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«Оренбургский государственный университет»

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ENGLISH FOR MACHINE-BUILDING ENGINEERS

Учебное пособие

Рекомендовано ученым советом федерального государственного
бюджетного образовательного учреждения высшего образования
«Оренбургский государственный университет» для обучающихся
по образовательным программам высшего образования
по направлениям подготовки 15.03.01 Машиностроение,
15.03.04 Автоматизация технологических процессов и производств,
15.03.05 Конструкторско-технологическое обеспечение
машиностроительных производств, 09.03.01 Информатика и
вычислительная техника, 20.03.01 Техносферная безопасность,
22.03.01 Материаловедение и технологии материалов,
27.03.03 Системный анализ и управление,
27.03.04 Управление в технических системах

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Учебное пособие включает профессионально-ориентированные тек-сты на английском языке с комплексом лексико-грамматических упраж-нений, направленных на развитие навыков чтения, понимания, обсуждения и перевода специальной литературы. Тематика текстов отражает спе-цифику работы инженера, технологических процессов на предприятиях в сфере машиностроения.

Пособие предназначено для студентов 2 курса инженерных специальностей высших учебных заведений, изучающих дисциплину «Иностранный язык».

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Введение

Учебное пособие предназначено для студентов Аэрокосмического института, обучающихся по направлениям подготовки 15.03.01 Машиностроение, 15.03.04 Автоматизация технологических процессов и производств, 15.03.05 Конструкторско-технологическое обеспечение машиностроительных производств, 09.03.01 Информатика и вычислительная техника, 20.03.01 Техносферная безопасность, 22.03.01 Материаловедение и технологии материалов, 27.03.03 Системный анализ и управление, 27.03.04 Управление в технических системах в курсе изучения дисциплины «Иностранный язык».

Целью данного пособия является развитие навыков перевода научно-технических текстов, «способности студентов к коммуникации в устной и письменной формах на иностранном языке для решения задач профессионального взаимодействия». Профессионально-ориентированные тексты, сопровождаемые разнообразными лексическими упражнениями, позволят студентам обогатить терминологический словарный запас, расширить знания о профессиональной деятельности на английском языке. Теоретические пояснения и комплекс упражнений способствуют правильному пониманию учебного материала, а также развитию навыков адекватного перевода специальной литературы.

Пособие может быть рекомендовано к использованию, как для аудиторных, так и для самостоятельных занятий.

1 Unit 1 The engineering profession

1.1.1 Learn the words and phrases below

to comprise – включать в себя

automated manufacturing of products – автоматизированное производство товаров

robotics – робототехника

horizons – горизонты

cheap – дешевый

to generate – генерировать, производить

to transmit – передавать

to store – хранить

scale – масштаб

unprecedented in history – не имеющий прецедентов в истории

indication – указание, свидетельство

explosive – взрывной

to deal with – иметь дело с, заниматься чем-либо

integration – интеграция

application – приложение, использование

circuits – электрические схемы, цепи

device – устройство

transmission – передача

processing – обработка

to rely – полагаться

Fourier analysis – анализ Фурье

linear systems theory – теория линейных систем

linear algebra – линейная алгебра

differential equations – дифференциальные уравнения

probability theory – теория вероятности

extensively – широко

replacement – замещение

fiber optics – оптоволоконные технологии

copper – медь

digital – цифровой

immunity – защищенность, невосприимчивость

carrying capacity – пропускная способность

light – легкий

rapidly growing – быстрорастущий

artificial intelligence – искусственный разум

sophisticated – сложный

superconductivity – сверхпроводимость

1.1.2 Make up sentences with these words and phrases in English

1.1.3 Read Text 1.1 and make a plan of it

Text 1.1 My future profession

I was always good in mathematics, and physics. My parents bought me a computer when I was in the 10^{th} form. Since then, I knew that I would become a specialist in computer technologies – a computer engineer.

The computer industry is developing so fast that it comprises almost all spheres of professional life. No business now is possible without computers. This is especially true about automated manufacturing of products and robotics. Computer control of automated production opens new horizons for the cheap and quality production of goods. Information is now generated, transmitted, received, and stored electronically through computer networks on a scale unprecedented in history. There is every indication that the explosive rate of growth in this field will continue.

Computer engineering is a general field. It deals with both the electric and electronic industries.

Electronic engineering deals with the research, design, integration, and applica-

tion of circuits and devices used in the transmission and processing of information.

Engineers in electric and electronic engineering are concerned with all aspects of electrical communications, from fundamental questions such as ‘What is information?’ to the efficient, such as the design of telephone systems. In designing communication systems, engineers rely on various advanced mathematics branches, such as Fourier analysis, linear systems theory, linear algebra, differential equations, and probability theory.

Engineers work on control systems that are used extensively in automated manufacturing and robotics.

Significant developments in communications and control have been replacing analog systems with digital systems; fiber optics are used now instead of copper cables. Digital systems offer far greater immunity to electrical noise. Fiber optics are likewise immune to interference; they also have excellent carrying capacity and are extremely light and inexpensive to manufacture.

Computer engineering is now the most rapidly growing field. The electronics of computers are the design and manufacture of memory systems, central processing units, and peripheral devices. The most prospective industry now is the Very Large-Scale Integration (VLSI) and new computer architectures. Computer science is closely related to computer engineering; however, the task of making computers more ‘intelligent’ (artificial intelligence), through the creation of sophisticated programs or development of higher-level machine languages or other means, is generally regarded as the dream of computer science.

One current trend in computer engineering is microminiaturization. Engineers continue to work to fit greater and greater numbers of circuit elements onto smaller and smaller chips.

Another trend is increasing the speed of computer operations through the use and superconducting materials.

So, as you see, there are a lot of employment opportunities in my field. I don’t worry about finding a job. The most important thing for me now is to study well and to graduate from the University.

1.1.4 Find words and phrases from exercise 1.1.1 in text 1.1 and translate these sentences into Russian

1.1.5 Add to your active vocabulary

a) mechanical engineer – инженер-механик; electric engineer – инженер-электрик; electronic engineer – инженер электроник; computer engineer – инженер-компьютерщик; military engineer – военный инженер;

b) prestigious job (work) – престижная работа

well-paid job – высокооплачиваемая работа

employee – наемный рабочий

employer – наймодатель

businessman – предприниматель, бизнесмен

state-employed – государственный служащий

white-collar worker – «белый воротничок», работник умственного труда

blue-collar worker – «синий воротничок», работник физического труда

skilled worker – квалифицированный рабочий

unskilled worker – неквалифицированный рабочий

experienced worker – опытный работник

to be hired for a job – быть нанятым на выполнение работы

to look for a new job (work, position) – искать новую работу

to apply for a new job – претендовать на какую-либо должность

application for a position of – заявление на какую-либо должность

resume – резюме

C.V. (curriculum vitae) – автобиография

to be fired – быть уволенным

to retire – уходить на пенсию

to be unemployed – быть безработным

1.1.6 Translate into English

1 Родители купили мне компьютер, когда я училась(ся) в десятом классе.

2 Никакой современный бизнес невозможен без компьютерной техники.

3 Компьютерная индустрия – наиболее быстро развивающееся производство.

4 Компьютерное управление автоматизированными производственными линиями открывает новые горизонты дешевого и качественного производства товаров.

5 Крупным достижением в сфере коммуникации является замена аналоговых систем на цифровые.

6 В настоящее время оптоволоконные цифровые технологии обеспечивают более качественную и доступную связь, чем аналоговые системы.

1.1.7 How do you see your future profession? Answer the following questions:

1 What kind of work are you interested in?

a) well paid
b) interesting
c) in a large and famous company
d) quiet
e) in an industry that has a future
f) prestigious
g) not to sit the whole day in the office
h) to travel a lot

2 What position would you like to have?

a) to manage people – manager
b) to work for someone else – employee
c) to be your own boss – self-employed, businessman
d) to be responsible for everything – top manager, director
e) to work for the state – state employee

1.1.8 Ask your groupmates the questions from text 1.1

1.1.9 Review text 1.2 to understand what it is all about. Find the main topics of the paragraphs and give each a suitable title

1.1.10 Discuss with your group the advantages and disadvantages of your fu-

ture profession. Do you think the engineering profession is prestigious? Is it paid well? How difficult is it to find a good job in this field?

Text 1.2 The future of the engineering profession

Among various recent trends in engineering, profession computerization is the most widespread. The trend in modern engineering offices is also towards computerization. Computers are increasingly used for solving complex problems as well as for handling, storing, and generating the enormous volume of data modern engineers must work with.

Scientific methods of engineering are applied in several fields not connected directly to manufacture and construction. Modern engineering is characterized by the broad application of what is known as systems engineering principles.

Engineers in the industry work with machines and people to determine, for example, how devices can be operated most efficiently by workers. A small change in the location of the controls of a machine or its position with relation to other machines or equipment, or a change in the operator's muscular movements, often results in significantly increased production. This type of engineering work is called time-study engineering.

A related field of engineering, human-factors engineering, also known as ergonomics, received wide attention in the late 1970s and 1980s when the safety of nuclear reactors was questioned following severe accidents that were caused by operator errors, design failures, and malfunctioning equipment.

Human-factors engineering seeks to establish criteria for the efficient, human-centered design of, among other things, the large, complicated control panels that monitor and govern nuclear reactor operations.

1.2.1 General understanding. Answer the questions

1 What is the most widespread trend in the engineering profession?

2 What are computers used for in modern engineering?

3 What approaches are used in modern engineering?

4 What is ‘ergonomics?’

5 What does human-factors engineering deal with?

1.3.1 Skim Text 1.3 and say

a) which paragraph refers to the specifics of mechanical engineering at the end of the 20th century;

b) in which paragraphs it is said about the role of the engineer and his main functions;

c) what paragraphs refer to the engineer’s activities: in the laboratory, in production, in the design office.

Text 1.3 Mechanical engineers

The engineer typifies the twentieth century. He is making a vast contribution to design, engineering, and promotion. In the organization and direction of large-scale enterprises, we need his analytical frame of mind. We need his imagination.

He is either designing the product itself or inventing new products or testing the product, its components, and the materials in it, or analyzing its performance and making a mathematical analysis.

He may be engaged in the development of the new product, making drawings and specifications.

He may be concerning himself with developing a new production process or adapting a current approach to a new product.

He may be utilizing his engineering know-how in determining the best processes and equipment for the mass production of high-quality products.

He may be the project engineer in charge of designing and installing a highly automatic conveyer system for handling different kinds of parts between various assembly stations.

He may be working on designing and developing tools, dies, jigs, assembly fixtures, and welding fixtures to produce an automotive body.

In the 20th century, the engineer had at his command many new sources of

power. He works hard to develop better materials, especially new alloys, for particular purposes. He wants to make machinery automatic.

1.3.2 What are the meanings of the following international words

a) specify the meanings of the highlighted words ('false friends of a translator') in the dictionary

Contribution, organization, test, component, to analyze, adaptation, project, conveyer, special, *direction,* analytical, analysis, specifications, *assembly,* station, *command;*

b) find sentences with these words in the text and check the context for the correctness of the meanings you have chosen

1.3.3 Write out from the third and the last paragraphs the English words and word combinations used to denote concepts related to an engineer's activities in a design bureau. Translate them into Russian using the polytechnic dictionary and complete Table 1

Table 1 – Type and object of an activity

Вид деятельности		**Объект деятельности**	
1 to develop	разрабатывать	new product	
2		drawings and specifications	
3 to design			новая продукция, новые инструменты, узлы, крепления

1.3.4 Write out from the second paragraph of text 1.3 the English words and word combinations that are used to denote concepts related to an engineer's activities in the laboratory. Translate them into Russian using the polytechnic dictionary

1.3.5 Find in the fourth to eighth paragraphs of text 1.3 the English equivalents for the following Russian words and phrases

существующий процесс, источники энергии, установка, узлы, сплавы, транспортировка, упорно работать, инженерное умение, ответственный за…, в своем распоряжении.

1.3.6 Complete the sentences in the numbered list by matching the corresponding endings from the alphabetical list below

1 The engineer typifies...

2 He makes a great contribution...

3 His main functions are…

4 The engineer also analyses...

5 So, he can work in...

6 At present, the engineer...

7 The work of the engineer requires...

a) the products' performances.

b) deals with the automation of production processes.

c) the 20th century.

d) he analytical frame of mind and imagination.

e) the designing office, in the lab, and the production field of engineering.

f) to progress.

g) designing, developing, and testing the products.

