



UNIVERSITY OF
ILLINOIS
URBANA - CHAMPAIGN

ME 330: Engineering Materials

Lab - 8

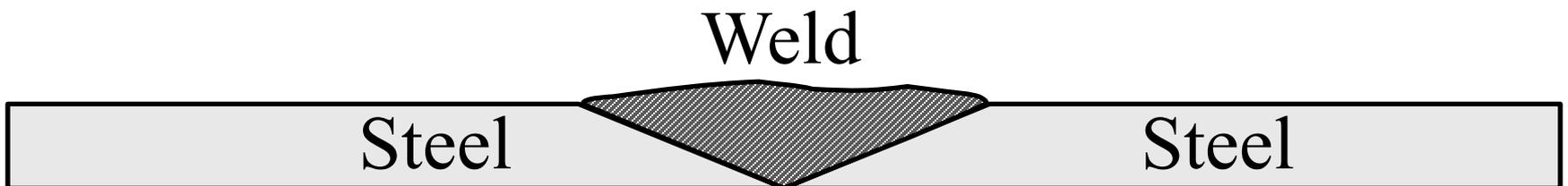
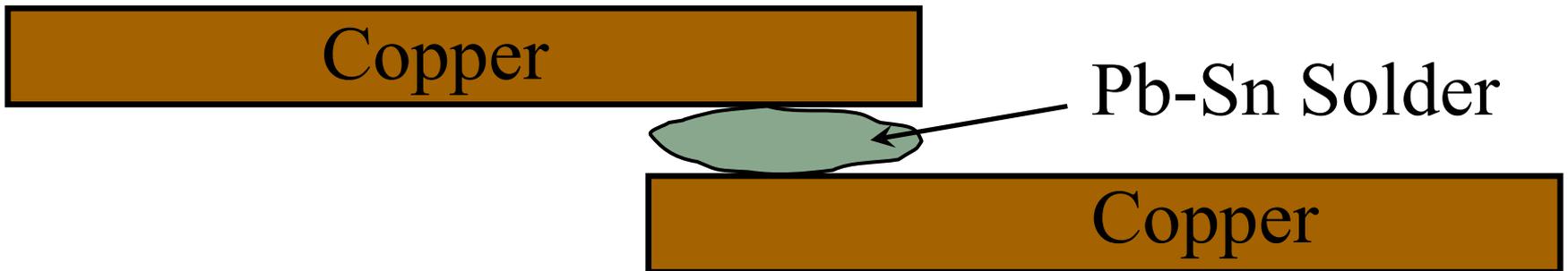
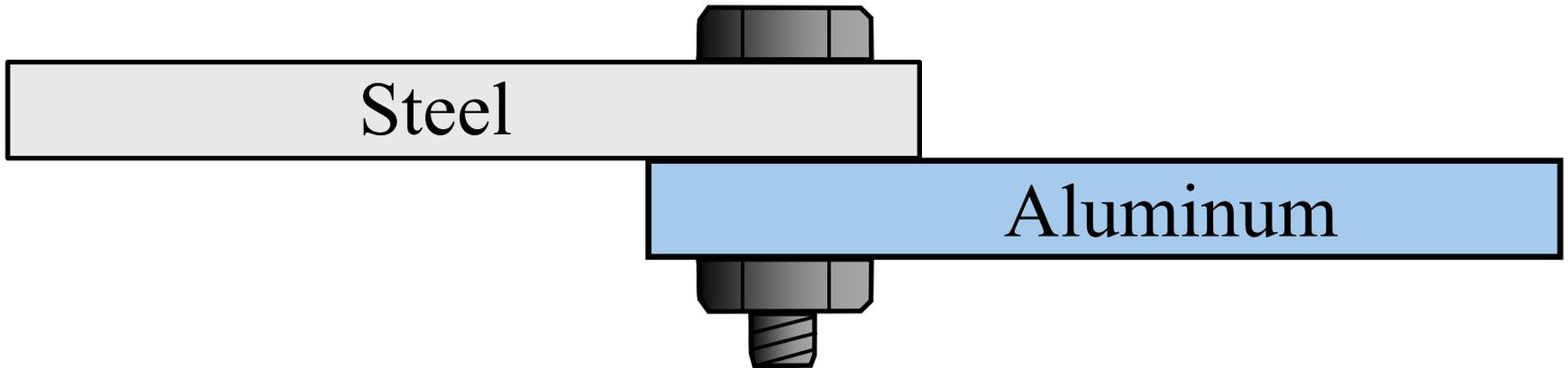
Welding and Allied Processes



