Machining and its Importance in Engineering

# Engineering and its Importance in Machining

The Importance of Machining

- I'd say by now we are well aware of how machining is important.

- If we want to take our designs from the virtual to the real world, this can only be achieved through manufacturing.

- Machining is incredibly important for the manufacture of metal products, but can also be applied to plastics, woods, ceramics and composites.
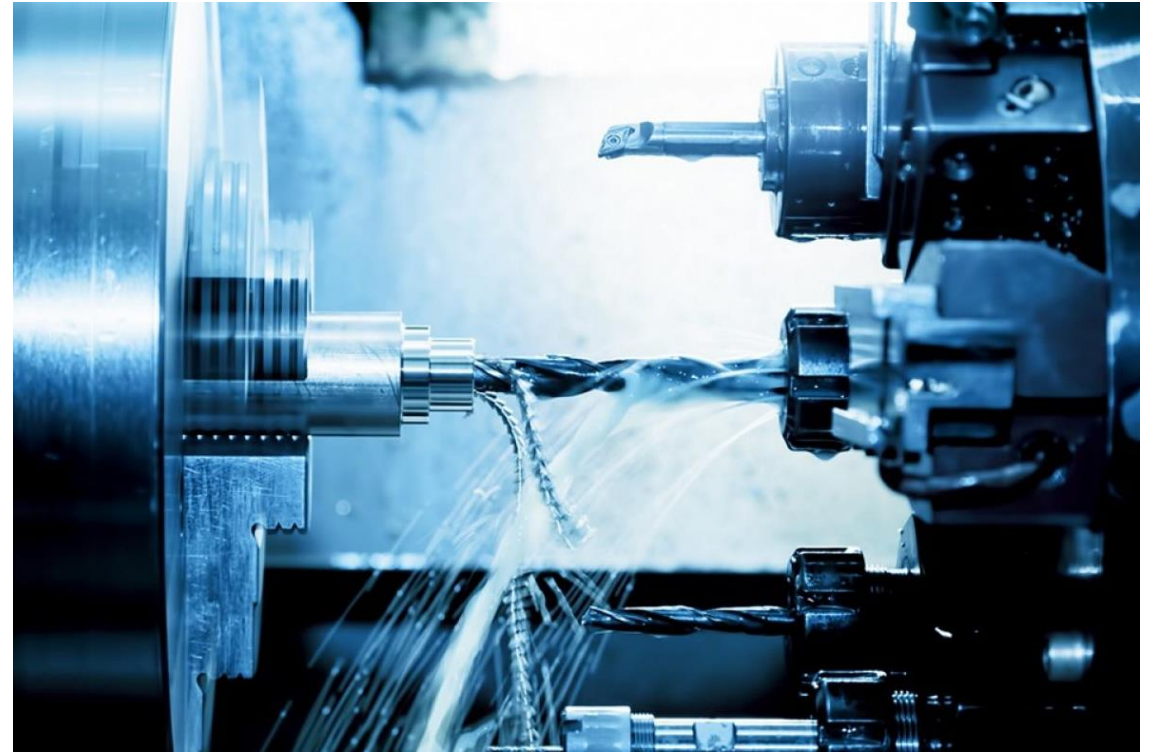
The Rules of Engagement

- If we want to manufacture products, we must face reality.

- Tolerancing systems are the only way we can reconcile the perfect (nominal) dimensions in CAD/CAM and what the machine is capable of achieving.

- Let's take a closer look at one of the most important tolerancing systems in engineering.

