

Extrusion Process Cheat Sheet

Types, ratio, force, temperature, dies and defects

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
Extrusion ratio	$R = A_{\text{billet}} / A_{\text{die}}$	Post's definition; drives press force
Extrusion force (ideal)	$F = A_o k \ln R$	Textbook form; k = extrusion constant (falls with temperature)
Aluminum hot extrusion	375 to 475 °C (700 to 890 °F)	Most commonly hot extruded metal
Process variables	Melt T, motor load I, melt pressure P	Pressure also depends on die angle, reduction, speed, lubrication
Indirect vs direct	≈ 25 to 30% lower friction	Die moves with the ram; billet stays still in container
Heat sink alloy	6063-T5	Extrudability and finish; 6061-T6 for structural strength
Chevron crack remedy	Smaller die angle or larger reduction	Enlarges the plastic zone

Key takeaways

- Five steps: prepare billet and die, load, extrude, quench, finish (stretch, cut, age-harden).
- Four types: direct, indirect, impact (cans, tubes), hydrostatic (brittle materials, very low friction).
- Metal flow: high friction or a cooling billet skin makes a dead zone and the pipe defect.
- Main defects: surface cracking, chevron (central burst), buckling. Central bursts can stay hidden unless parts are inspected.
- Dies: flat-face for nonferrous, pocket for ferrous, feeder/shaped dies with glass lubricant, as the post describes them.
- Design: avoid sharp corners, keep wall thickness uniform, avoid undercuts.
- The post gives no force equation (its extrusion-constant graph is an image), so the F formula here is the textbook form.