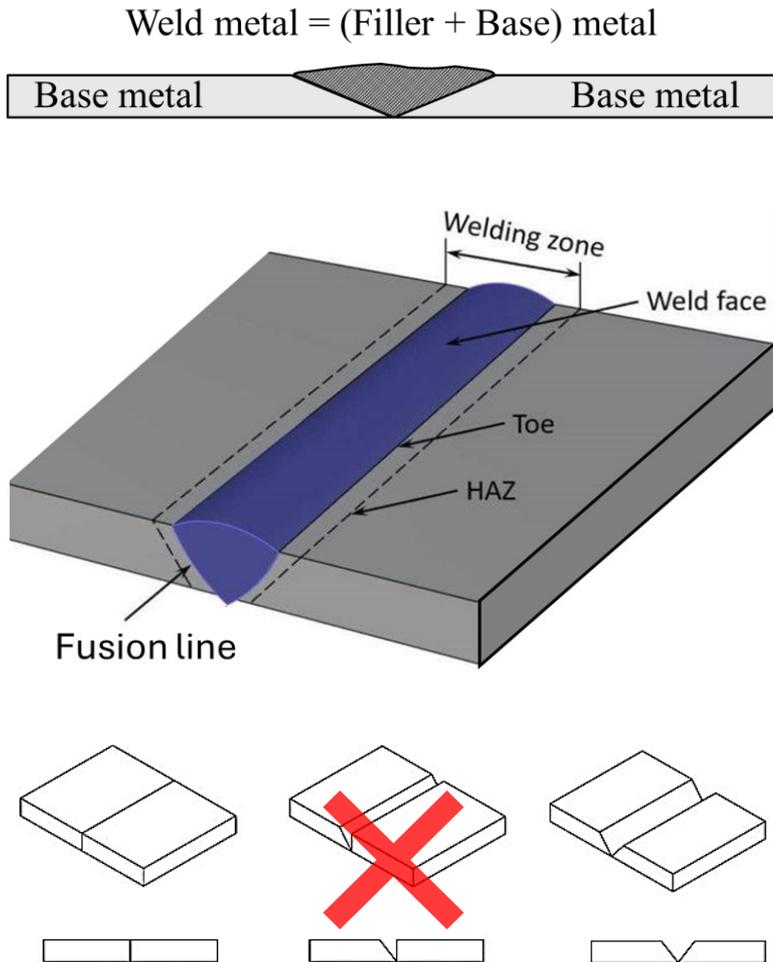
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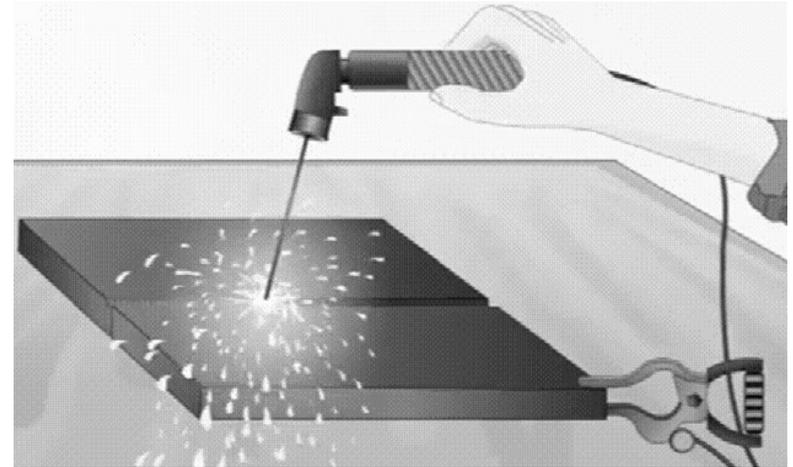
Metal Joining Processes



