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Dear Mr. Shorrock,

I am writing to you regarding the tensile test conducted in the first lab. The group was first tasked to examine coupon specimens of 3 various metals and were tasked to find out what specific type they were. This was Done by first taking note of physical properties as well as taking measurements of the diameter and area using a digital caliper. Then, the coupons were tested using the tensile test in the Instron testing machine until failure. The next part of the lab was to compile stress vs. strain graphs and gather other important properties from the data.

The testing was done by placing one of the three coupons in the Instron testing machine. Once in the machine, the extensometer was put where the two inches on the coupon was marked. This measured the amount of elongation each coupon had up until a certain stress to get an even more accurate measurement for the stress and strain graphs. Each coupon was tested under tension until failure. This lab also used digital software that measured and graphed the displacement in inches and the force (lbf) of each coupon test. The next part of the lab had each group create stress vs. strain graphs for each coupon using the data given to us from the tests in excel. This helped us find the ultimate stress, stress at failure and yield stress.

The blue coupon was tested first at 0.04 in/min. The graph is shown Figure A.1. This specimen was particularly ductile and had a calculated modulus of elasticity of 30400 ksi. It also experienced somewhat of a plastic plateau as well as some visual necking. The copper test was done at 0.02 in/min and it was a much more brittle test. This material had a dark grey color and snapped without any necking. Figure A.2. Also did not have a yield point or a plastic plateau. The copper graph continued an upward trend until failure and had the weakest ultimate stress of all three. The Final test was the white coupon which was considered ductile as it elongated 19.3 % (Table A.3.). It also experienced some necking before failure. The more ductile materials are much better under tension and would be better in tension situations in suspension bridge cables, while the copper coupon may apply more to compression or become stronger under compression for a foundation of a bridge or house.

In accordance with the results discussed, the blue material had a modulus of elasticity 30400 and was very ductile under tension compared to the others and was also the strongest. The copper coupon did the opposite and was very brittle. It did not have much elongation and had the smallest ultimate stress value. very similar to that of Steel (Table A.4.). It also had a similar tensile ultimate stress of 77.8 which meets the range for Steel A36. This leads me to believe that the blue coupon is Steel A36. For the copper coupon, there were some similarities to cast iron (grey 20). My E calculation for the copper coupon was 11400 ksi from calc.A.1. The closest range was Cast Iron Grey 20 (see Table A.4.). The copper also had a lower tensile ultimate stress of about 45.6 ksi, which is close to the books given tensile ultimate stress value of 42. It was also a dark silver material that was very brittle, so it shares very common properties to Cast Iron. The White coupon had a shiny gold-like color and was relatively ductile because it experienced some elongation and necking. I matched this up with brass because it had a similar Tensile ultimate Stress. The White coupon had a Us of 58.12 ksi which is within the range of ultimate stress of 49 to 68 ksi. Brass generally has a Modulus of Elasticity of 16700 according to the book and my calculation was 7030 ksi so this is far off. I think my error may have been entering the wrong parameters for the E calculation of the white coupon. I may not have entered the proper proportional range so my slope could be off from that. Some other sources of error may have been that the specimens were not all perfectly homogenous metals. They may have had some imperfections that could have led to slight differences or downgrades in strength.

In general, I learned a lot about how to conduct a tensile test and how calculate various important stresses from metals. The lab also found that the blue coupon matched up well with the properties of Steel A36, the copper coupon was like that of Cast Iron, and the white coupon had similar properties to Brass. My results are not perfect in any way, but the tests conducted were able to point in the right direction and made me more cognizant of errors and uncertainties for tests in the future.

Sincerely,

Nicholas Valianti

Appendix A:

Table A.1. Shows the properties and calculations for the blue coupon that were taken before the tensile tests.

	Tension Coupon Testing			
Coupon Marking	Blue			
	Original		Final	
Gage Length	2		2.64	
Diameter	0.2375		0.14	
Area	0.0443		0.0154	
Load Rate (in/min)	0.04	Reduction in Area		0.0289
Elongation	0.64	Percent Reduction %		65.2
% Elongation	32 %	Load that visible necking occurs		
Notes:	the material is silver or metal colored, material is pretty ductile			
It had some necking that occurred. Also experienced cupping. It also had a plastic plateau shaped graph				
Strain hardening occurred.				

