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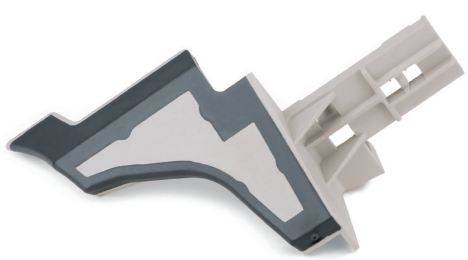
Multi-Material Systems



Multi-Material Systems

What are Multi-Material Systems?

Multi-material systems (also referred to as multi-shot, 2k and bi-material) produce parts consisting of two or more materials that are moulded together within the same moulding machine, during the same process, to form a single part.

Multi-material moulding is commonly used to create products with a soft-touch exterior that provides a unique or aesthetic design and improved function of the end product e.g handle grips (often found on products like toothbrushes and razor handles).

There are many reasons for mould makers to invest in Multi-material moulding including:

- eliminate manual assembly time and labour costs
- ensure proper alignment between components, resulting in superior part quality
- improved part strength as components are moulded directly onto each other (no bonding step is required with glue or fasteners)

Multi-material moulding allows companies to design products that have unique, often complex designs with improved strength and durability. Other advantages include:

- aiding end-user functionality e.g soft grip
- improving overall aesthetics of a part with multiple colours
- enhanced design flexibility
- improving part usage e.g. resistance to vibration and shock
- increased complexity reducing the likelihood of counterfeiting

Multi-Material products are commonly produced in a variety of markets including:

- Home Interior
- Kitchen Utensils
- Sporting Goods
- Medical Instruments
- Electrical Switches
- Automotive Interior
- Garden Tools
- Cosmetic Products
- Drink Bottles
- Hand and power tools

General Principles for Multi-material Moulding

To ensure quality parts, common principles exist for multi-material moulding including:

- The melting temperature of the overmould material should be less than the substrate
- Ensure there is chemical compatibility between overmould materials and substrate
- Try to ensure uniform wall thickness of each material to obtain the best cycle time
- Transitions between wall thickness should be gradual to reduce flow problems e.g. back fills
- If further bonding strength is required, design mechanical features to lock materials together

The Process of Multi-Material Moulding

Flexible Design

Multi-material moulding machines are equipped with two or more injection barrels, allowing two or more materials to be injected into the same mould, during the same moulding cycle.

There are a variety of methods to move cavities into the correct position for each injection stage including rotating, transferring, or shuttling.

The following diagram illustrates a rotational moulding process for a multi-material part.

Step 1 - The Mould is in the closed position and both Cavity A and Cavity B have been filled. **Cavity A** (Green material) is the first component of the final part. **Cavity B** is the completed part that includes the Green material and over-moulded Orange material.

