December 2008

DVS – DEUTSCHER VERBAND FÜR SCHWEISSEN UND VERWANDTE VERFAHREN E.V.

Thread inserts for the joining of mouldings made of plastics

DVS
Technical Bulletin
DVS 2240-1

Translation of the German version from May 2005

Contents:

1 Scope of application

This technical code applies to the joining of mouldings made of plastic with inserts. The "insert" term is equivalent to the "(thread) insert" and "bush" terms used in the literature. Inserts may possess an internal thread or a threaded bolt. The technical code presents the various incorporation procedures and provides the designer with criteria for the designing of such joints. Purely computational designing is not possible at the moment because of the diverse influencing variables. Therefore, experiments and queries to manufacturers of raw materials, inserts and machines are always necessary.

Further information about the incorporation procedures for inserts is provided in the DVS 2216-4 technical code, "Ultrasonic joining and processing of mouldings and semi-finished products made of thermoplastics in series fabrication – Embedding of metal parts and dissimilar materials with ultrasound".

2 Procedural description

The screwing of components with inserts is a detachable joining procedure which is utilised preferably whenever particular requirements exist for functional reasons or because of assembly or service aspects. An insert with an internal thread is incorporated into one joining member. The other joining member can be braced with this using standard screws. Inserts are introduced not only into preformed screw-in tubes but also directly into the wall of the plastic component.

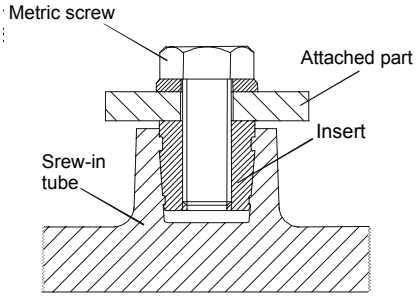

Figure 1. Screwed joint into an insert.

The geometrical executions and anchoring mechanisms of the inserts differ depending on the incorporation procedure, which can be divided into two methods:

- **mould-in technique** in which the inserts are placed in the mould before the component is manufactured (e. g. injection moulding or pressing) and the polymer material flows around them
- **after-moulding technique** in which the inserts are incorporated into the finish-moulded component afterwards

Figure 2 shows an overview of the different incorporation procedures for inserts.

Inserts are manufactured not only from metal (e. g. brass, steel or aluminium) but also from glass fibre-reinforced thermoplastics.

2.1 Mould-in procedure

In the case of the mould-in procedure, the inserts are placed in the mould before the component is manufactured (e. g. injection moulding or pressing) and the polymer material flows around them. The inserts must be positioned exactly before the tool is closed so that the polymer material can be sprayed around or can flow around thread inserts in the injection moulding or extrusion tool. This happens either manually or using automatic positioning facilities and results in extended cycle times. In addition, there is the danger of tilting in the tool and even of falling-out. In certain circumstances the inserts must be heated before the spraying around in order to avoid any residual stresses in amorphous thermoplastics. Some of the inserts around which the polymer material can be sprayed are standardised according to DIN 16... These have basic construction shapes which are portrayed on page 3.

DVS, Technical Committee, Working Group "Joining of Plastics"

Orders to: DVS Media GmbH, P. O. Box 10..65, 40..0 Düsseldorf, Germany, Phone: +49(0)211/1591-0, Telefax: +49(0)211/1591-150

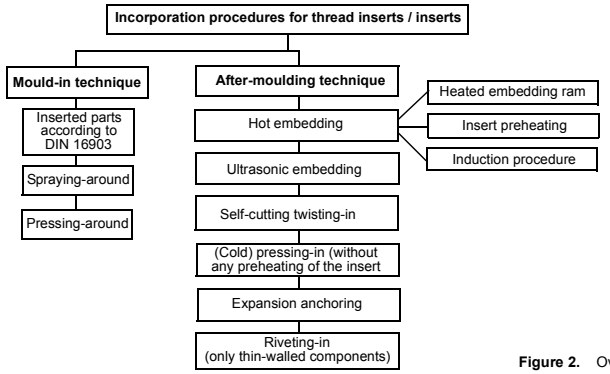

Figure 2. Overview of the incorporation procedures for inserts.

