve.

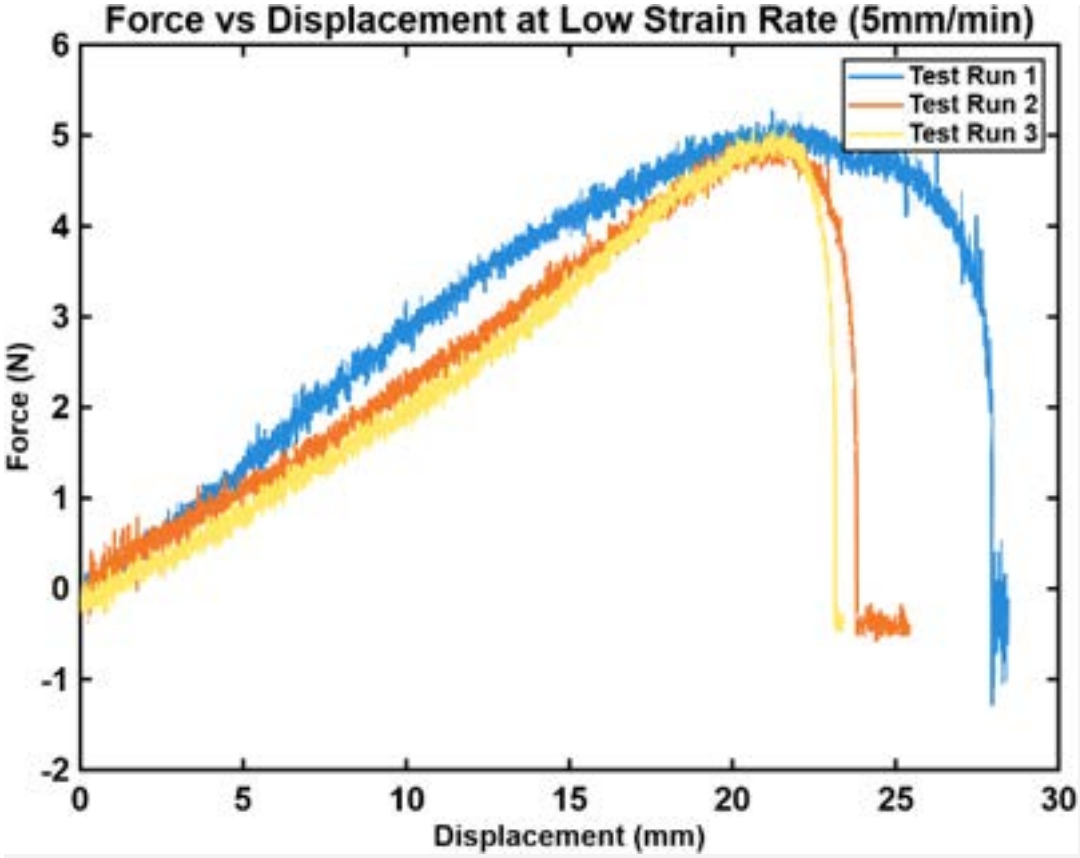
Content:

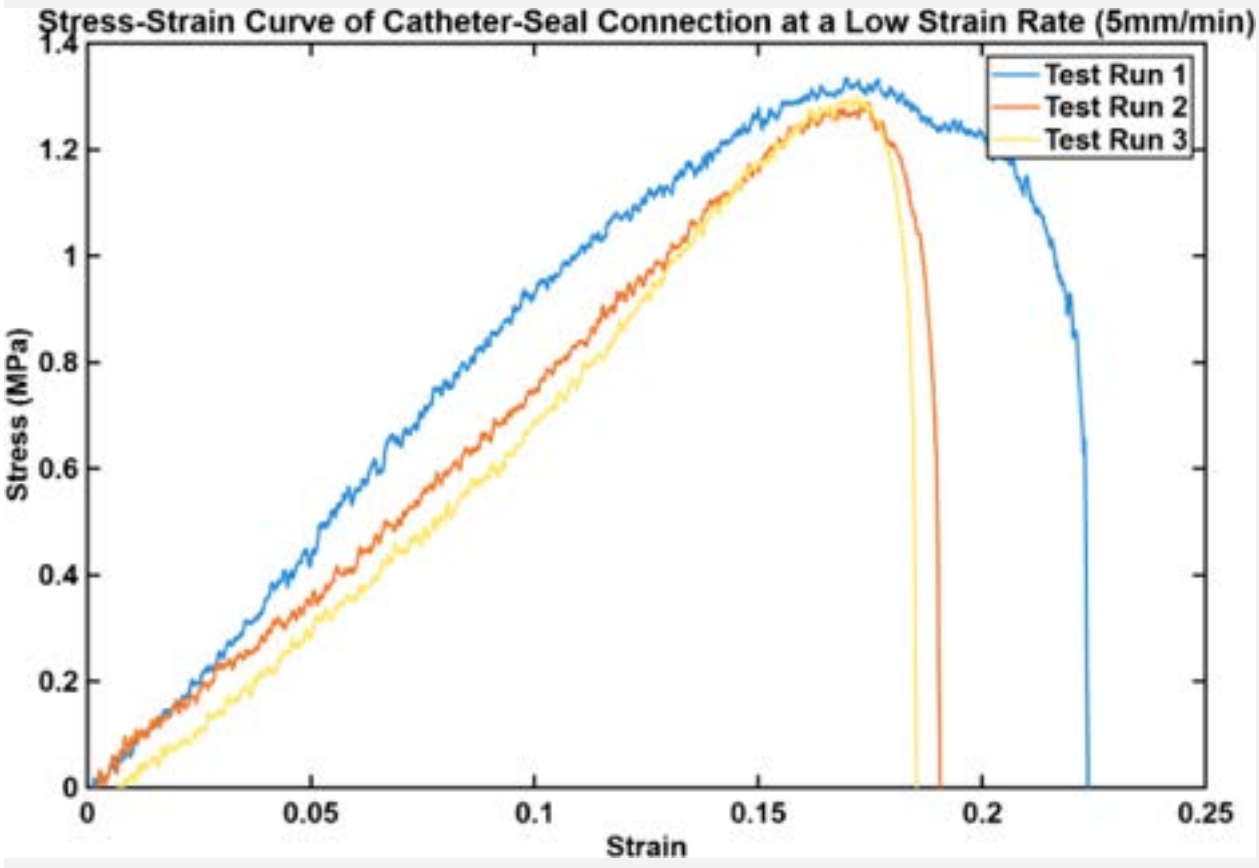
Completed on 4/22/2026

```
close all;
clear all;


Lo=125; % Gauge Length
Di = 2.5;
Do = 3.33;
A = pi/4 * (Do^2 - Di^2);


file1="/MATLAB Drive/BME402/Run1.txt";
data1=readtable(file1);


displacement1=data1{:,1};
force1=data1{:,2};
time1=data1{:,3};


stress1 = force1 ./ A;
strain1 = (displacement1 - displacement1(1)) ./ Lo;


stress1_f = sgolayfilt(stress1, 3, 21);
strain1_f = sgolayfilt(strain1, 3, 21);


file2="/MATLAB Drive/BME402/Run2.txt";
data2=readtable(file2);


displacement2=data2{:,1};
force2=data2{:,2};
time2=data2{:,3};


stress2 = force2 ./ A;
strain2 = (displacement2 - displacement2(1)) ./ Lo;


stress2_f = sgolayfilt(stress2, 3, 21);
strain2_f = sgolayfilt(strain2, 3, 21);
```

```
file3="/MATLAB Drive/BME402/Run3.txt";
data3=readtable(file3);


displacement3=data3{:,1};
force3=data3{:,2};
time3=data3{:,3};


stress3 = force3 ./ A;
strain3 = (displacement3 - displacement3(1)) ./ Lo;


stress3_f = sgolayfilt(stress3, 3, 21);
strain3_f = sgolayfilt(strain3, 3, 21);


figure;


plot(strain1_f, stress1_f, 'LineWidth', 2);
hold on;
plot(strain2_f, stress2_f, 'LineWidth', 2);
hold on;
plot(strain3_f, stress3_f, 'LineWidth', 2);




xlabel('Strain');
ylabel('Stress (MPa)');
xlim([0, 0.25]);
ylim([0, 1.4]);
title('Stress-Strain Curve of Catheter-Seal Connection at a Low Strain Rate (5mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');




set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 18, 'FontWeight', 'bold', 'LineWidth', 1.5);
```

```
idx = strain1_f > 0.02 & strain1_f < 0.06;
p = polyfit(strain1_f(idx), stress1_f(idx), 1);
E1 = p(1);
disp(['Youngs Modulus Run 1: ', num2str(E1), ' MPa']);




figure;
plot(displacement1, force1, 'LineWidth', 2);
hold on;
plot(displacement2, force2, 'LineWidth', 2);
plot(displacement3, force3, 'LineWidth', 2);
xlabel('Displacement (mm)');
ylabel('Force (N)');
title('Force vs Displacement at Low Strain Rate (5mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');


set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 14, 'FontWeight', 'bold', 'LineWidth', 1.5);
```





Conclusions/action items:

Complete for 50 mm/min as well

Dhruv Nadkarni - Apr 29, 2026, 3:30 PM CDT

Download

402Analysis_1_.mlx (53 kB)

2026/04/29 - Data Analysis for Tensile Testing 50mm/min

Dhruv Nadkarni - Apr 29, 2026, 3:30 PM CDT

Title: Data Analysis for Tensile Testing - 50mm/min strain rate

Date: 04/29/2026

Content by: Dhruv Nadkarni

Present: N/A

Goals: Create a stress strain and force displacement curve.

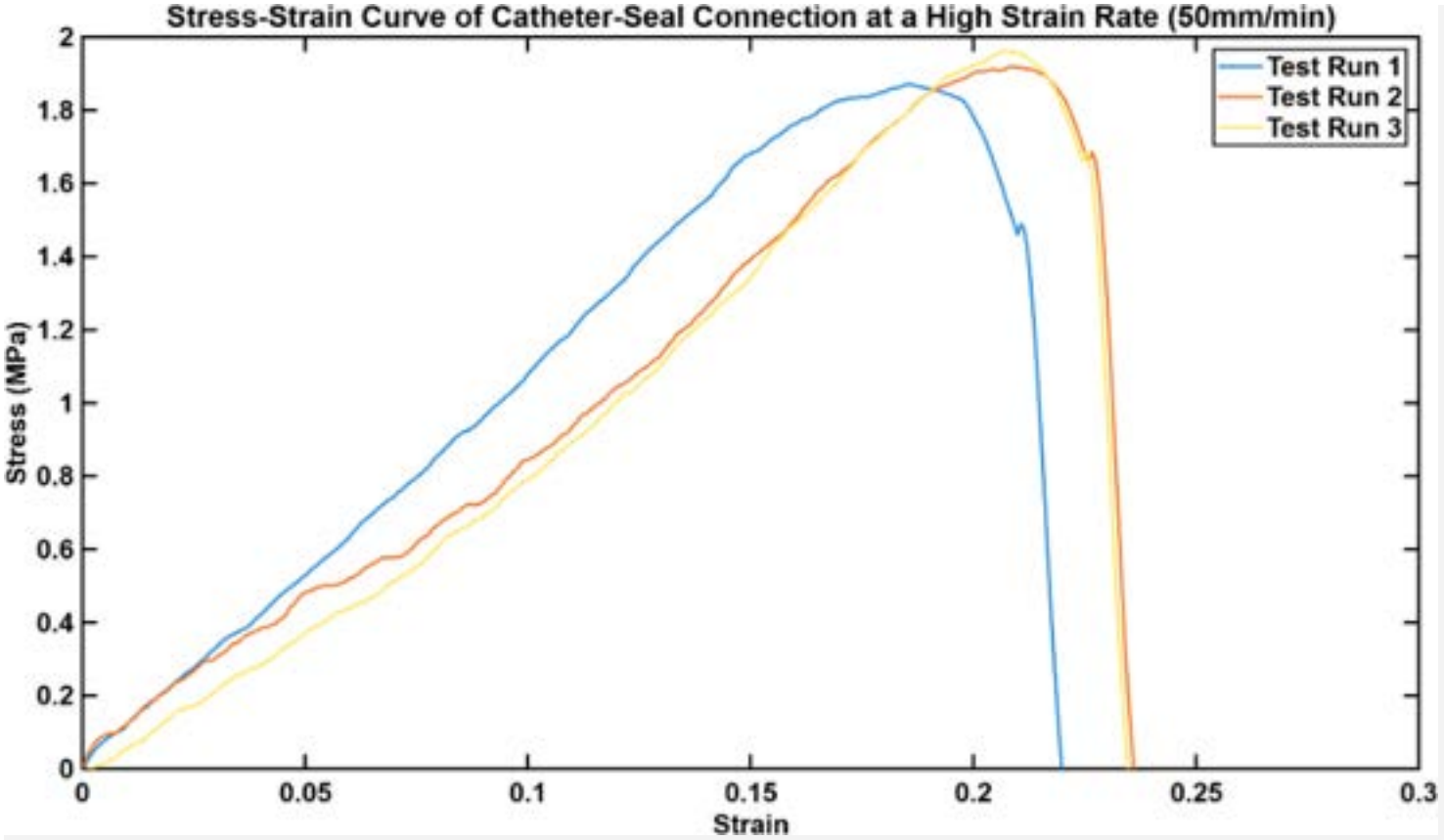
Content:

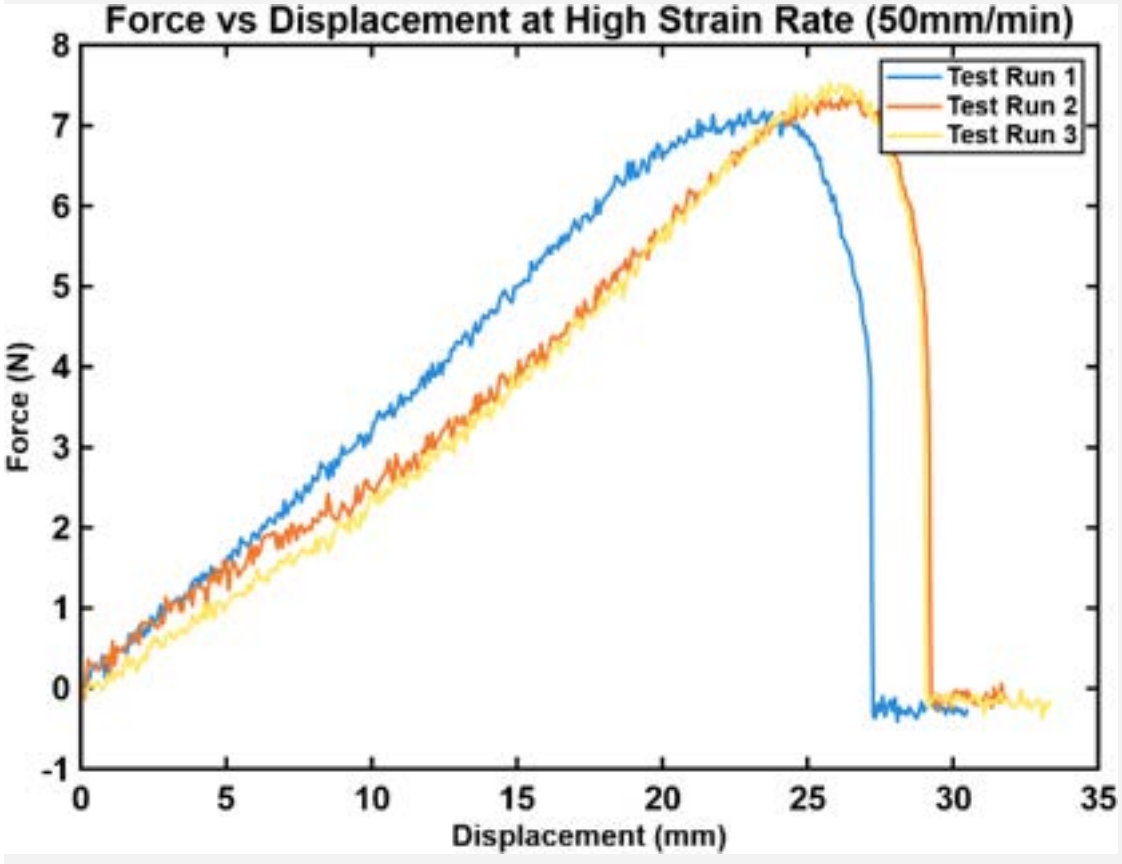
Completed on 4/22/2026

```
close all;
clear all;


Lo=125; % Gauge Length
Di = 2.5;
Do = 3.33;
A = pi/4 * (Do^2 - Di^2);


file1="/MATLAB Drive/BME402/Run4.txt";
data1=readtable(file1);


displacement1=data1{:,1};
force1=data1{:,2};
time1=data1{:,3};


stress1 = force1 ./ A;
strain1 = (displacement1 - displacement1(1)) ./ Lo;


stress1_f = sgolayfilt(stress1, 3, 21);
strain1_f = sgolayfilt(strain1, 3, 21);


file2="/MATLAB Drive/BME402/Run5.txt";
data2=readtable(file2);


displacement2=data2{:,1};
force2=data2{:,2};
time2=data2{:,3};


stress2 = force2 ./ A;
strain2 = (displacement2 - displacement2(1)) ./ Lo;


stress2_f = sgolayfilt(stress2, 3, 21);
strain2_f = sgolayfilt(strain2, 3, 21);
```

```
file3="/MATLAB Drive/BME402/Run6.txt";
data3=readtable(file3);


displacement3=data3{:,1};
force3=data3{:,2};
time3=data3{:,3};


stress3 = force3 ./ A;
strain3 = (displacement3 - displacement3(1)) ./ Lo;


stress3_f = sgolayfilt(stress3, 3, 21);
strain3_f = sgolayfilt(strain3, 3, 21);


figure;


plot(strain1_f, stress1_f, 'LineWidth', 2);
hold on;
plot(strain2_f, stress2_f, 'LineWidth', 2);
hold on;
plot(strain3_f, stress3_f, 'LineWidth', 2);




xlabel('Strain');
ylabel('Stress (MPa)');
xlim([0, 0.30]);
ylim([0, 2.0]);
title('Stress-Strain Curve of Catheter-Seal Connection at a High Strain Rate (50mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');


set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 18, 'FontWeight', 'bold', 'LineWidth', 1.5);
```

```
idx = strain1_f > 0.02 & strain1_f < 0.06;
p = polyfit(strain1_f(idx), stress1_f(idx), 1);
E1 = p(1);
disp(['Youngs Modulus Run 1: ', num2str(E1), ' MPa']);


figure;
plot(displacement1, force1, 'LineWidth', 2);
hold on;
plot(displacement2, force2, 'LineWidth', 2);
plot(displacement3, force3, 'LineWidth', 2);
xlabel('Displacement (mm)');
ylabel('Force (N)');
title('Force vs Displacement at High Strain Rate (50mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');


set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 14, 'FontWeight', 'bold', 'LineWidth', 1.5);
```





Conclusions/action items:

N/A

Dhruv Nadkarni - Apr 29, 2026, 3:30 PM CDT

Download

402Analysisfor50_2_.mlx (46.8 kB)

2026/03/11 - Preliminary Report Upload

Dhruv Nadkarni - Mar 12, 2026, 10:35 PM CDT

Title: Preliminary Report Upload

Date: 2026/03/12

Content by: Dhruv Nadkarni

Present: Entire Team

Goals: Upload Preliminary Report to Lab Archives

Content:

PDF is attached.

Conclusions/action items:

Continue with testing and update reports.

Dhruv Nadkarni - Mar 12, 2026, 10:35 PM CDT

BMES

Download

Preliminary_Report-_402.pdf (913 kB)

3/13/2026 - Rubber Stopper Vacuum Interface Considerations

BRYAN HEATON - Mar 13, 2026, 12:34 PM CDT

Title: Rubber Stopper Vacuum Interface Considerations

Date: 3/13/2026

Content by: Bryan

Present: Bryan

Goals:

1. Identify optimal kind of rubber to use in future EarVac seals

Content:

Using this website, we find that shore hardness is a measure of how soft or hard a rubber is, and is an important consideration for the vacuum interface we've made.

It appears that Shore A hardness of 70-80 is used for industrial seals, and it's main description is that it "resists deformation". To combat rubber's elastomeric property of creep over time this could be optimal. (We care about creep as the tube sits through the rubber stopper interface. Creep means the rubber will gradually expand to match the diameter of the tube used, meaning vacuum may be lost). Shore A hardness of 40-60 is also shown to be used for gaskets and tubing. We likely want the high end of this range and the low end of the other range, so a target from 60-70 should be ideal for our application.

Conclusions/action items:

- Revisit shore A hardness of the rubber we are currently using to see if it should hold for the time we need it to.

3/13/2026 - WARF Invention Disclosure

BRYAN HEATON - Mar 13, 2026, 12:14 PM CDT

Title: WARF Invention Disclosure

Date: 3/13/2026

Content by: Bryan

Present: Bryan

Goals:

1. Look into the details of doing an invention disclosure with WARF

Content:

https://www.warf.org/invent/disclose-an-invention/

Is a good starting point for this process, maybe we get a meeting afterwards?

Conclusions/action items:

- Fill out the form with the team

3/2/2026 - Y-connector size determination

BRYAN HEATON - Mar 11, 2026, 3:24 PM CDT

Title: Y-connector size determination

Date: 3/2/2026

Content by: Bryan

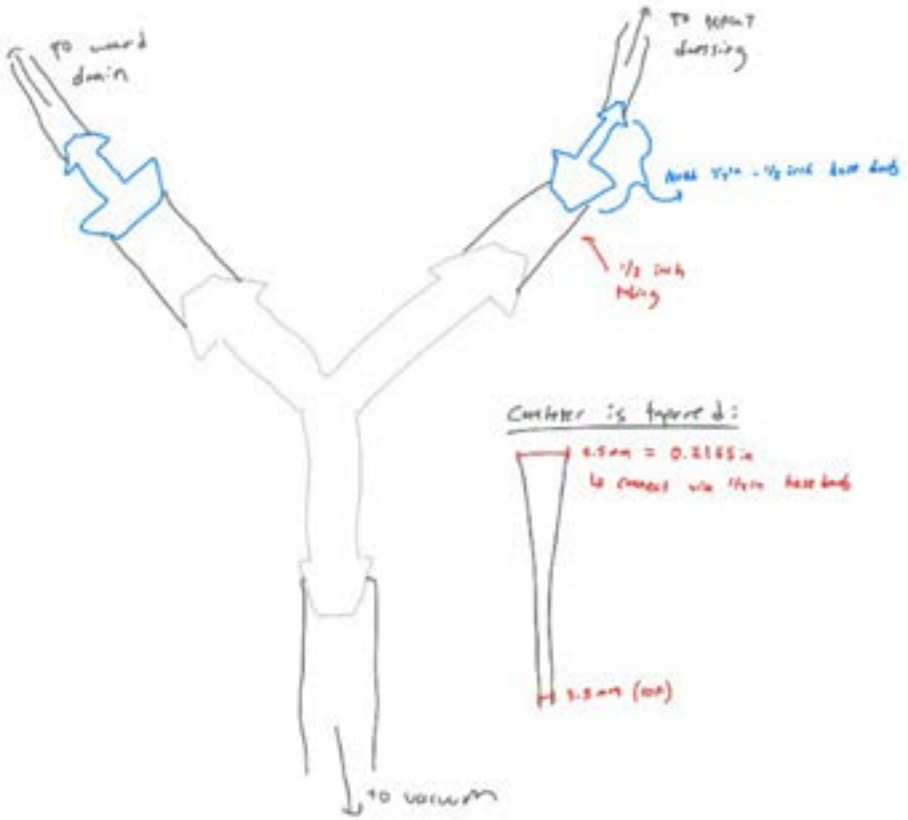
Present: Bryan, Harshad

Goals:

1. Find a commercially available y-connector suited for our design

Content:

This system allows for equal diameter tubing between wound drain and dressing while using commonly commercially available hose barb adaptors. It also only uses a 1/2 inch all around y-connector which is easy to find



Conclusions/action items:

- Continue to test with this setup

3/2/2026 - Dressing Evolution

BRYAN HEATON - Mar 02, 2026, 1:42 PM CST

Title: Dressing Evolution

Date: 3/2/2026

Content by: Bryan Heaton

Present: Bryan

Goals:

1. Show the evolution of the NPWT dressing over time

Content:

The first version (v0) of the dressing was applied to a flat surface (table). It implemented

- Hot dog foam design
- Integrated tube / adhesive layer combination
    - Incorrect tubing diameter for y-connector compatibility

The first test-ready (v1) dressing implemented some changes:

- Correct tube diameter (10F) into dressing
- Tube - seal interface secured with hydrocolloid dressing

The second test-ready dressing (v2) only changed the location of the tube-adhesive interface to be towards the bottom of the ear to be more compatible with the earmuff piece.

Future improvements include:

- A more secure and modular tube-adhesive interface

- A more accurate diameter of adhesive layer around the foam to better approximate patient dressing security

Conclusions/action items:

- See above for improvements

3/2/2026 - First Vacuum Test

BRYAN HEATON - Mar 02, 2026, 3:17 PM CST

Title: First Vacuum Test

Date: 3/2/2026

Content by: Bryan

Present: Bryan Heaton, Harshad

Goals:

1. Show the v1 dressing before and during vacuum
2. Evaluate seal viability for v1 seal

Content:

The v1 dressing worked as planned even with the hydrocolloid dressing security of the vacuum interface. This will be tested with future iterations of the dressing.

Conclusions/action items:

- Investigate other dressing improvements

3/11/2026 - Upgraded Vacuum Interface

BRYAN HEATON - Mar 11, 2026, 3:22 PM CDT

Title: Upgraded Vacuum Interface

Date: 3/11/2026

Content by: Bryan

Present: Bryan & Dhruv

Goals:

- Implement new interface into dressing for improved accessibility into NPWT dressing

Content:

Below displays the new dressing both under suction and without suction.

- The dressing still appears to distribute negative pressure evenly throughout the entire dressing
- Only one part had to be externally sealed with hydrocolloid dressing around the interface
    - Due to method of punching hole for stopper insertion
- All necessary hydrocolloid dressing shown is underneath the adhesive layer and will be replaced with a less volume-taking alternative in the future
- All concerns with the dressing will be resolved if the dressing is manufactured in a high-quality, high reproducibility facility.

Conclusions/action items:

- Re-do testing related to transmission of negative pressure with new seal
- Investigate repeatability of tube insertion through interface: any issues?

