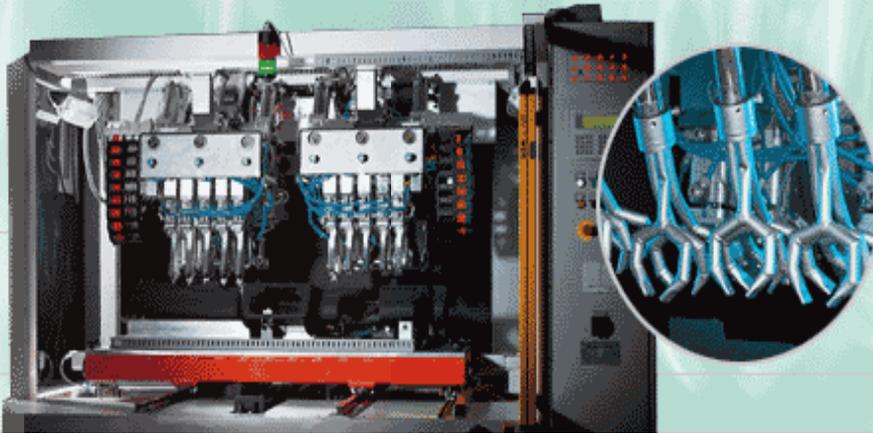


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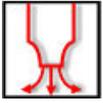
Hot forming / hot air



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Process description

1. Introductions

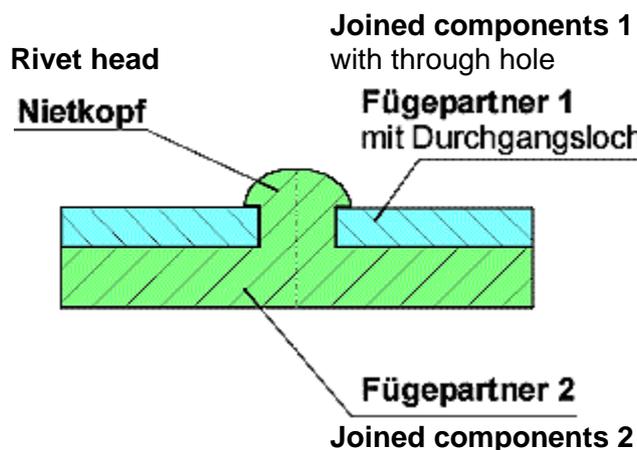
Permanent, form-locked connections are achieved by riveting. The connection is made by the deformation or moulding of the thermoplastic material. This process is generally employed only to achieve spot or segmented joint seams. In contrast to the welding of two components, this cannot be employed to achieve solid welded seams. A particular variation of this method is the joining of plastics with metals, textiles and cardboard.

Riveting plastics

Properties

- Joins the components by deformation or moulding
- Produces a spot or segmented joint seam
- The joint seam must be overlapped

The joined components must have a penetrating hole.



Advantages

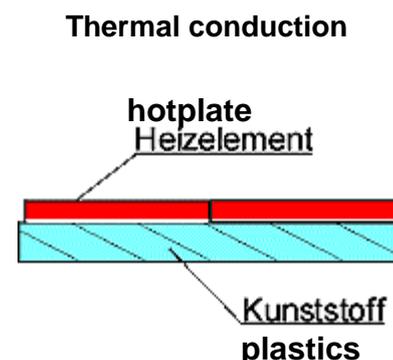
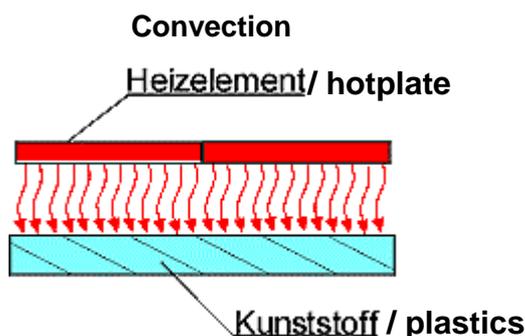
- Attachment of differing and identical plastics
- Connection of plastics with metals, textiles or cardboard

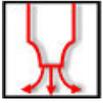
Economical installation and connecting technique

In contrast to ultrasonic riveting, thermal riveting can be employed simply for sheet metal/plastic connections because no vibrating tools are in contact with the sheet metal, which could endanger the joint. Particularly for critical plastics which are difficult to weld such as POM or PA66, which tend to perish during ultrasonic riveting, thermal riveting achieves a joint of a very high quality. The method is also highly beneficial where contamination of the parts by the splintering of perished particles must be avoided at all cost for reasons of safety.