Chamfering



Power setting

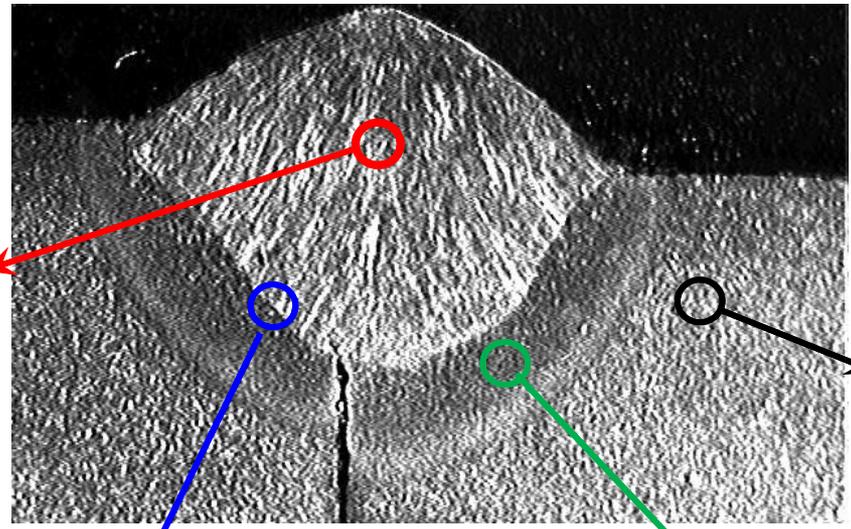


Right power

Low power

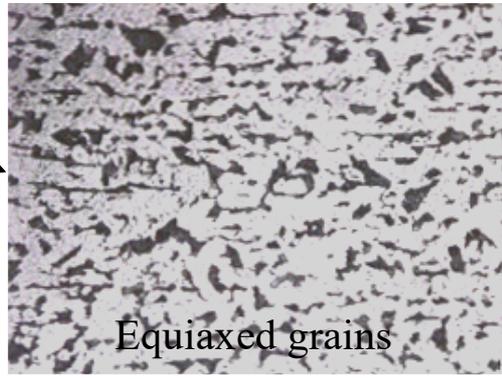
High power

Weld Microstructure



Weld Metal
Fusion Zone

Base Metal



Columnar grains

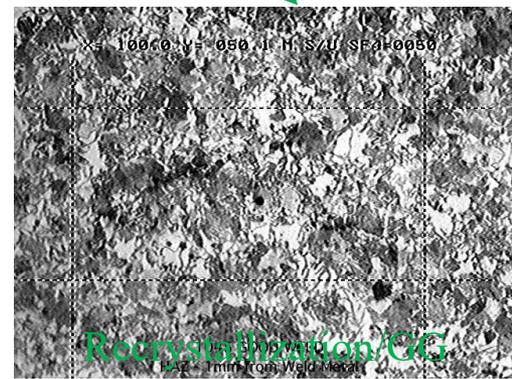
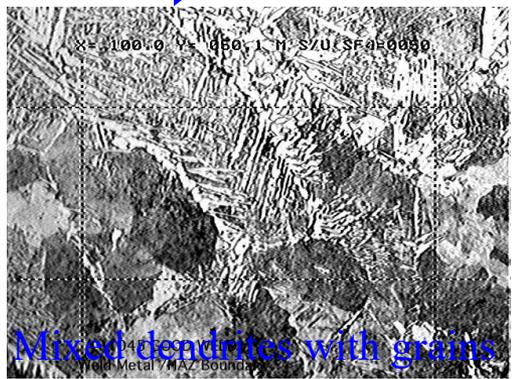
Equiaxed grains

