

University of Wales Trinity Saint David

Wales Institute of Science & Art



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Tensile Test

Engineering Science 1 & Laboratory Skills (ACMA 4033)

Emiah Dowling

2203508

June, 2026

1. Contents

1. Contents	1
2. Introduction	2
2.1. Tensile Stress	2
2.2. Strain.....	2
2.3. Youngs Modulus.....	2
2.4. Yield Point.....	2
2.5. Ultimate Tensile Strength.....	2
2.6. Necking.....	2
2.7. Fracture	3
2.8. Uniaxial Loading	3
2.9. Hooke's Law.....	3
3. Experimental Procedure	4
4. Results	6
4.1. Steel	6
4.2. Aluminium.....	7
4.3. Duralumin.....	8
4.4. PVC	9
5. Analysis	10
6. Conclusion	12
7. Evaluation.....	13
8. Further Work	14
9. References	15
Appendix A – Aluminium Specimen.....	16
Appendix D – Duralumin Specimen.....	1
Appendix C – PVC Specimen.....	2

2. Introduction

The purpose of this report is to identify the tensile behaviour of Steel, Aluminium, Duralumin, and PVC, using the Tensile Tester Kit (Practical 1P10 Tensile Testing, n.d.). Tensile testing is essential for accurate mechanical characterisation, informing both material selection and safety factors. This is done through determining how materials respond to uniaxial loading, providing key properties such as Young's modulus, yield stress, ultimate tensile strength, and fracture strain. Under tensile loading, materials first undergo elastic deformation, where stress and strain remain proportional. Once the elastic limit is exceeded, plastic deformation begins, followed by necking and eventual fracture.

Tensile testing is a destructive method that progressively increases axial load while measuring elongation, allowing determination of yield strength, tensile strength, and ductility through observed strain.

2.1. Tensile Stress

Tensile stress (σ) is stress that tends to stretch or lengthen the material, with respect to stress being the ratio of applied force (F) to a cross-sectional area of the material (A). Tensile stress, is given by the formula :

Equation 1. Formula of Tensile Stress.

$$\sigma = \frac{F}{A}$$

2.2. Strain

Strain (ϵ) is the deformation of a material due to stress, by elongation or contraction of a line segment, measured by the change of length (L) from its original length (l), given by the formula:

Equation 2. Formula of Strain.

$$\epsilon = \frac{L}{l}$$

2.3. Young's Modulus

Young's Modulus (E) is a measure of a specimen's stiffness in the elastic region, being the ratio of stress to strain, (Cabezas and Celentano, 2004) a greater value means the material resists elastic deformation more, as follows:

Equation 3. Formula of Young's Modulus.

$$E = \frac{\sigma}{\epsilon}$$

2.4. Yield Point

Yield point is the point where nonlinear deformation begins, described (Material Properties, 2020b) as: *the point on a stress-strain curve that indicates the limit of elastic behavior and the beginning plastic behavior.*

2.5. Ultimate Tensile Strength

The ultimate tensile strength is measures as the maximum point of the stress-strain curve, giving the maximum stress that can be sustained by a structure in tension, where the material will fracture if this stress is applied and maintained (Material Properties, 2020a).

2.6. Necking

Ductile materials have a localised reduction in the cross-sectional area, necking, once reached the Ultimate Tensile Strength. This becomes a fracture once the material has stretched beyond the Ultimate Tensile Strength, and deformation becomes concentrated in one region, causing a visible narrowing described as necking.

2.7. Fracture

At this point, the strain reaches its maximum value, and the material fractures and physically separates, known as the fracture point.

2.8. Uniaxial Loading

Uniaxial loading, as the name suggests, refers to the application of force along a single, specific axis. It's a straightforward but essential concept in the field of engineering. The deformation caused by uniaxial loading, such as stretching, compression, or bending, is one-dimensional, making it ideal for studying and analysing the mechanical properties of materials.

2.9. Hooke's Law

Hooke's Law (BBC Bitesize, n.d.) states that, within the elastic limit, deformation is proportional to the applied force, with respect to stiffness (k) and extension (x):

Equation 4. Formula of Hooke's Law

$$F = kx$$

3. Experimental Procedure

The experiment was conducted using the Tensile Tester Kit ES6, in the Engineering Science Laboratory (UWTSD, SA1 Campus, IQ 007) at a measured room temperature of 24°C. Each specimen was inspected for defects and measured to obtain its initial gauge length and cross-sectional dimensions, shown in Figure 1.

