Electrical Test Technique Designed for the CLAS 12 Toroid Coils

Jeremiah Afolabi
Fermilab, Technical Division
SIST Internship

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VANDERBILT UNIVERSITY

Overview

- Goal
  - To detect turn to turn short in the coils of the CLAS 12 Toroid magnet

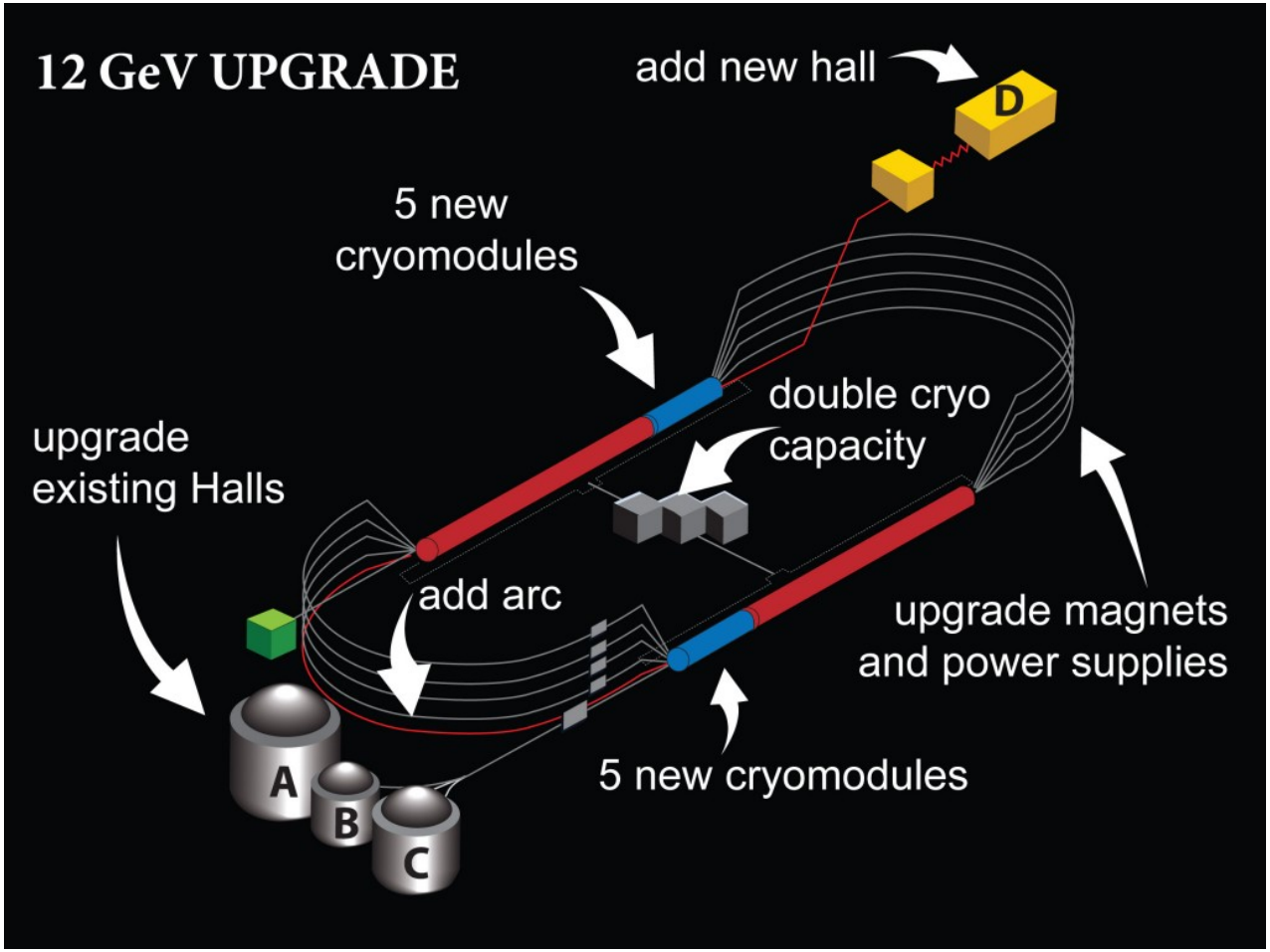
- Background Information
  - CEBAF Upgrade
  - Electrical Testing

- Instrumentation

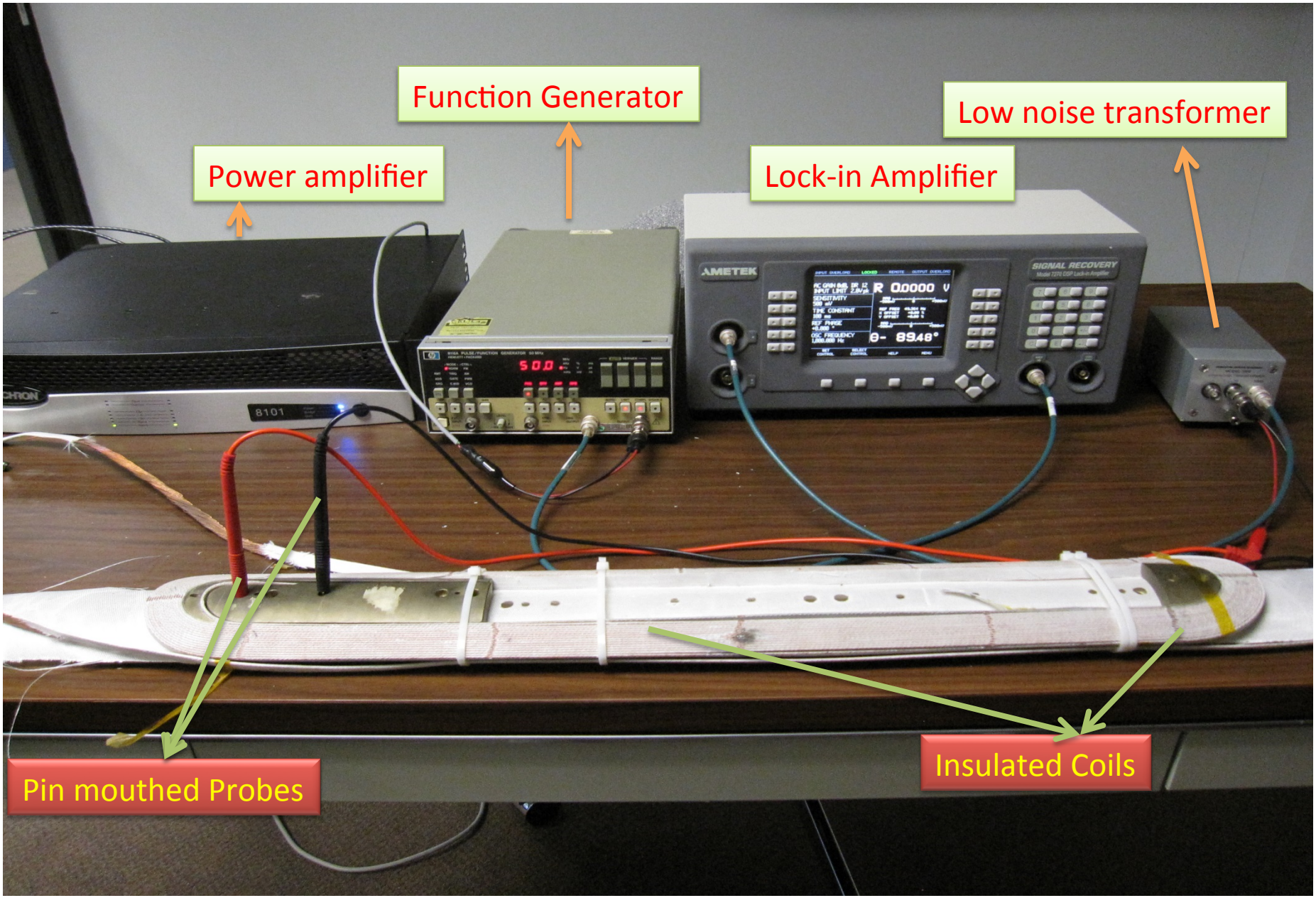
- Case Studies
  - Testing with low voltage Source
  - Testing with a power amplifier
  - Introduction of soft short

