

# UWTSD

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Tensile Strength Experiment.

Engineering Science ACHA4002

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## Contents

|     |                             |    |
|-----|-----------------------------|----|
| 1   | Introduction .....          | 1  |
| 1.1 | Background.....             | 1  |
| 1.2 | Aims .....                  | 1  |
| 2   | Experimental Procedure..... | 1  |
| 3   | Results .....               | 4  |
| 4   | Analysis.....               | 5  |
| 4.1 | Steel.....                  | 5  |
| 4.2 | Aluminium .....             | 7  |
| 4.3 | Duralumin .....             | 9  |
| 4.4 | PVC.....                    | 11 |
| 5   | Conclusion .....            | 13 |
| 6   | Evaluation.....             | 14 |
| 7   | Further work.....           | 15 |
| 8   | References.....             | 15 |

|     |                                                             |
|-----|-------------------------------------------------------------|
| 1.  | Figure 1.1: Securing Specimen to Tensile tester.....        |
| 2.  | Figure 1.2: Safety guard fitted before use.....             |
| 3.  | Figure 1.3: Broken Specimen is tester.....                  |
| 4.  | Figure 1.4: Measuring cross-section after breakage.....     |
| 5.  | Figure 2.1: Table of Steel Data.....                        |
| 6.  | Figure 2.2: Graph of Steel Stress & Strain Curve.....       |
| 7.  | Figure 2.3: Gradient of Steel's Elastic Region.....         |
| 8.  | Figure 3.1: Table of Aluminium data.....                    |
| 9.  | Figure 3.2: Graph of Aluminium Stress & Strain Curve.....   |
| 10. | Figure 3.3: Gradient of Aluminium's Elastic Region.....     |
| 11. | Figure 4.1: Table of Duralumin data.....                    |
| 12. | Figure 4.2: Graph of Duralumin's Stress & Strain Curve..... |
| 13. | Figure 4.3: Gradient o Duralumin's Elastic Region.....      |

14. Figure 5.1: Table of PVC data.....
15. Figure 5.2: Graph of PVC's Stress & Strain Curve.....
16. Figure 5.3: Gradient of PVC's Elastic Region.....

# 1 Introduction

## 1.1 Background

The materials in this experiment are all expected to portray different levels of similar characteristics. Firstly, as stated by Anon, (2023), steel should show resistance and malleability, allowing it to withstand forces without being damaged, but have the ability to be deformed and shaped without breaking, also showing plasticity, alongside being tough enough to resist tension and breakage. As explained by Royal Society Of Chemistry (2024), aluminium is malleable and among the most ductile metals as its can be easily machined and formed. Chemistry Learner (2011), states how duralumin is a strong, malleable metal that can easily be shaped and is ductile and high strength. Finally, PVC will also display the traits of these other materials but at different intensities.

## 1.2 Aims

Aim 1 – To record the extension of materials when a load is applied to them until they break and to use these results to find the tensile strength, young's modulus and yield point of the specimens.

Aim 2 – To utilise equations and the use of excel to calculate and produce a table of data and to use this table of data to produce graphical data that we can later use to examine the validity of this experiment.

Aim 3 – To analyse and evaluate the accuracy of our results and explore how we could have improved the experiment and its accuracy.

# 2 Experimental Procedure

Firstly, we set up the experiment by fixing the tensile tester to the work panel and set the dial gauge to zero. Before setting each specimen in the tensile tester we recorded the length and width of the cross-section using a vernier calliper. From here we could add our first specimen to the tensile tester, securing it by screwing both ends of the material to the tester (As shown in fig.1.1 below),

ensuring that we fit the safety guard afterwards (As shown in fig.1.2 below) and then recorded the reading from the dial gauge.

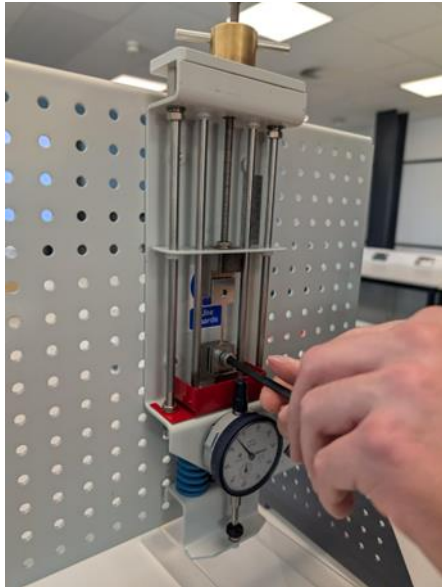


*Figure 1.1: Securing Specimen to Tensile tester.*



*Figure 1.2: Safety guard fitted before use.*

We then proceeded to turn the load nut clockwise by 0.2mm intervals, recording the reading on the dial gauge each time, up until we had turned the gauge by 5mm, from here we turned the load nut by 1mm at a time, again recording the results at each step. For the PVC specimens the dial gauge reading starts to drop slowly after the yield point, as a result, the reading on the gauge must be

taken immediately after changing the load to give consistent results. We will continue this until the specimen breaks (As shown in fig.1.3 below).



