Lab Report #2: Poisson's Ratio
Date Submitted: 1/8/13

Name: Sarah Brown
Section #4: T 10-12
Instructor: Morgan DeLuca

Group Members:

1. Maura Chmielowiec
2. Travis Newberry
3. Thomas Cannon

Title: Poisson's Ratio

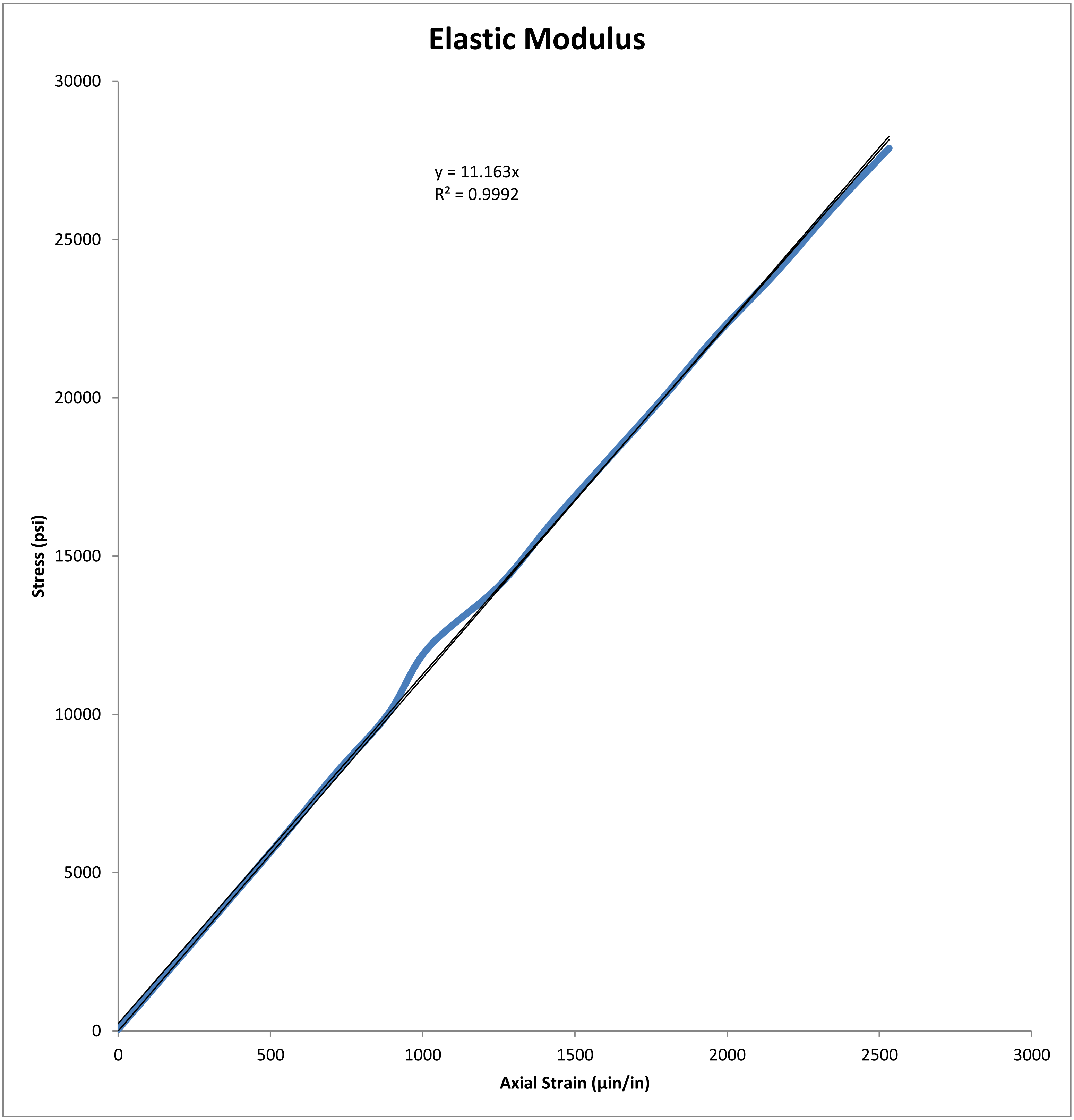
Equipment: Instron Servohydraulic 22 kips