1.3.7 Using the information in text 1.3, complete Table 2 by answering the question: What does the engineer do?

1.3.8 Read aloud the following words with their Russian equivalents

to condense down – *зд.* уменьшить до, objective – цель, to recognize – определять; признавать, to encourage – поощрять, interchange – (взаимо)обмен

Table 2 – The work that the engineer does on different premises

At the plant	In the lab	In the designing office
1 2 3 4		

1.4.1 Read text 1.4

Text 1.4 Educating tomorrow's engineers

Engineering education developed very differently on the Continent and in the UK. On the Continent, engineering and technical sciences were set up in technical universities. In the UK, engineering departments were set up in multi-discipline universities. Consequently, engineering education developed on the Continent as a more professionally oriented subject, while in the UK, the emphasis was on engineering science. Perhaps because of their size and more professional engineering-oriented courses, the Continental technical universities have developed a closer relationship with industry. In Germany, the Herr Professor is also likely to be a Herr Director. Many visiting industrial professors will spend a day a week at the University. In France, much of the lecturing is provided by staff from the appropriate industries. There is nothing similar in UK engineering departments.

The question is, what is to be done about engineering education in the UK? In the opinion of Britain's specialists, 70 to 80 engineering faculties in English universities and polytechnics should be condensed down into 20 or so major technical universities. They should become more industrially-oriented.

Lastly, the objective of engineering education and training should be recognized. So what should be the objective of undergraduate education? It is to educate and train people to think and search out knowledge for themselves and to have the self-assurance to apply it to the job at hand. Many of the courses are now much too intensive, and students have too little time or encouragement to read and think for themselves. The solution is to recognize that it is impossible to cover all the subjects

an engineer may find useful in a lifetime and realize that if he has been correctly educated, he can read up on issues he may need to progress in his career.

However, the industry must recognize that a graduate will need training in the specific area in which he is working and must also be prepared to encourage him to attend continuing education courses and seminars, and conferences as appropriate. There is to be much more interchange of staff between industry and higher education.

The education and training of engineers must be a partnership between industry and higher education, extending from undergraduate education and training to postgraduate short and long courses and research.

1.4.2 The first paragraph of text 1.4 compares higher technical education in the UK and on the continent. Are there any differences between them? What kind?

Highlight in this paragraph:

a) cause,

b) effect,

c) example

1.4.3 The rest of text 1.4 answers the question: What is to be done about engineering education in the UK? Reread this part of the text and list the changes that, according to the author, should be made to the UK technical education system.

1.4.4 One of the ways to improve engineers' training is the cooperation of higher education institutions with industry. How should it manifest itself?

Confirm your answer with a link to the text

Инфинитив (The Infinitive)

Инфинитив представляет собой основу глагола, которой обычно предшествует частица to, и относится к неличным формам.

Формы инфинитива

The Indefinite Infinitive Active и Passive употребляется для выражения действия, одновременного с действием, обозначенным глаголом-сказуемым в

предложении, в настоящем, прошедшем и будущем времени:

I am glad to help him.	Я рад помочь ему.
I was glad to help him.	Я был рад помочь ему.
I'll be glad to help him.	Я буду рад помочь ему.
I am glad to be helped.	Я рад, что мне помогают.

Table 3 – Infinitive

Tense	**Active**	**Passive**
Indefinite	to help	to be helped
Continuous	to be helping	-
Perfect	to have helped	to have been helped

The Indefinite Infinitive Active и Passive употребляется для выражения действия, одновременного с действием, обозначенным глаголом-сказуемым в предложении, в настоящем, прошедшем и будущем времени:

I am glad to help him.	Я рад помочь ему.
I was glad to help him.	Я был рад помочь ему.
I'll be glad to help him.	Я буду рад помочь ему.
I am glad to be helped.	Я рад, что мне помогают.

The Continuous Infinitive Active употребляется для выражения действия в процессе его развертывания, происходящего одновременно с действием, обозначенным глаголом-сказуемым в предложении:

I am glad to be helping him.	Я рад, что сейчас помогаю ему.
It was pleasant to be helping him again.	Было приятно снова помогать ему.

The Perfect Infinitive Active и Passive употребляется для выражения действия, которое предшествует действию, обозначенному глаголом-сказуемым в предложении:

I am glad to have helped him.	Я рад, что помог ему.
I am glad to have been helped.	Я рад, что мне помогли.

Функции инфинитива

Инфинитив может выполнять в предложении следующие функции:

– **подлежащего**:

В этом случае инфинитив стоит в самом начале предложения во главе группы слов перед сказуемым. Инфинитив в функции подлежащего можно переводить как неопределенной формой глагола, так и отглагольным существительным.

To translate such an article without a dictionary is difficult.	Переводить такую статью без словаря трудно. = Перевод такой статьи без словаря труден.
To work with a computer was new to many of us.	Работать с компьютером было новым для нас. = Работа с компьютером была нова для нас

– **обстоятельства цели**:

В этом случае инфинитив может стоять как в самом начале предложения перед подлежащим, так и в конце предложения. В функции обстоятельства цели инфинитиву могут предшествовать союзы ‘in order to’, ‘so as’ – ‘чтобы’, ‘для того, чтобы’.

To translate such an article without a dictionary you must know English well.	Чтобы переводить такую статью без словаря, вы должны хорошо знать английский язык.
One must work hard to master a foreign language.	Нужно много работать, чтобы овладеть иностранным языком.
To increase the speed the designers have to improve the aircraft shape and engine efficiency.	Чтобы увеличить скорость, конструкторы должны улучшить форму самолета и КПД двигателя.
Once a week, a student of Cambridge is to go to his tutor to discuss his work.	Раз в неделю студент Кембриджа должен встретиться с наставником, чтобы обсудить свою работу.

– **части сказуемого (простого и составного)**:

В этом случае инфинитив стоит либо после глагола ‘to be’, либо после модальных глаголов, либо после вспомогательных глаголов.

Our aim is to translate technical articles without a dictionary.	Наша цель – переводить (перевод) технические статьи без словаря.
He can translate this article without a dictionary.	Он может переводить такую статью без словаря.
He will translate the article next week.	Он будет переводить (переведет) эту статью на следующей неделе.

– **дополнения:**

В этом случае инфинитив стоит после глагола или прилагательного.

He doesn’t like to translate technical articles.	Он не любит переводить технические статьи.
The article was not difficult to translate.	Эту статью было нетрудно переводить.
I am glad to have spoken to our lecturer about my work.	Я рад (а), что поговорил(а) с нашим лектором о моей работе.

– **определения:**

He was the first to translate this article.	Он первым перевел эту статью.

В этой функции инфинитив стоит после слов ‘the first’, ‘the second’, ‘the last’ и т. д. или после существительного.

После существительного инфинитив чаще всего стоит в пассивной форме, обычно имеет модальное значение и выражает действие, которое должно произойти в будущем. В этом случае инфинитив переводится определительным придаточным предложением:

He gave me some articles to translate.	Он дал мне несколько статей, которые нужно было перевести (для перевода).
Here is the article to be translat-	Вот статья, которую нужно перевести.

ed.

Here is the article to translate.	Вот статья для перевода.
Gagarin was the first to orbit the Earth.	Гагарин первый облетел Землю.
The device to be tested has been made in our lab.	Прибор, который будет (должен) испытываться, сделан в нашей лаборатории.

Запомните случаи, в которых инфинитив употребляется **без частицы ‘to’:**

- после модальных глаголов;
- после глаголов ‘to let’ и ‘to make’;
- в сложном дополнении после глаголов восприятия: to see, to hear, to feel, etc.;
- после выражений ‘I would rather’, ‘You had better’.

1.5.1 Insert the particle ‘to’ before the infinitive where necessary and translate the sentences into Russian

1 I’d like ... dance. 2 She made me ... repeat my words several times. 3 I saw him ... enter the room. 4 She did not let her mother ... go away. 5 Do you like ... listen to good music? 6 Would you like … listen to good music? 7 That funny scene made me ... laugh. 8 I like ... play the guitar. 9 My brother can ... speak French. 10 We had ... put on our overcoats because it was cold. 11 They wanted ... cross the river. 12 It is high time for you ... go to bed. 13 May I ... use your telephone? 14 They heard the girl ... cry out with joy. 15 I would rather ... stay at home today. 16 He did not want ... play in the yard anymore. 17 Would you like ... go to England? 18 You look tired. You had better ... go home. 19 I wanted ... speak to Nick but could not ... find his telephone number. 20 It is time ... get up. 21 Let me ... help you with your homework. 22 I was planning ... do a lot of things yesterday. 23 I’d like ... speak to you. 24 I think I shall be able ... solve this problem. 25 What makes you ... think you are right? 26 I shall do all I can ... help you. 27 I like ... dance.

Remember the following fixed phrases with infinitives:

to cut a long story short – короче говоря

to tell (you) the truth – сказать (вам) по правде

to say nothing of – не говоря уже о

to put it mildly – мягко выражаясь

to say the least of it – по меньшей мере

to begin with – начнем с того что

Remember the following sentences:

The book leaves much to be desired. – Книга оставляет желать лучшего.

He is difficult to deal with. – С ним трудно иметь дело.

He is hard to please. – Ему трудно угодить.

She is pleasant to look at. – На нее приятно смотреть.

1.5.2 Translate into English using fixed phrases with infinitives

1 Для начала она открыла все окна.

2 С моим соседом трудно иметь дело.

3 По правде говоря, я очень устал.

4 Его поведение оставляет желать лучшего.

5 Мягко выражаясь, вы меня удивили.

6 На этих детей приятно посмотреть.

7 Короче говоря, они поженились.

8 Самая известная книга Джерома – ‘Трое в лодке, не считая собаки’.

9 Вам трудно угодить.

10 По меньшей мере, мы были удивлены.

11 Мягко выражаясь, она была Невежлива.

12 Ваша работа оставляет желать лучшего.

13 Сказать по правде, я не люблю бокс.

14 Вашей сестре трудно угодить.

15 Начнем с того, что я занят.

16 На него было приятно смотреть.

17 Короче говоря, он не сдал экзамен.

18 Мы все были рады, не говоря уже о маме: она сказала, что это самый счастливый день в ее жизни.

19 Твое сочинение оставляет желать лучшего.

20 Это очень странно, по меньшей мере.

Pay attention to the absence of the conjunction 'to' before the infinitive as the adverbial modifier of purpose:

To get this book, you must go to the library.	*Чтобы* получить эту книгу, вы должны пойти в библиотеку.

Remember the following sentences:

I have nothing to read. – Мне нечего читать.

She has nobody to speak with. – Ей не с кем поговорить.

What is to be done? – Что делать?

Who is to blame? – Кто виноват?

I am not to blame. – Я не виноват.

To see is to believe. – Видеть значит верить.

He was the first (last) to come. – Он пришел первым (последним).

It is out of the question to go there. – Не может быть и речи, чтобы идти туда.

1.5.3 Translate into English using set expressions with infinitives

1 Сказать по правде, мне это не нравится.

2 Им было нечего есть.

3 Кто виноват?

4 Короче говоря, он не сделал урок.

5 В нашей семье мама всегда встает первая.

6 На нее приятно смотреть.

7 Чтобы перевести эту статью, вы должны воспользоваться словарем.

8 Мне некуда ехать летом.

9 О том, чтобы купаться в этой реке, не могло быть и речи.

10 Ему было не с кем обсудить эту проблему.

11 Вчера Катя пришла в школу последней.

12 Чтобы получить хорошую оценку, вы должны упорно поработать.

13 С ней трудно иметь дело.

14 Что делать?

15 Начнем с того, что он болен.

16 Чтобы читать Диккенса в оригинале, вы должны хорошо знать язык.

17 Мягко выражаясь, он не прав.

18 Она была не виновата.

19 Ребенку не с кем играть.

20 Видеть значит верить.

21 Чтобы успеть на этот поезд, вы должны поторопиться.

1.5.4 Complete the sentences with the correct form of the infinitive

1 He seems (to read) a lot. 2 He seems (to read) now. 3 He seems (to read) since morning. 4 He seems (to read) all the books in the library. 5 We expect (to be) back in two days. 6 He expected (to help) by the teacher. 7 The children seem (to play) since morning. 8 I was glad (to do) all the homework yesterday. 9 She seems (to work) at this problem ever since she came here. 10 I am sorry (to break) your pen. 11 I want (to take) you to the concert. 12 I want (to take) to the concert with my father.13 She hoped (to help) her friends. 14 She hoped (to help) by her friends. 15 I hope (to see) you soon.