*Figure 1.3: Broken Specimen is tester.*

After the specimen breaks, we remove it from the tensile tester, place the broken ends together and measure the new length of the cross-section (As seen in fig.1.4), allowing us to determine the elongation. We repeated this process for the four different materials, steel, aluminium, duralumin and plastic.



*Figure 1.4: Measuring cross-section after breakage.*

### 3 Results

**Table of raw Tensile Strength data.**

|                           | <b>Steel</b>           | <b>Aluminium</b>       | <b>Duralumin</b>       | <b>PVC</b>             |
|---------------------------|------------------------|------------------------|------------------------|------------------------|
| Load Nut Movement<br>(mm) | Dial Indicator<br>(mm) | Dial Indicator<br>(mm) | Dial Indicator<br>(mm) | Dial Indicator<br>(mm) |
| 0                         | 0                      | 0                      | 0                      | 0                      |
| 0.2                       | 0.17                   | 0.16                   | 0.17                   | 0.09                   |
| 0.4                       | 0.35                   | 0.35                   | 0.35                   | 0.13                   |
| 0.6                       | 0.54                   | 0.53                   | 0.54                   | 0.19                   |
| 0.8                       | 0.73                   | 0.71                   | 0.72                   | 0.24                   |
| 1.0                       | 0.91                   | 0.89                   | 0.91                   | 0.26                   |
| 1.2                       | 1.11                   | 1.08                   | 1.09                   | 0.25                   |
| 1.4                       | 1.29                   | 1.26                   | 1.27                   | 0.16                   |
| 1.6                       | 1.48                   | 1.44                   | 1.45                   | 0.14                   |
| 1.8                       | 1.64                   | 1.70                   | 1.63                   | 0.18                   |
| 2.0                       | 1.84                   | 1.86                   | 1.82                   | 0.18                   |
| 2.2                       | 2.02                   | 2.02                   | 2.00                   | 0.17                   |
| 2.4                       | 2.22                   | 2.15                   | 2.18                   | 0.16                   |
| 2.6                       | 2.39                   | 2.25                   | 2.36                   | 0.16                   |
| 2.8                       | 2.56                   | 2.34                   | 2.54                   | 0.16                   |
| 3.0                       | 2.75                   | 2.42                   | 2.72                   | 0.17                   |
| 3.2                       | 2.91                   | 2.51                   | 2.89                   | 0.17                   |
| 3.4                       | 3.09                   | 2.58                   | 3.06                   | 0.16                   |
| 3.6                       | 3.21                   | 2.61                   | 3.24                   | 0.16                   |
| 3.8                       | 3.35                   | 2.70                   | 3.41                   | 0.16                   |
| 4.0                       | 3.48                   | 2.71                   | 3.57                   | 0.17                   |
| 4.2                       | 3.62                   | 2.76                   | 3.72                   | 0.17                   |
| 4.4                       | 3.75                   | 2.77                   | 3.89                   | 0.15                   |
| 4.6                       | 3.86                   | 2.80                   | 4.07                   | 0.16                   |
| 4.8                       | 3.98                   | 2.78                   | 4.23                   | 0.17                   |
| 5.0                       | 4.09                   | 2.82                   | 4.41                   | 0.16                   |

|      |      |  |      |      |
|------|------|--|------|------|
| 6.0  | 4.54 |  | 4.95 | 0.22 |
| 7.0  | 4.89 |  | 5.27 | 0.22 |
| 8.0  | 5.14 |  | 5.30 | 0.20 |
| 9.0  | 5.28 |  |      | 0.19 |
| 10.0 | 5.38 |  |      | 0.18 |

## 4 Analysis

### 4.1 Steel

| Load Nut Movement | Dial Indicator | Force | Extension | Stress               | Nominal Strain |
|-------------------|----------------|-------|-----------|----------------------|----------------|
| (mm)              | (mm)           | (N)   | (mm)      | (N/mm <sup>2</sup> ) | ( $\epsilon$ ) |
| 0                 | 0              | 0     | 0         | 0                    | 0              |
| 0.2               | 0.17           | 17    | 0.03      | 10.4938              | 0.000970874    |
| 0.4               | 0.35           | 35    | 0.05      | 21.6049              | 0.001618123    |
| 0.6               | 0.54           | 54    | 0.06      | 33.3333              | 0.001941748    |
| 0.8               | 0.73           | 73    | 0.07      | 45.0617              | 0.002265372    |
| 1                 | 0.91           | 91    | 0.09      | 56.1728              | 0.002912621    |
| 1.2               | 1.11           | 111   | 0.09      | 68.5185              | 0.002912621    |
| 1.4               | 1.29           | 129   | 0.11      | 79.6296              | 0.003559871    |
| 1.6               | 1.48           | 148   | 0.12      | 91.358               | 0.003883495    |
| 1.8               | 1.64           | 164   | 0.16      | 101.235              | 0.005177994    |
| 2                 | 1.84           | 184   | 0.16      | 113.58               | 0.005177994    |
| 2.2               | 2.02           | 202   | 0.18      | 124.691              | 0.005825243    |
| 2.4               | 2.22           | 222   | 0.18      | 137.037              | 0.005825243    |
| 2.6               | 2.39           | 239   | 0.21      | 147.531              | 0.006796117    |
| 2.8               | 2.56           | 256   | 0.24      | 158.025              | 0.00776699     |
| 3                 | 2.75           | 275   | 0.25      | 169.753              | 0.008090615    |
| 3.2               | 2.91           | 291   | 0.29      | 179.63               | 0.009385113    |
| 3.4               | 3.09           | 309   | 0.31      | 190.741              | 0.010032362    |
| 3.6               | 3.21           | 321   | 0.39      | 198.148              | 0.012621359    |
| 3.8               | 3.35           | 335   | 0.45      | 206.79               | 0.014563107    |
| 4                 | 3.48           | 348   | 0.52      | 214.815              | 0.016828479    |
| 4.2               | 3.62           | 362   | 0.58      | 223.457              | 0.018770227    |
| 4.4               | 3.75           | 375   | 0.65      | 231.481              | 0.021035599    |
| 4.6               | 3.86           | 386   | 0.74      | 238.272              | 0.02394822     |
| 4.8               | 3.98           | 398   | 0.82      | 245.679              | 0.026537217    |
| 5                 | 4.09           | 409   | 0.91      | 252.469              | 0.029449838    |
| 6                 | 4.54           | 454   | 1.46      | 280.247              | 0.047249191    |
| 7                 | 4.89           | 489   | 2.11      | 301.852              | 0.06828479     |
| 8                 | 5.14           | 514   | 2.86      | 317.284              | 0.092556634    |
| 9                 | 5.28           | 528   | 3.72      | 325.926              | 0.12038835     |
| 10                | 5.38           | 538   | 4.62      | 332.099              | 0.149514563    |