- Conclusion

Background-CEBAF Upgrade

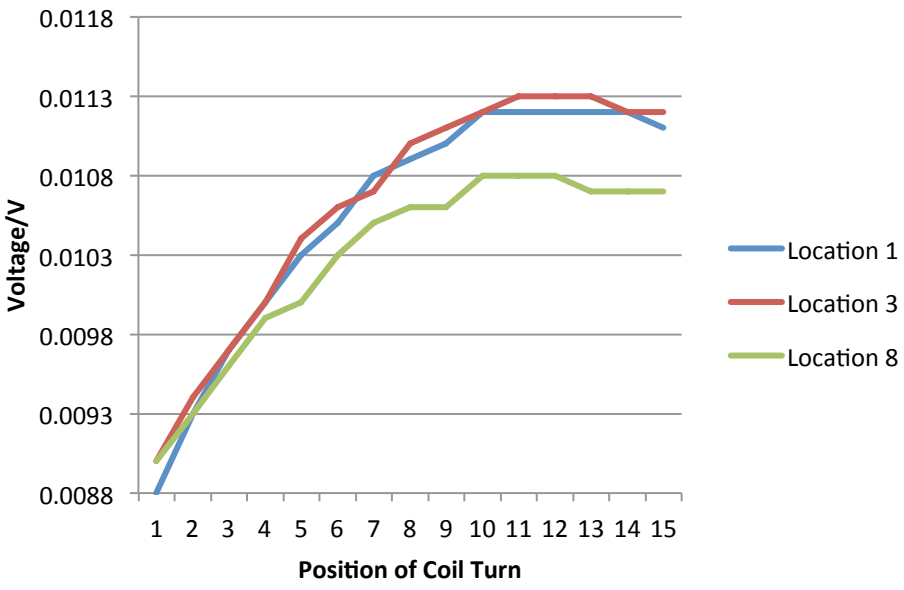


Measurement Set-Up

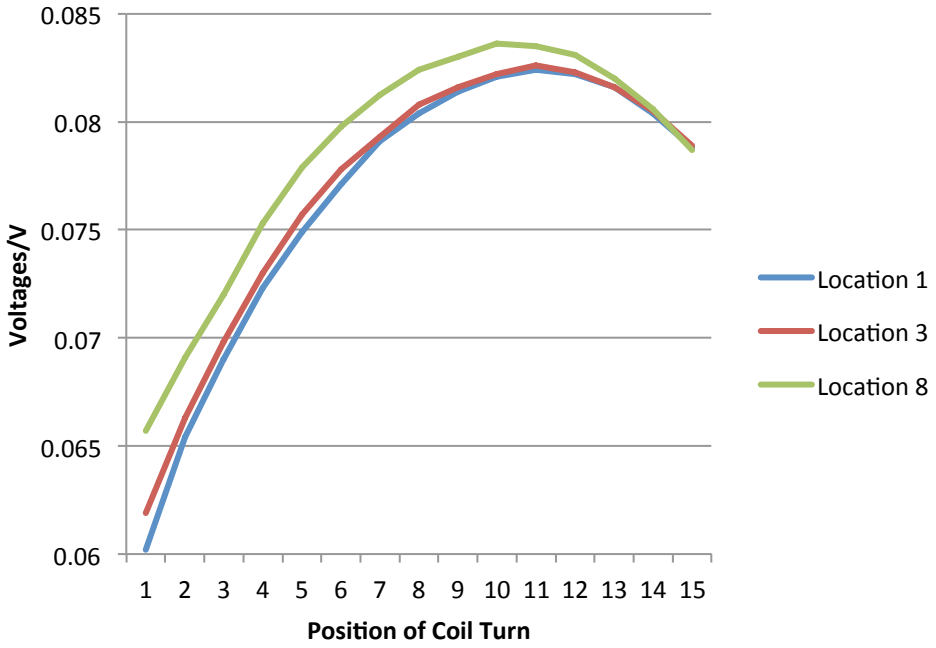


Case 1- Testing with low voltage source

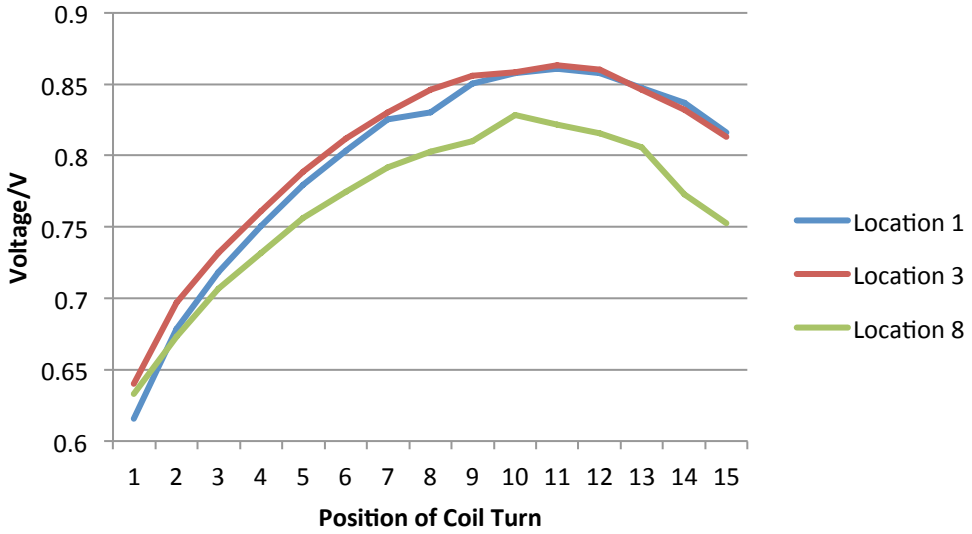
Voltage Variation at Turn Ratio of 1:10 and Osc Frequency of 50Hz



