



# Seminar Contents

1. Industries driving demand for heat exchanger (HX)
2. Trends in those industries – Market/OEM “hot buttons”
3. HX function defined
4. Variables which impact HX function
5. Metallurgical basics which control the variables
6. Design for Manufacturability / Ease of Fabrication
7. Cost Reduction opportunities
8. Diversity of Small Tube Products



# Copper Metallurgical Basics

- **Physical Properties**
- **Mechanical Properties**
- **Corrosion Resistance**
- **Ease of Fabrication**
- **Cost Reduction opportunities**

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	Rf	Db	Sg	Bh	Hs	Mt										
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			



# Physical Properties

## Thermal Conductivity

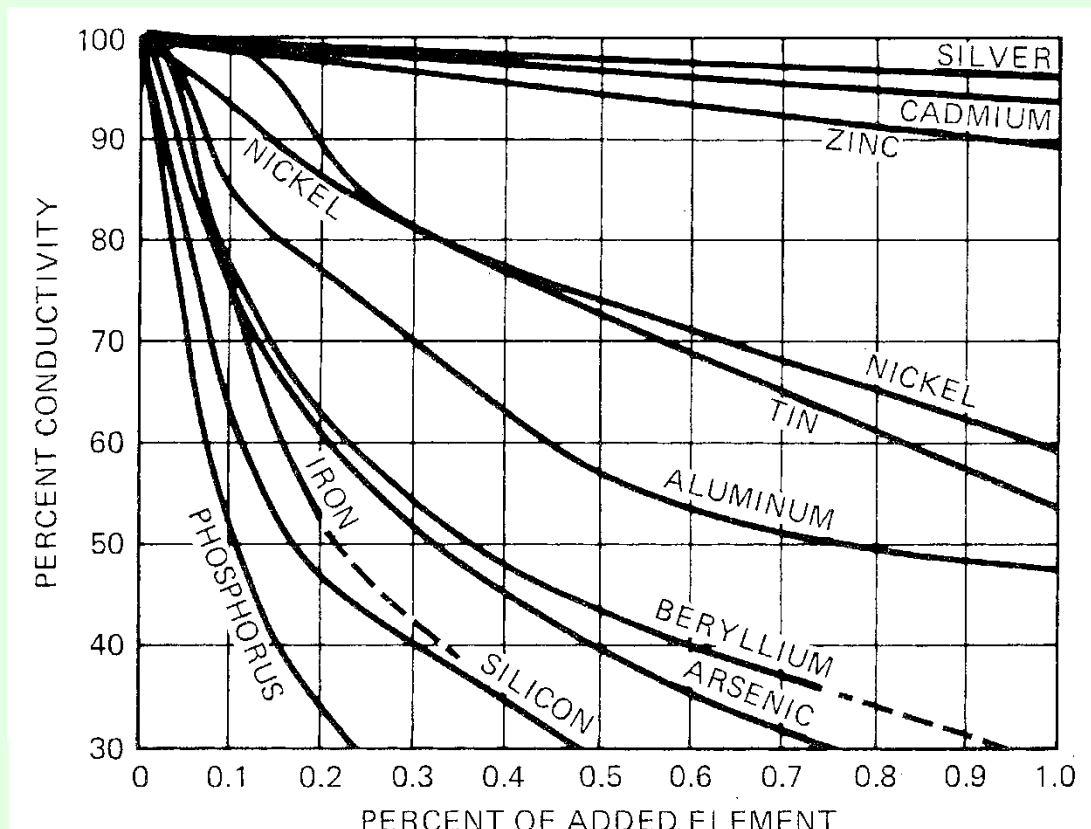
- Influence of chemistry
- Tube wall dimensions
- Relationship to electrical conductivity
- How to optimize