Lab-4: Solidification and Casting

Lab-1/2: Tension/compression Hardness

Fusion Line

HAZ



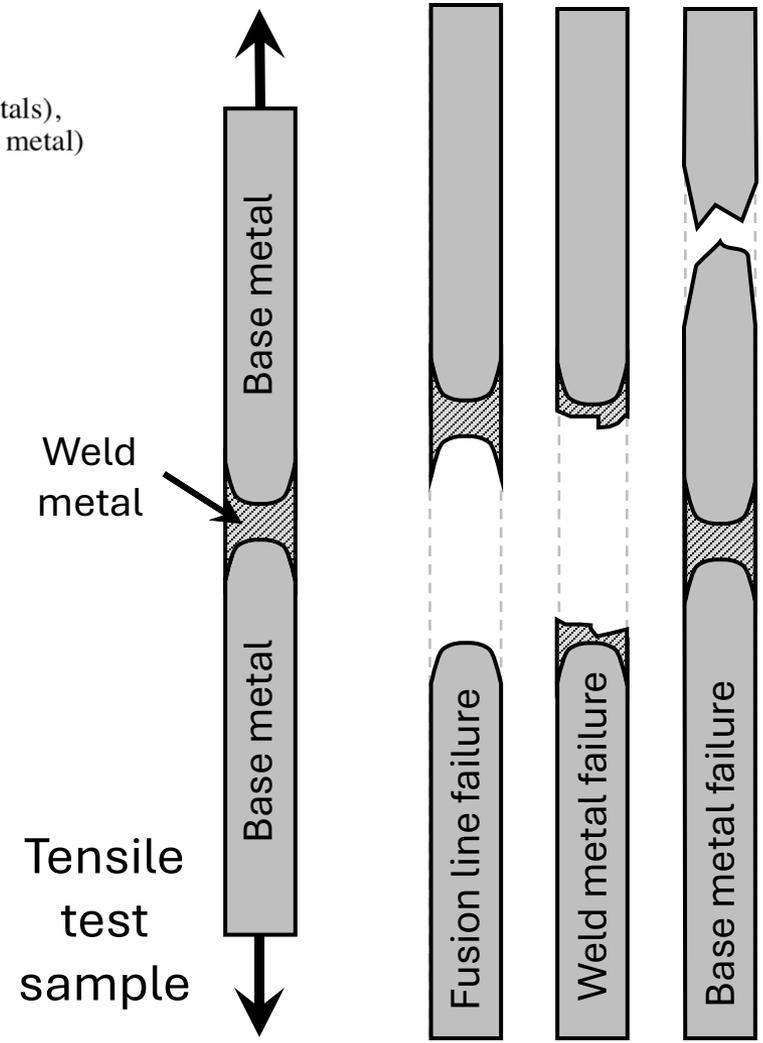
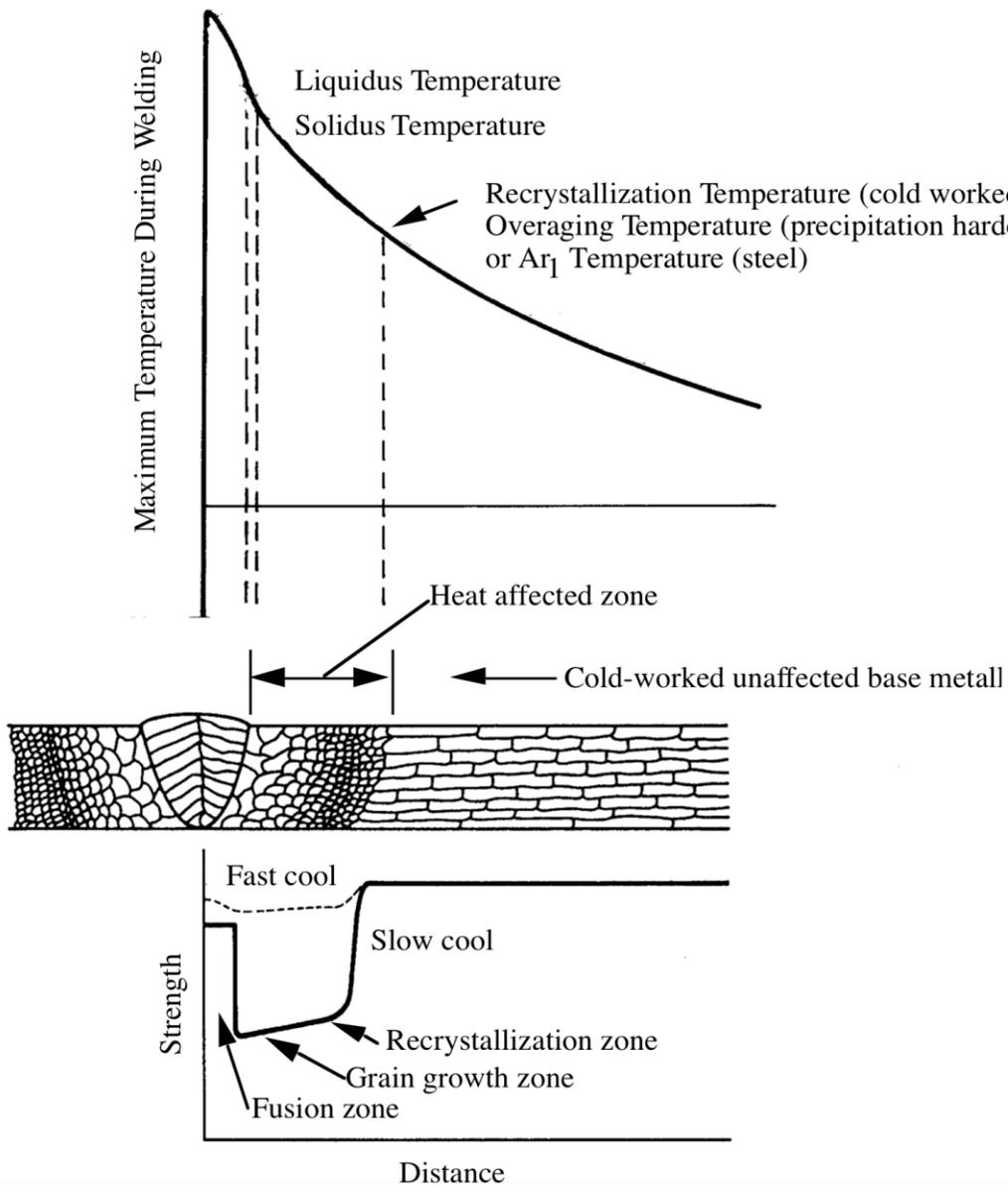
Mixed dendrites with grains