Table A.2. Shows the properties and preliminary calculations for the copper coupon.

	Tension Coupon Testing			
Coupon Marking	Copper			
	Original		Final	
Gage Length (in)	2		2.09	
Diameter (in)	0.2375		0.236	
Area (in^2)	0.04430		0.04374	

Load Rate (in/min)	0.02	Reduction in Area	0.00056
Elongation	0.09	Percent Reduction (%)	1.25917
% Elongation (%)	4.5	Load that visible necking occurs	No necking
Notes:	Felt the lightest of the 3 = smallest density		
Brittle, snapped easily, no necking			
Dark gray color			

Table A.3. Shows the properties and calculation notes that were taken for the white coupon pre-tensile test.

	Tension Coupon Testing			
Coupon Marking				
	Original		Final	
Gage Length (in)	2		2.3875	
Diameter (in)	0.24		0.15	
Area (in^2)	0.045239		0.01767	
Load Rate	0.02 in/min	Reduction in Area		0.027569
Elongation	0.3875	Percent Reduction		60.94078
% Elongation	19.375	Load that visible necking occurs		
Notes:	White is heavier than the blue coupon and the copper coupon			
Material is a shiny gold-like color, material is ductile (it stretched)				
Necking occurred before failure, experienced cupping around the fracture				

Table A.4. Shows a table of all the materials and their various properties in the preliminary lab assignment.

Materials	Density(lb/in^3)	E (Ksi)	Tensile yield stress (Fy) (ksi)	Tensile Ultimate Stress (Fu) (ksi)
Aluminum 2024-T351	0.1	10,600	47.0	68.0
Steel A36	0.284	29,000	36.0	58.0 to 80.0
Steel A992(grade 50)	0.2836	27,550 – 30,500	50.0 – 65.0	65.0
Cast iron (Grey 20)	0.258	12,200		20
Brass	0.3	16,700	18- 45	48 - 68
Titanium	0.16	Unalloyed (15,000) alloyed	120	130

		(18,000)		