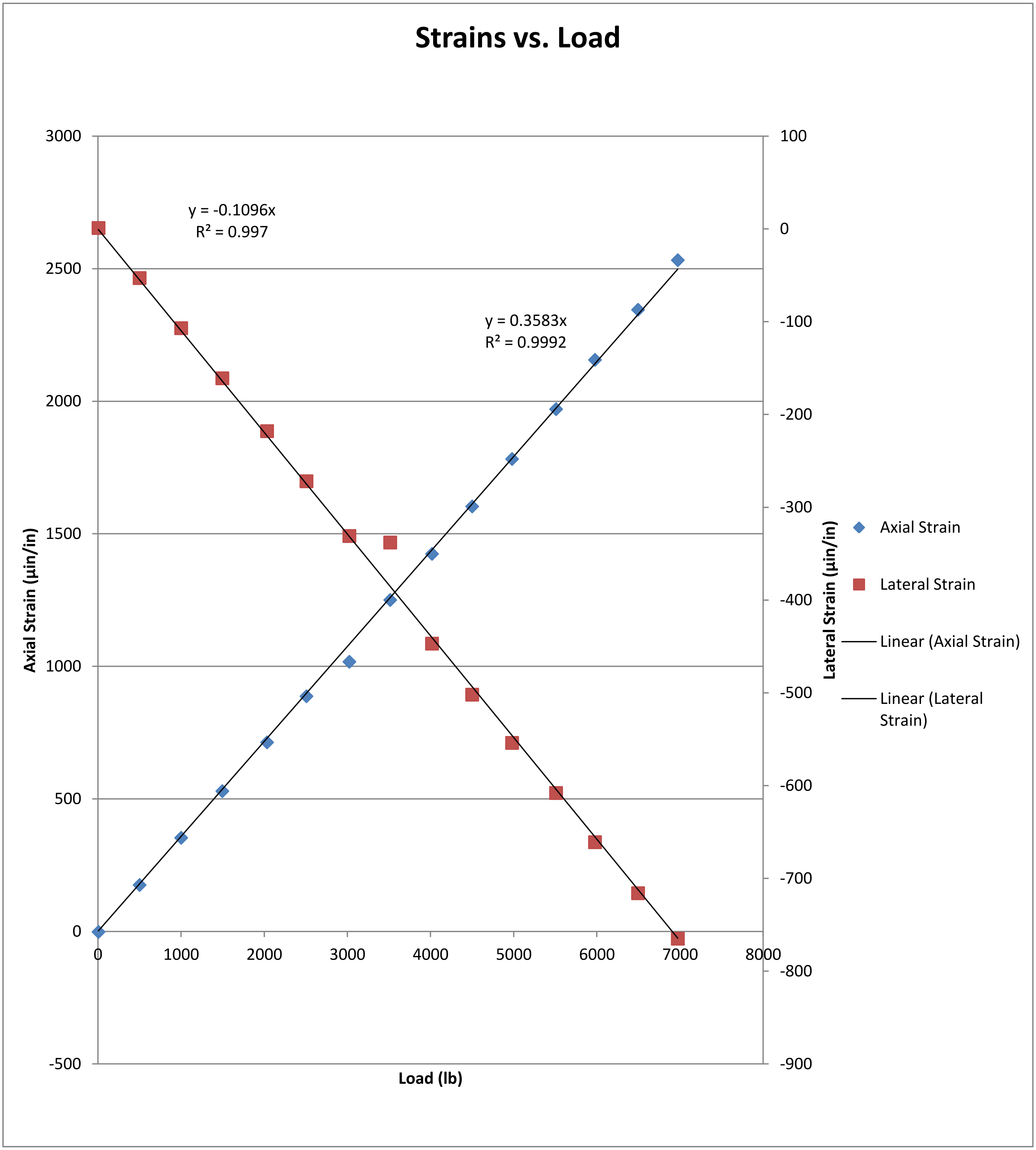
Specimen: 2024-T351 Aluminum Alloy

Abstract

The overall purpose of this experiment was to determine Poisson's ratio and see how close it agreed with the accepted handbook value. Testing was performed on a flat piece of Aluminum Alloy with the initial dimensions of width=1" and thickness=0.25". By using the Instron Servohydraulic testing machine, and a LabView program, uniaxial loading was applied to the specimen, and strains in the x-direction(axial strain) and y-direction(strain) were recorded. From our experiment Poisson's ratio was found to be 0.306 (7.31% lower than the accepted value), also an Elastic Modulus of 11.163 Msi (5.31% higher than the accepted value, and 6.22% higher than the value obtained from Tensile Testing), and a Shear Modulus of 4.274 Msi was found (5.27% higher than the accepted value. Overall, the experiment was successful because we obtained a reasonable value for Poisson's ratio, Elastic and Shear Modulus. Our experimental values are all within 10% of the accepted Handbook values according to Mat Web.