Figure 2.1: Table of Steel Data.

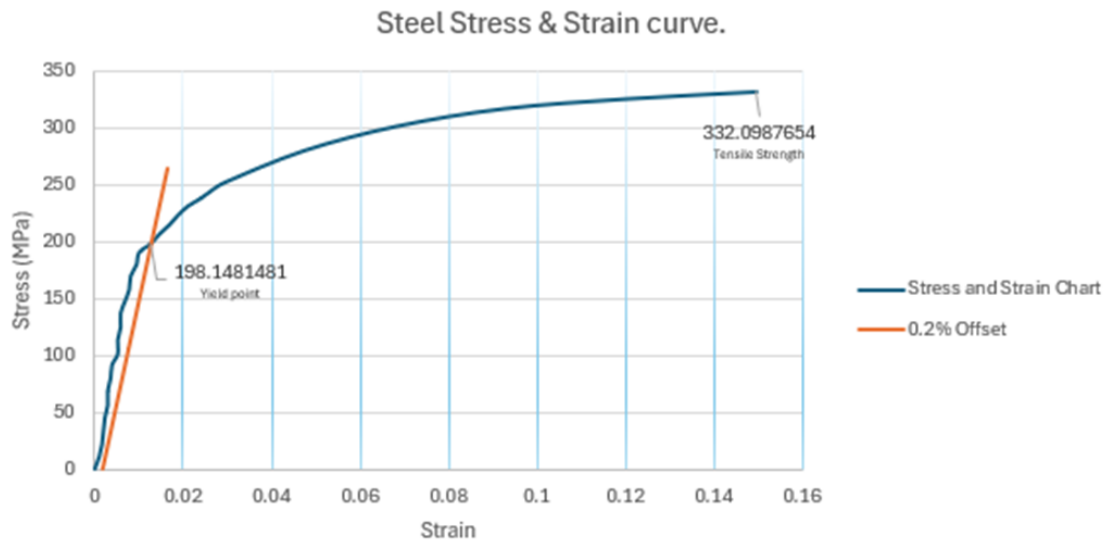


Figure 2.2: Graph of Steel Stress & Strain Curve.

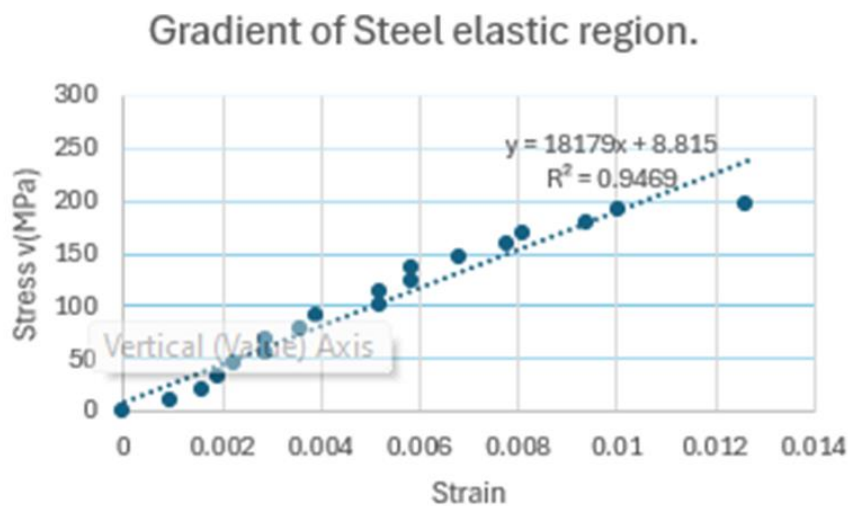


Figure 2.3: Gradient of Steel's Elastic Region.