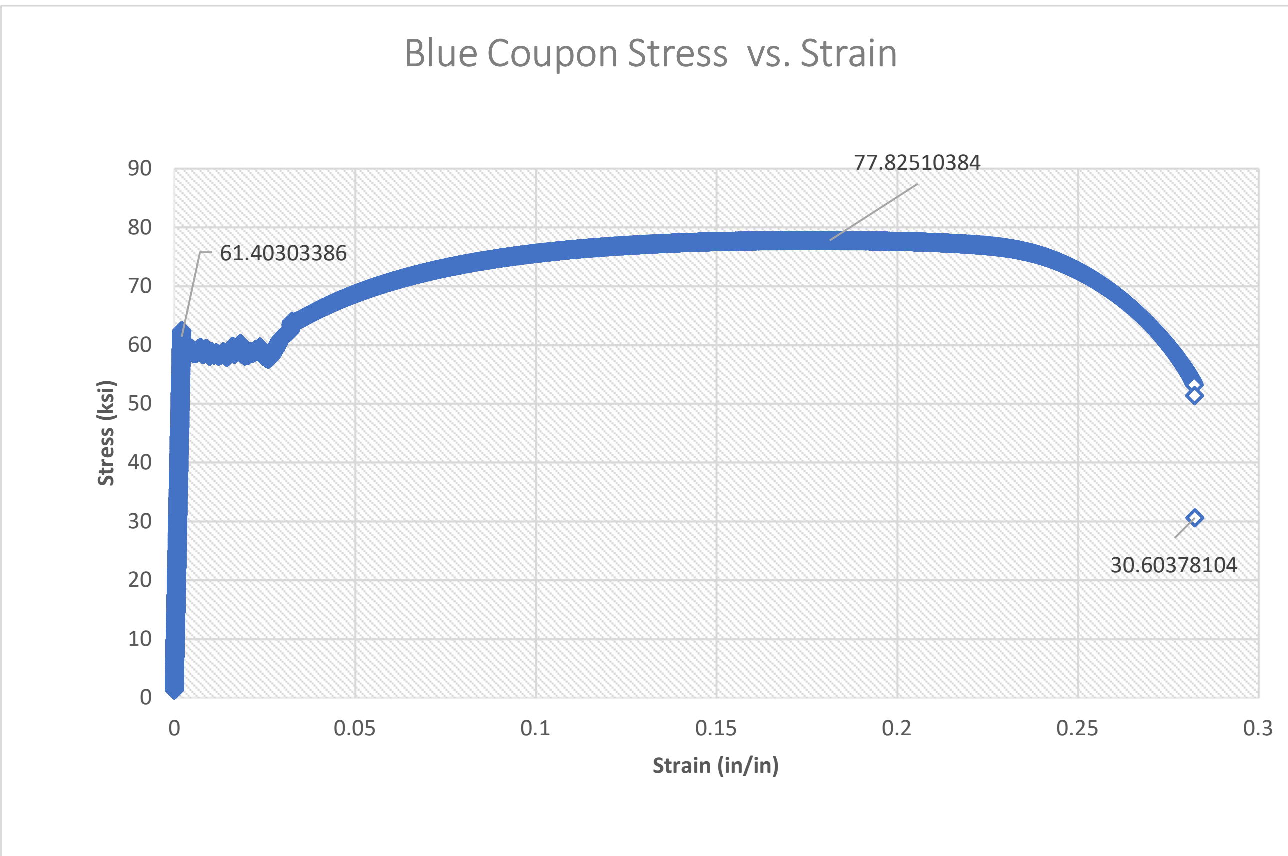

Figure A.1. (above)Demonstrates the relationship between the stress (ksi) and strain (in/in) using the data from the blue coupons tensile test.

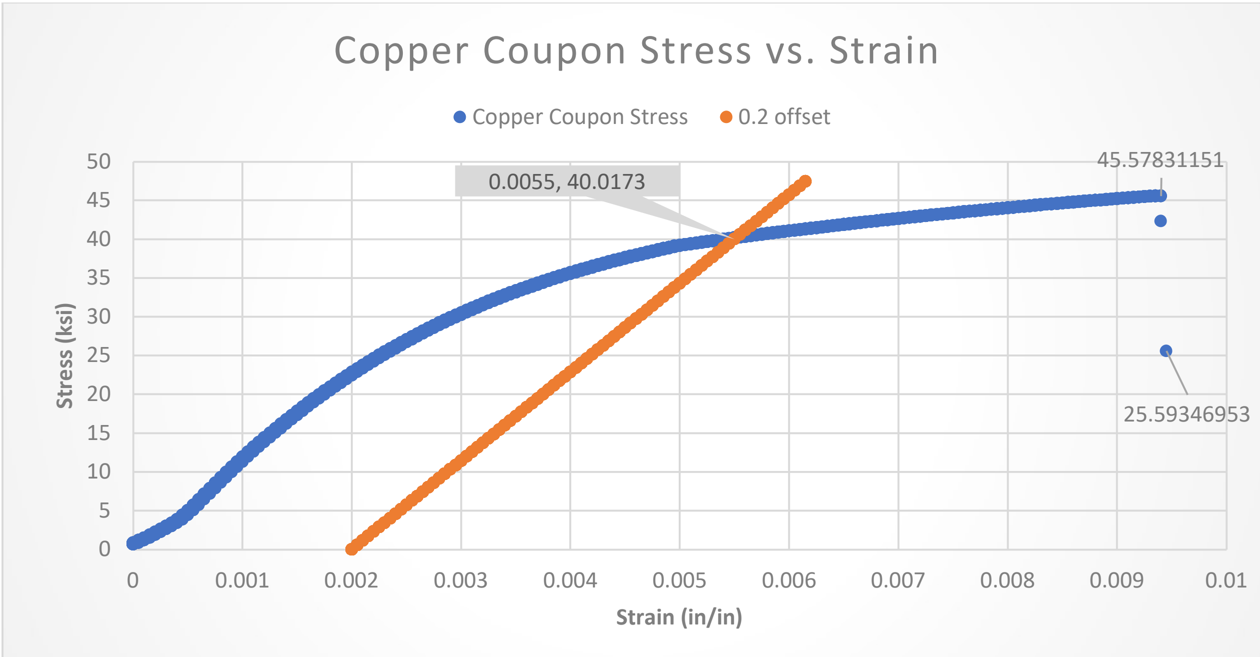

Figure A.2. (above), represents the relationship between stress and strain of the copper coupon. The 0.2 offset line was added to find the yield stress for this specific coupon because it was brittle and needed the 0.2 % rule.

