

About the materials

Metal materials

- ▶ **Iron or steel** Iron is the most familiar metal material and its workability can be used for drawing and rolling, heat treatment and as an alloy such as stainless steel. It can be used in a wide range of applications. Depending on the application, it can be used in accordance with the processing characteristics.
- **SS material (general structural rolled steel)**

It is a low-carbon steel that can be made into a variety of shapes, including steel plates, flat steel, steel bars, and shaped steel. It is inexpensive and the most popular steel material. We mainly use SS400, where the number "400" means the tensile strength (N/mm²) of the steel material.
 - **SPH material (hot-rolled steel sheet)**

This is a steel material that is rolled in a high-temperature environment and processed into a plate. The surface of the material is covered with an oxide film called black skin, which is resistant to corrosion against the progression of rust. Compared to SPC material (cold-rolled steel sheet), it can be obtained at a lower cost due to fewer material processing steps. However, the thickness accuracy and appearance are lower.
 - **SPC material (cold rolled steel sheet)**

Steel material made by rolling hot-rolled material at room temperature. It can be formed into thin sheets of 0.5 to 3.2 mm in thickness, has a smooth surface, and has a high accuracy in thickness. It is called "Migaki" material. However, compared to SPH materials, the price is higher due to the increased machining work, and the oxide film on the surface is destroyed.
 - **SWCH material (carbon steel wire rod for cold heading)**

SWRCH material made by steelmakers is remanufactured as SWRCH material by wire-drawing manufacturers. The carbon content varies depending on the standard. Therefore, it should be noted that the mechanical properties of SWCH materials vary depending on the wire diameter and processing method.
 - **SWRM material (mild steel wire rod)**

It is a steel material called "mild steel" with a carbon content of up to 0.25%, which is made into wire rod. Since it is a material for thin wire rods, it is not suitable for manufacturing products that require high precision and strength for processing. It is generally used for nails and rivets.
 - **SUM material (free-cutting steel)**

This steel material improves the free-cutting and workability of steel by adding sulfur and other properties that improve the workability of steel. We use SUM22L, which focuses on machinability.
 - **FC material (cast iron)**

Cast iron is a material used in the casting process. It is used in the process of making products by pouring iron melted down to a liquid state into a mold called a cast iron mold. Compared to other steel materials, it has higher carbon content, which makes it more heat resistant, but it is less tenacious and has lower tensile strength.
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- ▶ **Stainless steel** Stainless steel is an alloy of iron to which chromium and nickel are added to improve corrosion resistance. It has the meaning of stain (stain, discoloration) less (less likely to occur). The surface layer of stainless steel is covered with a passive film of chromium, making it highly resistant to corrosion.
- **SUS304**

It is the most widely distributed stainless steel material, also known as 18-8 stainless steel, an alloy with 18% chromium and 8% nickel. In addition, because it is formed with an austenite composition, it is a stainless steel with low magnetization.
 - **SUS303**

A stainless steel with improved free-machinability by adding sulfur and phosphorus to type SUS304. Compared to SUS 304, this stainless steel has inferior corrosion resistance and is unsuitable for welding.
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- ▶ **Copper** Copper is a metal with high workability and corrosion resistance, and has properties that allow it to conduct heat and electricity easily. It also has good elongation and can be processed into various shapes such as copper sheets and rods. Ordinary copper cannot be used as it is because it contains many impurities. Therefore, copper used in manufacturing is smelted to pure copper with as many impurities removed as possible.
- **Brass**

An alloy of copper with zinc added. It refers to copper with at least 20% zinc added. Characteristically, it is similar to copper, but with the addition of zinc, which makes it available at a lower cost.
 - **Phospheric bronze**

This alloy is made by adding tin to copper. Mechanical properties such as tensile strength are higher than those of copper, and it has excellent workability. The alloy is also resistant to corrosion, such as sulfurous acid, which corrodes brass.
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- ▶ **Zinc Alloys** It is an alloy of zinc with aluminum, copper, and magnesium. It is mainly used for die casting. Zinc alloys are suitable for machining precision parts because they are easy to dimensionally accurate, have high impact resistance, absorb vibrations, and have damping properties, and can be cast into complex shapes.
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- ▶ **Aluminum** It is a metal classified as a nonferrous metal that does not contain iron. Compared to iron, it is a lightweight material with excellent workability (cutting, forging, extrusion, drawing, etc.), corrosion resistance, and thermal conductivity. Aluminum does not develop white rust, but it is not a deterioration of the metal, but a strong aluminum oxide film. Corrosion resistance is lower than stainless steel, and electric corrosion may occur when combined with iron or copper due to potential difference.