3/11/2026 - Reproducibility of Tube Through New Interface Testing (copy)

BRYAN HEATON - Mar 11, 2026, 3:41 PM CDT

Title: Reproducibility of Tube Through New Interface Testing

Date: 3/11/2026

Content by: Bryan

Present: Bryan and Dhruv

Goals:

1. See if the seal is maintained after several insertion / removal cycles of the tube through the interface

Content:

Trial	Success?
1	Y
2	Y
3	Y
4	Y
5	Y
6	Y
7	Y
8	Y
9	Y
10	Y

Conclusions/action items:

- The seal demonstrated successful a vacuum pull after several insertions and removal of the tube from the dressing. This implies the dressing is viable even if tubing must be removed and replaced several times during treatment.

2024/3/5 - Machining Permit

BRYAN HEATON - Mar 12, 2024, 11:16 PM CDT

Title: Machining Permit

Date: 3/5/2024

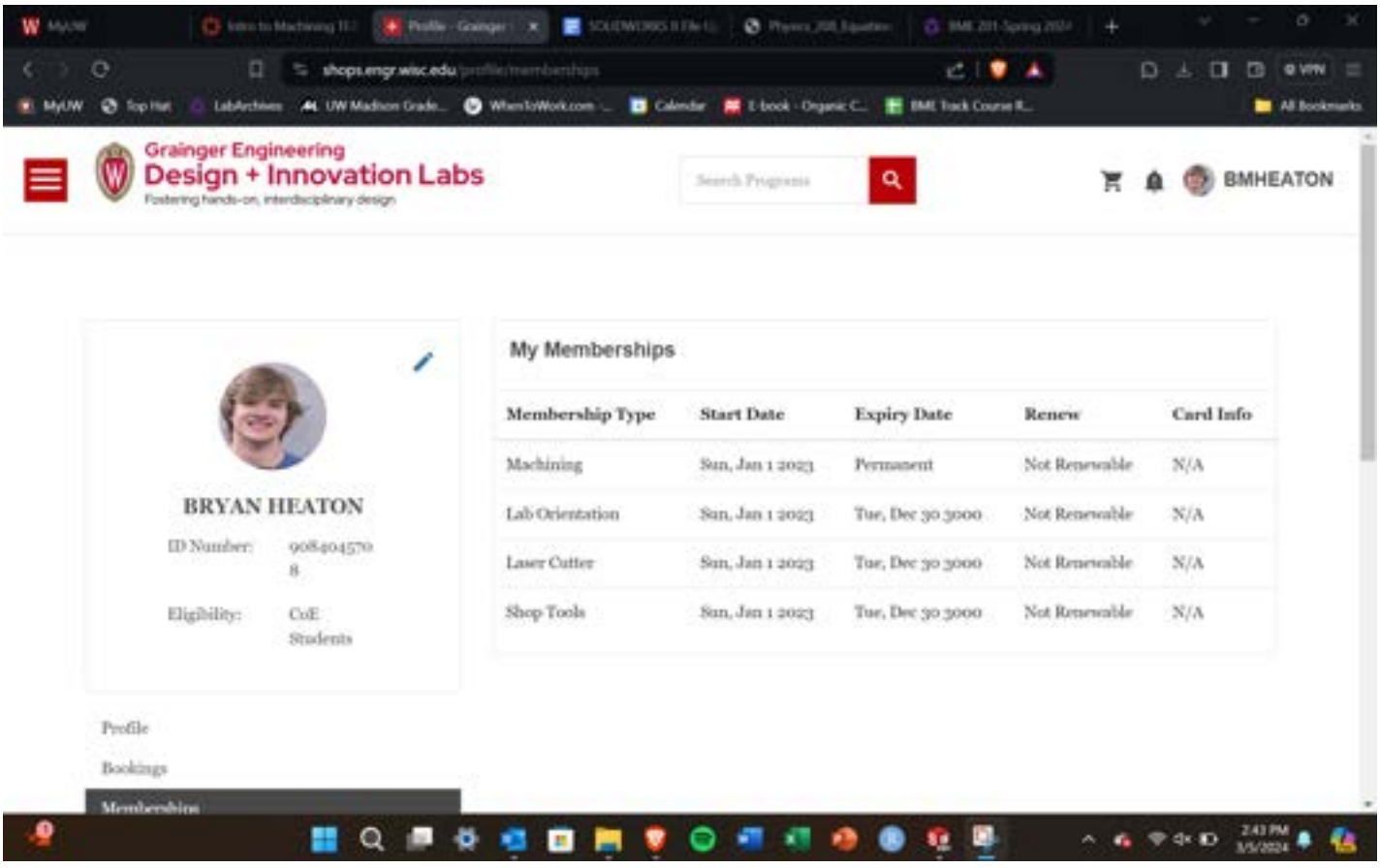
Content by: Bryan Heaton

Present: Bryan Heaton

Goals:

Show my documentation for machining

Content:



Conclusions/action items:

- Utilizing the lathe and mill in the TEAMlab will be essential for fabrication of our sample holder and other design projects

10/28/2025 - Training Record (Animal Safety)

BRYAN HEATON - Oct 28, 2025, 9:47 AM CDT

Title: Animal Safety Training Record

Date: 10/28/2025

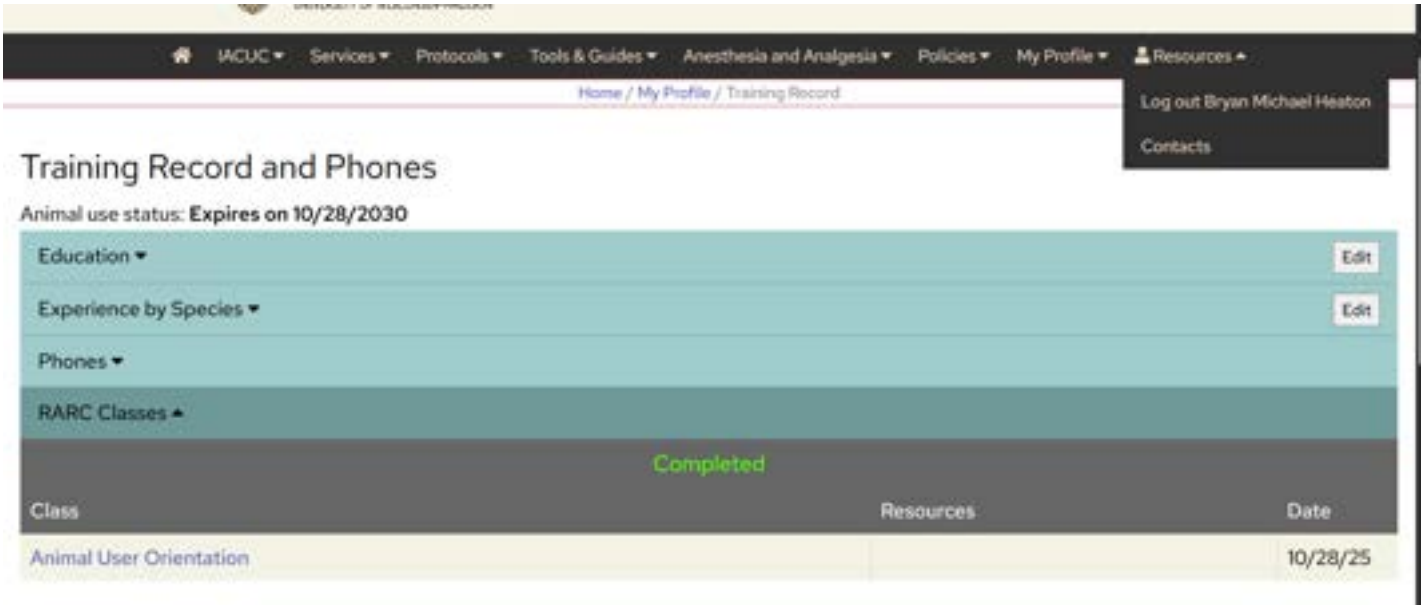
Content by: Bryan Heaton

Present: Bryan Heaton

Goals:

1. Record training completion for animal safety

Content:



Conclusions/action items:

N/A

2024/3/9 - Biosafety & Chemical Lab Safety Training

BRYAN HEATON - Mar 12, 2024, 11:17 PM CDT

Title: Biosafety & Chemical Safety Training Documentation

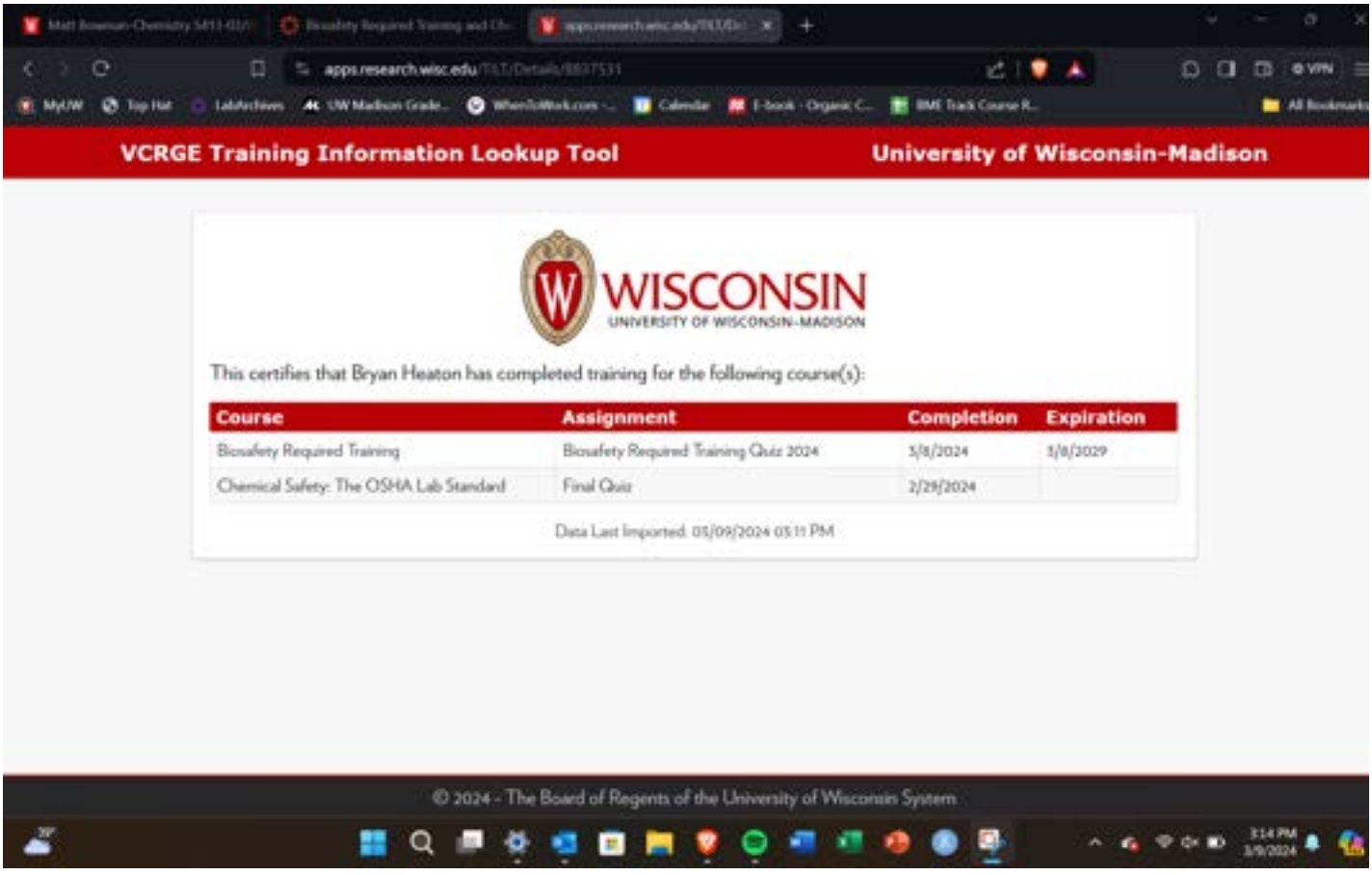
Date: 3/9/2024

Content by: Bryan Heaton

Present: Bryan Heaton

Goals: N/A

Content:



Conclusions/action items:

- Biosafety and Chemical training will be essential for individual and coursework in laboratory settings in the future.