1.6.1 Read Text 1.5 and identify:

a) what engineering professions are referred to in the first paragraph;

b) what mechanisms and machines are reported in the third paragraph;

c) in connection with which the XIX century is mentioned in the last paragraph

Text 1.5 The engineering profession

Engineering is one of the most ancient occupations in history. Without the skills included in the broad field of engineering, our present-day civilization never could have evolved. The first toolmakers who chipped arrows and spears from the rock were the forerunners of modern mechanical engineers. The craftsmen who discovered metals in the earth and found ways to refine and use them were mining and metallurgical engineers' ancestors. And the skilled technicians who devised irrigation systems and erected the buildings of the ancient world were the civil engineers of their time.

Engineering is often defined as making practical applications of theoretical sciences such as physics and mathematics. Many of the early engineering branches were based not on science but on valuable information that depended on observation and experience.

The remarkable engineering works of ancient times were constructed and operated mainly employing slave labor. During the Middle Ages, people began to seek devices and work methods that were more efficient and humane. Wind, water, and animals were used to provide energy for some of these new devices. This led to the Industrial Revolution that began in the eighteenth century. First, steam engines and then other kinds of machines took over more and more of the work that had previously been done by human beings or by animals. James Watt, one of the key figures in the early development of steam engines, devised the concept of horsepower to make his customers understand the amount of work his machines could perform.

Since the nineteenth century, both scientific research and practical application of its results have escalated. The mechanical engineer now has the mathematical ability to calculate the mechanical advantage that results from the complex interaction of many different mechanisms. He or she also has new and more robust materials to work with and enormous new power sources. The Industrial Revolution began by putting water and steam to work; since then, machines using electricity, gasoline, and other energy sources have become so widespread that they now do a massive proportion of the world's work.

1.6.2 In the second paragraph of Text 1.5, you came across the term 'empirical information,' in the third paragraph, 'horsepower,' in the fourth paragraph, 'mechanical advantage.' How is each of these terms translated? Write down their meanings from the dictionary. In what connection, each of these terms is mentioned in the corresponding paragraph?

1.6.3 Write out from text 1.5 the names of all mechanisms and machines of the past and give the corresponding Russian terms

1.6.4 Write out the types of energy sources from text 1.5 and give the corresponding Russian equivalents

1.6.5 a) The following words have a common root with the words of the Russian language. Try to translate them without referring to a dictionary

engineering, civilization, modern, metal, construction, to refine, metallurgical, irrigation, practical, physics, empirical, application

b) Write down the transcription of these words from the dictionary and try to identify patterns in the pronunciation of English and corresponding Russian words

c) The following words are 'false friends of a translator.' Write down those meanings from the dictionary that correspond to the context

occupation, civil, human, observation

1.6.6 Write out all international words from the last paragraph of text 1.5, name their meanings, highlight the 'false friends of the translator.' Prepare this paragraph for reading aloud.

1.6.7 Arrange the following verbs in alphabetical order. Find their meanings in a dictionary. Go back to text 1.5 and write down the combinations in which these verbs occur. Translate these combinations into Russian

to discover, to refine, to devise, to erect, to depend, to provide, to perform, to lead, to escalate, to calculate

1.6.8 The infinitive following a noun is an attribute for it

…ways to refine… – …способы (для) очистки…

…ways to use… – …способы (для) использования…

Translate the following sentences from the text

1 the ability to calculate... 2 materials to work with...

1.6.9 Insert verbs from the list below instead of the blanks. Translate the sentences into Russian. Note that the infinitive is used without 'to' after the verb 'to make' in the meaning of "to make".

to enable – давать возможность, to allow – позволять, to make – заставлять, to cause – вызывать

1 The rise in temperature ... the mercury ... rise up the tube. 2 The motorway... motorists... travel from London to Birmingham much more quickly than before. 3 The use of tractors ... more food ... be produced more cheaply. 4 The presence of oxygen ... the mixture ... burn rapidly. 5 The increase in exports ... the country... import more raw materials. 6 The risk of an explosion ... the workers ... leave the factory. 7 The sharp rise in temperature ... the engine ... overheat. 8 The presence of non-metallic constituents in iron... it... behave in various ways. 9 The growth of industrial towns ... many people ... leave the countryside. 10 The differential gear ... the two rear wheels ... turn at different speeds.

1.6.10 The infinitive after the predicate verb can be the adverbial modifier of purpose

They were used to provide… – Их использовали (для чего?), чтобы обеспечить…

Find in text 1.5 sentences containing the given combinations of words, and translate them into Russian

1 ... the wind was used to provide energy... 2 ...water was used to provide energy... 3 …the concept 'horsepower' was devised to make customers…

1.6.11 If there is a noun after the verb-predicate, and after it, there is an infinitive, then the infinitive can be either an adverbial modifier of purpose or an attribute

to a noun

He devised this concept to calculate the amount of work.

Он изобрел это понятие (1 - какое?) (2 - с какой целью?)

…чтобы подсчитать количество работы.

He invented steam engine to perform work.

Он изобрел паровой двигатель (1 - какой?)

...производящий работу.

(2 - с какой целью?)

…для производства работы.

Translate the following sentences from text 1.5

1 They discovered ways to refine metals. 2 James Watt devised the concept of horsepower to make his customers understand... 3 The engineer has the ability to calculate... 4 He has stronger materials to work with...

1.6.12 Complete the sentences matching the two lists below

1 Engineering is…

2 It is based on …

3 In ancient times engineering work was done...

4 In the Middle Ages, the methods and devices of work...

5 In the 18th century...

6 Steam gave man...

7 Since the 19th century, both scientific research and its practical application...

8 In the 20th century, the mechanical engineer had...

9 The engineer has new and…

a) many new sources of power such as electricity, gasoline, atomic power, etc.

b) the Industrial Revolution began.

c) one of the most ancient occupations in history.

d) and much stronger materials to work with.

e) employing slave labor.

f) became more efficient.

g) theoretical sciences such as physics and mathematics.

h) great sources of energy,

i) have greatly progressed.

1.6.13 Using the information from text 1.5, complete table 4

Table 4 – Engineering specialty

Engineering specialty	**Its forerunner**	**Its function**
mechanical engineer	toolmakers who chipped arrows and spears from rock	to make tools and machinery
mining engineer		
civil engineer		
metallurgical engineer		

1.6.14 Translate the phrases with the given word

to expand – расширять: expansion of scientific knowledge

to increase – увеличивать: the increase of scientific knowledge

to grow – расти: the growth in the number of specialties; the growth in the number of engineering fields

competition – соревнование: to compete with somebody

head – глава, руководитель: to head something

to contribute – делать вклад: to combine the contributions made by all the different disciplines

advanced – продвинутый, повышенного типа: advanced education; advanced degree.

1.7.1 Read text 1.6

Text 1.6

One result of the rapid expansion of scientific knowledge was an increase in the number of engineering specialties. By the end of the nineteenth century, mechanical, civil, and mining and metallurgical engineering were established. Still, the newer specialties of chemical and electrical engineering also emerged. This growth in the number of specialties is developing such disciplines as aerospace, nuclear, petroleum, and electronic engineering. Many of these are subdivisions of earlier specialties – for example, electronic from electrical engineering or petroleum from chemical. In mechanical engineering, the major subdivision is industrial engineering, concerned with complete mechanical systems rather than individual machines.

Engineers design and make machines, equipment, and the like. Such work requires creative ability and a working knowledge of scientific principles. The engineer must also understand the various processes and materials available to him/her and could be working in any of the following areas: the organization of manufacture, research, and development, design, construction, sales, and education.

Because of the large number of engineering fields today, many different kinds of engineers are working on large projects such as nuclear power or new aircraft. In designing a new plane, mechanical engineers work on the plane's engines and other mechanical aspects such as the braking system.

When the aircraft goes into production, mechanical and industrial engineers design the machines necessary to fabricate the different parts and the entire system for assembling them. In both phases of such a project, mechanical engineers work with specialists in aerospace and electronic engineering. Each engineer is a member of a team often headed by a system engineer able to combine the contributions made by all the different disciplines.

Another result of the increase of scientific knowledge is that engineering has become a profession. A profession is an occupation like law or medicine that requires specialized advanced education. Today it requires at least four or five years of university study leading to a Bachelor of Science degree.

More and more often, engineers, especially those engaged in research, get an advanced master's or doctor's degree. Even those engineers who do not study for advanced degrees must keep up with changes in their profession. A mechanical engineer who does not know about new materials cannot successfully compete with one who does.

1.7.2 Define the functions of the infinitive in the sentences, then translate them

1 To develop a new submersible craft with a manipulator is not an easy task. 2 To develop the supercomputer, highly developed electronics and new materials were required. 3 One of the best ways to keep the car speed steady is to use a computer. 4 Experiments helped Mendeleev discover new chemical elements' properties. 5 Francis Chichester was the first to sail round the world by himself. 6 Some materials with new useful properties may be produced in space. 7 A special electronic device signals the engine to stop. 8 Radar may control the brakes to avoid collisions with other cars. 9 High-temperature alloys make it possible for jet engines to operate under severe conditions for a long time. 10 Recently, a radar to be mounted on cars has been developed. 11 In a new Japanese car, the driver's information will come through a navigation earth satellite. 12 To help helicopters and aircraft find the capsule, its upper part is covered with special paint that radar. 13 To detect objects at a distance such as ships, airplanes, buildings, mountains, etc. is of great importance for navigation both at sea and in air. 14 The radar detects the stationary objects ahead of the car to warn the driver about them and slow down the speed.

1.7.3 Determine which of the statements correspond to the content of text 1.6

a) Plastics evolved as replacements for natural products, b) Plastics have evolved as replacements for natural products.

1 a) Those people who considered plastics unreliable did not keep up with polymer technology developments in the past. b) Those people who consider plastics unreliable have not kept up with polymer technology developments for the past ten years.

2 a) Plastics properties won many applications for these materials in the past. b) Plastics properties have won many applications for these materials.

1.7.4 Find phrases with the infinitive in the sentences below and show the difference in their structural models through translation

Model I: To obtain a steel of the desired quality is the main subject of the experiments carried out in the research laboratory of the plant. – Получение стали желаемого качества является основной целью опытов, проводимых экспериментальной лабораторией завода.

Model 2: To obtain a steel of the desired quality the research laboratory of the plant carried out a lot of experiments. – Для того, чтобы получить сталь желаемого качества, экспериментальная лаборатория завода провела много экспериментов.

1 To develop a new method of cutting metals was necessary. To develop a new method of cutting metals, the engineers did some exciting experiments.

2 To make good castings, it is necessary to use large and properly placed risers to feed heavy sections. To make good castings is impossible without using large and properly placed risers to provide heavy areas.

3 To discover the stresses occurring requires careful figuring. To find the stresses occurring, we need cautious figuring.

4 To use an aluminum paint spray was the only promising mold treatment developed in the test work. The engineers designed the only really promising mould-treatment during the test work to use an aluminum paint spray.

5 To design new machine tools is the task of a mechanical engineer. To create new machine tools, a mechanical engineer must study a lot.

6 To be an ideal engineer means to have the knowledge, to improve one's ability to analyze, synthesize and develop insight into one's field. To be a perfect engineer, one must know how to improve one's ability to analyze, synthesize and develop understanding into one's area.

1.7.5 Very often, the infinitive is used as an attribute in the N + to V model. When translated into Russian, the meaning of future or obligation is introduced

Example:

A casting **to be made** in a metal mould must be comparatively short. – Отливка, которая будет изготовляться в металлической форме, должна быть сравнительно небольшой.

Translate the following sentences with an infinitive as an attribute into Russian

1 Engineers must know the best and most economical materials **to use,** understand the properties of these materials, and how they can be worked.

2 Another factor for the industrial engineer **to consider** is whether each manufacturing process can be automated in whole or in part.

3 Industrial robots **to be built** now perform specific tasks even better than a human being.

4 There are few written instructions **to help** a melter in determining alloying additions **to be made** to a heat of steel melted in an induction furnace.

5 Heating temperatures, quenching methods, and shape of the part **to be treated** are the factors that mainly affect distortion amounts.

6 The tube **to be drawn** is mounted on the rollers on the turn-table bedpiece, and the left-hand end of the tube is brought in contact with the stripper plate incorporated in the head.

