

APPENDIX GA36a

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	SZYMON PARCHETA		Student ID number:	
Programme:	HNC Mechanical Engineering			
Module:	Materials			
Module code:	SGDM4003	Contribution to Overall Module Assessment (%):	50%	
Lecturer:	Chris Davies	Internal Verifier:	Robert Rees	
Assignment Title:	Assignment 1 Tensile Test to Destruction.	Word count (or equivalent):	2000	
Submission deadline:	21/11/2019	Return date of provisional marks & written feedback:		
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.			
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.			

Module Learning Outcomes (from module syllabus)

1. Demonstrate a detailed knowledge and understanding of the structure, properties, processing and subsequently the use of engineering materials;
2. Use standard materials testing apparatus and derive the mechanical properties of materials and analyse and understand the cause of materials failures.

STUDENT FEEDBACK FORM

This section details the extent to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills	20	
Rather descriptive style noted - you needed a more detailed literature review. This would have encouraged a more critical style of written writing.		8
2. Knowledge and Understanding Skills	30	
Reasonable knowledge and understanding demonstrated but you sometimes lacked sufficient detail. This again is a reflection on a rather weak literature review.		16
3. Cognitive and Intellectual Skills	20	
Good use of data and correct calculations made. Reasonable conclusions made.		12
4. Practical Application Skills	15	
Some good points raised but I would have liked some specific examples in more detail on how the results of the tensile test can be used.		7
5. Transferable Skills for Life and Professional Practice	15	
Reasonable presentation and structure. Referencing convention not always followed.		7

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)

Late Submission Penalties (tick if appropriate)

Up to 1 week late (40% Max)

Over 1 week late (20%)

50 %



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Szymon Parcheta

HNC Mechanical Engineering

Materials

Assignment 1 – Tensile Test to
Destruction

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Summary

The purpose of this report is to present results gathered from a tensile test on five different materials, which were:

-70/30 Brass normalised

-70/30 Brass annealed

-0.1% Carbon Steel

-0.4% Carbon Steel

-Copper annealed

Once the results were tabulated, graphs were produced in order to present the results more clearly, also a graph with all of the materials on it was produced which gave a good contrast of how the materials compare to each other. The results were discussed in detail, which led to a conclusion that the properties of materials can be changed by putting them through different types of processes. Annealing and alloying was discussed in detail, as fine as atomic level. The report was then concluded and evaluated.

This is a reasonable start to a summary but you needed to include some results and main conclusions also.

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4 – Introduction

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are these page numbers? (try this format in future)

Section No Description Page no

Introduction

The purpose of this assignment was to carry out a destructive tensile test with different materials. The test was carried out in the college lab, with a purpose-built testing rig. Five different materials, each with different properties were tested and destroyed in order to gather data on how each material behaves under tensile load.

The materials tested were:

- 70/30 Brass
- 70/30 Brass (Annealed)
- Copper (Annealed)
- 0.4% Carbon Steel
- 0.1% Carbon Steel

Out of the five materials tested, there are two pairs which are very similar, however have gone through a heat treatment process or have been alloyed to different ratios. In theory, this should affect the properties of these materials due to the defects created/removed in the material structure. The tensile test was carried out with samples of each material, the same size and length to give a better contrast as to how each material compares to another. The length of the test pieces and the cross-sectional area has also been measured in order to work out the total extension just before fracture and the % of reduction in area due to necking. The ultimate goal of the test was to gather data on material extension and force applied in order to produce graphs which represent the properties of each material visually. As stated by 'twi-global', the tensile test is an easy one to carry out, and allows to determine a lot of information about a tested material such as:

- Yield strength
- Ultimate tensile strength
- Ductility
- Strain hardening characteristics
- Young's modulus
- Poisson's Ratio

You need to
ensure you follow
the proper conventions
so referencing

Method and Equipment

A college tensiometer was used for the testing carried out. The machine was set up and operated by a college tutor who has experience and knowledge on how to operate the rig. The five test samples were provided in the same shape and size. A test sample was secured inside the tensiometer and force/extension readings were taken regularly. The force was applied to steadily to the test piece until its fracture. The same steps were taken with each of the test pieces. After fracture occurred and the test pieces were removed from the test rig, the cross-sectional area at the fracture point was measured to provide a value in order to work out the % reduction in cross sectional area. Once all five pieces were tested and the results recorded, the tensiometer was put away and the fractured test pieces were disposed of.

