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METALWORKING TOOLS
(Металлообрабатывающие инструменты)

Методические указания по английскому языку
для практических занятий студентов направления
подготовки 151900.62 «Конструкторско-технологическое
обеспечение машиностроительных производств»
очной формы обучения

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Содержание

Предисловие

Методические указания «Metalworking tools» разработаны в соответствии с рабочей программой направления подготовки 151900.62 «Конструкторско-технологическое обеспечение машиностроительных производств» и предназначены для аудиторной работы студентов очной формы обучения.

Цель данных методических указаний – дальнейшее развитие умений и навыков владения английским языком для его активного применения в профессиональном общении.

В соответствии с ФГОС ВПО, требованием которого является подготовка специалистов, способных общаться с зарубежными коллегами и вести профессиональную деятельность, данные методические указания способствуют формированию у студентов следующих общекультурных компетенций:

– способность к кооперации с коллегами, работе в коллективе – (ОК3);

– способность к саморазвитию, повышению своей квалификации, мастерства (ОК6);

– способность осознавать социальную значимость своей будущей профессии, высокая мотивация к выполнению профессиональной деятельности (ОК8);

– способность работать с информацией в глобальных компьютерных сетях (ОК18);

– способность использовать один из иностранных языков на уровне не ниже разговорного (ОК19).

Методические указания предназначены для изучения следующих тем: «Металлообработка» (текст «General Metalworking Processes»), «Металлообрабатывающие инструменты» (текст «Metalworking Tools and their Uses»), «Стоимость оборудования» (текст «Total cost of manufacture»).

Методические указания организованы по тематическому принципу, каждый раздел включает в себя вокабуляр, упражнения на его закрепление, тексты для изучающего и ознакомительного чтения, имеющие информативный характер, а также послетекстовые упражнения коммуникативной направленности по пройденной тематике.

UNIT I
METALWORKING PRODUCTION

Warming up

Ex. 1. What comes to your mind when you look at this picture? How does it refer to the topic?

Vocabulary

metalworking	металлообработка
strength of materials	сопротивление материалов
theory of elasticity	теория упругости
producing engineering	технология производства
carry out	выполнять
power machine	энергетическая машина
material working machine	технологическая машина
supervisory control machine	контрольно-управляющая машина
information machine	информационные машины
cybernetic machine	кибернетическая машина
conversion	превращение
automatic transfer line	автоматическая линия
automatic -machine device	машина-автомат
working machine	станок
machine unit	машинный агрегат
actuator	исполнительный механизм

converter	преобразователь
executive mechanism	исполнительный механизм
machine shop	машинный цех
work piece	обрабатываемое изделие
forming	профилирование
cutting	резка металла
joining	сращивать
marking out (layout)	делать разметку, планировка
caliper	штангенциркуль
sawdust	древесные опилки
chip	глубина резания
swarf	стружка; шлифовальный шлам
oxyfuel torch	кислородно-топливная горелка
welding	сварка
burning	сварка свинца
kerf	ширина линии разреза
drilling	сверление, бурение
milling	обогащение полезных ископаемых на фабрике, фрезеровать
sawing	пиление
chisel	долото, стамеска, зубило
shear	деформация сдвига; летучие ножницы
turning	токарная обработка, точение
grinding	шлифовка, доводка, зачистка
snip	разрезать ножницами
rabbeting	прорезывание пазов
spindle	соединительный вал
coolant	охлаждающая жидкость
lathe	токарный станок
headstock	передняя бабка станка
facing	наружное покрытие

Ex. 2. Find synonyms to the following words.

Activity, interaction, creativity, indifference, locate, performance, perform, production, technique, productive, similarity, technician, carry out.

Ex. 3. Give definitions of the following terms, if necessary consult English – English dictionary.

- Strength of materials –
- Acting forces –
- Executive forces –
- Liquid –
- Material-working machine –
- Gaseous body –
- Feeder –
- Transmission –
- Production engineering –
- Actuator –

Ex. 4. Analyze these definitions of the term "metalworking". Say which of them is more appropriate and why? Propose your own definition.

Metalworking is the processing of metal to change its shape, size, etc., as by rolling, forging, etc., or by making metal articles (From The Free Dictionary).

Metalworking is the process of working with metals to create individual parts, assemblies, or large scale structures. The term covers a wide range of work from large ships and bridges to precise engine parts and delicate jewelry. It therefore includes a correspondingly wide range of skills, processes, and tools (From Wikipedia, the free encyclopedia).

Metalworking is a science, art, hobby, industry and trade. Metalworking has evolved from the discovery of smelting various ores, producing malleable and ductile metal useful for tools and adornments. Modern metalworking processes, though diverse and specialized, can be categorized as forming, cutting, or joining processes (from Merriam Webster dictionary).

Reading

Ex. 5. Read the text.

General Metalworking Processes

Metalworking generally is divided into the following categories: forming, cutting, and, joining. Each of these categories contain various processes. Prior to most operations, the metal must be marked out and/or measured, depending on the desired finished product. Marking out (also known as layout) is the process of transferring a design or pattern to a workpiece and is the first step in the handcraft of metalworking.