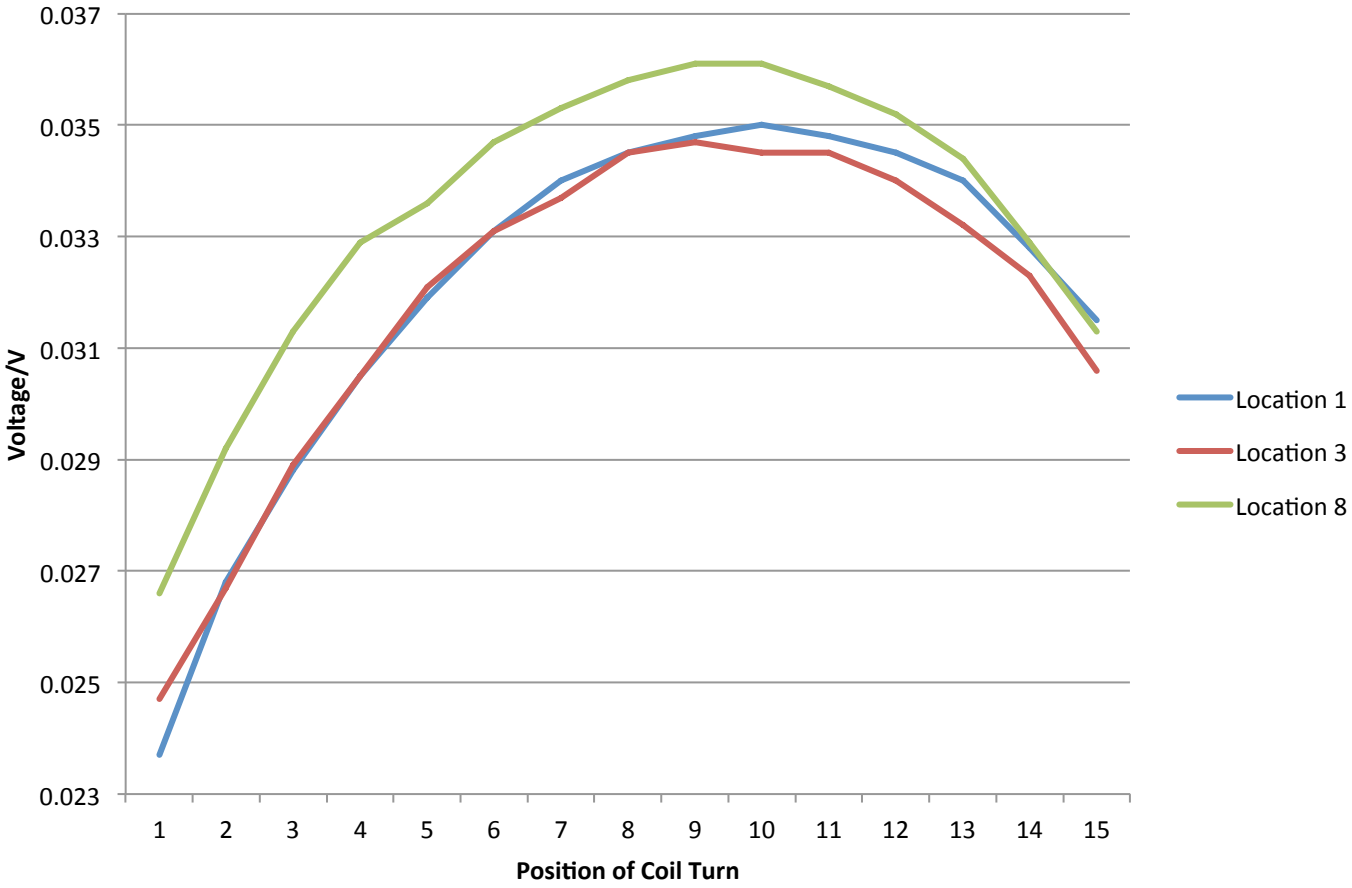
Voltage Variation at Turn Ratio of 1:10 and Osc Freq of 500 Hz



