Case Studies

Aluminum Beverage Can

Background

- 300 million cans/day (~5 cans/sec) – 100 billion/year
- Totally replaced steel can (30 billion in 1973)
- Can weight 13.6g (0.48 oz) down from 18.7 g (0.66oz) in 1960
- Save 1% wt in can = ~$20 million in Al
- Al used in can required 2.3 MJ energy to produce (=100W bulb lit for 6hrs)
- Cans now 20% Al production: 1/3 beer, 2/3 soft drink
- Walls ~0.003” = 0.075mm (can take 90 psi)
- Steel cans still widely used in South America, Europe and Asia

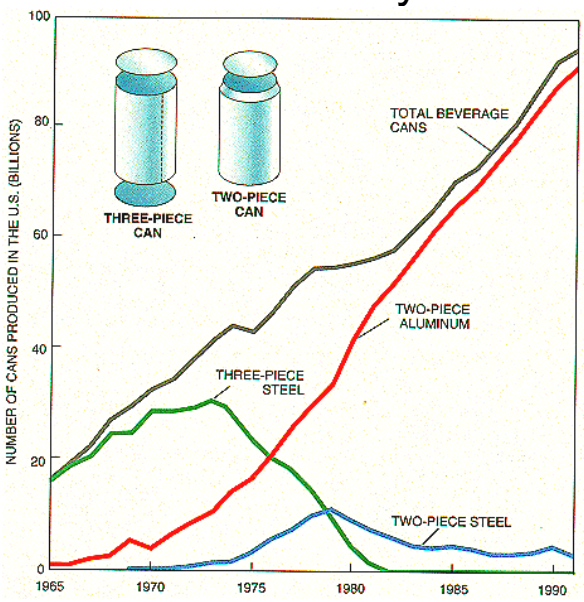
Alloys used in aluminum can

Body:	AA3004 (Al-1.2%Mg-1.0%Mn) →	Formability
Top:	AA5182 (Al-4.5%Mg) →	Strength
Tab:	AA5052 (Al-2.5%Mg) →	Strength

History

1935	1st three piece steel beverage can Kreuger Brewing (Richmond, Va)
1940's	Government shipped quantities of beer in steel cans to servicemen overseas
1958	1st aluminum beverage can Adolph Coors - Golden Colorado
1963	Reynolds metals pioneers modern method to produce Al cans
1996	Al has virtually displaced steel in all beverage cans

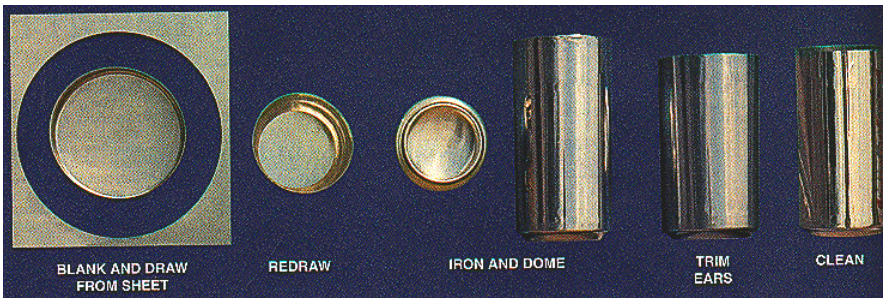
History



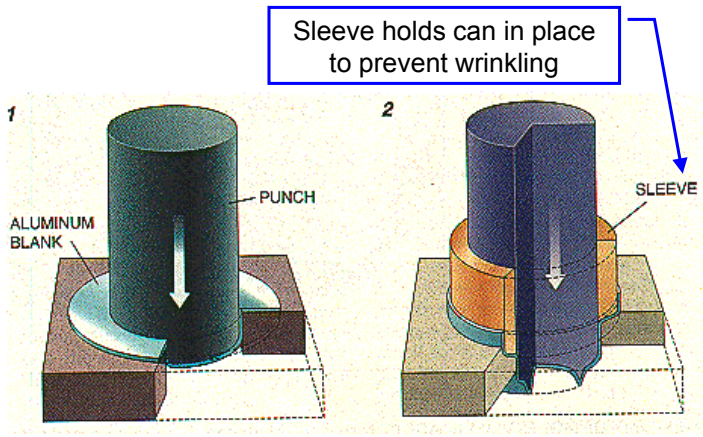
Early advertisement marketing pull-top Al can (~1960's)

Production of aluminum cans

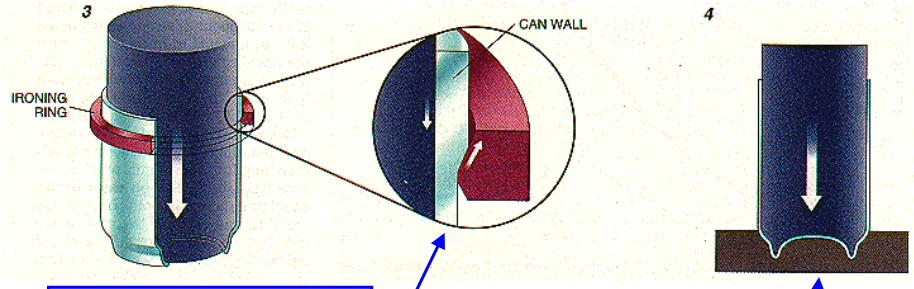
- 2 piece drawing and ironing
  - Starts with sheet in the H19 condition
- Process
  - Cut circular blanks (5.5” dia.)
  - Draw into 3.5” dia. Cup (with punch)
  - Drawing and ironing operation
  - Base formed against metal dome: all in ~0.2 seconds!