Firstly, the beginning proportion of the graph for steel (Seen in fig.2.2), shows elastic deformation as the stress increases proportionately with strain (Enlarged in fig.2.3), this indicates that steel obeys Hooke's law in this region and no permanent deformation occurs, and this slope represents Young's modulus which indicates the stiffness of steel, giving the value of 18,179GPa.

Using the 0.2% offset method on the graph (Shown in fig.2.2), the yield point of steel can be found, and a measurement can be given, steel's yield strength is  $198.1481481\text{N/mm}^2$ , from this point onwards plastic deformation occurs, and the specimen cannot return to its original form, which is shown by the non-linear increase in stress with strain. Steel's yield point is clearly defined which is a typical trait of ductile materials. However, despite this permanent deformation, steel can still withstand a significant amount of force until it breaks, which indicates tensile strength, shown in the graph to be  $332.0987654\text{N/mm}^2$ . This shows that steel can undergo significant deformation from high loads before breaking, proving it to have good ductility and serves as an indication of steel's ability to absorb energy.

## 4.2 Aluminium

| Load Nut Movement | Dial Indicator | Force | Extension | Stress               | Nominal Strain |
|-------------------|----------------|-------|-----------|----------------------|----------------|
| (mm)              | (mm)           | (N)   | (mm)      | (N/mm <sup>2</sup> ) | ( $\epsilon$ ) |
| 0                 | 0              | 0     | 0         | 0                    | 0              |
| 0.2               | 0.16           | 16    | 0.04      | 9.35673              | 0.001294498    |
| 0.4               | 0.35           | 35    | 0.05      | 20.4678              | 0.001618123    |
| 0.6               | 0.53           | 53    | 0.07      | 30.9942              | 0.002265372    |
| 0.8               | 0.71           | 71    | 0.09      | 41.5205              | 0.002912621    |
| 1                 | 0.89           | 89    | 0.11      | 52.0468              | 0.003559871    |
| 1.2               | 1.08           | 108   | 0.12      | 63.1579              | 0.003883495    |
| 1.4               | 1.26           | 126   | 0.14      | 73.6842              | 0.004530744    |
| 1.6               | 1.44           | 144   | 0.16      | 84.2105              | 0.005177994    |
| 1.8               | 1.7            | 170   | 0.1       | 99.4152              | 0.003236246    |
| 2                 | 1.86           | 186   | 0.14      | 108.772              | 0.004530744    |
| 2.2               | 2.02           | 202   | 0.18      | 118.129              | 0.005825243    |
| 2.4               | 2.15           | 215   | 0.25      | 125.731              | 0.008090615    |
| 2.6               | 2.25           | 225   | 0.35      | 131.579              | 0.011326861    |
| 2.8               | 2.34           | 234   | 0.46      | 136.842              | 0.014886731    |
| 3                 | 2.42           | 242   | 0.58      | 141.52               | 0.018770227    |
| 3.2               | 2.51           | 251   | 0.69      | 146.784              | 0.022330097    |
| 3.4               | 2.58           | 258   | 0.82      | 150.877              | 0.026537217    |
| 3.6               | 2.61           | 261   | 0.99      | 152.632              | 0.032038835    |
| 3.8               | 2.7            | 270   | 1.1       | 157.895              | 0.035598706    |
| 4                 | 2.71           | 271   | 1.29      | 158.48               | 0.041747573    |
| 4.2               | 2.76           | 276   | 1.44      | 161.404              | 0.046601942    |
| 4.4               | 2.77           | 277   | 1.63      | 161.988              | 0.052750809    |
| 4.6               | 2.8            | 280   | 1.8       | 163.743              | 0.058252427    |
| 4.8               | 2.78           | 278   | 2.02      | 162.573              | 0.065372168    |
| 5                 | 2.82           | 282   | 2.18      | 164.912              | 0.070550162    |

Figure 3.1: Table of Aluminium data.

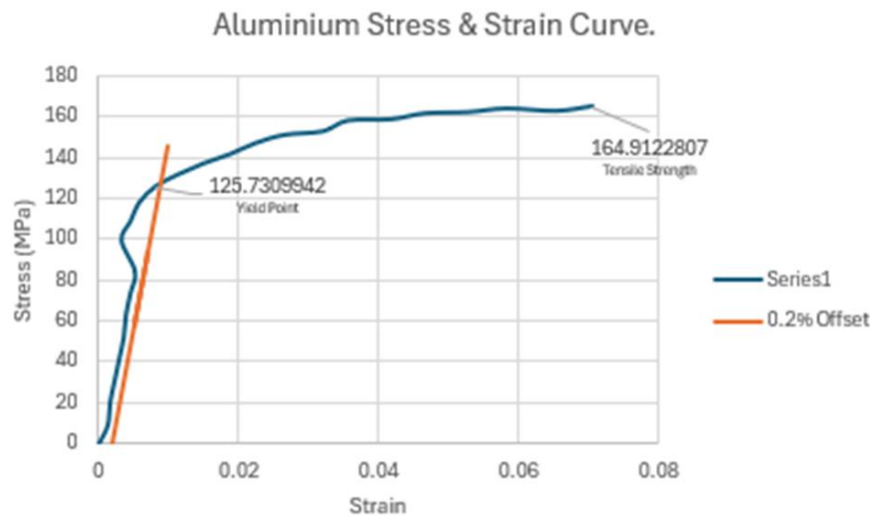


Figure 3.2: Graph of Aluminium Stress & Strain Curve.