4/6/2026 - OVERALL TRAINING RECORD

BRYAN HEATON - Apr 06, 2026, 11:35 AM CDT

Title: Overall Training Record

Date: 4/6/2026

Content by: Bryan Heaton

Present: Bryan Heaton

Goals:

1. Record overall training completion

Content:

Woodworking training is new as of this semester

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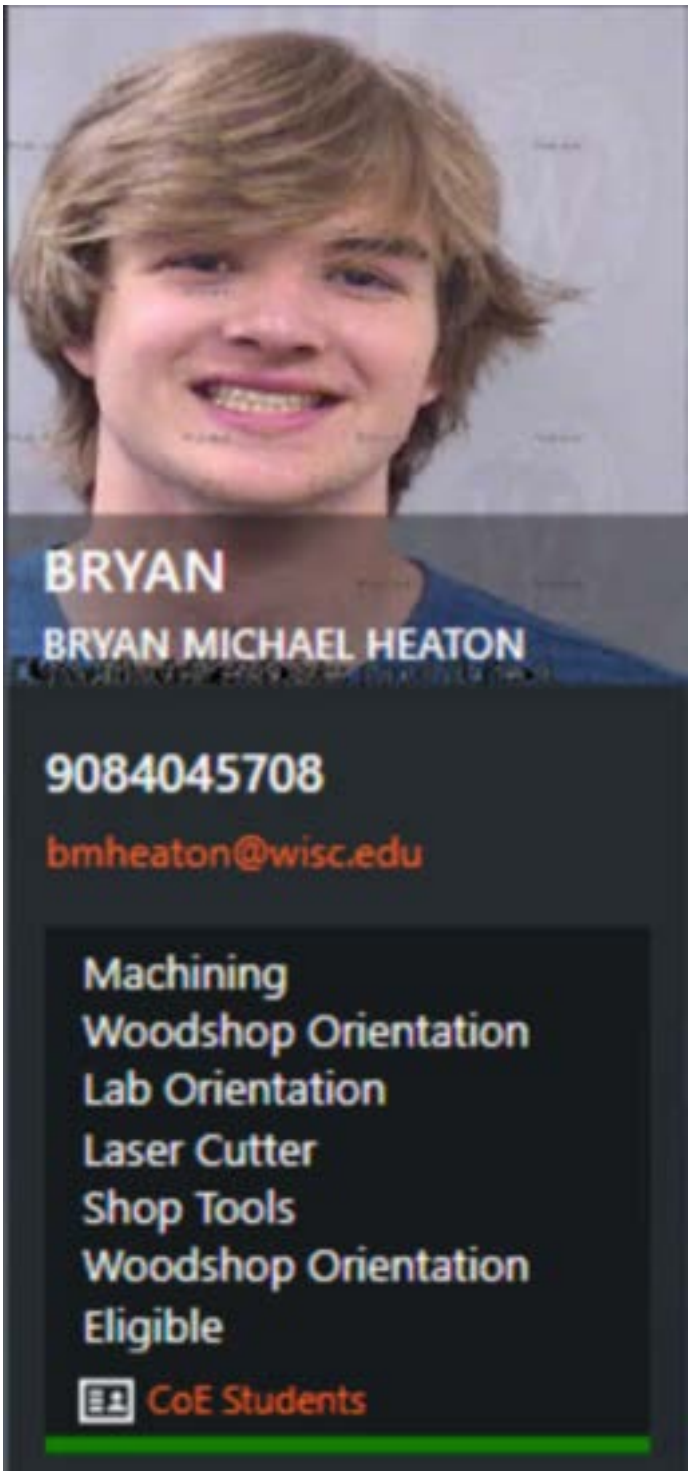
This certifies that Bryan Heaton has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2023-24 HIPAA Privacy & Security Training	HIPAA Attestation	5/20/2024	
2024-2025 HIPAA Privacy & Security Training	2024-2025 HIPAA Privacy & Security Training	12/3/2024	
Biosafety 102: Bloodborne Pathogens for Laboratory and Research	Biosafety 102: Bloodborne Pathogens Safety in Research Quiz 2024	5/9/2024	5/9/2025
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	11/21/2024	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/8/2024	3/8/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	2/29/2024	

Data Last Imported: 10/28/2025 09:24 AM



Conclusions/action items:

4/6/2026 - Woodworking Orientation Training

BRYAN HEATON - Apr 06, 2026, 11:34 AM CDT

Title: Woodworking Orientation Training

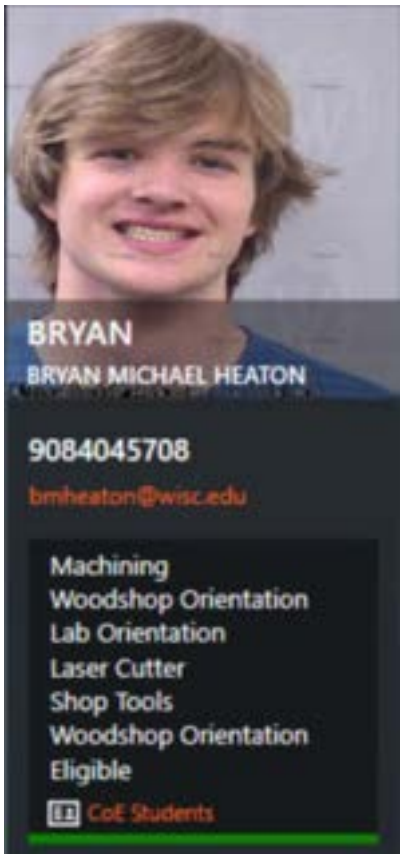
Date: 4/6/2026

Content by: Bryan

Present: N/A

Goals: N/A

Content:



Conclusions/action items:

N/A

2026/02/05 - Biofluids and Flow Sensing Techniques

Dhruv Nadkarni - Feb 05, 2026, 1:30 PM CST

Title: Overview of Biofluids and Flow Sensing Techniques Applied in Clinical Practice

Date: 2026/02/05

Content by: Dhruv Nadkarni

Present: N/A

Goals: Research methods of testing for fluids

Content:

[1] C. Yáñez, G. DeMas-Giménez, and S. Royo, “Overview of Biofluids and Flow Sensing Techniques Applied in Clinical Practice,” Sensors, vol. 22, no. 18, p. 6836, Jan. 2022, doi: https://doi.org/10.3390/s22186836.

Current flow sensing methods consist of the following:

- Imaging techniques

- Flowmeters and sensors

- Nuclear MRF

Flowmeters and Sensors in Depth:- Measures rate and volume of fluid flow

- Plethysmography, Doppler and ultrasonic flowmeters, electromagnetic and laser Doppler devices.

- Plethysmography: Changes in volume of a limb or organ via air displacement

- Doppler and ultrasonic flowmeters: Uses doppler effect to measure change in frequency of ultrasound

- electromagnetic and laser Doppler devices: measures via a detecting voltage change when a conductive fluid passes through a magnetic field

- Our test could follow something similar, where we use a conductive liquid rather than simple water and measure flow at 4 different points in the tubing.

Conclusions/action items:

Our project would either have to do imaging techniques (not X-ray but rather video tape) or flowmeter. Flowmeter would make the most sense as it measures flow more so than liquid.

2026-02-05 - Antistasis Retrograde Flow Vascular Catheter

Dhruv Nadkarni - Feb 05, 2026, 1:43 PM CST

Title: Antistasis Retrograde Flow Vascular Catheter: A Novel Solution to Thrombogenicity: A Computational Fluid Dynamics Study

Date: 2026-02-05

Content by: Dhruv Nadkarni

Present: N/A

Goals: Develop retrograde flow tests and solutions in case of failure

Content:

[1] A. Abdelaal Ahmed Mahmoud M. Alkhatip et al., “Antistasis Retrograde Flow Vascular Catheter: A Novel Solution to Thrombogenicity: A Computational Fluid Dynamics Study,” Anesthesia & Analgesia, vol. 131, no. 4, pp. 1281–1290, Apr. 2020, doi: https://doi.org/10.1213/ane.0000000000004782.

Findings:

- Catheter designs with a 15 degree or 30 degree opening have less areas of stagnant fluid that could cause retrograde flow. Higher angled models have a higher rate.

- Design of the catheter has to be angled to acomodate for any bending. Our device could possibly show this.

Additional research shows an image with a Y connector we were looking for.

Conclusions/action items:

Apply catheter design and test methods to our project.

2026/03/12 - An analysis of quantitative measurements of drainage exudate using negative suction in 96 microtia ear reconstructions

Dhruv Nadkarni - Mar 12, 2026, 9:44 PM CDT

Title: An analysis of quantitative measurements of drainage exudate using negative suction in 96 microtia ear reconstructions

Date: 2026-03-12

Content by: Dhruv Nadkarni

Present: N/A

Goals: Determine whether or not the fluid tests are required for documentation purposes.

Content:

[1] Z. Xu, R. Zhang, Q. Zhang, and F. Xu, “An analysis of quantitative measurements of drainage exudate using negative suction in 96 microtia ear reconstructions,” Canadian Journal of Plastic Surgery, vol. 20, no. 4, pp. 218–222, Dec. 2012, doi: https://doi.org/10.1177/229255031202000401.

- 96 patients underwent microtia reconstruction surgery and also applied a negative suction drainage system.
- Volume of drainage decreased over time: highest was on the first day and there was minimal by day three.
- 2 different types of drains were observed in the study group, the first was scapha drain and the second was concha drain.
    - No significant affect on drainage volume.
- Scapha: 10-20mL on first day, <10 second day, near 0 third day.
- Concha: 8-15 mL first day, <5 mL second day, near 0 third day.

Conclusions/action items:

No need to run a fluidic test. We can instead just demonstrate with visuals that the product does suction liquids.

2026/02/20 - Updated Test Design

Dhruv Nadkarni - Feb 20, 2026, 1:57 PM CST

Title: Negative Pressure Transmission Test Protocol a

Date: 02/20/2026

Content by: Dhruv Nadkarni

Present: Meghan, Serena, Harshad, and Bryan

Goals: Rework the pressure test for better efficiency

Content:

Overview: The purpose of the continuous negative pressure transmission test is to assess the vacuum's ability to apply pressures of -50 to -130 mmHg for a 10 minute interval whilst remaining accurate to the intended value. Additionally, the mm deviation of the adhesive seal from original value (pre-vaccum) will be noted on each run to determine efficacy of adhesive and seal stickiness. The tests will have the vacuum apply pressures of 50, 90, and 130 mmHg below atmospheric pressure. Each pressure value will be tested for 10 minutes, 3 times. During each trial, the measured pressure values must not exceed +/- 5mmHg of the applied pressure values. Additionally, we will have to note down the deviations of adhesive seal quadrants.

Procedure:

1. Turn the vacuum on and set the pressure applied to 50mmHg below atmospheric pressure.
2. Let the vacuum run for 10 minutes. Monitor the pressure value via an external pressure meter. Also record the pressure displayed via the vacuum. Note down pressure readings every 2 minutes.
    1. Should the displayed pressure and measured pressure exceed +/- 5mmHg of the intended pressure at any point, the test will be considered a fail. Additionally, if the vacuum does not continuously suction for 10 minutes (ripping or else wise), the test will be considered a fail.
3. Prior to each test, the adhesive pull will be measured on all 4 sides of the seal. Anywhere between 2-5 minutes in suction, we will re-measure. Following the test, the adhesive stretch will be measured again. Adhesive stretch is the pull off from the sponge and the skin.
    1. We could try 2 versions of this protocol. The first is immediately turning it off and measuring adhesive stretch, the second is lowering pressure to 40mmhg and then turning it off.
4. Repeat the test for 50, 90, and 130 mmHg below atmospheric pressure. Take 3 minute breaks in between runs to ensure the sponge returns to equilibrium.

Conclusions/action items:

Results posted in results tab

2026/02/24 - Transducer Validation

Dhruv Nadkarni - Mar 12, 2026, 10:50 PM CDT

Title: Transducer Validation

Date: 2026/02/24

Content by: Dhruv Nadkarni

Present: N/A

Goals: Validate pressure from across the

Content:

Only 5-25 mmHg was tested. The device used a "transducer" which was reattached to the open end of the y connector to measure pressure suction.

The device was turned on and off multiple time for each test run.

5 mmHg: 5, 5, 5

10 mmHg: 10, 9, 10

20 mmHg: 20, 20, 20

25 mmHg: 25, 25, 25

Conclusions/action items:

Retest with another method as this only covers the lower pressure. We need something to validate the 150 mmHg sub atmospheric.

Dhruv Nadkarni - Mar 12, 2026, 10:50 PM CDT

Download

IMG_0498.JPG (109 kB)

2026-03-14 - Modifying Catheter Pull Out 1

Dhruv Nadkarni - Mar 14, 2026, 6:26 PM CDT

Title: Noting Down Catheter Issue

Date: 03/14/2026

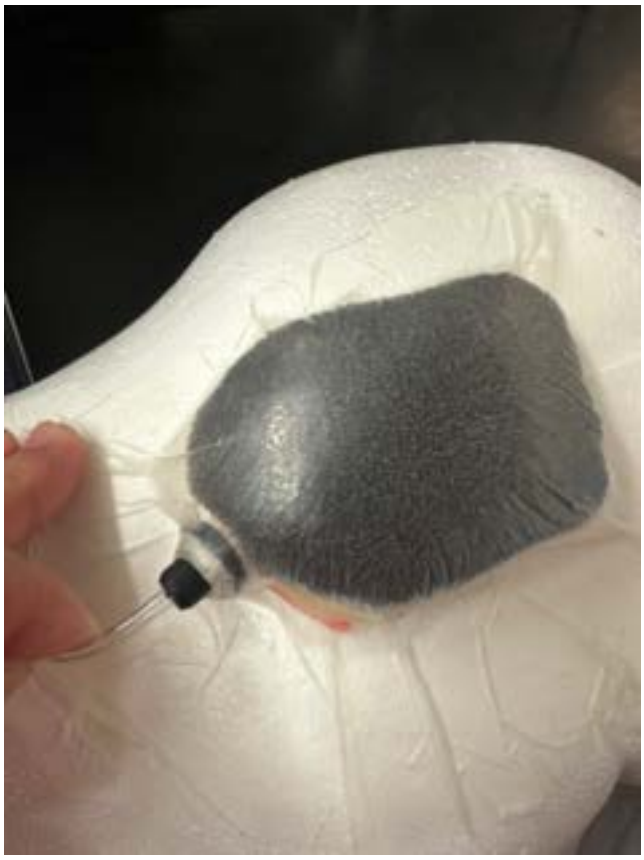
Content by: Dhruv Nadkarni

Present: N/A

Goals: Understand potential tear spots in the design

Content:

The image above demonstrates the current setup with the insertion hole. There is no stretch around the adhesive seal.



