

Introduction (chapter 1)

- ♦ What is **MANUFACTURING** ?
 - production engineering, materials process technology, manufacturing processes for engineering materials
 - produzione manifatturiera, produzione industriale, tecnologie e sistemi di lavorazione, tecnologia meccanica...
- ♦ Manufacturing transformation of raw materials into *components*, in such a shape ready for assembly into the final *product*

NOTE:

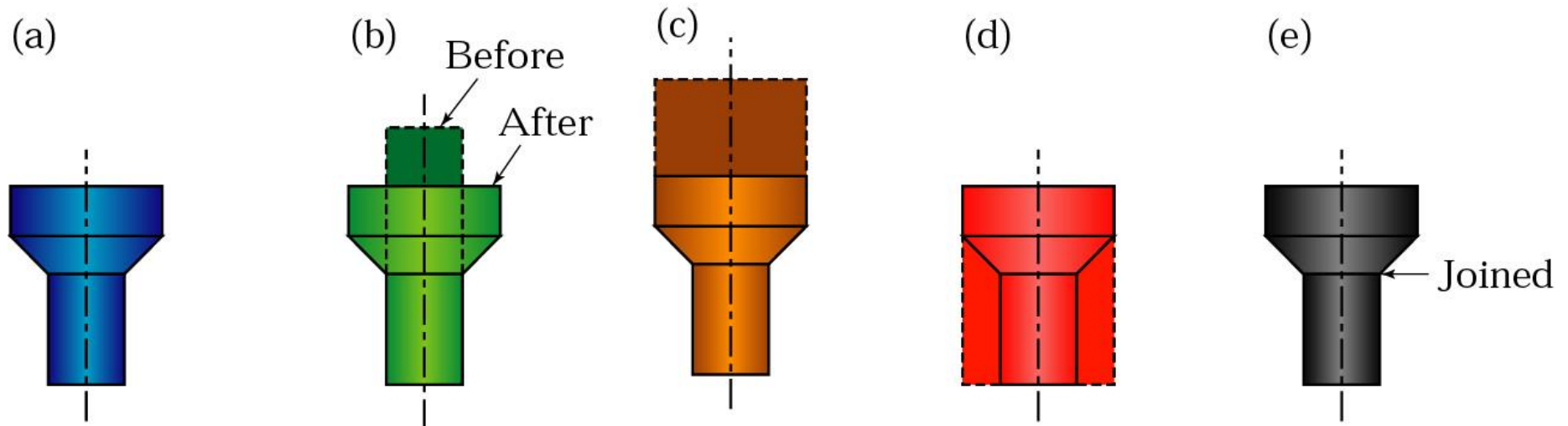
- Manufacturing transformation: **DISCRETE**, with countable output
- Process transformation: CONTINUOUS, with output countable only after final product assembly
(not MANUFACTURING and therefore not subject of this course)

Materials selection

- ♦ Engineering materials
 - Ferrous and non-ferrous metals
 - Polymers
 - Engineering ceramics
 - Composites
 - New materials
 - nanomaterials, shape memory alloys, superconductors, ...
- ♦ Criteria for choosing
 - Mechanical properties
 - Physical and chemical properties
 - Formability
 - Costs and availability
 - Expected product life
 - Recycling chance