Calipers are hand tools designed to precisely measure the distance between two points. Most calipers have two sets of flat, perpendicular edges used for inner or outer diameter. These calipers can be accurate to within one-thousandth of an inch.

The forming processes modify metal or workpiece by deforming the object without removing any material. Forming is done with a system of mechanical forces and, especially for bulk metal forming, with heat.

Drilling a hole in a metal part is the most common example of a chip producing process. Using an oxy-fuel cutting torch to separate a plate of steel into smaller pieces is an example of burning. Chemical milling is an example of a special process that removes excess material by the use of etching chemicals and masking chemicals.

Cutting is a collection of processes wherein material is brought to a specified geometry by removing excess material using various kinds of tooling to leave a finished part that meets specifications. The net result of cutting is two products, the waste or excess material, and the finished part. In cutting metals the waste is chips or swarf and excess metal. These processes can be divided into chip producing cutting, generally known as machining. Burning or cutting with an oxyfuel torch is a welding process, not machining. There are also miscellaneous specialty processes such as chemical milling.

There are many technologies available to cut metal, including:

- manual technologies: saw, chisel, shear or snips;

- machine technologies: turning, milling, drilling, grinding, sawing;
- welding/burning technologies: burning by laser, oxy-fuel burning, and plasma;
- erosion technologies: by water jet or electric discharge.

Cutting fluid or coolant is used where there is significant friction and heat at the cutting interface between a cutter such as a drill or an end mill and the workpiece. Coolant is generally introduced by a spray across the face of the tool and workpiece to decrease friction and temperature at the cutting tool/workpiece interface to prevent excessive tool wear. In practice, there are many methods of delivering coolant.

Milling is the complex shaping of metal or other materials by removing material to form the final shape. It is generally done on a milling machine, a power-driven machine that in its basic form consists of a milling cutter that rotates about the spindle axis (like a drill), and a worktable that can move in multiple directions (usually two dimensions [x and y axis] relative to the workpiece). The spindle usually moves in the z axis. It is possible to raise the table (where the workpiece rests). Milling machines may be operated manually or under computer numerical control (CNC), and can perform a vast number of complex operations, such as slot cutting, planing, drilling and threading, rabbeting, routing, etc. Two common types of mills are the horizontal mill and vertical mill.

The pieces produced are usually complex 3D objects that are converted into x, y, and z coordinates that are then fed into the CNC machine and allow it to complete the tasks required. The milling machine can produce most parts in 3D, but some require the objects to be rotated around the x, y, or z coordinate axis (depending on the need). Tolerances are usually in the thousandths of an inch (Unit known as Thou), depending on the specific machine.

Materials that can be milled range from aluminum to stainless steel and almost everything in between. Each material requires a different speed on the milling tool and varies in the amount of material that can be removed in one pass of the tool. Harder materials are usually milled at slower speeds with small amounts of material

removed. Softer materials vary, but usually are milled with a high bit speed.

Ex. 6. Answer the questions.

1. How many categories are there in metalworking?
2. What should be done to metal?
3. What is the process of marking out (or layout)?
4. What is the forming process?
5. What is the essence of cutting process?
6. What are the technologies available to cut metal?
7. What is cutting fluid used for?
8. What is milling?
9. What complex operations can be done by milling machines?
10. What kinds of materials can be milled?

Ex. 7. Read the text and make the appropriate order of the paragraphs. Argue your choice.

Turning

A. A lathe is a machine tool which spins a block or cylinder of material so that when abrasive, cutting, or deformation tools are applied to the workpiece, it can be shaped to produce an object which has rotational symmetry about an axis of rotation. Examples of objects that can be produced on a lathe include candlestick holders, table legs, bowls, baseball bats, crankshafts, camshafts, and bearing mounts.

B. Turning is a metal cutting process for producing a cylindrical surface with a single point tool. The workpiece is rotated on a spindle and the cutting tool is fed into it radially, axially or both. Producing surfaces perpendicular to the workpiece axis is called facing. Producing surfaces using both radial and axial feeds is called profiling.

C. Lathes have three main components: the headstock, the carriage, and the tailstock. The headstock's spindle secures the workpiece with a chuck, whose jaws (usually three or four) are

tightened around the piece. The spindle rotates at high speed, providing the energy to cut the material.

D. The carriage is a platform that can be moved, precisely and independently, horizontally parallel and perpendicular to the axis of rotation. A hardened cutting tool is held at the desired height (usually the middle of the workpiece) by the toolpost. The carriage is then moved around the rotating workpiece, and the cutting tool gradually shaves material from the workpiece.

E. Modern computer numerical control (CNC) lathes and (CNC) machining centres can do secondary operations like milling by using driven tools. When driven tools are used, the work piece stops rotating and the driven tool executes the machining operation with a rotating cutting tool. The CNC machines use x, y, and z coordinates in order to control the turning tools and produce the product. Most modern day CNC lathes are able to produce most turned objects in 3D.

F. Other operation that can be performed with a single point tool on a lathe are: chamfering, parting, threading, boring, drilling, knurling.