Voltage Variation at Turn Ratio of 1:100 and Oscillation Frequency of 500 Hz

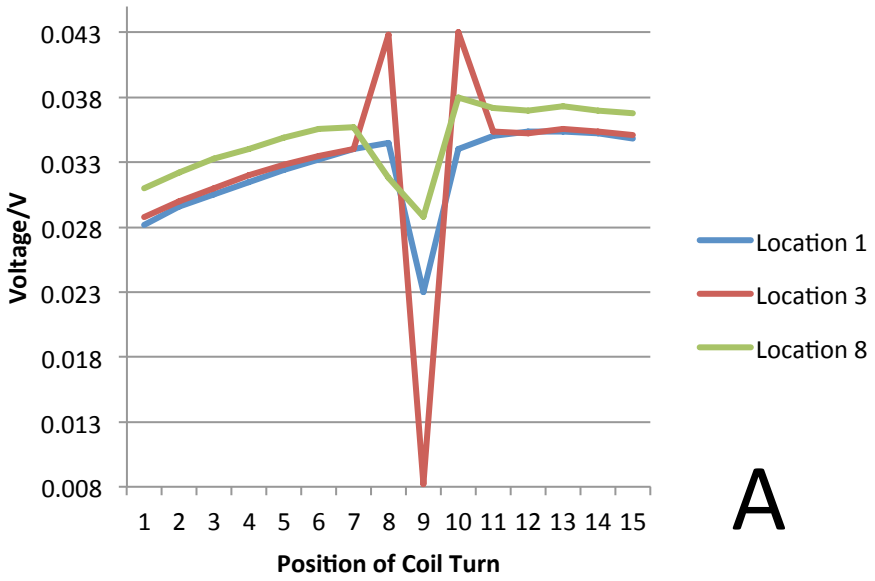


Case 2-Testing with Power Amplifier

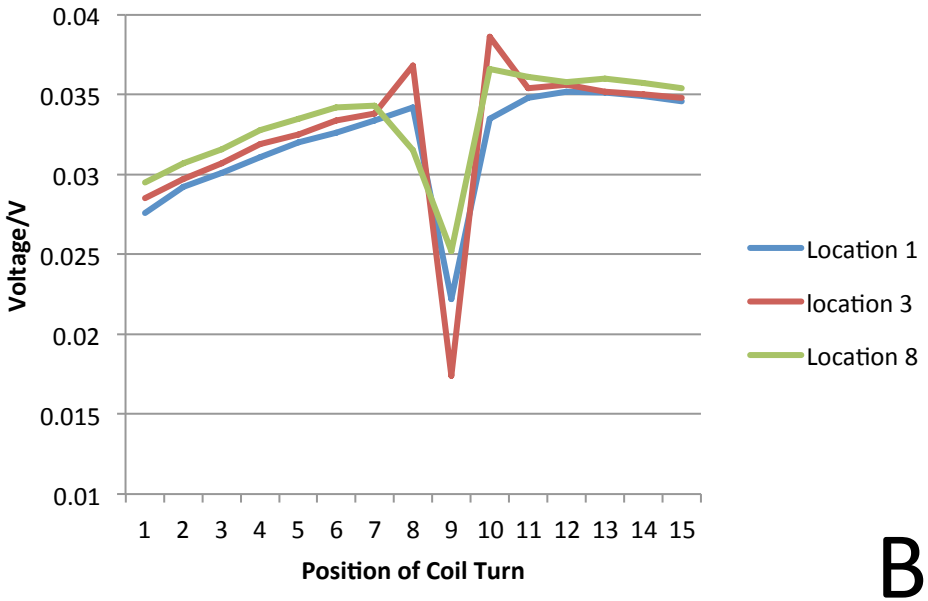


Voltage Variation at Turn Ratio of 1:10 and Oscillation Frequency of 500 Hz

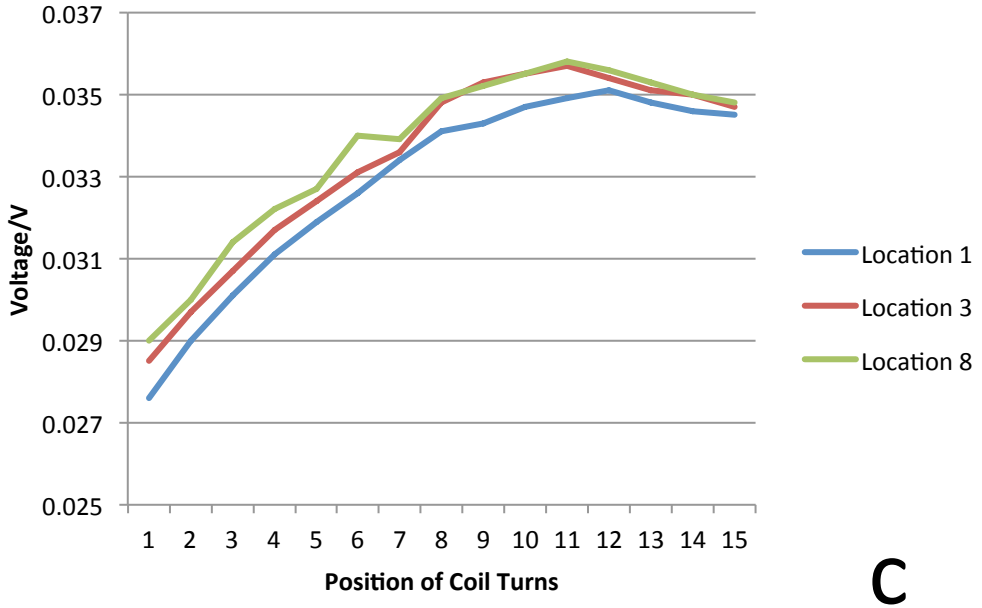
Introduction of “soft short”



A



B



C

A- Soft short of 10 ohms

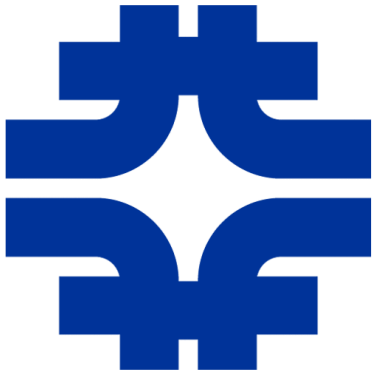
B- Soft short of 1.5K ohms

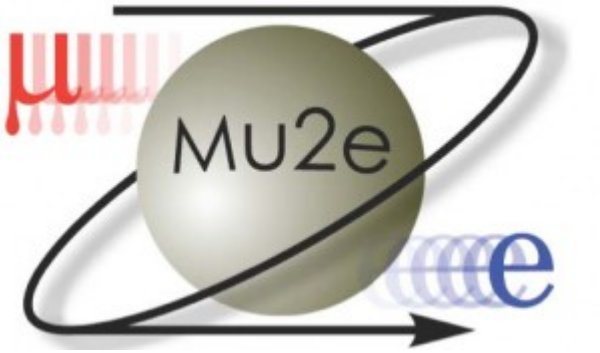
C- Soft short of 10K ohms

Conclusion

In summary, I have been able to establish that with an AC current injection via a power amplifier and with an introduction of a soft short of the order of 10 ohms and not greater than 1.5K ohms, turn-to-turn shorts can be effectively detected and located within the coils of the CLAS 12 toroid magnet.

Finally, to obtain an easy detection of these turn to turn shorts, the oscillation frequency of the input signal should be set to 50 Hz and the step up ratio on the low noise transformer should be 1:100.