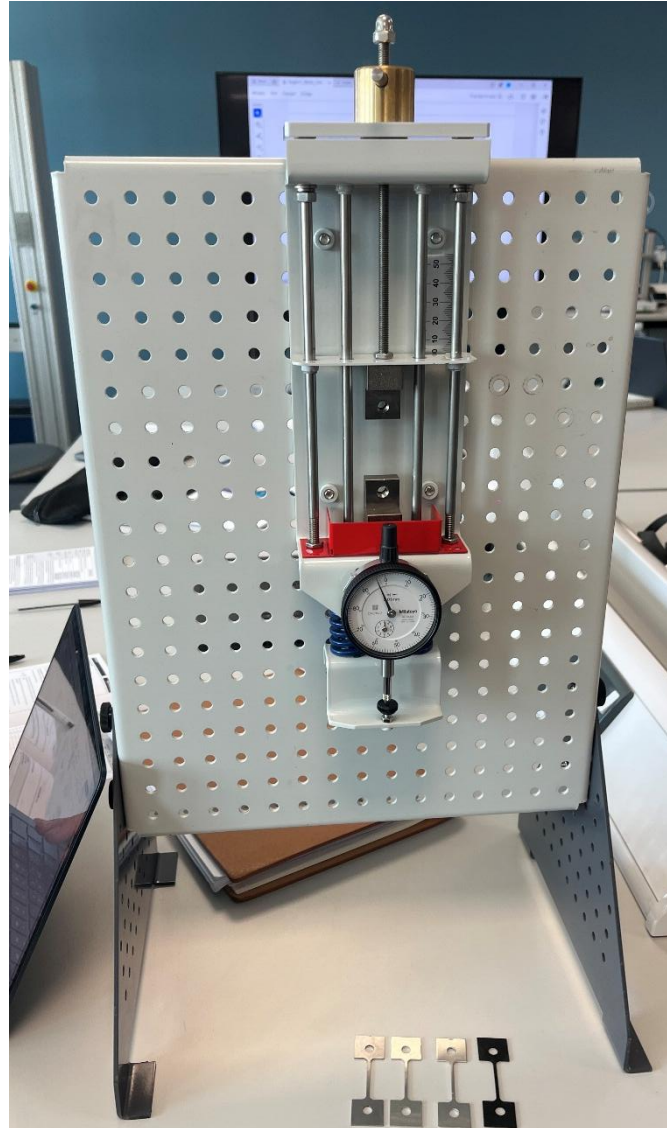


Figure 1. Cole, B. Tensile Tester Kit. Dated 05.06.2026.

The specimens were mounted vertically in the tester chucks, ensuring correct alignment to minimise bending stresses. The Load Nut applies tension by raising the top chuck 1 mm per full turn, while the bottom chuck is connected to two large springs. A Dial Indicator measures the spring deflection, obeying Hooke's Law, corresponding directly to applied force. The Top Plate and vertical scale record the number of turns performed, providing the extension measurements.

Force and extension were calculated using the following formulas:

$$\text{Extension (mm)} = \text{Number of Turns of Force Control (mm)} - \text{Dial Indicator Reading (mm)}$$

Equation 5. Formula for measuring Extension.

The Dial Indicator also gives an indication of the force applied to the specimen. The springs have a combined spring rate of 100 N/mm. The Dial Indicator gives a direct reading of the change in spring length, so each mm it changes by is equal to a change of force of one hundred Newton.

$$\text{Force (N)} = \text{Dial Indicator reading (mm)} \times 100$$

Equation 6. Formula for measuring Force.

Load and extension readings were taken at regular intervals until each specimen exhibited necking and subsequently fractured. Photographs of the setup, specimens, and fracture surfaces are included in the appendix.

The tested specimens, as provided within the Kit, are of the following materials:

- Aluminium alloy
- Duralumin
- Mild steel
- PVC (polyvinyl chloride)

Duralumin and aluminium are very similar, and therefore TecQuipment have put a small notch in the aluminium specimens. TecQuipment make the specimens to fit in the machine. all specimens have the same nominal dimensions.

4. Results

The following raw datasets collected during the experiment for each specimen, please refer to Appendix for the corresponding image data:

4.1. Steel

Table 1. Results of experiment, with respect to the Steel Specimen.

Specimen Material:		Steel		Test Condition (°C):	24
Original Cross-Sectional Area (mm ²):		2			
Original Gauge Length (mm):		31		Gauge Length (mm):	38
Original Length (mm):		67		Length (mm):	75
Load Nut Movement (mm)	Dial Indicator (mm)	Force (N)	Extension (mm)	Stress (N/m ²)	Nominal Strain
0	0	0	0	0	0
0.2	0.165	16.5	0.035	8.25	0.001129032
0.4	0.345	34.5	0.055	17.25	0.001774194
0.6	0.53	53	0.07	26.5	0.002258065
0.8	0.72	72	0.08	36	0.002580645
1	0.95	95	0.05	47.5	0.001612903
1.2	1.1	110	0.1	55	0.003225806
1.4	1.2	120	0.2	60	0.006451613
1.6	1.39	139	0.21	69.5	0.006774194
1.8	1.58	158	0.22	79	0.007096774
2	1.76	176	0.24	88	0.007741935
2.2	1.95	195	0.25	97.5	0.008064516
2.4	2.15	215	0.25	107.5	0.008064516
2.6	2.33	233	0.27	116.5	0.008709677
2.8	2.52	252	0.28	126	0.009032258
3	2.69	269	0.31	134.5	0.01
3.2	2.87	287	0.33	143.5	0.010645161
3.4	3.05	305	0.35	152.5	0.011290323
3.6	3.21	321	0.39	160.5	0.012580645
3.8	3.34	334	0.46	167	0.01483871
4	3.47	347	0.53	173.5	0.017096774
4.2	3.59	359	0.61	179.5	0.019677419
4.4	3.7	370	0.7	185	0.022580645
4.6	3.85	385	0.75	192.5	0.024193548
4.8	3.98	398	0.82	199	0.026451613
5	4.09	409	0.91	204.5	0.029354839
6	4.6	460	1.4	230	0.04516129
7	5.01	501	1.99	250.5	0.064193548
8	5.34	534	2.66	267	0.085806452
9	5.49	549	3.51	274.5	0.113225806
10	5.61	561	4.39	280.5	0.141612903
13	6.7	670	6.3	335	0.203225806
20	/	/	/	/	/
30	/	/	/	/	/
40	/	/	/	/	/
50	/	/	/	/	/
60	/	/	/	/	/
Tensile Strength (N/m ²):		335			
Yield Stress (N/m ²):		335			
% Elongation:		11.94029851			

4.2. Aluminium

Table 2. Results of experiment, with respect to the Aluminium Specimen.