G. Materials appropriate for turning used are softer metals, although harder metals can be turned with a bit more time and effort.

Ex. 8. Answer the questions.

1. What is turning?
2. What are appropriate materials for turning?
3. What is a lathe?
4. What are the main components of a lathe?
5. What operation can be performed on a lathe?
6. What are examples of objects that can be produced on a lathe?
7. What are two types of producing surfaces?
8. What is a carriage?
9. Can computers be used in metalworking processes?

Ex. 9. Are these statements True or False? Correct the false ones.

1. The threading processes don't include cutting threads with a tap or die, thread milling, single-point thread cutting, thread rolling and forming, and thread grinding.
2. A tap is used to cut a female thread on the inside surface of a pre-drilled hole, while a die cuts a male thread on a preformed cylindrical rod.
3. Grinding uses an abrasive process to remove food from the workpiece.
4. A grinding machine is a machine tool used for producing very fine finishes, making very light cuts, or high precision forms using an abrasive wheel as the cutting device.
5. The most difficult grinder is a bench grinder or a hand-held angle grinder, for deburring parts or cutting metal with a zip-disc.
6. Old technology has advanced grinding operations to include CNC controls, high material removal rates with high precision, lending itself well to aerospace applications and high volume production runs of precision components.
7. Modern grinding wheel materials and the use of industrial diamonds or other man-made coatings (cubic boron nitride) on wheel forms have allowed grinders to achieve excellent results in production environments instead of being relegated to the back of the shop.
8. Filing is combination of grinding and saw tooth cutting using a file.

Ex. 10. Fill in the gaps with the words given below.

metalworking processes, metals, heat treatment, annealing process, dissolved solute atoms, the dissolved alloying elements, thermo-mechanical treatments, surface-treatment technique, finishing option.

1. While these processes are not primary….., they are often performed before or after metalworking processes.
2. …. can be heat treated to alter the properties of strength, ductility, toughness, hardness or resistance to corrosion. Common …..

processes include annealing, precipitation strengthening, quenching, and tempering.
3. The ….. softens the metal by allowing recovery of cold work and grain growth.
4. Quenching can be used to harden alloy steels, or in precipitation hardenable alloys, to trap ….. in solution.
5. Tempering will cause ….. to precipitate, or in the case of quenched steels, improve impact strength and ductile properties.
6. Mechanical and thermal treatments are combined in what is known as ….. for better properties and more efficient processing of materials. These processes are common to high alloy special steels, super alloys and titanium alloys.
7. Electroplating is a common….. It involves bonding a thin layer of another metal such as gold, silver, chromium or zinc to the surface of the product. It is used to reduce corrosion as well as to improve the product's aesthetic appearance.
8. Thermal spraying techniques are another popular….., and often have better high temperature properties than electroplated coatings.

Writing

Ex. 11. Summarize what is said on *metalworking processes in modern industry.*

Speaking

Ex. 12. Study the table and speak on metalworking processes.

Other Metalworking Processes

Process	Process Description
Broaching	is a machining operation used to cut keyways into shafts. Electron beam machining (EBM) is a machining process where high-velocity electrons are directed toward a work piece, creating heat and vaporizing the material. Ultrasonic machining uses ultrasonic vibrations to machine very hard or brittle materials.
Welding	is a fabrication process that joins materials, usually

	metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material that cools to become a strong joint, but sometimes pressure is used in conjunction with heat, or by itself, to produce the weld.
Brazing	is a joining process in which a filler metal is melted and drawn into a capillary formed by the assembly of two or more work pieces. The filler metal reacts metallurgically with the workpiece(s) and solidifies in the capillary, forming a strong joint. Unlike welding, the work piece is not melted. Brazing is similar to soldering, but occurs at temperatures in excess of 450 °C (842 °F). Brazing has the advantage of producing less thermal stresses than welding, and brazed assemblies tend to be more ductile than weldments because alloying elements can not segregate and precipitate. Brazing techniques include flame brazing, resistance brazing, furnace brazing, diffusion brazing, and inductive brazing.
Soldering	is a joining process that occurs at temperatures below 450 °C (842 °F). It is similar to brazing in the fact that a filler is melted and drawn into a capillary to form a join, although at a lower temperature. Because of this lower temperature and different alloys used as fillers, the metallurgical reaction between filler and work piece is minimal, resulting in a weaker joint.
Riveting	is one of the most ancient metalwork joining processes. Its use has declined markedly during the second half of the 20th century, but it still retains important uses in industry and construction into the 21st century. The earlier use of rivets is being superseded by improvements in welding and component fabrication techniques.

Ex. 13. Work in pairs, discuss the following.

- Optimization of cutting conditions in terms of reduced costs, maximised manufacturing productivity and improved surface quality,
- Prediction of tool service life,
- Monitoring of cutting stability, energy demands and environmental impacts,
- Development of mathematical models of the cutting process,
- Optimisation of cutting conditions, using information about the dynamic behaviour of tool,
- Use of environment-friendly cutting fluids and lubricants.