1.7.6 a) study Table 5, paying attention to various ways of expressing the different likelihood of an action.

b) rewrite the sample sentences using the information given in Table 5

Model: I am sure that the ideal engineer has technical competence. - The ideal engineer **is sure to have** technical competence.

1 The ideal engineer has technical competence. 2 The outstanding engineer possesses social skills, such as cooperativeness. 3 The excellent engineer doesn’t do what interests him most without regard to the organization’s needs. 4 The ideal engineer doesn’t approach his job with unrealistically high expectations. 5 The perfect

engineer is interested in some promotion. 6 The outstanding engineer doesn't expect work privileges without proving that he is worth it. 7 The ideal engineer is practical and realistic. 8 The ideal engineer has initiative. 9 The ideal engineer won't learn the organizational system slowly. 10 The ideal engineer knows how to report results orally and in writing. 11 The ideal engineer has some scientific abilities. 12 The ideal engineer keeps up with technological progress and grows professionally.

Table 5 – Methods of expressing the likelihood of an action

Степень вероятности	**Способы выражения**
certainly (несомненно)	I am sure/confident/positive that the ideal engineer will need much more technical knowledge. The ideal engineer is certain/bound to need much more technical knowledge.
probably (вероятно)	The ideal engineer will likely need much more technical knowledge. The ideal engineer is likely to need much more technical knowledge.
possibly (возможно)	The ideal engineer may/might need much more technical knowledge.
probably not (маловероятно)	It is unlikely that the ideal engineer will need some teaching skills. The ideal engineer is unlikely to need some teaching skills.
certainly not (определенно нет)	The ideal engineer definitely/certainly won't need any artistic skills. I am sure/confident/positive that the ideal engineer won't need any artistic skills.

2 Unit 2 Manufacturing engineer

2.1.1 Before reading text 2.1, look through the following words and phrases, learn them

in turn – в свою очередь, way – метод, способ, to be familiar with –знать что-л., быть в курсе чего-л., tool engineer – технолог, common – общий, approach

– подход, advanced engineering courses – курсы повышения квалификации для инженеров, complicated – сложный

2.1.2 Skim text 2.1 and say

a) whether it is related by subject matter to the previous texts of this cycle;

b) which paragraphs of the text contain information about the work of the engineer;

c) in which paragraph of the text the concept of 'the essential triangle' is deciphered;

d) whether the title 'The Essential Triangle' reveals the content of the text.

Suggest your titles

Text 2.1 The essential triangle

Technological and industrial progress depends on the scientist, the engineer, and the technologist – an essential triangle. Each makes a significant contribution to progress. The engineer depends upon the scientist for new knowledge and specialized assistance in translating engineering plans into operating reality upon the technologist.

The interests of the research engineer are in the area of applied science and research. Scientists work in a world of generalizations and abstractions. On the other hand, the technologist works in the real world of specific things and concrete objects. His problems are practical, and they require pragmatic solutions. He is more interested in how to do things. He must understand engineering tables and formulas and apply them in his work. The scientist, the research engineer, the technologist – all play an essential role in the modem world.

The principal work of the engineer is design. He has to design products, machines, and production systems. Like the research engineer, the engineer asks, 'why?'. Like the technologist, he is also concerned with 'how?'

The engineer must combine many of the characteristics of the scientist, research engineer, and technologist. He must have a basic knowledge of the sciences

and understanding of the research engineer's abstract techniques and know much of the technology employed by technologists.

Perhaps the most crucial function of the engineer is to integrate the work of the essential triangle. His interest must be in combining the abstract-theoretical world and the technical-practical world.

2.1.2 Complete sentences by matching the two parts

1 The essential triangle consists of...

2 The scientist makes his contribution to progress through...

3The technologist is more interested in...

4 The principal work of the engineer is...

5 The most important function of the engineer is...

a) to design

b) how to do things

c) to integrate the work of the essential triangle

d) the scientist, the technologist, the engineer

e) the investigation of the unknown

2.1.3 Using the information in text 2.1, complete Table 6

Table 6 – Field of activity and its participants

Сфера деятельности	**Деятель**
new knowledge	scientist
work in applied science and research	
translating engineering plans into operating reality	
production process	
designing products, machines, production systems	

2.1.4 Study the following words and phrases

productive – производительный: productivity to improve – улучшать, совершенствовать: improvements in productivity

available – имеющийся в наличии: availability of engineers

to process – обрабатывать: metal processing; processing problems

Text 2.2 The role of science in manufacture

Future productivity improvements are primarily dependent on the application of science to manufacturing. This depends in turn on the availability of large numbers of scientifically trained engineers. Higher schools can serve industry needs in two ways: by performing fundamental research and by training well-qualified engineers in the manufacturing field.

There is a growing need for engineers familiar with the fundamental problems in metal processing and manufacturing. Shortly many of the engineers will be recent university graduates. A few will come through courses of study in the industry.

Having a basic engineering knowledge will continue additional studies at colleges to prepare themselves for industry work. Therefore, an engineer does not finish his education when he receives his diploma, particularly in interest to tool engineers who are to study new developments constantly.

There are numerous ways in which industry and education can cooperate on problems of common interest.

Scientists and research engineers are engaged in work intended to provide a scientific approach to many purely industrial issues.

These scientists and engineers can make a real contribution to engineering education or academic research. For example, they can teach advanced engineering courses and actively participate in basic and applied research.

Similarly, extensive and complicated new technologies could be handled by institute researchers working on practical applications. This would often provide the most efficient approach to the solution of processing problems.

2.2.1 Read the following statements and arrange them in the sequence as in text 2.2

a) An engineer does not finish his education when he receives his diploma.

b) There is close cooperation between industry and education.

c) The higher school can serve the needs of the industry.

2.2.2 What is each of these statements based on? Submit your answer regarding text 2.2

2.3.1 The first paragraph of text 2.3 emphasizes that modern machines and machine tools are subjected to enormous loads and perform complex movements. At the same time, a car engine is called a 'simple' machine. How do the first and second provisions of this paragraph relate to each other?

The central part of the text is devoted to classifying the main branches of technology, specialists working in each of these areas, and listing the industry's leading products. Name the paragraphs and sentences of text 2.3 that relate directly to mechanical engineering

Text 2.3 Engineering

Today, machines have to withstand such tremendous stresses and be able of such complex motions that complicated and specialized calculations taking hundreds of factors into account are needed in the design of a simple machine like a motor-car engine.

So, as engineering progresses, engineers must become ever more scientific and specialized. Today the branches of engineering are so broad that it is impossible to classify them satisfactorily. But we may try to divide them into uses. The main divisions of engineering may be listed as follows:

1 Mechanical engineering.

Steam engines, internal combustion engines, turbines (steam, gas, water), pumps; compressors; machine tools; mechanisms.

2 Electrical engineering.

a) Power: generators; motors; transformers; transmission (power lines and so on).

b) Electronics: radio, radar, television.

3 Civil engineering.

Dams, tunnels, roads, and so on.

4 Structural engineering.

The structural details of all large buildings and bridges.

5 Chemical engineering.

Any of these branches of engineering may require the special services of the following specialists: the metallurgist; the strength of materials expert; the thermodynamics of heat expert, the mechanics or machines experts; the various production engineering experts such as the engineering designer or the tool designer; the mathematician specializing in engineering problems and many more.

The engineer must also deal with the economists to assure that he is producing what is wanted and economically.

2.3.2 a) Translate the following words and phrases into Russian. What are the meanings of international words? Check the correctness of your guess in the dictionary; b) Find these words in the text and clarify their meaning in context

metallurgist, expert, mechanics, structural engineering, chemical engineering, mathematician, generator, civil engineering, heat expert, tool designer, economist, electrical engineering, engineering designer,

strength of materials expert, turbine, tunnel, radio, engine, steam engine, the internal combustion engine

2.3.3 Find in the first paragraph of text 2.3 phrases with the verb 'have to.' Specify how the verb 'have' is translated. Make up your sentences using the model below. Translate them into Russian

The engineer		deal with the problems of the economy
The mathematician		know mechanisms
The mechanic	has to	withstand a pressure of steam
A steam engine		deal with thermodynamics
The heat expert		solve engineering problems

2.3.4 Analyze all sentences of text 2.3 that contain modal verbs and their equivalents. What meaning does each of these verbs convey in the sentence?

2.3.5 Select phrases from text 2.3 to fill in the schemes in Figures 1 and 2, which reflect the relationship between the industry, manufacturer, and product

2.4.1 Read about the importance of technical specialties in the UK economy and create a logical framework for text 2.4 similar to the one above. The main block of the scheme is 'Engineering'.