2. Process engineering

Technically speaking, the processes of hot forming, hot stamping and hot air riveting can be discerned. In practice, the heat is applied by thermal conduction and convection. One example of heat application by thermal conduction is heater element welding. In the application of heat by convection, heating can be directed accurately with the aid of a hot air jet.





2.1 Hot formed riveting

Hot forming riveting is usually conducted as a single cycle process. In the simplest of these processes, a heating stamp heats the rivet stem and forms the rivet head under pressure in the same step of the process.

After forming, the stamp is raised and the formed head cools in the air to the ambient temperature level. The riveting temperature should be adjusted precisely in order to keep the return of the material in the formed head to its original shape as low as possible.

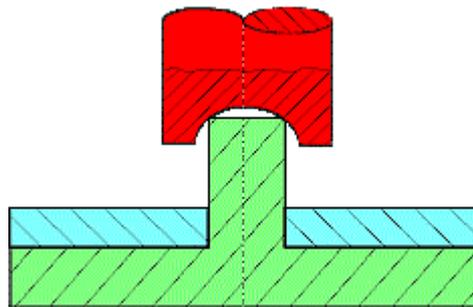
In amorphous plastics, this is beneath the clarification temperature and in partially crystalline plastics between the melting and clarification temperatures.

Despite this, low to moderate joint qualities and strengths can be achieved.

Hot forming riveting is a comparatively economical process which is employed for parts with moderate quality requirements. The short process times are particularly advantageous.

Single cycle process

- Stamp lowers onto the rivet cap
- Stamp forms the rivet cap
- Stamp finishes the rivet head
- Stamp raises and the rivet head cools



Advantages

- Economical process
- Short process times

Disadvantages

- Moderate rivet quality
- Material encrustations with critical plastics

2.2 Hot stamped riveting

Hot stamp riveting is a two-cycle process. The heat is applied by a hot stamp.

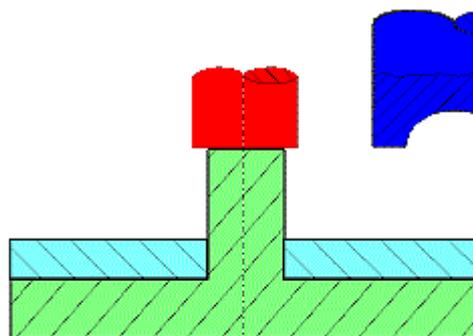
The actual forming of the rivet head is conducted by a cold stamp in a separate station. The succeeding cooling phase under pressure and a constrained form achieves a lower degree of relaxation in the plastic.

However, the stamp temperature is generally over 300 °C to allow the heat to be applied in a short time.

Good force fitting can be achieved between the joined parts. This joining method requires a comparatively long process time.

Two-cycle process

- Hot stamp lowers onto the rivet cap
- Rivet cap is formed in the cold stamp station
- Cold stamp cools the rivet head
- Stamp raises and the rivet head cools