Ex. 14. Role play.

Work in two groups. One group is working in the Technical Services division of Keighley Laboratory and dealing with plant order to create new technologically advanced metalworking equipment (cutting tools).
The second group is engineers from the enterprise. They are not satisfied with the first tests results of this equipment. Discuss pros and cons of innovations of cutting tools:

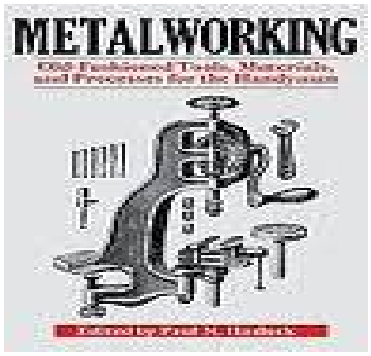
- edge geometry
- cutting stability, tool edge durability and machined surface quality
- cutting stability, tool edge durability and machined surface quality
- improved cooling
- simulations of tool functions in the design phase
- simulations of the environmental impact of machining methods combined with particular tools

UNIT II

METALWORKING TOOLS

Warming up

Ex. 1. What comes to your mind when you look at this picture? How does it refer to the topic?



Do you know that metalworking tools are divided into four categories: machine tools, metalworking cutting tools, metalworking hand tools, metalworking measuring instruments?

Vocabulary

metalworking tool	металлообрабатывающие инструменты
machine tool	металлорежущий станок
metalworking cutting tool	металлообрабатывающий отрезной инструмент
metalworking hand tool	металлообрабатывающий ручной инструмент
metalworking measuring instrument	металлообрабатывающий измерительный инструмент
centre punch	кернер
hammer head	баба молота
scriber	разметочный инструмент
outside caliper	кронциркуль для внешних обмеров
wing compasses	циркуль с сектором
card wire brush	щётка из игольчатой ленты
cold chisel	слесарное зубило

soldering-iron	паяльник
gas stove	газовая горелка
hack saw	ножовка по металлу
arbor press	пресс для насадки втулок
brake	тормозной механизм
die	пресс-шайба
drill bushing	кондукторская втулка для сверления
half-round bastard file	полукруглый напильник
hand bastard file	ручной напильник
wrought iron	сварочное железо
eye	проушина
pane (peen)	боёк молота
chisel	резец
steel-brass	стальной вкладыш подшипника
cutting edge	режущая кромка
teeth	зубцы
staking	укреплять
riveting	клепать
bend	коленчатый патрубок
crease	отбортовка
jig	технологическая оснастка

Ex. 2. Find synonyms to the following words.

To express, production, to remain, to populate, to equate, to combine, to differ, to hope, to measure.

Ex. 3. Give definitions of the following terms, if necessary consult English – English dictionary.

- Mitre punch –
- Scriber –
- Pane –
- Wing compass –
- Hand bastard file –
- Half-round bastard file –

Ex. 4. Fill in the gaps using the words below.

technological, solid, properties, structure-sensitive.

1. The … of materials are sometimes referred to as structure-sensitive, as compared to structure-insensitive properties.
2. The … properties include the tensile and yield strength, hardness, and impact, creep, and fatigue resistance.
3. All mechanical tests of material properties are … tests.
4. In the … state, materials can be classified as metals, polymers, ceramics, and composites.

Reading

Ex. 5. Read the text.

Metalworking Tools and their Uses

The tools illustrated in Fig. 1 are as follows:

A centre punch (1) is sometimes called a mitre punch. It is used for marking work of all descriptions, also for dotting the place where holes have to be drilled for the centre of the drill to start in. It is made of tool steel.

The Engineer's Hammer head (2) consists of three parts the face, the eye, and the pane, pene, or peen. The shaft should be of hickory or ash, and fastened with a metal wedge driven in parallel with the length of the head. The shaft should be carefully fitted so that the oval of the shaft is true with the head; if it is otherwise, it causes the student when using a chisel to miss the head of the chisel and hit his hand.

A scriber (3) is made either of brass or steel-brass for use on iron and steel, steel for use on brass, copper, etc.

An outside calipers (4) is used for measuring the outside diameters of bodies and for transferring sizes from the rule to articles in the round, or vice versa. It is usually made of iron or steel and used largely in turning.

A wing compasses (5) is made of iron with hardened steel points. It is used for geometrical setting out of all kinds.

A scratch card or card wire brush (6) is used for cleaning files by brushing it on the file and in the same direction as the cut of the teeth.

It consists of card wire tacked on a piece of wood shaped so that it is suitable for holding in the hand.

A hand bastard file (7) is used for filing all kinds of flat surfaces and roughing down any metal. Sometimes it is called a safe edge flat file, as it has one edge without teeth, for use when filing shoulders.

A half-round bastard file (8) is used for the preliminary roughing down of flat and curved surfaces for any metal.