Results

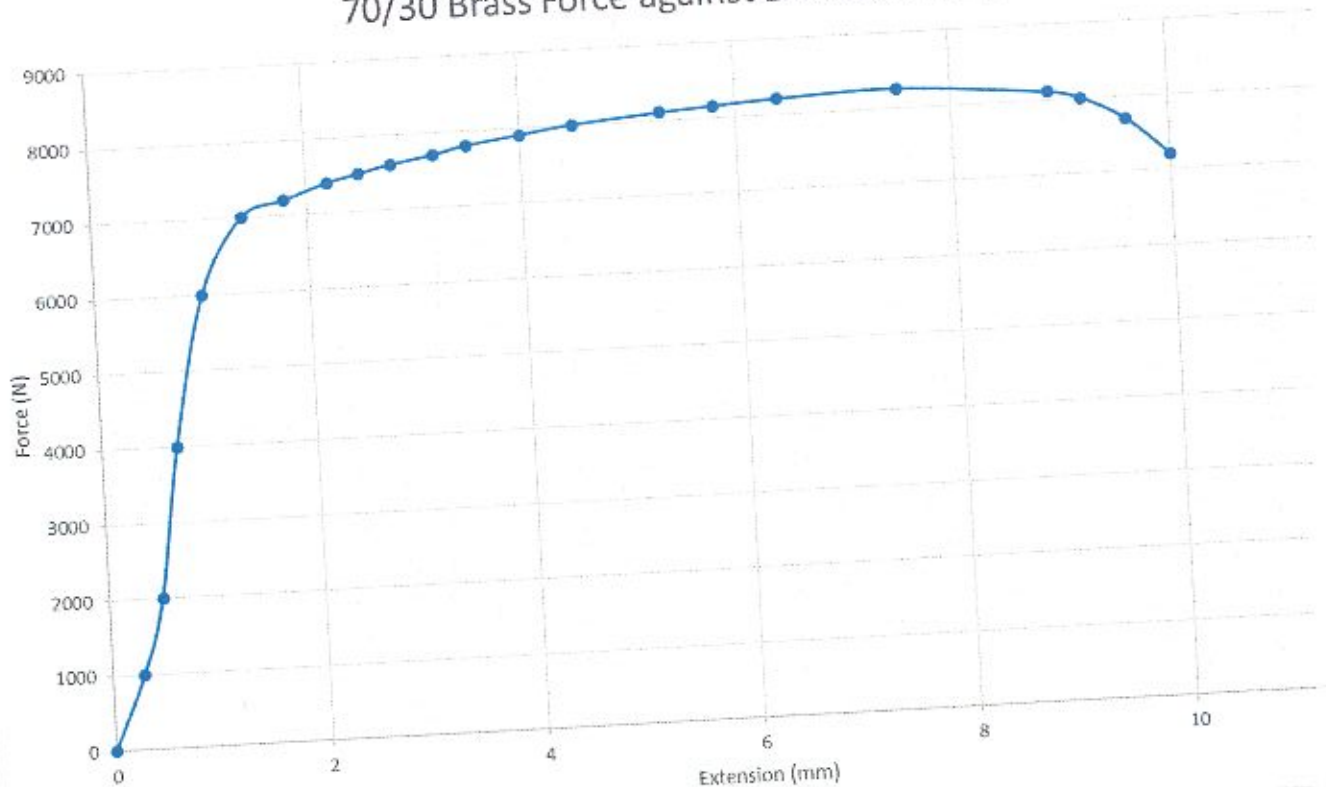
70/30 Brass

70/30 Brass	
Force (N)	Extension (mm)
0	0
1000	0.3
2000	0.5
4000	0.7
6000	1
7000	1.4
7200	1.8
7400	2.2
7500	2.5
7600	2.8
7700	3.2
7800	3.5
7900	4
8000	4.5
8100	5.3
8150	5.8
8200	6.4
8250	7.5
8100	8.9
8000	9.2
7700	9.6
7200	10



(Fig 1)

