



TECHNICAL BUYER'S GUIDE · PRATISHNA ENGINEERS

# TOYS & GAMES COMPONENTS INJECTION MOULDING MACHINE GUIDE

A practical guide for toy and game makers: components, materials, mould requirements, production planning, automation, quality and safety checks, worked examples and what to send for a machine recommendation.

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### WHO THIS GUIDE IS FOR

Owners, plant and production managers, process engineers and purchase teams moulding toys, construction sets, games, baby and ride-on products and play equipment fittings.

### HOW TO USE IT

Sections 01 to 04 define the part, material and mould. Section 05 plans output. Sections 06 to 09 cover automation, quality, examples and your enquiry. Clamp force and shot sizing are covered in our Machine Selection Guide.

### NEED A RECOMMENDATION?

Send your drawing, material, part weight, cavities and output target to [sales@pratishnaengineers.com](mailto:sales@pratishnaengineers.com). The checklist in Section 09 lists what to include.

SECTION 01 · OVERVIEW

# TOYS & GAMES COMPONENTS & INJECTION MOULDING

Toys are bought on look and feel, and sold only if they pass safety rules. Injection moulding has to deliver both on every shot.

## WHERE INJECTION MOULDING FITS IN TOY MAKING

India issued a Quality Control Order for toys on 25 February 2020, and toys came under compulsory BIS certification from 1 January 2021. Every toy on the market must meet the relevant Indian Standard and carry the Standard Mark under a BIS licence, for domestic and foreign makers alike<sup>[1]</sup>.

Exports face their own gates: EN 71 in Europe<sup>[4]</sup> and the small-parts rules for under-threes in the US<sup>[3]</sup>. So a toy mould is designed around the age grade and target markets from the first drawing.

## MAIN COMPONENT CATEGORIES

|                                                           |                                                   |                                                             |                                                                |
|-----------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------------|
| <b>GENERAL TOYS</b><br>Figures, vehicles, playsets        | <b>CONSTRUCTION</b><br>Building blocks and bricks | <b>BABY &amp; RIDE-ON</b><br>Walkers, ride-on and push toys | <b>MECHANISMS</b><br>Wheels, axle housings, gears              |
| <b>DOLLS &amp; FIGURES</b><br>Limbs, joints, rigid bodies | <b>GAMES</b><br>Game pieces, dice, counters       | <b>SOFT &amp; BATH</b><br>Bath, squeeze and teether toys    | <b>LEARNING &amp; OUTDOOR</b><br>Puzzles, trays, play fittings |

### WHY INJECTION MOULDING SUITS THESE PARTS

- Fine detail, bright colour and gloss straight from the tool.
- Repeatable fits for sets that must go together.
- Low cost per piece at the volumes toys sell in.

### TYPICAL MANUFACTURING CHALLENGES

- Colour matching across tools and resins in one set.
- Fit tolerance on mating parts and bricks<sup>[6]</sup>.
- No sharp edges, flash or loose small parts.
- Chemical limits on pigments and regrind<sup>[5]</sup>.

## FROM DESIGN TO SHELF

|                                           |                                     |                                         |                                          |                                        |                                             |                                  |
|-------------------------------------------|-------------------------------------|-----------------------------------------|------------------------------------------|----------------------------------------|---------------------------------------------|----------------------------------|
| <b>AGE GRADE</b><br>sets the safety rules | <b>DESIGN</b><br>radii, fits, parts | <b>MOULDING</b><br>colour, surface, fit | <b>DECORATION</b><br>print, paint, plate | <b>ASSEMBLY</b><br>axles, joints, sets | <b>SAFETY TESTS</b><br>mechanical, chemical | <b>PACKING</b><br>warnings, sets |
|-------------------------------------------|-------------------------------------|-----------------------------------------|------------------------------------------|----------------------------------------|---------------------------------------------|----------------------------------|

Often not injection moulded: hollow squeeze toys and soft doll heads (rotational casting or blow moulding), large ride-on bodies and slides (rotomoulding), and die-cast vehicle bodies.

