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Some comments on drawing operations

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MONTANA AEROSPACE & INDUSTRIAL COMPONENTS

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First trials

Chemical compositions tested :

		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ag	Li	Zr	Sc
2196	P30133	0.03	0.06	2.91	0.27	0.39	-	-	0.02	0.04	0.28	1.87	0.11	-
2395	P30261	0.02	0.05	3.84	0.01	0.38			0.01	0.03	0.285	1.22	0.11	

															others		
		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ag	Li	Zr	Sc	each	total	density
2196	AA	0.12	0.15	2.5 - 3.3	0.35	0.25 - 0.8	-	-	0.35	0.10	0.25 - 0.6	1.4 - 2.1	0.04 - 0.18	-	0.05	0.15	2.63
2395	AA	0.08	0.10	3.6 - 4.3	0.35	0.25 - 0.8	-	-	0.25	0.10	0.1 - 0.45	0.9 - 1.4	0.05 - 0.15	-	0.05	0.15	2.69

Typical mechanical properties for extrusion (source : MMPDS)

			3.2 - 6.3 mm			6.3 - 12.7 mm		
	base	tempers	Rm	R0.2	A%	Rm	R0.2	A%
2196	valeurs A MMPDS	T8511	524	475	6	524	490	7
2395	valeurs A MMPDS	T84	586	537	6	586	544	6

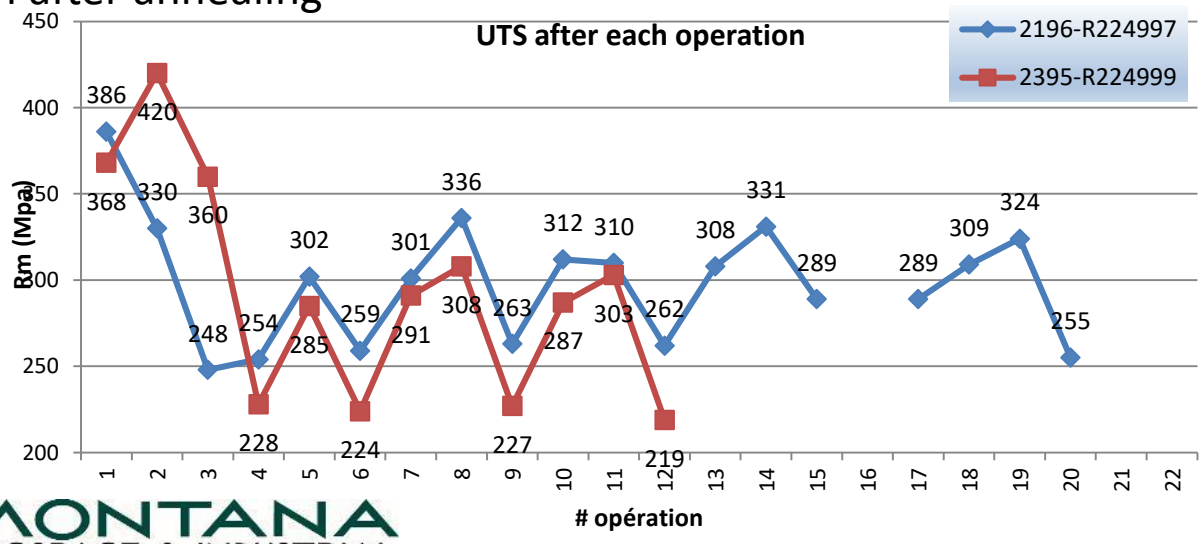
First trials

Issues met during manufacturing :

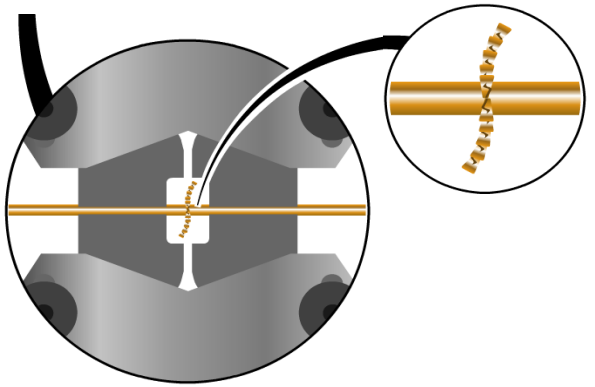
- No issue for extrusion
- Wire drawing
  - Difficult to weld for 2395