70/30 Brass Force against Extension Graph



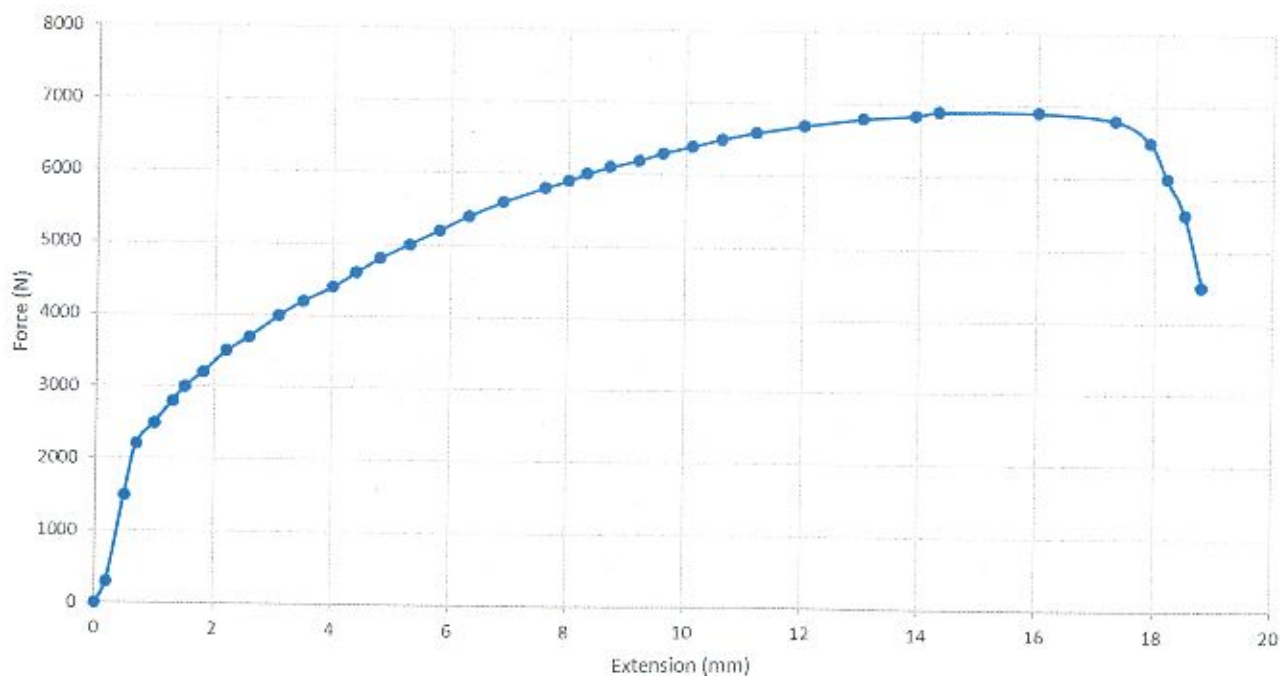
70/30 Annealed Brass



(Fig 2)

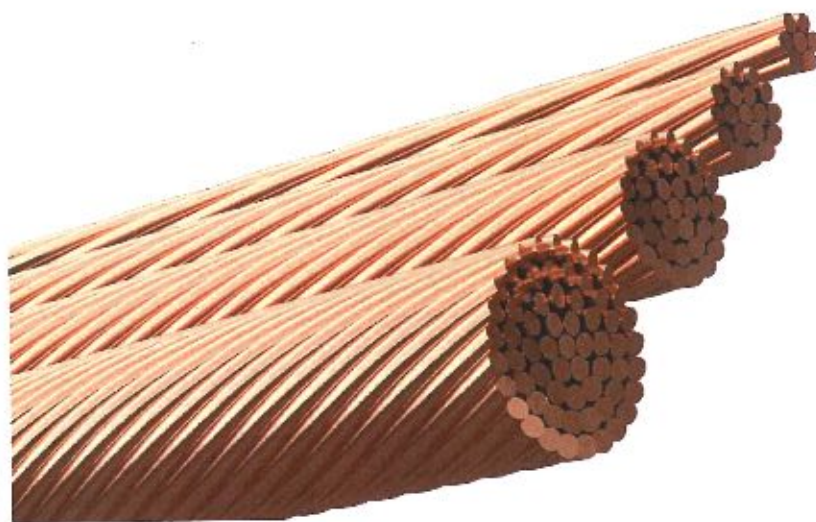
70/30 Brass Annealed	
Force (N)	Extension (mm)
0	0
300	0.2
1500	0.5
2200	0.7
2500	1
2800	1.3
3000	1.5
3200	1.8
3500	2.2
3700	2.6
4000	3.1
4200	3.5
4400	4
4600	4.4
4800	4.8
5000	5.3
5200	5.8
5400	6.3
5600	6.9
5800	7.6
5900	8
6000	8.3
6100	8.7
6200	9.2
6300	9.6
6400	10.1
6500	10.6
6600	11.2
6700	12
6800	13
6850	13.9
6900	14.3
6900	16
6800	17.3
6500	17.9
6000	18.2
5500	18.5
4500	18.8