## WHO BUYS THE PARTS

|                                                   |                                                      |                                                      |                                                       |
|---------------------------------------------------|------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|
| <b>TOY BRANDS</b><br>Figures, vehicles, playsets. | <b>GAME MAKERS</b><br>Pieces, dice, counters, trays. | <b>BABY PRODUCTS</b><br>Walkers, teething, ride-ons. | <b>PLAY EQUIPMENT</b><br>Clips, brackets, connectors. |
|---------------------------------------------------|------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|

## KEY REQUIREMENTS FOR TOY COMPONENTS

|                                                                                                                   |                                                                                             |                                                                                           |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| <b>LEGAL MARKET ACCESS</b><br>BIS licence and ISI mark in India <sup>[1]</sup> ; EN 71 in Europe <sup>[4]</sup> . | <b>SMALL PARTS</b><br>Nothing that fits the test cylinder for under-threes <sup>[3]</sup> . | <b>CHEMICAL LIMITS</b><br>Migration of heavy elements from toy materials <sup>[5]</sup> . |
| <b>APPEARANCE</b><br>Gloss, colour and clean parting lines sell the toy.                                          | <b>FIT AND PLAY</b><br>Bricks, puzzles and wheels must fit and move just right.             | <b>DURABILITY</b><br>Drops, loads and outdoor use without breaking.                       |

SECTION 02 · COMPONENTS

MAJOR TOYS & GAMES COMPONENTS

The toy and game parts covered by this guide, their materials and what each asks of the moulding process.

| COMPONENT                                                       | APPLICATION                       | MATERIAL(S)                                | INJECTION MOULDING CONSIDERATIONS                                                                                            |
|-----------------------------------------------------------------|-----------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Plastic toy (figures, vehicles, playsets)                       | General moulded toys              | ABS, PP copolymer, HDPE, PS, TPE, PA6      | Surface quality and fit. No sharp edges or points; small-parts and migration rules shape design and colours.                 |
| Building block                                                  | Construction sets                 | ABS, ABS-compatible bioplastics            | Very tight fits held by uniform ABS shrinkage <sup>[6]</sup> . Clutch must match older blocks. Flatness and gloss inspected. |
| Baby walker                                                     | Frame and tray                    | PP copolymer, HDPE, ABS, TPE               | Large mouldings. Check regulations before tooling. Brake pads, locking legs, no finger traps.                                |
| Ride-on and push toy parts (body panels, seat, steering)        | Ride-on and push toys             | PP copolymer, HDPE, ABS                    | Load and drop tested with a child's weight. Snap and screw joints with no sharp edges. UV grade outdoors.                    |
| Toy wheel, axle housing, gear                                   | Moving toys                       | POM, PP, ABS, PA6                          | Bore-to-axle clearance decides free rolling. POM for meshing gears. Small parts, high cavitation.                            |
| Doll and action figure parts (limbs, joints, heads)             | Rigid bodies, joints, accessories | ABS, PP, POM (joints), TPE                 | POM ball and ratchet joints for steady friction. Skin-tone matching across resins.                                           |
| Board game piece, dice, counter                                 | Games                             | ABS, PS, POM, PP                           | Tiny high-cavitation parts. Dice need face and corner symmetry. Small-parts warnings.                                        |
| Toy vehicle body and chassis                                    | Toy cars and trucks               | ABS, PP, POM (chassis), PA6                | Class A bodies, often painted or plated: plating grade, high-polish tool. Chassis on its own tool.                           |
| Bath, squeeze and teether toy                                   | Infant toys                       | TPE, TPU, PP, LDPE                         | Solid and two-shot TPE designs. Food-contact grade and EN 71-3 compliance. No trapped water.                                 |
| Educational tray, sorting insert, storage case                  | Sets and storage                  | PP copolymer, PS, ABS                      | Flatness after ejection for lids and stacking. PP living hinges. Colour match across tools.                                  |
| Puzzle frame, peg, stacking ring, shape sorter                  | Early learning toys               | PP copolymer, ABS, PS, TPE                 | Consistent shrinkage between mating pieces. Generous radii for safety.                                                       |
| Outdoor play fittings (slide clips, swing brackets, connectors) | Play equipment hardware           | PP copolymer (UV-stabilised), HDPE, PA6-GF | Load-path parts tested to EN 1176 or local equal. UV stability; dry nylon.                                                   |

MOULDED PARTS VERSUS OTHER PROCESSES

|                                                                                                  |                                                                                      |                                                                                                      |
|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| <b>DOLLS AND BATH TOYS</b><br>Rigid and solid TPE parts are moulded; soft hollow parts are cast. | <b>TOY VEHICLES</b><br>Plastic bodies are moulded; premium bodies are zinc die-cast. | <b>RIDE-ONS AND PLAY SETS</b><br>Panels and fittings are moulded; bodies and slides are rotomoulded. |
|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|

GROUPING BY MOULDING DEMAND

|                                                                                            |                                                                                    |                                                                                          |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| <b>PRECISION FIT</b><br>Blocks, gears, wheels, puzzles, pieces. Shrinkage and consistency. | <b>APPEARANCE</b><br>Figures, vehicles, dolls, sets. Colour, gloss, parting lines. | <b>LARGE AND LOADED</b><br>Walkers, ride-ons, outdoor fittings. Footprint, strength, UV. |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|