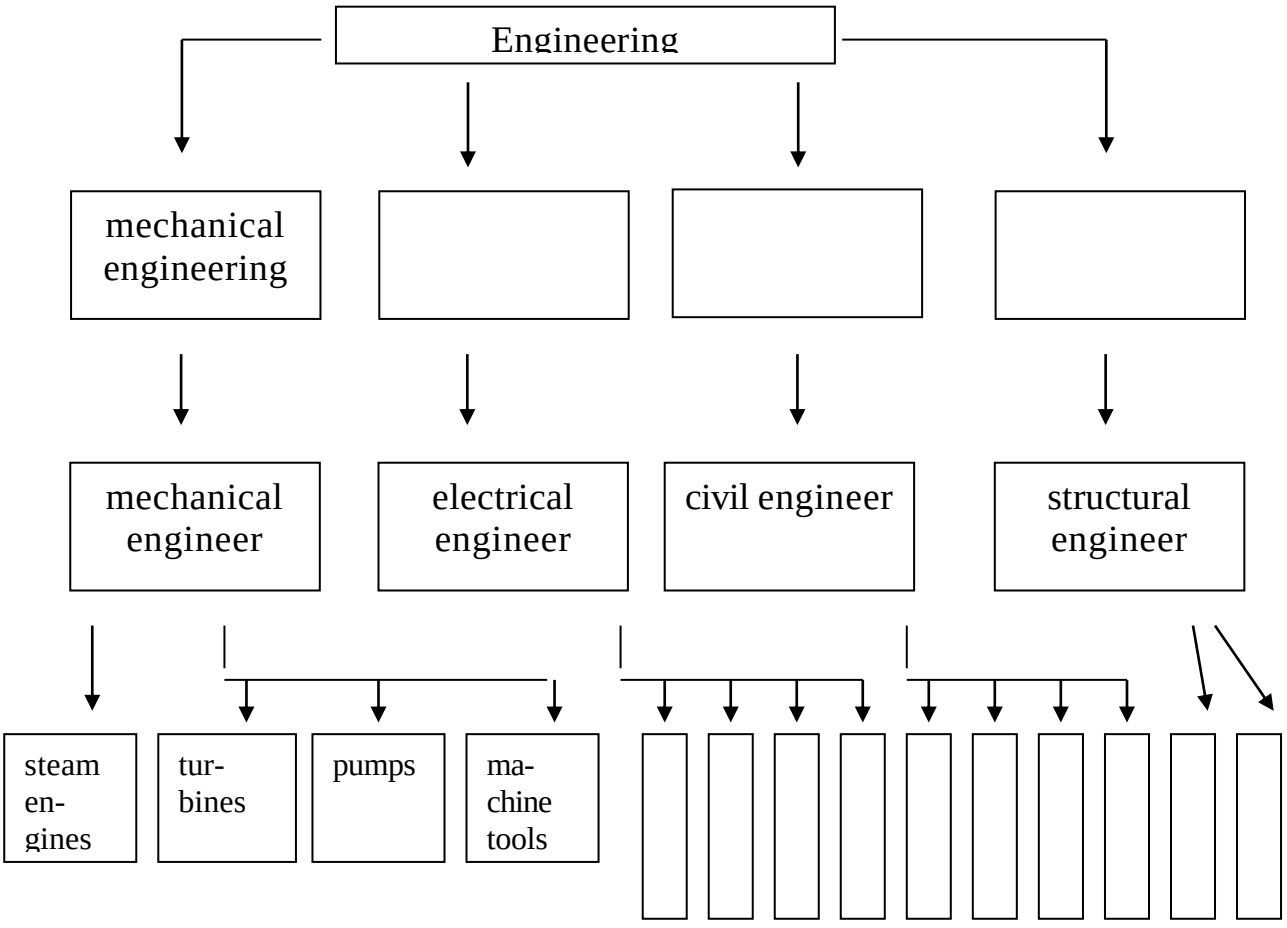


Figure 1 – Engineering. General scheme

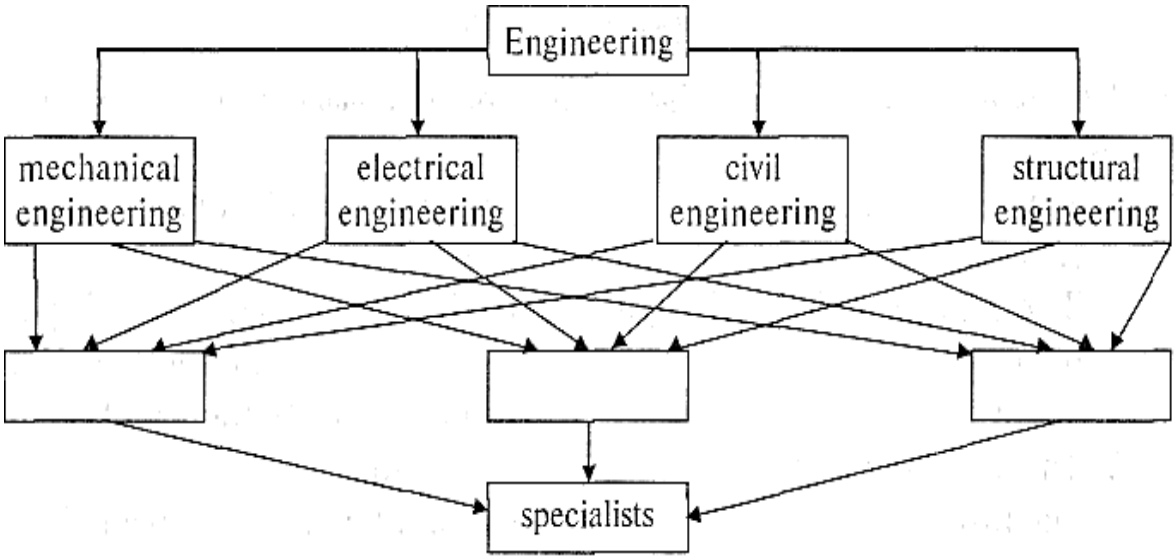


Figure 2 – Engineering. Specialists

Text 2.4 What Is Engineering?

The engineering industry makes the most essential and valuable things: aerospace, cars, hospital equipment, telecommunications, and even the humble kettle. Engineering also makes most of the things other industries need, from cash dispensers and electronic mail for the banking industry to microphones and staging for the entertainment industry. In the production of everything from chocolates to the Channel Tunnel, the key individuals are the engineers. It's an industry that still contributes significantly to the wealth of the UK. The very diverse manufacturing industry sector alone generates around a third of the national wealth. It employs approximately 32 percent of the working population.

In recent years, engineering has changed out of all recognition. The sheer speed of change in many manufacturing technologies is startling. Thanks to the introduction of computers and new technologies like Virtual Reality, people are more in control than ever. This also means the engineering employers are looking for people with a broader range of skills and personalities: from lone theorists to more gregarious and practical individuals; from managers who can handle people, lead teams, solve problems, and creative designers with a keen sense of market realities. Engineering needs them all – women, as well as men.

2.4.2 Complete the sentences by matching the two lists below

1 At present, there are...

2 It is challenging...

3 The main divisions of engineering are...

4 So, engineers must become...

5 In designing even a simple machine...

6 Thus, any branch of engineering may require...

a) more scientific and specialized

b) the special services of specialists from various branches

c) numerous branches of engineering

d) complicated and specialized calculations are needed

e) to give a satisfactory classification of these branches

f) mechanical engineering, electrical engineering, civil engineering, structural engineering, and chemical engineering

2.4.3 Fill in table 7 according to the example

Table 7 – Engineering and its object

Branch of Engineering	**Specialist**	**Object of Work**
1 civil engineering	civil engineer	dams, tunnels, roads...
2 mechanical engineering		
3 electrical engineering		a) b)
4 structural engineering		
5 chemical engineering		

2.4.4 Using the completed table 7, speak about the main branches of technology, specialists working in these branches, and their work content.

Situations for speaking. When preparing, use the Active Vocabulary below

a) You have graduated from high school and are about to become a civil engineer. Tell us, in which university you can get this specialty, what its specificity is.

b) You are a student of the 'Motors' faculty of the Automotive Institute. Tell us, to which branch of industry the auto-building belongs; what you know about your future specialty.

c) You are developing a new type of turbine for thermal power plants. Tell us, what kind of specialists you need help with.

Active Vocabulary

Область применения	**Существительные и сочетания с существительными**	**Прилагательные. причастия**
1. Области техники	mechanical engineering electrical engineering civil engineering structural engineering chemical engineering	specialized scientific
2. Специалист различных отраслей техники	metallurgist strength of materials expert mechanics heat expert production engineering expert engineering designer tool designer mathematician economist	
3. Машины и механизмы	steam engine internal combustion engine turbine	

	pump machine-tool
	generator
	motor
	radio
4. Объекты строи-	tunnel
тельства	bridge
	dam

3 Unit 3 Materials Science and Technology

3.1.1 Read the following words and phrases, learn them

bar – брусок, прут

completely – полностью, совершенно

compression – сжатие

creep – ползучесть

cross-sectional area – площадь поперечного сечения

cyclic stress – циклическое напряжение

decrease – уменьшение

elastic deformation – упругая деформация

elastic limit – предел упругости

exceed – превышать

external forces – внешние силы

fatigue – усталость металла

fracture – перелом, излом

loosen – ослаблять, расшатывать

permanent deformation – постоянная деформация

remaining – оставшийся

shear – срез

simultaneously – одновременно

to stretch – растягивать

technique – методы

tension – напряженность

to propagate – распространять(ся)

to bend – гнуть, согнуть

to extend – расширять, продолжаться

to meet the needs – отвечать требованиям

to occur – происходить

to respond – отвечать реагировать

to suffer – страдать

torsion – кручение

twisting – закручивание, изгиб

volume – объем, количество

rupture – разрыв

Text 3.1 Mechanical properties

Materials Science and Technology is the study of materials and how they can be fabricated to meet the needs of modern technology. Using the laboratory techniques and knowledge of physics, chemistry, and metallurgy, scientists are finding new ways of using metals, plastics, and other materials.

Engineers must know how materials respond to external forces, such as tension, compression, torsion, bending, and shear. All materials respond to these forces by elastic deformation. That is, the materials return their original size and form when the external force disappears. The materials may also have permanent deformation, or they may fracture. The results of external forces are creep and fatigue.

Compression is pressure causing a decrease in volume. When a material is subjected to a bending, shearing, or torsion (twisting) force, both tensile and compressive forces are simultaneously at work. When a metal bar is bent, one side of it is stretched and subjected to a tensional pressure, and the other side is compressed.

Tension is a pulling force; for example, the force in a cable holding a weight. Under tension, a material usually stretches, returning to its original length if the force does not exceed the material's elastic limit**.** Under more enormous tensions, the material does not return ultimately to its original condition, and under greater powers, the material ruptures.

Fatigue is the growth of cracks under stress. It occurs when a mechanical part is subjected to repeated or cyclic stress, such as vibration. Even when the maximum stress never exceeds the elastic limit, failure of the material can occur even after a short time. No deformation is seen during fatigue, but small localized cracks develop and propagate through the material until the remaining cross-sectional area cannot support the maximum stress of the cyclic force. Knowledge of tensile stress, elastic limits, and materials' resistance to creep and fatigue is essential in engineering.

Creep is a slow, permanent deformation that results from a steady force acting on a material. Materials at high temperatures usually suffer from this deformation. The gradual loosening of bolts and the deformation of machines and engines' components are all the examples of creep. In many cases, the slow deformation stops because deformation eliminates the force causing the creep. Creep extended over a long time finally leads to the rupture of the material.

3.1.2 Answer the questions to text 3.1

1 What are the external forces causing the elastic deformation of materials? Describe those forces that change the form and size of materials.

2 What are the results of external forces?

3 What kinds of deformation are the combinations of tension and compression?

4 What is the result of tension? What happens if the elastic limit of the material is exceeded under stress?

5 What do we call fatigue? When does it occur? What are the results of fatigue?

6 What do we call creep? When does this type of permanent deformation take

place? What are the results of slime?

3.1.3 Find the appropriate equivalents in text 3.1 and learn them

1 отвечать требованиям современной технологии

2 используя лабораторные методы

3 новые способы использования металлов

4 сжатие, растяжение, изгиб, кручение, срез

5 возвращать первоначальный размер и форму

6 внешняя сила

7 постоянная деформация

8 уменьшение объема

9 растягивающие и сжимающие силы

10 превышать предел упругости материала

11 повторяющиеся циклические напряжения

12 разрушение материала

13 развитие и распространение мелких трещин

14 сопротивление материалов ползучести и усталости

3.1.4 Translate the following sentences into English:

1 Упругая деформация – это реакция всех материалов на внешние силы, такие, как растяжение, сжатие, скручивание, изгиб и срез.

2 Усталость и ползучесть материалов являются результатом внешних сил.

3 Внешние силы вызывают постоянную деформацию и разрушение материала.

4 Растягивающие и сжимающие силы работают одновременно, когда мы изгибаем или скручиваем материал.

5 Растяжение материала выше предела его упругости дает постоянную деформацию или разрушение.

6 Когда деталь работает долгое время под циклическими напряжениями

в ней появляются небольшие растущие трещины из-за усталости металла.

7 Ползучесть – это медленное изменение размера детали под напряжением.

3.1.5 Read the following words and phrases, learn them

ability – способность

amount – количество

absorb – поглощать

amount – количество

application – применение

brittle – хрупкий, ломкий

car body – кузов автомобиля

constituent – компонент

crack – трещина

creep resistance – устойчивость к ползучести

definition – определение

density – плотность

ductility – ковкость, эластичность

failure – повреждение

gradual – постепенный

permanent – постоянный

rigid – жесткий

to sink – тонуть

square root – квадратный корень

stiffness – жесткость

strain – нагрузка, напряжение, деформация

strength – прочность

stress – давление, напряжение

tensile strength – прочность на разрыв

toughness – прочность, стойкость

yield strength – прочность текучести

Young modulus – модуль Юнга

3.2.1 Read Text 3.2

Text 3.2 Mechanical Properties of Materials

Density (specific weight) is the amount of mass in a unit volume. It is measured in kilograms per cubic meter. The water density is 1000 kg/m^3, but most materials have a higher density and sink in water. Aluminum alloys, with typical densities around 2800 kg/m^3, are considerably less dense than steels, which have typical densities around 7800 kg/m^3. Density is essential in any application where the material must not be heavy.

Stiffness (rigidity) is a measure of the resistance to deformation, such as stretching or bending. The Young modulus is a measure of the resistance to simple stretching or compression. It is the applied force ratio per unit area (stress) to the fractional elastic deformation (strain). Stiffness is essential when a rigid structure is to be made.

Strength is the force per unit area (stress) that a material can support without failing. The units are the same as those of stiffness, MN/ra^2, but in this case, the deformation is irreversible. The yield strength is the stress at which a material first deforms plastically. For a metal, the yield strength may be less than the fracture strength, which is the stress it breaks. Many materials have a higher strength in compression than in tension.

Ductility is the ability of a material to deform without breaking. One of the significant advantages of metals is their ability to be formed into the needed shape, such as car body parts. Materials that are not ductile are brittle. Flexible materials can absorb energy by deformation, but brittle materials cannot.

Toughness is the resistance of a material to breaking when there is a crack in it. For a material of given toughness, the stress at which it will fail is inversely proportional to the square root of the size of the most prominent defect present. Toughness

is different from strength: the toughest steels, for example, are different from the ones with the highest tensile strength. Brittle materials have low toughness: glass can be broken along a chosen line by first scratching it with a diamond. Composites can be designed to have considerably more excellent toughness than their constituent materials. An example of a very tough composite is fiberglass that is very flexible and strong.

Creep resistance is the resistance to a gradual permanent change of shape, and it becomes especially important at higher temperatures. Successful research has been done in materials for machine parts that operate at high temperatures and under high tensile forces without gradually extending, for example, the elements of plane engines.

