



UNIVERSITY OF
ILLINOIS
URBANA-CHAMPAIGN

ME 330: Engineering Materials

Lab - 6

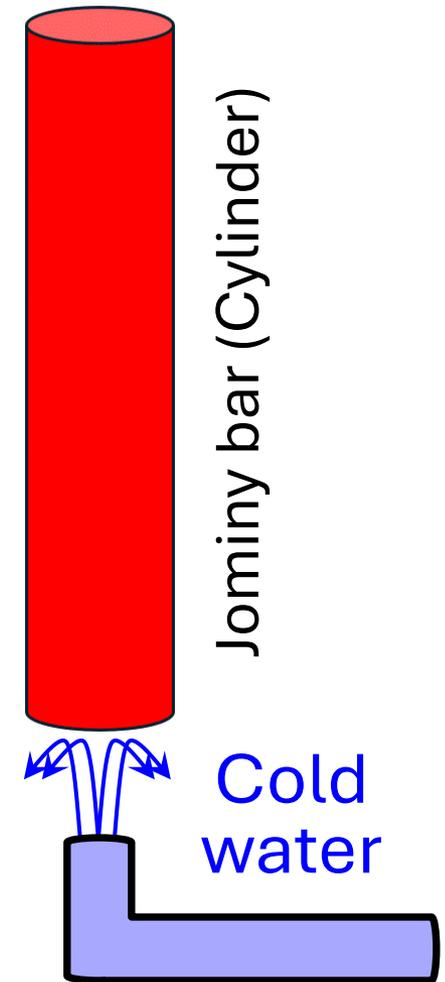
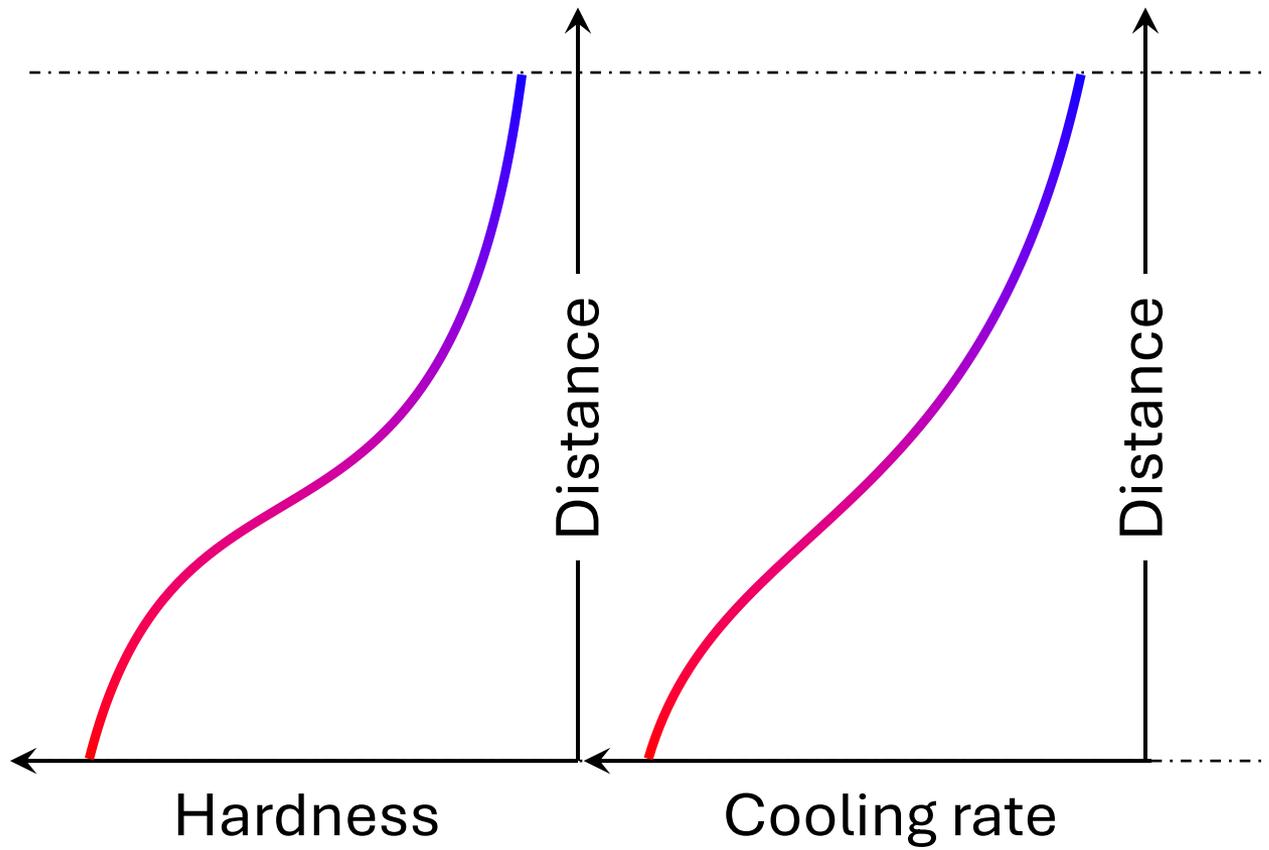
Hardenability of Steels