# Physical Properties

## Effect of *Chemistry* on Conductivity

Alloying elements and their impact on conductivity

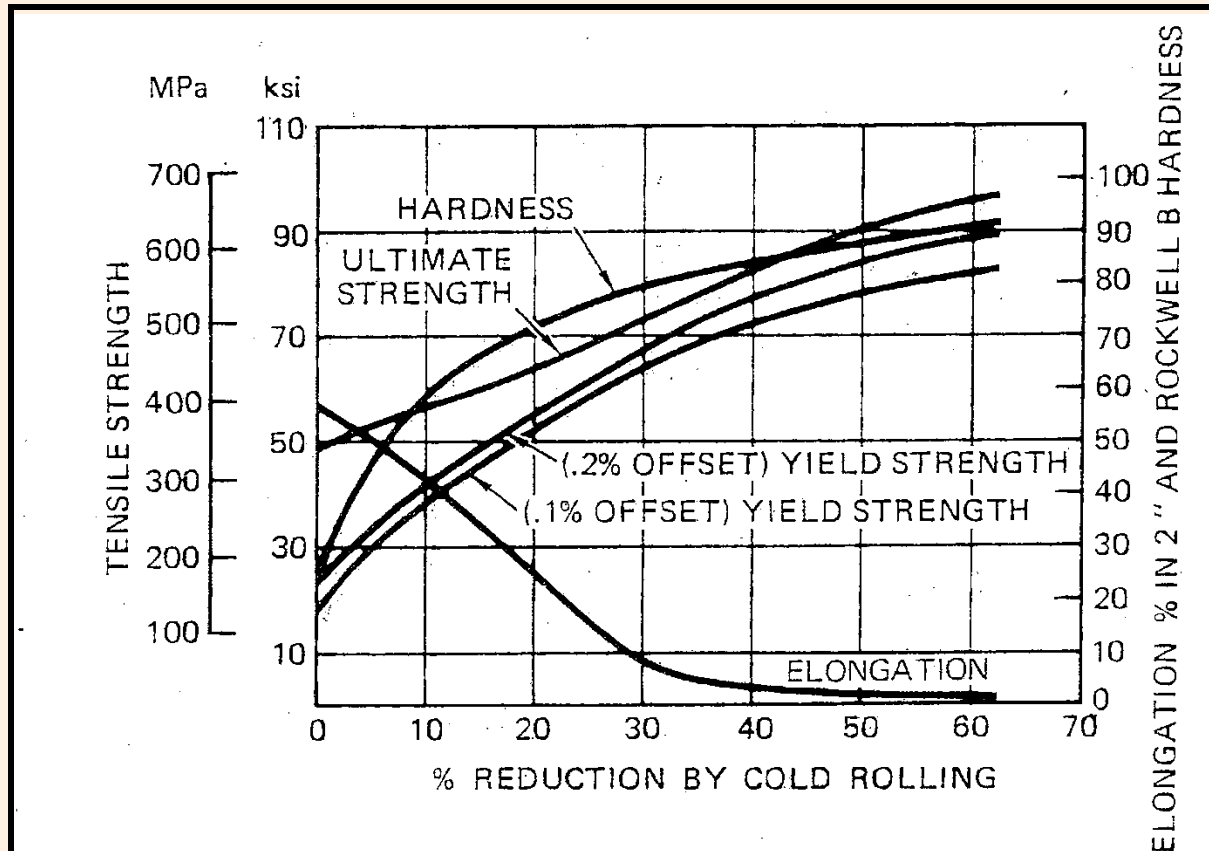




# Mechanical Properties

## Effect of *Cold Work* on properties

Cold working annealed C23000





# Corrosion Resistance

## Galvanic Chart



**ANODIC END (*Most Likely to Corrode*)**

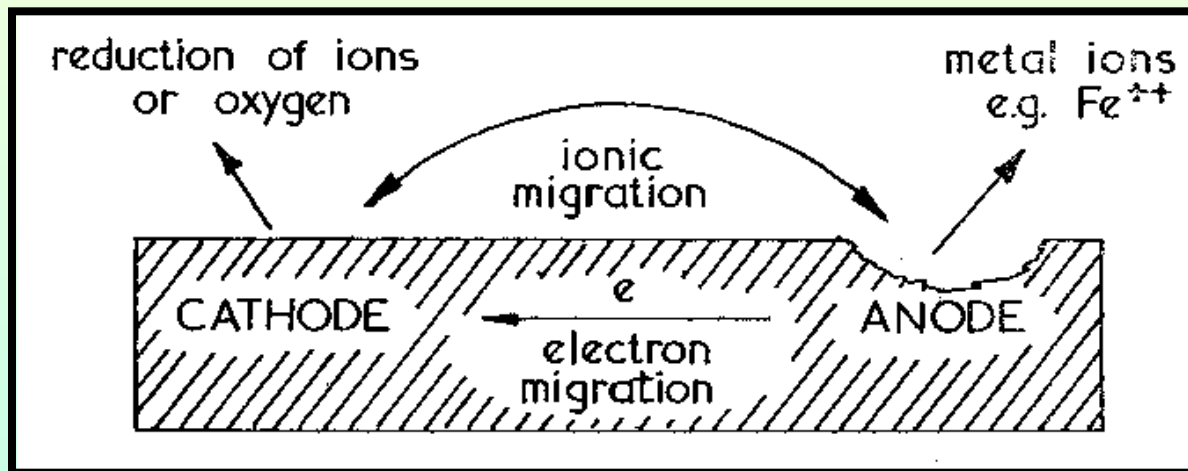
Magnesium and its alloys  
Zinc and zinc plating on steel  
Cadmium  
Aluminum Alloys  
Steel or Cast Iron  
Alloyed Cast Irons  
Type 304 Stainless Steel (active)  
BS 3111 Type 394S17 Stainless Steel (active)  
Type 316 Stainless Steel (active)  
Tin-Lead, Lead and Tin  
Nickel Plating (active)  
**Brasses**  
**Copper**  
**Bronzes**  
**Copper-Nickel Alloy (Monel)**  
Silver Solder  
Nickel Plating (passive)  
Type BS 3111 394S17 Stainless Steel (passive)  
Type 304 Stainless Steel (passive)  
Type 316 Stainless Steel (passive)  
Silver  
Titanium  
Gold and other precious metals

**CATHODE END (*Least Likely to Corrode*)**



# Corrosion Resistance

## *Simple Corrosion Cell*





# Diversity of Small Tube Products

## Precision redraw tube mill

- ✓ Over 70 years of tube manufacturing experience copper and alloy
- ✓ Independent testing available in our ISO 17025 accredited lab
- ✓ Round and Shaped metal tube solutions
- ✓ ISO 9001:2015



### Plant Information:

- 170 employees
- 210,000 sq. ft.
- 3 shifts / 5 day week