3.2.2 Answer the questions to text 3.2

1 What is the density of a material?

2 What are the units of density? Where is low density needed?

3 What are the densities of water, aluminum, and steel?

4 A measure of what properties is stiffness. When is stiffness significant?

5 What is the Young modulus?

6 What is strength?

7 What is yield strength? Why is fracture strength always greater than yield strength?

8 What is flexibility? Give examples of ductile materials. Give examples of brittle materials.

9 What is toughness?

10 What properties of steel are necessary for the manufacturing of:

a) springs,

b) car body parts,

c) bolts and nuts,

d) cutting tools?

11 Where is aluminum primarily used because of its lightweight?

3.2.3 Find the appropriate equivalents in text 3.2, learn them

1 количество массы в единице объема

2 килограмм на кубический метр

3 мера сопротивления деформации

4 отношение приложенной силы на единицу площади к частичной упругой деформации

5 жесткая конструкция

6 прочность на сжатие

7 способность материала деформироваться не разрушаясь

8 поглощать энергию путем деформации

9 обратно пропорционально квадрату размера дефекта

10 постепенное изменение формы

11 повышенные температуры

12 высокие растягивающие усилия

3.2.4. Translate the sentences into English

1 Плотность измеряется в килограммах на кубический метр.

2 Большинство материалов имеют более высокую плотность, чем вода и тонут в воде.

3 Плотность материала очень важна, особенно в авиации.

4 Модуль Юнга – отношение приложенной силы к упругой деформации данного материала.

5 Чем более металл жесткий, тем менее он деформируется под нагрузкой.

6 Когда металл растягивают, он сначала течет, то есть пластически деформируется.

7 Свинец, медь, алюминий и золото – самые ковкие металлы.

8 Сопротивление ползучести является очень важным свойством материалов, которые используются в авиационных моторах.

4 Unit 4 Materials Technology

4.1.1 Read the title and the last paragraph of text 4.1. What field of science or technology is being discussed in the text?

4.1.2 Review the second and third paragraphs of text 4.1 and find sentences that contain a message about the goals for which changes in engineering technology are being made

Text 4.1 Changes in Materials Technology

Since the technology of any age is founded upon the materials of the period, the era of new materials will profoundly affect the future's engineering.

New materials are related, and equally important, unique, and improved. Less wasteful processes for the shaping, treating, and finishing of both traditional and contemporary materials are continuously being developed.

An engineer must be familiar with them. These include casting, injection molding, and rotational molding of components of ever-increasing size, complexity, and accuracy; manufacture of more complex parts by powder metallurgy techniques; steel forming and casting processes based on new, more extensive, and more mechanized machines, giving reduced waste and closer tolerances; the avoidance of waste in forging by the use of powder metallurgy or cast press forms and new finishing processes for metals and plastics, to name a few. A high proportion of these processes is aimed at producing complex, accurate shapes with a much smaller number of operations and with far less waste than the traditional methods of metal manufacture.

Joining techniques have developed to an unprecedented level of sophistication and are also providing opportunities for economies. It is necessary to mention that these newer techniques allow the manufacture of complicated parts by welding together simpler sub-units requiring little machining; such assemblies can be made from various materials. The methods can also be used effectively for the group, allowing savings to be made in both materials and machine utilization.

The brief review of new processes above has indicated that a new materials technology is rapidly emerging, providing new opportunities and challenges for imaginative product design and more efficient manufacture.

4.1.3 Name the meanings of the italicized international words. Check the dictionary for the meanings of the words in bold. Check the meanings you have selected, match their contextual meanings

technology, *era,* to have **an effect,** *process,* **finishing,** *traditional* materials, *manufacture, complex component, mechanized* machine, press form, **accurate** shape, joining **technique, assemblies, assembly,** *to indicate*

4.1.4 Add new details to table 8

Table 8 – Ratio of action and result

Процесс				**Изделие, продукт**	
to cast	отливать	casting	литье	casting	отливка
to forge	ковать	forging	ковка	forging	
to assemble	собирать	assembly	сборка	assembly	
to mould	формовать, отливать форму	moulding	формовка, прессование в формах	moulding	

4.1.5 Modal verbs that you encounter in the text may have the following meanings: should-preferably, should; quite likely; can/could – possibly, really; quite likely

a) Find sentences with modal verbs in the text and name their contextual meanings; б) Make sentences using words from different columns

The engineer	should	be used effectively for welding
These methods	could	know the cost of materials
New materials	can	develop a new and improved process
New technology		provide new opportunities for more efficient manufacture

4.1.6 a) Study the scale showing the degree of probability of actions expressed by modal verbs

Uncertain	might
↓	may
↓	could
↓	can
↓	should
↓	ought to
Certain	would

b) Fill in the gaps in the following text with modal verbs and translate the text. Specify how likely the action that introduces the modal verb is

Corrosion

Corrosion attacks all engineering materials, especially metals.

No material... be completely corrosion-resistant. Even stainless steels ... corrode. Engineers ..., however, fight corrosion. For example, they ... use high-purity metals because these metals are more resistant than alloys. They... also make sure that two dissimilar metals are not allowed to touch each other. Finally, engineers ... protect the surfaces of the metals in many different ways. One of the most common methods ... be to paint them.

4.1.7 a) Find the comparative adjectives in text 4.1. Name the items which qualities are being compared

b) Change the form of the adjectives in the following combinations so that the resulting combinations reflect the change in the better production process. Translate the combinations into Russian

Model: wasteful process – **less** wasteful process

complex component, giant machine, accurate shape, a small number of operations, trim waste, new techniques, simple unit, efficient manufacture

4.1.8 Study Table 9. Make suggestions based on the model

Table 9 – Reinforcement structures

Усилители	**Прилагательные**	**Существительные**
many far	more fewer	Materials, processes *}* исчисляемые
much far	more less	Space, time *}* неисчисляемые

Model 1: We need *much more space* for this equipment.

Model 2: Now we know *many more* strong *materials.*

4.1.9 Analyze the last sentence of the second paragraph of text 4.1 and write out two groups of nouns from it, like those given in exercise 4.1.4. Translate them into Russian

4.1.10 Find the sentences in text 4.1 that use the following constructions and translate them into Russian

1) not only ... but

2) both ... and

- не только... но
- как ...так и

4.1.11 Translate the following sentences and determine their compliance or inconsistency with the content of text 4.1

1 Joining techniques have developed to a high level of sophistication. Joining techniques are expanding to a high level of complexity. 2 The review of new processes has indicated that a new materials technology is rapidly developing. The study of new techniques is suggesting that new materials technology is quickly growing. 3 The avoidance of waste in forging has been achieved by the use of powder metallurgy. The use of powder metallurgy is achieving the release of waste in forging.

Сложноподчиненное предложение (The Complex Sentence)

$$S_1 + S_2 + S_n \blacktriangleright S_{complex}$$

При порождении сложноподчиненного предложения из простых предложений одно из них становится **матричным** (главным в традиционной терминологии), а остальные превращаются во **вставочные** (т. е. придаточные).

Помните, что придаточные предложения занимают одну из позиций членов простого предложения – подлежащего, именной части сказуемого, дополнения, определения или обстоятельства. Структура представлена в таблице 10.

Table 10 – The Complex Sentence

Придаточные предложения		
Придаточные в позиции прилагательного Adj-S	Придаточные в позиции существительного N-S	Придаточные в позиции наречия Adv-S

1 Образец трансформации простых предложений в сложноподчиненное с придаточным в позиции прилагательного:

S_1 – I know this engineer.
S_2 – This engineer is standing at the door } ⟶

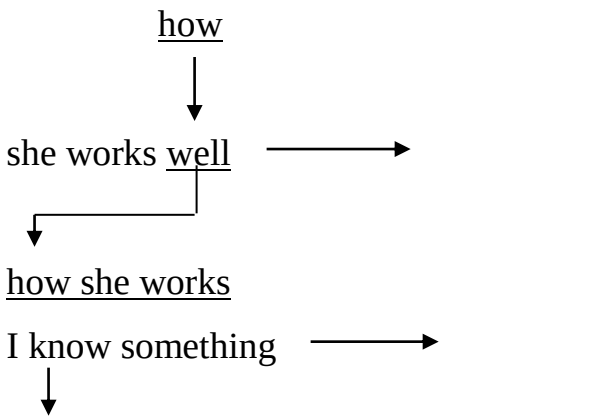
who

I know this engineer, *this engineer is standing at the door* ⟶

I know the engineer *who is standing at the door*.

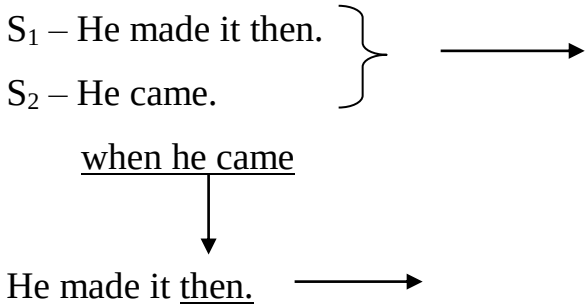
2 Образец трансформации простых предложений в сложноподчиненное с придаточным в позиции существительного:

S_1 – I know something.
S_2 – *She works well.* } ⟶



I know *how she works.*

3 Образец трансформации простых предложений в сложноподчиненное с придаточным в позиции наречия:



He made it *when he came.*

Сложноподчиненное предложение отличается от простого тем, что имеет два и более ядра (т. е. по крайней мере два сказуемых и два подлежащих). Поэтому перевод на русский язык следует всегда начинать с нахождения центра (ядра) главного предложения, после чего легко определить тип придаточного и правильно перевести его.

Придаточные предложения в позиции существительного

Придаточные предложения, занимающие позицию существительного, образуются из простых предложений после ряда трансформаций.

Образцы трансформации простых предложений в придаточные предложения, занимающие позицию существительного в сложноподчиненном предложении:

а) *The head engineer said something.*

what

The head engineer said ~~something~~. ► **what** *the head engineer said*

b) *He will come tomorrow.*

<u>when</u>

He will come ~~tomorrow~~. ► **when** *he will come*

Исходя из позиции существительного, этот тип придаточных предложений распадается на следующие подтипы:

1) д

ополнительные придаточные (в позиции после глагола):

a) I know **what** *the head engineer said.*

b) I know **when** *he will come.*

2) п

ридаточные – подлежащие (в позиции перед глаголом):

a) **What** *the head engineer said* is very important.

b) **When** *he will come* is not known.

3) п

редикативные придаточные (в позиции после глагола-связки):

a) The question is **what** *the head engineer said.*

b) The question is **when** *he will come.*

4.2.1 Analyze complex sentences from text 4.1. Determine the type of subordinate clause

4.2.2 Determine which of the following sentences are simple and which are complex. Translate the sentences into Russian

1 They also undertake the training of people who want to work at the new plant but do not have the required qualification. 2 The students know how to conduct this experiment. 3 The students know how they have to conduct this experiment. 4 He shows me the results of his work. 5 He shows me what results he has obtained. 6 There is a growing need for engineers familiar with the fundamental problems in metal processing and manufacturing. 7 There is a growing need for engineers familiar with the fundamental problems in metal processing and manufacturing. 8 When new

types of autos are designed, all the latest scientific and engineering progress achievements are taken into account. 9 When designing new types of autos, all the latest achievements of scientific and engineering progress are taken into account. 10 On receiving his diploma, the engineer does not finish his education. 11 When the engineer receives his diploma, he does not finish his education.

4.2.3 Group the sentences according to the type of subordinate clause

1 The history of civilization shows that transport always was and remains one of the largest branches in the world economy's general system.

2 In those days, people thought that a cart with an engine instead of a horse was dangerous.

3 The program was launched in 1918 by establishing the automobile laboratory, which two years later was reorganized into NAM I.

4 The question was how we could repair this equipment.

5 All students know that to become an engineer, they must study hard.

6 The newly built and reconstructed motor works soon had intense designing and engineering teams, which later produced world-famous scientists.

7 The fact is that they are excellent engineers.

4.2.4 Translate the following sentences into Russian, having previously determined the type of subordinate clause

1 At present, Moscow has a significant number of cars running on liquid gas, which is cheaper than gasoline. 2 The exploitation of gas-driven cars and scientific experiments show that it is now possible to produce engines operating on gas. 3 As a rule, a mechanic tells you what is wrong with your car. 4 It is expected that shortly cars with less toxic exhaust gases will be widely used soon. 5 Nowadays, it is possible to produce engines operating on gas whose exhaust is 60-90 percent less harmful than gasoline engines. 6 It is not only plastics and their reinforcement that are changing the materials scene. 7 The ceramic magnets we use in electrical engineering have replaced the traditional steel pole-piece plus copper field coil. 8 It is a well-known

fact that quantitative changes are associated with radical changes in technology. 9 The rapidity of change in materials technology is typified because plastics are now being used in large volumes. 10 Plastics are used in volumes that have exceeded those of all the non-ferrous metals put together.