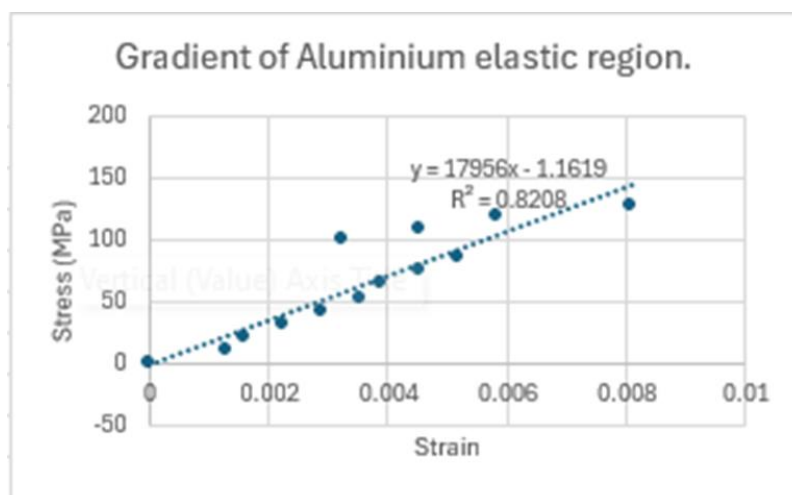


Figure 3.3: Gradient of Aluminium's Elastic Region.

Similarly to steel, the initial linear portion of the stress-strain curve for aluminium (Shown in fig.3.2) indicates elastic deformation, showing that the material is obeying Hooke's law and that no permanent deformation is occurring. This slope represents Young's modulus (Shown in fig.3.3), which for aluminium is given the value of 17,956GPa, this is lower in comparison to steel, indicating that aluminium is less stiff. The yield strength of aluminium can be seen to be 125.7309942N/mm<sup>2</sup> (Shown in fig.3.2), this shows that aluminium has a lower resistance to plastic deformation than steel. Beyond this point aluminium undergoes plastic deformation until it breaks, this breaking point of 164.9122807N/mm<sup>2</sup> (Seen in fig.3.2), is lower than the breaking point of steel, showing that the

tensile strength of aluminium is less than steel. However, the significant elongation before this breaking point shows how aluminium exhibits good ductility, along with its moderate ability to absorb energy before it fails.

### 4.3 Duralumin

| Load Nut Movement | Dial Indicator | Force | Extension | Stress               | Nominal Strain |
|-------------------|----------------|-------|-----------|----------------------|----------------|
| (mm)              | (mm)           | (N)   | (mm)      | (N/mm <sup>2</sup> ) | ( $\epsilon$ ) |
| 0                 | 0              | 0     | 0         | 0                    | 0              |
| 0.2               | 0.17           | 17    | 0.03      | 8.947368             | 0.000970874    |
| 0.4               | 0.35           | 35    | 0.05      | 18.42105             | 0.001618123    |
| 0.6               | 0.54           | 54    | 0.06      | 28.42105             | 0.001941748    |
| 0.8               | 0.72           | 72    | 0.08      | 37.89474             | 0.002588997    |
| 1                 | 0.91           | 91    | 0.09      | 47.89474             | 0.002912621    |
| 1.2               | 1.09           | 109   | 0.11      | 57.36842             | 0.003559871    |
| 1.4               | 1.27           | 127   | 0.13      | 66.84211             | 0.00420712     |
| 1.6               | 1.45           | 145   | 0.15      | 76.31579             | 0.004854369    |
| 1.8               | 1.63           | 163   | 0.17      | 85.78947             | 0.005501618    |
| 2                 | 1.82           | 182   | 0.18      | 95.78947             | 0.005825243    |
| 2.2               | 2              | 200   | 0.2       | 105.2632             | 0.006472492    |
| 2.4               | 2.18           | 218   | 0.22      | 114.7368             | 0.007119741    |
| 2.6               | 2.36           | 236   | 0.24      | 124.2105             | 0.00776699     |
| 2.8               | 2.54           | 254   | 0.26      | 133.6842             | 0.008414239    |
| 3                 | 2.72           | 272   | 0.28      | 143.1579             | 0.009061489    |
| 3.2               | 2.89           | 289   | 0.31      | 152.1053             | 0.010032362    |
| 3.4               | 3.06           | 306   | 0.34      | 161.0526             | 0.011003236    |
| 3.6               | 3.24           | 324   | 0.36      | 170.5263             | 0.011650485    |
| 3.8               | 3.41           | 341   | 0.39      | 179.4737             | 0.012621359    |
| 4                 | 3.57           | 357   | 0.43      | 187.8947             | 0.013915858    |
| 4.2               | 3.72           | 372   | 0.48      | 195.7895             | 0.015533981    |
| 4.4               | 3.89           | 389   | 0.51      | 204.7368             | 0.016504854    |
| 4.6               | 4.07           | 407   | 0.53      | 214.2105             | 0.017152104    |
| 4.8               | 4.23           | 423   | 0.57      | 222.6316             | 0.018446602    |
| 5                 | 4.41           | 441   | 0.59      | 232.1053             | 0.019093851    |
| 6                 | 4.95           | 495   | 1.05      | 260.5263             | 0.033980583    |
| 7                 | 5.27           | 527   | 1.73      | 277.3684             | 0.055987055    |
| 8                 | 5.3            | 530   | 2.7       | 278.9474             | 0.087378641    |

Figure 4.1: Table of Duralumin data.

