

# Uni-TechSpace



## Plastic Fasteners

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## Plastic Fasteners Introduction

In applications where high mechanical strength is not required and service temperature is moderate, plastic fasteners possess several properties that make them the preferred alternative over their conventional metal counterparts:

- Thermally insulative
- Electrically insulative
- Low electromagnetic interference
- Corrosion resistant
- Biocompatible
- Non-magnetic
- Low density
- Anti-static
- Highly moldable

## Materials

The group of polymer materials used for manufacturing of fasteners at Unisteel is known as thermoplastics. The main advantage of thermoplastics compared to another group of plastics, the thermosets, is that thermoplastics can be recycled. This keeps wastes to minimum. Thermoplastics are also generally easier to form.

- Polyamide (PA)/High Performance Polyamide (HPPA)
- Polycarbonate (PC)
- Polyetheretherketone (PEEK)
- Polyimide (PI)
- Polypropylene (PP)
- Polyphenylene Sulphide (PPS)
- Polytetrafluoroethylene (PTFE)
- Polyoxymethylene (POM)
- Liquid-crystal Polymer (LCP)



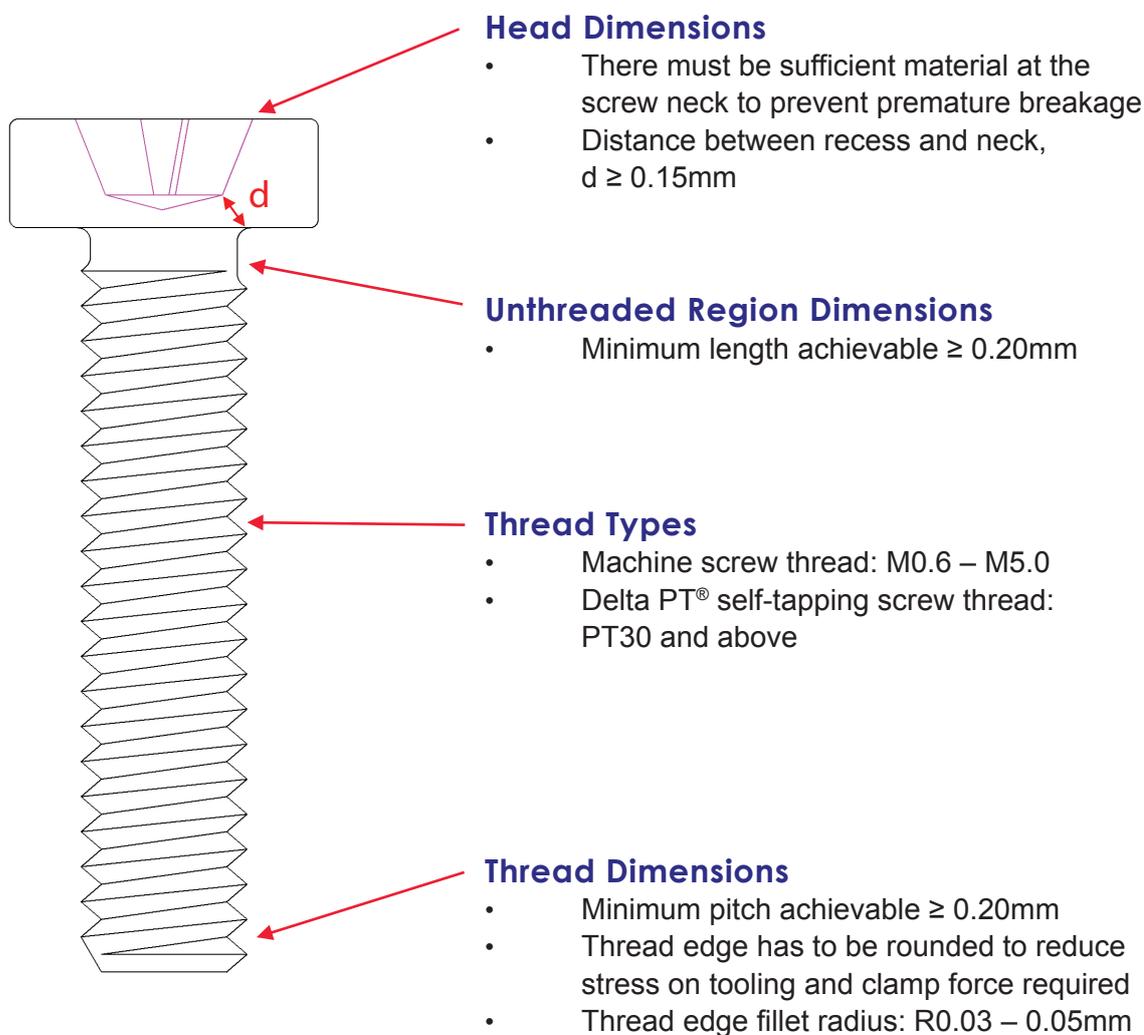
*(Refer to plastic screw brochure for more details on plastic materials available)*

Depending on the applications of the end product, different additives can be added to enhance any desired properties. For example, mineral fillers are added for better plastic surface quality while glass fibres are commonly added to reinforce plastics. For fasteners, fibres can take up to 55 – 60% mass of fibre-reinforced polymers such as HPPA for superior mechanical performance.

While the material for machine screws can be any of the above, thread-forming screws with Delta PT® threads require harder, fibre-reinforced polymers such as HPPA, PPS, LCP to form thread patterns in pilot holes. Conversely, pilot hole materials should be made of softer plastics like PC, PE and ABS.

## Designs of Plastic Fasteners

Plastic injection moulding for plastic screws is one of Unisteel's core technologies. Our machines are capable of forming screws with head designs and recess types similar to metal screws. However, there are minor differences in plastic screw dimensions that have to be considered.