SECTION 03 · MATERIALS

MATERIALS USED FOR TOYS & GAMES COMPONENTS

Toy materials are chosen for fit, feel and colour first, then checked against chemical limits for the markets the toy will be sold in.

| MATERIAL                   | TYPICAL COMPONENTS                                                                                      | RELEVANT PROPERTIES                                       | PROCESSING CONSIDERATIONS                       | LIMITATIONS TO CHECK                 |
|----------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------|--------------------------------------|
| ABS                        | Toys, blocks, walker and ride-on parts, wheels, doll parts, game pieces, vehicle bodies, trays, puzzles | Rigid, glossy; shrinks about 0.3 to 0.5% <sup>[6]</sup> . | Dry before moulding; plating grades for chrome. | Yellows outdoors <sup>[6]</sup> .    |
| ABS-compatible bioplastics | Building blocks                                                                                         | Bio-based alternative.                                    | Must match ABS shrinkage and clutch.            | Fit with existing blocks.            |
| PP copolymer, PP           | Toys, walkers, ride-on parts, wheels, doll parts, dice, vehicles, bath toys, trays, puzzles, fittings   | Tough, impact resistant, living hinges.                   | Shrinks about 1 to 3% <sup>[6]</sup> ; warpage. | UV grade outdoors.                   |
| HDPE, LDPE                 | Toys, walkers, ride-on parts, fittings; LDPE in bath toys                                               | Tough, flexible, low cost.                                | High shrinkage.                                 | Low stiffness; paint adhesion.       |
| PS                         | Toys, game pieces, trays, puzzles                                                                       | Rigid, clear or bright colours.                           | Easy flow; polished tools.                      | Brittle under impact.                |
| TPE, TPU                   | Soft grips, walker parts, doll parts, bath and teether toys, puzzles                                    | Soft touch; two-shot bonding.                             | Dry TPU; bond to rigid substrate.               | Food-contact grade for mouthed toys. |
| POM                        | Gears, joints, game pieces, chassis                                                                     | Low friction, stiff, steady wear <sup>[7]</sup> .         | Controlled mould temperature; never with PVC.   | Hard to print or bond.               |
| PA6, PA6-GF                | Toys, wheels, chassis; PA6-GF in play fittings                                                          | Strength, fatigue, wear <sup>[7]</sup> .                  | Must be dried <sup>[6]</sup> ; GF abrasive.     | Moisture changes size and stiffness. |

General material behaviour only. Confirm grade data, food-contact status and compliance statements with the resin and masterbatch suppliers.

WHAT THE SAFETY STANDARDS ASK OF MATERIALS

| STANDARD                | MATERIAL POINT                                                                                                                        |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| IS 9873 Part 3, EN 71-3 | Migration limits for certain elements from toy materials <sup>[2][5]</sup> . EN 71-3:2019+A2:2024 covers 19 elements <sup>[5]</sup> . |
| IS 9873 Part 9          | Certain phthalate esters in toys and children's products <sup>[2]</sup> .                                                             |
| IS 9873 Part 2, EN 71-2 | Flammability of toy materials <sup>[2][4]</sup> .                                                                                     |

COLOUR AND REGRIND

Pigment choice can change shrinkage<sup>[6]</sup> as well as chemical compliance. Approve each masterbatch, test each colour for fit, and control regrind so it does not carry unapproved material into certified toys.

Outdoor fittings and ride-on parts need UV-stabilised grades.

MATERIAL SELECTION QUESTIONS

- ☐ What age grade and which markets?
- ☐ Will the child mouth it?
- ☐ Does it mate with other parts?
- ☐ Indoor or outdoor use?
- ☐ Printed, painted or plated?

SECTION 04 · DESIGN & MOULD

COMPONENT DESIGN & MOULD REQUIREMENTS

Toy moulds carry two jobs at once: cosmetic surfaces that sell the toy and safety features that let it be sold.