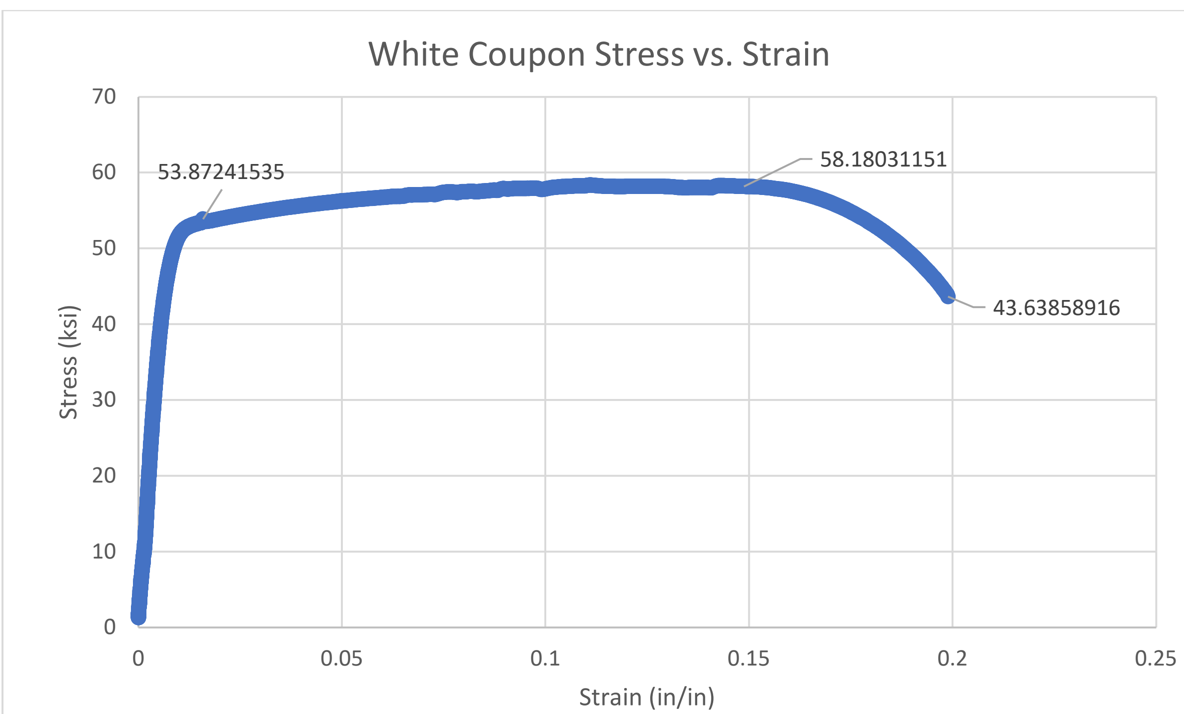

Figure A.3. (above) demonstrates the relationship of the stress versus the strain of the white coupon during the tensile test.

Table A.5. (below) shows the properties of each coupon that was found from the tensile test conducted in the lab

Properties of coupons	Blue	Copper	White
prop limit (from graph) (ksi)	1.31-50.0	3-23.0	1.32-40.0
Ys (ksi)	62.3	40.0	53.8
Us (from Graph or max stress) (ksi)	77.8	45.6	58.3
Tfs (from Graph) (ksi)	30.6	25.6	43.6
E (ksi)	30,400	11,400	7030

Calc A.1. the modulus of elasticity or E (ksi) was calculated by taking the Slopes from the proportional limit and the corresponding x-values. For the Blue coupon Change in Y / Change in x = (50-1.31/(0.0016-0) = 30431.25 = 30400 (three sig figs).

Calc A.2. For the yield stress I found that the graph of the blue coupon and the white had enough ductility to give me a reasonable number for my yield point. Although I needed to use the 0.2 % offset rule for the copper coupon because the yield point was not well defined. I did this by finding the slope of the proportional limit and added 0.002 to each point for the copper coupons strain. To find the y corresponding to the x's I plugged the equation =11428.6*(S4)-22.84. This was the formula I found when reverting the proportional limits slope 0.002 in the x direction. Then, I used the x values and the y to insert the 0.2 offset line into the copper coupon equation and found where they interested.