A computer programme has been developed which enables the moulding cavity to be precisely generated to compensate for predictable moulding shrinkages in the tooth form.

It is advantageous if in the component design certain elementary component design rules are followed. To help with these points the following diagrams and notes have been compiled.

1. (a) Thick sections result in longer cycle times and increase the risk of void and sink marks.
(b) The practical maximum wall thickness in plastic mouldings is 12mm but desirably should be cored out to an overall section thickness of 3mm using ribs to give additional strength where necessary.

![Fig 19 Bad design](image1)
![Fig 19 Good design](image2)

2. Wall thicknesses should be kept uniform to prevent distortion and the formation of voids.

![Fig 20](image3)

3. Incorrect design of bosses can also cause areas of varying section thickness and lead to inaccuracy and voids.

![Fig 21 Bad design](image4)
![Fig 21 Good design](image5)

4. Inserts should be carefully selected to avoid areas of concentrated stress.

![Fig 22](image6)

5. Where run out tolerance is tight the addition of off centre holes can give unacceptable errors. Inserts and holes can often be added after moulding.

6. Ribs can be used to compensate for the loss of rigidity due to coring out. Rib thickness should be kept to 1/3 of the section thickness. Rib height should generally be 3 times the rib thickness.
7. a) Radii and/or fillets should be added to all sharp intersections (1 mm is adequate) otherwise variations in section thickness may occur.

b) Radii and fillets streamline the flow and reduce stress since most engineering plastics are notch sensitive.

Fixing to Shafts
This can be achieved in many ways. The following are recommended for plastic gears and pulleys (in approximate order of effectiveness).

- Mould directly onto metal hub — superior
- Cross pin
- ‘D’ hole
- Square hole
- Keyway
- Grub screws
- Split boss for clamp fixing
- Push fit (small clock gears) — subject to relaxation
- Adhesives

likely to cause stress problems.

Recommendations on Materials
Crystalline materials (Acetal, Nylon, Polyester) are normally preferred to Amorphous materials (Noryl, Polycarbonate) because of better wear properties and superior fatigue resistance. They also have better chemical resistance of oil and greases. Amorphous materials are sometimes selected where low mould shrinkage is desirable.

Acetal is preferred to Nylon because of lower moisture absorption which gives better dimensional stability.

Glass filled materials give far greater strength but inferior wear properties. This is normally attributed to the abrasive nature of exposed glass fibre and also the harder surface finish of the glass filled grades which do not absorb the loose particles in the same way as softer unfilled grades.

Dissimilar materials give best results between mating gears, particularly Nylon/acetal.

Nylon has the best wear properties when mated with steel and can be improved further with the addition of Mo, Si, and Graphite.

Friction and wear are reduced where the mating metal component is polished 2–5μm finish. Friction and wear may also be reduced by using harder materials.

The coefficient of friction is greatly increased when temperatures exceed 80°C and it is dramatically reduced by the presence of oil or grease.