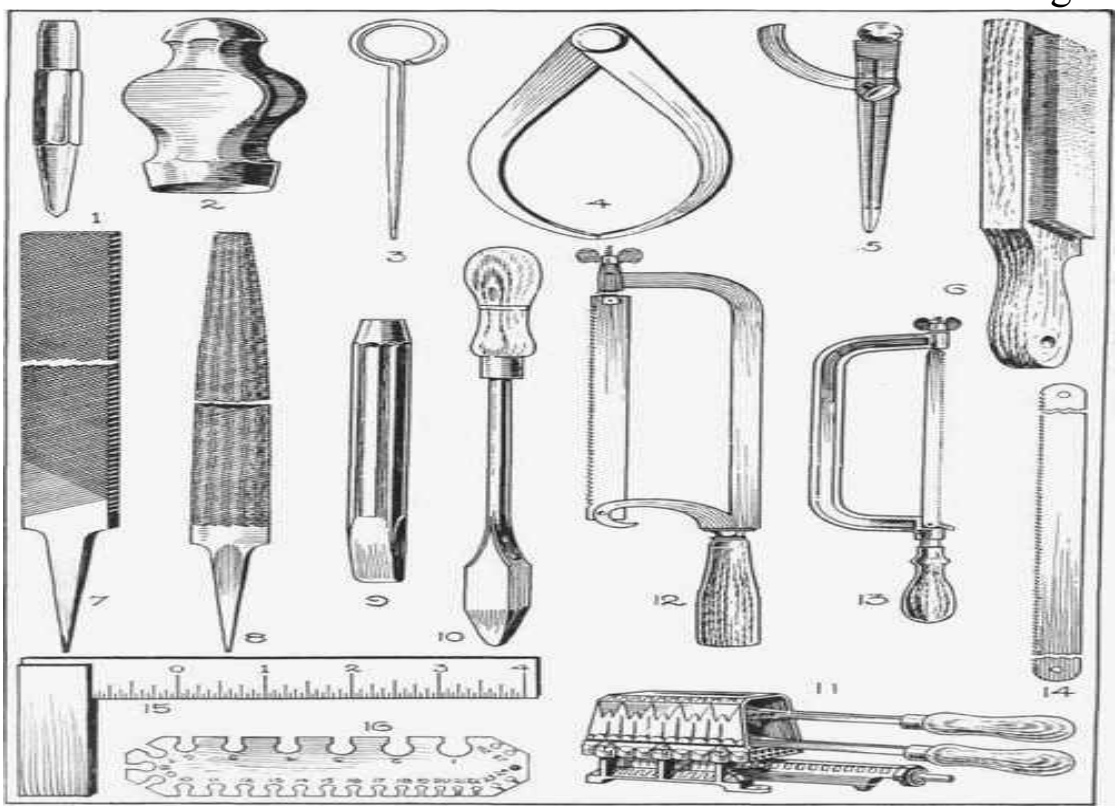
A Hand or Cold Chisel (9) is used for cutting all kinds of metals in a cold state in contradistinction to a hot hand chisel that is used for cutting metals in a hot state. For this purpose it would be 3 in. longer and thinner at cutting edge.

A soldering iron (10) is sometimes called a copper bit. It is used for all kinds of soft soldering. A handle is usually made of wood, rein of wrought iron, bit of wrought copper.

A tinman's gas stove (11) is used by a tinman when soft soldering, so that one iron can be getting hot while the other is being used. A stove is made of cast iron.

A lancashire hack saw (12) is used only for soft metals, such as brass, copper, etc. Frame of wrought iron, blade 12 in. long, and thick on edge where teeth are, thin at the back, tempered so that it can be filed.

Fig.1.



Ex. 6. Answer the questions.

1. What is a centre punch used for?
2. What is the engineer's hammer head?
3. What is a scriber used for?
4. What is a caliper used for?
5. What is a wing compasses?
6. What is a scratch card used for?
7. What is a hand bastard file used for?
8. What is the function of a half-round bastard file?
9. What can be done with a hand or cold chisel?
10. What is a soldering iron made of?
11. Who uses a gas stove?
12. What is a lancashire hack saw used for?
13. Do you know any other tools? What are they? What are they used for?

Ex. 7. Read the sentences and fill in the gaps with the words below.

alligator shear, jigsaw, milling cutters, abrasive saw, bolt cutter, burrs, nibbler, endmill, snips, bench shear.

1. An…., also known as a cut-off saw or metal chop saw, is a power tool which is typically used to cut hard materials, such as metals.
2. An….., historically known as a lever shear and sometimes as a crocodile shear, is a metal-cutting shear with a hinged jaw, powered by a flywheel or hydraulic cylinder.
3. A…., sometimes called bolt cropper, is a tool used for cutting chains, padlocks, bolts and wire mesh. The original use for bolt cutters was as the name suggests to cut bolt seals from shipping containers at the delivery point. It typically has long handles and short blades, with compound hinges to maximize leverage and cutting force.
4. …. are small cutters used in die grinders, rotary tools or dentist's drills. The name may be considered appropriate when their small-sized head (3 mm diameter shaft) is compared to that of a seed of the burr fruit or the teeth compared to a metal burr.
5. A …. is a tool used for cutting arbitrary curves, such as stenciled designs or other custom shapes, into a piece of wood, metal, or other material. It can be used in a more artistic fashion than other saws, which typically cut in straight lines only. In this way, it is similar to the rasp and the chisel.
6. …. are cutting tools typically used in milling machines or machining centres to perform milling operations (and occasionally in other machine tools). They remove material by their movement within the machine (e.g., a ball nose mill) or directly from the cutter's shape (e.g., a form tool such as a hobbing cutter).
7. …., also known as shears, are hand tools used to cut sheet metal and other tough webs. There are two broad categories: tinner's snips, which are similar to common scissors, and compound-action snips, which use a compound leverage handle system to increase the mechanical advantage.
8. A …. is a tool for cutting sheet metal with minimal distortion. One type operates much like a punch and die, with a blade that moves in a