Selection of the manufacturing process

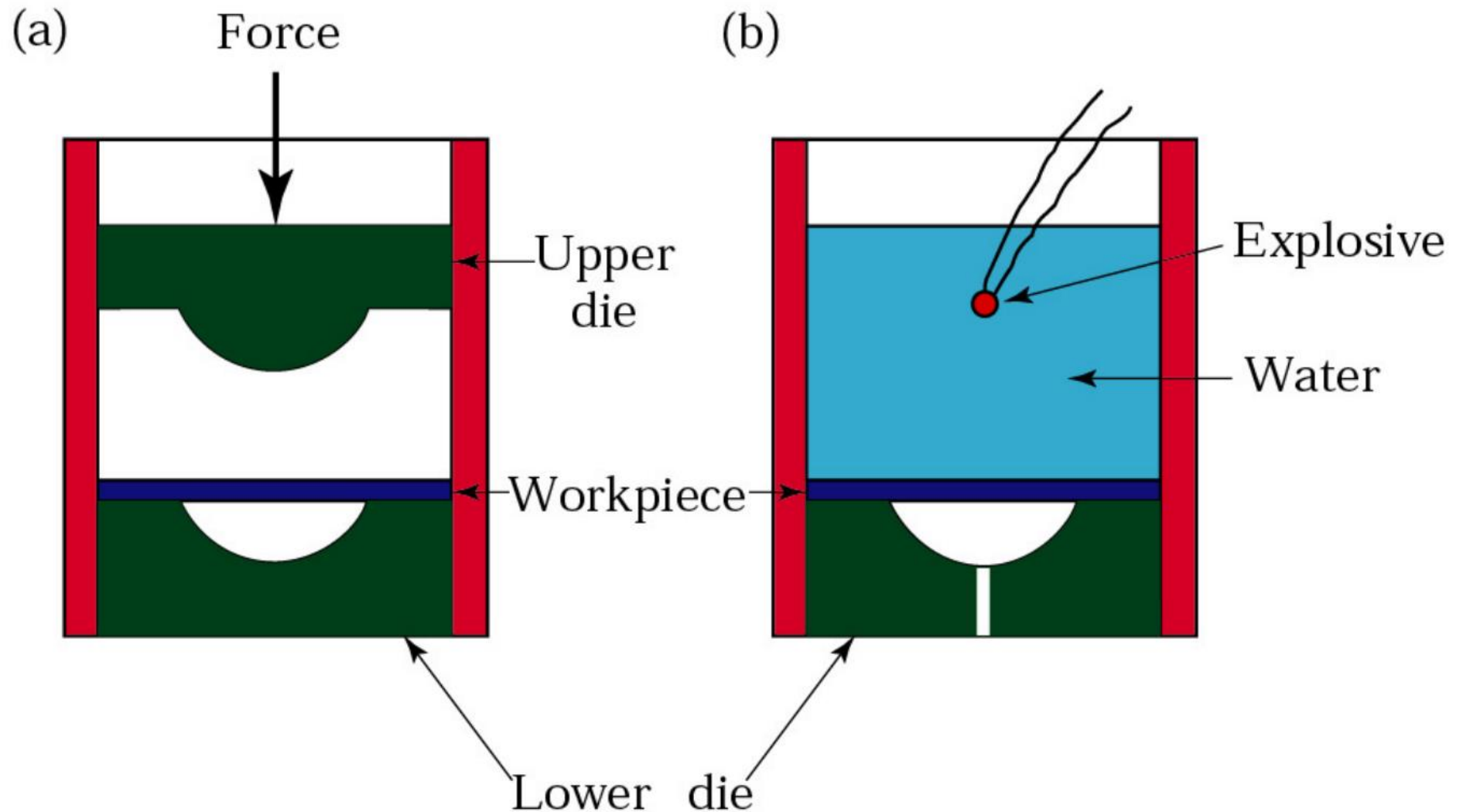
- CASTING
- FORMING AND SHAPING
- MACHINING
- JOINING
- FINISHING



Different technologies available to produce the same component:

(a) casting or powder metallurgy, (b) forging, (c) extrusion, (d) machining, (e) joining.

