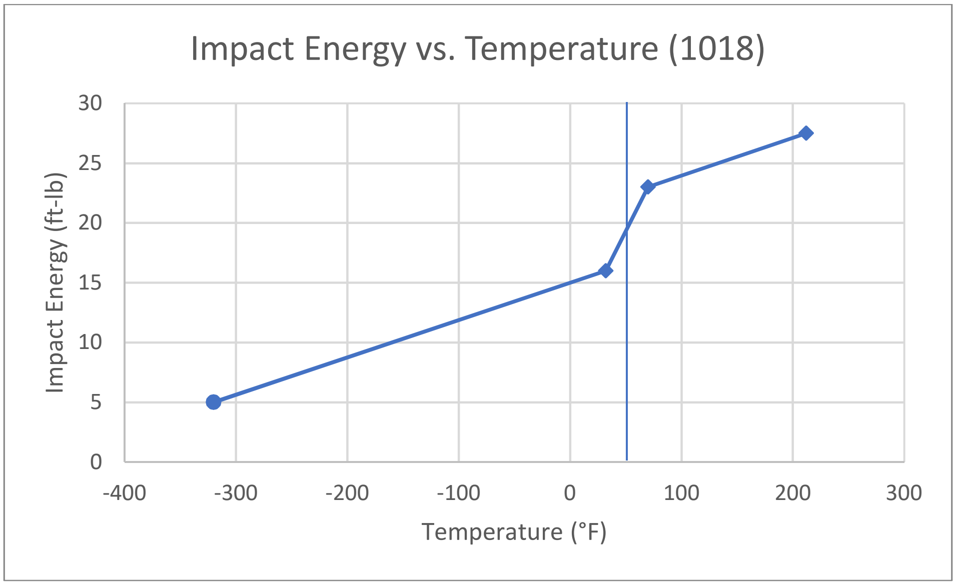
Anisah Alahmed

1. Generate a freehand plot of impact energy versus temperature for each of the three materials, **<u>each on a separate graph</u>**. Identify each graph by material.



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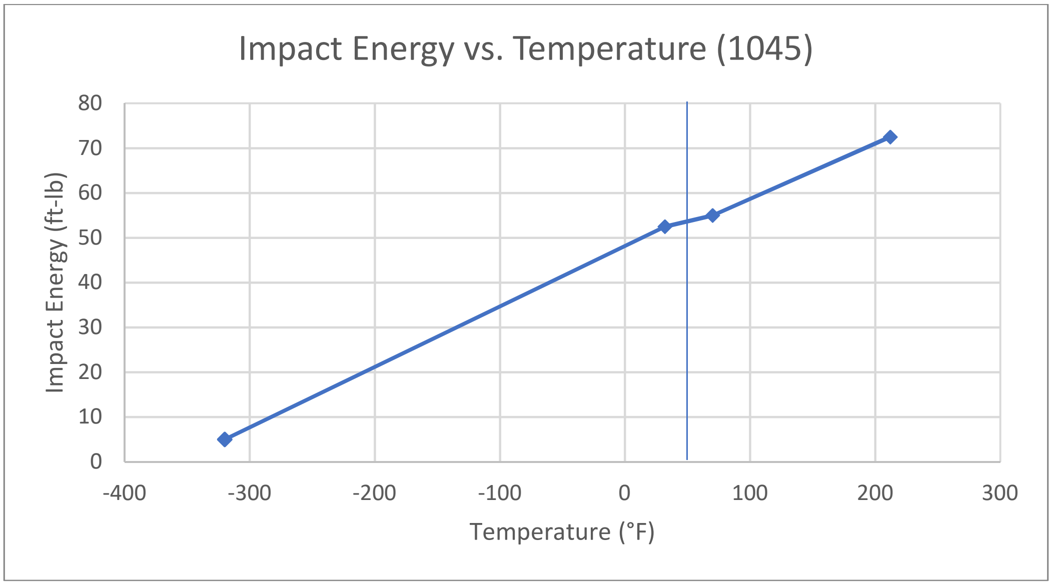