linear fashion against a fixed die, removing small bits of metal and leaving a kerf approximately 6 mm wide.

9. An …. is a type of milling cutter, a cutting tool used in industrial milling applications. It is distinguished from the drill bit in its application, geometry, and manufacture. While a drill bit can only cut in the axial direction, a milling bit can generally cut in all directions, though some cannot cut axially.

10. A …., also known as a lever shear, is a bench mounted shear with a compound mechanism to increase the mechanical advantage. It is usually used for cutting rough shapes out of medium sized pieces of sheet metal, but cannot do delicate work.

Ex. 8. Mark the following statements True or False, correct the false ones.

1. An angle plate is a work holding device used as a fixture in metalworking. The angle plate is made from high quality material (generally cast iron) that has been stabilized to prevent further movement or distortion.

2. A range of gauges are used to increase a bore's size, by transferring the internal dimension to a remote measuring tool. They are an indirect equivalent of inside calipers and require the operator to develop the correct feel to obtain repeatable results.

3. A combination square is a tool used for unic purposes in woodworking, stonemasonry and metalworking. It is composed of a ruled blade and one or more interchangeable heads that may be affixed to it.

4. A wiggler, edge-finder, or center-finder is a tool used in the spindle of a machine such as an excavator. The device is used to accurately determine edges or markings and therefore the center of a workpiece or a previously machined feature during the set-up phase of a machining operation.

5. A micrometer is a device incorporating a calibrated screw used widely for precise measurement of large distances in mechanical engineering and machining as well as most mechanical trades, along with other metrological instruments such as dial, vernier, and digital calipers.

6. A tap wrench is a hand tool used to turn taps or other small tools, such as hand reamers and screw extractors.

7. A honing steel, sometimes referred to as sharpening steel, sharpening stick, sharpening rod, butcher's steel, and chef's steel is a rod of steel, ceramic or diamond coated steel used to hone or sharpen blade edges.

Writing

Ex. 9. Summarize what is said on the *future of metalworking industry.*

Speaking

Ex. 10. Study the table and speak about functions of metalworking tools.

An arbor press	is a small hand operated press. It is typically used to perform smaller jobs, such as staking, riveting, installing and removing bearings and other press fit work. Punches, inserters, or other tools/dies may be added to the end of the ram depending on the desired task. Arbor presses are usually rated by the maximum load they can apply. Typically common are presses with a leverage of 1-5 tons. This leverage is achieved when a force is applied to the lever arm or wheel.
A brake	is a metalworking machine that allows the bending of sheet metal. A cornice brake only allows for simple bends and creases, while a box-and-pan brake also allows one to form box and pan shapes. It is also known as a bending machine or bending brake.
A die	is a specialized tool used in manufacturing industries to cut or shape material using a press. Like molds, dies are generally customized to the item they are used to create. Products made with dies range from simple

	paper clips to complex pieces used in advanced technology.
A drill bushing, also known as a jig bushing	is a tool used in metalworking jigs to guide cutting tools, most commonly drill bits. Other tools that are commonly used in a drill bushing include counterbores, countersinks, and reamers. They are designed to guide, position, and support the cutting tool
A metal lathe or metalworking lathe	is a large class of lathes designed for precisely machining relatively hard materials. They were originally designed to machine metals; however, with the advent of plastics and other materials, and with their inherent versatility, they are used in a wide range of applications, and a broad range of materials. These rigid machine tools remove material from a rotating workpiece via the (typically linear) movements of various cutting tools, such as tool bits and drill bits.
A rotary tool	is a hand held power tool with a variety of rotating accessory bits and attachments that can be used for cutting, carving, sanding, polishing and many other applications.
A shaper	is a type of machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to machine a linear toolpath. Its cut is analogous to that of a lathe, except that it is (archetypally) linear instead of helical. A shaper is analogous to a planer, but smaller, and with the cutter riding a ram that moves above a stationary workpiece, rather than the entire workpiece moving beneath the cutter.

Ex.11. Work in pairs. Find information on metalworking processes in other countries, and compare tools which are used in Russian metalworking processes with tools used abroad.

Ex. 12. Work in pairs and make up a dialogue on the topic "Metalworking department buys new equipment" . Use the following words and word collocations:

Metalworking, machine tools, types of tools, engineers, metalworking cutting tools, improvements in industry, new technologies, metalworking hand tools, metalworking measuring instruments, new kinds of products, international trade.