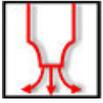


Advantages

- High quality riveting
- Short process times

Disadvantages

- Material encrustations with critical plastics

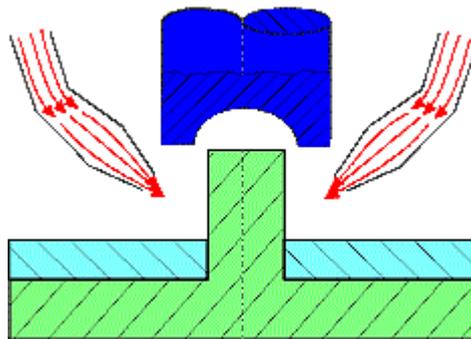


2.3 Hot air riveting

Hot air riveting operates without contact during the heating-up phase. A jet of hot air heats the rivet stem from all sides. In this process, the rivet head is also cooled by a cold stamp in a separate station. The succeeding cooling phase under pressure and a constrained form achieves a lower degree of relaxation in the plastic. The stamp temperature is generally over 300 °C. To retain constant process conditions during heating, an overall control system which regulates all parameters is essential. The air flow rate monitor has a decisive influence. As a further important element, the air outlet nozzle determines the air flow. It is designed and adapted according to the application. In this way, only minor relaxation processes occur during hot air riveting, so that firm connections with excellent force fitting can be achieved. This process can be employed for all thermoplastic materials.

Two-cycle process

- Heating up phase of the rivet stem without contact
- Forming of the rivet stem in a separate cold stamp station
- Cold stamp cools the rivet head



Advantages

- High quality riveting
- No material encrustations
- Homogeneous heating of the rivet stem

Disadvantages

- Long process times

3. Weld joint design

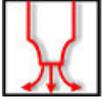
A correct and application-related design of the welded seam is essential for a high-quality welded joint. We will be delighted to provide aid and advice in the design of your plastic parts to suit them for welding.

4. Machinery

In general, the machines used to rivet plastic parts are designed as two-cycle machines. One way of shortening the overall cycle time for the riveting process is by employing revolving tables. In the example explained below, a motor cover made of plastic is to be riveted to a piece of sheet metal. The necessary heat is applied to the rivet stem by thermal conduction in the heating station. The homogeneously heated rivet stem is formed under pressure and constrained for in a second station, the cold stamp unit.

5. Conclusion

The different variations of the process have arisen because of the different material properties of thermoplastic materials and the resulting general conditions for plastification. The advantage of this method is particularly that connections between plastic and metals or other materials can be created with force fitting without play. Strength values are achieved within the range of the characteristic values of the plastic. A wide range of applications in the field of hybrid components has been created in recent times, particularly by the further development of hot air riveting.

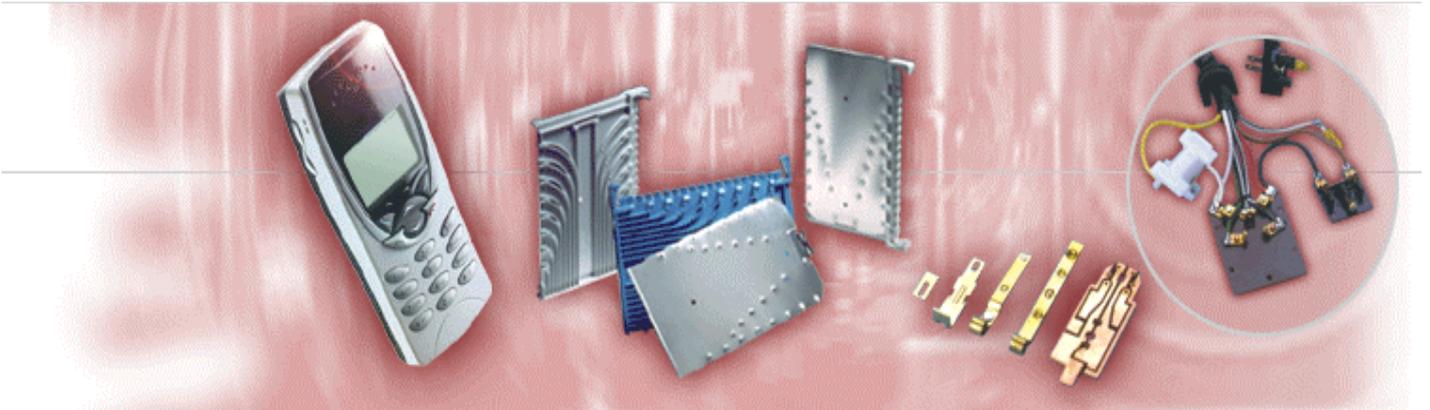


Hot forming/hot air



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6. Example applications



Further information is available at our homepage at

<http://www.kln.de>

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