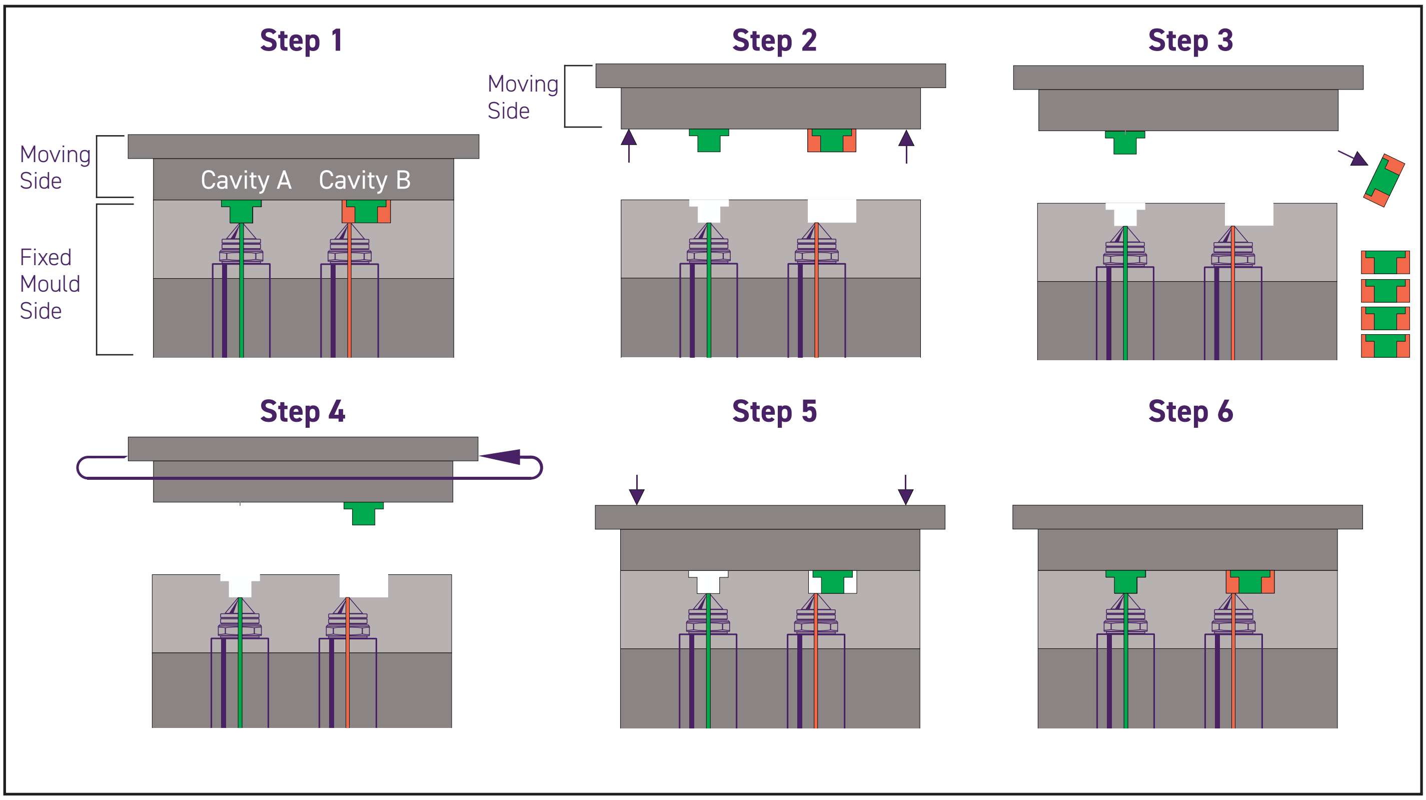
Step 2 - The moving side of the mould opens removing the parts from **Cavity A** and **Cavity B.**

Step 3 - The completed part from **Cavity B** is ejected (to go with all the completed parts).

Step 4 - The moving side of the mould is rotated 180° to place the Green component from **Cavity A** into the **Cavity B** position.

Step 5 - The Moving side of the mould closes, placing the Green component into **Cavity B.**

Step 6 - **Cavity A** is injected with Green material, **Cavity B** is injected with Orange material to complete the final part.



Material Compatibility Requirements

Forming a Strong and Durable Bond

To ensure that different materials bond together to form a strong, durable and high-quality part, the following adhesion methods are typically used:

- melt cohesion
- chemical cohesion
- mechanical interlocks

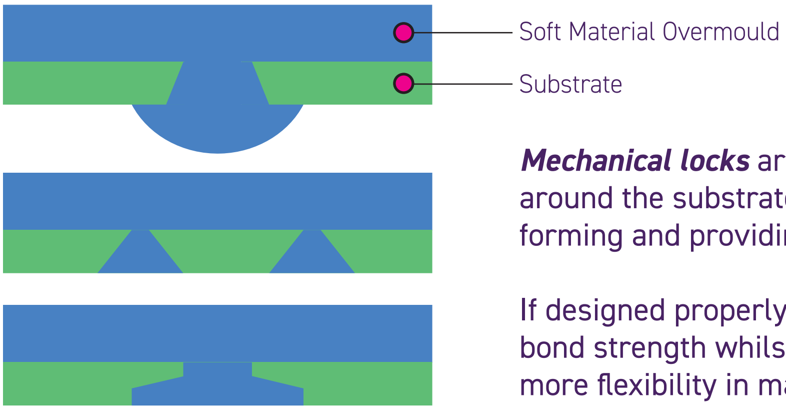
Melt cohesion requires closely matched melting points. The strength of the bond is determined by how well the two materials melt together at the interface.

