Materials for Advanced Heat Exchangers

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Contents

- Technology development
- What is *Cu*proBraze (CB)?
- Process in brief
- CB vs Al and stainless steel
- Why special materials?
- Introduction to materials

Technology development

I Soldered Copper/Brass

II Brazed Aluminium

III *Cu*proBraze®

+ Stainless steel

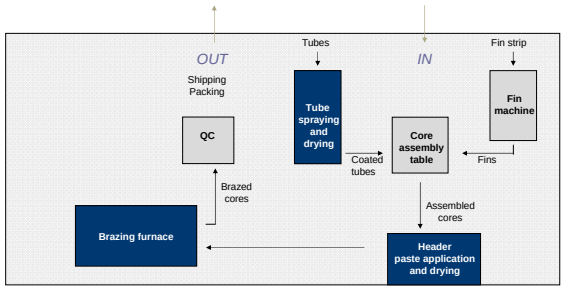
What is *Cu*proBraze?

Copper is an outstanding heat conductor.

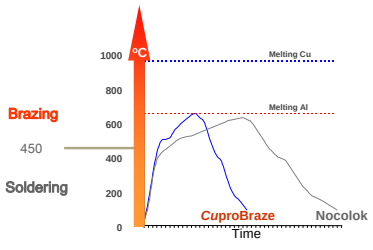
*Cu*proBraze is an industrial process to manufacture heat exchangers.

Durable heat exchangers with an environmentally friendly process.

Plant layout for radiator for core manufacturing



Brazing cycle



Benefits vs. soft soldering

I Soldered Copper/Brass

- ✓ **Stronger cores**
- ✓ **No lead**
- ✓ **Better corrosion resistance**
- ✓ **Cleaner process**
- ✓ **No fluxing stage**
  > No rinsing
  > No waste water treatment
- ✓ **Charge Air Cooler production possible**

III *Cu*proBraze®

Note: Better tolerances on components required!

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Benefits vs. brazed aluminium

II Brazed Aluminium

Materials
- ✓ Conductivity
- ✓ Thermal expansion
- ✓ Antimicrobial
- ✓ Specific heat
- ✓ Strength at elevated temperatures

Field service
- ✓ **Durability**
- ✓ Spring-back
- ✓ Corrosion resistance
- ✓ Repairability
- ✓ Less fan noise and energy

Process
- ✓ Mixed production
- ✓ No fluxing stage
  >No rinsing
  >No water treatment
- ✓ Smaller investment

Environmental
- ✓ Recyclability
- ✓ No waste waters
- ✓ Energy savings

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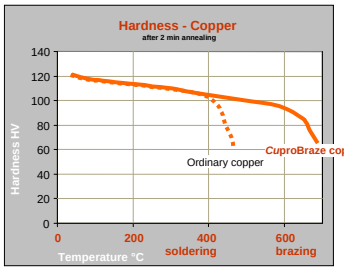
Special materials retain their strength at brazing temperature



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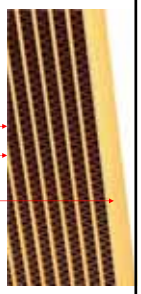
Material compositions (%)

	Cu	Zn	Additional elements	Delivery form
Fins	99.8	-	Cr 0.2	Thin strip
Tubes	85	14	Fe 1	Thin strip
Headers **Side supports** **Tanks**	64	33	Ni 3	Strip, sheet
Joints	74.9 77.2	- -	Ni 4.2, Sn 15.6, P 5.3 Ni 7.0, Sn 9.3, P 6.5	Paste Foil



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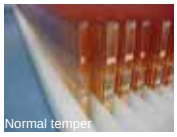
Copper for fins – SM0502

- Copper with 0.2% Cr.
- Precipitation hardening.
- Finely dispersed CuCr particles prevent softening (recrystallization)
- Particle size 2 nm


Normal temper

- Normal temper for corrugated fins and soft temper for turbulators
- Brazing cycle brings up the conductivity


Soft temper

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Brass for tubes – SM2385 (C6640)

- CuZn15 with Fe
  - no dezincification
  - no stress corrosion
- Precipitation hardening
- Finely dispersed Fe particles prevent softening (recrystallisation)
- Particle size 0.2 µm
- Tubes made by HF welding


Radiator tube


CAC tube

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Brass for headers, tanks and side supports – SM 2464 (C74400, CuZn36Ni3)

Excellent formability!

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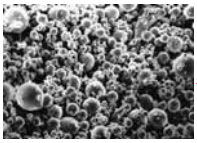
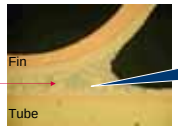
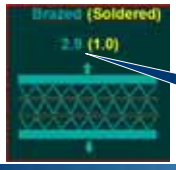
Brazing filler alloy OKC 600 powder



The powder is mixed to paste



As noble as brass > No galvanic corrosion.



About 3 times stronger than soldered joints.

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Material comparison

Property	Unit	Cu fin	Brass tube	Al fin	Al tube	Stainless Steel
Density	g/cm³	8.95	8.53	2.75		7.8 - 8
Thermal conductivity	W/m °C	377	(120)	222	(160)	3 - 24
Tensile strength at room temperature	MPa	330	435	40	145	> 485
Tensile strength at elevated temperature 260°C	MPa	270	290	31	69	> 475
Thermal expansion	µm/m°C	16.5	19.9	23.6		11 - 19
Specific heat	J/kg °K	377		963		500
Melting temperature	°C	1083	915	643		> 1400
Safety margin in brazing operation against core melting	°C	300		30		350

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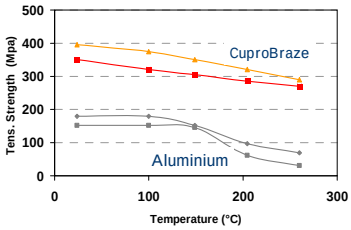
Strength at elevated temperatures



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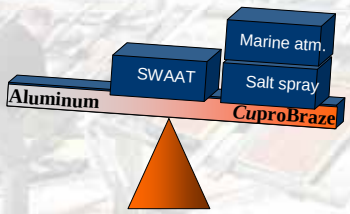
Corrosion testing



Ref: SAE 2001-01-1718

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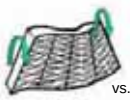
The core has spring-back



2,6 x vs. soft soldered

Al stays in twisted position

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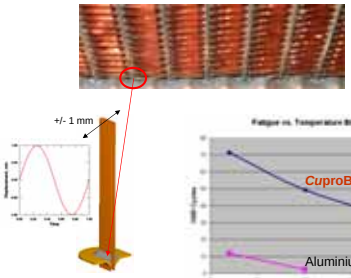
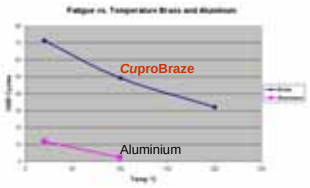
Fatigue resistance of single tube/header joint





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Summary

The new materials

provide a sound basis for building

durable heat exchangers!

More info:
www.cuprobraze.com
www.luvata.com
Luvata's *Cu*proBraze Brazing Handbook
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