



Materials and Manufacturing

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**Swansea
College of Art**
Founded 1853

*Trawsnewid Addysg; Trawsnewid Bywydau
Transforming Education; Transforming Lives*



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Injection moulding processes

- [Traditional injection moulding](#)
- Multi shot moulding
- (WIT) WATER INJECTION TECHNOLOGY
- GAS ASSISTED
- (RIM) Reaction injection moulding / S-RIM, R-RIM
- (MIM) Metal injection moulding



Injection Moulding

Overview.

Process

Volumes

Speed

Design considerations

Surface

Complexity/ shape

Scale



Injection Moulding

- Most commonly used manufacturing process for polymers
- Thermoplastic, metals and some thermoforming materials
- Generally large volumes 10,000+
- Common cycle times for parts
- 30 to 40 seconds

Process has 3 core elements:

- Machine
- Tool
- mould



Manufacturing processes

Machine elements

A-Clamping motor drive

B-Clamping bar

C-Rear platen

D-Moveable platen

E-Mould core

F-Mould cavity

G-Stationary platen

H - Tie bar

I-Barrel

J-Hopper

K-Raw plastic

L-Screw motor drive

M-Ejector bar

N-Ejection system

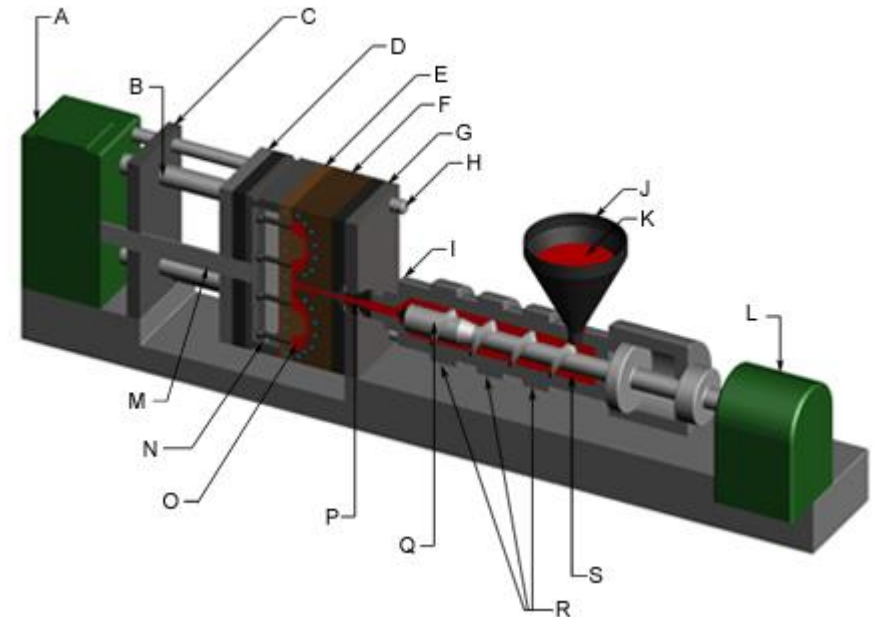
O-Molded part

P-Nozzle

Q-Reciprocating screw

R-Heaters

S-Molten plastic



Manufacturing processes