DESIGN FEATURES THAT AFFECT MOULDING

| FEATURE               | WHY IT MATTERS IN TOYS                                                                   | MOULDING IMPLICATION                                |
|-----------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Edges and points      | Accessible sharp edges and points fail mechanical tests <sup>[4]</sup> .                 | Radii in the tool; clean shut-offs, no flash.       |
| Small parts           | Parts for under-threes must not fit the test cylinder, even after abuse <sup>[3]</sup> . | Size and retention of eyes, wheels and caps.        |
| Interference fits     | Bricks and puzzles depend on clutch and fit <sup>[6]</sup> .                             | Tool accuracy and stable shrinkage per colour.      |
| Bores and gear teeth  | Wheels roll and gears mesh only at the right clearance.                                  | Cavity-to-cavity consistency; POM process control.  |
| Class A surfaces      | Gloss and colour are what the buyer sees.                                                | High-polish or textured steel; gate witness hidden. |
| Snap and screw joints | Ride-ons and walkers are assembled.                                                      | Boss and snap design without sharp exposed ends.    |
| Two-shot soft parts   | Teethers and grips join TPE to a rigid part.                                             | Two-shot or overmould tooling; bond compatibility.  |
| Large flat parts      | Walker trays and cases must stay flat.                                                   | Rib balance, cooling layout, ejection.              |

MOULD CONSIDERATIONS

| ITEM          | TOY POINTS                                                                       | ITEM          | TOY POINTS                                                |
|---------------|----------------------------------------------------------------------------------|---------------|-----------------------------------------------------------|
| Cavity layout | Game pieces, wheels, gears: 8 to 64.<br>Figures: family moulds. Walker trays: 1. | Steel         | Polished or textured cavities; hardened steel for PA6-GF. |
| Runner        | Hot runners cut waste on high-volume small parts.                                | Cooling       | Wall thickness drives cooling time <sup>[10]</sup> .      |
| Gating        | Gate away from Class A faces and fit features.                                   | Family moulds | Balance fill when parts differ in size.                   |
| Venting       | Fine detail and thin ribs need venting.                                          | Mould size    | Walker and ride-on tools need large platens.              |

SAFETY FEATURES BUILT INTO THE TOOL

| SAFETY POINT         | TOOL FEATURE                                          |
|----------------------|-------------------------------------------------------|
| No sharp edges       | Radii cut into cavity and core, not added by trimming |
| No flash             | Tight shut-offs and parting-line maintenance          |
| Retained small parts | Undercuts, bosses and snaps sized for pull tests      |
| No finger traps      | Gap sizes on folding joints set in the drawing        |
| No trapped water     | Drain holes or solid designs for bath toys            |

TOOLING CHOICES THAT SAVE COST

|                                       |                                              |                                       |                                    |
|---------------------------------------|----------------------------------------------|---------------------------------------|------------------------------------|
| FAMILY MOULDS                         | INSERT CHANGES                               | COLOUR PLAN                           | TWO-SHOT                           |
| All parts of a small set in one shot. | Swap details for new characters on one base. | Group tools by colour to cut changes. | Removes glue and an assembly step. |

## SECTION 05 · PRODUCTION PLANNING

# PRODUCTION CAPACITY & CYCLE-TIME PLANNING

Toy demand is seasonal and colour-heavy. Small parts run in many-cavity tools, large baby and ride-on parts run one per shot, and both must be ready before the selling season.

**OUTPUT**

Parts/hour = Cavities × 3600 ÷ Cycle time (s)

Effective/hour = Parts/hour × Utilisation

Day = Effective/hour × Hours run

Utilisation covers colour and mould changes, start-up, maintenance and rejects.

**EXAMPLE 1 · 16-CAVITY ABS BUILDING BLOCK**

16 × 3600 ÷ 12 s = 4,800 /h

× 0.85 utilisation = 4,080 /h

× 22 h = 89,760 /day

× 26 days = 2,333,760 /month

**EXAMPLE 2 · 1-CAVITY PP COPOLYMER WALKER TRAY**

1 × 3600 ÷ 60 s = 60 /h

× 0.85 = 51 /h · × 22 h = 1,122 /day

× 26 days = 29,172 /month

**Working backwards:** for 40,000 trays a month in 572 running hours, you need 70 per hour. Cavities =  $70 \times 60 \div (3600 \times 0.85) \approx 1.4$ , so a 2-cavity mould or a second machine.

