Description

Image

Image caption

(1) Iron surface with rivets © Public Domain Pictures at Pixabay [Public domain] (2) Eyelet Rivet in clothing © Picdream at Pixabay [Public domain] (3) Stapler and staples in documents © Granta Design

The process

Mechanical fasteners have three special attractions: they do not require heat; they can join dissimilar materials; and these can be of very different thickness. RIVETS are widely used in aircraft design - a testament to their strength, permanence and reliability. Riveting is done by inserting a stud with a head on one end through pre-drilled holes in the mating components, and clinching (squashing) the other end where it sticks out by hitting it with a shaped hammer. STAPLES - familiar as a way of binding paper and attaching leather and cloth to frames in furniture - are fast and cheap; they can also be used to assemble sheet metal. Staples are applied with a spring-loaded, electric or pneumatic jig that forces the staple through the materials and onto a grooved anvil, bending the legs inwards and pinching the materials together. In blind stapling there is no anvil - the legs of the staple are simply driven through one material into the other, where they stick in the same way that nails do.

Process schematic

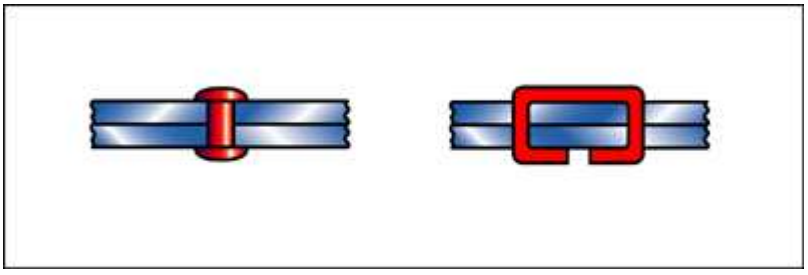

Figure caption

Riveting and stapling

Material compatibility

Ceramics	✓
Composites	✓
Metals - ferrous	✓
Metals - non-ferrous	✓
Natural materials	✓

Polymers - thermoplastics	✓

Function compatibility

Electrically conductive	✓
Thermally conductive	✓
Watertight/airtight	✓
Demountable	✗

Joint geometry compatibility

Lap	✓
Scarf	✓

Load compatibility

Tension	✓
Compression	✓
Shear	✓
Bending	✓
Torsion	✓
Peeling	✓

Economic compatibility

Relative tooling cost	low
Relative equipment cost	low
Labor intensity	medium

Physical and quality attributes

Range of section thickness	0.1	-	30	mm
Unequal thicknesses	✓			
Processing temperature	16.9	-	36.9	℃

Process characteristics

Discrete	✓

Supporting information

Design guidelines

Both rivets and staples can be used to join similar materials, but they can also be used to join one material to another even when there is a large difference in their strengths - leather or polymer to steel or aluminum for instance. Both allow great flexibility of design although a stress concentration where the fastener penetrates the material should be allowed for. Rivets should have heads that are 2.5 - 3 times the shank diameter; when one material is soft, it is best to put a washer under the head on that side to avoid pull-out. Staples are good when materials are thin; when metal staples are used, the maximum thickness is about 1mm, when non-metallic it can be up to 10mm

Technical notes

Rivets and staples are usually metallic: steel, aluminum and copper are common. Polymeric rivets and staples are possible: they are clinched by using heat as well as pressure. Almost any material, in the form of sheet, mesh or weave, can be joined by these methods; stapling also allows wire to be joined to sheet.

Typical uses

Stapling: joining of paper, leather, cloth, fiberboard. Rivets are extensively used in aerospace, automotive and marine applications, but have much wider potential: think of the riveting of the leather label to the denim of jeans.

The economics

Both riveting and stapling are cheap, fast and economic even for very low production runs. Equipment, tooling and labor costs are all low. The processes can be automated.

The environment

The sound of the shipyard is that of riveting - it can be very loud. Over-enthusiastic staplers have been known to staple themselves. These aside, both processes are environmentally benign.

Links

MaterialUniverse

Reference