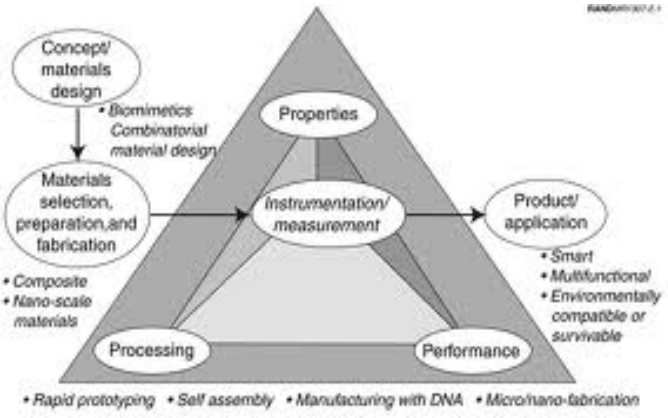
Ex. 13. Role play.

Work in two groups. Each team represents a pioneer company which invented a new metalworking technology for the regional usage. A total of 36 pioneering companies will be granted awards for their outstanding contributions to the industry. The 2012 Ringier Technology Innovation Awards for the Metalworking Industry will be announced in Shanghai. As the backbone of innovation, companies should grasp the trend and ride the wave of the technological revolution by being active in research investment, technological innovation and industrialization.
Make a presentation of the team's technical project.

UNIT III
RELATIVE COST OF ENGINEERING MATERIALS

Warming up

Ex. 1. What comes to your mind when you look at this picture? How does it refer to the topic?



Vocabulary

functional design	функциональное конструирование
selection	выбор
lack	недостаток, пробел
proper	надлежащий
deadline	срок
yield strength	предел текучести
ability	способность
criterion	критерий
primarily	в первую очередь
propertiy	свойство
electrical	электрический
conductivity	электропроводность
corrosion resistance	сопротивление коррозии
end-use	конечный потребитель
match	сообразовывать
esthetic	эстетический
requirement	требование
behavior	поведение
production engineer	технолог
materials specialist	металловед
handle	обращаться
entire	целый, полный
assignment	предписание, задача
flux	поток
recognized	признанный
ebb	отлив, упадок

flow	течение, поток
supply	предложение
demand	спрос
copper	медь
nickel	никель
production capacity	производительность
competition	конкуренция
polymer	полимер
aluminum	алюминий
density	плотность
strength	прочность, сила
converted	превращенный
unit volume	единичный объем
meaningful	значащий
comparison	сравнение
dominance	преобладание
severely	сильно, значительно
challenged	конкурировать

Ex. 2. Find synonyms among the following words.

Damage, deterioration, dimension, failure, form, major repair, operation, overhaul, performance, shape, size, wear, price, material.

Ex. 3. Give definitions of the following words, if necessary consult English – English dictionary.

- Mass production –
- Power transmission –
- Metal treatment –
- Toothed gear –
- Welded parts –
- Bending strength –
- Riveted parts –
- Surface hardening –
- Excessive stress –
- Interchangeable parts –

Reading

Ex. 4. Skim the text and explain the the terms.

initial specification, functional design, deadline, yield strength, corrosion, entire assignment, esthetic requirements, production capacity.

The design engineer is responsible for the initial specification of a material, yet in many cases he spends little time checking alternatives. Many designers feel that their obligation ends with the functional design, so they tend to minimize the importance of material selection. There are many reasons, but two are likely to be lack of proper education in their engineering courses and inadequate time because of the need to meet a deadline.

In over 90 percent of all designs a material is selected primarily on the basis of yield strength and ability to fill space at the lowest cost. In some cases, other criteria, depending primarily on physical properties such as electrical conductivity or chemical properties, corrosion resistance are dictated by the end-use of the design and form the basis for the material specification.

It is the designer's responsibility to match the functional and esthetic requirements of his design with the behavior of a particular material so that the total cost after manufacture is minimized. In a large organization, this undertaking is a team effort in which design engineers, production engineers, and materials specialists all play an important role. In a small company, a designer may handle the entire assignment.

The costs of engineering materials are in a constant state of flux. Three components may be recognized: firstly, the general price changes that follow the ebb and flow of the national economy; secondly, the supply-and-demand effect on the price of some metals, specifically copper and nickel; and finally, the effect of rising production capacity and strong competition, as found in the polymer industry since the 1950s. In general, polymers have dropped in price in the past decade, whereas the cost of all metals but aluminum has increased. Inflation had led to increasing prices.

Materials cannot be compared on the basis of cost alone because they have widely varying densities and strengths. If the cost per pound is converted to cost per unit volume, a more meaningful comparison can be made. When the same materials are compared, it is evident that not only the most materials have become strongly competitive, but that in the future, if stronger polymers are created, the 4000-year dominance of metals might be severely challenged.

Ex. 5. Answer the questions.