4.2.5 Find the subordinate clauses in text 4.1 that take the position of the noun

4.2.6 Translate the following complex sentences into Russian. Pay special attention to the translation of the conjunctions 'if, that, whether.'

1 In those days, people thought **that** a cart with an engine instead of a horse was dangerous. 2 A coach **that** had a motor instead of a horse was felt hazardous. 3 **Whether** the reinforced plastics will be used in this car depends on the test results. 4 If we obtain good results, the reinforced plastics will be used in this car. 5 **That** future productivity improvements largely depend on the application of science to manufacturing is a well-known fact. 6 The achievements of science **that** are applied to manufacturing increase productivity in all branches of industry.

4.2.7 Translate the following complex sentences with subordinate clauses that take the position of a noun

1 Specialist has estimated that the amount of energy in the uranium and thorium reserves in the earth's crust is 10 to 20 times greater than that in all coal and oil deposits put together. 2 We must define **now** how the conditions change with temperature. 3 Under such conditions, the problem arises whether the unit will operate adequately. 4 You will learn what a diesel engine is, how it works and how it differs from a gasoline engine. 5 The advantage of the diesel engine is that it has higher thermal efficiency.

4.2.8 Translate the following passage with a dictionary. Pay special attention to the translation of subordinate clauses of various types

Chemistry has had a new birth in our century, essentially organic chemistry. The new light clothes that are so popular everywhere globally are often made out of

synthetic artificial materials based on cellulose. Beautiful paints, plastics, cosmetics, and many medicines are all based on cellulose. What is most important is that there is cellulose in all trees, vegetables, and fruits. Cellulose is easily found everywhere in nature, in all things that grow. Every day, chemists are finding new uses for this beautiful material.

4.2.9 Find in the first sentence of the second, third and fourth paragraphs of text 4.1 the words indicating the content connection of each of them with one of the previous paragraphs

4.2.10 In which paragraphs of text 4.1, in your opinion, is its main content expressed?

4.2.11 Answer the questions to text 4.1

1 Is materials technology changing nowadays? 2 What do new manufacturing processes include? 3 What are they aimed at? 4 Can complicated parts be manufactured by welding together simpler sub-units? 5 Can these assemblies be made from a variety of materials? 6 What has the brief review of new materials and processes indicated? 7 Why is it necessary for an engineer to know these processes?

4.2.12 Express your attitude to the statements made using the following colloquial formulas:

That’s right!

I don’t think so.

I’m afraid you’re wrong.

I believe (suppose) ...

I entirely agree with you.

In my opinion ...

1 A good engineer must have a thorough knowledge of new technological processes. 2 New technical processes increase productivity. 3 Only a few of these processes aim to produce complex shapes. 4 Joining techniques are providing opportunities for economies.

4.2.13 Tell about new trends in the development of materials technology, using the questions to text 4.1 and the active vocabulary in Table 11

Table 11 – Technological processes, methods: characteristics and results

Область применения	**Существительные и сочетания с существительными**	**Глаголы и глагольные сочетания**	**Прилагательные**	**Наречия**
1 Технологические процессы и методы	shaping treating finishing casting injection/ rotational moulding powder metallurgy techniques forging joining techniques welding machining assembly	to shape to treat to finish to cast to mould to forge to join to weld to machine to assemble		
2 Характеристика и результат технологического процесса	complexity accuracy waste close tolerance economy saving	to reduce waste to avoid waste to require little machining to make savings	profound accurate efficient complex	effectively equally

4.3.1 The introductory paragraph of text 4.2 contains a description of the conditions for optimal design and how to implement them. Read the introductory paragraph carefully and comment on this link

4.3.2 Skim through text 4.2 and find information in it that reveals the content of the introductory paragraph

4.3.3 Read the last paragraph of text 4.2 and find in it the characteristics of the machines and materials of the future, which were discussed in the introductory paragraph

Text 4.2 Working with new materials

A successful design is almost always a compromise among the highest performance, attractive appearance, efficient production, and lowest cost. Achieving the best compromise requires satisfying the mechanical requirements of the part, utilizing the most economical material that will perform satisfactorily, and choosing a manufacturing process compatible with the part design and material choice. Stating realistic requirements for each of these areas is of the utmost importance.

The rapidity of change in materials technology is typified by the fact that plastics, a curiosity at the turn of the century, are now being used in volumes that have for many years exceeded those of all the non-ferrous metals put together, and which are beginning to rival steel

The changes which are taking place are, of course, not only quantitative. They are associated with radical changes in technology – the range and nature of the materials and processes available to the engineer.

The highest specific strength (i.e., the force available from the material's unit weight) now available comes from non-metals, such as fiberglass, and metals, such as beryllium and titanium, new ultra-high-strength steels.

Fiber technology, in its modern form, is of more recent origin than plastics. Still, composites based on glass and/or on carbon fibers are already being applied to pressure vessels, lorry cabs, and aircraft engines. They may well replace aluminum for the skin and structure of aircraft. An all-plastic car has been exhibited: nearly the whole car, except the engine and transmission, is plastics or reinforced plastics.

It is not only plastics and their reinforcement that are changing the materials scene. Ceramics, too, are gaining an increasing foothold. Their impact as tooling materials in the form of carbides, nitrides, and oxides is also well known – cutting tools made of these materials are allowing machining rates that had previously been considered quite impossible.

Silicon nitride seems to offer promise for a wide variety of applications. Among these is liquid metal handling. Pumps for conveying liquid aluminum are now on trial, which could revolutionize the foundry industry. Silicon nitride is also being

tested for the bearing surfaces of the Wankel rotary engines, which are being developed as potential replacements for the conventional piston engines of our motor cars. And ceramic magnets have replaced the traditional steel pole-piece plus copper field coil for providing the engineering field for many electric motors.

The number of combinations of all kinds of original trends in the production of new materials is practically unlimited. This, in turn, opens new realms for the designing of still cheaper, effective, and unthinkably perfected, compared to that we have today, machines and mechanisms.

4.3.4 Make a table, reflecting the following information in it:

a) names of materials used in mechanical engineering;

b) the characteristics of these materials;

c) the scope of application of these materials.

4.3.5 Using the information from the table you have compiled, prepare a message on the topic 'New Materials Technology.'

4.4.1 Translate the title of text 4.3

4.4.2 Read text 4.3 and find in it:

a) the paragraph that defines the casting;

b) the paragraph that refers to the use of castings;

c) the paragraph that summarizes the process of making castings.

4.4.3 What is the conclusion contained in the final paragraph of text 4.3?

Text 4.3 Metal casting – an essential manufacturing process

One of the fundamental processes of the metal-working industry is the production of metal castings. Casting may be defined as 'a metal object obtained by allowing molten metal to solidify in a mold,' the shape of the object being determined by the shape of the mold cavity. A foundry is a commercial establishment for producing castings.

Numerous methods have been developed through the ages for producing metal castings. Still, the oldest process is that of making sand castings in the foundry.

Primarily, work consists of melting metal in a furnace and pouring it into suitable sand molds. It solidifies and assumes the shape of the mold.

Most castings serve as details or parts of complex machines and products. In most cases, they are used only when machined and finished to specified manufacturing tolerances providing easy and proper assembly of the product.

At present, the foundry industry is going through rapid transformation, owing to the modern development of new technological methods, new machines, and new materials.

Because casting methods have advanced rapidly due to the general mechanical progress of recent years, there is no comparison between the quality of castings, the complexity of the patterns produced, and the speed of manufacture with the work of a few years ago.

4.4.4 a) write out from the first and second paragraphs of text 4.3 the English words and phrases that serve to designate the foundry's main processes. Find their Russian equivalents

b) complete table 12 with the sample

Table 12 – Technological process and its location

Процесс		**Место протекания**	
1 production of metal castings	производство металлических отливок	in the foundry	в литейном цехе
2 melting the metal			
3 pouring		into the mould	
4	затвердение металла		

4.4.5 Find in text 4.3 the English equivalents of the following Russian words and phrases:

быстро развиваться, обрабатывать механически, качественные отливки, правильная сборка, до установленных допусков, служить деталями, сложные модели, обрабатывать начисто

4.4.6 Translate phrases with international words into Russian. The words in bold are "false friends of the translator." Check their meanings in the dictionary and clarify the meaning of this phrase. Check the context for the correctness of the meanings you have selected

The primary *process, metal object,* **commercial** establishment, numerous *methods,* to serve as *details* and parts, **complex** *machines* and *products*, proper **assembly,** rapid *transformation, technological methods,* **general** *mechanical progress*

4.4.7 Find pairs of words that are close in meaning

To define, to progress, nowadays, proper, parts, to produce, quick, details, to advance, to manufacture, rapid, to determine, suitable, at present

4.4.8 a) translate the following sentence fragments from text 4.3

1 ...a metal object obtained by... 2 ...the poured mold... 3 ...machined and finished castings... 4 ...specified tolerances... 5 ...the complexity of patterns produced...

b) compare the following word combinations, built on the Ved + N model and the Ving + N model, which you already know, in which Ving is translated by the Russian participle to "-щий(ся)" > "-вший(ся)." Explain the semantic difference between them

1 developed methods – developing methods
2 solidified castings – solidifying castings
3 melted (molten) cast iron – melting cast iron
4 machined parts – machining parts

Независимый причастный оборот

В зависимом причастном обороте действующее лицо совпадает с подлежащим предложения.

The engineer made a lot of calculations.
The engineer was carrying out this experiment. →

Carrying out this experiment the engineer made a lot of calculations.

Независимый причастный оборот имеет собственное подлежащее, отличное от подлежащего предложения.

All the calculations were made.
The engineer was carrying out the experiment. →

All the calculations made, the engineer was carrying out the experiment.

Независимый причастный оборот отделяется от остальной части предложения запятой.

В зависимости от места в предложении оборот может переводиться:

а) самостоятельным предложением с союзами *а, и, причем, при этом,* если он стоит в конце предложения (после запятой).

Performance observations were recorded, particular stress being laid on the variables. – Наблюдения за работой (механизма) регистрировались, причем особое внимание уделялось переменным величинам.

б) придаточным предложением с союзами причины – *так как, поскольку,* времени – *когда, после того как,* условия – *если,* когда он стоит в начале предложения (перед подлежащим).

All the money having been spent, they started looking for a job. – Когда все деньги были истрачены, они начали искать работу.

4.5.1 Find the independent participial construction in the following sentences and translate the sentences

1 The first metals used by men were gold, silver, and copper. These metals were found in nature in the native or metallic state. 2 The melting point of pure iron reaches 1535 °C, most steels melting at about 1300 to 1500°C. 3 There are several

branches of the metalworking industry, foundry being one of the most important ones. 4 There are several methods of producing metal castings, the production of sand castings in the foundry being the oldest one. 5 After the metal has been melted, it is poured into the mold, the casting assuming the mold's shape.

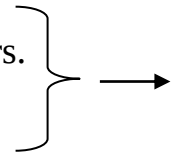
4.5.2 Complete the sentences by selecting the appropriate words from the brackets

1 ...the general development of new technological methods the foundry industry is rapidly advancing, *(in most cases, owing to)* 2 ...this general development the quality of castings has dramatically improved, *(in case, because of)* 3 ...castings are produced in sand molds, *(owing to, in most cases)* 4 ...castings are used as details and parts of complex machines and mechanisms, *(in most cases, because of)* 5 ...castings must be machined and finished to specified manufacturing tolerances, *(owing to, in this case)*

Придаточные предложения в позиции наречия указывают на время, место, причину, условие, следствие и другие обстоятельства, при которых совершается действие, выраженное сказуемым главного предложения.

Придаточное предложение **Adv** занимает позицию обстоятельства в английском предложении. Например:

– The engineers of the Research Institute test all the parts of the cars.
– *Any automobile is put into mass production*.