If the outer material has a melt temperature that is significantly lower than the inner material (substrate) it will not melt the surface of the substrate and this can will result in a poor bond. Alternatively if the melt temperature of the outer material is too high it can over melt the substrate leading to distortion.

Chemical adhesion requires a very close chemical compatibility whereby a chemical reaction occurs at the material interface to form a bond. The chemical reaction occurs when the surface of both materials have softened due to melting. Once softened the polymer chains have increased mobility and the over mould material entangles with the substrate molecules. When the interface between the materials cools, the entangled molecules are solidified and locked together to form a strong bond.

Examples of materials with strong chemical adhesion include:

Outer Material	Chemically Compatible Substrate
TPU	PC, PC/ABS, PMMA, Acrylic, PA6, PA66, PP
TPE	TPU, TPE, LDPE, PP, HDPE, ABS, PET
HDPE	TPU, TPE, LDPE, PP, HDPE
PP	TPU, TPV, TPE, LDPE, HDPE, PP
PVC	ABS, AL, ST, SS
LDPE	TPU, TPE, LDPE, PP, HDPE
TPV	TPU, PP, AL, ST, SS



Mechanical locks are formed when softer material flows around the substrate, into holes and undercuts before forming and providing the locking mechanism.

If designed properly the mechanical locks can have a high bond strength whilst also providing product designers with more flexibility in material selection.

Multi-Material Case Studies

Multiple Manifolds, Single Parts

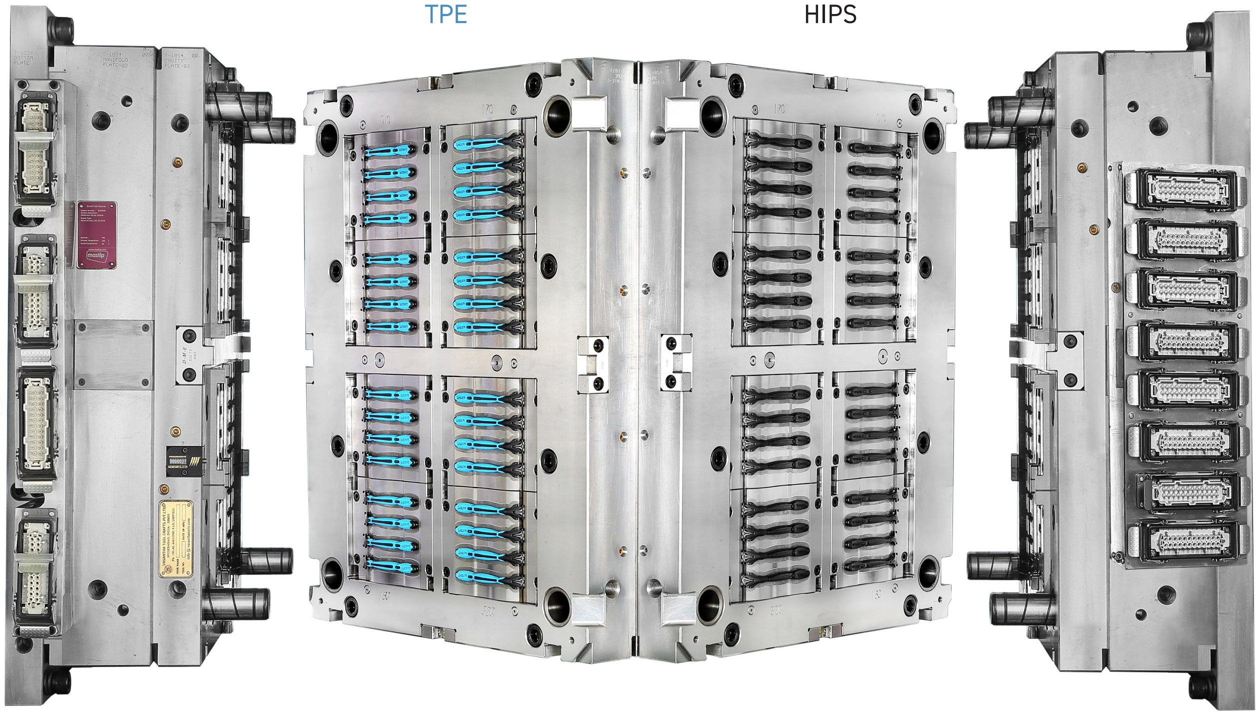
Case Study: 64 Drop Multi-material System (Consumer Goods - Razor Handle)