1. What kind of specialist provides the primary choice of material for the production of any detail?
2. What are the reasons of functional design preference?
3. What properties of materials are taken into account in designing?
4. What are the additional requirements for selection of the material?
5. What are the problems, which usually the designer faces with?
6. How the issues of functionality, aesthetics and low cost are settled in large and small engineering organizations?
7. What can be said on changes in prices of construction materials?
8. What are the three major factors affecting the construction materials price fluctuations?
9. What is the trend in price changes for polymers, aluminum and other metals?
10. Is the price of any metal the reason for selection of this material for production?
11. What materials can compete with traditional metals in the future?

Ex. 6. Give the summary of this text in English.

Для правильного выбора и рационального использования материалов о них необходимы все сведения. Правильный выбор обеспечивает выполнение поставленных требований (например, заданных технических условий, техники безопасности и т. д.); наименьшие затраты на собственно материал и на издержки, связанные с его обработкой; высокое качество (работоспособность) изделий в эксплуатации.

Выбор проводят в два этапа. Сначала выбирают ряд материалов, которые удовлетворяют предъявляемым требованиям к заданным физико-механическим, эксплуатационным, технологическим и другим свойствам и внешнему виду изделия. Затем методом технико-экономического анализа, с точки зрения минимальных затрат при производстве и эксплуатации изделия, принимают решение об окончательном выборе материала.

В процессе выбора материала учитывают:

- первичные требования, которые задаются, исходя из основных условий службы изделия (например, требования коррозионной стойкости);
- вторичные требования, которые задаются, исходя из технологических условий изготовления (например, требования к свариваемости).

При выборе материалов учитываются следующие важнейшие критерии:

физические — структура, механические, оптические (например, цвет), акустические (например, уровень звучания), термические (например, линейное расширение), электрические (например, проводимость), магнитные (например, коэрцитивная сила) и другие свойства;

- технологические – первичное получение заготовок, обработка давлением, резанием, литьем; монтаж, нанесение покрытий и т. п.;
- химические – устойчивость против агрессивных сред (например, кислот), устойчивость против атмосферного влияния и др.;
- биологические – устойчивость по отношению к воздействию живых организмов (плесени, грибов, насекомых);
- связанные с доставкой – возможность доставки, масса, форма и состояние материала;
- экономические – цена, стоимость переработки, транспортные затраты, затраты на обслуживание, дефицитность;
- экологические – безвредность материала для окружающей среды, возможность утилизации отходов технологической обработки.

Освоение и выработка навыков оптимального выбора (назначения) конструкционного материала для изготовления того или иного изделия является одним из важнейших этапов в изучении материалов.

Ex. 7. Are these statements True or False? Correct the false ones.

1. The purpose of machine creation is to increase the productivity.
2. It is not possible to classify all machines into several groups.
3. The machines are means of production which use the forces of nature to facilitate work.
4. It seems to be convenient to divide all problems of mechanisms analysis into six parts.
5. Mechanisms are used seldom in all branches of modern technology.
6. The machine is a device intended for transmission of energy, materials and money.
7. The working machines are multiplied into transport and technological ones.
8. The mechanisms which are included in the structure of a machine can incorporate firm, liquid, gaseous bodies.
9. All problems of the theory of mechanisms can be divided into three groups.

Writing

Ex. 8. Summarize what is said on the *main rules of engineering materials selection.*

Speaking

Ex. 9. Make up a dialogue on the topic "Advantages of composite materials usage". Use the following words and combinations:

Definite qualities of material, materials saving, unification of machine parts, to save engineering materials, several principal ways, technical products, manufacturing conditions, optimal parameters of parts and units.

Ex. 10. Read and discuss the following with your partner.

There is the possibility that the future of engineering is very bright, that this will be the one science of the future that no other science can live without. There is also a chance that this is the science that will make the world highly uncomfortable with the potential power to transform the world.

Ex. 11. Discuss the following with your partner.

- Composite materials,
- Composite building materials,
- Metal Composites,
- Ceramic Composites,
- Examples of composite materials,
- Physical properties of composite materials,
- Application of composite materials.

Ex. 12. Role play.

You are a future metalworking engineer. Discuss in pairs what is engineering, what qualities the engineer should possess in order to be successful.

Discussion points

1. Explain clearly and as fully as possible, why is the engineer not free to select the problem which interests him?
2. What does efficiency mean to the engineer?
3. Give clear illustration of the emphasis on efficiency. What does efficient functioning depend on?
4. Speak out that any problem involving the low - cost production of large quantities of any item is an engineering problem even if the item itself originated in the work of other disciplines. Explain how any given result of (a) medical research, (b) agricultural research, (c) nuclear physics, (d) optical research is likely to need solutions requiring the skills of an engineer.
5. Explain in details why:

a) "efficiency costs money";

b) "safety adds complexity";
c) "performance increases weight".
6. You have read that engineering solution to most problems is the "most desirable end result taking into account many factors". Does this apply to your own discipline? If so, explain in what way.
7. What do you understand by the definition "engineering of the highest type"?
8. What is your opinion with regard to that "the successful engineer is a malcontent always trying to change things for the better"?

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METALWORKING TOOLS
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