ATI Alloys for Brazed Heat Exchangers

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Alloy considerations with sCO_2 heat exchangers

- Temperature capability
  - Strength at temperature
  - Corrosion / oxidation
    - The higher the Cr content the greater the corrosion resistance and oxidation resistance.
- Brazeability
  - Cu braze may have trouble wetting materials with significant Ti and/or Al contents.
- Etching
  - The higher the alloy content, the more difficult forming channels may be.

Alloy capability considerations (ASME SC-I)

Alloy	ASME Max Temperature	ASME Max Stress @T
316L	850 F	12.7 ksi
316 (>0.04% C)	1500 F	1.3 ksi
304L	1200 F	3.2 ksi
304 (>0.04%C)	1500 F	1.4 ksi
347 (>0.04%C)	1500 F	0.80 ksi
347H	1500 F	1.3 ksi
321 (>0.04%C)	1500 F	0.30 ksi
321H	1500 F	1.1 ksi
309S (>0.04%C)	1500 F	0.20 ksi
309H	1500 F	0.75 ksi
310S (>0.04%C)	1500 F	0.20 ksi
310 H	1500 F	0.75 ksi

Alloy capability considerations (ASME SC-I)

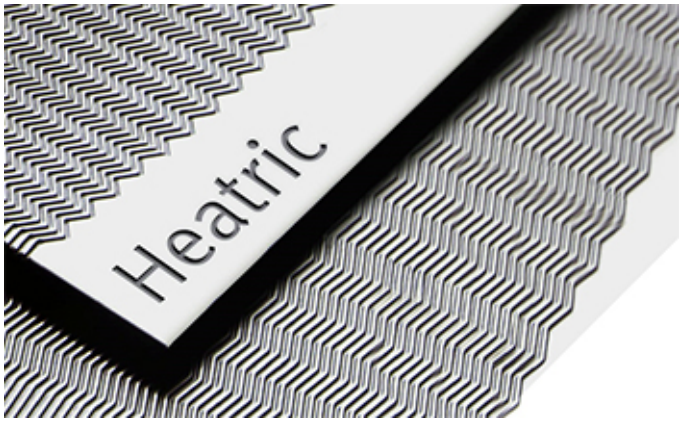
Alloy	ASME Max Temperature	ASME Max Stress @T
N06022	1250 F	7.6 ksi
N06600	1200 F	2.0 ksi
N06601*	1650 F	0.71 ksi
N06617	1650 F (1800 F SC-VIII)	1.8 ksi (SC-I)
N06625*	1100 F (1600 F SC-VIII)	0.80 ksi (SC-I)
N08800	1500 F	1.3 ksi
N08810	1500 F (1650 F SC-VIII)	1.9 ksi (SC-I)
N08811*	1500 F (1650 F SC-VIII)	2.2 ksi (SC-I)
N10276	1000 F (1250 F SC-VIII)	22.3 ksi (SC-I)

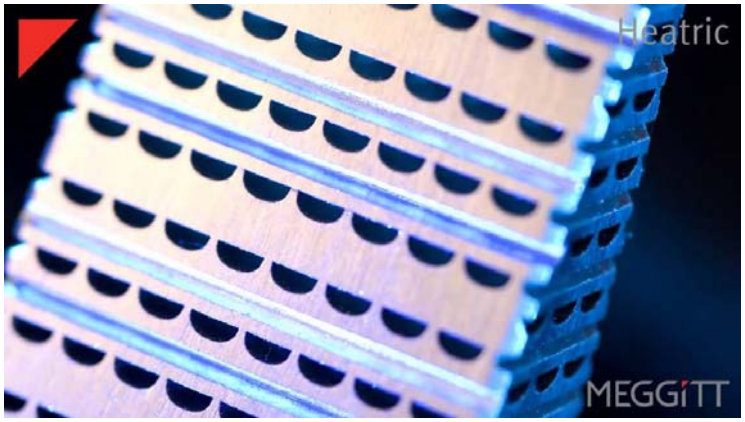
* Brazeability concerns

ATI Alloys not yet in ASME

Alloy	Composition
ATI 20-25+Nb™ Austenitic Stainless Steel UNS S35140	Ni 25% min, Cr 20% min, Mo 1-2%, Nb 0.25-0.75%, Fe balance
ATI 840™ Austenitic Stainless Steel	Ni 18% min, Cr 18% min, Fe balance

Etched, brazed heat exchanger





Add

- ASME welcomes BPV committee volunteers
- Fatigue is often a thermal expansion issue – Solar makes high-CTE material work because they considered CTE at the beginning – Some others have poor fatigue resistance because they don't accommodate TE well.
- However, better fabrication does help fatigue resistance.

Add

- Product form issues: seamless vs. welded.
- Product size issues – there are limits.