

IME 100 - BRAZING AND SOLDERING

BASIC CLASS NOTES

NOVEMBER 18, 2015

Reading Review and Class Preparation

This should be filled out prior to class.

Key Concepts to Be Discussed in Class:

Questions About Subject Matter for Class Session:

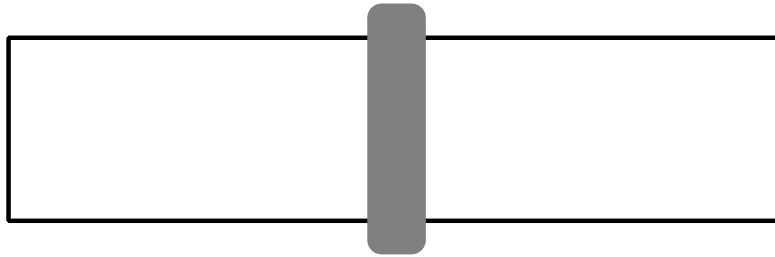
So What? Why? Who Cares?

- Quite often Making Something Requires Joining the Pieces Together
- Techniques other Than Mechanical Fastening are Often Used

- A Problem Correctly Stated is a Problem Half Solved
 - Charles Kettering
 -

Definition of Brazing

- Joint forms Without Melting Base Materials



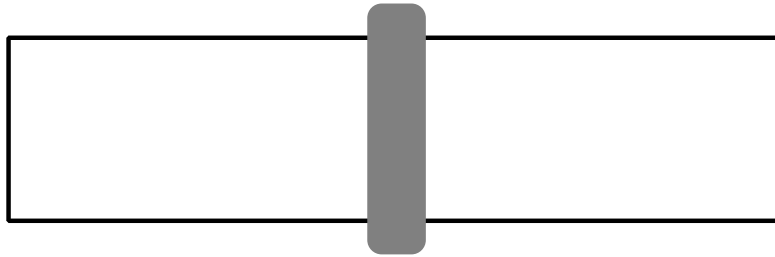
Ref: Brazing Handbook;AWS (1991)

- Filler Metal Must Wet the Base Metal Surfaces and Be Drawn into Joint by Capillary Action

- The Lowest Temperature that the Filler Metal is Completely Liquid Must Be at Least 450°C

Definition of Soldering

- Joint forms Without Melting Base Materials



Ref: Brazing Handbook;AWS (1991)

- Filler Metal Must Wet the Base Metal Surfaces and Be Drawn into Joint by Capillary Action

- The Lowest Temperature that the Filler Metal is Completely Liquid Must Be Less Than 450°C

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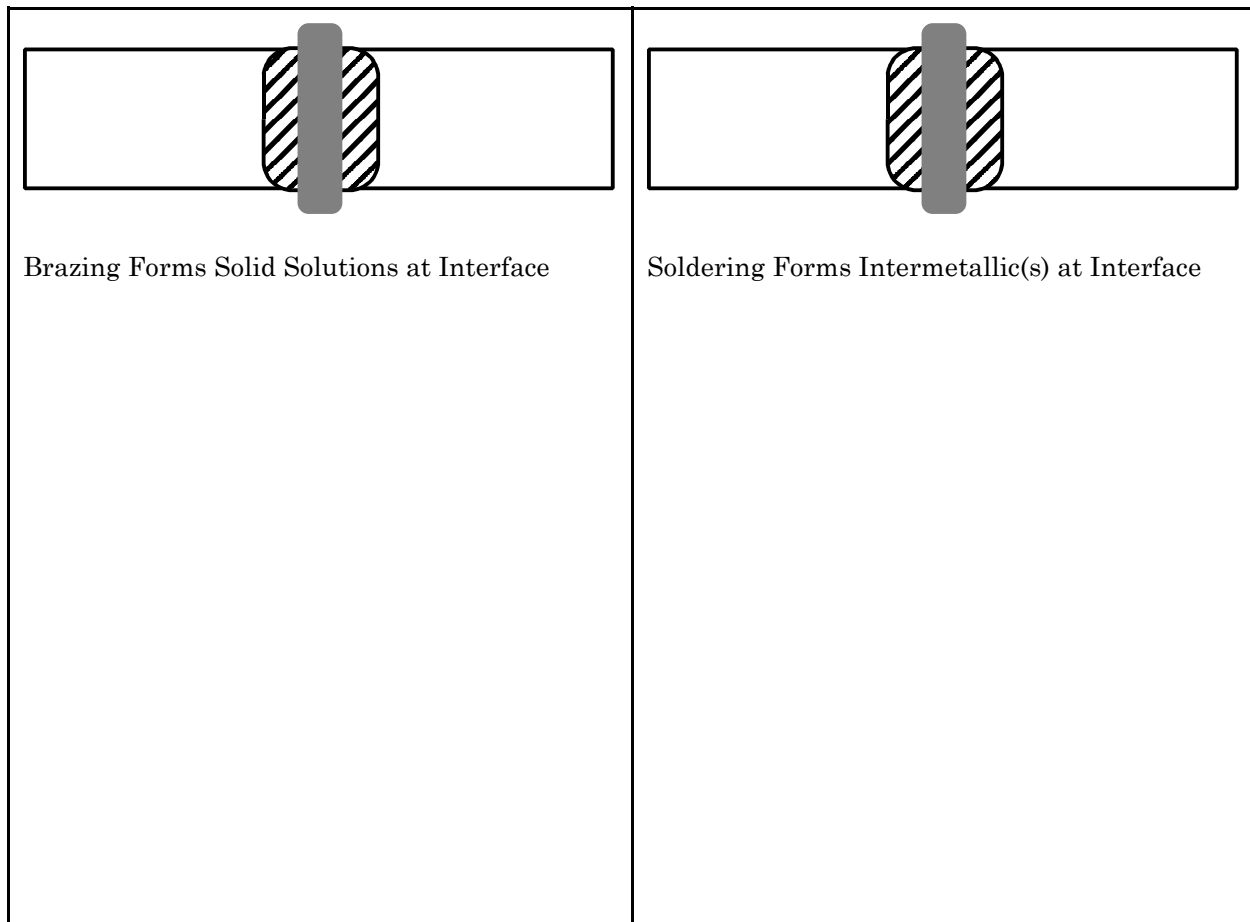
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Temperature 450°C