Plastics / Resin Materials

- ▶ **ABS Resins** It is one of the most commonly distributed, inexpensive, and produced general-purpose resins. It is classified as a “thermoplastic resin” that softens upon heating and solidifies again upon cooling.
A resin chemically bonded from acrylonitrile, butadiene, and styrene, it has a good balance of strength, hardness, and toughness.

- ▶ **Polyethylene** It is one of the general-purpose resins along with ABS resin. It is also used in medical products because of its low water and moisture absorption and water permeability, and because the material itself is harmless and non-toxic.
However, its large mold shrinkage rate makes it difficult to process for precision.

- ▶ **Polypropylene** It is a general-purpose resin with properties similar to polyethylene. It has a wide variety of manufacturing methods, including injection, extrusion, and blow molding.
It is suitable for mass production. In recent years, it has also been used as a material for 3D printers.
However, it has poor weatherability and is susceptible to ultraviolet rays, requiring the addition of antioxidants.

- ▶ **Vinyl Chloride** It is a general-purpose resin in line with the above resins.
It has the characteristic of being able to control hardness and softness by adding plasticizers in the manufacturing process.
They are also known as “PVC”. Poorly heat resistant, with a heat resistance temperature of 60-80°C. Impact values may decrease even in low-temperature environments.

- ▶ **Nylon (polyamide)** Nylon is a resin product with improved heat resistance, a drawback of plastic materials.
It also has other excellent properties such as toughness and chemical resistance.
However, its high thermal shrinkage rate results in low dimensional accuracy.
 - **Nylon 6**
It is the most widely used polyamide resin and has excellent mechanical strength and heat resistance.
As a resin, it is sometimes considered a substitute part for metal because of its toughness.
 - **Nylon 66**
This resin has improved mechanical strength and heat resistance compared to nylon 6.

- ▶ **Silicon** It has heat resistance, water repellency, and electrical insulation properties, and has the versatility to control hardness and softness.
Silicon is an organic compound containing “silicon,” which constitutes glass, and is an artificially created resin.

About surface treatment

- ▶ **Plating** Thin metal films cover metal or non-metal surfaces to improve corrosion protection, durability, and other functions.
It is also a processing technology for use in decorative applications for appearance.
 - **Chrome plating**
Chromium is a hard metal with excellent corrosion resistance properties that are resistant to wear and rust.
It is also used for decorative purposes to add luster to product surfaces.
 - **Satellite chrome plating (pear-skin chrome)**
 - **Nickel plating**
It has excellent corrosion resistance and is mainly plated for anticorrosion purposes.
The film thickness can be thicker than the aforementioned “chrome plating.”
 - **Copper Plating**
It is utilized as a base plating to make it easier for nickel and chrome plating to adhere.
It is also used as a functional plating utilizing copper’s high thermal and electrical conductivity.
 - **Zinc plating (Trivalent chromate)**
This is a surface treatment in which steel components are zinc plated for corrosion prevention and then covered with a trivalent chromium conversion coat. Zinc has a sacrificial corrosion function for steel materials, but by itself, this function disappears.
Therefore, corrosion-resistant chromium is used as a coating to improve corrosion resistance.

- ▶ **Anodizing** This is a treatment that artificially generates an oxide film on the surface of aluminum using the principle of anodic oxidation (electrochemical reaction).

- ▶ **Buffing** This is a type of polishing method used to finish the surface of a material.

- ▶ **Painting** This is a surface treatment in which the surface of a material is covered with a coating of paint to provide decorative and anticorrosive functions.