- This is a great video that covers off all the fundamentals

  - https://www.youtube.com/watch?v=wvVMs2BZdeU
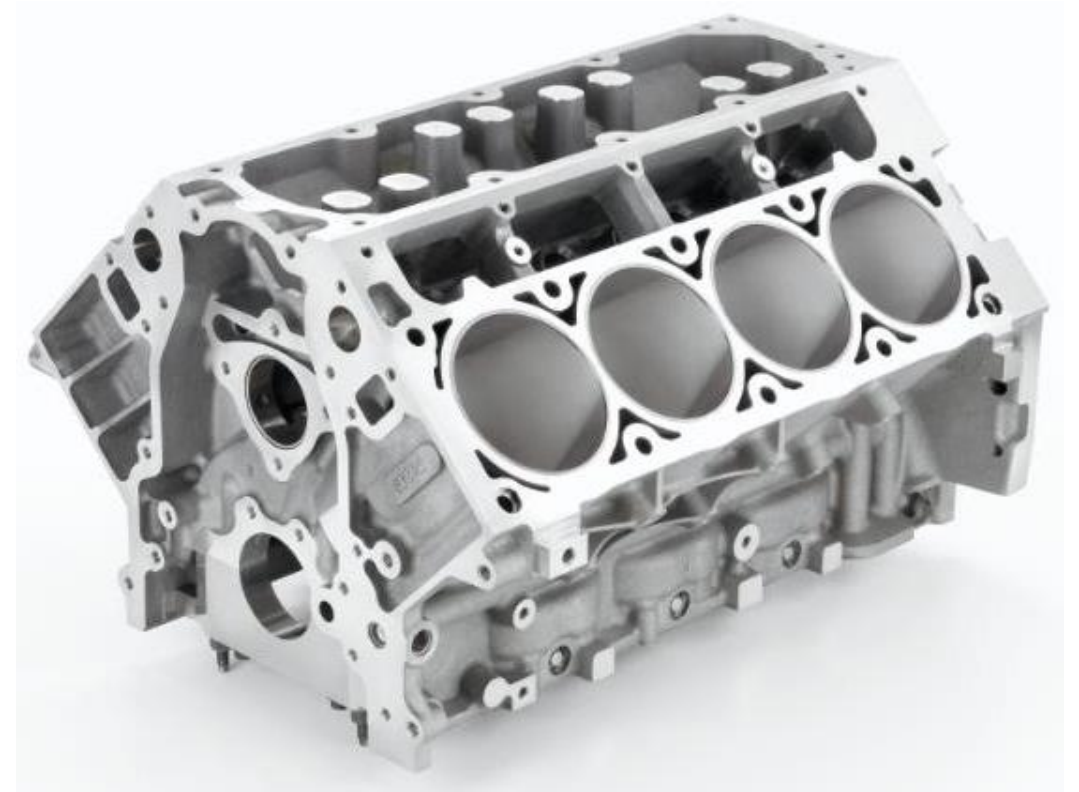
Hole-Basis and Shaft-Basis Systems

- A shaft is a component that fits into a hole.

    – Can be stationary or rotating

- A hole is a feature in a component that (often) houses or fits a shaft

    – Can also be stationary or rotating

Hole-Basis and Shaft-Basis Systems

- Any time we talk about tolerances, we need to appreciate the physical limits for the holes and shafts.

- Maximum Material Limit (MML)

  – The maximum (upper) limit for an external feature (shaft)

  – The minimum (lower) limit for an internal feature (hole)

- Least Material Limit (LML)

  – The minimum (lower) limit for an external feature (shaft)

 – The maximum (upper) limit for an internal feature (hole)
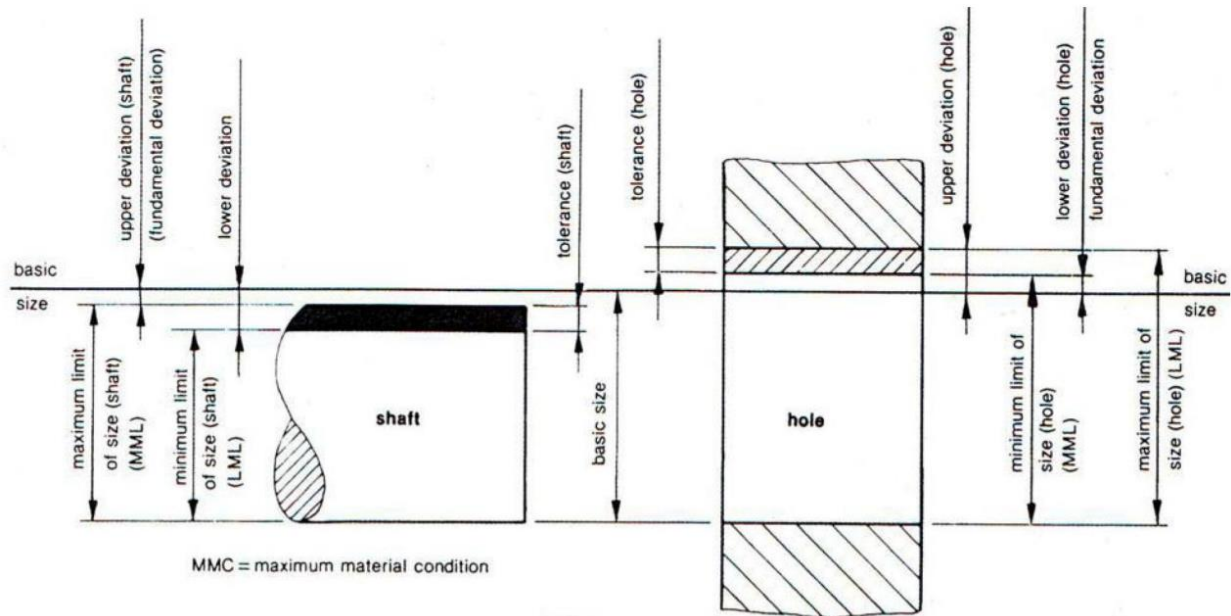
Hole-Basis and Shaft-Basis Systems