- Historical
 - Based on Joining of Steel
 - Brazes Based on Cu-Zn Alloys of Brasses
 - Solders Based on Sn Based Alloys

- Practical
 - Lowest T Braze Al-4Cu-10Si ($T_M = 524^\circ\text{C}$)
 - Highest T Solder Au-3Si ($T_M = 363^\circ\text{C}$)

- Scientific



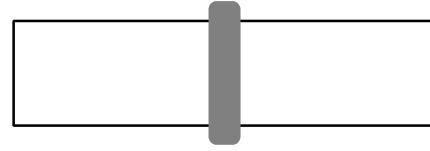
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Fluxes in Brazing

- Filler Metal Must Wet the Base Metal Surfaces and Be Drawn into Joint by Capillary Action



Ref: Brazing Handbook:AWS (1991)

- Oxide Formation Must Be Prevented

- You Will Need to Add Flux When Brazing

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Brazing or Welding?

- Two Pieces of 1040 Steel
 - Joined With Copper Filler Metal

- 1040 Steel has a Higher Melting Temperature than Copper
- Copper has a Higher Melting Temperature than 70-30 Brass

- Two Pieces of Copper
 - Joined With Copper Filler Metal

- Two Pieces of Copper
 - Joined With 70-30 Brass Filler Metal

- A Piece of Copper and a Piece of 1040 Steel
 - Joined With Copper Filler Metal

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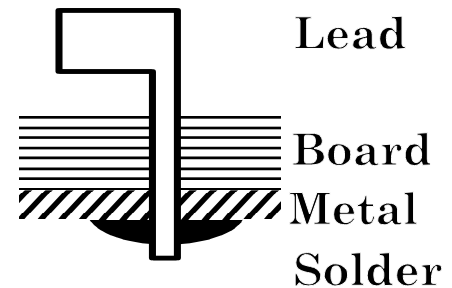
Sample Solder Alloys

- Mostly Tin (Sn) Based
- Historical Workhorse Lead(Pb)-Tin(Sn)

Solder	Tm (C)	Shear Strength (MPa)	Ductility %
Sn-Pb	183	28	1.3
Sn-Ag	221	30	0.69
Sn-Bi	138	24	1.3
95-5	280	30	18.3

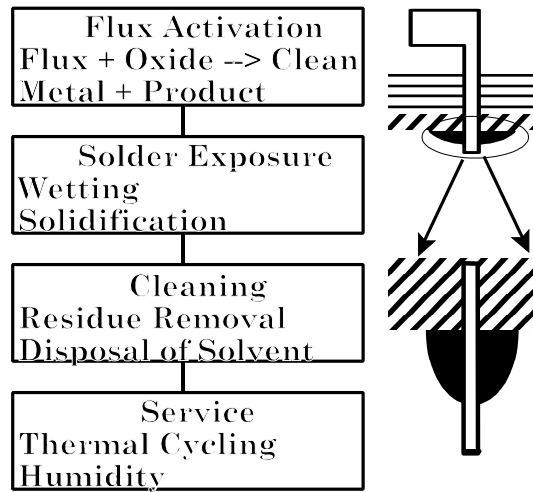
Importance of Solder Joints

- Provides Electrical Contact
 - Requires Metallurgical Bond
 - Strength / Fatigue Resistance Required
- Critical for Electronic Performance
 - Unglorified Part of Semiconductor Revolution
 - “For Want of a Nail ... A Kingdom was Lost”



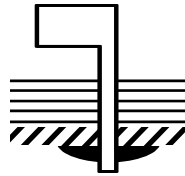
Production of Solder Joints

- Form Contact Between Lead and Metal
 - Remove any Oxide or Impurity
 - Cause Molten Solder to Wet Metal
 - Solidify Solder
 - Remove any Residue

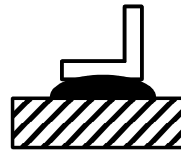


Miniaturization of Joints

- Increasing Amount of SMT
- Paste
 - Combination of Alloy Powder and Flux
 - Identified Based On Through-Hole Experience



Through-Hole Assembly



Surface Mount Assembly

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Polymer Joining and Adhesive Bonding