	A	B	C	D	E	F	G
1	**Poisson's Ratio Test: T351 2024 Aluminum**						
2							
3	Gage Factor	Width (in)	Thickness (in)	Area (in^2)		**Elastic Modulus (Msi)**	**11.163**
4	2.1	1	0.25	0.25			
5							
6	**lb**	**µin/in**	**µin/in**	**psi**			
7	**Load**	**e_axial**	**e_lateral**	**Stress**			
8	6	-2	1	24			
9	500	175	-53	2000			
10	1000	353	-107	4000			
11	1495	529	-161	5980			
12	2033	713	-218	8132			
13	2507	887	-272	10028			
14	3023	1017	-331	12092			
15	3514	1250	-338	14056			
16	4017	1424	-447	16068			
17	4500	1603	-502	18000			
18	4980	1782	-554	19920			
19	5509	1970	-608	22036			
20	5977	2156	-661	23908			
21	6495	2345	-716	25980			
22	6973	2532	-765	27892			


Elastic Modulus
y = 11.163x
R² = 0.9992
Stress (psi)
Axial Strain (µin/in)
30000
25000
20000
15000
10000
5000
0
0
500
1000
1500
2000
2500
3000



Strains vs. Load
y = -0.1096x
R² = 0.997
y = 0.3583x
R² = 0.9992
Axial Strain (µin/in)
Lateral Strain (µin/in)
Load (lb)
3000
2500
2000
1500
1000
500
0
-500
100
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
0
1000
2000
3000
4000
5000
6000
7000
8000
Axial Strain
Lateral Strain
Linear (Axial Strain)
Linear (Lateral Strain)

Materials Properties Table			
	Experimental	**Handbook***	**% difference**
Poisson's Ratio	0.306	0.330	7.31
Elastic Modulus (Msi)	11.163	10.600	5.31
Shear Modulus (Msi)	4.274	4.060	5.27

**Mat Web for Aluminum 2024-T3*

Comparison to Tensile Testing *Lab #1*			
	Experimental	**Tension**	**% difference**
Elastic Modulus (Msi)	11.163	10.49	6.22

Comments and Conclusions:

1. Stress Calculation: In order to calculate the stress (in psi), the load (in lb) was divided by the area (in in^2). There is a stress value for each applied load value, the stress is increasing as the loads increases.

2. Elastic Modulus: The elastic modulus for this specimen of Aluminum was found by plotting the axial strain (in µin/in) against the stress (in psi). After plotting these two values against one another a linear line of best fit is applied, the y-intercept is set to zero and the slope gives us the elastic modulus (in Msi). The R^2 value displayed relates how well the trend line matches the data, an R^2 value of .9992 shows that the data is very close to being linear. The experimental value for modulus of elasticity was 11.163 Msi, this value was 5.31% higher than the accepted handbook value.

3. Axial Strain: The axial strain (in µin/in) was plotted against the applied load (in psi) by applying a linear trend line a slope value can be obtained which will be used to calculate Poisson's Ratio. The R^2 value displayed relates how well the trend line matches the data, an R^2 value of .9992 shows that the data is very close to being linear.

4. Transverse Strain: On the same plot (adding a secondary y-axis) the transverse strain (in µin/in) was plotted against the applied load (in psi). A linear best fit line was applied to the graph resulting in a slope value and an R2 value. The slope will be used to later calculate Poisson's Ratio. The R^2 value displayed relates how well the trend line matches the data, an R^2 value of .997 shows that the data is very close to being linear.

5. Poisson's Ratio: The experimental value for Poisson's Ratio was found by putting the slope of the transverse strain plot over the slope of the axial strain plot and applying a negative ($-\frac{m\_transverse}{m\_axial}$) The value obtained from this experiment was 0.306 which was 7.31% lower than the handbook value, but overall this value is acceptable and makes sense for this aluminum specimen.

6. Shear Modulus: The shear modulus was also obtained for this experiment by dividing the Elastic Modulus (in Msi) by 2 times the quantity 1 + Poisson's Ratio ($G = \frac{E}{2(1+v)}$). The value equated to 4.274 Msi which was 5.27% higher than the accepted handbook value.

7. Materials Properties Table: The Materials Property Table displays all the experimental values, the accepted handbook values (from Mat Web) and how close the experimental values correspond to the handbook values. This table show how well the experiment performed with accepted values as the benchmark

8. Material Properties Table Comparison: A second aspect to the Materials Properties table is the comparison to the previous Tensile Testing experiment. We compared the experimental Elastic Modulus value (11.163 Msi) to that found during the previous experiment (10.49 Msi). The values differed by 6.22%. This shows that both experiments were fairly accurate because both experiments yielded a value under 10% difference of the accepted value, and only differed by 6.22%.

9. Conclusion: Overall, this experiment was successful because values for Poisson's Ratio, Elastic Modulus, and Shear Modulus were all calculated, and agree fairly well with the accepted value. The ultimate goal for this lab was to calculate Poisson's Ratio for the Aluminum Alloy, and that was accomplished by obtaining a value that is sensible for this type of specimen.