*Illustrative example. Cycle times of 12 s and 60 s, 85% utilisation, 22 h per day and 26 days per month are assumptions. Actual requirements depend on the component, material, mould and production conditions.*

**WHAT SETS THE CYCLE TIME**

| PHASE           | TOY INFLUENCE                                                                          |
|-----------------|----------------------------------------------------------------------------------------|
| <b>Filling</b>  | Fine detail and thin walls need fast filling.                                          |
| <b>Cooling</b>  | Usually the largest share; rises roughly with wall thickness squared <sup>[10]</sup> . |
| <b>Flatness</b> | Large trays may need longer cooling to stay flat.                                      |
| <b>Take-out</b> | Class A parts removed without marking.                                                 |

**BALANCING CAVITIES, CLAMP FORCE AND OUTPUT**

| PP TOY WHEEL MOULD | PROJECTED AREA      | CALCULATED FORCE | RATED AT 85% | SHOT  | EFFECTIVE OUTPUT |
|--------------------|---------------------|------------------|--------------|-------|------------------|
| <b>8 cavities</b>  | 40 cm <sup>2</sup>  | 16 t             | 19 t         | 28 g  | 1,632 /h         |
| <b>16 cavities</b> | 76 cm <sup>2</sup>  | 31 t             | 36 t         | 54 g  | 3,264 /h         |
| <b>32 cavities</b> | 148 cm <sup>2</sup> | 60 t             | 70 t         | 106 g | 6,528 /h         |

*Illustrative example. Force = projected area × clamp factor K × safety factor S. PP, PE and PS are commonly given 2 to 3 US tons per square inch<sup>[9]</sup>, about 0.28 to 0.42 t/cm<sup>2</sup>; K = 0.35 t/cm<sup>2</sup> and S = 1.15 assumed. Also assumed: 4 cm<sup>2</sup> and 3 g per wheel, runner area 8 / 12 / 20 cm<sup>2</sup> and weight 4 / 6 / 10 g, 15 s cycle, 85% utilisation.*

**PLANNING TOTAL MACHINE HOURS**

Machine hours =  $\Sigma$  (monthly volume per part and colour ÷ effective output)

Add the hours for every part and colour in the range, then divide by the running hours per machine (572 here) to see how many machines the season needs.

Toy lines change every season, so plan tool life and machine hours per line, not per year. A tool built for a short-lived character line has to pay back within one or two seasons, while basic blocks and game pieces can run for many years on the same tools, so tool life and steel choice follow the expected run.

**MACHINE UTILISATION AND PLANNED DOWNTIME**

|                                                                         |                                                                              |                                                                   |                                                                             |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <b>COLOUR CHANGES</b><br>Run light to dark; purge well between colours. | <b>SEASONAL PEAKS</b><br>Build stock months ahead of festivals and holidays. | <b>SET BALANCE</b><br>Plan all parts of a set to finish together. | <b>CERTIFICATION LOTS</b><br>Keep approved resin and colour lots traceable. |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------|

SECTION 06 · AUTOMATION

AUTOMATION & PRODUCTION EFFICIENCY

In toy plants, automation mostly protects cosmetic surfaces, keeps sets complete and cuts the hand work of assembly and packing.

| AUTOMATION                  | WHERE IT ADDS VALUE IN TOYS                               | WHEN IT USUALLY MAKES SENSE                     |
|-----------------------------|-----------------------------------------------------------|-------------------------------------------------|
| Sprue picker                | Removes runners from game piece, wheel and figure moulds. | Multi-cavity cold-runner moulds.                |
| Robot take-out              | Lifts Class A bodies and large trays without marks.       | Cosmetic parts and large mouldings.             |
| Degating and separation     | Cuts parts from runners cleanly.                          | Figures and accessories with visible gates.     |
| Counting and set packing    | Counts pieces into game and construction sets.            | Sets sold by piece count.                       |
| Vision inspection           | Checks colour, short shots and flash.                     | High-volume parts with cosmetic or fit rejects. |
| Two-shot or insert handling | Moulds soft TPE onto rigid parts.                         | Teethers, grips, bath toys.                     |
| Axle and wheel assembly     | Presses axles into wheels and chassis.                    | Toy vehicles at volume.                         |
| Colour dosing               | Doses masterbatch to approved ratios.                     | Many colours on one machine.                    |

AUTOMATION BY PRODUCT GROUP

| PRODUCT GROUP               | MAIN AUTOMATION                    | WHY                           |
|-----------------------------|------------------------------------|-------------------------------|
| Blocks, game pieces, wheels | Sprue picker, counting, vision     | High counts, fit and colour   |
| Figures and vehicles        | Robot take-out, degating, assembly | Cosmetic surfaces, multi-part |
| Walkers, ride-ons, trays    | Robot take-out                     | Large, heavy parts            |
| Teethers and bath toys      | Two-shot handling                  | Soft and rigid in one part    |

DECIDING ON AUTOMATION

|                                                                                       |                                                                      |                                                                  |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------|
| <b>VOLUME AND LABOUR</b><br>Sorting and counting pieces into sets is heavy hand work. | <b>COSMETIC DAMAGE</b><br>Hand removal can scratch Class A surfaces. | <b>SAFETY</b><br>Clean degating avoids sharp gate stubs on toys. |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------|

