



Attachment

Materials: Metals

Types

a. Stainless Steel

Stainless steel is a durable and high quality material, that is used for everything from wristwatches and jewellery, to kitchen utensils and hardware parts. There are various types of stainless steel. However, the 300 series is more commonly used:

- 316L
- 304

316L is generally considered to be of slightly higher quality than 304. Further, steel parts are often polished by hand, which further adds to the processing cost. That said, steel maintains its finish and shape for over very long time periods.

b. Zinc Alloy

Zinc alloy, which consists of zinc and copper, is generally cheaper than stainless steel. However, zinc alloy tends to lose its luster within 2 to 4 years, as the material oxidates. Zinc alloy is used to make watches, jewelry and electronic components.

c. Copper

Copper is often used to make wires, or combined with other metals in alloys. Copper can also be molded, but is today mostly used in the electronics industry. Copper is softer than stainless steel.

d. Cast Iron

Cast iron is used in home products and cooking ware. Iron is cheaper than stainless steel. There are 4 main types of cast iron:

- White iron
- Gray iron
- Ductile iron
- Malleable iron

e. Aluminum

Aluminum is typically cheaper than stainless steel, and used in electronics, phone cases and various other consumer products. There are many different types of aluminum:

- Alloy 1100
- Alloy 2011
- Alloy 2024
- Alloy 3003
- Alloy 5052

They differ in terms of response to heat treatment, machinability, weldability, strength and end use.

Tooling

a. Injection Molding

Melted metal (i.e., stainless steel) is inserted into a cavity. The metal cools down and forms a solid component, for example a watch case. An injection mold cannot be modified, and is generally only used for a certain type of metal.

b. CNC

A CNC Machine use various tools (i.e., drills and saws) to cut a metal block into a certain shape. CNC is used to make certain hardware parts, and prototypes.

c. Punching / Cutting Tools

Punching can cut and/or bend metal sheets into certain shapes.

d. 3D Printing

A 3D printer prints thin layers of melted metallic powder into objects. Today, relatively few manufacturers in China use 3D printers. However, as 3D printers are becoming relatively cheap, some suppliers adopt 3D printing when making prototypes. However, a 3D print is only a model, and cannot be used for mass production or replace an injection mold.

Specifications

a. Ion Plating (IP)

Physical vapor deposition (PVD) is a process that bombards metal coatings of, for example, gold on stainless steel, zinc alloys or other metals. Hence, a stainless steel surface can be turned into various shades of gold or other color:

- Rose Gold
- Gold
- Black
- Blue

However, you cannot select pantone colors. You are limited to the colors that the IP machine can produce.

Notice that the quality of the plating (i.e., how long it lasts and its scratch resistance) largely depends on the thickness. Two examples follow below:

- Standard IP: $0.3 \mu (\text{cu}) + 0.2 \mu (\text{au}) = 0.5 \mu$
- High quality IP: $0.6 \mu (\text{cu}) + 0.2 \mu (\text{au}) = 0.8 \mu$
- $\mu = 1 / 1000000$ meters (micron / mic)

Notice that the thickness depends on which metal the plating is applied to.

b. Colors

If you want a stainless steel part to be delivered in a certain pantone color, there are ways to apply spray or oil based paints. However, paint coatings on stainless steel and other metal surfaces tend to wear out.

d. Printing

There are various ways to print colored or black text and graphics to metal surfaces:

- Screen print (Colors)
- Laser engraving (Black)
- Etching
- Embossing / stamping