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| DVS – DEUTSCHER VERBAND FÜR SCHWEISSEN UND VERWANDTE VERFAHREN E.V. | **Mechanical joining of plastic components – Snap joints** | DVS Technical Code DVS 2242-1 |
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*Replaces July 2003 edition*

**Contents:**



## 1 Scope of application

The joining of components and construction elements with snap joints is a joining technology appropriate for plastics. Snap joints constitute one of the joining technologies which are economically viable and appropriate for plastics. In the manufacturing process, they can be connected directly to the component as a result of a corresponding tool configuration. Advantages are short assembly times and the fact that no additional assembly elements are necessary. Additional costs are incurred due to the scope of the work during the tool configuration. Snap joints are suitable, in particular, in the case of larger quantities.

This technical code applies to the joining of mouldings with snap joints which click into an undercut in the joining member during the assembly and thus lead to a non-positive-locking joint. It is characteristic of snap joints that a protruding element is deflected for a short time, clicks into a corresponding recess in the joining member and thus creates a non-positive-locking joint. Because of the complexity of the configuration possibilities of snap joints, it is not possible to describe the joining technology in a closed form. The technical code therefore introduces essential influencing variables which should be taken into consideration during the designing, the processing, the joining operation as well as the utilisation of the joined components. At present, it is difficult to carry out purely computational designing because some of the material/component parameters are not available. Corresponding calculation software can be used for the approximate designing of the snap joint. However, it is always recommended to experimentally validate the results on functional specimens close to practice.

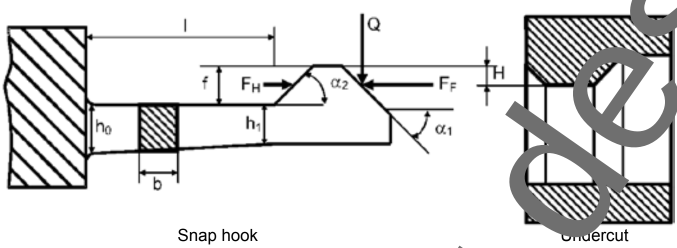
## 2 Functional principle

It is characteristic of snap joints that the material is subjected to high loads for a short time during the joining operation and, in most cases, only to low loads after the joining operation depending on the operating load. It is common to all snap joints that a protruding element (e.g. a hook, a nub or a bead) is deflected for a short time during the assembly and clicks into a recess (undercut) in the joining member (Fig. 1).

**Table 1. Variables of a snap hook.**

| **Characteristic dimensions of a snap hook** | |
|---|---|
| $F_F$ | Joining force |
| $F_H$ | Holding force |
| Q | Deflection force |
| H | Snap height (undercut) |
| f | Maximum snap height |
| l | Lever arm length |
| $h_0$ | Profile height at the foot of the snap hook |
| $h_1$ | Profile height at the tip of the snap hook |
| b | Profile width |
| $\alpha_1$ | Joining angle |
| $\alpha_2$ | Holding angle |

The typical geometrical dimensions are indicated in Table 1. By altering the corresponding variables, the releasability of snap joints can be executed from easy via difficult right up to practically unreleasable. Releasable snap joints can be dismantled quickly and without any special jigs, e.g. in the case of recycling-oriented designs, and can even be reassembled.




Snap hook Undercut

**Figure 1.** Functional principle of a snap hook.



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## 3 Classification of snap joints

A large number of different snap joints are utilised in practice. In general, these can be distinguished according to the course of their lines, i.e. according to the contact lines between both joining members. Accordingly, a distinction may be made between the five basic shapes portrayed on Fig. 2.

Torsional snap joints

Torsional snap joints are a rarely applied but efficient and easy-to-release joining process. Due to a deflection force Q, the formation of the snap arm as a double rocker on an axis predominantly subjected to torsional stresses allows the joint to be opened easily. Typical applications are frequently releasable housings/covers.

Snap hooks

Click-in cams which are stiff on one side and have sprung hooks on the opposite side lead to an arrangement which is practically immovable and, depending on the designing of the holding angle, nevertheless releasable. An increase in the wall thicknesses towards the clamp prevents any deformation-induced breaks.