Specimen Material:		Aluminium		Test Condition (°C):	24
Original Cross-Sectional Area (mm ²):		2			
Original Gauge Length (mm ²):		31		Gauge Length (mm ²)	34.5
Original Length (mm):		67		Length (mm):	70
Load Nut Movement (mm)	Dial Indicator (mm)	Force (N)	Extension (mm)	Stress (N/m ²)	Nominal Strain
0	0	0	0	0	0
0.2	0.175	17.5	0.025	8.75	0.000806452
0.4	0.37	37	0.03	18.5	0.000967742
0.6	0.56	56	0.04	28	0.001290323
0.8	0.74	74	0.06	37	0.001935484
1	0.935	93.5	0.065	46.75	0.002096774
1.2	1.1	110	0.1	55	0.003225806
1.4	1.295	129.5	0.105	64.75	0.003387097
1.6	1.475	147.5	0.125	73.75	0.004032258
1.8	1.64	164	0.16	82	0.00516129
2	1.78	178	0.22	89	0.007096774
2.2	1.9	190	0.3	95	0.009677419
2.4	2	200	0.4	100	0.012903226
2.6	2.09	209	0.51	104.5	0.016451613
2.8	2.2	220	0.6	110	0.019354839
3	2.28	228	0.72	114	0.023225806
3.2	2.33	233	0.87	116.5	0.028064516
3.4	2.4	240	1	120	0.032258065
3.6	2.45	245	1.15	122.5	0.037096774
3.8	2.49	249	1.31	124.5	0.042258065
4	2.56	256	1.44	128	0.046451613
4.2	2.56	256	1.64	128	0.052903226
4.4	2.56	256	1.84	128	0.059354839
4.6	2.575	257.5	2.025	128.75	0.065322581
4.8	2.59	259	2.21	129.5	0.071290323
5	/	/	/	/	/
6	/	/	/	/	/
7	/	/	/	/	/
8	/	/	/	/	/
9	/	/	/	/	/
10	/	/	/	/	/
20	/	/	/	/	/
30	/	/	/	/	/
40	/	/	/	/	/
50	/	/	/	/	/
60	/	/	/	/	/
60	/	/	/	/	/
Tensile Strength (N/m ²):		129.5			
Yield Stress (N/m ²):		129.5			
% Elongation:		4.47761194			

4.3.Duralumin

Table 3. Results of experiment, with respect to the Aluminium Specimen.

Specimen Material:		Duralumin		Test Condition (°C):	24
Original Cross-Sectional Area (mm ²):		2			
Original Gauge Length (mm ²):		31	Gauge Length (mm ²):		33
Original Length (mm):		67	Length (mm):		69.5
Load Nut Movement (mm)	Dial Indicator (mm)	Force (N)	Extension (mm)	Stress (N/m ²)	Nominal Strain
0	0	0	0	0	0
0.2	0.005	0.5	0.195	0.25	0.006290323
0.4	0.03	3	0.37	1.5	0.011935484
0.6	0.03	3	0.57	1.5	0.018387097
0.8	0.135	13.5	0.665	6.75	0.021451613
1	0.33	33	0.67	16.5	0.021612903
1.2	0.48	48	0.72	24	0.023225806
1.4	0.65	65	0.75	32.5	0.024193548
1.6	0.83	83	0.77	41.5	0.02483871
1.8	1.03	103	0.77	51.5	0.02483871
2	1.22	122	0.78	61	0.02516129
2.2	1.31	131	0.89	65.5	0.028709677
2.4	1.6	160	0.8	80	0.025806452
2.6	1.78	178	0.82	89	0.026451613
2.8	1.97	197	0.83	98.5	0.026774194
3	2.165	216.5	0.835	108.25	0.026935484
3.2	2.35	235	0.85	117.5	0.027419355
3.4	2.54	254	0.86	127	0.027741935
3.6	2.73	273	0.87	136.5	0.028064516
3.8	2.92	292	0.88	146	0.028387097
4	3.1	310	0.9	155	0.029032258
4.2	3.29	329	0.91	164.5	0.029354839
4.4	3.485	348.5	0.915	174.25	0.029516129
4.6	3.67	367	0.93	183.5	0.03
4.8	3.855	385.5	0.945	192.75	0.030483871
5	4.045	404.5	0.955	202.25	0.030806452
6	4.9	490	1.1	245	0.035483871
7	5.29	529	1.71	264.5	0.05516129
8	5.49	549	2.51	274.5	0.080967742
8.7	0	0	8.7	0	0.280645161
9	/	/	/	/	/
10	/	/	/	/	/
20	/	/	/	/	/
30	/	/	/	/	/
40	/	/	/	/	/
50	/	/	/	/	/
60	/	/	/	/	/
Tensile Strength (N/m ²):		274.5			
Yield Stress (N/m ²):		274.5			
% Elongation:		3.731343284			

4.4. PVC

Table 4. Results of experiment, with respect to the Aluminium Specimen.

Specimen Material:		PVC		Test Condition (°C):	24
(mm ²):		2			
Original Gauge Length (mm ²):		31		Gauge Length (mm ²):	55
Original Length (mm):		67		Length (mm):	91
Load Nut Movement (mm)	Dial Indicator (mm)	Force (N)	Extension (mm)	Stress (N/m ²)	Nominal Strain
0	0	0	0	0	0
0.2	0.06	6	0.14	3	0.004516129
0.4	0.12	12	0.28	6	0.009032258
0.6	0.18	18	0.42	9	0.013548387
0.8	0.21	21	0.59	10.5	0.019032258
1	0.21	21	0.79	10.5	0.025483871
1.2	0.205	20.5	0.995	10.25	0.032096774
1.4	0.21	21	1.19	10.5	0.038387097
1.6	0.22	22	1.38	11	0.044516129
1.8	0.22	22	1.58	11	0.050967742
2	0.22	22	1.78	11	0.057419355
2.2	0.22	22	1.98	11	0.063870968
2.4	0.22	22	2.18	11	0.070322581
2.6	0.22	22	2.38	11	0.076774194
2.8	0.22	22	2.58	11	0.083225806
3	0.22	22	2.78	11	0.089677419
3.2	0.22	22	2.98	11	0.096129032
3.4	0.24	24	3.16	12	0.101935484
3.6	0.22	22	3.38	11	0.109032258
3.8	0.223	22.3	3.577	11.15	0.115387097
4	0.223	22.3	3.777	11.15	0.12183871
4.2	0.22	22	3.98	11	0.128387097
4.4	0.22	22	4.18	11	0.13483871
4.6	0.23	23	4.37	11.5	0.140967742
4.8	0.23	23	4.57	11.5	0.147419355
5	0.23	23	4.77	11.5	/
6	0.25	25	5.75	12.5	/
7	0.25	25	6.75	12.5	/
8	0.25	25	7.75	12.5	/
9	0.25	25	8.75	12.5	/
10	0.25	25	9.75	12.5	/
20	0.22	22	19.78	11	/
27.5	0.22	22	27.28	11	/
30		/	/	/	/
40		/	/	/	/
50		/	/	/	/
60		/	/	/	/
Tensile Strength (N/m ²):		11			
Yield Stress (N/m ²):		12.5			
% Elongation:		35.82089552			

5. Analysis

The tensile test results for the four specimens were compared to evaluate differences in mechanical behaviour under identical loading conditions. Tensile stress and strain were calculated using Equation 1 and Equation 2.