70/30 Annealed Brass Force against Extension Graph



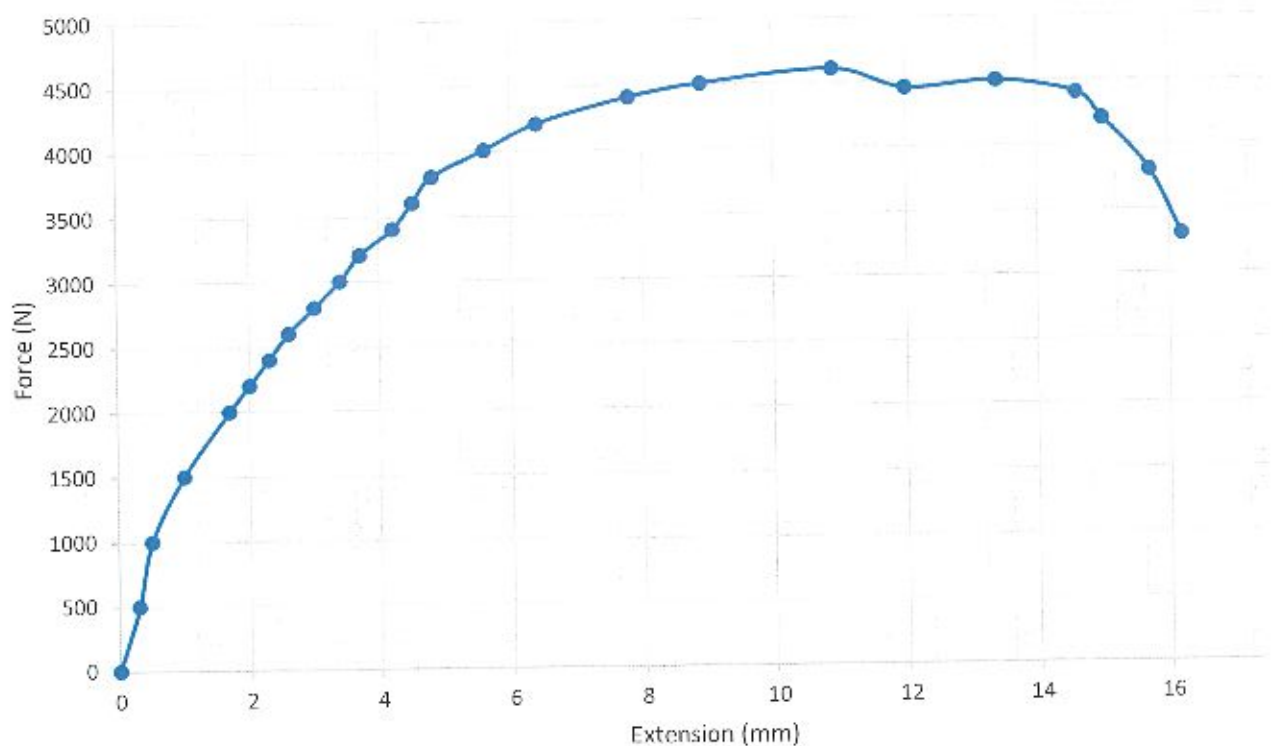
Annealed Copper

Copper Annealed	
Force (N)	Extension (mm)
0	0
500	0.3
1000	0.5
1500	1
2000	1.7
2200	2
2400	2.3
2600	2.6
2800	3
3000	3.4
3200	3.7
3400	4.2
3600	4.5
3800	4.8
4000	5.6
4200	6.4
4400	7.8
4500	8.9
4600	10.9
4450	12
4500	13.4
4400	14.6
4200	15
3800	15.7
3300	16.2



(Fig 3)