Annular snap joints

After clicking-in, an annular snap joint connects two rotationally symmetrical mouldings in a largely relaxed but positive-locking form. Depending on the dimensioning of the bead and its angles, the joint is releasable or non-releasable. Because of the normal stresses applied in the circumferential direction, the assembly is associated with, in part, high joining forces. Typical applications are lamps, bottle tops or hinged connectors.

Segmented annular snap joints

The segmented annular snap joint constitutes a special shape of the conventional annular snap joint. Due to the targeted separation of the closed course of the lines, the required joining force can be reduced considerably. Of course, the holding force is also decreased in this respect. This can be achieved not only by the number of subdivisions but also additionally by the gap width.

Special shapes

The special shapes relate to annular snap joints in the widest sense. This joint type exhibits a closed course of the lines which does not have to be characterised by rotational symmetry.

## 4 Dimensioning of snap joints

Snap elements are designed in relation to the deformation. The deflection arising during the snapping-in operation is designated as the undercut. In order to illustrate the procedure during the designing, an example of the calculation of a snap hook is provided below.

### 4.1 Analytical designing of a snap hook

In order to calculate the snap hook, it must be ensured that the permissible strain $\varepsilon$ of the material is not exceeded by the deflection during the joining operation and that the snap hook is not destroyed at an early stage. The mathematical relationship portrayed in Equation 1 can be used for this purpose.

$$H_{zul} = \frac{2}{3} \cdot \frac{l^2}{h_0} \cdot \frac{\varepsilon_{zul}}{100} \qquad \text{(Eq. 1)}$$

with:

$H_{zul}$ permissible undercut [mm]
$l$ lever arm length [mm]
$h_0$ profile height at the foot of the snap hook [mm]
$\varepsilon_{zul}$ permissible strain [%] (dependent on the utilised material)

The deflection force Q can be calculated according to Equation 2 depending on the undercut to be overcome, the lever arm length and its geometrical structure as well as on the corresponding modulus:

$$Q = \frac{3 \cdot H \cdot E \cdot I}{l^3} \qquad \text{(Eq. 2)}$$

with:

Q deflection force
H undercut
E secant modulus (Es) in the case of short-time loads
creep modulus (Ec) in the case of long-time loads
I axial area moment
l lever arm length [mm]

Taking account of the angles on the snap hook and the friction conditions (Fig. 3), the joining force can also be calculated from this (Equation 3).

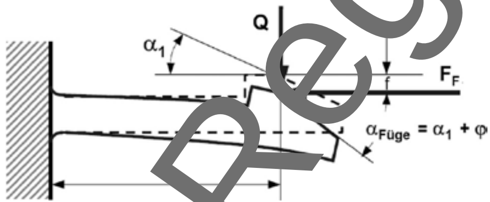


**Figure 3.** Consideration of the friction conditions during the joining [3].

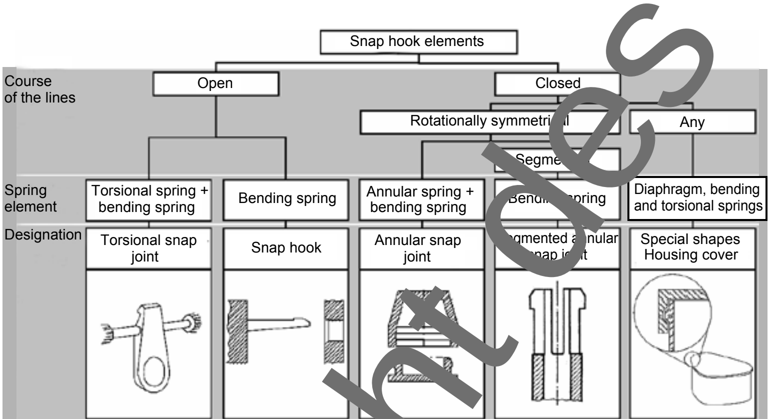


**Figure 2.** Executions of snap joints [2].