Recrystallization/CIG

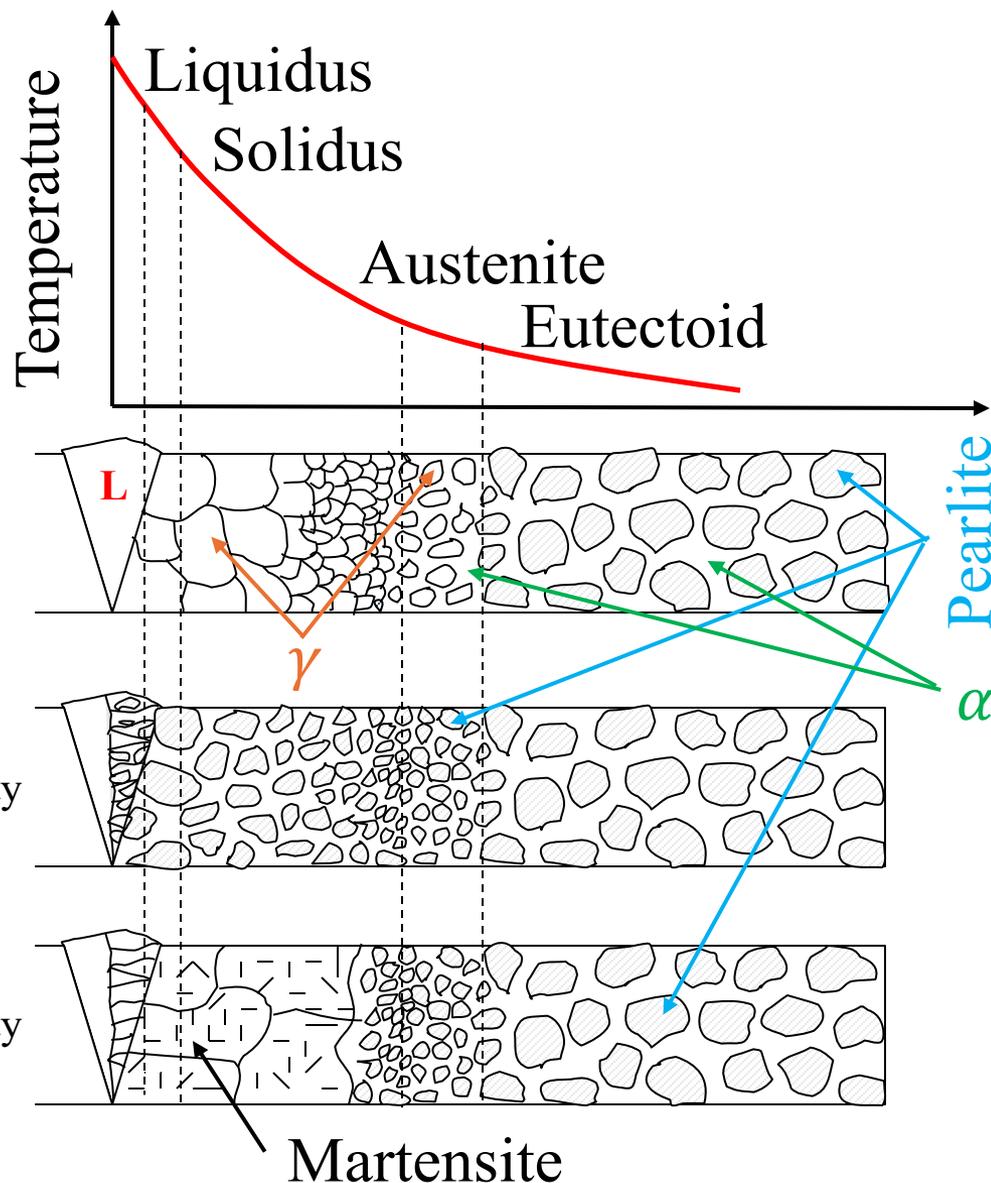
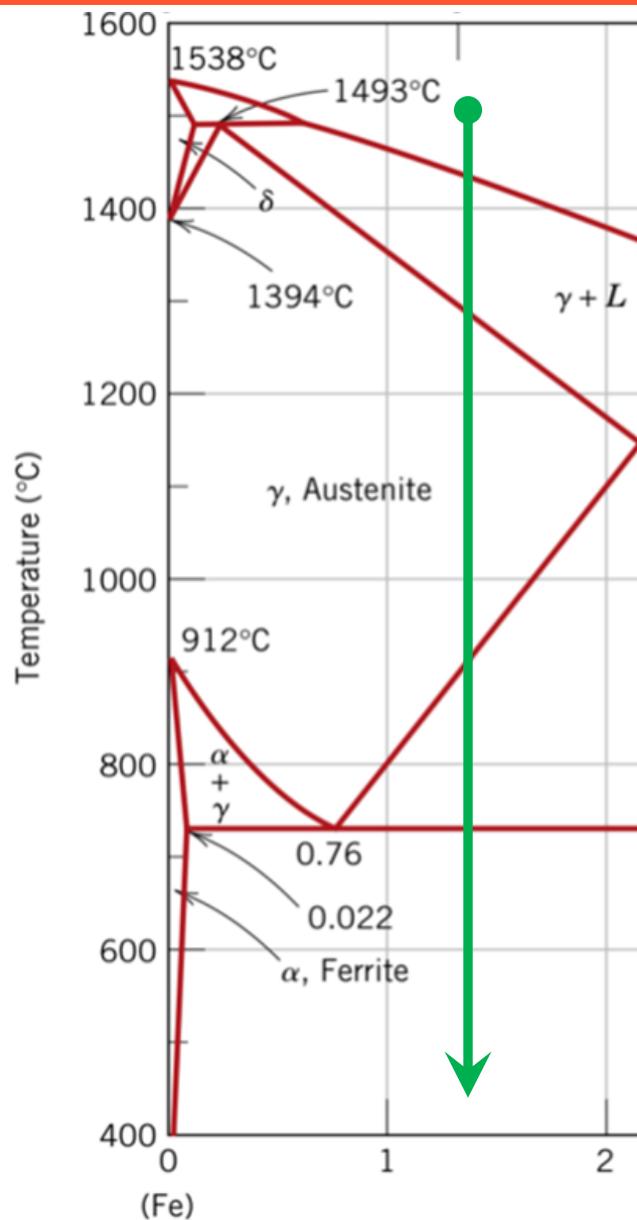
New in Lab-8

