Technical Manual: Industrial Press Tonnage & Material Selection

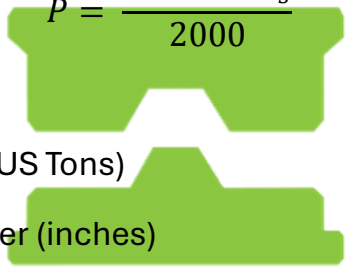
1. Fundamental Tonnage Calculation

Tonnage is the measure of force required to perform a specific mechanical operation on a material. Failure to calculate this accurately leads to "die-slap," premature tool wear, or catastrophic frame deflection.

1.1 The Blanking and Punching Formula

For shearing operations (cutting through material), the force is determined by the shear strength of the metal.

$$P = \frac{L \times t \times S_s}{2000}$$



- **P** = Required Force (US Tons)
- **L** = Total cut perimeter (inches)
- **t** = Material thickness (inches)
- **S_s** = Shear Strength (PSI) — *Usually 80% of Tensile Strength*

1.2 The Deep Drawing Formula

Drawing requires overcoming the material's yield strength while maintaining enough force to pull the metal into the die without tearing.

$$P = \frac{\pi \times L \times t \times S_t}{2000} \times k$$

- **d** = Mean diameter of the part
- S_t = Tensile Strength (PSI)
- **k** = Constant factor (usually 1.2 to 1.4) to account for blank holder/cushion force.

2. Material Selection & Constant Variables

The "PSI" value in your calculations must reflect the specific alloy's resistance. Using a generic "steel" value for high-strength automotive alloys will result in undersized equipment.

Material Group	Avg. Tensile Strength (PSI)	Shearing Constant (Ss)	Characteristics
Aluminum (1100-0)	13,000	10,000	High ductility; low tonnage.
Aluminum (6061-T6)	45,000	30,000	Common in aerospace/automotive.
Low Carbon Steel	55,000	44,000	Standard industrial "Mild Steel."
Stainless Steel (304)	85,000	70,000	High work-hardening; requires rigid frames.
DP 600 (Dual Phase)	90,000+	75,000	High energy; causes "snap-through" shock.
Boron Steel (UHSS)	180,000+	150,000	Extreme force; requires Servo technology.

3. Press Architecture Selection

Selecting the right frame and drive system depends on where the tonnage is required in the stroke and the complexity of the part.

3.1 Straight-Sided Servo Presses

- **When to use:** High-volume automotive, structural aerospace parts, and AHSS/Boron steel.
- **Advantage:** The closed-box frame minimizes deflection. The **Servo Drive** allows you to program the velocity, slowing down at the point of impact to reduce noise and tool shock, then speeding up on the return to maintain OEE.

3.2 4-Post Hydraulic & Servo-Hydraulic Presses

- **When to use:** Deep drawing (EV battery trays), composite molding, and coining.
- **Advantage:** Provides the most uniform pressure distribution across the bed. Essential for deep-draw parts that require a heavy bed cushion to prevent wrinkling.

3.3 C-Frame Double Crank Presses

- **When to use:** High-speed secondary operations, trimming, and progressive die stamping.
- **Advantage:** Open-front access for easy die changes and manual part loading. The "Double Crank" setup allows for wider dies than a standard single-point C-frame.

4. Engineering Safety Factors & Rules of Thumb

1. **The 80% Rule:** Never plan to run a press at 100% of its rated capacity for sustained production. Aim for 70–80% to account for material thickness variances and tool dulling.

2. **Reverse Tonnage (Snap-Through):** In blanking, the breakthrough of the material creates a shock wave. If the reverse tonnage exceeds 10% of the press capacity, you risk cracking the frame. Use a **Servo Press** or hydraulic dampers to mitigate this.
3. **Center of Loading:** Always try to center the tonnage within the press bed. Off-center loading leads to "gib wear" and uneven part thickness.

5. Technical Decision Matrix

Process	Primary Goal	Recommended Architecture
Punching/Blanking	High Speed	C-Frame or Straight-Sided Mechanical
Deep Drawing	Constant Pressure	4-Post or Straight-Sided Hydraulic
AHSS Forming	Shock Control	Straight-Sided Servo
Trimming	Edge Precision	Trim Press / High-Speed Hydraulic

For specific capacity evaluations or custom tandem line configurations, consult with the engineering department to perform a full load-curve analysis.

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