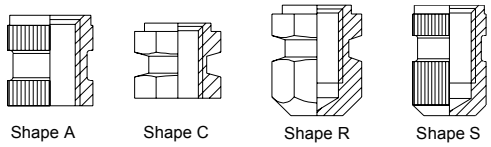

Figure 3. Basic construction shapes of inserts around which the polymer material is sprayed, according to DIN 16903.

2.2 After-moulding procedure

In the case of the after-moulding technique, non-standardised inserts are generally anchored in an additional operation after the component has been manufactured. The anchoring is carried out by means of:

- subsequent embedding with the aid of heat and pressure
- embedding with ultrasound
- mechanical twisting-in with a self-cutting or self-forming external thread
- cold pressing-in
- expansion anchoring: pressing-in with the subsequent expansion of the inserts during the twisting-in of the screw and the assembly mandrel or the expander plate

Corresponding to the incorporation procedures, a distinction is made according to the anchoring mechanisms and the structural designing of the inserts. Various after-moulding inserts are portrayed schematically on Figure 4.

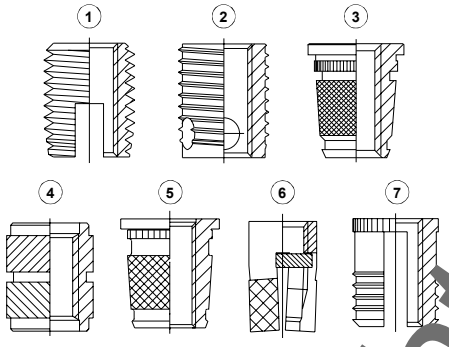

Figure 4. Examples of after-moulding inserts (① and ② – twist-in inserts made of metal; ③ – ultrasonic insert made of glass-fibre reinforced thermoplastic; ④ and ⑤ – ultrasonically embedded and hot-embedded inserts; ⑥ and ⑦ – expansion inserts with and without expander plate).

2.2.1 Hot embedding

The parts to be embedded are heated for the hot embedding of inserts. This heat is transferred to the contact faces in the holder borehole of the thermoplastic component. Thus, plasticisation takes place there and the insert can be embedded in the plasticised plastic by the action of force. Because the polymer material flows around the surface profiles and the undercuts, this anchors the insert in the thermoplastic component in a positive-locking form after the cooling.

2.2.1.1 Heated embedding ram

The heat is transferred by direct contacting with the insert during the embedding. Due to the permanently heated embedding ram, it may become more difficult to position the insert accurately because the insert floats when the embedding ram has been retracted.

2.2.1.2 Insert preheating

The inserts are preheated and the embedding operation is carried out without any additional heat supply. The cooling time can be optimised even further by a cooled pin. The preheated insert serves to prevent the material flowing out or the insert from floating. Therefore, this procedure is suitable not only for the induction procedure but also, in particular, for components with stringent tolerance requirements.

2.2.1.3 Induction procedure

During the embedding the inserts are inductively heated by an alternating high-frequency electromagnetic field. Due to the relatively cold embedding ram, the inserts cool down more quickly. It is thus possible to achieve not only the exact positioning of the inserts but also short cycle times. Because of the high investment costs, this procedure is only economically viable in the case of large-scale series.

2.2.2 Ultrasonic embedding

High-frequency mechanical vibrations are generated in the case of ultrasonic embedding. The insert to be embedded is stimulated to vibrations via a sonotrode. The relative movement resulting from this leads to heating in the contact face between the insert and the plastic component. Using a defined press-on pressure, the insert is incorporated into the locally plasticised plastic component in a targeted way and is positioned. In this respect, the polymer material flows around the surface profiles and the undercuts. After the cooling, this results in the positive-locking anchoring of the insert in the component. The embedding of inserts with ultrasound is dealt with in the DVS 2216-4 technical code.