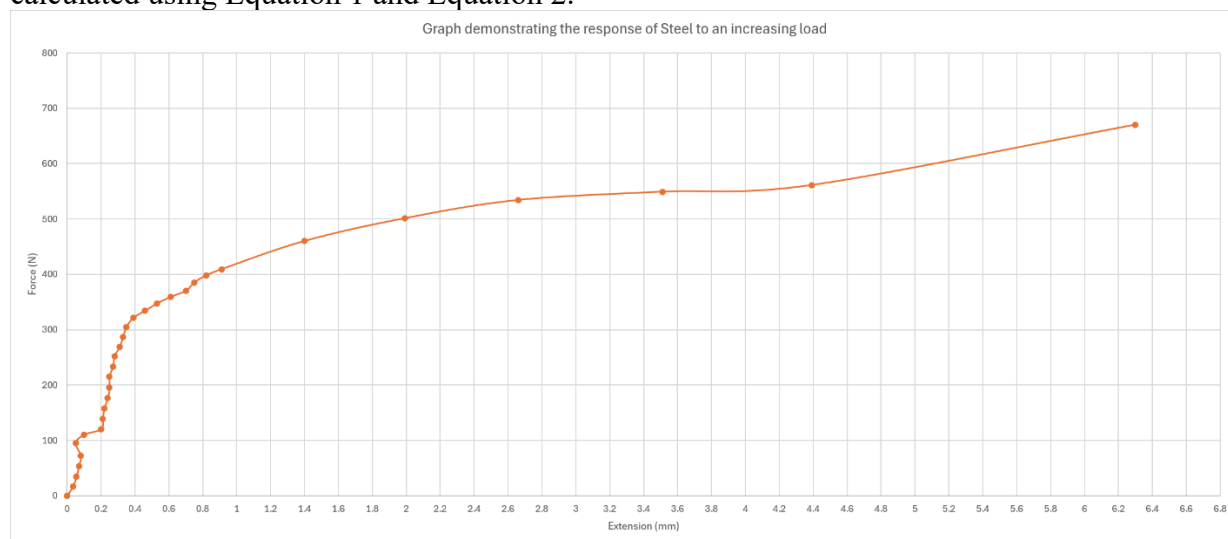


Figure 2. Dowling, E. Graph demonstrating the response of Steel to an Increasing Load.

The steel specimen exhibited the highest stiffness and strength. Its stress–strain curve showed a clear linear elastic region, followed by yielding, strain hardening, and fracture. The yield stress ($\sim 113 \text{ N/mm}^2$) and ultimate tensile strength ($\sim 335 \text{ N/mm}^2$) align with typical mild steel values. Steel also demonstrated moderate ductility, with elongation around 11%.

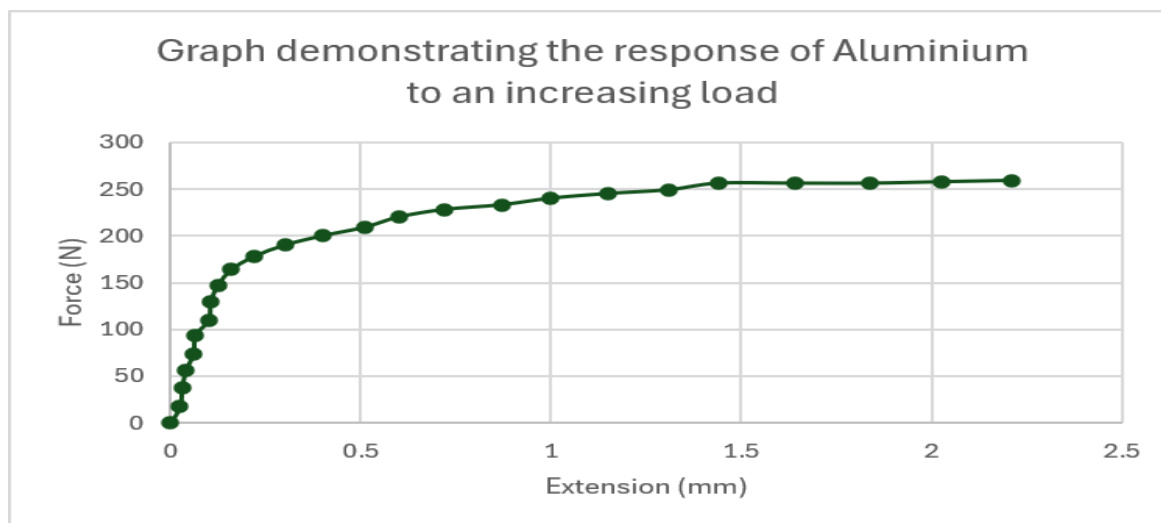


Figure 3. Dowling, E. Graph demonstrating the response of Aluminium to an Increasing Load.

The aluminium specimen showed lower stiffness and strength compared with steel, consistent with aluminium's lower modulus. Its ultimate tensile strength ($\sim 355 \text{ N/mm}^2$) was relatively high for aluminium, suggesting a stronger alloy or temper.

The Duralumin specimen exhibited significantly higher strength than PVC and aluminium, with an ultimate tensile strength of approximately 275 N/mm^2 , consistent with the expected behaviour of high-strength aluminium alloys. The yield stress was considerably lower, around $30\text{--}40 \text{ N/mm}^2$, identified from the first deviation from linearity. The specimen showed limited ductility, with an elongation of 3.7%, which is typical for Duralumin when tested in small cross-section form. These results highlight the influence of alloy composition and specimen geometry on tensile performance.