Tensile Testing of the Transport Solenoid for the Mu2E Experiment

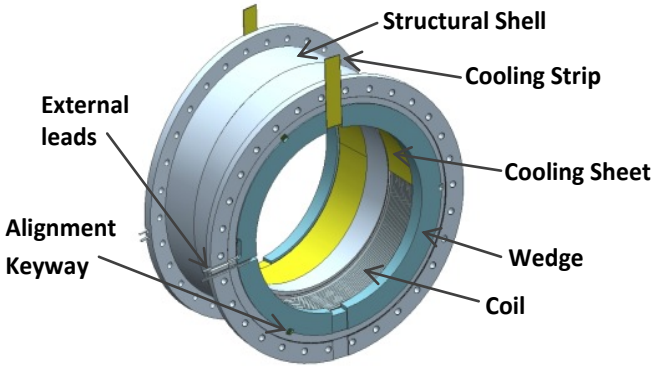
Jeremiah Afolabi
SIST intern

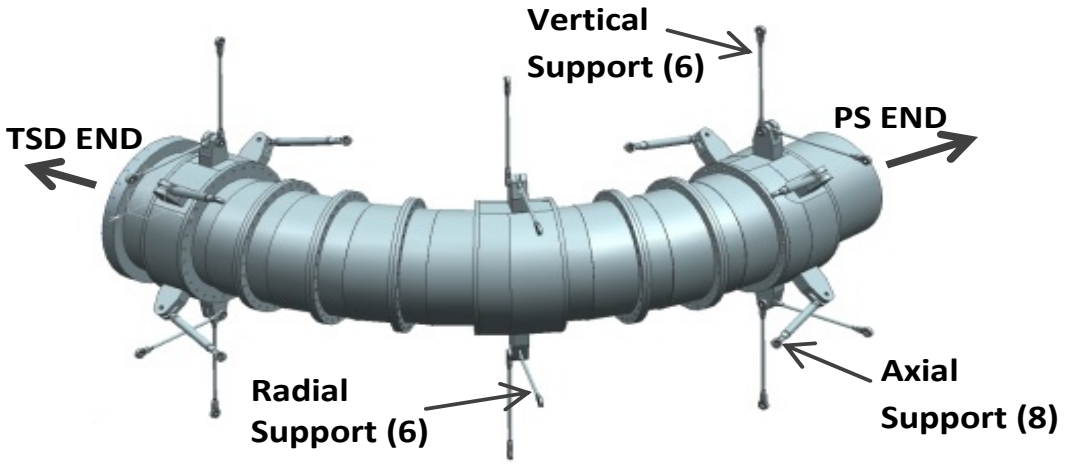
VANDERBILT
UNIVERSITY

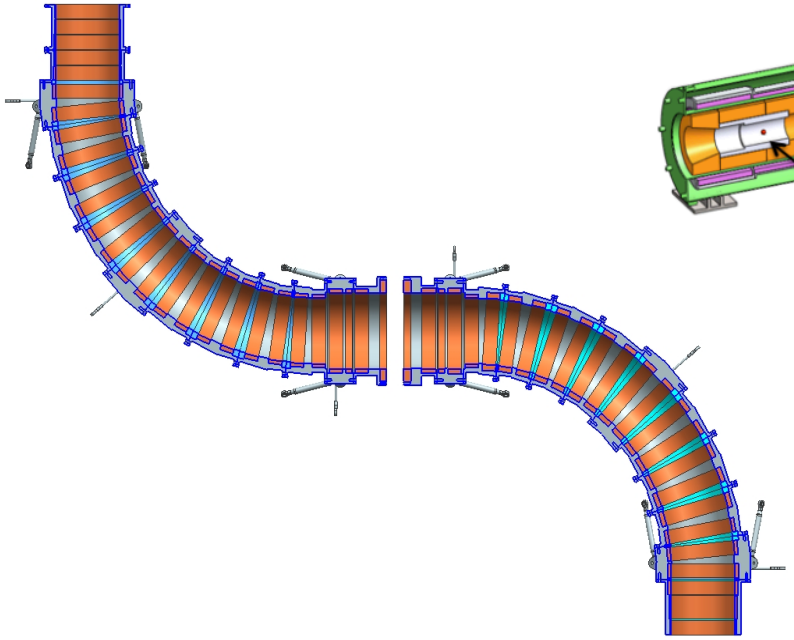
Overview

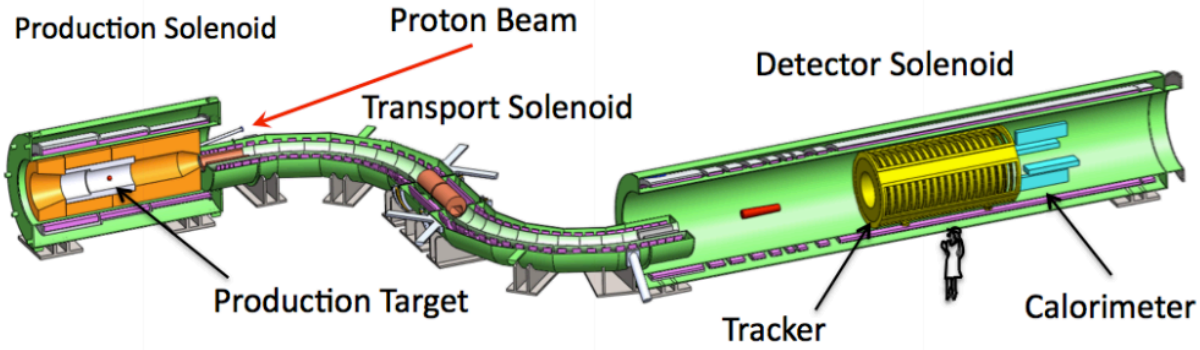
- The Transport Solenoid
  - Main objective
  - Design
- Sample preparation
- The Instron Machine
- Results
- Summary