Drawing



Ironing



Punch pushes the can past ironing rings, which thin the walls

Bottom is shaped against a metal dome

Labelling

After the “ears” at the top of the walls are trimmed, the can is cleaned, decorated and then “necked” to accommodate the smaller lid. The top is flanged to secure the lid. Once filled and seamed shut, the can is ready for sale.

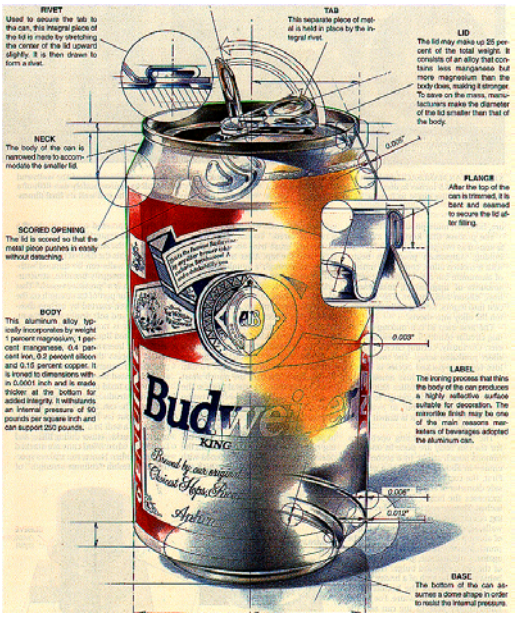
Properties

- Body thickness: 0.3mm ± 0.005 mm
  - (~2 sheets of paper)
- Can weight: 11 grams
- Pressure in can: >620 KPa
  - (~3x Pressure in car tyre)
- Body can support 100 Kg (column strength)

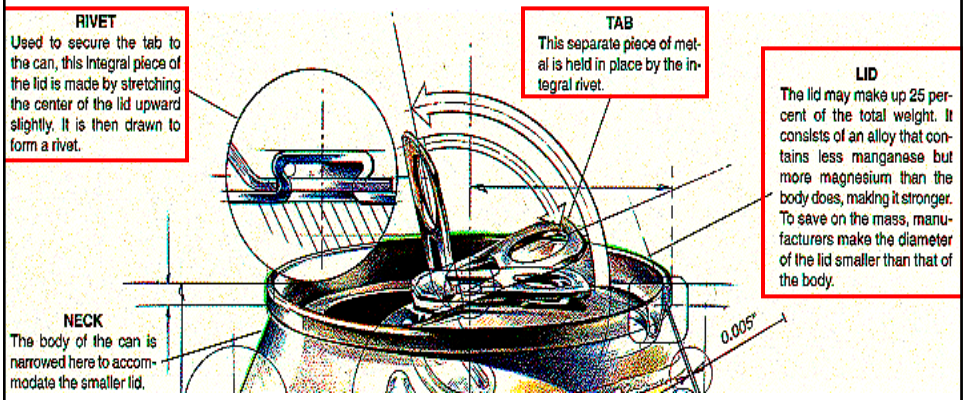
Design considerations

- Lid must be stiffer than the body
  - Thicker and stronger alloy (~25% of the weight)
  - Decrease diameter of lid
- Need strong yet formable sheet alloys
  a) Mn + Mg solid solution hardening: 3104, 3004
  b) Intermetallics Fe+Mn compounds harder than alloy therefore strengthening dispersion hardening → galling
  c) Cold rolling of sheet (strain hardening)
- Base of can must resist internal pressure:
  - Base and bottom sidewalls are made thicker than any other part of the wall
  - Bottom given a dome shape to resist internal pressure

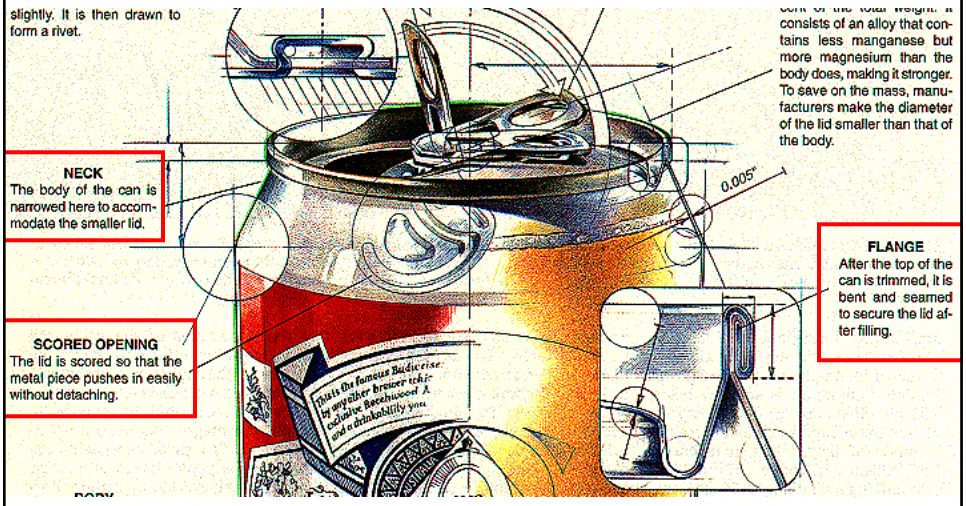
Design consideration



Top



Neck flange and opening



Body, base and label