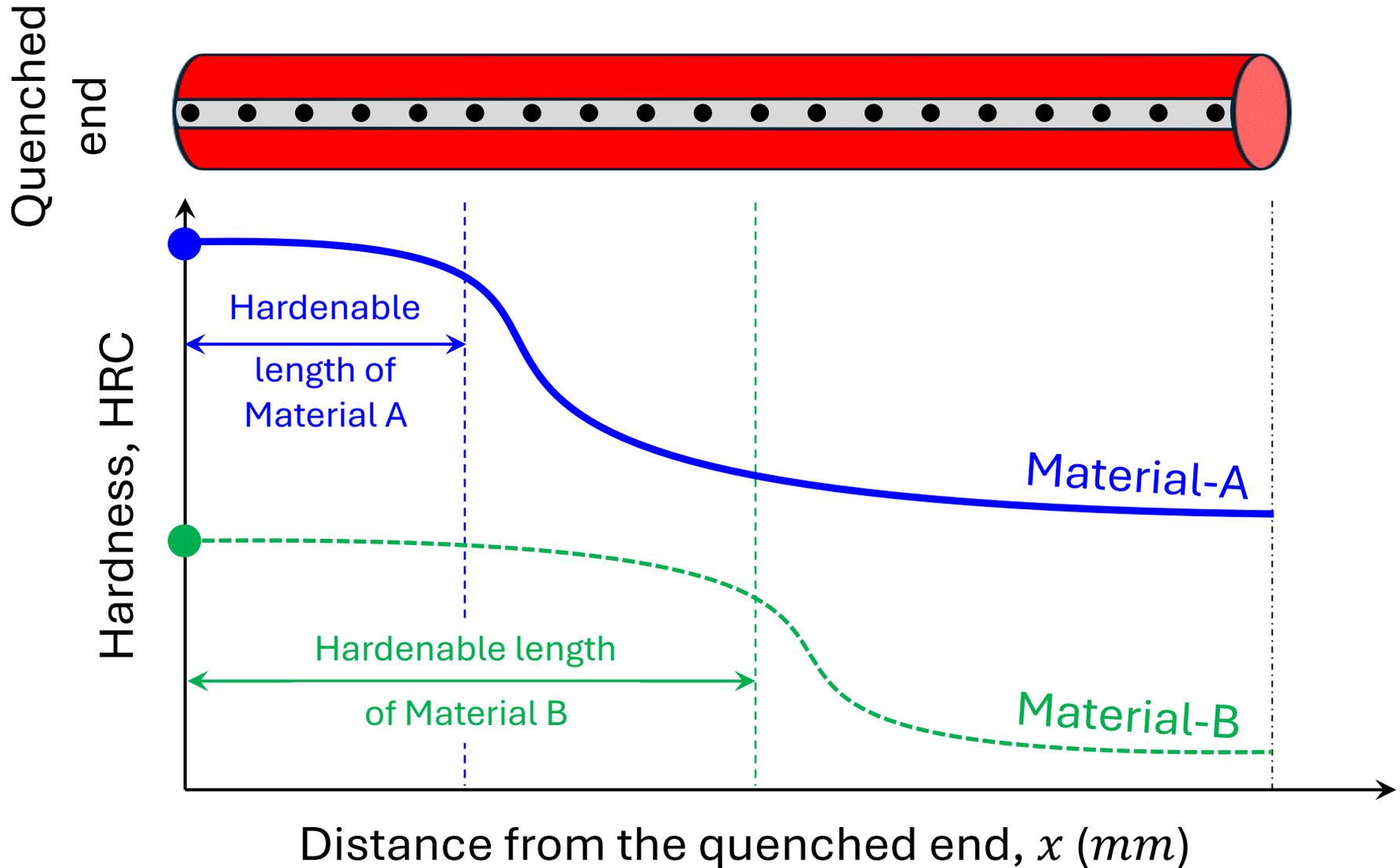
**Grainger College
of Engineering**

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Jominy end-quench test



Hardness Vs hardenability



Hardness Vs hardenability

- Hardness – resistance to local plastic deformation