  - Hardly Impossible to weld for 2196

- Only small passes allowable between annealing
  - ➔ mechanical properties remain high after annealing
  - ➔ probably too high for 2196



Welding issues



Principe of cold pressure welding

- if two metallic surfaces are brought together with only a few angstroms separation, interaction between the free electrons and ionised atoms can occur. This will eliminate the potential barrier, allowing the electron cloud to become common. This, in turn, results in a bond and therefore a weld.
- the two opposing faces are stretched and enlarged over their entire surface area as they are pushed against each other. The oxide and other surface impurities are forced outward from the core of the material and a bond is effected

Issue with this technique

- this implies that oxide layer can be removed during process
- Li in Al-Li very reactive to oxygen and oxide can not be removed

Welding issues : recommendations

- Another welding technique

- Cold weld under neutral atmosphere (Argon) or at least argon scanning of the heads
  ➔ Not possible at Selectarc

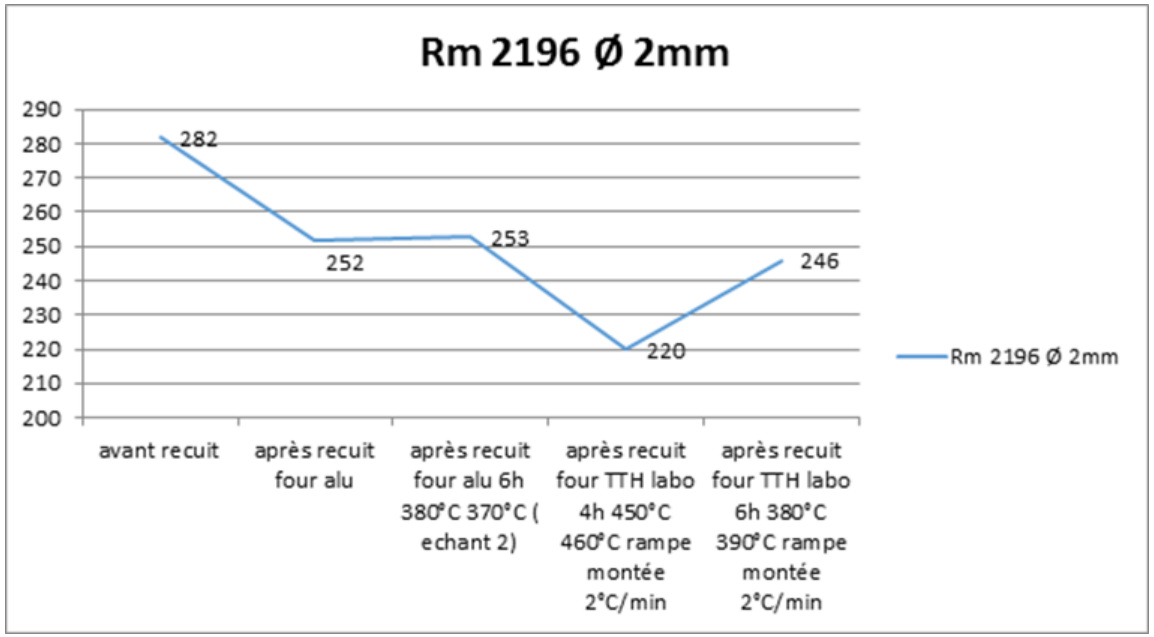
- Lower Li contents ➔ different behavior between 2196 (1.87%) and 2395 (1.22%)
  ➔ no much interest as the density will increase

- Use Selectarc “small” extrusion press : container diameter approx. 55mm
  ✓ If direct extrusion, extruded round bar from billet “n” naturally sticks to bar from bloc “n+1”

Wire drawing issues

- ❑ 2395 has higher mechanical properties at RT but lower after annealing
- ❑ Only small drawing passes

- Wire remains hard even after 380°C annealing : UTS > 250 MPa
  ➔ Push annealing higher / longer : 4h @ 450°C



Shaving issues

- Same principle as cold welding

- So oxide layer can not be removed due to permanent oxidation of Li
  ➔ Shave under neutral atmosphere (Argon) or Ar scanning

- Other option :
  - ✓ no mechanical shaving
  - ✓ Use chemical etching to remove excessive oxyde layer

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