Lab-5/6: heat treatment/hardenability

Property of Weld Material



Evolution of Weld Microstructure

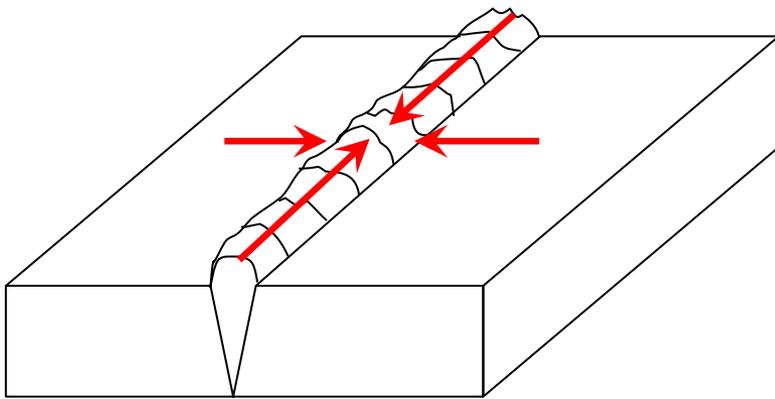


Weldability

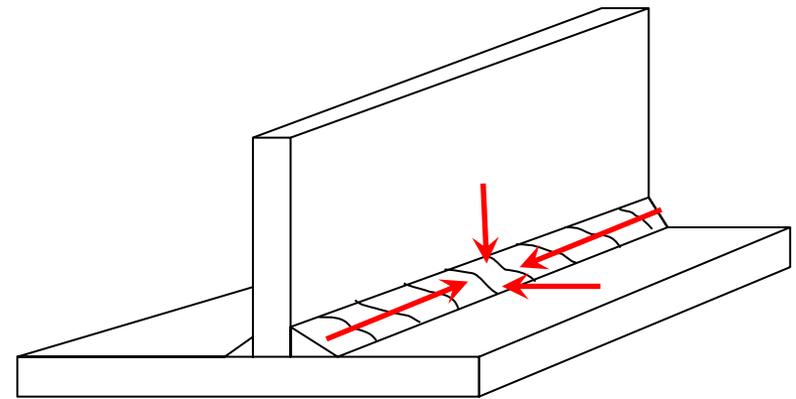
- **Weldability:** Ability of a particular alloy to be welded without substantial embrittlement due to martensite formation
 - Generally, the **opposite of hardenability**
 - Of particular concern for high strength steels!
 - High strength steels are heavily alloyed, shifting TTT curves
 - Some alloys, under severe thermal cycling, will recrystallize, grow grains, and even age in heat-affected zone

- Concept of **effective carbon content:**
 - Higher carbon content \Rightarrow harder to weld
 - Carbon equivalent = $\%C + \frac{\%Mn}{6} + \frac{\%Ni}{15} + \frac{\%Cr}{5} + \frac{\%Mo}{4} + \frac{\%V}{5}$

- Huge thermal cycling in welding leads to shrinkage and residual stress.
- In nearly all cases, weld metal and HAZ end up under residual tension



Shrinkage in a butt weld



Shrinkage in a fillet weld