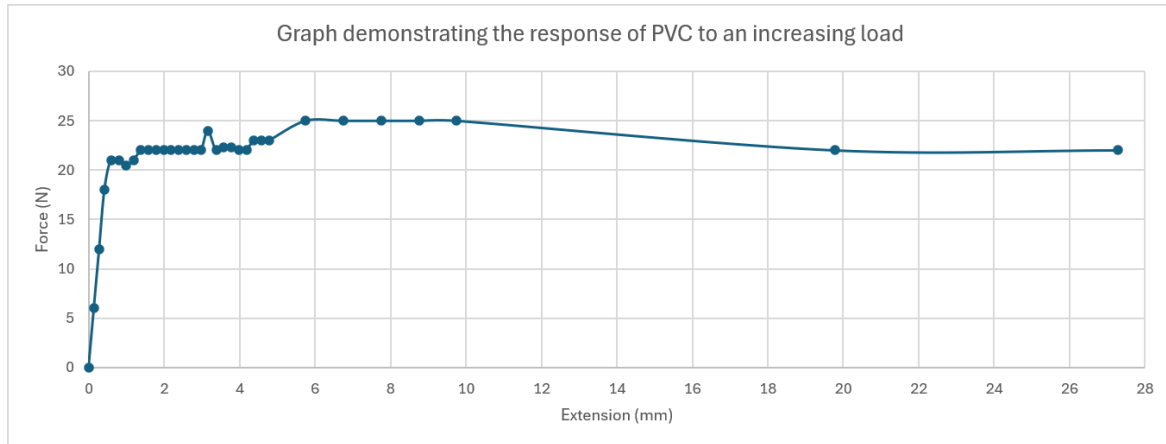


Figure 4. Dowling, E. Graph demonstrating the response of PVC to an Increasing Load.

The PVC specimen demonstrated the lowest stiffness and strength of all materials. Its stress values remained below 13 N/mm^2 , and the material yielded early with gradual plastic deformation. The elongation ($\sim 12\%$) indicates moderate ductility, but the overall behaviour reflects the typical characteristics of polymers: low modulus, low strength, and high strain capacity compared with metals.

Comparing all specimens, steel showed the highest resistance to deformation and the greatest load-carrying capacity. Aluminium displayed intermediate behaviour, with significant variation between the aluminium and duralumin. PVC behaved as expected for a polymer, with low strength and high deformability. These results collectively illustrate how material class strongly influences tensile performance, and how geometry and alloying affect individual specimen behaviour.

6. Conclusion

The tensile tests successfully identified the key mechanical properties of steel, aluminium, Duralumin, and PVC, including yield stress, ultimate tensile strength, stiffness, and percentage elongation. The stress–strain behaviour of each specimen matched expectations for its material class. Steel showed the highest stiffness and strength, aluminium displayed intermediate behaviour, and Duralumin demonstrated significantly higher strength than aluminium due to alloying. PVC exhibited low strength, low stiffness, and high strain capacity, consistent with polymer behaviour.

Elastic deformation followed Hooke’s Law within the initial linear region, while plastic deformation occurred after yielding, where strain increased rapidly with little additional stress. Because the ES6 tester measures nominal strain, early elastic strains could not be used to calculate precise Young’s modulus values, but the nominal stress–strain gradients still allowed meaningful comparison of stiffness between materials. Final elongation measurements confirmed the ductility of steel and PVC and the lower ductility of aluminium and Duralumin.

Overall, the experiment met its aims and clearly demonstrated how material type, alloy composition, and specimen geometry influence tensile performance under uniaxial loading

7. Evaluation

The tensile tests produced generally reliable results, though several factors may have affected accuracy. Minor specimen misalignment could have introduced bending stresses, influencing the early elastic region and the apparent stiffness. Machine calibration and compliance within the ES6 tester may also have affected force and extension readings, particularly because strain was measured as nominal strain, which includes movement of the machine rather than true specimen extension.

Human reading error is another limitation, as dial indicator values were recorded manually. The absence of a precision extensometer reduced strain accuracy in the elastic region, limiting the reliability of Young's modulus calculations. Grip slippage, especially for smoother metallic specimens, may have altered extension readings, while surface defects such as scratches or small variations in cross-section could have acted as stress concentrators and influenced yield and fracture behaviour.

The limited sample size prevented assessment of natural variability within each material, and minor environmental factors such as temperature may have slightly affected polymer behaviour.

Despite these limitations, the tests were conducted carefully, and the results were consistent enough to support meaningful comparison of stiffness, strength, and ductility across all specimens.

8. Further Work

With greater resources, several enhancements could improve the accuracy and reliability of the tensile test. Using a high-precision extensometer or digital strain gauge would allow measurement of actual strain rather than nominal strain, significantly improving accuracy in the elastic region and enabling precise calculation of Young's modulus. Testing multiple specimens for each material would provide statistically reliable results and help identify natural variability in strength and ductility.

A universal testing machine with automated data acquisition and digital strain measurement would reduce human reading error, eliminate machine compliance effects, and improve force and extension accuracy. Expanding the range of materials tested would allow broader comparison of mechanical behaviour across metals and polymers. Additional mechanical tests could be used to correlate tensile strength with other material properties, providing a more complete understanding of each material's performance.

These improvements would increase measurement precision, reduce experimental error, and strengthen the reliability of conclusions drawn from tensile testing.