Annealed Copper Force against Extension Graph



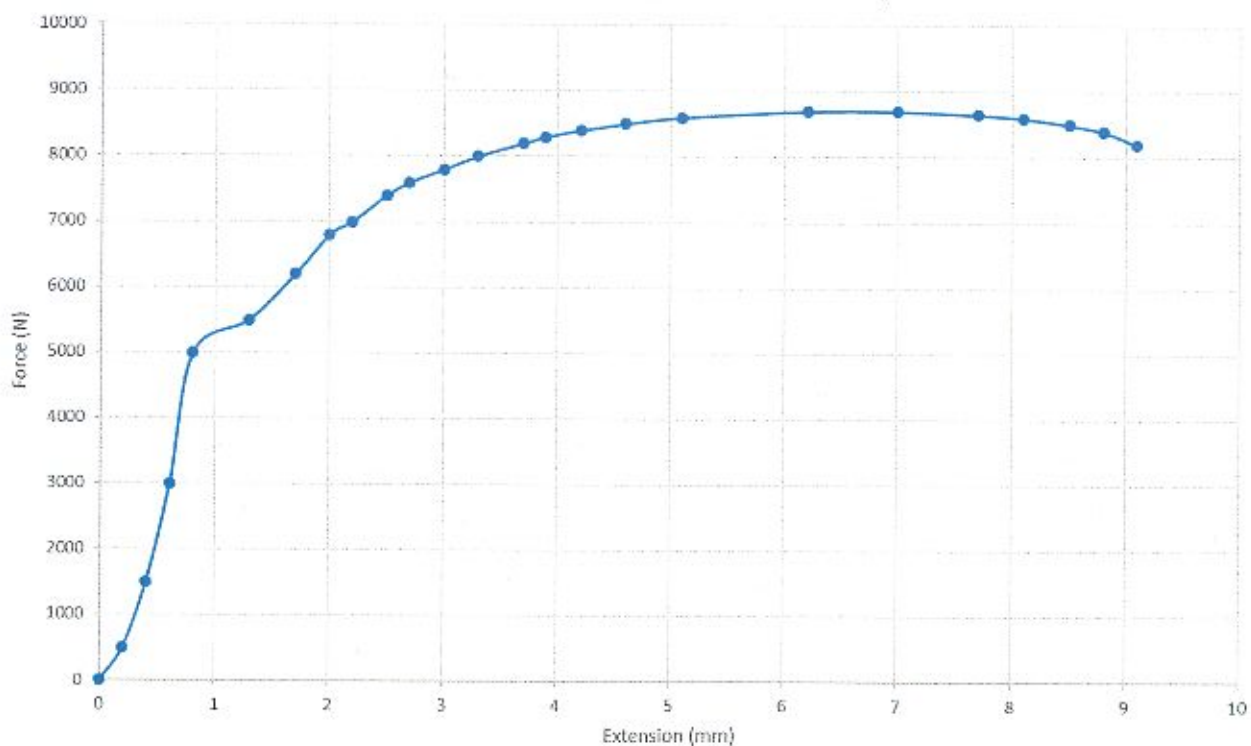
0.1% Carbon Steel

0.1 % Carbon Steel	
Force (N)	Extension (mm)
0	0
500	0.2
1500	0.4
3000	0.6
5000	0.8
5500	1.3
6200	1.7
6800	2
7000	2.2
7400	2.5
7600	2.7
7800	3
8000	3.3
8200	3.7
8300	3.9
8400	4.2
8500	4.6
8600	5.1
8700	6.2
8700	7
8650	7.7
8600	8.1
8500	8.5
8400	8.8
8200	9.1
7800	9.6
7500	9.8
7000	10.1
6000	10.4



(Fig 4)