There are three main types of fits:

1. Clearance fit

   - Relative motion between the shaft and the hole is always possible.

   - Shaft is always smaller than the hole.

   - Minimum clearance occurs at maximum shaft and minimum hole size.

   - Maximum clearance occurs at minimum shaft size and maximum hole size.
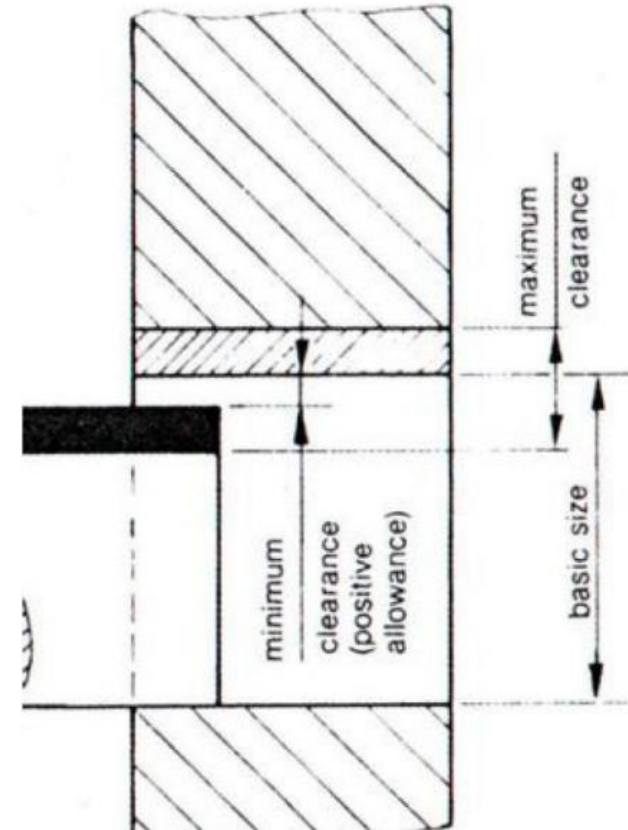
Hole-Basis and Shaft-Basis Systems

There are three main types of fits:

2. Interference fit

  – Relative motion between the shaft and the hole is not possible.

  – Shaft is always larger than the hole.

  – Minimum interference occurs at minimum shaft and maximum hole size.

  – Maximum interference occurs at maximum shaft size and minimum hole size.
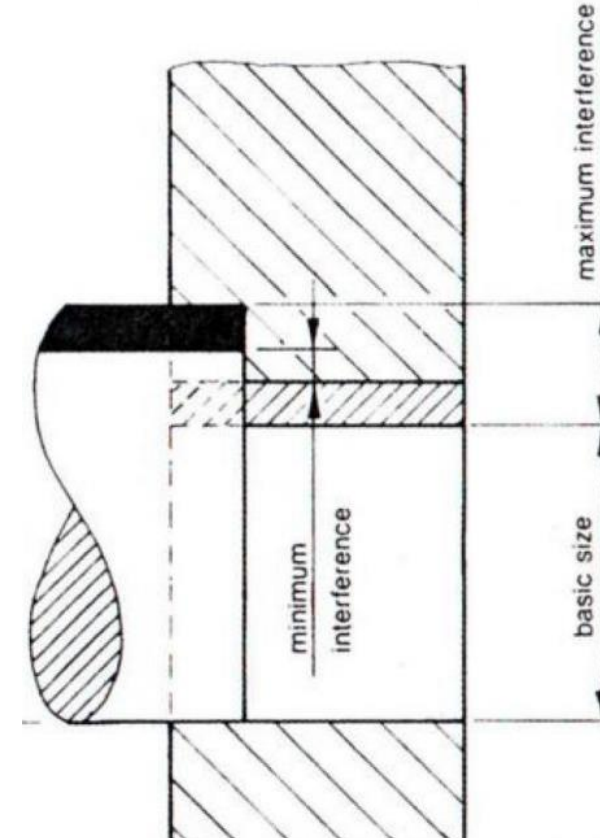
Hole-Basis and Shaft-Basis Systems