When pulling the catheter wthout supporting the insert stopper, the adhesive seal stretches. THIS is a potential tear zone that needs to be evaluated and either fixed or mitigated.

Current removal method includes holding down the insert stopper whilst pulling the catheter. This works fine for now but a solution needs to be in place in the event the catheter is ripped out and causes tears at the lower parts of the seal.

Conclusions/action items:

Discuss with team regarding a slight redesign OR ensure that this specific removal method is enforced.

2026/04/29 - Data Analysis for Tensile Testing for 5mm/min

Dhruv Nadkarni - Apr 29, 2026, 3:25 PM CDT

Title: Data Analysis for Tensile Testing - 5mm/min strain rate

Date: 04/29/2026

Content by: Dhruv Nadkarni

Present: N/A

Goals: Create a stress strain and force displacement curve.

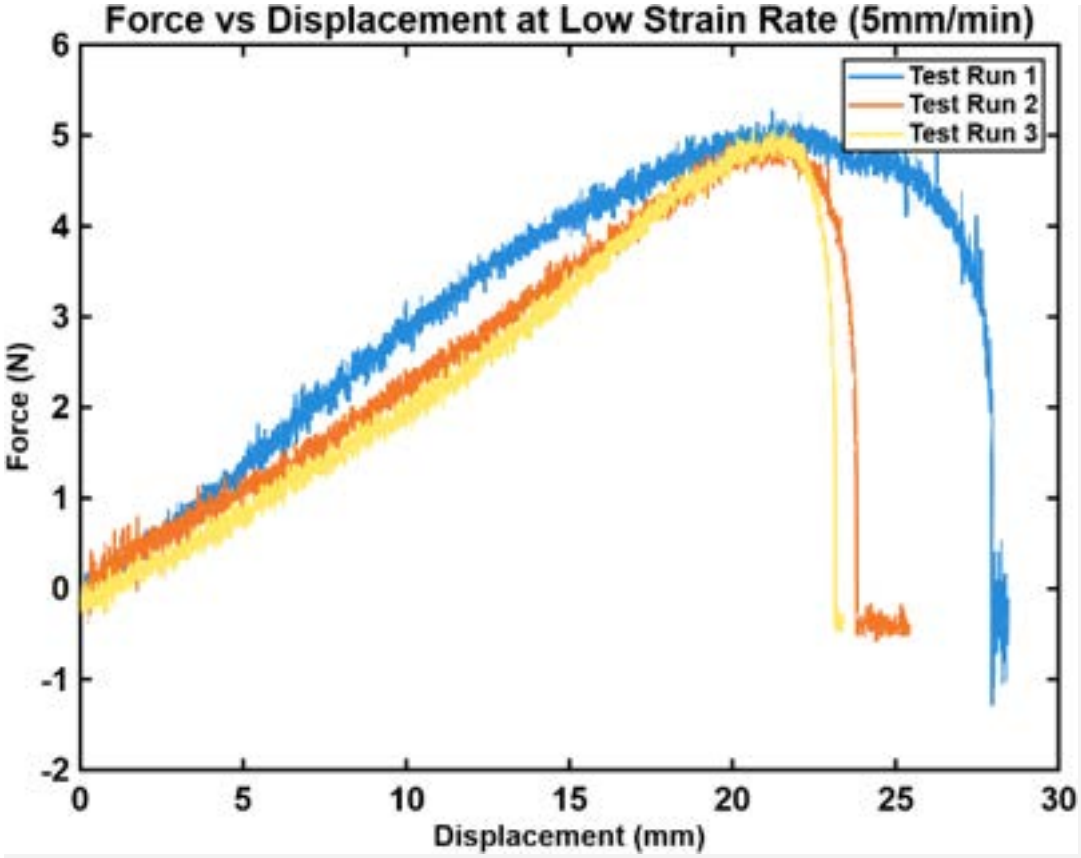
Content:

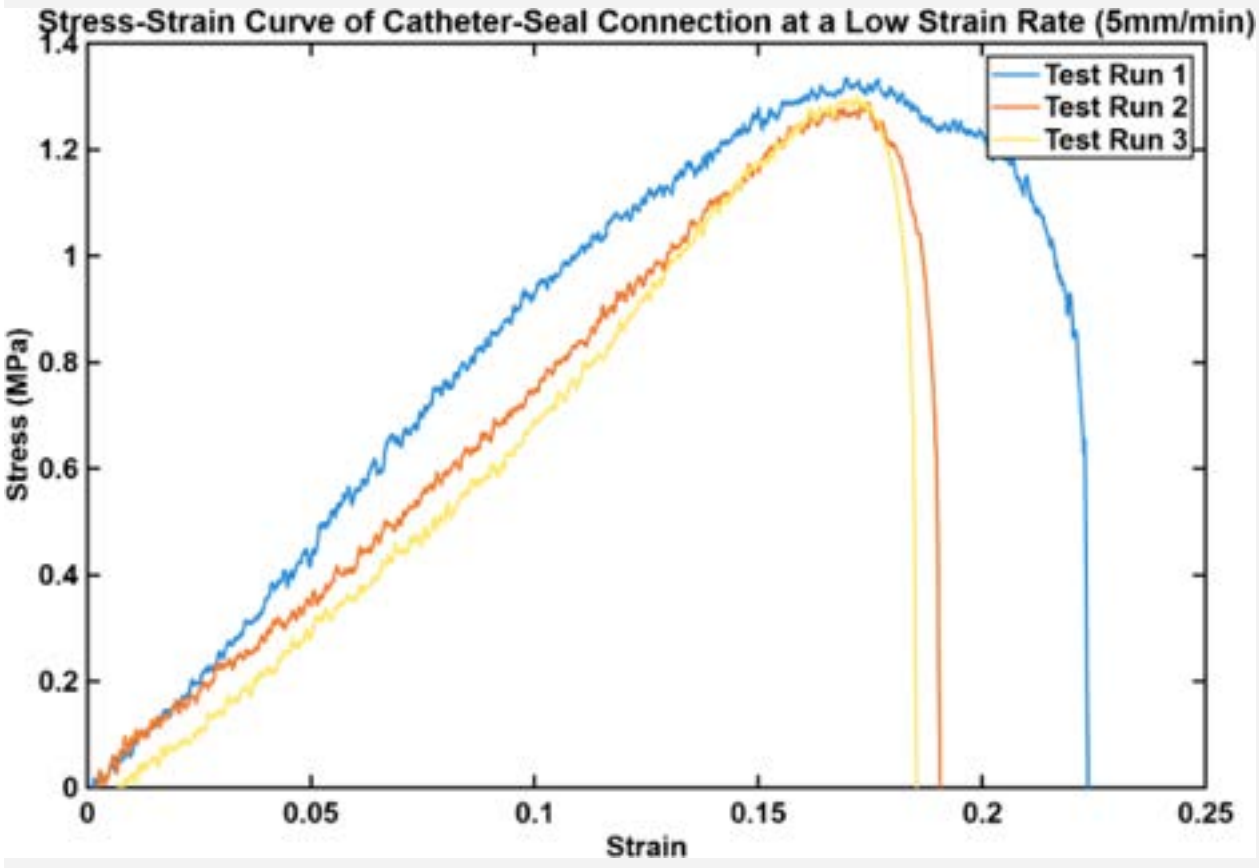
Completed on 4/22/2026

```
close all;
clear all;


Lo=125; % Gauge Length
Di = 2.5;
Do = 3.33;
A = pi/4 * (Do^2 - Di^2);


file1="/MATLAB Drive/BME402/Run1.txt";
data1=readtable(file1);


displacement1=data1{:,1};
force1=data1{:,2};
time1=data1{:,3};


stress1 = force1 ./ A;
strain1 = (displacement1 - displacement1(1)) ./ Lo;


stress1_f = sgolayfilt(stress1, 3, 21);
strain1_f = sgolayfilt(strain1, 3, 21);


file2="/MATLAB Drive/BME402/Run2.txt";
data2=readtable(file2);


displacement2=data2{:,1};
force2=data2{:,2};
time2=data2{:,3};


stress2 = force2 ./ A;
strain2 = (displacement2 - displacement2(1)) ./ Lo;


stress2_f = sgolayfilt(stress2, 3, 21);
strain2_f = sgolayfilt(strain2, 3, 21);
```

```
file3="/MATLAB Drive/BME402/Run3.txt";
data3=readtable(file3);


displacement3=data3{:,1};
force3=data3{:,2};
time3=data3{:,3};


stress3 = force3 ./ A;
strain3 = (displacement3 - displacement3(1)) ./ Lo;


stress3_f = sgolayfilt(stress3, 3, 21);
strain3_f = sgolayfilt(strain3, 3, 21);


figure;


plot(strain1_f, stress1_f, 'LineWidth', 2);
hold on;
plot(strain2_f, stress2_f, 'LineWidth', 2);
hold on;
plot(strain3_f, stress3_f, 'LineWidth', 2);




xlabel('Strain');
ylabel('Stress (MPa)');
xlim([0, 0.25]);
ylim([0, 1.4]);
title('Stress-Strain Curve of Catheter-Seal Connection at a Low Strain Rate (5mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');




set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 18, 'FontWeight', 'bold', 'LineWidth', 1.5);
```

```
idx = strain1_f > 0.02 & strain1_f < 0.06;
p = polyfit(strain1_f(idx), stress1_f(idx), 1);
E1 = p(1);
disp(['Youngs Modulus Run 1: ', num2str(E1), ' MPa']);




figure;
plot(displacement1, force1, 'LineWidth', 2);
hold on;
plot(displacement2, force2, 'LineWidth', 2);
plot(displacement3, force3, 'LineWidth', 2);
xlabel('Displacement (mm)');
ylabel('Force (N)');
title('Force vs Displacement at Low Strain Rate (5mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');


set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 14, 'FontWeight', 'bold', 'LineWidth', 1.5);
```





Conclusions/action items:

Complete for 50 mm/min as well

Dhruv Nadkarni - Apr 29, 2026, 3:29 PM CDT

Download

402Analysis.mlx (53 kB)

2026/04/29 - Data Analysis for Tensile Testing 50mm/min

Dhruv Nadkarni - Apr 29, 2026, 3:25 PM CDT

Title: Data Analysis for Tensile Testing - 50mm/min strain rate

Date: 04/29/2026

Content by: Dhruv Nadkarni

Present: N/A

Goals: Create a stress strain and force displacement curve.

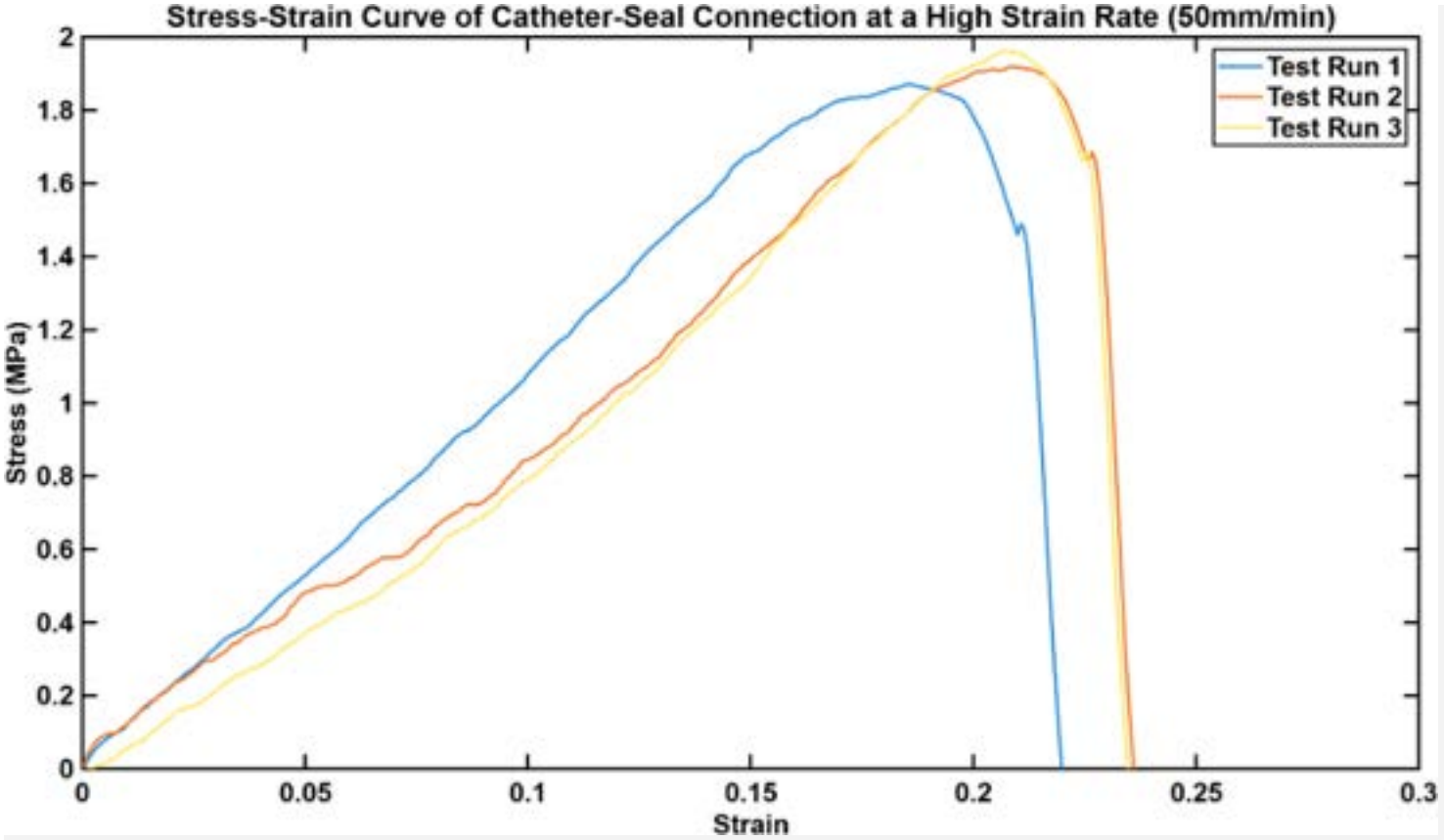
Content:

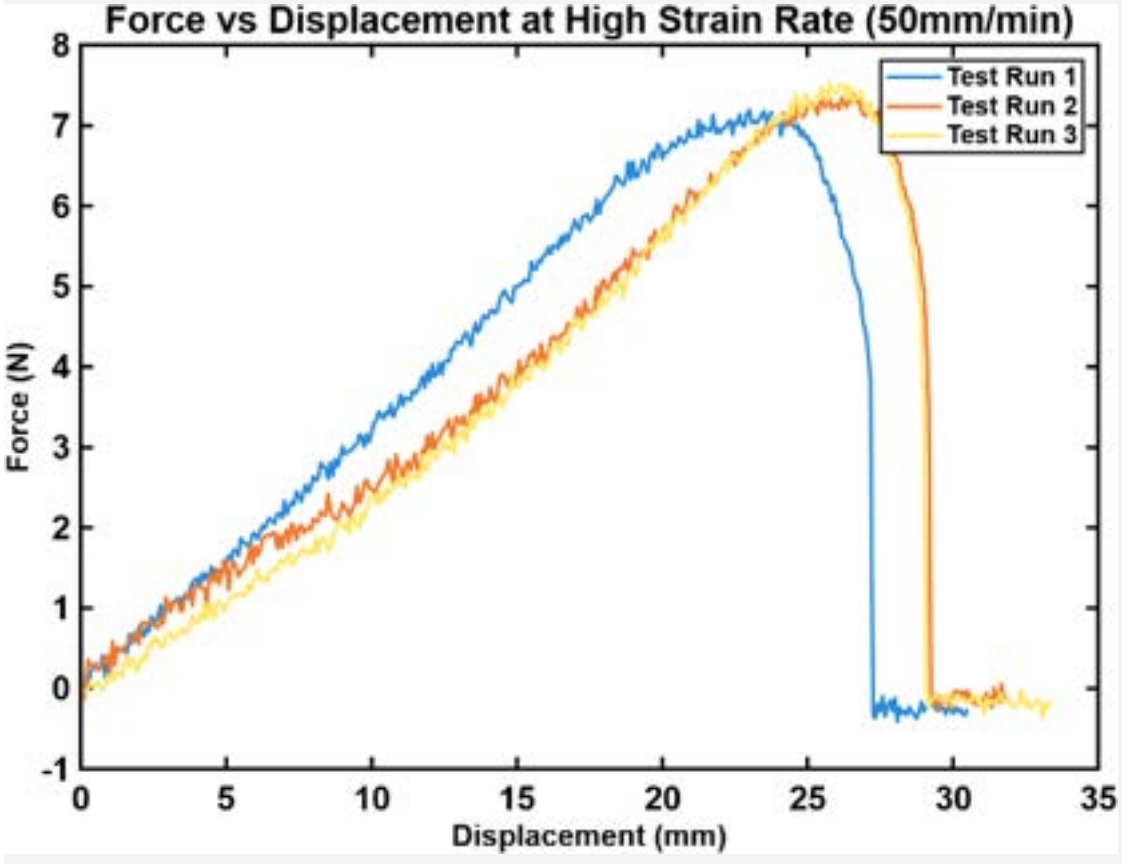
Completed on 4/22/2026

```
close all;
clear all;


Lo=125; % Gauge Length
Di = 2.5;
Do = 3.33;
A = pi/4 * (Do^2 - Di^2);


file1="/MATLAB Drive/BME402/Run4.txt";
data1=readtable(file1);


displacement1=data1{:,1};
force1=data1{:,2};
time1=data1{:,3};


stress1 = force1 ./ A;
strain1 = (displacement1 - displacement1(1)) ./ Lo;


stress1_f = sgolayfilt(stress1, 3, 21);
strain1_f = sgolayfilt(strain1, 3, 21);


file2="/MATLAB Drive/BME402/Run5.txt";
data2=readtable(file2);


displacement2=data2{:,1};
force2=data2{:,2};
time2=data2{:,3};


stress2 = force2 ./ A;
strain2 = (displacement2 - displacement2(1)) ./ Lo;


stress2_f = sgolayfilt(stress2, 3, 21);
strain2_f = sgolayfilt(strain2, 3, 21);
```

```
file3="/MATLAB Drive/BME402/Run6.txt";
data3=readtable(file3);


displacement3=data3{:,1};
force3=data3{:,2};
time3=data3{:,3};


stress3 = force3 ./ A;
strain3 = (displacement3 - displacement3(1)) ./ Lo;


stress3_f = sgolayfilt(stress3, 3, 21);
strain3_f = sgolayfilt(strain3, 3, 21);


figure;


plot(strain1_f, stress1_f, 'LineWidth', 2);
hold on;
plot(strain2_f, stress2_f, 'LineWidth', 2);
hold on;
plot(strain3_f, stress3_f, 'LineWidth', 2);




xlabel('Strain');
ylabel('Stress (MPa)');
xlim([0, 0.30]);
ylim([0, 2.0]);
title('Stress-Strain Curve of Catheter-Seal Connection at a High Strain Rate (50mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');


set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 18, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 18, 'FontWeight', 'bold', 'LineWidth', 1.5);
```

```
idx = strain1_f > 0.02 & strain1_f < 0.06;
p = polyfit(strain1_f(idx), stress1_f(idx), 1);
E1 = p(1);
disp(['Youngs Modulus Run 1: ', num2str(E1), ' MPa']);


figure;
plot(displacement1, force1, 'LineWidth', 2);
hold on;
plot(displacement2, force2, 'LineWidth', 2);
plot(displacement3, force3, 'LineWidth', 2);
xlabel('Displacement (mm)');
ylabel('Force (N)');
title('Force vs Displacement at High Strain Rate (50mm/min)');
legend('Test Run 1','Test Run 2', 'Test Run 3');


set(gcf, 'Color', 'w');
set(gca, 'Color', 'w');


set(gca, 'XColor', 'k', 'YColor', 'k', ...
'FontSize', 18, ...
'FontWeight', 'bold', ...
'LineWidth', 2);


set(get(gca, 'Title'), 'Color', 'k', 'FontSize', 20, 'FontWeight', 'bold');
set(get(gca, 'XLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');
set(get(gca, 'YLabel'), 'Color', 'k', 'FontSize', 16, 'FontWeight', 'bold');


set(legend, 'TextColor', 'k', 'Color', 'w', 'EdgeColor', 'k', ...
'FontSize', 14, 'FontWeight', 'bold', 'LineWidth', 1.5);
```





Conclusions/action items:

N/A

Dhruv Nadkarni - Apr 29, 2026, 3:30 PM CDT

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402Analysisfor50.mlx (46.8 kB)

2026/03/16 - HIPPA Privacy Training Confirmation

Dhruv Nadkarni - Mar 16, 2026, 5:11 PM CDT

Title: HIPPA Privacy Training Confirmation

Date: 03/16/2026

Content by: Dhruv Nadkarni

Present: N/A

Goals: Upload training for BME 402

Content:

WISCONSIN
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This certifies that Dhruv Nadkarni has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2025-2026 HIPAA Privacy & Security Training	2025-2026 HIPAA Privacy & Security Training	1/28/2026	
Biosafety 102: Bloodborne Pathogens for Laboratory and Research	Biosafety 102: Bloodborne Pathogens Safety in Research Quiz 2024	9/3/2024	9/3/2025
Biosafety Required Training	Biosafety Required Training Quiz 2024	2/27/2024	2/27/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	2/27/2024	
Responsible and Ethical Conduct of Research (RECR)	RCR Certification	10/31/2025	No Expiration
Stem Cell Ethics and Policy Training 2024	Assurance	9/3/2024	9/3/2027
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	9/24/2023	9/24/2026

Data Last Imported: 03/16/2026 04:54 PM

Conclusions/action items:

Do additional trainings and continue work on projects.

2/2/26: "3D bioprinting bone/cartilage organoids: contruction, applications, and challenges"

MEGHAN KAMINSKI - Feb 04, 2026, 12:56 PM CST

Title: "3D bioprinting bone/cartilage organoids: contruction, applications, and challenges"

Date: 2/2/26

Content by: Meghan

Present: N/A

Link: 3D bioprinting bone/cartilage organoids: construction, applications, and challenges - PMC

Citation:

[1] D. Gao *et al.*, "3D bioprinting bone/cartilage organoids: construction, applications, and challenges," *Journal of Orthopaedic Translation*, vol. 55, pp. 75–93, Sep. 2025, doi: https://doi.org/10.1016/j.jot.2025.08.008.

Goals: Develop an understanding of how-to simulate the ear for testing

Content:

Overview & Problem

- **Osteoarthritis affects >500 million globally; 5-10% of fractures fail to heal**
- **Current 2D cultures and animal models inadequately replicate human bone/cartilage physiology**
- **Organoids = 3D miniature tissue analogs that partially recapitulate native organ structure/function**

Key Construction Components

Seed Cells

- **ESCs: Unlimited self-renewal but ethical issues**
- **iPSCs: Patient-specific, minimal immunogenicity; challenges with low reprogramming efficiency**
- **MSCs: From bone marrow, umbilical cord, adipose tissue; well-characterized osteochondrogenic capacity**
- **PDCs: Mechanoresponsive, higher osteogenic activity than BMSCs under mechanical stimulation**

Biomaterials

- **Natural hydrogels: Collagen, gelatin, GelMA, alginate, hyaluronic acid, chitosan, silk fibroin**
- **Synthetic hydrogels: PEG, PLGA, PLA, PCL**
- **Inorganic additives: Hydroxyapatite (HAp), tricalcium phosphate (TCP), calcium silicate - promote mineralization and osteogenesis**

Signaling Pathways

- **Osteoblast: IGF, FGF, BMP, TGF-β, PI3K/AKT, Notch, Piezo 1/2**
- **Chondrocyte: TGF-β, FGF, Hippo/YAP, PI3K/AKT, BMP, PKA**

Three Major Advantages of 3D Bioprinting

- **1. Precision & Personalization**
  - **Computer-aided modeling enables spatially precise cell deposition**
  - **Integrates patient MRI/CT data for customization**
  - **Overcomes stochastic nature of self-organization**
- **2. Direct Vascularization**
  - **Sacrificial ink strategy (gelatin, PEG, Pluronic F127) creates hollow perfusable channels**

- Overcomes diffusion limitation (~200 μm from capillaries)
- Multi-nozzle/coaxial printing enables complex vascular networks

- 3. High-Throughput & Automation
  - Computer-automated spatial patterning
  - Examples: 384 organoids in 3 minutes; ~30 organoids from 5 μL bioink
  - Enhanced reproducibility and scalability

3D Bioprinting Techniques

- Inkjet: High resolution (50-100 μm), high-throughput; limited by shear stress, requires low viscosity
- Extrusion: Accommodates high viscosity/cell density (10^6-10^7 cells/mL); shear stress damages cells
- DLP/SLA: Exceptional resolution, rapid printing; DLP ideal for miniature organoids
- Volumetric: Single-step bulk solidification in seconds, >95% cell viability, centimeter-scale
- Microfluidic-Assisted: Real-time cellular concentration control, ultrahigh density (10^7 cells/mL)
- Aspiration-Assisted: Precise positioning of spheroids (80-800 μm), high viability

Recent Advances

Bone Organoids

- Self-mineralizing organoids with HAp-doped bioinks form mature trabecular structures
- Neurovascular integration using calcium silicate nanowires enables neurotized bone regeneration
- Prevascularized constructs with GO microparticles achieve centimeter-scale, high-density organoids

Cartilage Organoids

- MNP-loaded bioinks restore lamellar cartilage architecture in vivo
- Modular biofabrication using cartilage microspheres as building blocks
- Laser-assisted bioprinting (LIPMO) enables high-cell-density constructs

Callus & Bone Marrow Organoids

- DLP with stepwise induction creates callus-mimetic organoids for rapid bone repair
- Bone marrow organoids model hematopoietic development

Applications

- Regenerative Medicine: Patient-specific transplantable organoids avoid immunological barriers
- Disease Modeling: Osteoarthritis, osteoporosis, bone tumors, genetic bone diseases
- Drug Screening: High-fidelity pathophysiology emulation, reduced animal testing, lower costs
- Biocompatibility Testing: Evaluation of orthopedic implants
- Aerospace Medicine: Microgravity bone loss models, astronaut-specific predictions, on-orbit bioprinting

Major Challenges

- Vascularization
- Current resolution (50-200 μm) insufficient for capillaries (6-8 μm)
- Incomplete sacrificial material removal, vascular collapse
- Solutions: Triaxial bioprinting, tough dual-network hydrogels

Systemic Integration

- Lack neural innervation, immune modulation, multi-organ crosstalk

- **Cannot assess systemic drug effects**
- **Need multi-tissue organoid systems**

Standardization & Scalability

- **No consensus on critical parameters (dimensions, density, performance)**
- **Batch-to-batch variability**
- **Require internationally recognized guidelines**

Technical Barriers

- **Shear stress reduces cell viability**
- **Bioinks struggle to meet both mechanical and bioactive requirements**
- **iPSC reprogramming slow (improving: 40 days → 7-12 days with FCR)**
- **AI may optimize parameters and screen ideal bioinks**
- **Bioink Development**
- **Must balance printability, mechanical strength, cytocompatibility, and biomimicry**
- **Natural materials lack mechanical properties; synthetic lack bioactivity**
- **dECM has xenogeneic risks and batch variability**

Future Directions

- **Develop adjustable universal bioinks**
- **Efficient iPSC induction protocols**
- **Multi-axis co-printing (vascular/neural/organ integration)**
- **Establish standardized platforms**
- **AI-driven optimization**
- **Clinical translation acceleration, particularly for regenerative medicine**

Conclusion

- 3D bioprinting represents a paradigm shift enabling precise bone/cartilage organoid construction. Despite challenges in vascularization, standardization, and biomaterial development, integration of advanced bioprinting technologies with optimized bioinks will accelerate clinical translation for disease modeling, drug screening, and regenerative medicine.