- Hardenability – ability to be hardened (form martensite)

Thinking:

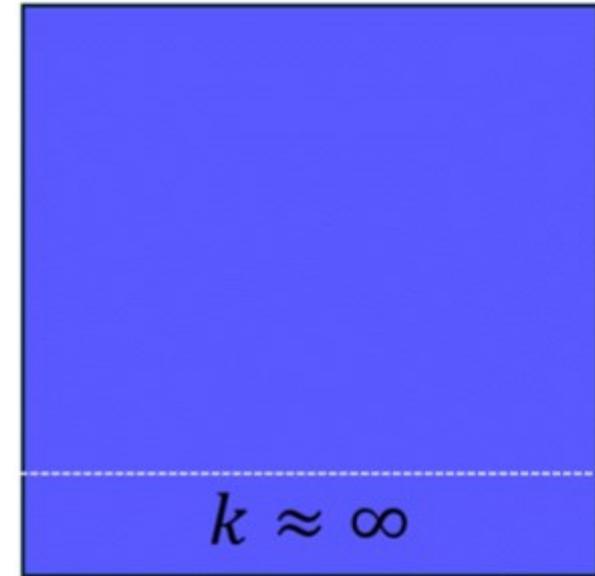
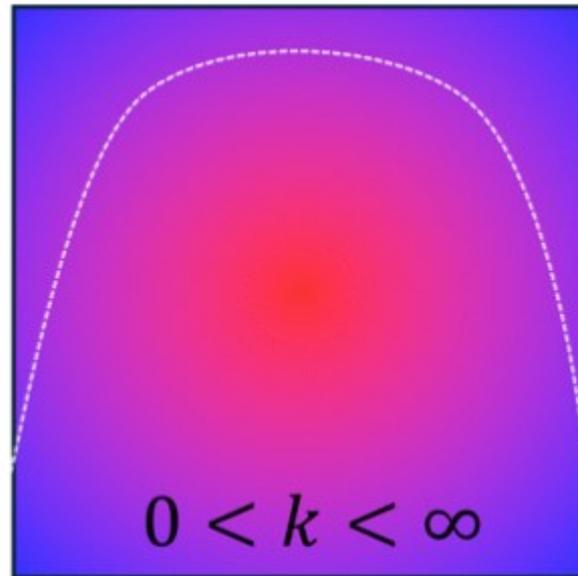
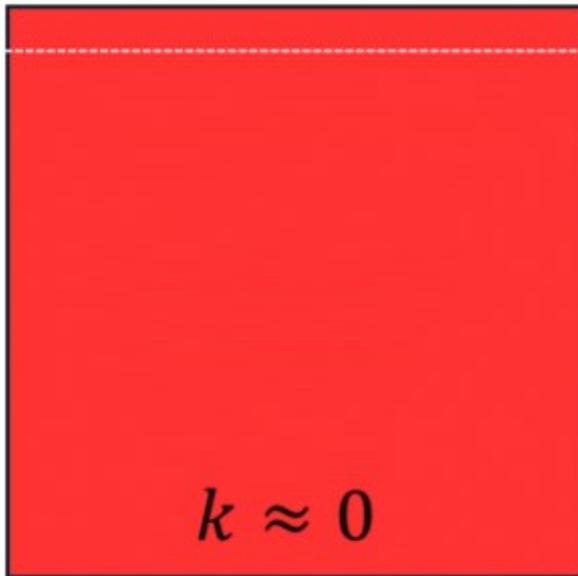
Why are buildings (any construction of steel) considered unsafe after a “fire-accident”?