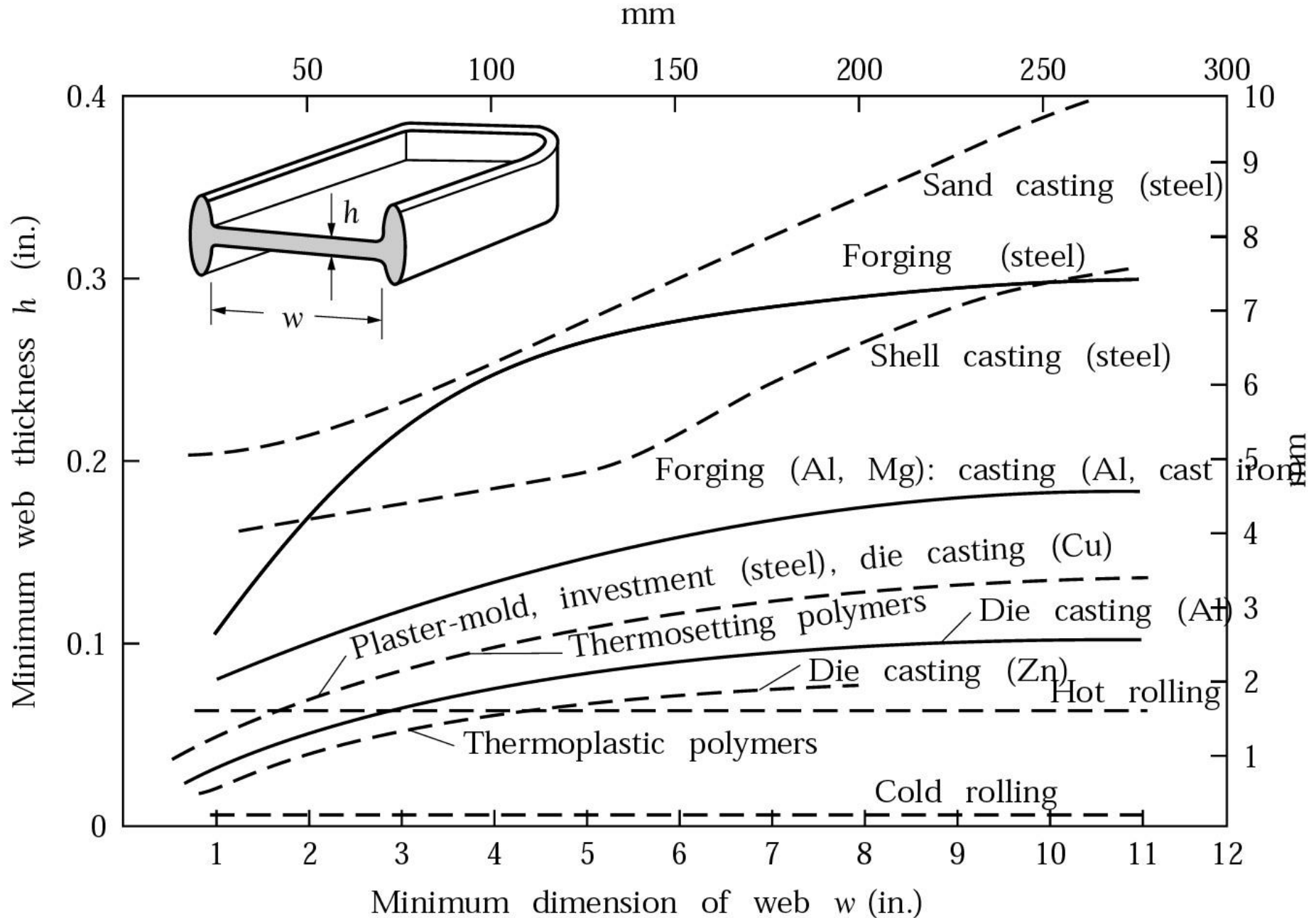
Selection of the manufacturing process



a) Sheet stamping (two molds) and b) explosive forming

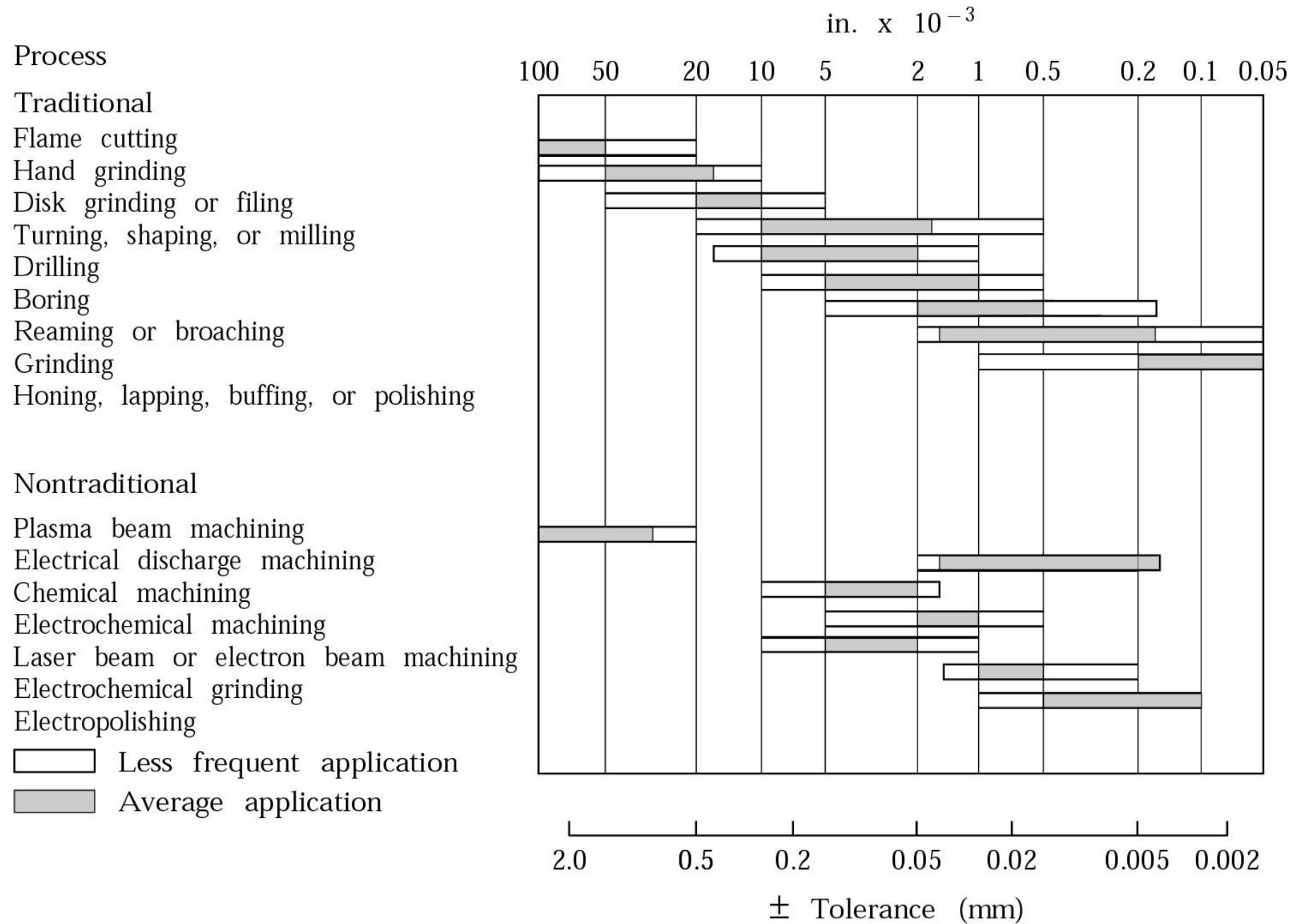
Selection of the manufacturing process

Manufacturing process capabilities - minimum part dimensions



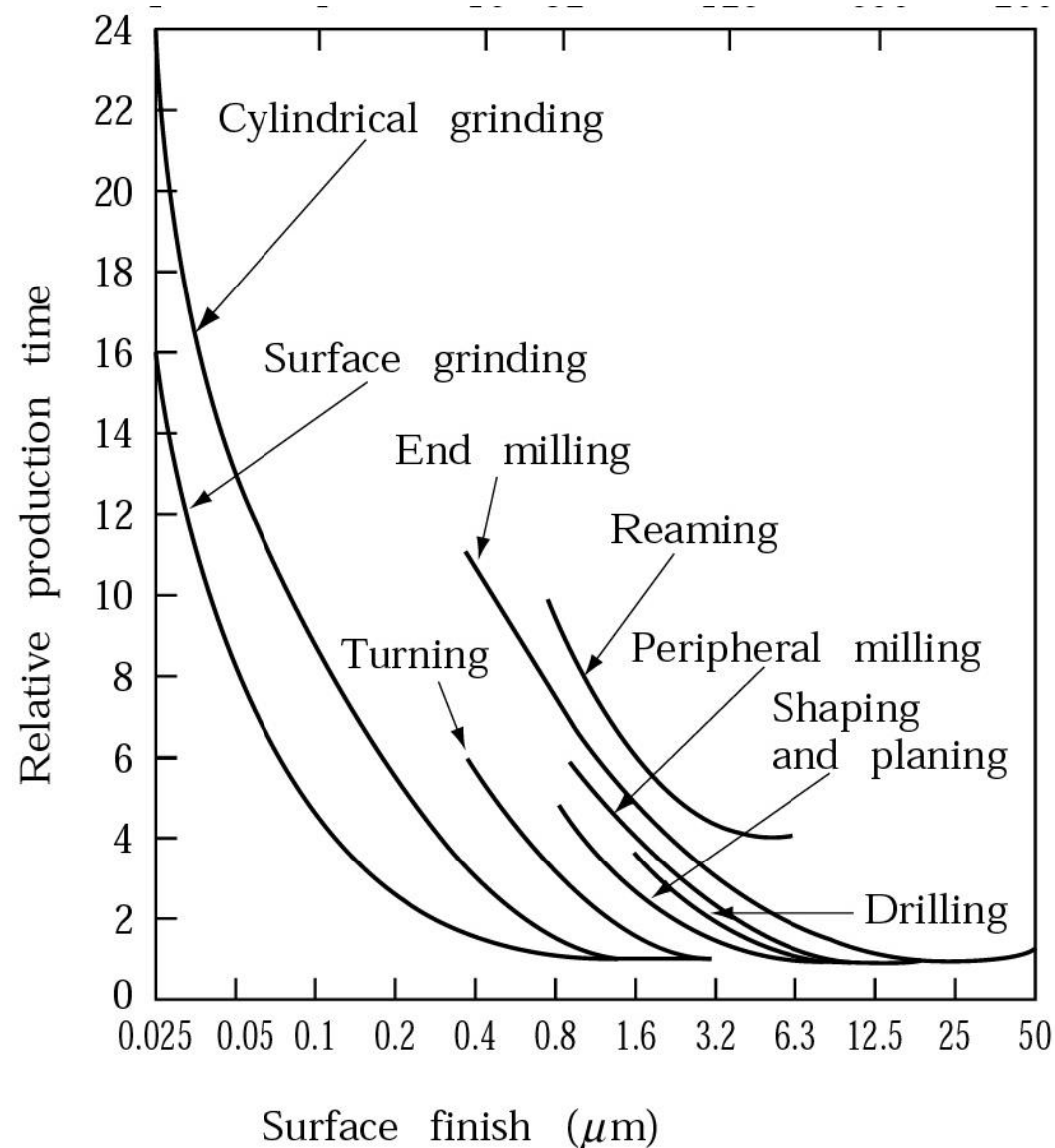
Selection of the manufacturing process

Manufacturing process capabilities - tolerance on dimensions



Selection of the manufacturing process

Manufacturing process capabilities - surface finish



Selection of the manufacturing process

Manufacturing process cost

Type of machinery	Price range	Type of machinery	Price range
Broaching	10–300	Machining center	50–1000
Drilling	10–100	Mechanical press	20–250