0.1% Carbon Steel Force against Extension Graph



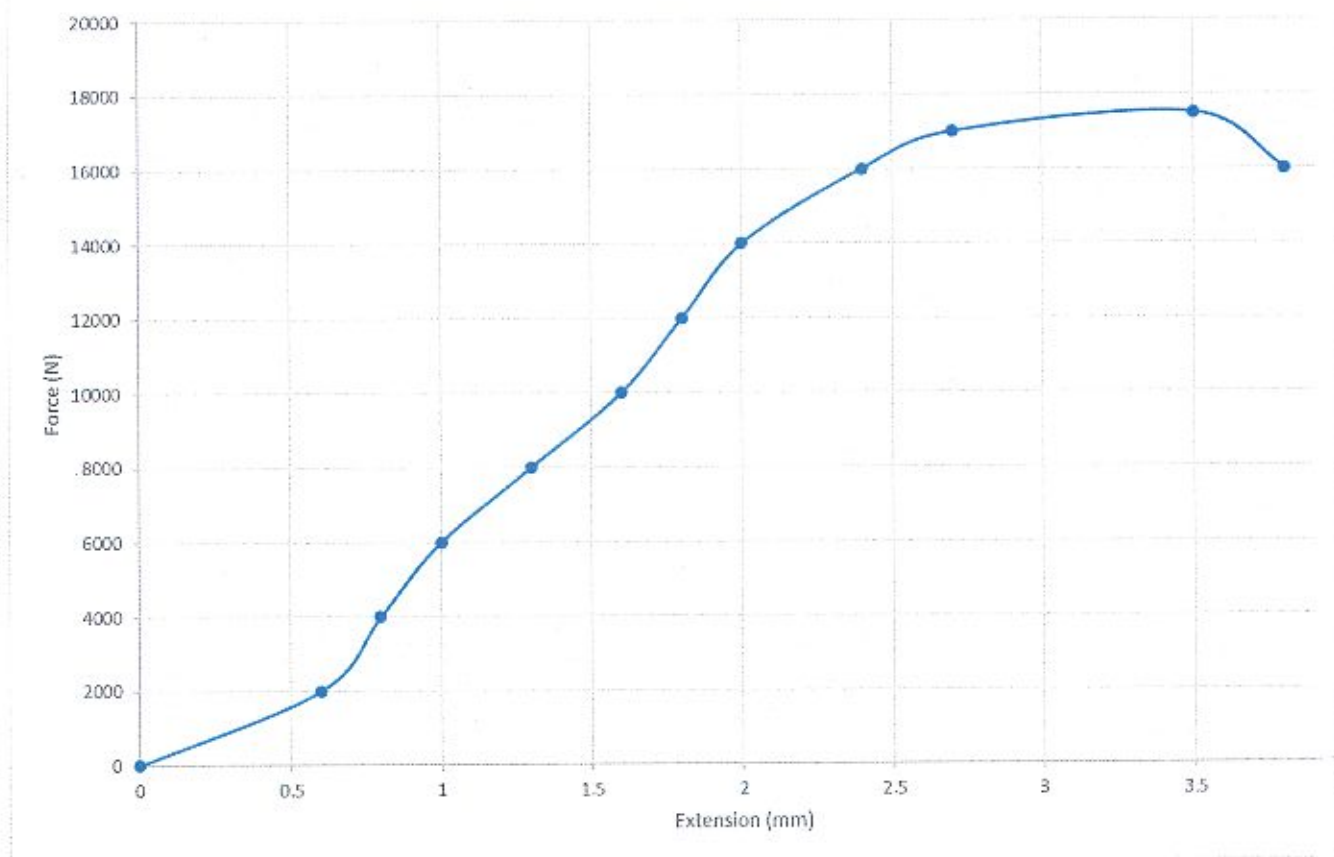
0.4% Carbon Steel

0.4 % Carbon Steel	
Force (N)	Extension (mm)
0	0
2000	0.6
4000	0.8
6000	1
8000	1.3
10000	1.6
12000	1.8
14000	2
16000	2.4
17000	2.7
17500	3.5
16000	3.8
15000	4.3



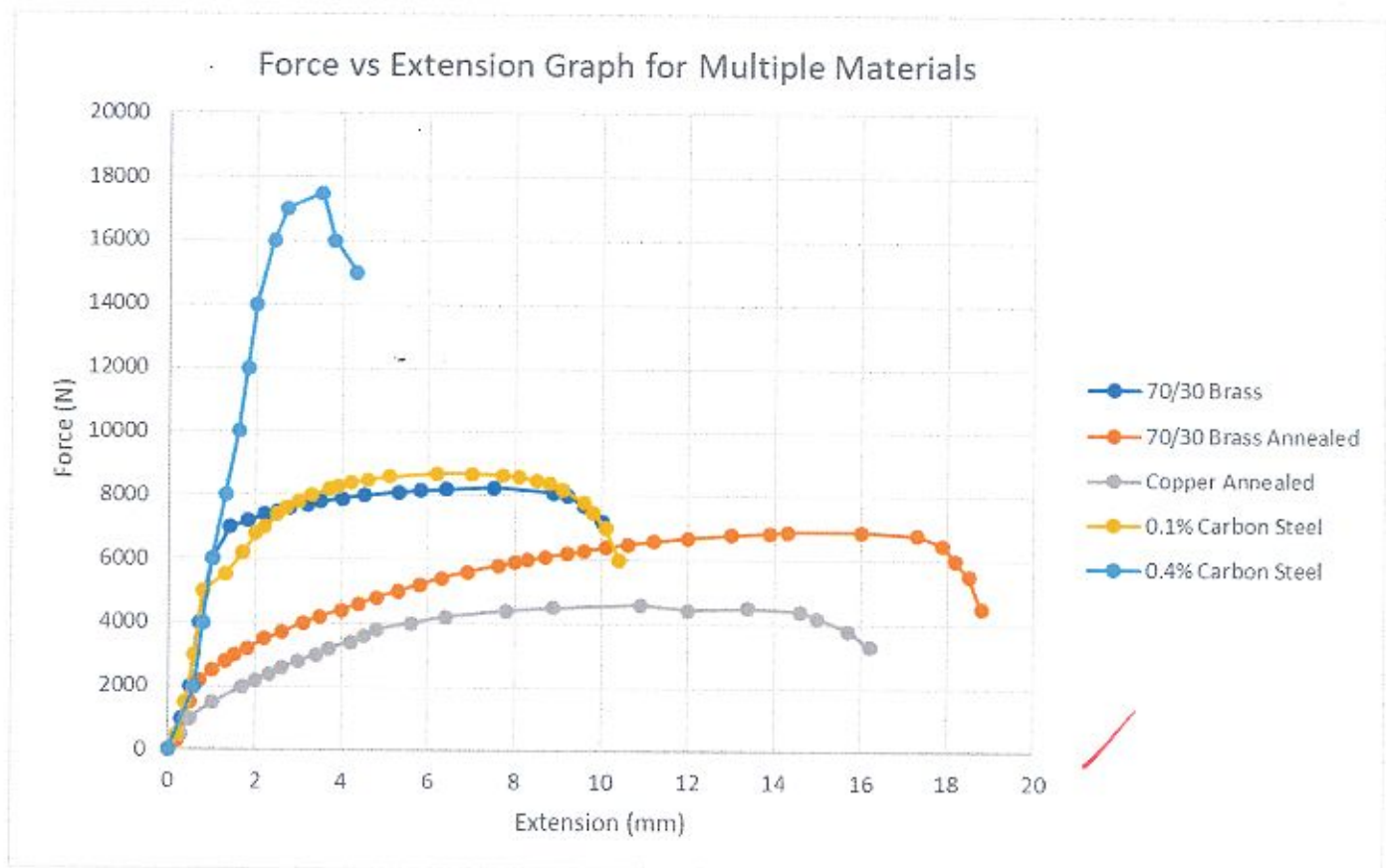
(Fig 5)