Tool elements

A-Support plate

B-Ejector retaining plate

C-Ejector plate

D-Ejector bar

E-Ejector pins

F-Molded part

G-Cooling channel

H-Parting line

I-Ejector box

J-Mold core

K-Mold cavity

L-Support plate

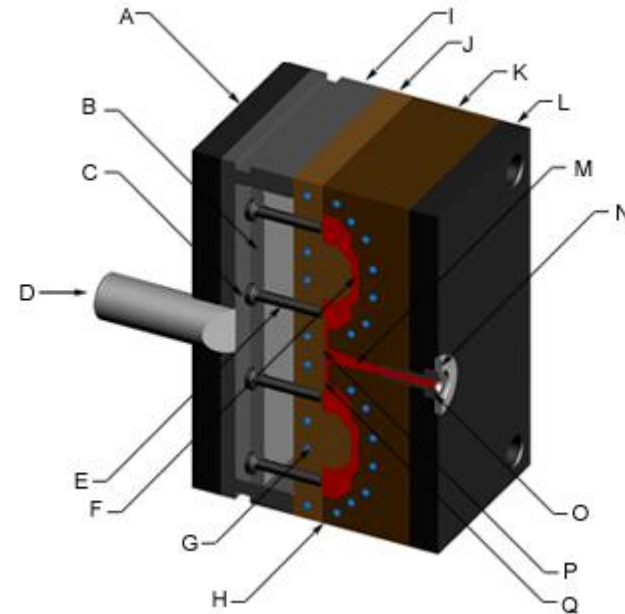
M-Sprue

N- Locating ring

O-Sprue bushing

P-Runner

Q-Gate



Manufacturing processes

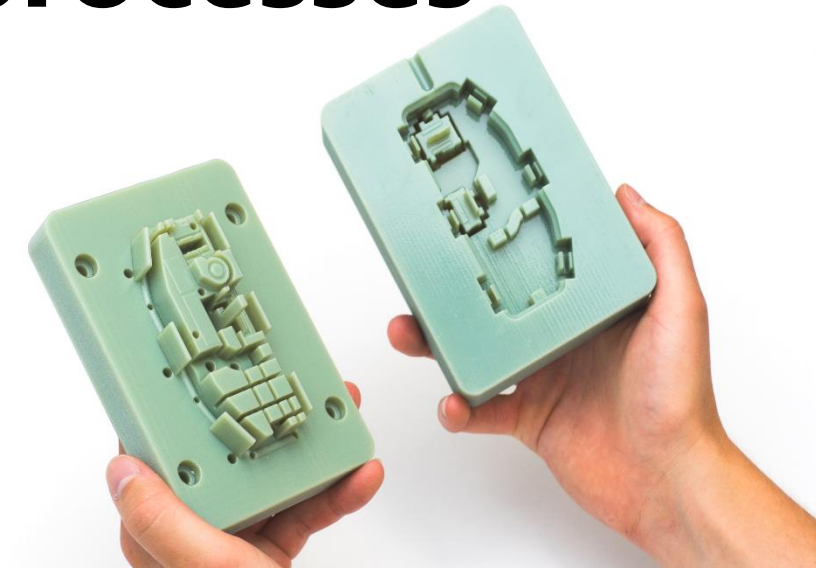
TOOL

Material

Soft tooling aluminium, epoxy

hard tooling steel

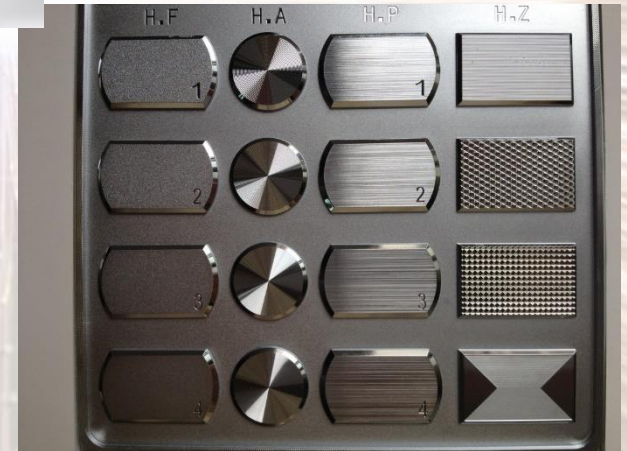
3D printed tools



Manufacturing processes

TOOL FINISHING

SPRAYED
POLISHED
BEAD BLASTED
SPARK EROSION
INDUSTRIAL ETCHING/CHEMICAL MILLING



Manufacturing processes

TOOL LIFE

- the size of the production run
- the complexity of the part
- the finish quality needed
- the material to be moulded (some plastics are corrosive; others contain abrasive glass fibers)

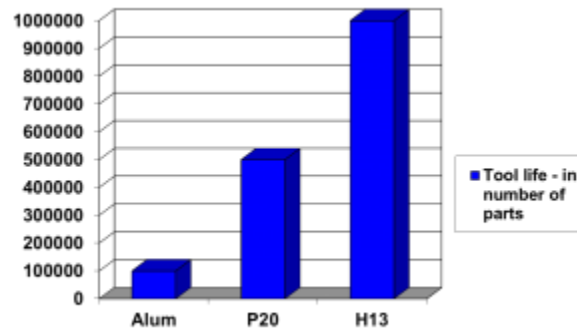


Figure 3: Comparison of tool life for various injection mold metals

Composite Tool Life Expectancies	
Thermoplastic	Tool Life (# shots)
ABS	50 - 3000
Acetal	100 - 1000
Nylon	250 - 3000
Nylon (Glass filled)	50 - 200
PBT	100 - 500
PC/ABS blends	100 - 1000
Polycarbonate	100 - 1000
Polyethylene	500 - 5000
Polypropylene	500 - 5000
Polystyrene	500 - 5000
Investment Casting Wax	1000 - 10000

