

# TEST 1

## 1. Define the term steel?

Steels - are malleable iron alloys containing, in addition to iron, a small amount of carbon whose content is below 2.14%, i.e. below the austenite solubility limit. Alloy steels also contain noble metal additives. Steels are the main construction material for machines, engines, structures, especially for their mechanically salivated parts such as shafts, gears, bolts, springs, pins and camshafts

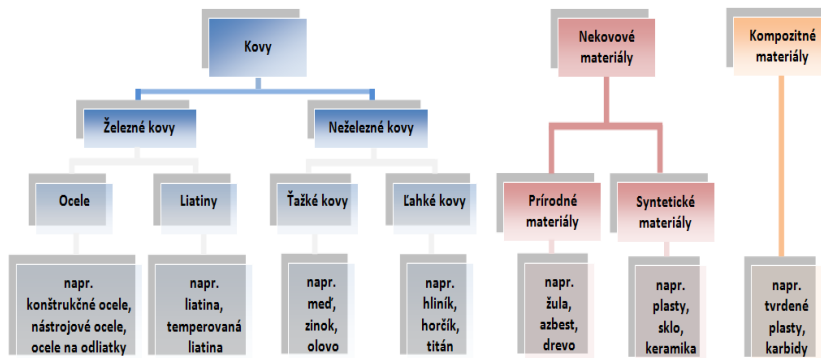
## 2. Define the term synthetic materials?

Synthetic materials - this includes a large group of macromolecular polymers of simple organic substances called plastics, as well as glass and ceramics. Plastics are lightweight, water resistant, electrically nonconductive, thermally well insulating and chemically resistant. The mechanical properties are different, some plastics are elastic and some are rigid and brittle. The heat resistance of plastics is low. The use of plastics varies from tires to gears. Ceramic materials are used as cutting inserts, nozzles and sliding gaskets for their hardness and abrasion resistance.

## 3. Define the term composite materials?

Composite materials - consist of several types of different materials. Glass laminates consist of artificial resin and glass fiber fabric. They are tough, light and strong. They are used for the production of tanks, kayaks, printed circuit boards for electronics boards or swimming pools. Another type of composite materials are sintered carbides (SK) or also carbides. They have carbide grain hardness and bonding metal toughness. They are used for the production of cutting tools for cutting tools.

## 4. Draw the material distribution into groups



## 1. What are the physical properties?

Density, melting point, electrical conductivity, thermal elongation, thermal conductivity.

## 2. Define the thermal linear expansion

The thermal expansion coefficient  $\alpha$  indicates the extension of the length  $\Delta l$  of the body by 1 m when the temperature  $t = 1^\circ \text{C}$ . addition.

### 3. Describe the elastic-plastic deformation behavior.

The rod of unalloyed structural steel exhibits both elastic and plastic deformation when bent. After a large deformation, the bar only returns to its original shape. Permanent plastic deformation remains. Many materials, such as non-hardened steel, copper-aluminum alloys, have elastic-plastic deformation behavior. Different materials can have elastic, plastic and elastic-plastic deformation behavior.

### 4. What are technological features?

Castability, formability, machinability, weldability, hardenability.

### 5. What does the distribution channel contain?

The distribution channel can include: manufacturers, retail network, warehouses (m + v), agencies, banks, insurance companies, carriers, stores, online retailers...

### 6. Define the term corrosion behavior.

Corrosion Behavior - Describes the behavior of a material in a humid air, industrial atmosphere, water, or other aggressive environment. The failure of the structure beginning on the surface of the material caused by chemical and electrochemical processes is called corrosion.

### 7. What criteria must be considered when choosing a material other than material?

However, in addition to material characteristics, other material selection criteria must be considered when selecting a material, in particular:

- production technology
- Material and production costs
- economical use of the selected material
- other criteria

### 8. define the product design process

Designing a new product is an interactive process, beginning with an idea and ending with a product that fulfils the original idea or market demand

### **9. What is the European standard for steel marking and distribution?**

The distribution of steels is given by the European standard EN 10020-88 (ČSN EN 10020-94) which defines:

the concept of steel on a mold,

classification of steel types according to chemical composition into unalloyed and alloyed,

divided into major quality groups based on the characteristics and purpose of use. The number marking systems are specified in EN 10027-2-92 (EN 10 027-2-95).