The following case study makes use of rotational plate technology to create a 32 + 32 drop Hot Runner Stack Mould to produce a bi-material razor.

In Injection Stage 1 Hips material is injected into the cavity. In Injection Stage 2 the mould is rotated and the HIP's material is over moulded with TPE material to create a soft grip for the razor handle.

Injection Stage 2
TPE

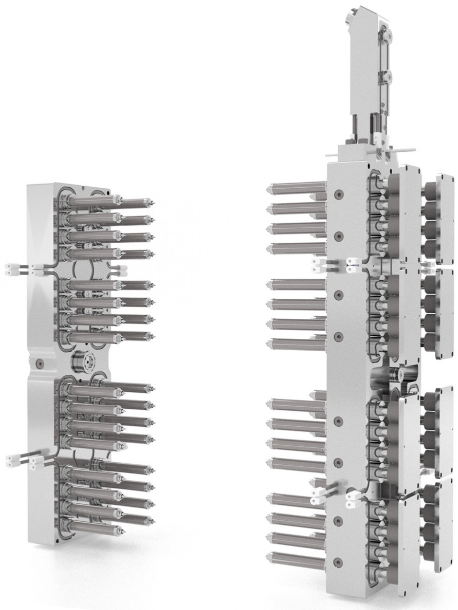
Injection Stage 1
HIPS



Mastip Hot Runner Configuration

System: 32 + 32 Cube Mould
Material: HIPS & TPE
Part Weight: 4.0gm + 1.6gm
Part Thickness: 0.6mm - 1.2mm

Gating: MVG25 Valve Gates
Cycle Time: 7 seconds
Temperature Zones: 80



Multi-Material Case Studies

Multiple Manifolds, Single Parts

Case Study: 6 Drop Multi-material System (Consumer Goods - Utility Handle)

The following case study incorporates a 6 drop multi-material system with two separate manifolds to produce a 2 colour knife handle made of PA6 and TPE.

In this multi-stage moulding process, the substrate material (PA6) is injected into the first cavity then the mould rotates and the over mould material (TPE) is injected on top of the substrate in the second cavity to form the final combined part.

Mastip Hot Runner Configuration

System: 6 Drop Multi-material
Material: PA6 & TPE
Part Weight: 58.6g
Part Height: 28mm
Part Length: 160mm
Gating: MVG40 Valve Gates

Manifold 1 - Part 1

Hot Runner System: 2 Drop 2x1 Manifold System
Nozzle Selection: BXOV19075G5
Material: PA6 +30% Glass Fibre
No. of Cavitites: 2
No. of Drops: 2