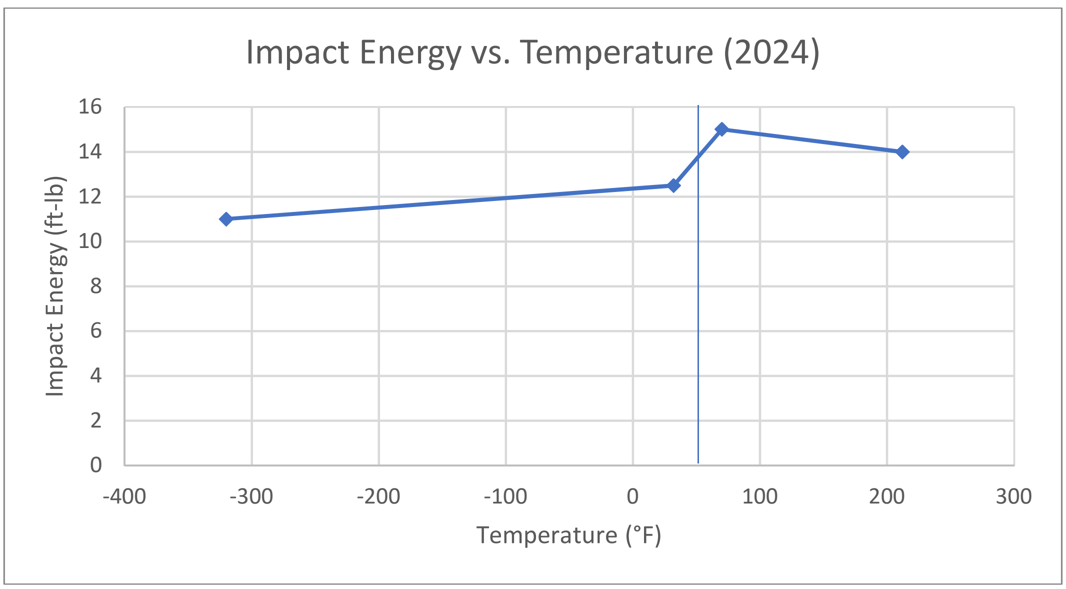

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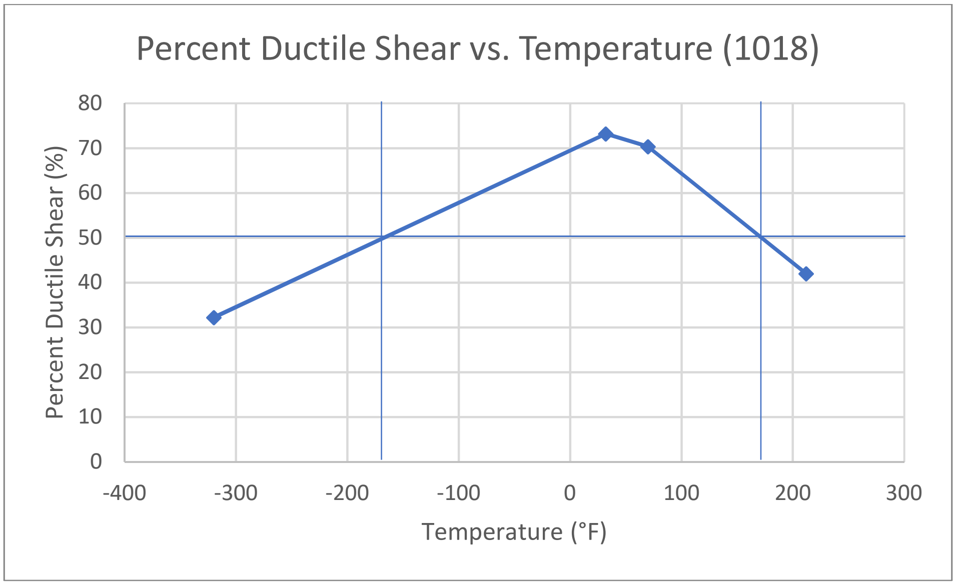
2. Determine the transition temperature (where appropriate) based on the graph in (1).

All three of the graphs above seem to indicate a transition temperate at about 55 °F.

3. Generate a freehand plot of percent ductile (shear) fracture versus temperature for the 1018 steel sample. Determine the transition temperature of this material from this graph.



The transition temperate seem to be about -175 °F and 180 °F, though the presence of two transitions seems to be in error.

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4. Compare the transition temperatures for 1018 annealed steel as determined in (2) and (3) above. What reasons can you give that may explain the differences? Do you believe the actual transition temperature is really different when determined by two different systems (energy and % ductile fracture)? What kinds of problems with the two systems would cause the temperatures to be different?

The transition temperatures estimated by the separate graphs are different. There is a slight oddity in one of them, likely in error, which is that the % Ductile Shear line crosses 50% in multiple places, giving multiple transition temperatures? I do not believe that -175 °F is actually a transition temperature, but even if it is ruled out, the other estimate is still much higher at 180 °F. Some issues that could have caused this discrepancy is inconsistent sample geometry, wear on the test machine, or variation in the notch on the samples.

5. Which one is tougher (1018 or 1045 steel)? Explain why one is tougher and base your argument on the microstructure differences between the two samples.

Between 1018 steel and 1045 steel, 1018 steel has a higher impact resistance. This is because the higher Carbon content present in 1045 steel results in a higher concentration of cementite, which reduces the ductility in the steel. In general, a higher carbon content correlates with higher strength but more brittleness.

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Material	Heat Treatment			
	Liquid Nitrogen (-320 °F)		Ice Water (32 °F)	
	Toughness (ft-lb)	Ductile Shear (%)	Toughness (ft-lb)	Ductile Shear (%)
1018	5	32.24	16	73.2
1045	5	62.61	52.5	65.91
2024	11	16.8	12.5	19.23

Material	Heat Treatment			
	Room Temperature (70 °F)		Boiling Water (212 °F)	
	Toughness (ft-lb)	Ductile Shear (%)	Toughness (ft-lb)	Ductile Shear (%)
1018	23	70.3	27.5	41.97
1045	55	43.3	72.5	51.95
2024	15	2.86	14	22.02