## ***TEST 2***

### **1. Describe the mark for non-alloy quality steels?**

These steels have a medium carbon content in the mark.

- 1st character - letter C

- 2nd character - a number indicating 100 times the mean carbon content.

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### **2. Describe the labeling of high-alloy steel?**

In the case of these steels, the actual content of the main alloying elements shall be indicated when expressing the content. Unlike low alloy steels, the first character is the letter X.

- 1st character - letter X

- 2nd character - a number indicating 100 times the mean carbon content

- 3rd emblem - chemical symbols of significant alloying elements

- 4th character - a number indicating the approximate mean content of the main alloying elements

### **3. How the accompanying elements are divided - give an example?**

The elements that are most often found in steels can be divided according to the previous criteria as follows:

- harmful accompanying elements: S, O<sub>2</sub>, P, N<sub>2</sub>, H<sub>2</sub>

- accompanying elements beneficial: Mn, Si, Cu, Al

- alloy elements (alloy): Cr, Ni, Mn, Si, Mo, W, Al, Ti, Nb, Cu, B, N

### **4. Define the term technological formability.**

Technological tests, unlike the basic ones (tension, compression, bending, etc.) are performed in very close conditions to the conditions of actual technological methods.

The tensile test is performed under the agreed conditions of the shape and dimensions of the sample, uniaxial state of stress, quasi-static loading speed, room temperature and without friction

#### **5. Describe the concept of compressibility**

Compressibility is applied formability for sheet and bulk cold and semi-heat forming technologies.

#### **6. What standard does surface measurement currently follow?**

The ISO 4287 standard is currently the main international standard in force, which specifies the terms, definitions and surface parameters. These parameters correspond to different parts of the touch-generated signal.

#### **7. What kinds of surface profiles do you know?**

- scanned profile
- full profile
- Primary profile
- Roughness profile
- Wavy profile

#### **8. Describe the 6 bath types that the metal strips must pass?**

- through a bath in which grease and dirt are removed,
- through a bath containing dissolved tin,
- through a cleaning bath,
- the strips are then cleaned to remove excess tin and then soaked in a component containing the purest tin,
- through a container containing lubricant heated at very low temperatures,
- a crimping container containing tin in which the edges of the strip are dipped.

#### **9. Explain the concept of continuous annealing?**

The strip is annealed in the furnace continuously for approximately two minutes up to  $600 \div 660$  ° C and at a belt feed speed of  $180 \div 360$  m / min, it is harder and more resistant than with intermittently annealed material. The tin plates produced in this way are called CA (Continual Annealing).

#### **10. What are the current methods of evaluating the properties of thin packaging sheets?**

On the basis of the results, the judgment about the properties of the sheet and its suitability for compression gains several tests, which can be divided into:

- tests of mechanical properties,
- metallographic and chemical composition tests,
- tests imitating,
- other tests.

**11. Steel sheets and strips currently produced can be divided into several categories from several points of view?**

- according to the steel production method
- according to the rolling method
- according to surface protection
- depending on the use
- according to strength and plastic properties, chemical and structural conception

**12. Define IF steels**

- Steels of type IF are designed for deep-drawn shape-complicated outer and inner parts.
- They are characterized by high plastic properties and are therefore suitable for deep drawing.

***TEST 3***

**1. Explain and describe multiphase steels.**

- They are characterized by good strength properties and exhibit excellent ductility during cold forming.
- - During their plastic deformation, austenite is converted to deformation-induced martensite, which significantly contributes to the overall strengthening of the material.