0.4% Carbon Steel Force against Extension Graph



Comparing the Results

	70/30 Brass	70/30 Brass Annealed	Copper Annealed	0.1% Carbon Steel	0.4% Carbon Steel
Yield Force (kN)	6	2.25	1	6.25	7.5
Maximum Force (kN)	8.25	6.9	4.6	8.7	17.5
Yield Stress (MN/m ²)	300	112.5	50	312.5	375
Tensile Strength (MN/m ²)	412.5	345	230	435	875
Reduction in area %	60	70	72	45	25
Elongation at fracture %	40	75.2	64.8	41.6	25



The graph above clearly shows how the materials compare to one another. It can be observed that 0.4% carbon steel is by far the strongest, and that the annealed brass is the most ductile.

Discussion

The tensile test which was carried out is significant because the results obtained from it can be used in calculations to find further properties and characteristics of materials. Considering that the tensile test only gives two values which are force applied and extension, it is very useful because this portrays a good picture of what a given material would behave like in a practical application. From the extension due to tensile stress, and the reduction in cross sectional area, it can be seen how ductile a material is which then can be taken a step further to roughly judge what type of structure the material has. The tensile test has many advantages, such as the quickness of it, simplicity and low cost. Test samples for the test rig are relatively cheap as long as they are not made out of exotic materials, which makes it one of the favoured material testing methods in the industry. The results obtained can be used in practice by engineers, scientists, etc. to determine what type of material should be used for a specific application. A good and simple example of when results from such test might be used is the application of bolts. A bolt holding a cylinder head in an engine would experience a massive tensile stress due to the internal pressure in the cylinders, this is where an engineer would want to test different materials in order to select a suitable material. From the tensile test, the Ultimate Tensile Strength can be calculated which can then be used to design parts with a suitable factor of safety, which is arguably one of the most important aspects of products. From the table of results included in the report, it can be determined that a steel bolt would be better than a copper bolt because it can withstand a higher tensile stress with much less extension which is more suitable for the example mentioned earlier. Carrying out a test such as this one is crucial in the industry in order to design and manufacture products which guarantee safety and reliability.

The results obtained from the tensile test, which were then calculated and translated into material property values could be compared to the standard values in order to see if there are any discrepancies. According to LEA-wires.com which is a specialist company dealing with alloys and copper, the claimed UTS (Ultimate Tensile Strength) of 70/30 annealed Brass is from 330MN/m² to 375MN/m². The results obtained from the test carried out in the lab, the UTS was found to be 345MN/m² which is almost in the middle of the values claimed by specialists. This shows that the values obtained during the test are solid and do not differ from the standard values. For the non-annealed 70/30 Brass, 'Austral Wright Metals' which is a highly rated metal supplier, claims the UTS to be 420MN/m² which is very close to the 412.5MN/m² obtained in the test. This is a relatively small difference considering the high numbers, therefore it shouldn't be considered a discrepancy.

Again, referencing conventions not followed.
Rather descriptive approach being taken. You
need to develop a more critical style.

From the materials tested there are two pairs of materials which need to be discussed in detail as they are very similar materials, however they have undergone a treatment which affected their properties. The first comparison to be made is the 70/30 Brass, of which two samples were tested, one normalised and one annealed. The results gathered for these two materials are in the table below.