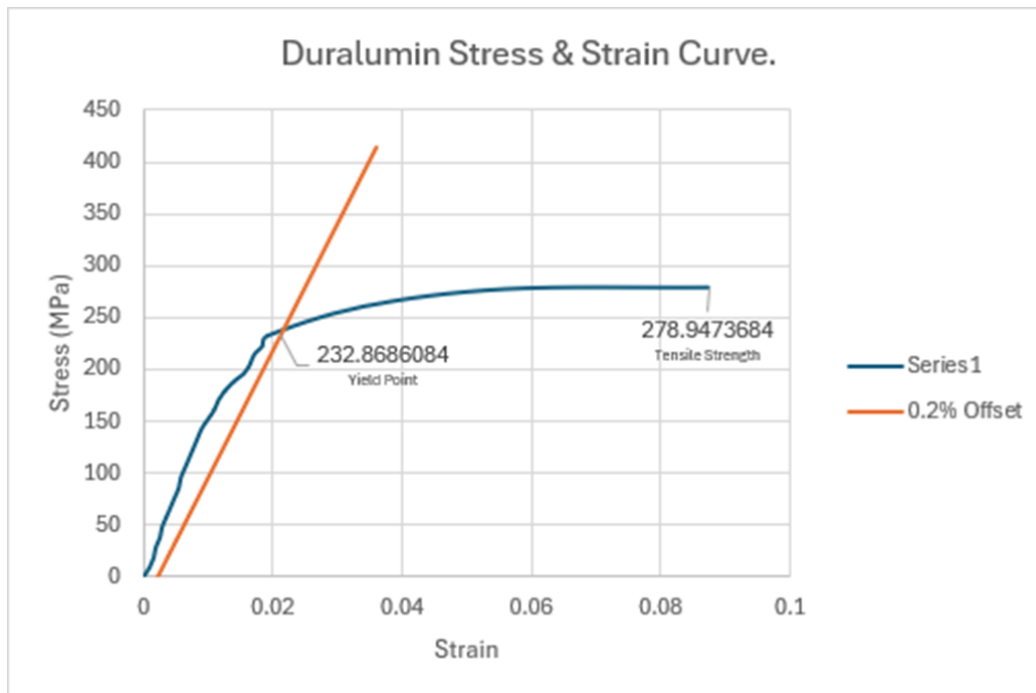


Figure 4.2: Graph of Duralumin's Stress & Strain Curve.

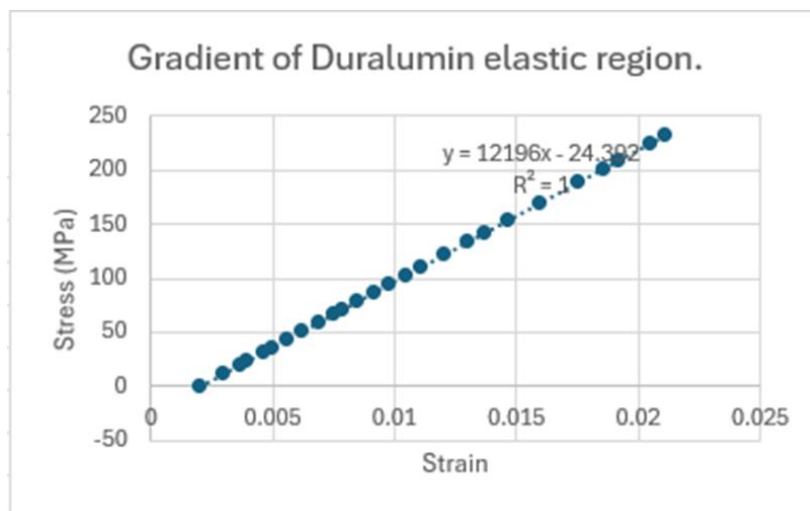


Figure 4.3: Gradient of Duralumin's Elastic Region.

Furthermore, looking at the results for duralumin they again show in the beginning section of the graph (Shown in fig.4.2, amplified in fig.4.3) how stress is directly proportional to strain, indicating its elastic deformation and how it obeys Hooke's law, with the young's modulus equating to 12,196MPa. Duralumin's yield strength (Shown in fig.4.2) is 232.8686084N/mm<sup>2</sup>, this is higher than aluminium's yield strength, which is an indication of duralumin's improved strength as a result of alloying. Following this yield point, the specimen begins to exhibit plastic deformation as stress

increases less linearly with strain until it breaks, displaying a tensile strength of  $278.9473684\text{N/mm}^2$ , this is lower than steel's tensile strength, but is higher than Aluminium, showing duralumin has better resistance to deformation and can withstand more stress and absorb more energy than pure aluminium, but less than steel.