There are three main types of fits:

3. Transition fit

   – Relative motion between the shaft and the hole is sometimes possible.

   – The tolerance zones overlap and allows for either clearance or interference fits.

   – Maximum interference occurs at maximum shaft and minimum hole size.

   – Maximum clearance occurs at minimum shaft size and maximum hole size.

   – Two common transition fits are light push fit and heavy push fit
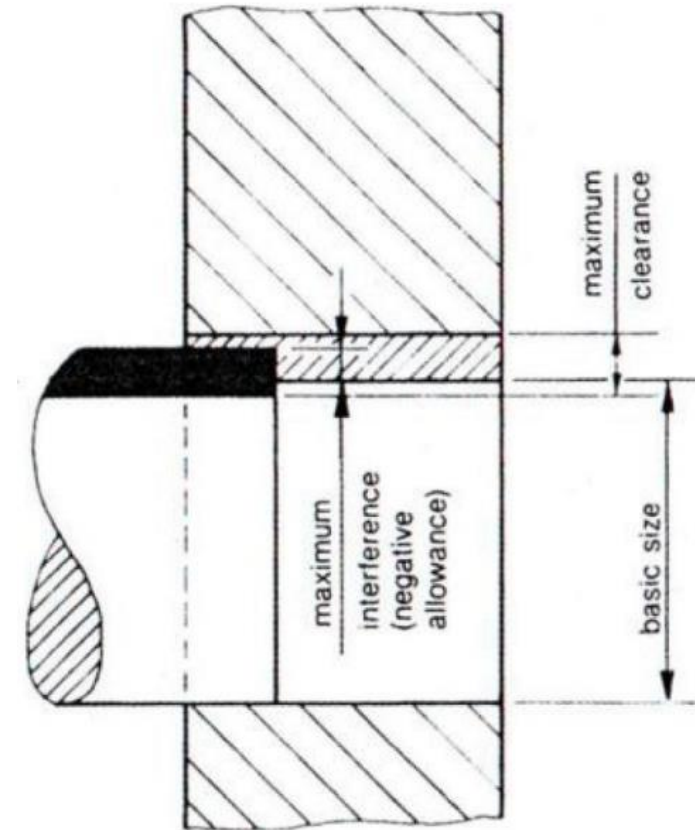
Hole-Basis and Shaft-Basis Systems

- When designing systems that utilise shafts and holes, we have two options.

- Hole-basis (Tables 4.1a in Boundy)

  - Hole is treated as standard with zero fundamental deviation

  - More commonly used.

  - Easier to produce standard holes

  - Easier to turn the shaft to accommodate the hole

Hole-Basis and Shaft-Basis Systems

- When designing systems that utilise shafts and holes, we have two options.

- Shaft-basis (Tables 4.1b in Boundy)

  – Shaft is treated as standard with zero fundamental deviation

  – Is desirable in some cases when the shaft needs to have a large number of parts fitted to it.

    » Such as?

Hole-Basis System

Clearance fit (Normal Running) H8/f7

Assume Basic size 31mm diameter

Hole tolerance: +0.039 max and +0.000 min

Shaft tolerance -0.025 max and -0.050 min

Shaft-Basis System Example

Clearance fit (Normal Running) F8/h7

Assume Basic size 31mm diameter

Hole tolerance: +0.064 max and +0.025 min

Shaft tolerance: -0.000 max and -0.025 min

What fit and system is best here?

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