

Description

Image



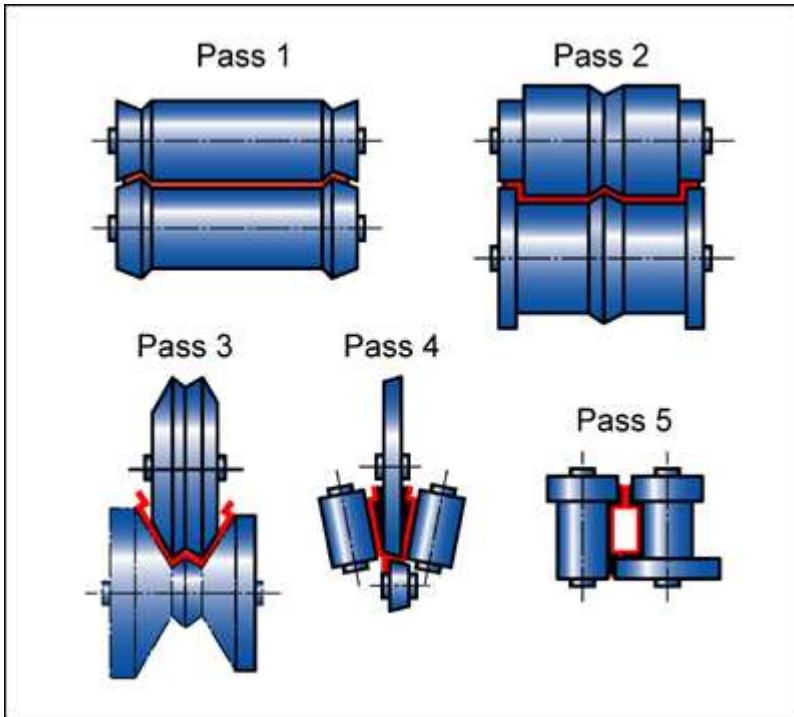
Image caption

(1) Metal sheets © Ibokel at Pixabay [Public domain] (2) Steel sheet rollers © Jfobe1 at Pixabay [Public domain] (3) Roof corrugated © Unsplash at Pixabay [Public domain]

The process

Many products are made by cutting, pressing, punching, folding or spinning of sheet. Press forming covers a range of sheet forming processes that use a die and a press; these include blanking, shearing, drawing and stretching. They may be performed consecutively to form complex shapes. Tools are dedicated, so tooling costs are high. In roll forming a continuous strip of sheet metal is fed through a series of shaped rolls, gradually forming it to the desired profile. The process is suited for long lengths of constant, sometimes complex, cross sections. Hollow components are possible by incorporating seam welding into the process. High production rates, tooling and capital costs make the process economic only for large production levels. In Spinning a circular blank of sheet metal is formed over a rotating mandrill or forming block, against which it is pressed by a rigid tool or roller as it spins. The tools are very simple, made of wood or metal, and are therefore cheap.

Process schematic



Material compatibility

Metals - ferrous	✓
Metals - non-ferrous	✓

Shape

Circular prismatic	✓
Non-circular prismatic	✓
Flat sheet	✓
Dished sheet	✓

Economic compatibility

Relative tooling cost	high
Relative equipment cost	high
Labor intensity	medium
Economic batch size (units)	2.5e4 - 2.5e5

Physical and quality attributes

Mass range	0.1	-	50	kg
Range of section thickness	0.2	-	5	mm
Tolerance	0.1	-	0.8	mm
Roughness	0.4	-	1.6	μm
Surface roughness (A=v. smooth)	A			

Process characteristics

Primary shaping processes	✓
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Continuous