Manifold 2 - Part 2

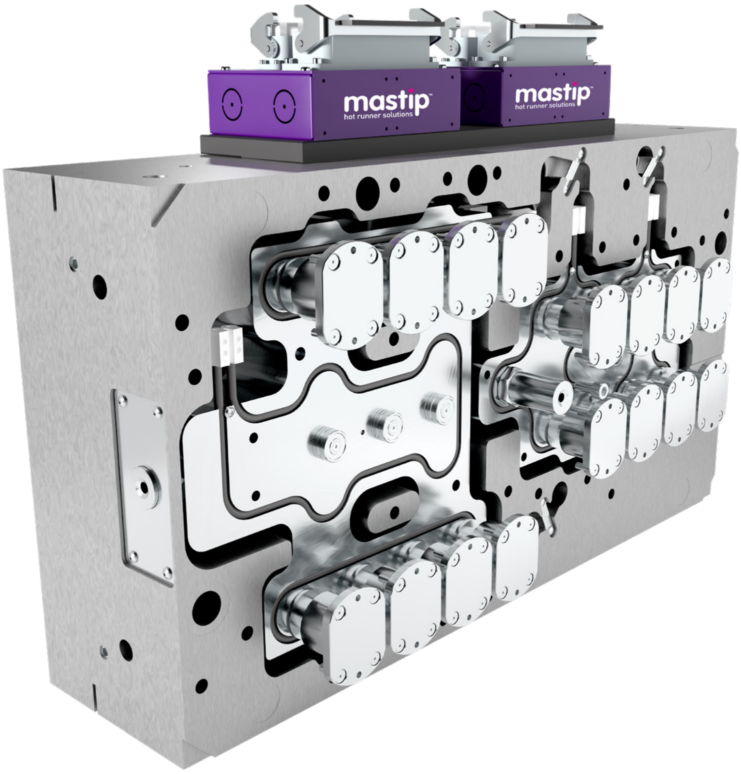
Hot Runner System: 4 Drop 2x2 Manifold System
Nozzle Selection: MXOV13065G1
Material: TPE
No. of Cavitites: 2
No. of Drops: 4

Multi-Material Case Studies

Multiple Manifolds, Single Parts

Case Study: 16 Drop Multi-material System (Household Goods - Scent Loop)

A combination of two 8 Drop manifolds completes this 8 cavity mould, injecting two different materials, PP and EVA with a scent additive for this household air freshener product.



Mastip Hot Runner Configuration

System: 16 Drop Multi-Material System
Part Height: 11mm
Part Length: 81.63mm
Part Weight: 6gm

Manifold 1:
Nozzle Selection:
MXOV13095G1
Material: PP

Manifold 2:
Nozzle Selection:
MXOV13095G1
Material: EVA

What are Family Mould Systems?

Family Moulds are designed to produce multiple (unique) parts in a single mould during a single cycle.

There are several advantages to using family moulds including increased productivity (multiple parts can be produced within one cycle), cost effectiveness (lowered cost per unit) and manufacturing optimisation (can reduce the cost and number of moulds required).

Family moulds are more complex to design than a single part mould due to the gating, cooling and ejection requirements of multiple parts.

Overall, family moulds are a valuable tool in injection moulding, enabling efficient production of multiple parts and optimizing resources, but they require careful design and maintenance to ensure successful operation.

mastip™
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Mastip is a leading supplier of innovative hot runner solutions to the global plastic injection moulding industry.

The company believes foremost in providing service and support, throughout the life cycle of the hot runner. This means you can be confident that spares and technical support is always available.

At Mastip we strive to understand our customers exact moulding requirements in order to deliver reliable and high performing solutions. Every Mastip system provides faster cycle times and material savings while producing quality components, all leading to higher efficiencies and a better return on investment.

Automotive
Mastip's extensive experience in highly cosmetic and structural parts means we can deliver a customised solution which will provide long-term reliability and performance.

Electrical
Mastip's comprehensive range of nozzles and valve gate solutions are able to withstand the corrosive and abrasive nature of Engineering polymers used for the electrical market.

Packaging
Mastip's valve gate solutions are ideal for the packaging market, delivering both the reliability and performance needed for fast-cycle thin-wall through to long-cycle thick-wall applications.

Caps and Closures
Mastip's high cavity hot half solutions, in either thermal or valve gate configuration, allow for maximum productivity while ensuring part quality is maintained even at fast-cycle times.

Engineering
Mastip's technical expertise and long-life components provide durable hot runner solutions manufactured from high-grade materials to withstand abrasive polymers.

Medical
Mastip's range of valve gate solutions are ideal for medical applications, producing fast cycle parts of exceptional surface quality while eliminating gate vestige.

Michael Rose, President of Omega Plastics

"I always get such a great response from Mastip, it's one of the many reasons I use them as my hot runner supplier. The Mastip team offers excellent service and technical support every time."

Hot Runner: 2 drop, MVG40 pneumatic valve gate, MX16 series nozzle.

Application: 2 shot ABS substrate and TPE over-mould.

Experience the difference that Mastip makes for our customers in everything we do. Talk to us today about your next project and see for yourself.

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