The Transport Solenoid



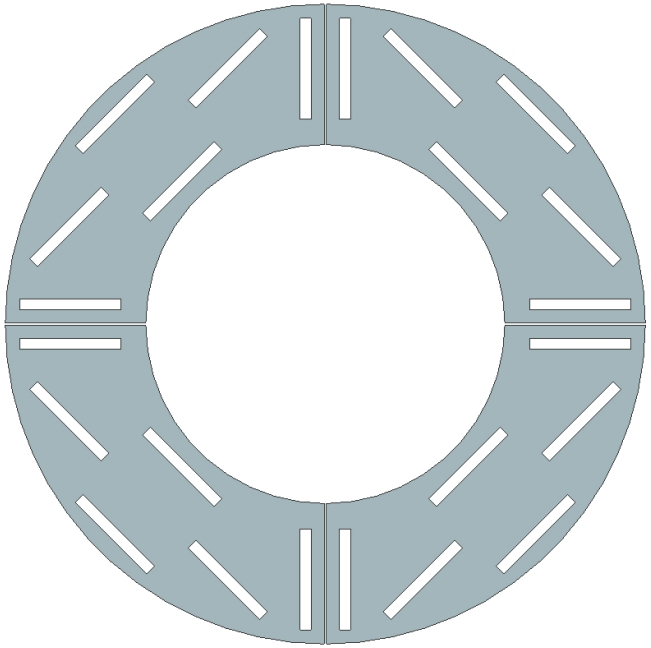


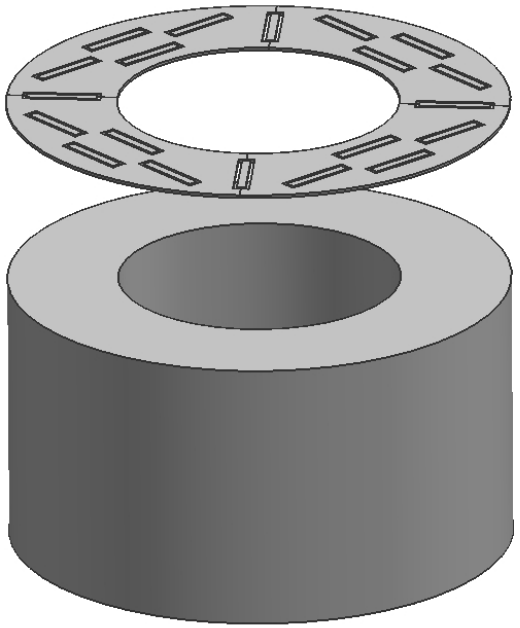




Sample Preparation

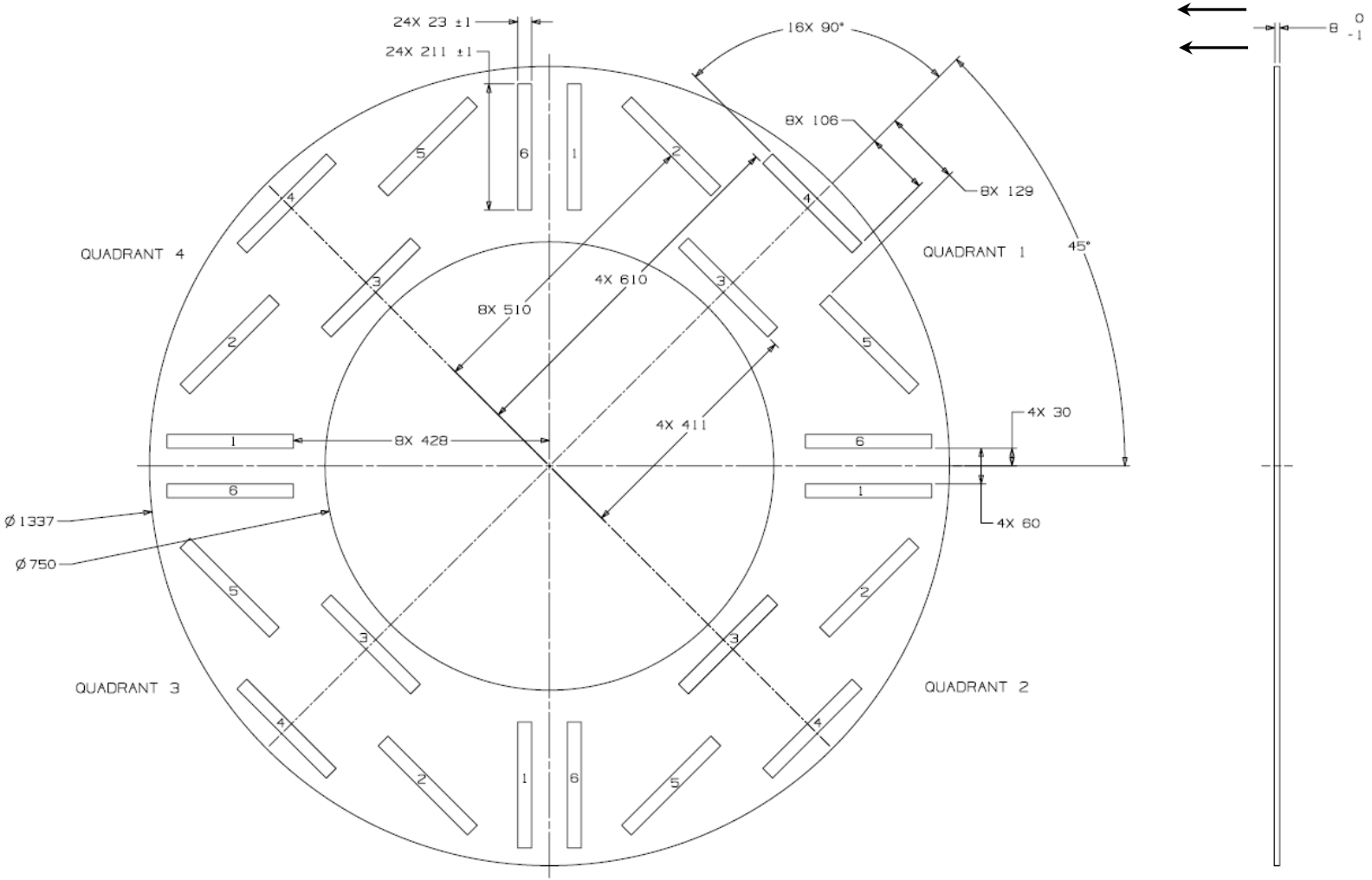
- 8mm thick slice
- 4 quadrants
- A total of 24 test samples



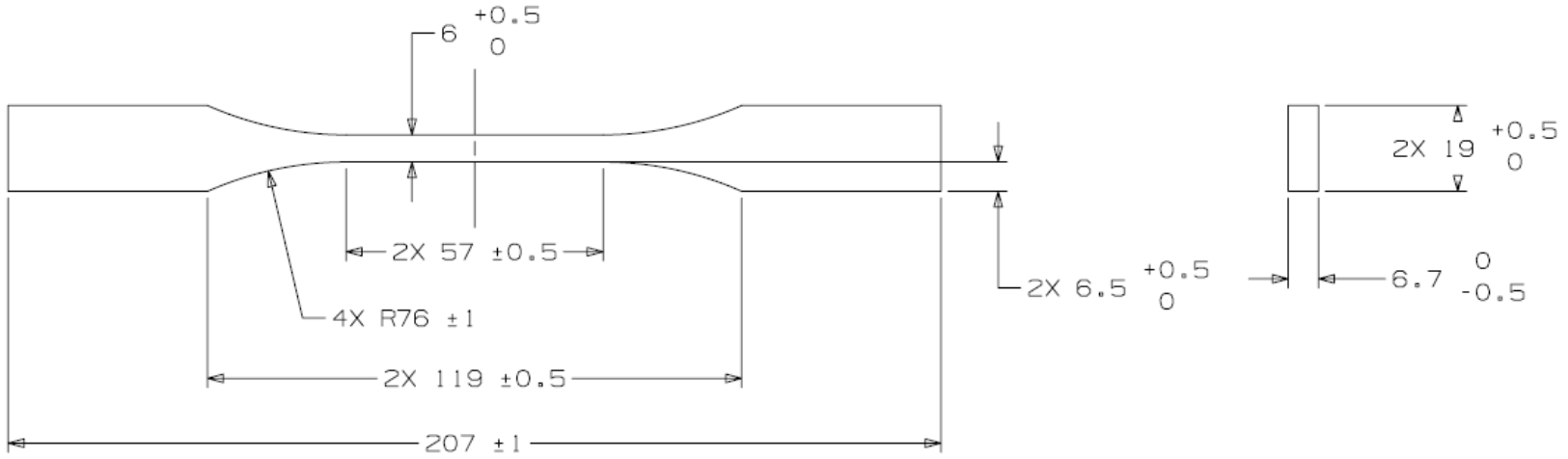


SAMPLE NUMBER	QUAD 1	QUAD 2	QUAD 3	QUAD 4
1	Q1R1	Q2R1	Q3R1	Q4R1
2	Q1A1	Q2A1	Q3A1	Q4A1
3	Q1A2	Q2A2	Q3A2	Q4A2
4	Q1A3	Q2A3	Q3A3	Q4A3
5	Q1A4	Q2A4	Q3A4	Q4A4
6	Q1R2	Q2R2	Q3R2	Q4R2