Manufacturing processes

Mould

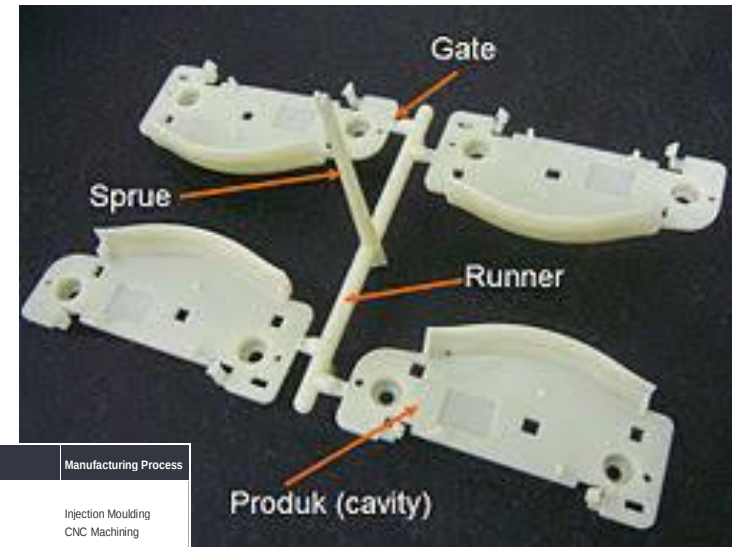
In mould decoration

Over moulding

Design consideration. Thickness, draft, parting line, etc..

Material – affects tool life and design

Post processing



Material	Attributes	Manufacturing Process
ABS	• Cosmetic appearance • Dimensional stability • Impact resistant	Injection Moulding CNC Machining
ABS/PC	• Cosmetic appearance • Dimensional stability • Impact resistance	Injection Moulding CNC Machining
HDPE	• Durability • Impact resistant • Stiffness	Injection Moulding CNC Machining
LDPE	• Crack resistance • Flexibility • Impact resistance	Injection Moulding
LSR	• Cosmetic appearance • Durability • Flexibility • Temperature resistance	Injection Moulding
LSR (Optical)	• Temperature resistance	Injection Moulding

Manufacturing processes

Post Processing/ secondary processes.

Inserts

Surface finishes – polishing, spraying coating, over moulding trimming, electro-plating, water transfer graphics



Manufacturing processes

Design considerations

Thin walls

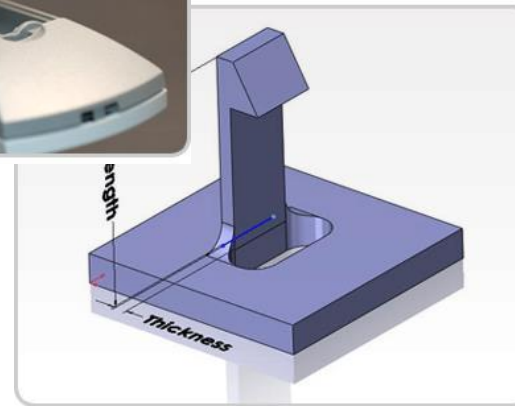
Undercuts

Ribs bosses

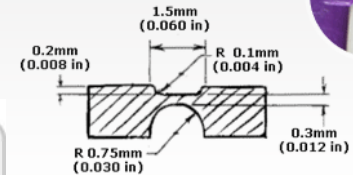
Living hinges

Radius edges

Snap fits

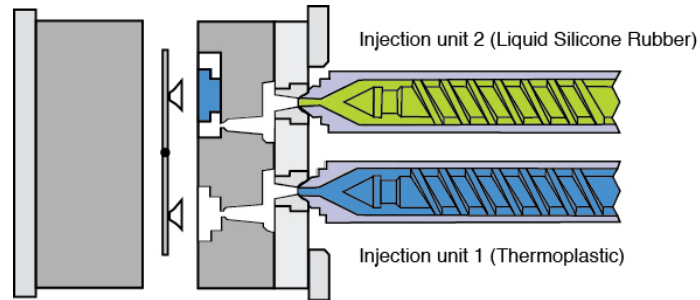
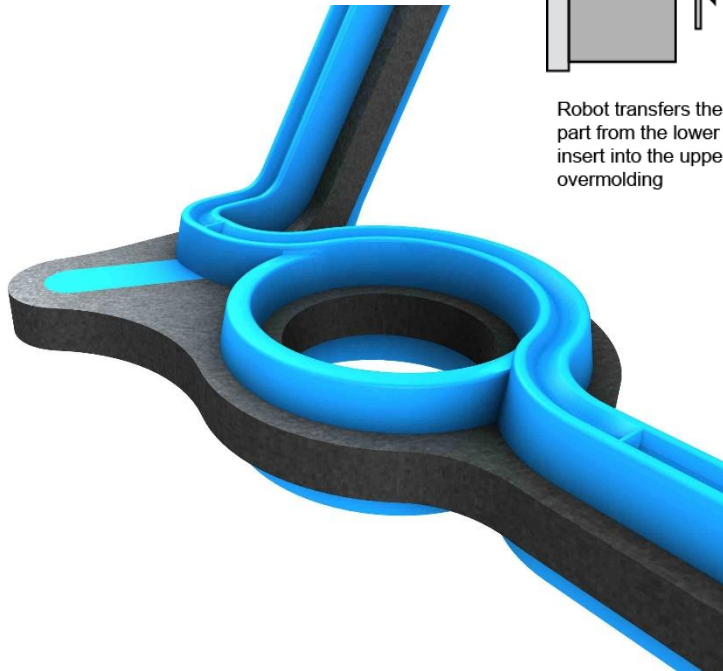