Conclusions/action items: The content in the article may lead us towards simulating an ear with biomaterials/bioprinting in order to test in the most accurate setting.

2/2/26: "Materials used to simulate physical properties of human skin"

MEGHAN KAMINSKI - Feb 04, 2026, 1:19 PM CST

Title: "Materials used to simulate physical properties of human skin"

Date: 2/2/26

Content by: Meghan

Present: N/A

Goals: Develop an understanding of how-to simulate the ear for testing

Link: Materials used to simulate physical properties of human skin - Dąbrowska - 2016 - Skin Research and Technology - Wiley Online Library

Citation:

[1] A. K. Dąbrowska *et al.*, "Materials used to simulate physical properties of human skin," *Skin Research and Technology*, vol. 22, no. 1, pp. 3–14, Jun. 2015, doi: https://doi.org/10.1111/srt.12235.

Content:

- Introduction & Background
  - Human skin is the largest organ, comprising 12-16% of total body weight
  - Skin has multiple critical functions: mechanical protection, barrier function, sensation (mechanoreceptors, thermoreceptors, nociceptors), temperature regulation, vitamin D synthesis, and excretion
  - Skin appearance provides social information about health, age, and gender
  - Physical skin models are needed because human skin properties vary widely by age, gender, body region, and physiological status
- Development Process for Skin Models
  - The development involves several distinct phases:
  - Requirements establishment: Define needed skin characteristics, properties, functions, and environmental/experimental conditions
  - Material selection: Choose appropriate materials and processing methods
  - Manufacturing: Effective construction of the model
  - Testing & characterization: Simplified experiments to select most promising designs
  - Validation: Compare against in vivo skin, cadaver skin, excised skin, animal skin (particularly porcine), other validated models, or theoretical calculations
- Liquid Suspensions
  - Purpose: Simulate optical properties of tissues (scattering and absorption)
  - Components:
    - Lipid solutions (for intravenous delivery)
    - Polystyrene and titanium dioxide particles as scatterers
    - Absorbers and fluorophores (biological and synthetic) for light absorption control
  - Advantages: Good reproducibility, well-defined commercially available substances
  - Limitations: Must be embedded in solid containers creating new interfaces; cannot simulate surface or mechanical properties
  - Applications: Testing measurement systems and theoretical models
- Gelatinous Substances
  - *Gelatine:*
  - Properties: Protein from partial hydrolysis of collagen; water-gelatine solutions simulate density and viscosity of human tissue
  - Ballistic gelatine: Standard for ballistic testing and wound ballistic forensic reconstructions
  - Limitations: Not accurate for low kinetic energies; requires multilayer approach with second material simulating epidermis
  - Applications:
    - Ballistic testing and cavity formation studies
    - Elastography (provides matrix with appropriate density, stiffness, sound speed, absorption, light scattering)
    - Testing sun creams, self-tanning formulations, moisturizers
    - Adhesive testing
  - Advantages: Parameters can be independently controlled through chemical or physical modification
- *Agar:*
  - Composition: Gelatinous substance from seaweed polysaccharides
  - Properties: Acoustic velocity, impedance, and density similar to skin

    - Production: Mixed with deionized water or saline; can incorporate chromophores, scattering media, sodium chloride (for conductivity), magnetic particles (for thermal studies)
    - Process: Homogeneous mixture in liquid phase, poured into 3D molds, polymerization by heating to boiling then rapid cooling
    - Concentration: Few percent agar powder significantly influences density and mechanical properties
    - Advantages: Versatile, easy to produce
    - Limitations: Not very stable, limited lifetime, suitable only for non-contact or light contact applications
    - Applications: Optical imaging, thermal imaging and transport, photoacoustic and ultrasound imaging, dosimetry, body-centric applications
- *Polyvinyl Alcohol (PVA) Gels:*
    - Properties: Synthetic polymer, highly water-soluble, forms hydrogels after cross-linking
    - PVA Cryogels: Especially suitable for magnetic resonance studies; important for tissue-mimicking phantoms
    - Tunable properties: Scattering coefficient and stiffness adjusted by freeze/thaw cycles
    - Additives: Can incorporate scatterers, absorbers, Indian ink (to simulate melanin and pigmented lesions), nanoparticles
    - Mechanical range: Properties tunable within soft tissue range
    - Applications:
        - Magnetic resonance imaging techniques
        - Optical tomography
        - X-ray examination
        - Acousto-optical elastography
        - Photoacoustic imaging
        - Ultrasound systems (testing, optimization, education)
        - Computer game controller design
    - Advantages: Relatively stable, easy to store
- Elastomers
    - *General Properties:*
    - Polymers with rubber-like viscoelastic properties
    - Glass transition well below room temperature
    - Properties similar to human skin
    - Allow tailoring physical properties through composites
- *Silicones:*
    - Composition: Inorganic-organic polymers with Si, O, C, H and secondary elements
    - Type used: Cross-linked polydimethylsiloxanes
    - Fillers for property control:
        - Carbon black: electrical conductivity
        - Titanium dioxide: dielectric constant
        - Barium sulphate: radiopacity
    - Refractive index: 1.3-1.5 (similar to skin), further tunable
    - Surface capabilities: Can reproduce surface morphologies with defined roughness; can create direct skin replicas
    - Shape versatility: Can be molded from simple geometric to anthropomorphic anatomical shapes
    - Applications:
        - Optical imaging
        - Specific absorption rate measurement
        - Drug delivery
        - Needle penetration studies
        - Acoustic and photoacoustic imaging
        - Tactile assessment
        - Indentation testing
        - Friction studies
    - Advantages: Broad range of tunable properties, easy manipulation, non-toxic, long-term stability
- *Polyurethanes:*
    - Types: Primarily thermosetting, some thermoplastic addition polymers
    - Property control: Different soft-to-hard phase ratios, sponges, reinforcing particles
    - Lorica™ artificial leather: Polyamide microfleeece coated with polyurethane
        - Realistically simulates friction against textiles under dry conditions
        - Reproduces surface properties (roughness, topography, water contact angle)
        - Similar force-deformation characteristics to skin
    - Applications:
        - Tactile sensing robotic skin
        - Mechanical skin models
        - Friction behavior simulation
        - Medical training (intradermal injection, skin surgery)
        - Prediction of skin softness
        - Epidermis simulation in biomechanical models
        - Dermis simulation (polyurethane sponges) for non-ballistic skin wounding studies

        - Optical skin models
    - Advantages: Long shelf life, stability, highly tunable properties
- Epoxy Resin
    - Properties: Cross-linked/thermoset plastics with wide property range
    - Thermal diffusivity: 0.070-0.084 mm^2/s (close to human skin's ~0.11 mm^2/s)
    - Refractive index: 1.54 (close to skin), adjustable with titanium dioxide and aluminum oxide particles
    - Property control: Mixing with plasticizers and diluents
    - Applications:
        - Thermal skin models
        - Skin-simulant temperature sensors for burn prediction
        - Cryogen spray cooling processes
        - Raman instrumentation calibration
        - Optical tomography validation (e.g., neonatal brain)
        - Near-infrared examination calibration
        - Outer layer of breast phantoms for X-ray imaging quality control
        - Mammography education
    - Metals
    - Primary use: Systems probing thermal properties of clothing
    - Design focus: Not critical which specific metal; relies on overall system design
    - Advantages:
        - High thermal responsiveness
        - Stable properties
        - Robustness
        - Various shape production capabilities
        - Can incorporate heating/cooling elements with electronic control
        - Sweating and movement capabilities implemented
    - Example: ISO 11092:2014 "sweating guarded-hotplate" - porous sintered metal plate heated to 35°C for textile-physiological effects assessment
    - Integration: Often coupled with thermodynamical and thermophysiological models in controlled climatic conditions
    - Key parameters: Skin temperature, sweating rate, heat transport
    - Limitations: Mechanical properties and thermal inertia not realistic
    - Applications: Material testing/development, body monitoring systems, thermophysiological response studies
- Textiles
- Materials: Natural (cotton, chamois) and synthetic (polytetrafluoroethylene, polyamide, polyester)
- Types of sweating textile models:
    - Pre-wetted textile skin
    - Textile skin with water delivered by sweating nozzles
    - Waterproof textile skin that is vapor permeable
- Primary functions: Redistribution and transport of moisture
- Property control:
    - Material selection (fiber composition, surface properties, hygroscopicity, hydrophobicity)
    - Structural properties (thickness, construction, porosity, surface pattern)
- Applications:
    - Liquid and water vapor transport investigation
    - Thermal insulation studies
    - Combined comfort and protective properties of clothing systems
    - Integration of sensing elements for continuous body monitoring
- Emerging area: Textile-based flexible sensors utilizing large textile surface area for spatial information on multiple parameters (heat flux, sweating rate, evaporative flux, skin temperature)
- Other Specialized Materials
    - Albumin: Simulates thermal damage to skin
    - Onion, peach, cellophane: Simulate diffusion mechanisms of human skin
    - Multilayer designs: Polycarbonate porous membrane + skin replica membrane for sweating simulation in X-ray micro-computed tomography studies
    - Nano- and Micro-fillers
    - Purpose: Obtain tailored properties and functionality in skin models
    - Types: Nanoparticles, nanowires, chromophores, fluorophores
    - Effects: Influence mechanical, thermal, optical, dielectric, and magnetic properties
    - Unique capabilities:
        - Exploit quantum effects at nanoscale
        - Coupling between nanomaterials and matrix properties
        - Implement sensing capabilities for monitoring or robotic skin applications
    - Specific filler examples:

    - Optical property tuning: Metallic gold, titanium dioxide, silicon dioxide, aluminum oxide, polystyrene, carbon black, graphite, lipid (Intralipid)
    - Mechanical properties: Carbon black
    - Dielectric/resistive properties: Graphite, nickel, ferroelectric fillers
    - Key Requirements for Physical Skin Models
    - Must consider:
    - Human skin characteristics: Age, gender, body region, physical status (fitness, health), physiological status (temperature, sweating, hydration, sebum)
    - Properties to simulate: Mechanical, optical, thermal, electrical, chemical, surface
    - Functions to simulate: Sensing, cooling, heating, protection, appearance
    - Environmental conditions: Temperature, humidity, air flow, precipitation, radiation
    - Experimental conditions: Speed, time, pressure, frequency, deformation, hysteresis, geometry (anthropomorphic or simplified)
- Future Perspectives
    - Historical approach: Development largely through trial-and-error, selecting materials that look/feel similar to skin or provide comparable measurements
    - Current limitations: Due to skin complexity, empirical investigations still necessary
    - Improvement opportunities:
        - Combine suitable material compositions with skin-like structure, morphology, and surface properties
        - Incorporate nanoparticles for optical properties (titanium oxide, gold, aluminum oxide, polymer microspheres, chromophores)
        - Multi-property combinations in single models
        - Interdisciplinary/multiphysics approaches for more realistic models
    - Medical applications: Need biocompatible materials combining specific functions with skin-adapted thermal, mechanical, and tactile properties
    - Technology advances: Expected to enable improved models reproducing more skin properties/functions, valid for wider conditions and applications
    - Tunable/actively controllable models: Would simulate skin's response to external influences more accurately, accounting for physiological and regulatory processes
- Validation Methods
    - Models validated through comparison with:
    - In vivo skin
    - Cadaver skin
    - Explants and excised skin
    - Animal skin (especially porcine)
    - Other validated skin models
    - Analytical calculations and theoretical modeling

Conclusions/action items: The content in the article may lead us towards simulating an ear with biomaterials/bioprinting in order to test in the most accurate setting.

3/12/26: "3M Medical Tape, 1509"

MEGHAN KAMINSKI - Mar 12, 2026, 1:35 PM CDT

Title: "3M Medical Tape, 1509"

Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Research materials for interface between earmuff and dressing

Link: [3M™ Medical Tape, 1509]

Citation:

[1] "3M™ Medical Tape, 1509," *Solventum.com*, 2017. https://www.solventum.com/en-us/home/f/b10186518/ (accessed Mar. 12, 2026).