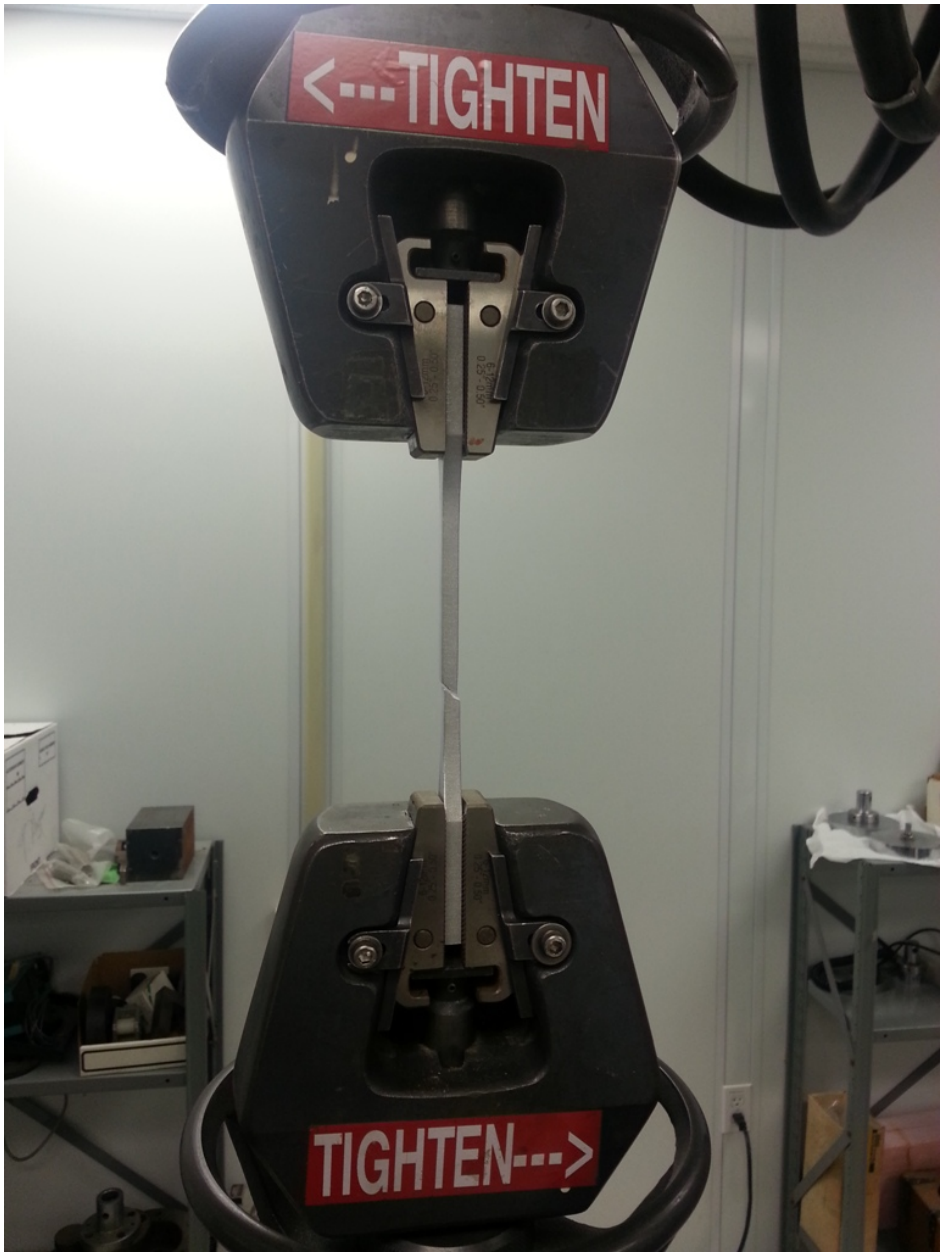
Previously Tested samples
My samples



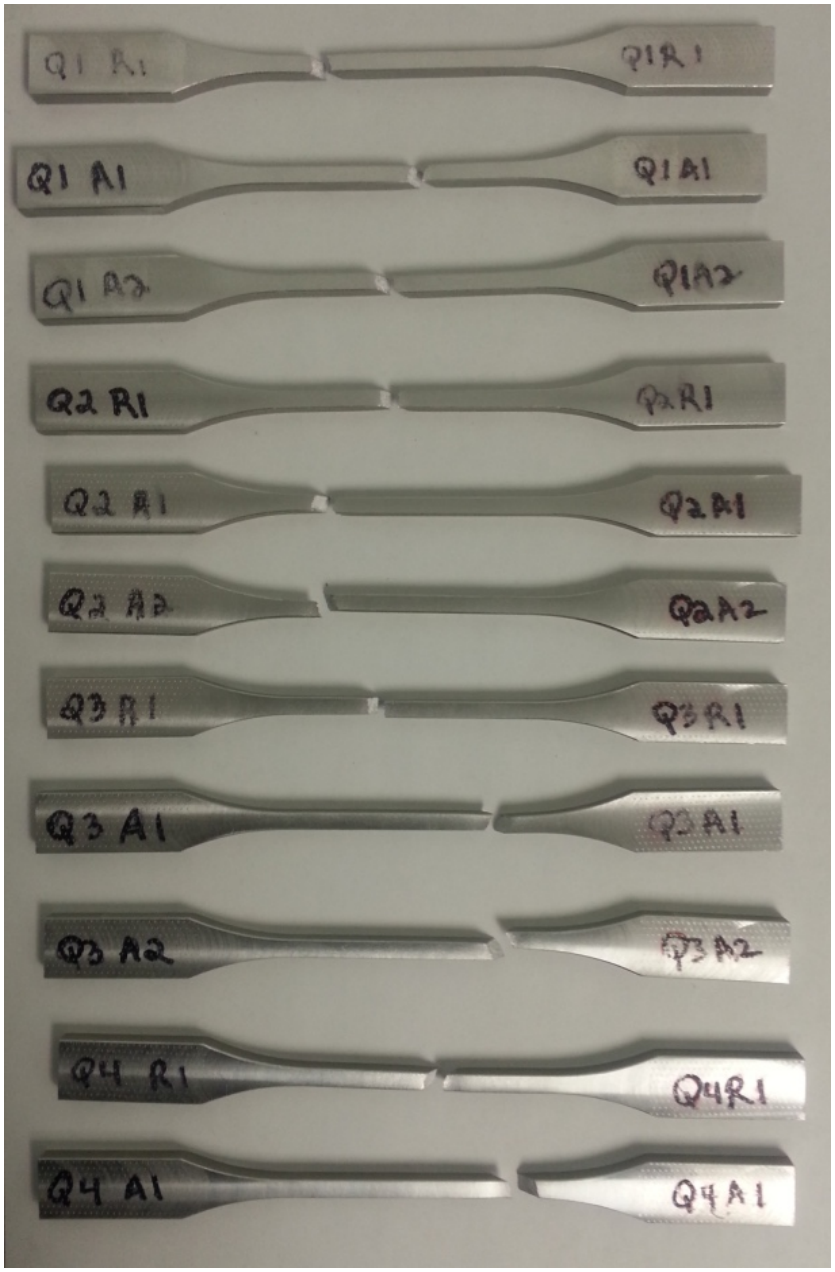
Finished sample for testing



The Instron Machine



Destroyed samples

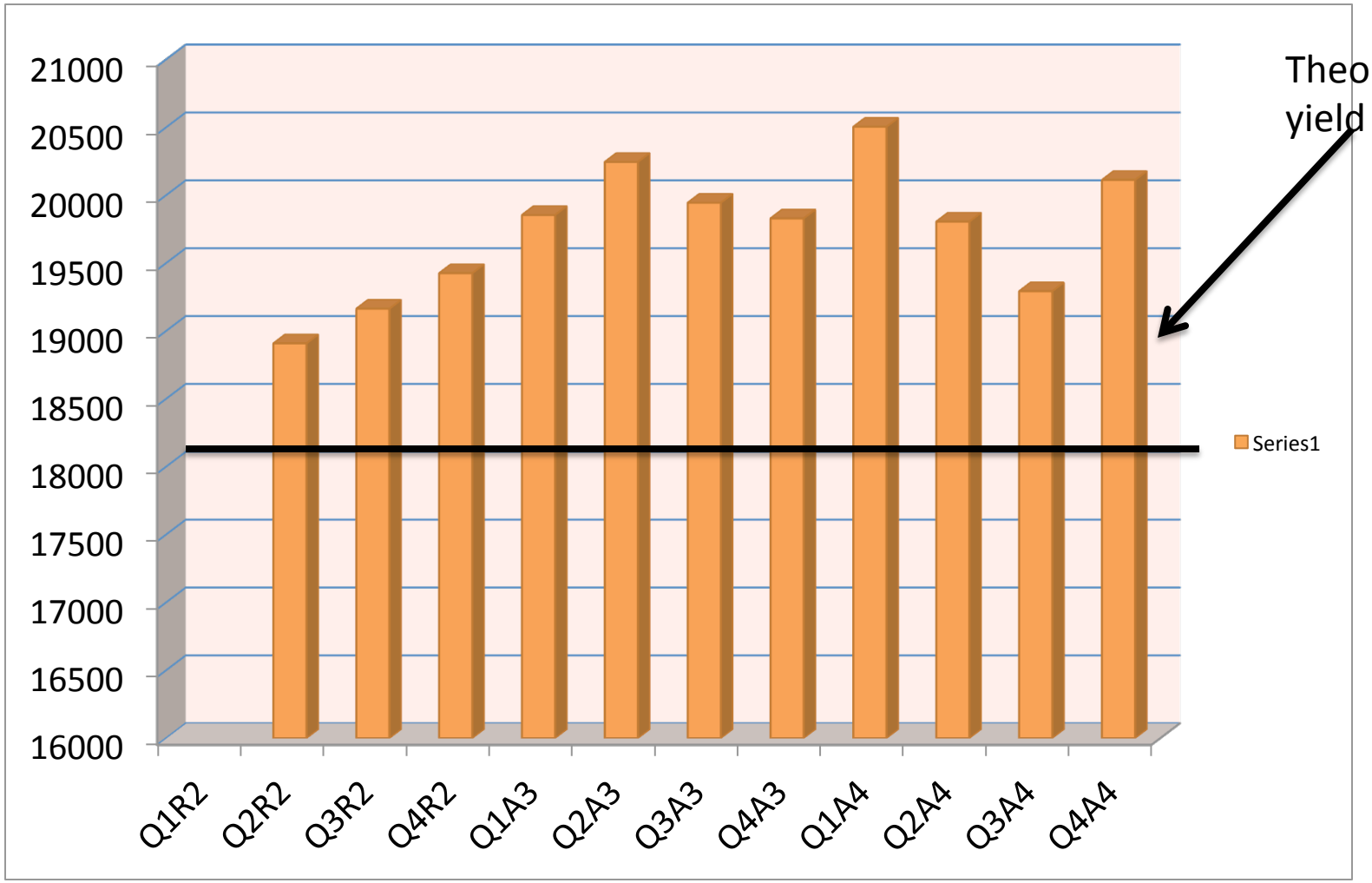


All Samples	Load at Peak (lbs)	% Strain at Peak	Yield Strength (psi)	Young's Modulus (ksi)	
Q1R2	****	****	****	****	
Q2R2	1179	0.534	**18910**	9658	
Q3R2	1178	0.525	**19165**	10749	
Q4R2	1192	0.542	**19427**	10618	
Q1A3	1236	0.543	**19856**	8520	
Q2A3	1244	0.531	**20247**	9519	
Q3A3	1244	0.521	**19946**	8859	
Q4A3	1229	0.525	**19831**	9685	
Q1A4	1281	0.511	**20506**	9416	
Q2A4	1224	0.529	**19807**	10615	
Q3A4	1217	0.525	**19294**	8883	
Q4A4	1249	0.541	**20114**	9395	

Theoretical values for Al 5083-O from matweb

Gauge Length	**2.00**	***in***
Theoretical Yield Strength	**21000**	***psi***
Thoretical YS range	**18100 - 29000**	***psi***
Theoretical UTS	**42000**	***psi***
Thoretical UTS range	**39900 - 50800**	***psi***
Theoretical % elongation @ break	**25**	***%***
Theoretical % elong range @ break	**>= 16**	***%***
Theoretical elastic modulus	**10300**	***ksi***

Results


21000
20500
20000
19500
19000
18500
18000
17500
17000
16500
16000
Q1R2
Q2R2
Q3R2
Q4R2
Q1A3
Q2A3
Q3A3
Q4A3
Q1A4
Q2A4
Q3A4
Q4A4
Theoretical yield strength
Series1

Summary

- An extensometer was used
- No sign of weakness on all samples
- Result would be communicated to forging vendor

Acknowledgements

- Luciano Elementi (supervisor)
- Gustavo Cancelo(mentor)
- Mayling Wong-Squires (mentor)
- Donna Hicks
- Daniel Evbota
- SIST Committee
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