	70/30 Brass	70/30 Brass Annealed
Yield Force (kN)	6	2.25
Maximum Force (kN)	8.25	6.9
Yield Stress (MN/m ²)	300	112.5
Tensile Strength (MN/m ²)	412.5	345
Reduction in area %	60	70
Elongation at fracture %	40	75.2

From the results it can be determined that a normalised brass is indeed a stronger material, which has a higher limit of plasticity and a higher tensile strength, however the annealed brass is much more ductile and turned out to have a much higher % elongation at fracture as well as a higher % reduction in cross sectional area at fracture. This tells us that annealing can be considered to be a process which decreases the strength of a material, however increases the ductility. This might be a desirable effect for many applications in the engineering industry. For example, a 70/30 brass might be used to make a wire, meaning it would be desirable for the material to be ductile in order to draw it through a die and stretch it out into a given thickness. An annealed brass would be much better for making wire due to its increased property of ductility. Knowing the effects of annealing on a material is very beneficial, however it is important to understand what changes occur in the material during this process. When a material is cold-worked, it affects its grain structure as well as the atomic structure. For example, after a material is rolled, the atoms within the material are forced to move and sometimes 'squeeze' between their natural atomic structure. This introduces internal compressive and tensile stresses between the ions. This is how 'defects' are made in a material, which affects the grain size and the area of the grain boundaries. This results in a higher strength and a decrease in ductility/malleability. Annealing is a process which can reverse these effects. According to www.metalsupermarkets.co.uk there are three stages of annealing, the first is heating the material up and providing the ions within the material with energy to move into their 'natural' atomic plane. This stage is called 'recovery' and it does not affect the grain structure of a material, however only the lattices within the grains. Stage two of annealing is called recrystallisation, this is where the atoms on the grain boundaries have enough kinetic energy, thanks to the high temperature to move and attach onto new grain nuclei. Over time the grains grow and increase in size, this is also dependant on temperature. As the material recrystallises with bigger grains, it gains on ductility as the larger grains offer more movement for ions within their lattice structure. The annealing process in this case gave a 34% increase in the % elongation for brass, considering the

normalised brass had 42% elongation, it can be considered a huge change for the material. Another crucial property change due to annealing is the UTS, which dropped from 412.5 MN/m² to 345 MN/m², this is also a significant change in the property, which shows how a material can be manipulated by changing the grain structure, therefore adding or removing defects.

The second pair to be compared are the two types of steel. One which is 0.1% carbon content and the other 0.4%. Both of these steels are a type of alloys, however different types and ratios of alloying give different changes in their properties. By looking at the results derived from the test, it can be said that the higher carbon content in a steel causes an increase in the UTS and the lower yield point. It can be seen again, that an increase in the strength of a material also means a decrease of ductility. Close comparison of both material properties are shown in the table below.

	0.1% Carbon Steel	0.4% Carbon Steel
Yield Force (kN)	6.25	7.5
Maximum Force (kN)	8.7	17.5
Yield Stress (MN/m ²)	312.5	375
Tensile Strength (MN/m ²)	435	875
Reduction in area %	45	25
Elongation at fracture %	41.6	25

Alloying is a process where two or more pure materials are joined together. In this case, steel which is an alloy of Iron (Fe) and Carbon (C) was tested to see the difference in properties when a different ratio of Carbon is used. A 0.3% more carbon, which may seem like a very small amount, can make a massive difference to the material's properties as seen in the results table. To understand how the amount of carbon in a steel alloy changes its property, it is required to think at an atomic level and the lattice structures. Iron at a liquid state is presented with a small amount of carbon, which atoms are much smaller than Iron. This means that when the cooling of steel occurs, the much smaller atoms of carbon find themselves to be sitting within the Iron's FCC (Face centred cubic) structure. This causes the ions within the material to have a more limited movement, therefore reducing the ductility. The amount of carbon is not the only factor which can affect the properties of an alloy, another way of manipulating the properties is to change the rate of cooling of the material from a liquid state. This will cause the alloy to form different types of grain structures. Each type of steel has its own use, for example a steel with a higher % of carbon would be used for tools such as drills, files, etc. whereas low % carbon steel is more likely to be used for things like pressed panels for cars, where ductility and malleability is needed. According to www.thefabricator.com low carbon steel, which is 0.3% carbon and less, is favoured for welding and machining.

You could have discussed the formation of pearlite and Fe₃C (and their effect on material properties).

Conclusion

The test carried out proved to be very educating, and gave not only numeric results but also a visual idea of how metals behave under tension and the way in which they fail. The results obtained from the test are very close, if not identical to standard values found from different sources which can be concluded that the results are legitimate and can be used for practical applications. The graphs produced using the results gave a clear overview of how different each material is, but also how annealing and different alloying can have a great effect on the properties. From the results, it can also be observed that to acquire a higher strength in a material, ductility must suffer and vice versa.

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