**2. Explain and describe Maraging Steel**

- - The name of maraging steels originated from the combination of two successive phase transformations, causing a strengthening (martensitic - martensite and aging - aging).
- - These are low carbon steels with C <0.03%, Mn <0.1%, Si <0.1%, S <0.01%, P <0.01%.
- - Admixtures C, S, N are particularly undesirable because they increase the density of anchorage points of dislocations, they form carbides and nitrides, which are mainly eliminated at grain boundaries.

**3. What European standard is the defined distribution of steel?**

- The classification of steels is given by the European standard EN 10020, which defines:
- - the term steel for forming,
- - classification of steel grades according to their chemical composition,
- - classification into main quality groups on the basis of characteristics and intended use.
- - Forming steels are called materials in which the proportion by weight of iron is greater than any other element, contains less than 2% C and contains other elements

#### 4. What are the categories of stainless steels?

- We divide stainless steels according to their chemical composition and structure into the following basic groups:
- austenitic - they have the highest corrosion resistance of all basic classes, which can be increased by adding molybdenum and copper.
- martensitic (hardenable) - Corrosion resistance is low, resistance to atmospheric corrosion is sufficient only in very clean air.
- ferritic - they are magnetic and sufficiently ductile. Higher chromium content increases their corrosion resistance, which is higher in oxidizing environments than in martensitic steels.
- austenitic-ferritic (duplex) - derived from classic austenitic steels, due to their high chromium and molybdenum content, they have excellent resistance to cracks and corrosion.

#### 5. What is the Swedish steel assortment?

- The current range of Swedish steels is as follows:
- DOMEX ® are hot rolled sheets used in applications such as shipbuilding, bridges, buildings, machinery, vehicles, lifting equipment and tanks.
- HARDOX ® is a hardened and tempered abrasion resistant steel used for superstructures of dumpers, containers, crushers, mills, buckets of excavators.
- DOCOL ® is a cold-rolled steel sheet, available from mild steel for stamping and bending to ultra-high strength steel.
- DOGAL are DP grades, they are two-phase steels of good formability and strength of material. The Dogal 600 D and 800 DP are extra and ultra-high strength steels galvanized.
- WELDOX ® is a high-strength structural steel used for products that are lighter but have the same or higher strength compared to ordinary steel products. It is used in applications such as cranes, trailers and vehicles.
- PRELAQ ® is a coated steel sheet for the construction industry and is used for roofing, facades, roofs, drip pipes and fittings.
- ARMOX ® is a steel grade that is mainly used as protection in the transport of valuables are bank counters, mine clearance vehicles, personal protection, and so on.
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- TOOLOX ® are modern tool steels for dies and machine parts.
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- QSTE - high-strength hot-rolled steel sheets for cold forming
- QSTE steels form a class of fine-grained microalloyed thermo-
- mechanically rolled (TM) steels, which are suitable for cold bending due to their increased strength

#### 6. Define the term composites?

- Composites are materials that have been created by the physical combination of existing simple materials. The matrix, the matrix, has the function of a binder. The second component, fibers, layers or dispersion particles, has a firming effect

### 7. How can composites be separated according to their properties?

- Depending on the properties, the composites can be divided into:
- composites with high mechanical properties;
- composites with special physicochemical properties.

### 8. Name the polymer-based composites.

- Macroscopic composites
- glass laminates
- Impregnated porous materials
- Laminated safety glass
- Cellular materials, foams
- Reinforced polymers

### 9. How do we divide composites with metal matrix?

- Metal matrix composites can be divided into:
- dispersed reinforced materials - metal matrix + non-coherent (incoherent) dispersed particles,
- fiber composites - metal matrix + thin wires or single crystal fibers

### 10. Define monolithic ceramic materials

- The basic elements of these materials are aluminum oxides, silicones and inorganic substances of various kinds.
- Structural ceramics has properties that allow it to be used:
- In an area where electrical and magnetic properties are a priority
- In an area where it is used as a cutting material.
- In the field of use of components operating at high temperatures,

### 11. Define monolithic ceramic composites

- Their properties are obtained by suitable arrangement of the structure - filling matrix and fibers. They have higher