9. References

- BBC Bitesize. (n.d.). *Hooke's law - Forces and movement - KS3 Physics*. [online] Available at: <https://www.bbc.co.uk/bitesize/articles/zv4jdp3#z2d2qfr>.
- Britannica (2019). Elasticity | Physics. In: *Encyclopædia Britannica*. [online] Available at: <https://www.britannica.com/science/elasticity-physics>.
- Cabezas, E.E. and Celentano, D.J. (2004). Experimental and numerical analysis of the tensile test using sheet specimens. *Finite Elements in Analysis and Design*, 40(5-6), pp.555–575. doi:[https://doi.org/10.1016/s0168-874x\(03\)00096-9](https://doi.org/10.1016/s0168-874x(03)00096-9).
- Encyclopedia Britannica (2019). Young's modulus. In: *Encyclopædia Britannica*. [online] Available at: <https://www.britannica.com/science/Youngs-modulus>.
- Engineeringtechnology.org. (2025). *Necking – EngineeringTechnology.org*. [online] Available at: <https://engineeringtechnology.org/engineering-materials/mechanical-properties-of-materials/strength/stress-strain-diagram/necking/>.
- Key Features Engineering Science. (n.d.).
- Material Properties. (2020a). *What is Ultimate Tensile Strength - UTS - Definition*. [online] Available at: <https://material-properties.org/what-is-ultimate-tensile-strength-uts-definition/>.
- Material Properties. (2020b). *What is Yield Strength - Yield Point - Definition*. [online] Available at: <https://material-properties.org/what-is-yield-strength-yield-point-definition/>.
- Nuclear Power. (n.d.). *Fracture Point - Fracture Strength - Stress-strain Curve*. [online] Available at: <https://www.nuclear-power.com/nuclear-engineering/materials-science/material-properties/strength/stress-strain-curve-stress-strain-diagram/fracture-strength-fracture-point/>.
- Osama, M., Elmardi, S. and Khayal (n.d.). *LABORATORY EXPERIMENTS TENSILE TESTING*.
- Practical 1P10 Tensile Testing. (n.d.).
- Zheng, P., Chen, R., Liu, H., Chen, J., Zhang, Z., Liu, X. and Shen, Y. (2020). On the standards and practices for miniaturized tensile test – A review. *Fusion Engineering and Design*, 161, p.112006. doi:<https://doi.org/10.1016/j.fusengdes.2020.112006>.

Appendix A – Aluminium Specimen

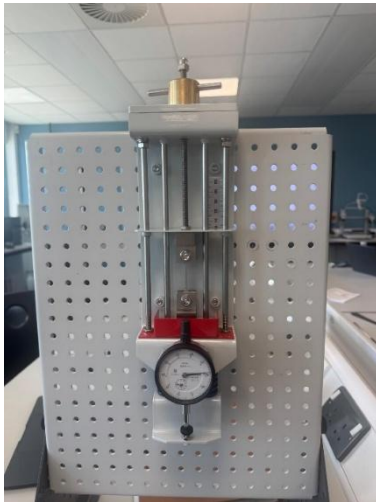


Figure 5. Dowling, E. Image showing the Tensile Testing of Aluminium.

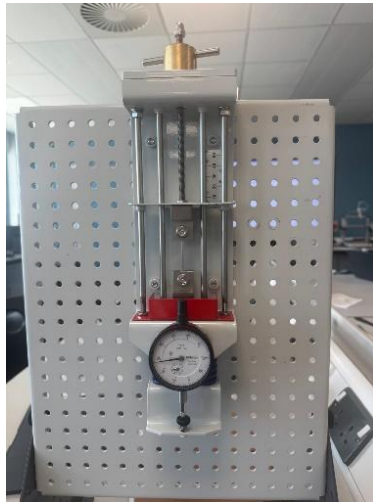


Figure 6. Dowling, E. Image showing the Tensile Testing of Aluminium.

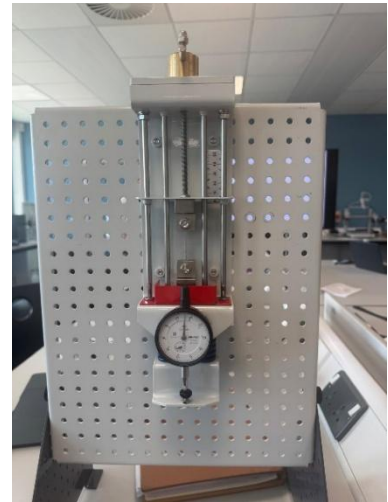


Figure 7. Dowling, E. Image showing the Tensile Testing of Aluminium.

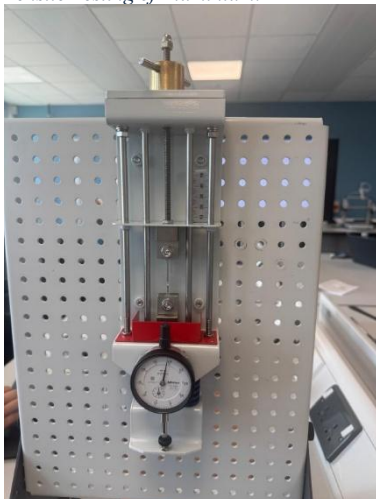


Figure 8. Dowling, E. Image showing the Tensile Testing of Aluminium.

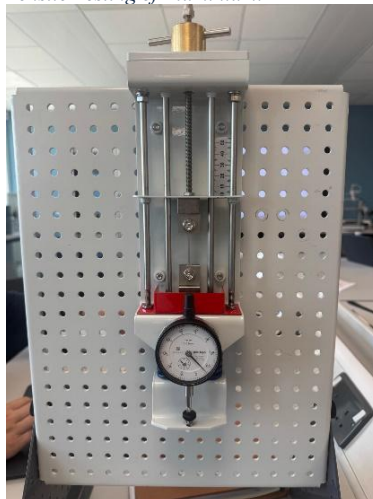


Figure 9. Dowling, E. Image showing the Tensile Testing of Aluminium.

Appendix D – Duralumin Specimen

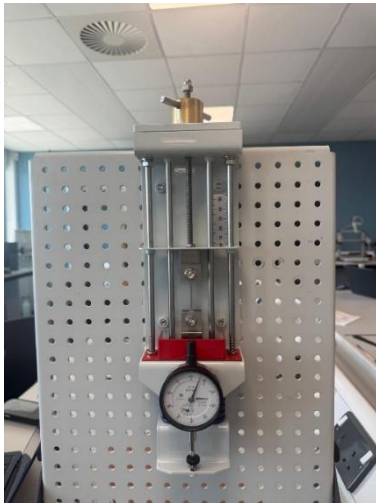


Figure 10. Dowling, E. Image showing the Tensile Testing of Duralumin.