INTERFACES TO SPECIFY ON THE MACHINE

|                                                         |                                                    |                                                                      |                                                                 |
|---------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>ROBOT</b><br>Signal interface and safety interlocks. | <b>HOT RUNNER</b><br>Zones for hot-runner control. | <b>TWO-SHOT</b><br>Second injection unit or rotary table, if needed. | <b>AUXILIARIES</b><br>Dosing, conveyor and counter connections. |
|---------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------|

WHERE THE COST OF A MOULDED PART COMES FROM

|                                       |                                    |                                    |                              |                                |                                   |                                  |
|---------------------------------------|------------------------------------|------------------------------------|------------------------------|--------------------------------|-----------------------------------|----------------------------------|
| <b>MATERIAL</b><br>resin, masterbatch | <b>MACHINE</b><br>per machine hour | <b>LABOUR</b><br>degating, packing | <b>POWER</b><br>kWh per part | <b>MOULD</b><br>seasonal tools | <b>REJECTION</b><br>colour, flash | <b>PACKING</b><br>sets, warnings |
|---------------------------------------|------------------------------------|------------------------------------|------------------------------|--------------------------------|-----------------------------------|----------------------------------|

On small pieces, machine hours and set packing dominate. On large baby and ride-on parts, material and cooling time dominate. Use your own rates to compare options.

## SECTION 07 · QUALITY

# QUALITY, TESTING & COMMON DEFECTS

A toy fails in two ways: it looks or fits wrong and does not sell, or it fails a safety test and cannot be sold at all.

## TESTS AND CHECKS

| CHECK                          | WHAT IT INVOLVES                                                                                                                                                           | LINK TO MOULDING                     |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>Indian certification</b>    | Toys must meet the relevant IS and carry the Standard Mark under BIS licence <sup>[1]</sup> . IS 9873 covers non-electric toys and IS 15644 electric toys <sup>[2]</sup> . | Consistent, traceable production     |
| <b>Mechanical and physical</b> | EN 71-1 sets mechanical requirements for toys for children under 14 <sup>[4]</sup> ; IS 9873 Part 1 in India.                                                              | Edges, points, small parts, strength |
| <b>Small parts</b>             | Parts must not fit the test cylinder after use and abuse tests, for under-threes <sup>[3]</sup> .                                                                          | Retention of eyes, wheels, caps      |
| <b>Chemical migration</b>      | EN 71-3 and IS 9873 Part 3 limit elements from toy materials <sup>[2][5]</sup> .                                                                                           | Resin, masterbatch, regrind control  |
| <b>Flammability</b>            | EN 71-2 and IS 9873 Part 2 <sup>[2][4]</sup> .                                                                                                                             | Material choice                      |
| <b>Fit and function</b>        | Clutch, wheel rolling, gear mesh, puzzle fit.                                                                                                                              | Shrinkage, cavity consistency        |
| <b>Appearance</b>              | Colour against standard, gloss, parting lines.                                                                                                                             | Colour dosing, tool polish, flash    |
| <b>Warning labels</b>          | Choking-hazard labelling where small parts apply <sup>[3]</sup> .                                                                                                          | Part size decided at design          |
| <b>Load and drop</b>           | Ride-on and walker parts loaded and dropped as the standard or buyer requires.                                                                                             | Walls, ribs, weld lines              |

Standard parts and editions change. Confirm the current edition and which parts apply to each toy with a recognised laboratory.

## IN-PROCESS CONTROLS

|                                                           |                                                             |                                                     |                                                     |
|-----------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|
| <b>FIT GAUGES</b><br>Go / no-go on studs, bores and pegs. | <b>COLOUR CHECK</b><br>Against master under standard light. | <b>WEIGHT BY CAVITY</b><br>Flags filling imbalance. | <b>EDGE CHECK</b><br>Flash and gate stubs by touch. |
|-----------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|

Hold production to the settings, resin and colour lots of the sample that passed certification.

