TOP TEN DESIGN TIPS

By Jürgen Hasenauer, Dieter Küper, Jost E. Laumeyer and Ian Welsh

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7. General assembly technology

The best assembly techniques – Part I

General Assembly Technology – Snap-fit, press-fit and threaded assemblies are simple techniques that allow designers to exploit great potential production savings through simple, rapid assembly of components.

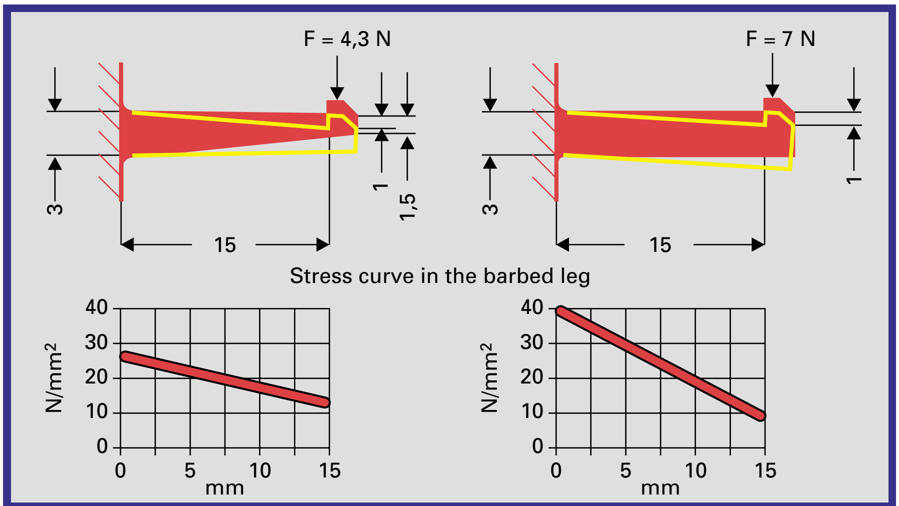
Assembly techniques can be divided into detachable and non-detachable types. The following techniques come under the category of non-detachable assemblies:
- welding
- riveting
- adhesive bonding
- insert technology
- snap-fits with 90° retaining angle.

Detachable assemblies include:
- snap-fits with < 90° retaining angle
- threaded assemblies
- hub assemblies
- press-fit assemblies.

Material	Permissible strain in %
POM homopolymer	about 5-8
PA unreinforced (cond.)	about 4-6
PA unreinforced (dry)	about 3
PA66 GR (conditioned)	about 0,9-1,5
PA66 GR (dry)	about 0,8
PET GR	about 0,5-0,8
PBT GR	about 0,7-1,5

Permissible material strains
(Values are valid only for a single assembly operation)

Fig. 1



Stress distribution with different cross sections

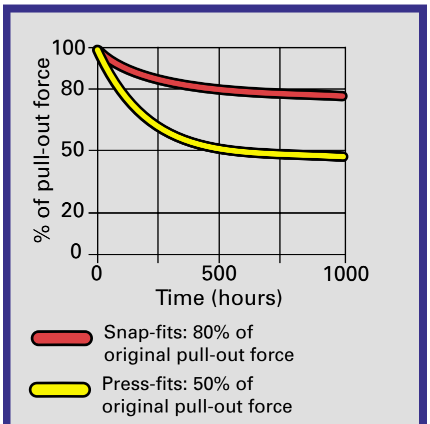
Fig. 2

Snap-fit Assembly Design

The great advantage of snap-fits is that with this technique no additional elements are needed to make the assembly.

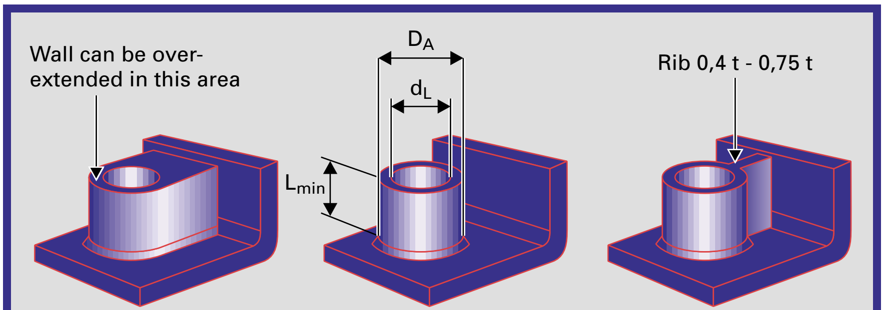
The most commonly used types of snap-fits in plastics technology are:
- barbed-leg-type snap-fits
- cylindrical snap-fits
- ball-and-socket snap-fits.