Even after the fire has been extinguished.

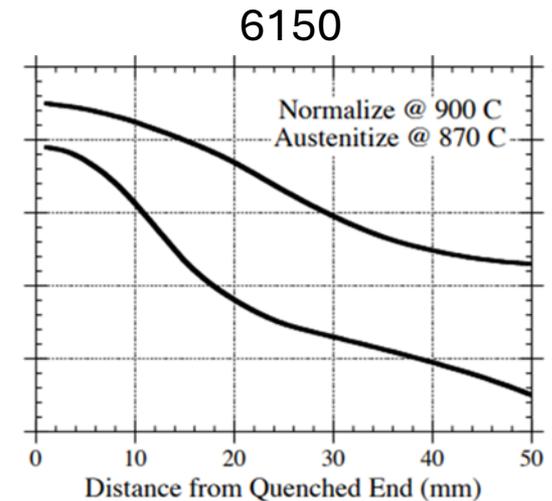
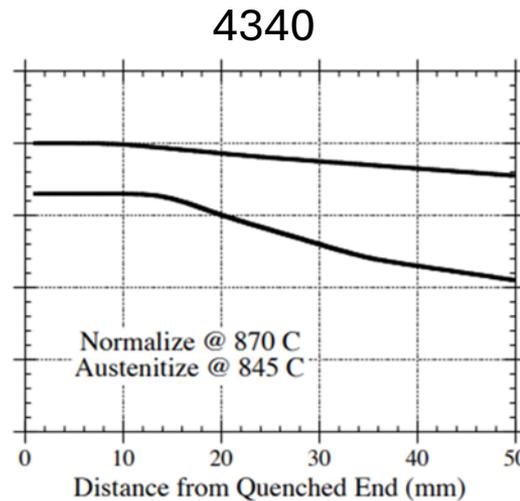
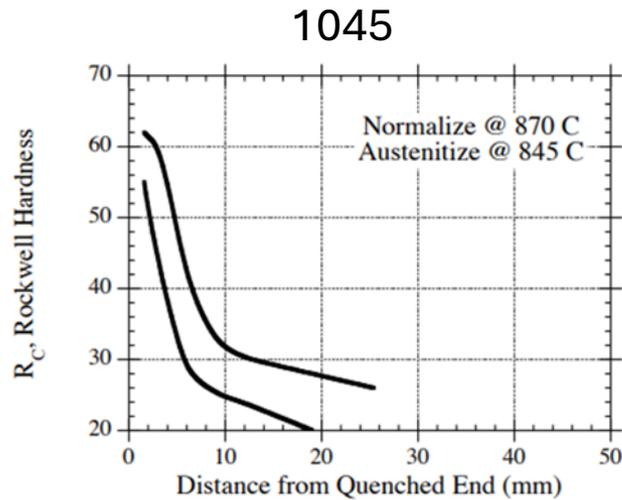
Thinking:

If a material has “zero” thermal conductivity, is it possible to form martensite at the center?

If a material has “infinite” thermal conductivity, what happens at the center of the sample during colling?