## TROUBLESHOOTING COMMON DEFECTS

| DEFECT                    | POSSIBLE CAUSES                                | EFFECT ON THE TOY           | AREAS TO INVESTIGATE                 |
|---------------------------|------------------------------------------------|-----------------------------|--------------------------------------|
| <b>Flash</b>              | Worn shut-offs, low clamp                      | Sharp edges, safety failure | Parting line, clamp setting          |
| <b>Sharp gate stubs</b>   | Poor degating, gate design                     | Sharp points                | Gate type and position               |
| <b>Colour variation</b>   | Dosing, lot changes, heat history              | Mismatched sets             | Dosing, masterbatch lot, temperature |
| <b>Poor fit or clutch</b> | Shrinkage drift, pigment effect <sup>[6]</sup> | Loose or tight parts        | Mould temperature, hold, colour      |
| <b>Warpage</b>            | Uneven cooling, ribs                           | Lids and trays do not close | Cooling layout, ejection             |
| <b>Sink marks</b>         | Thick sections, short hold                     | Visible cosmetic faults     | Wall design, hold pressure           |
| <b>Weld lines</b>         | Flow fronts around holes                       | Weak joints, visible lines  | Gate position, melt temperature      |
| <b>Splay</b>              | Moisture in ABS, PA, TPU                       | Streaks, weak parts         | Drying                               |

## SECTION 08 · WORKED EXAMPLES

## PRACTICAL MACHINE-SELECTION EXAMPLES

Three typical toy parts show how the selection logic changes with the component. These are engineering illustrations with assumed inputs, not customer case studies.

| A · PP TOY WHEEL                                                                                                                                                                                                               |                                                                              | SMALL PARTS, VOLUME |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------|
| APPLICATION · MATERIAL                                                                                                                                                                                                         | Push-along vehicle wheel · PP                                                |                     |
| CHARACTERISTICS                                                                                                                                                                                                                | About 3 g, 4 cm <sup>2</sup> projected area (assumed); bore for a metal axle |                     |
| CAVITIES · OUTPUT                                                                                                                                                                                                              | 16 · about 3,264 per hour at 15 s (Section 05)                               |                     |
| MOULD CONSIDERATIONS                                                                                                                                                                                                           | Balanced runner, bore core accuracy, venting                                 |                     |
| SECONDARY                                                                                                                                                                                                                      | Axle assembly                                                                |                     |
| <b>EVALUATE</b> The Section 05 table gives about 31 t calculated and a 54 g shot, so a clamp rated around 36 t or more. Bore consistency matters more than tonnage. <b>STILL NEEDED</b> CAD projected area, axle size, volume. |                                                                              |                     |

| B · ABS BUILDING BLOCK                                                                                                                                                                                  |                                                            | PRECISION FIT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------|
| APPLICATION · MATERIAL                                                                                                                                                                                  | 2×4 construction brick · ABS                               |               |
| CHARACTERISTICS                                                                                                                                                                                         | Studs and tubes on a tight interference fit <sup>[6]</sup> |               |
| CAVITIES · OUTPUT                                                                                                                                                                                       | 16 · about 4,080 per hour at 12 s (Section 05)             |               |
| MOULD CONSIDERATIONS                                                                                                                                                                                    | Precision cavities, cooling balance, cavity tracking       |               |
| SECONDARY                                                                                                                                                                                               | Vision check, counting into sets                           |               |
| EVALUATE Tonnage needs projected area from CAD. Shot and temperature repeatability, and process monitoring cavity by cavity, decide the machine. STILL NEEDED block range, colours, fit gauges, volume. |                                                            |               |

| C · PP COPOLYMER WALKER TRAY                                                                                                                                                                     |                                                  | LARGE PART |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------|
| APPLICATION · MATERIAL                                                                                                                                                                           | Baby walker tray · impact PP copolymer           |            |
| CHARACTERISTICS                                                                                                                                                                                  | Large footprint, ribs, snap points for the frame |            |
| CAVITIES · OUTPUT                                                                                                                                                                                | 1 · about 51 per hour at 60 s (Section 05)       |            |
| MOULD CONSIDERATIONS                                                                                                                                                                             | Flatness, rib balance, radii on every edge       |            |
| SECONDARY                                                                                                                                                                                        | Robot take-out, assembly                         |            |
| EVALUATE Footprint sets clamp force, platen size and tie-bar spacing. Check walker regulations in each market before tooling. STILL NEEDED tray drawing, projected area, target markets, volume. |                                                  |            |

## WHAT DECIDED THE MACHINE IN EACH EXAMPLE

| SELECTION FACTOR | A · TOY WHEEL           | B · BUILDING BLOCK   | C · WALKER TRAY |
|------------------|-------------------------|----------------------|-----------------|
| Main limit       | Cavities, bore accuracy | Repeatability        | Footprint       |
| Clamp force      | About 36 t rated        | Needs projected area | Largest factor  |
| Auxiliaries      | Sprue picker, assembly  | Vision, counting     | Robot take-out  |

*Illustrative example. Actual requirements depend on the component, material, mould and production conditions.*

In all three, the part drawing alone was not enough. The age grade, target markets, fit gauges and colour range had to be known before the configuration could be settled.