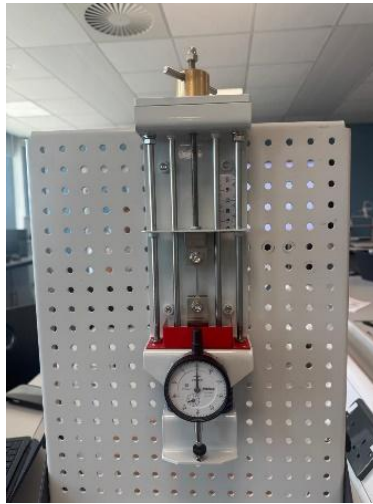


Figure 11. Dowling, E. Image showing the Tensile Testing of Duralumin.

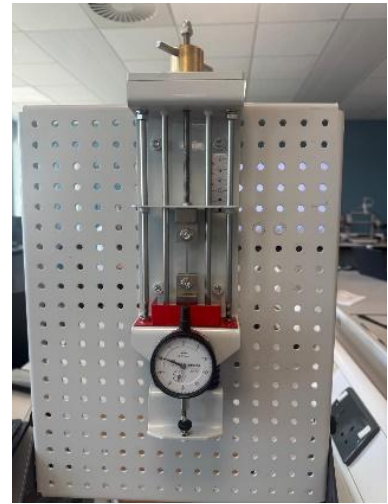


Figure 12. Dowling, E. Image showing the Tensile Testing of Duralumin.

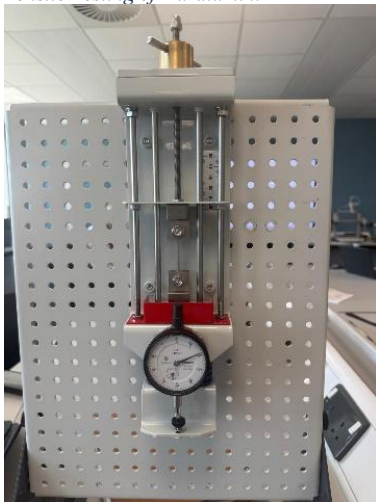


Figure 13. Dowling, E. Image showing the Tensile Testing of Duralumin.

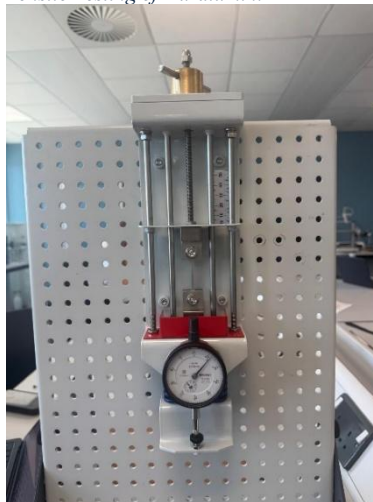


Figure 14. Dowling, E. Image showing the Tensile Testing of Duralumin.

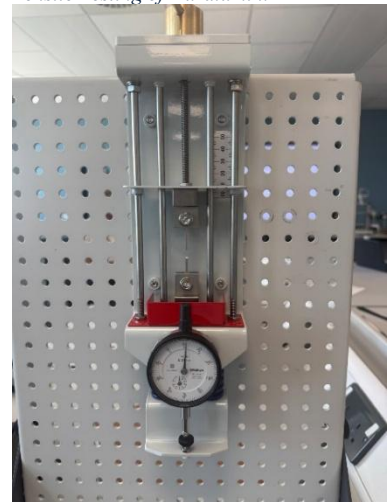


Figure 15. Dowling, E. Image showing the Tensile Testing of Duralumin.

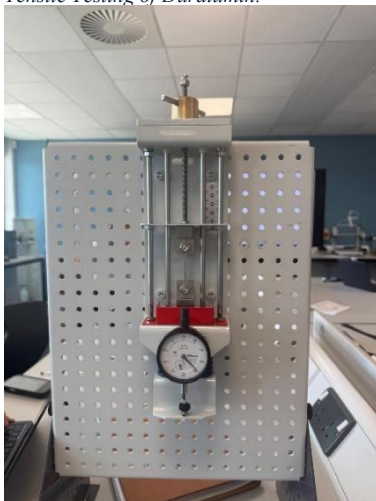


Figure 16. Dowling, E. Image showing the Tensile Testing of Duralumin.

Appendix C – PVC Specimen

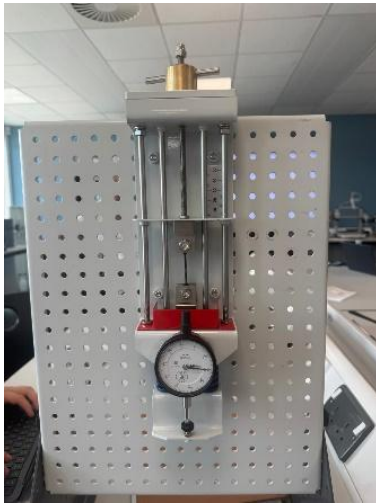


Figure 17. Dowling, E. Image showing the Tensile Testing of PVC.

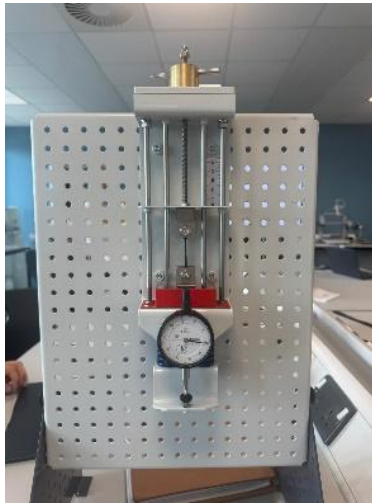


Figure 18. Dowling, E. Image showing the Tensile Testing of PVC.