Living Hinge Design for
Polypropylene and Polyethylene

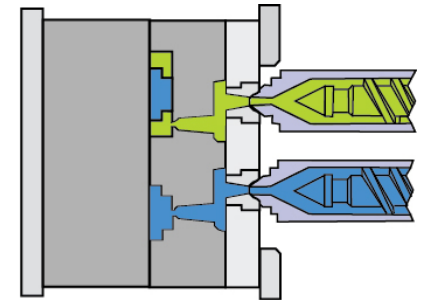


Manufacturing processes

Multishot mould



Robot transfers the thermoplastic part from the lower cavity as insert into the upper cavity for overmolding



Injection Molding of insert in lower cavity; Overmolding with LSR in the upper cavity



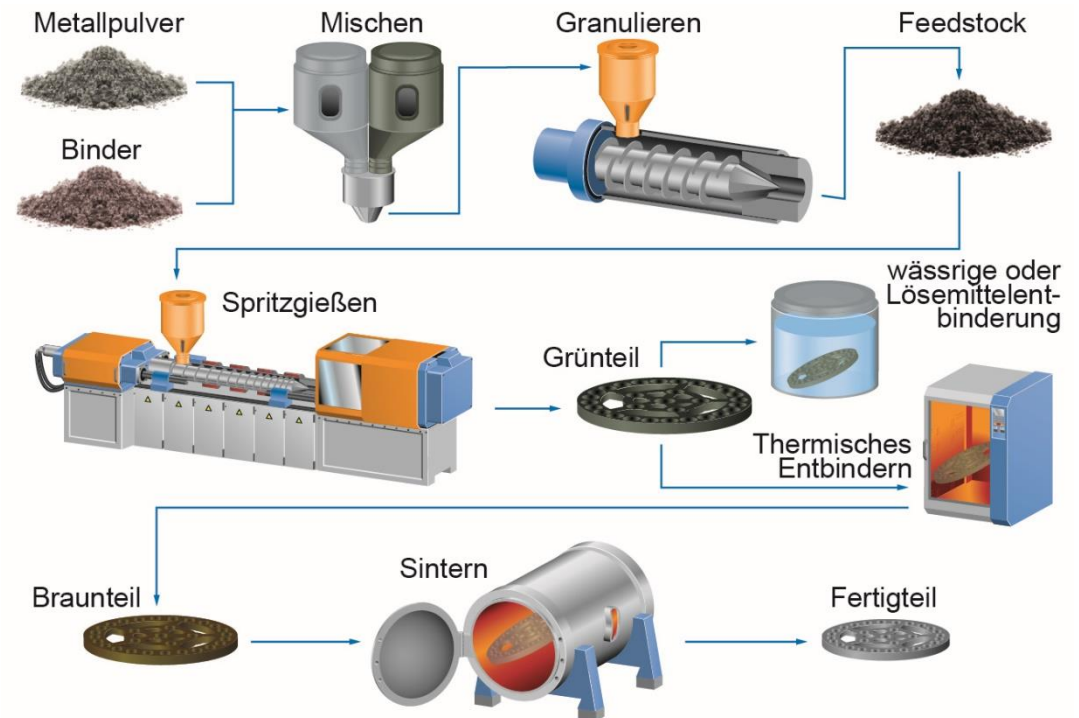
Manufacturing processes

MIM – Metal Injection Moulding

Parts 20 % bigger to allow for shrinkage

Debinding of wax and thermoplastic

Sintering part in vacuum furnace



Manufacturing processes

RIM– Reaction Injection Moulding

2 part MIX

Usually PU thermosetting liquid mixed

Exothermic reaction causing mixture to expand in mould forming smooth skin and foam core.

Fibres added for reinforcement (R-RIM)

Or overmoulding for structural support (S-RIM)



Benefits of using RIM?

- Low-cost tooling for large parts
- Polyurethane moulded parts in 2-5 weeks
- Thin walled components (1.5mm)
- Short lead-times for large components
- Low volume production components
- Cosmetic surface finishing
- Smooth satin/gloss In-mould coating (Avoids additional cost of post spray painting)
- Rigid foam buoyant water proof materials
- Encapsulation and over-moulding
- Low capital investment.
- Short or long runs
- Minimum set up



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Thank You



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University of Wales
Trinity Saint David

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