### Head Dimensions

- There must be sufficient material at the screw neck to prevent premature breakage
- Distance between recess and neck,  $d \geq 0.15\text{mm}$

### Unthreaded Region Dimensions

- Minimum length achievable  $\geq 0.20\text{mm}$

### Thread Types

- Machine screw thread: M0.6 – M5.0
- Delta PT® self-tapping screw thread: PT30 and above

### Thread Dimensions

- Minimum pitch achievable  $\geq 0.20\text{mm}$
- Thread edge has to be rounded to reduce stress on tooling and clamp force required
- Thread edge fillet radius: R0.03 – 0.05mm

## Manufacturing of Plastic Fasteners

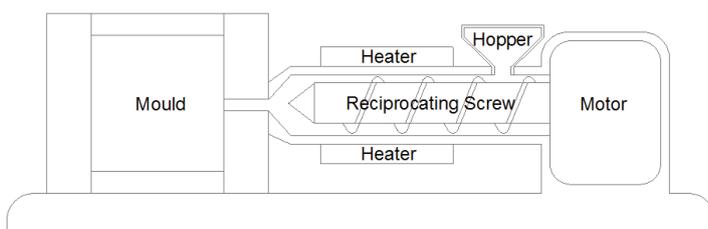


*Injection Moulding Machine (Sumitomo SE50EV-A C160)*

All plastic fasteners at Unisteel are produced using horizontal injection moulding machines, which can be split into 2 parts: injection and clamping. Below are the steps involved in the injection moulding:

### Pelletising:

- Plastic pellets are the raw materials for screw injection moulding
- For fibre-reinforced plastics, fibre filaments are pulled through melted polymer, so that they become embedded in the plastic material
- The composite is cooled down and chopped into small pellets

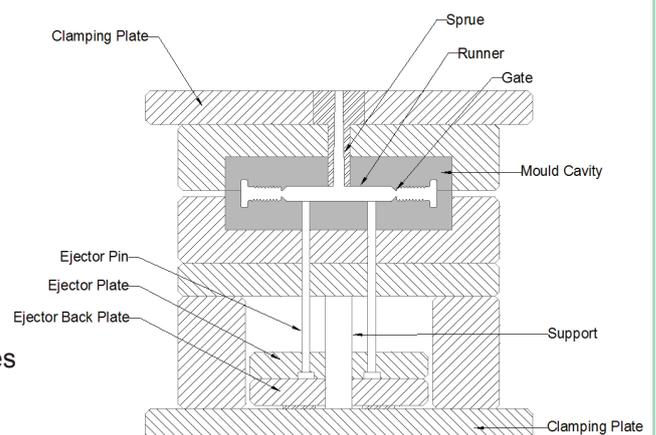


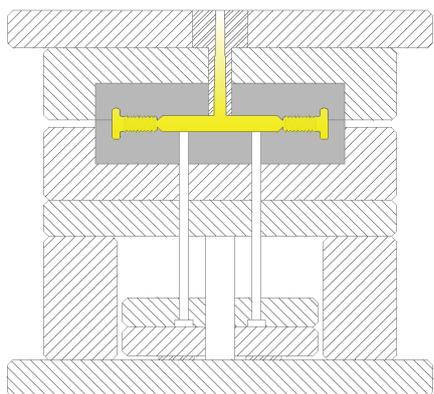
### Injection:

- Hopper drops pellets into machine barrel
- Reciprocating screw rotates to push pellets towards the nozzle
- Heater in barrel heats and melts pellets uniformly
- A shot (volume of melted plastic) is gathered at nozzle and injected into the mould

### Clamping:

- Before the shot is injected, the movable clamping plate closes with a high clamp force
- Clamp force is a function of:
  - Part size and geometry
  - Material properties
  - Number of cavities
  - Presence of sharp corners
- The clamping force of injection moulding machines used at Unisteel ranges from 50 tonnes – 130 tonnes to suit different designs



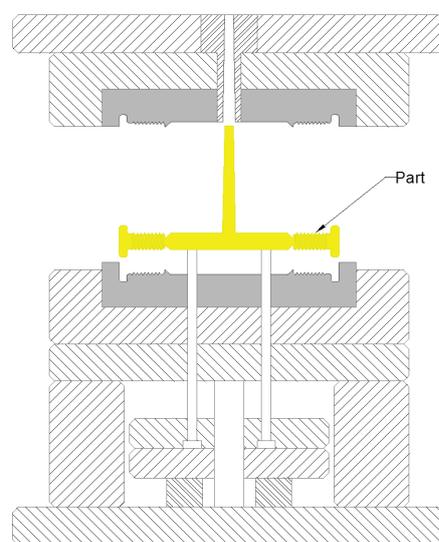


### Moulding:

- Plastics are forced through the sprue, with a valve that prevents backflow of molten plastics
- Runners are channels that guide the plastics to flow pass the gates into mould cavities
- At Unisteel, for fasteners production, the number of cavities are 8 and 16, whereas the number of cavities for plastic nuts are 4 and 8
- Hence, high production rates of 12k, 22k and 40k parts per day are achievable for 4, 8 and 16 cavities respectively

### Part Ejection & Separation:

- Part is cooled down in the mould so that it solidifies
- The movable plate opens and ejector pins pushes the formed part out for easy removal
- Screws are parted off the runner using a specially designed de-gating jig



## Quality Assurance

The range of quality assurance tests are similar to metal screws, including dimensional and mechanical checks. In addition, our company also performs appearance and application verifications that are specific to plastic screws. Below are an assortment of tests conducted for fasteners made of polymer materials:

- Thread ring gauge GO/NO-GO test
- Recess penetration depth check
- Overall dimensional measurement
- Breaking torque test
- Appearance and surface check
- Application tests



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