Electrical discharge	30–150	Milling	10–250
Electromagnetic and electrohydraulic	50–150	Ring rolling	500
Fused deposition modeling	60–120		
Gear shaping	100–200		
Grinding		Robots	20–200
Cylindrical	40–150	Roll forming	5–100
Surface	20–100	Rubber forming	50–500
Headers	100–150	Stereolithography	80–200
Injection molding	30–150	Stretch forming	400–> 1000
Boring		Transfer machines	100–> 1000
Jig	50–150	Welding	
Horizontal boring mill	100–400	Electron beam	200–1000
Flexible manufacturing system	> 1000	Spot	10–50
Lathe	10–100	Ultrasonic	50–200
Single- and multi-spindle automatic	30–250		
Vertical turret	100–400		

Note: Prices vary considerably, depending on size, capacity, options, and level of automation and computer controls.

Selection of the manufacturing process

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- ♦ Material workability
- ♦ Shape, dimensions, dimensional accuracy (tolerances)
- ♦ Surface finish
- ♦ Production volumes
- ♦ Production costs
- ♦ Additional processes to finish the part

→ *near-net-shape or net-shape manufacturing*

Tasks for the manufacturing engineer

- ♦ To plan the production of components:
 - Knowledge about the product, its service-life performances, specifications, standards
 - Choice of the manufacturing process
 - Choice of machines, plants, equipment, dies
 - Definition of the process plan

- ♦ To efficiently interact with:
 - Product designers
 - Materials experts
 - Plants experts
 - Production planners
 - Quality control engineers