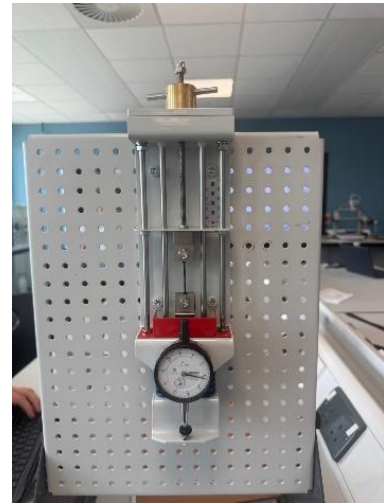


Figure 19. Dowling, E. Image showing the Tensile Testing of PVC.

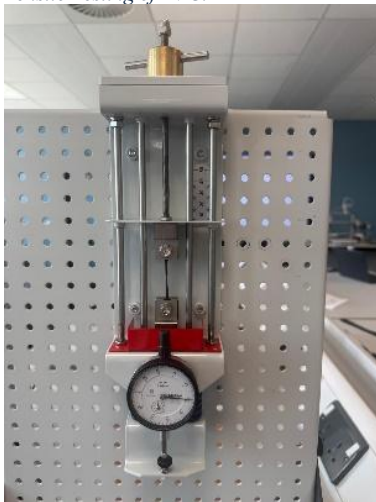


Figure 20. Dowling, E. Image showing the Tensile Testing of PVC.

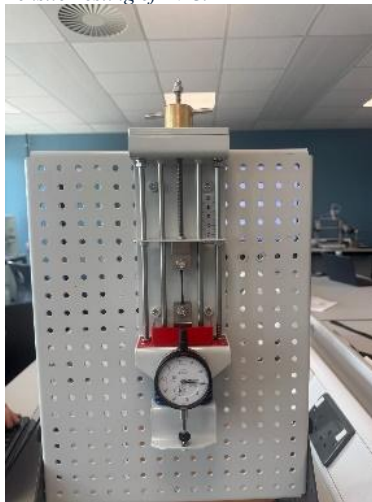


Figure 21. Dowling, E. Image showing the Tensile Testing of PVC.

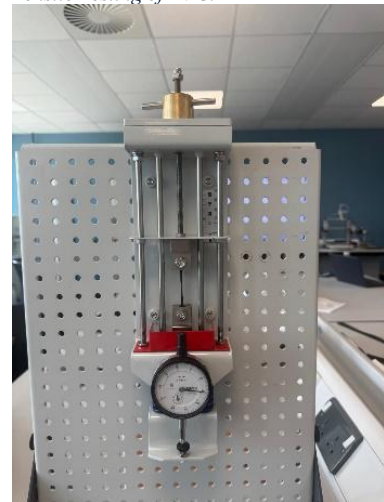


Figure 22. Dowling, E. Image showing the Tensile Testing of PVC.

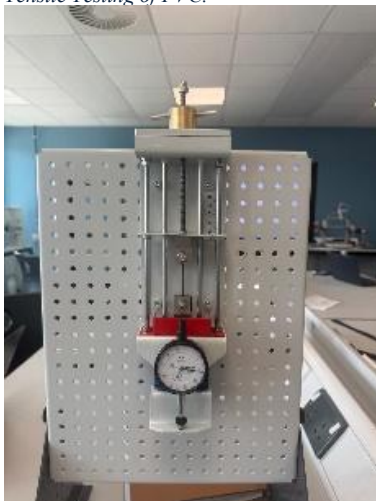


Figure 23. Dowling, E. Image showing the Tensile Testing of PVC.

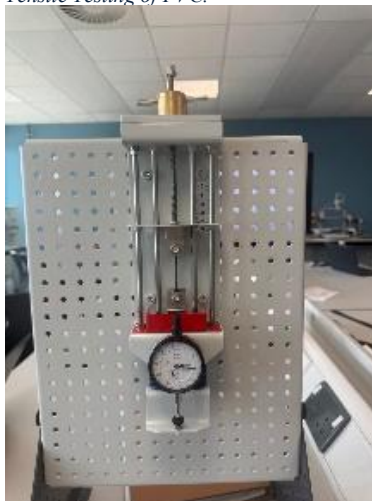


Figure 24. Dowling, E. Image showing the Tensile Testing of PVC.

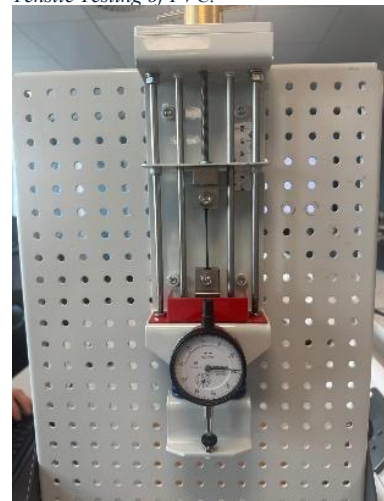


Figure 25. Dowling, E. Image showing the Tensile Testing of PVC.



Figure 26. Dowling, E. Image showing the Tensile Testing of PVC.

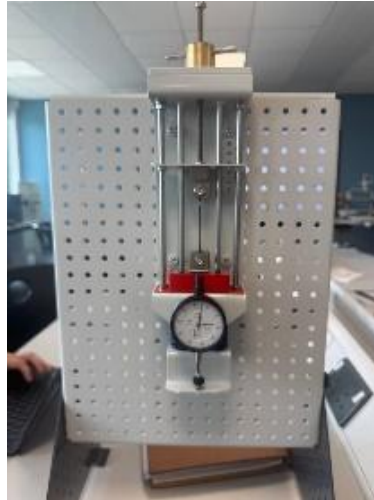


Figure 27. Dowling, E. Image showing the Tensile Testing of PVC.



Figure 28. Dowling, E. Image showing the Tensile Testing of PVC.