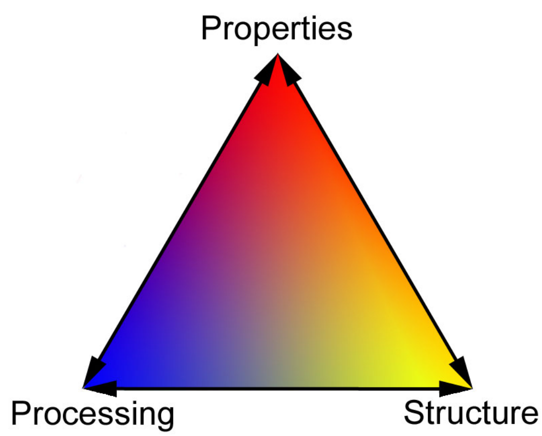
RECOMMENDATIONS FOR THE REPORT FOR THE RECOVERY, RECRYSTALLIZATION AND GRAIN GROWTH EXPERIMENT

This experiment brings together the three major elements of materials science – structure, properties and processing. Using your skills in hardness and tensile testing and your knowledge of mechanical properties you have been able to quickly gather quite a bit of information on how annealing can alter the mechanical properties of cartridge brass (C26000, 70/30 Cu/Zn). In the second part of the experiment the microstructures of these materials were examined, revealing which heat treatments cause recovery, recrystallization and grain growth, and how changes in the microstructure correlated with changes in mechanical properties. This completed the properties – processing – structure triangle.



Your primary job in writing the laboratory report will be to identify the annealing regimes for recovery, recrystallization and grain growth, and to clearly relate the annealing procedures, mechanical properties and microstructure. Another important and very practical concept demonstrated by this experiment is that compromises are usually involved in materials selection, that increasing one property often leads to decreases in others. The recommendations given in this document should help you sort out the data from this experiment, to validate the data and make the comparisons, and to write this report.

Stress-Strain Curves

Unlike your previous mechanical properties experiment the stress-strain curves are not the primary focus of our attention. Instead, the data extracted from these curves are what is needed to be able to understand how annealing alters the mechanical properties. Nevertheless, they can be very useful and effective illustrations and they are familiar to most engineers who would probably want to see them in your report. Here are a few suggestions to help you with your stress-strain graphs:

- If you plan to use the stress-strain curves printed out by the Instron's software you'll want to put them at the end of the report. If the text of your report does not direct the reader to these graphs then they should go in the appendix.
- The most effective way to present the stress-strain data from the six samples tested is to put them all on the same graph. The Instron software can do this for you. The alternative is to import each data file into a single spreadsheet and create the graph yourself. This graph can be easily cut and pasted into your report.
- If you use separate graphs for each material then be sure to use the same scaling for each. This will be very helpful to your reader who will probably want to lay the graphs side-by-side to

compare them.

Tables

The essential data extracted from you stress-strain curves will be recorded in you worksheets. If you create a spreadsheet to compile this data the table can be pasted into your report and it can be used to create the graphs you need to illustrate the effect of the annealing procedures on mechanical properties. Here are a few suggestions for creating your tables:

- Create the table in a spreadsheet first, then copy-paste it into your report. With the data in a spreadsheet you can easily create the other plots.
- Use standard table captions. These are located above the table and start out with "Table 1..." and then describe the table's contents.
- Use notes at the bottom of the table to explain anything unusual.
- Don't forget to include the units for each property.

Annealing Temperature -vs- Mechanical Properties Plots

The data extracted from your stress-strain data should be plotted so that the reader can clearly see how the mechanical properties were altered by annealing. Here are a few suggestions to help you create these plots.

- Use standard x-y plots that show the individual data points and the line or trend line.
- Consider plotting all of your hardness values, not just the average values. The line can be drawn through the average values.
- Your plots should show how annealing effects hardness, yield strength, tensile strength, modulus of toughness and ductility. To save effort and space in your report, consider combining these graphs into one or two. For instance, yield and tensile strength and modulus of toughness all have the same units, so if their magnitudes are similar they can all be plotted on the same graph. Also, consider using the second y-axis to plot ductility on the same graph. See the graph below.

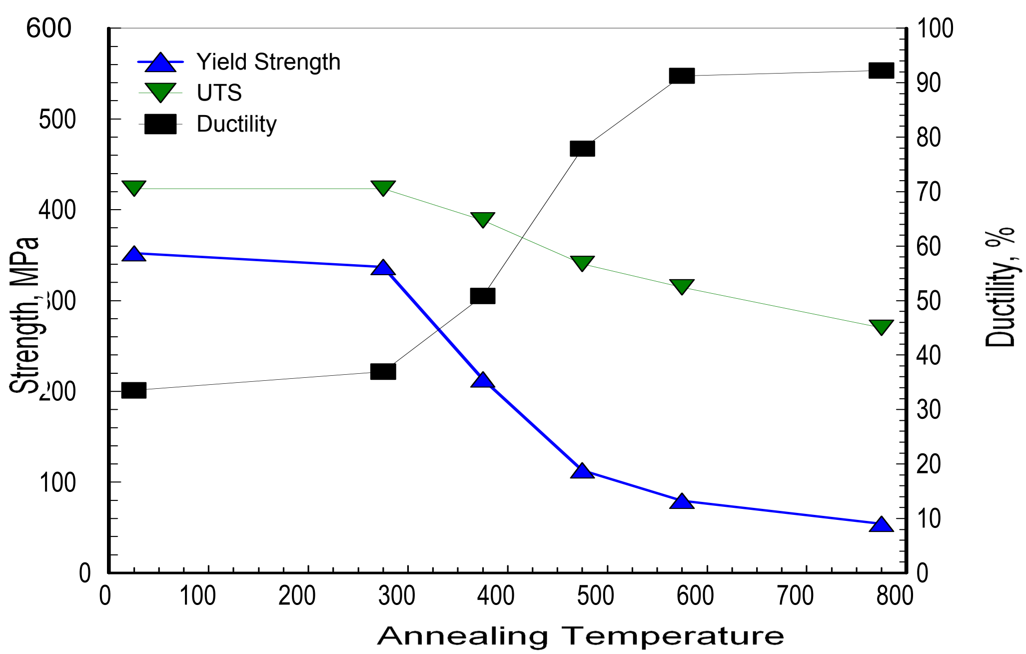


Figure 1 Yield strength, UTS and ductility after annealing cold worked C26000 brass for one hour.

- All graphs should use the same scaling on the x-axis and ideally would be the same size. This makes it easy for the reader to quickly compare the results in each table.
- A good trick that will help you line up your graphs on one page is to create a one-column table with one row per graph plus one for the caption. Past your graphs into the top rows and enter the caption in the bottom row. Finally, hide the table and cell borders.
- Do not include the standard graph titles that Excel and other spreadsheets employ. Use standard figure captions to tell the reader what each graph is about.

Errors and Comparisons to Reference Data

The annealing treatments used in this experiment do not match any of the standard industrial heat treatments. The data in the appendix of your laboratory manual, however, can be useful for broad comparisons and validation of your results. In general, the strengths and ductilities measured in this experiment will tend to lie towards, and perhaps a bit beyond, the more highly annealed end of the values listed for the C26000 alloy.