With all these snap-fit designs, designers must ensure that the geometry of the assembly allows the components to be as stress-free as possible after assembly to avoid stress relaxation, which would loosen the assembly with time.



Effect of time

Fig. 3



Material	d_L (mm)	D_A (mm)	L_{min} (mm)
POM	0,75 d	1,95 d	2,0 d
PET GR30	0,8 d	1,8 d	1,7 d
PBT GR30	0,8 d	1,8 d	1,7 d
PA66 GR30	0,82 d	2,0 d	1,8 d
PA66	0,75 d	1,85 d	1,7 d

d = Nominal screw diameter

Design recommendations for EJOT PT screws

Fig. 4

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Basic design principles

The design of a snap-fit assembly is determined by the permissible strain of the material to be used. Care should be taken with polyamide, for example, because in the dry state this material generally permits considerably lower strains than in the conditioned state. Glass fibre content also has an important effect on the permissible strain of the material and thus also on the permissible deflection of the barbed leg (Fig. 1).

In a barbed-leg-type snap-fit, tapering of the deflecting leg reduces stress (Fig. 2). This design allows better stress distribution over the entire bending length. Stress concentration peaks at the base of the leg are less and assembly forces are considerably reduced.

Failure to radius the junction between the base of the barbed leg and the main body of the component, or to provide sufficiently large radii in this area, often results in weak points. In principle, a sufficiently large radius should be provided to avoid stress concentration peaks. Cylindrical and ball-and-socket-snap-fits often have to be slotted to facilitate assembly; in this case the slot end must not be designed with a sharp edge.

Press-fit Assemblies

Press-fits enable high-strength assemblies to be made between plastic components at minimal cost. As with snap-fit assemblies, the pull-out force of a press-fit assembly decreases with time as a result of stress relaxation (Fig. 3). Design calculations must take this into account. In addition, tests with the expected service temperature cycles must be carried out to confirm the feasibility of the design.

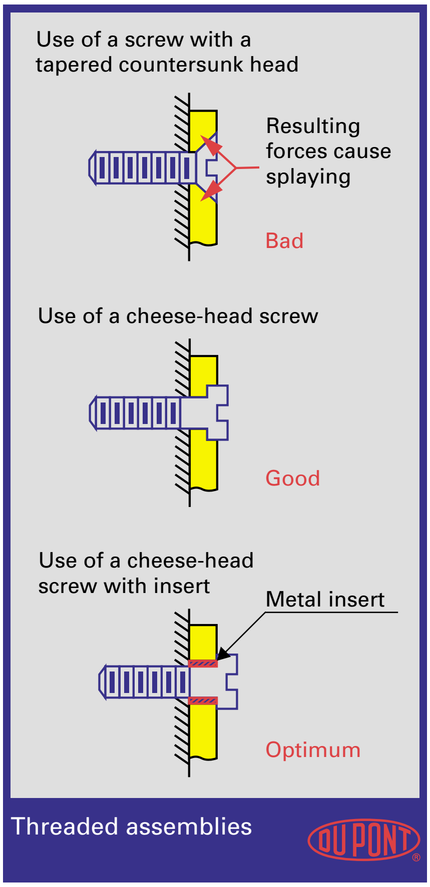

Fig. 5

Threaded Assemblies

Threaded assemblies can be produced with thread-cutting or thread-forming screws, or by the use of integrally moulded threaded inserts. The flexural modulus of the material to be used provides a good guide to the type of threaded assembly that is most appropriate. For example, up to a flexural modulus of about 2800 MPa, thread-forming screws may be used.

Metal inserts must be used if metric screws are required or if the threaded assembly is intended to be undone several times. To prevent premature component failure, it is important to ensure correct dimensioning of the boss (Fig. 4). Screw manufacturers give recommendations on this.

Screws with a tapered countersunk head should as a general rule be avoided in plastics assembly technology since the resulting forces (Fig. 5) cause the screw hole to “splay out”. One possible result of such additional stress is that weld lines can easily rupture.

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