## SECTION 09 • BUYER CHECKLIST

# MACHINE BUYER'S CHECKLIST

What to prepare before asking an injection moulding machine manufacturer for a recommendation on a toy or game component.

## COMPONENT

- ☐ 2D drawing and 3D CAD model
- ☐ Part and runner weight, wall thickness
- ☐ Fit dimensions and gauges
- ☐ Cosmetic faces marked
- ☐ Grade and masterbatch data
- ☐ Small parts and retention points

## PRODUCTION

- ☐ Monthly and seasonal volume
- ☐ Colour range per part
- ☐ Cavity count and target cycle time
- ☐ Operating hours and shifts
- ☐ Set and pack counts
- ☐ Selling season dates

## MOULD

- ☐ New or existing mould; size and weight
- ☐ Hot or cold runner
- ☐ Family or two-shot tooling
- ☐ Polish or texture specification
- ☐ Previous machine specification, if any
- ☐ Degating method

## TOY APPLICATION

- ☐ Age grade
- ☐ Target markets and standards
- ☐ Mouthed or food-contact parts
- ☐ Indoor or outdoor use
- ☐ Decoration: print, paint or plating
- ☐ Test lab and certificates needed

## DOCUMENTS TO REQUEST FROM THE MACHINE SUPPLIER

### PLATEN DRAWING

Tie-bar spacing, mounting holes, ejector pattern, nozzle details.

### LAYOUT

Footprint, robot and conveyor space, access.

### UTILITIES

Connected load, cooling water, air and oil needs.

### TRIAL REPORT

Trial or acceptance data at your settings.

## QUESTIONS TO ASK BEFORE YOU BUY A MACHINE

| #  | QUESTION                                                               | WHY IT MATTERS FOR TOYS            |
|----|------------------------------------------------------------------------|------------------------------------|
| 1  | What shot repeatability does the machine hold at my shot size?         | Fit of blocks, puzzles and wheels. |
| 2  | How stable are barrel and mould temperatures over a shift?             | Colour and shrinkage consistency.  |
| 3  | How many hot-runner zones can the machine control?                     | Many-cavity small parts.           |
| 4  | Will my largest walker or ride-on mould fit, with the stroke it needs? | Large baby and ride-on parts.      |
| 5  | Is two-shot or overmoulding possible on this platform?                 | Teethers, grips, soft-touch parts. |
| 6  | What robot, vision and dosing interfaces are supported?                | Cosmetic parts and colour control. |
| 7  | Can the control store settings per mould and colour?                   | Frequent seasonal changes.         |
| 8  | Can the machine log shot data for batch traceability?                  | Certification and recalls.         |
| 9  | What is the energy use per part at my cycle?                           | Low price per toy.                 |
| 10 | What installation, training and spare-parts support is included?       | Uptime before the selling season.  |

## SECTION 10 · TECHNICAL CONSULTATION

## PRATISHNA ENGINEERS &amp; TECHNICAL CONSULTATION

Pratishna Engineers Ltd. is a Mumbai-based injection moulding machine manufacturer with in-house design, manufacturing, assembly, testing and service, supplying plastic component manufacturers in India and international markets.

35+

YEARS OF EXPERIENCE

9,000+

MACHINES SUPPLIED

1,000+

CUSTOMERS

In-house

DESIGN TO SERVICE

Machines are used for automotive, packaging, electrical and electronics, medical, consumer, agriculture and industrial applications.

## OUR TECHNICAL APPROACH

| COMPONENT                                                                          | MATERIAL                                                            | MOULD                                                              | PRODUCTION REQUIREMENT                                           | MACHINE CONFIGURATION |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------|-----------------------|
| <b>1 · CALCULATE</b><br>Clamp force and shot weight from part, cavities and grade. | <b>2 · CHECK THE MOULD</b><br>Size, stroke, core pulls and inserts. | <b>3 · CHECK OUTPUT</b><br>Cycle and cavities against your volume. | <b>4 · CONFIGURE</b><br>Screw, barrel, controls and auxiliaries. |                       |

## SEND YOUR COMPONENT &amp; PRODUCTION REQUIREMENTS

Component drawing · material · part weight · mould details · cavity count · production requirement · other requirements such as age grade, target markets, safety standards or automation.

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Actual injection moulding machine and process requirements vary according to the component design, material, mould, production volume, machine configuration and operating conditions. The information, examples, calculations and recommendations provided should be independently evaluated and verified for the specific application before making any equipment, process or production decision. Information obtained from third-party sources remains subject to the accuracy and limitations of those sources.

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