#### 4.4 PVC

| Load Nut Movement | Dial Indicator | Force | Extension | Stress               | Nominal Strain |
|-------------------|----------------|-------|-----------|----------------------|----------------|
| (mm)              | (mm)           | (N)   | (mm)      | (N/mm <sup>2</sup> ) | ( $\epsilon$ ) |
| 0                 | 0              | 0     | 0         | 0                    | 0              |
| 0.2               | 0.09           | 9     | 0.11      | 5.263158             | 0.003594771    |
| 0.4               | 0.13           | 13    | 0.27      | 7.602339             | 0.008823529    |
| 0.6               | 0.19           | 19    | 0.41      | 11.111111            | 0.013398693    |
| 0.8               | 0.24           | 24    | 0.56      | 14.03509             | 0.018300654    |
| 1                 | 0.26           | 26    | 0.74      | 15.20468             | 0.024183007    |
| 1.2               | 0.25           | 25    | 0.95      | 14.61988             | 0.031045752    |
| 1.4               | 0.16           | 16    | 1.24      | 9.356725             | 0.040522876    |
| 1.6               | 0.14           | 14    | 1.46      | 8.187135             | 0.047712418    |
| 1.8               | 0.18           | 18    | 1.62      | 10.52632             | 0.052941176    |
| 2                 | 0.18           | 18    | 1.82      | 10.52632             | 0.059477124    |
| 2.2               | 0.17           | 17    | 2.03      | 9.94152              | 0.066339869    |
| 2.4               | 0.16           | 16    | 2.24      | 9.356725             | 0.073202614    |
| 2.6               | 0.16           | 16    | 2.44      | 9.356725             | 0.079738562    |
| 2.8               | 0.16           | 16    | 2.64      | 9.356725             | 0.08627451     |
| 3                 | 0.17           | 17    | 2.83      | 9.94152              | 0.09248366     |
| 3.2               | 0.17           | 17    | 3.03      | 9.94152              | 0.099019608    |
| 3.4               | 0.16           | 16    | 3.24      | 9.356725             | 0.105882353    |
| 3.6               | 0.16           | 16    | 3.44      | 9.356725             | 0.112418301    |
| 3.8               | 0.16           | 16    | 3.64      | 9.356725             | 0.118954248    |
| 4                 | 0.17           | 17    | 3.83      | 9.94152              | 0.125163399    |
| 4.2               | 0.17           | 17    | 4.03      | 9.94152              | 0.131699346    |
| 4.4               | 0.15           | 15    | 4.25      | 8.77193              | 0.138888889    |
| 4.6               | 0.16           | 16    | 4.44      | 9.356725             | 0.145098039    |
| 4.8               | 0.17           | 17    | 4.63      | 9.94152              | 0.15130719     |
| 5                 | 0.16           | 16    | 4.84      | 9.356725             | 0.158169935    |
| 6                 | 0.22           | 22    | 5.78      | 12.8655              | 0.188888889    |
| 7                 | 0.22           | 22    | 6.78      | 12.8655              | 0.221568627    |
| 8                 | 0.2            | 20    | 7.8       | 11.69591             | 0.254901961    |
| 9                 | 0.19           | 19    | 8.81      | 11.11111             | 0.287908497    |
| 10                | 0.18           | 18    | 9.82      | 10.52632             | 0.320915033    |

Figure 5.1: Table of PVC data.

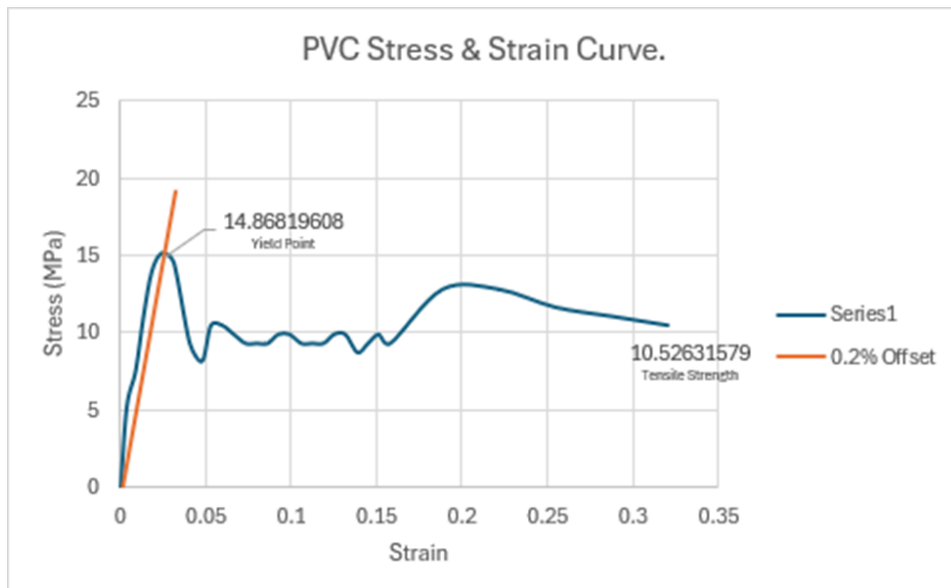


Figure 5.2: Graph of PVC's Stress & Strain Curve.