Content:

Double sided medical tape, packaged in a roll, 3 mil transparent polyethylene film, coated on two sides with a tacktified acrylic adhesive, used for medical devices, fluid resistant, good processability, heavy liner for easy use

Conclusions/action items: Order material to use for interface.

3/12/26: "Owens & Minor Comfort and Padding Materials- Rubber Foam Padding"

MEGHAN KAMINSKI - Mar 12, 2026, 1:44 PM CDT

Title: "Owens & Minor Comfort and Padding Materials- Rubber Foam Padding"

Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Research materials for the headband padding

Link: [Owens & Minor Comfort and Padding Materials - Rubber Foam Padding, 1/4 — Grayline Medical]

Citation:

[1] "Owens & Minor Comfort and Padding Materials - Rubber Foam Padding, 1/4", 21" x 36" - 58351LF," *Grayline Medical*, 2025. https://www.graylinemedical.com/products/owens-minor-comfort-and-padding-materials-rubber-foam-padding-14-21-x-36-58351lf?variant=31856324902969&msclkid=bc7617f7fe2b1e7d23517e44f9f42275&utm_source=bing&utm_medium=cpc&utm_campaign= (accessed Mar. 12, 2026).

Content:

Rubber foam padding (1.4", 21" x 36")

Medical grade rubber and foam

Conclusions/action items: Order materials to use for headband comfort aspect.

2/24/26: SolidWorks Update: Headband

MEGHAN KAMINSKI - Mar 12, 2026, 12:09 PM CDT

Title: SolidWorks Update

Date: 2/24/26

Content by: Meghan

Present: N/A

Goals: Update dimensions

Content:

Conclusions/action items: Edit the earmuff portion in relation to the new dimension of the headband. 3D print the designs in PLA.

3/12/26: SoldiWorks Update: Earmuff

MEGHAN KAMINSKI - Mar 12, 2026, 12:10 PM CDT

Title: SolidWorks Update: Earmuff

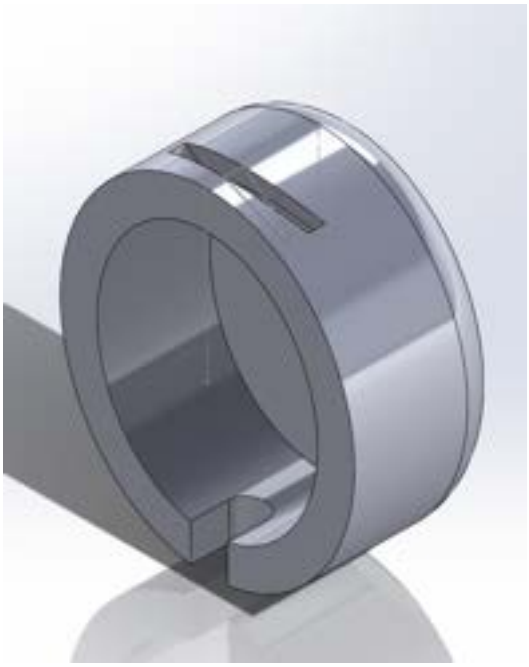
Date: 3/12/26

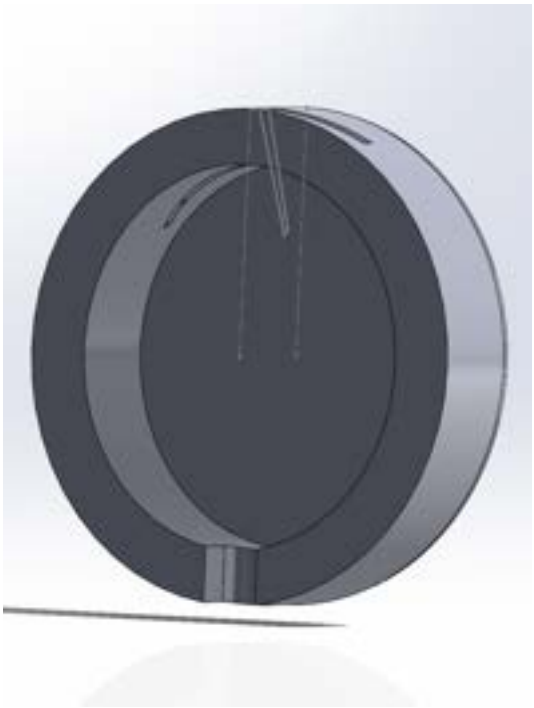
Content by: Meghan

Present: N/A

Goals: Update dimensions

Content:





Conclusions/action items: 3D print both components in PLA to test connection site.

3/12/26: SolidWorks Assembly

MEGHAN KAMINSKI - Mar 12, 2026, 12:12 PM CDT

Title: SolidWorks Assembly

Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Assembly to ensure components fit

Content:

Conclusions/action items: 3D print components in PLA.

3/12/26: Protective Ring

MEGHAN KAMINSKI - Mar 12, 2026, 12:34 PM CDT

Title: Protective Ring

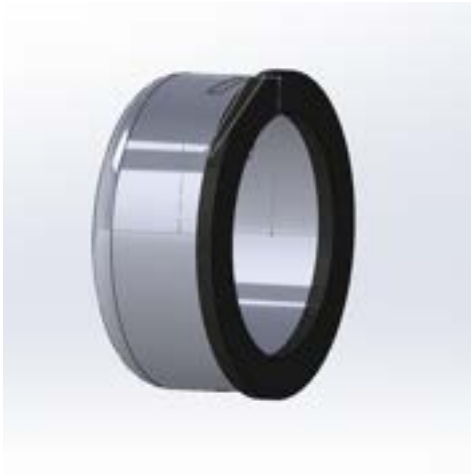
Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Create protective ring for earmuff and dressing interface

Content:



Conclusions/action items: 3D print protective ring in softer material.

3/12/26: SolidWorks Assembly 2

MEGHAN KAMINSKI - Mar 12, 2026, 12:33 PM CDT

Title: SolidWorks Assembly 2

Date: 3/12/26

Content by: Meghan

Present: N/A

Goals: Create assembly with protective ring

Content:

Conclusions/action items: 3D print all components.

3/18/26:3D printed Headband

MEGHAN KAMINSKI - Mar 18, 2026, 3:45 PM CDT

Title: 3D printed Headband

Date: 3/18/26

Content by: Meghan

Present: N/A

Goals: 3D Print pictures

Content:

Conclusions/action items: Reprint with more flexible material

3/18/26:3D printed earmuff

MEGHAN KAMINSKI - Mar 18, 2026, 3:46 PM CDT

Title: 3D printed earmuff

Date: 3/18/26

Content by: Meghan

Present: N/A

Goals: 3D Print pictures

Content:

Conclusions/action items: Reprint with more flexible material

3/18/26:3D printed earmuff with elastic ring

MEGHAN KAMINSKI - Mar 18, 2026, 3:47 PM CDT

Title: 3D printed earmuff with elastic ring

Date: 3/18/26

Content by: Meghan

Present: N/A

Goals: 3D Print pictures

Content:

Conclusions/action items: Reprint with more flexible material

1/29/2024 Biosafety and Chemical Safety Required Training

SERENA EVERS - Jan 29, 2024, 9:03 PM CST

Title: Biosafety and Chemical Safety Required Training

Date: 1/29/2024

Content by: Serena Evers

Present: Serena Evers

Goals: provide documentation for my completed Biosafety training and Chemical Safety: The OSHA Lab Standard training

Content:

pdf with proof of training completion attached

Conclusions/action items:

Utilize these trainings in BME design

SERENA EVERS - Jan 29, 2024, 9:03 PM CST

Download

Biosafety_and_Chemical_safety_training.pdf (60.8 kB)

10/28/25 CITI Human subjects course

SERENA EVERS - Dec 10, 2025, 3:46 PM CST

Title: CITI human subjects training

Date: 10/28/25

Content by: Serena E

Present: n/a

Goals: Complete the semester required training

Content:

attached

Conclusions/action items:

n/a

SERENA EVERS - Oct 28, 2025, 2:54 PM CDT

Download

CITI_human_subjects.pdf (77.4 kB)

3/11/2024 Intro to Machining Training

SERENA EVERS - Mar 11, 2024, 7:46 PM CDT

Title: Intro to Machining Required Training

Date: 3/11/2024

Content by: Serena Evers

Present: Serena Evers

Goals: Provide documentation for the Intro to Machining Required training

Content:

pdf with proof of training completion attached.

Conclusions/action items:

Utilize this training when fabricating the Bioreactor for the Bone Biomaterial

SERENA EVERS - Mar 11, 2024, 7:46 PM CDT

Download

Untitled_document_3_.pdf (168 kB)

3/19/2026 Six Sigma training

SERENA EVERS - Mar 19, 2026, 4:57 PM CDT

Title: Six Sigma Foundations: Applying Design for Six Sigma

Date: 3/19/26

Content by: Serena

Present: n/a

Goals: Complete BME training for this semester

Content:

Completion Certificate attached.

Conclusions/action items:

n/a

SERENA EVERS - Mar 19, 2026, 4:57 PM CDT

Download

CertificateOfCompletion_Six_Sigma_Foundations_Applying_Design_for_Six_Sigma.pdf (234 kB)

1/30/26 BSAC meeting

SERENA EVERS - Mar 12, 2026, 6:00 PM CDT

Title: BSAC meeting

Date: 1/30/26

Content by: Serena

Present: me

Goals: Attend the first BSAC meeting of the semester

Content:

We discussed the 200/201 curriculum as well as everyone's progress on their design projects.

Conclusions/action items:

I will remind my teammates about the required training for this semester.

2/20/26 NPWT review

SERENA EVERS - Mar 12, 2026, 6:13 PM CDT

Title: Negative Pressure Wound Therapy – A Review of its Uses in Orthopaedic Trauma

Date: 2/20/26

Content by: Serena

Present: n/a

Goals: Use this source in our prelim manuscript draft

Content:

At the macroscopic level, suction pulls wound edges closer together, reducing the area that must heal. At the microscopic level, mechanical strain on tissues stimulates cell proliferation, growth factor production, and angiogenesis. The system also removes excess fluid and inflammatory mediators from the wound while maintaining a warm, moist environment that supports granulation tissue formation.

Clinically, NPWT is frequently used for open fractures with soft-tissue damage, infected or contaminated wounds, high-risk surgical incisions, and skin graft stabilization. Studies suggest it can reduce infection rates, decrease wound size, promote granulation tissue formation, and improve graft incorporation compared with traditional wet-to-dry dressings. However, evidence about its ability to reduce bacterial load is mixed.

Despite its benefits, NPWT can cause complications such as pain during dressing changes, skin blistering, device malfunction, bleeding, or retained dressing fragments. Regulatory agencies like the FDA emphasize proper training and monitoring to prevent these issues.

Conclusions/action items:

I am using the highlighted quote in the manuscript to highlight the clinical relevance of our design.

3/28/26 Executive Summary draft

SERENA EVERS - Apr 28, 2026, 12:46 PM CDT

Title: Executive Summary draft

Date: 3/28/26

Content by: Serena E

Present: n/a

Goals: prepare for Bryan and I's pitch to the tong judges

Content:

product exists in the market that would challenge EarVac’s specific focus on post-surgical treatment. Sources estimate the number of microtia nstruction surgeries can reach up to 100,000 globally. Due to wide variation in microtia reconstruction techniques across surgeons and geographic tions, the total cost of reconstruction—including consultation, imaging if required, operative time, and postoperative care—ranges from $15,000 to ,000. Though no specific market valuation of ear-oriented NPWT exists, the NPWT market hit $2.37 billion dollars in 2021, and is expected to reach 2 billion dollars by 2030 according to Strategic Market Research. Hence, with the high quantity of surgeries, novel design aspects allowing ntability, and room to largely scale and optimize manufacturing of the product, EarVac exists within an untapped market.

Conclusions/action items:

Practice my pitch.

3/11/26 Prototype testing

SERENA EVERS - Mar 12, 2026, 6:15 PM CDT

Title: Prototype testing

Date: 3/11/26

Content by: Serena

Present: team

Goals: Continue testing on our current prototype

Content:

video attached

Conclusions/action items:

Continue testing

SERENA EVERS - Mar 12, 2026, 6:16 PM CDT

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IMG_7223.mov (23.8 MB)

2/10/26 Y connector

SERENA EVERS - Mar 12, 2026, 6:18 PM CDT

Title: Y connector

Date: 2/10/26

Content by: Serena

Present: n/a

Goals: Find y connector

Content:

These are the y connectors we purchased and integrated into our design:

https://urldefense.com/v3/__https://a.co/d/01Wlyq8z__;!!Mak6IKo!NxhOcgfb_9bN3QT-vCcn-G9u-jySawekNX4fs7sxAgKfNgtXY0atuGAitEC4EGZXRQKQZAfFPNEM63Gqd43bziHkbA$

Conclusions/action items:

Figure out which dimensions will work the best.

4/14/26 MTS testing

SERENA EVERS - Apr 28, 2026, 12:57 PM CDT

Title: MTS Testing

Date: 4/14/26

Content by: Serena E

Present: Dhruv and Serena

Goals: complete tensile strength of the tube attachment testing

Content:

Dhruv and I completed MTS testing of the seal today.

Image of MTS testing attached.

Conclusions/action items:

Complete statistical analysis

SERENA EVERS - Apr 28, 2026, 12:57 PM CDT

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IMG_7649.jpeg (3.84 MB)

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

BME Design - Fall 2025 Notebook

BRYAN HEATON - Jan 21, 2026, 9:21 PM CST

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