Effect of thermal conductivity



$$k \approx 52 \frac{J/s}{mK}$$

$$D \approx 14 \frac{mm^2}{s}$$

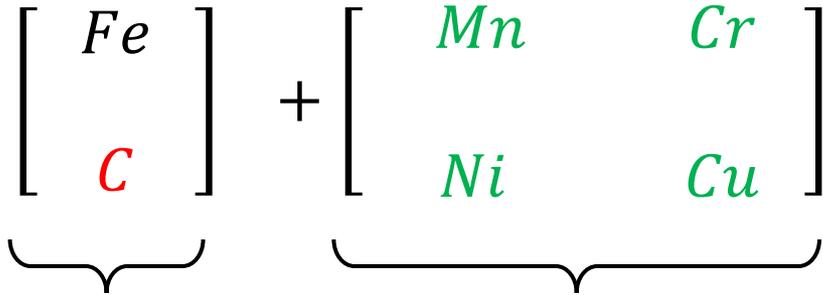
$$k \approx 45 \frac{J/s}{mK}$$

$$D \approx 12 \frac{mm^2}{s}$$

$$k \approx 47 \frac{J/s}{mK}$$

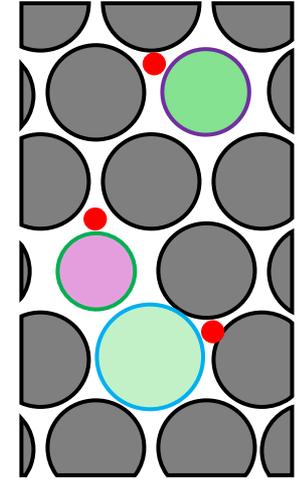
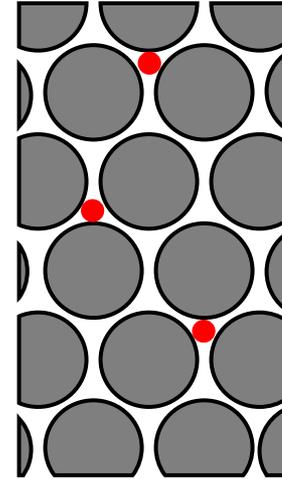
$$D \approx 13 \frac{mm^2}{s}$$

Effect of Alloying elements



Plain carbon steel

Alloying elements



1 H Hydrogen 1,008																	2 He Helium 4,003
3 Li Lithium 6,941	4 Be Beryllium 9,012											5 B Boron 10,811	6 C Carbon 12,011	7 N Nitrogen 14,007	8 O Oxygen 15,999	9 F Fluorine 18,998	10 Ne Neon 20,180
11 Na Sodium 22,990	12 Mg Magnesium 24,305											13 Al Aluminum 26,982	14 Si Silicon 28,086	15 P Phosphorus 30,974	16 S Sulfur 32,065	17 Cl Chlorine 35,453	18 Ar Argon 39,948
19 K Potassium 39,098	20 Ca Calcium 40,078	21 Sc Scandium 44,956	22 Ti Titanium 47,867	23 V Vanadium 50,942	24 Cr Chromium 51,996	25 Mn Manganese 54,938	26 Fe Iron 55,845	27 Co Cobalt 58,933	28 Ni Nickel 58,693	29 Cu Copper 63,546	30 Zn Zinc 65,390	31 Ga Gallium 69,723	32 Ge Germanium 72,640	33 As Arsenic 74,922	34 Se Selenium 78,960	35 Br Bromine 79,904	36 Kr Krypton 83,800
37 Rb Rubidium 85,468	38 Sr Strontium 87,620	39 Y Yttrium 88,906	40 Zr Zirconium 91,224	41 Nb Niobium 92,906	42 Mo Molybdenum 94,938	43 Tc Technetium 98,000	44 Ru Ruthenium 101,070	45 Rh Rhodium 102,906	46 Pd Palladium 106,420	47 Ag Silver 107,868	48 Cd Cadmium 112,411	49 In Indium 114,818	50 Sn Tin 118,710	51 Sb Antimony 121,760	52 Te Tellurium 127,600	53 I Iodine 126,905	54 Xe Xenon 131,293