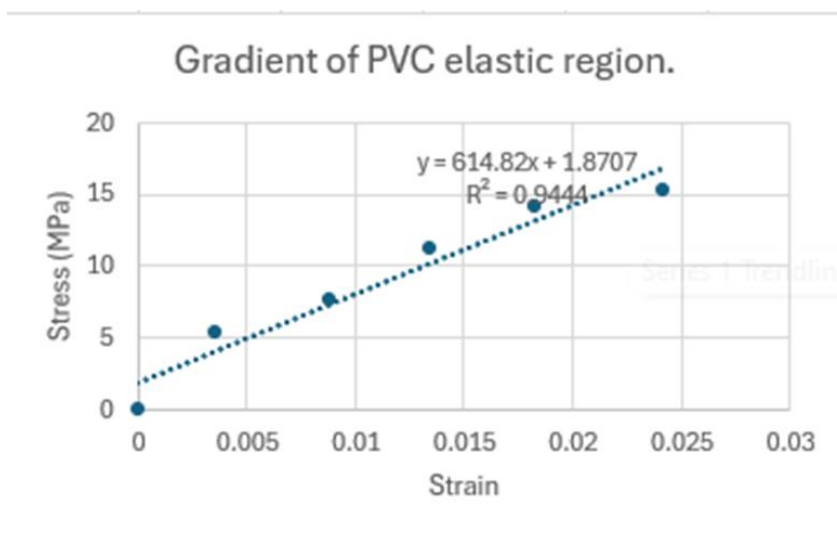


Figure 5.3: Gradient of PVC's Elastic Region.

Finally, looking at PVC, again the initial linear section of the graph (Shown in fig.5.2 and focused on in fig.5.3) shows PVC's elastic deformation region where the stress-strain relationship follows Hooke's law and represents young's modulus that measures at 614.82MPa. This is significantly lower than that of the other materials, reflecting PVC's flexibility and low stiffness. This material has a very distinct yield point, valued at 14.86819608N/mm<sup>2</sup>, where it transitions from elastic to plastic deformation. This yield strength is dramatically lower than steel, aluminium and duralumin, highlighting its lower strength.

Additionally, PVC's tensile strength is only  $10.52631579\text{N/mm}^2$ , this indicates its inability to withstand high loads of stress and expresses limited elongation before it breaks. This indicates that although it has moderate ductility, it has less toughness and strength when compared with the other materials, meaning it deforms easily but breaks at relatively low stress and strain levels.

## 5 Conclusion

To conclude, this experiment matches the trends that we expected to see. Firstly, for steel this tensile test proved that it is a ductile material with high stiffness, strength and toughness. Secondly, it highlighted aluminium's lower strength, toughness and stiffness, however, it demonstrated its excellent ductility. Thirdly, the test data on duralumin revealed its superior stiffness and strength over pure aluminium at the cost of its slightly reduced ductility. Finally, it showed how PVC is a flexible material with limited elongation and low tensile strength.

However, in comparison to other tensile experiments there are noticeable differences. Firstly, shown in data presented by MatWeb (2023), steel is stated to have a tensile strength ranging between 295MPa and 2400MPa, with yield strengths from 200MPa to 2100MPa whereas ours only measured at 332.10MPa(Rounded) tensile strength and 198.15MPa(Rounded) for yield strength.

amesweb.info. (n.d.), has recorded results of aluminium's tensile strength differing between 40MPa to 700MPa, in our experiment the tensile strength is calculated at 164.91MPa(Rounded). Our results for Duralumin show its tensile strength to be 278.95MPa(Rounded), and its yield strength to be 232.87MPa(Rounded), in comparison to those on Nuclear Power. (n.d.), duralumin has a tensile strength of about 450MPa and yield strength of about 300MPa, depending on the temper of the specimen. Finally, as stated by Vinidex Pty Ltd. (2024), PVC has an average tensile strength of 52MPa, in comparison to our results of 10.53MPa(Rounded).

Overall, the results of this experiment depended on the composition and quality of the materials and the temperatures of the specimens as some obtain stronger qualities at higher temperatures, and others at lower temperatures.

## 6 Evaluation

During this experiment we took many measures to ensure that our results were as accurate as possible by leaving little room for error. We did this by ensuring that the same person read the readings of the dial indicator and, when applicable, that we recorded the results before the dial indicator began to drop after turning the load nut. Furthermore, we conducted this experiment in a controlled environment and kept each specimen in the same conditions. Lastly, we ensured that we turned the load nut with as equal pressure and steady rate as we could.

## 7 Further work

Due to this being a small experiment with limited resources and time there are many ways in which we could improve it, if we had unlimited time and resources. Firstly, we recorded the nominal strain of each specimen, meaning that we recorded the affects of force on the entire specimen, and not the actual strain which would require an extensometer that would allow us to record the effects on purely the cross-sectional area of the materials, this would give us more accurate results for Young's modulus. Secondly, we could use a digital dial gauge to drastically improve the accuracy of our readings for the test. Moreover, we could use a completely automated tensile tester, this would leave very little room for human error, it would ensure that the load applied to the specimen was applied equally and at a steady and consistent rate, it would supply us with specific digital readings and, combined with an extensometer, would allow us to obtain more accurate results for the overall experiment.

## 8 References

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