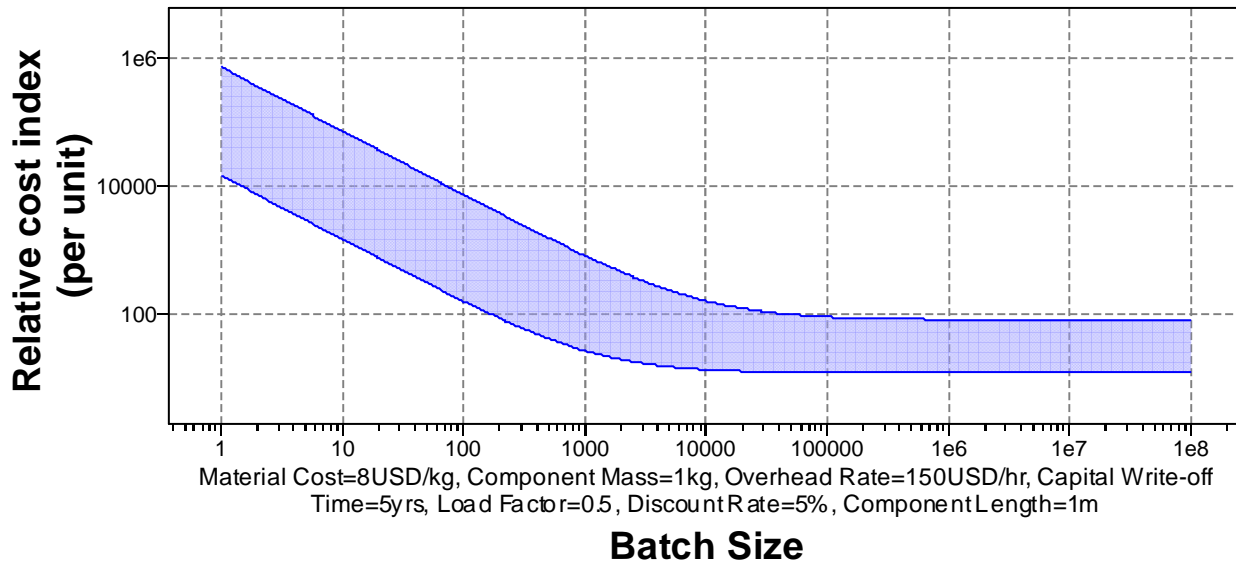


Cost model and defaults

Relative cost index (per unit)

26.1 - 804

Parameters: Material Cost = 8USD/kg, Component Mass = 1kg, Batch Size = 1e3, Component Length = 1m, Overhead Rate = 150USD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Capital cost	4.03e5	-	9.41e5	USD
Material utilization fraction	0.9	-	0.98	
Production rate (length)	0.015	-	1	m/s
Tooling cost	1.43e4	-	7.13e5	USD
Tool life (length)	5.66e3	-	1.89e4	m

Supporting information

Design guidelines

Skilled metal workers can form sheet into intricate shapes using drawing, bending, and forming operations. Shapes with holes, curves, recesses, cavities and raised sections are common. Sheet forming starts with sheet stock, giving the products an almost constant cross section unless folded. Spinning is limited to relatively simple hemispherical, conical, or cylindrical shapes, although re-entrant shapes are possible.

Technical notes

Sheet forming is most commonly applied to metals, particularly steels, although aluminum, copper, nickel, zinc, magnesium and titanium are all processed as sheet. Polymer and composite sheet can be processed, though here the operations are limited to blanking and shearing.

Typical uses

Press forming: automobile body parts, casings, shells, containers. Stamping and blanking: smaller mechanical components such as washers, hinges, pans and cups. Roll forming: architectural trim, window frames, roof and wall panels, fluorescent light fixtures, curtain rods, sliding door tracks, bicycle wheels. Spinning: rocket motor casings, missile nose cones, pressure vessels, kitchen utensils, light reflectors.

The economics

Rolls rolling have to be made from exceptionally hard materials and are expensive, meaning that shape rolling and closed die forging are suitable only for large batches.

The environment

Sheet metal forming carries no particular environmental hazard.

Links

MaterialUniverse

Reference