The Research Institute engineers test all the parts of the cars **before** *any automobile is put into mass production.*

4.5.3 Find the subordinate clause in the adverb position in text 4.3 and translate it into Russian

4.5.4 Determine in which of the above sentences the circumstance is expressed by a group of words, with '-ing' form, a subordinate clause. Translate into Russian

1 Until the invention of 'magic batteries,' the electric car will remain the car of

the future. Until ‘magic batteries’ are invented, the electric car will remain the car of the future. 2 When taking a work break on the assembly line, workers are replaced by other workers. When workers on the assembly line take a work break, they are replaced by other workers. 3 On receiving his diploma, an engineer does not finish his education. An engineer does not finish his education when he receives his diploma. 4 The charges being equal; the atom is electrically neutral. The charges are equal so that the atom is electrically neutral. 5 Knowing something about ordinary gasoline engines such as those in automobiles, you will notice that diesel engines, in many respects, work in the same way. Suppose you know something about ordinary gasoline engines such as those in automobiles. In that case, you will notice that diesel engines, in many respects, work in the same way.

4.5.5 Translate sentences with adjectives in the position of adverbs into Russian

1 In the field of auto-making, we started from nothing because tsarist Russia had no production or research and development facilities. 2 The parts of the first motorcars were made to very rough measurements, so the shaking and bumping on bad roads often broke them. 3 By ‘speeding up,’ the conveyer line’s output rose rapidly, although many of the workmen’s health broke down. 4 Term papers, research work, graduation theses of practical importance to industry – such are the stages of turning students into highly skilled and thinking engineers ready for independent work even before they get their diplomas. 5 Many young scientists try their hand in research long before they enter the postgraduate course. 6 Most automobile engines have six or eight cylinders. However, some four-, twelve-, and sixteen-cylinder machines are in use. 7 Since the technology of any age is founded upon the materials of the period, the era of new materials will profoundly affect the future’s engineering. 8 Although ferrous alloys are specified for more engineering applications than all non-ferrous metals combined, the large family of non-ferrous metals offers a wider variety of characteristics and mechanical properties.

4.5.6 Complete the sentences in the numbered list by selecting the appropriate endings from the alphabetical list below

1 A foundry is a commercial

2 Casting is a metal object producing metal castings, obtained by...

3 The shape of the casting is

4 Sand casting production is...

5 This method consists of...

6 Then the metal solidifies and

7 Most castings serve as details

8 But at first, they are machined and finished to...

a) the shape of the mold cavity, establishment for...

b) one of the oldest methods for

c) the form of sand mold.

d) allowing molten metal to solidify in a mold.

e) determined by...

f) complex machines and products.

g) producing castings

h) assumes...

i) specified tolerances.

j) melting metal in a furnace and or parts of...

k) pouring it into sand molds.

4.5.7 a) read text 4.4, the subject matter of which supplements text 4.3 with new details

b) tell us what additional information about the production of castings you have received in the field of:

1) liquid metal transportation;

2) the method of filling the mold.

Text 4.4 How a Casting Is Made

The process of making an iron casting can be described as the pouring of hot liquid or molten iron into a mold of the desired shape. Molten iron is poured from the ladles (ковш) into the sand molds. The iron travels along with a series of passage-ways *(зд.* отверстие) in the molds to the cavities. It then falls from the bottom to the top. The iron in the molds is allowed to cool for some time, and the casting solidifies and hardens (отверждаться). At this time, the casting is separated from the mold and the raw *(зд.* необработанный) casting is born.

Then the casting undergoes cleaning and checking before final processing.

4.5.8 Answer the questions on the topic 'How a Casting Is Made':

1 What is a foundry? 2 What is casting? 3 Is the shape of the casting determined by the shape of the mold cavity? 4 What basic processes does sand casting production consist of? 5 Where is the metal melted? 6 In what mold is it poured then? 7 Does the metal assume the shape of the mold? 8 Can most castings be used as parts of machines immediately following their solidification? 9 What operations should a casting be subjected to?

4.5.9 Using Table 13: a) prepare the messages on the topic 'How a Casting Is Made' according to the following plan:

1 Place of castings production.

2 The main processes of foundry production.

3 Application of castings.

b) situations for discussion:

1 You will have to explain to a non-specialist (i.e., in a popular form) what a foundry is, its main products, and its purpose. How will you do this?

2 You have visited the foundry of a machine-building plant. Tell us what processes you observed there.

4.6.1 In the first paragraph of text 4.5, the history of forging production devel-

opment is reported. What phrases and verb forms indicate that we are talking about the past?

4.6.2 In the second paragraph of text 4.5, it is reported that forging products are used in the most loaded machine components. How is this achieved?

4.6.3 The third paragraph of text 4.5 explains how the forging process improves the metal's mechanical properties. Using the introductory element 'therefore,' describe what is needed to improve the mechanical properties of the metal

4.6.4 The phrase "controlled plastic deformation" links the content of the last two paragraphs of text 4.5. Which sentence emphasizes the importance of this concept for the forging process?

Table 13 – Foundry production

Область применения	**Существительные и сочетания существительных**	**Глаголы**	**Прилагательные**	**Слова – организаторы научной мысли**
1 Место изготовления отливок	foundry			owing to because of in case in most cases
2 Оборудование и продукция литейного производства	(sand) casting mould mould cavity furnace pattern			
3 Технологические процессы		to melt to pour to solidify to form to machine to finish		
4 Характеристика и результат технологического процесса	tolerance quality shape		molten suitable proper rapid complex easy	
5 Классификация, спецификация изделий, процессов		to define to determine to specify		

Text 4.5 The fundamentals of forging

Forging is the oldest known metalworking process. It is believed to have begun when early man discovered he could beat pieces of ore into valuable shapes. History tells us that forging was widely practiced at the time when written records first appeared.

The blacksmith was one of the first to realize the advantages of forging. Although he did not know why he knew that hammering a piece of hot metal not only resulted in a usable shape, it improved its strength. This inherent improvement in strength of metal has placed forgings in the most highly stressed applications in machines.

To understand why forging improves metal's mechanical properties, it is essential to recognize that metal comprises grains. Each grain is an individual crystal. When the grains are large, cracks can occur and propagate along the grain boundaries. Therefore, it is desirable to minimize the grain size in metal.

Reducing the metal's grain size is one of the things forging does so well. Forging breaks down a coarse-grained structure producing a chemically homogeneous wrought system with much smaller grains by controlled plastic deformation. In forging, controlled plastic deformation, whether at elevated temperature or cold (at room temperature), results in greater metallurgical soundness and improved mechanical properties of the metal.

Metal shaping by controlled plastic deformation is the basis for all forging operations. However, because of the diversity of forging end-use applications, a wide range of processes and equipment have been developed to produce forgings. Some techniques are ideally suited to make large parts, others, small parts, and still others, rings. Modern forging is not only carried out in virtually all metals. It is done at temperatures ranging from more than 2500 °F to room temperature. Part configuration generally determines the forging method chosen.

4.6.5 Read the third and fourth paragraphs of text 4.5. Highlight the sentences in which it is reported: a) about the disadvantages of metals with a coarse-grained

structure; b) about what gives, in terms of improving the properties, a reduction in the size of the lattice grain. Translate these sentences into Russian

In the last paragraph of text 4.5. (first sentence), it is emphasized that plastic deformation of metal is the basis of all forging processes. However, a large variety of forging techniques and equipment is further reported. What is the reason for this?

4.7.1 Read text 4.6 and find in it:

a) the paragraph in which the classification of metal-cutting machines is given;

b) the paragraph in which the generalized description of technology of metal cutting is given;

c) the paragraph that describes the primary operations performed on metal-cutting machines;

d) the paragraph in which the types of products obtained as a result of mechanical processing are mentioned

Text 4.6 Metal cutting

Cutting is one of the oldest arts practiced in the stone age. Still, the cutting of metals was not found possible until the 18th century. Its detailed study started about a hundred years ago.

Now in every machine shop, you may find many machines for working metal parts. These cutting machines are generally called machine tools and are extensively used in many branches of engineering. Fundamentally all machine tools remove metal and can be divided into the following categories:

1 Turning machines (lathes).

2 Drilling machines.

3 Boring machines.

4 Milling machines.

5 Grinding machines.

Screw machines best accomplish machining of large-volume production parts. These machines can do turning, threading, facing, boring, and many other operations. Machining can produce symmetrical shapes with smooth surfaces and dimensional

accuracies not generally attainable by most fabrication methods.

Screw-machined parts are made from bar stock, or tubing fed intermittently and automatically through rapidly rotating hollow spindles. The cutting tools are held on turrets and tool slides convenient to the cutting locations. Operations are controlled by cams or linkages that position the work, feed the tools, keep them in position for the proper time, and then retract them. Finished pieces are automatically separated from the raw stock and dropped into a container.

Holdings, nuts, bolts, studs, shafts, and many other simple and complex shapes are among the thousands of products produced on screw machines. Screw machining is also used to finish forms created by other forming and shaping processes.

Most materials and their alloys can be machined – some with ease, others with difficulty. Machinability involves three factors: 1 Ease of chip removal. 2 Ease of obtaining a good surface finish. 3 Ease of getting good tool life.

4.7.2 a) write down from the second paragraph of text 4.6 the words denoting the names of metal-cutting machines and translate them

b) write out the words from the first and third paragraphs of text 4.6 that indicate the names of mechanical operations performed on metal-cutting machines and specify their meanings using the dictionary at the end of the book

4.7.3 Write out the words from the fourth paragraph of text 4.6, indicating the names of individual parts and components of the screw-cutting machine and their purpose.

4.7.4 Find the English equivalents of the following Russian words and phrases

срок службы, прутковая заготовка, гладкая поверхность, размерная точность, снимать стружку, удобный (подходящий), массовое производство, достижимый, отделка поверхности

4.7.5 Translate words and phrases into Russian. Name the meanings of the italicized international words. The words in bold are ‘false translator friends.’ Check their meanings in the dictionary and clarify the meaning of the word is used in the

phrase. Check whether the selected meanings match the context

detailed study, **fundamentally,** *symmetrical shapes,* **generally, fabrication**

methods, hollow *spindle,* cutting *location,* **to control** *operations, to position* the work, *to separate,* to drop into *a container,* to involve *a factor*

4.7.6 Find pairs of words that are close in meaning, and sentences with these words in the text

to work, proper, to produce, convenient, location, to fabricate, *to* machine, position

4.7.7 Find pairs of words that are opposite in meaning and sentences with these words in text 4.6

raw, simple, to feed, difficulty, complex, finished, ease, to retract

4.7.8 a) translate the phrases built on the models already known to you:

V_{ed} (какой) + N, N + V_{ed} (какой).

detailed study, screw-machined parts, finished pieces, products produced on screw machines, shapes produced by other processes

b) find the sentences with these phrases in the first, fourth and fifth paragraphs of the text and translate them into Russian

4.7.9 Determine which of the statements correspond to the content of the text

1 All machine tools employed for removing metal are divided into five general categories. 2 Screw-machined parts can’t be made from bar stock. 3 Cutting tools held on turrets and tool slides are used for machining metal parts. 4 The workpiece placed on the spindle doesn’t rotate. 5 Cams and linkages designed for controlling cutting operations position the work, feed, hold in class and retract the tools. 6 Metal parts worked on machine tools have smooth surfaces and high dimensional accuracies. 7 Finished pieces are of symmetrical shapes.

4.7.10 Find sentences with predicates formed by the be + Ved model in text 4.6 and translate them into Russian, paying attention to the different ways of translating this construction

4.7.11 Put as many special questions as possible to the fifth paragraph of the text

4.7.12 Classify:

a) engineering materials;

b) metal-cutting machines;

c) types of mechanical processing.

4.7.14 Answer questions to text 4.6

1 When did the study of metal cutting start? 2 What is the purpose of metal cutting? 3 What machines are called 'machine tools'? 4 List the general categories of machine tools. 5 What is the function of the spindle? 6 Where are cutting tools held? 7 By what means are cutting operations controlled? 8 List products produced on screw machines. 9 What are the general advantages of machining over other fabrication methods?

4.7.15 a) prepare a report on the following topics:

1 The main types of metal-cutting machines and their purpose.

2 Production of products on a screw cutting machine;

When preparing, use the information of the text 4.6 and the following plan:

– Types of workpieces processed on the machine.

– The main components, parts of the machine, and their purpose.

– Types of products obtained as a result of processing on the machine.

– Advantages of screw-cutting machine processing (compared to other production methods).

b) get ready for the discussion in the following situations:

1 You are undergoing a production internship in a machining shop. You will have to grind the workpiece, drill holes in it and sand it. Tell us on which machines you will perform these operations.

2 You are processing the workpiece on a screw cutting machine. Tell where you will install the cutting tool, where you will place the workpiece, and control the cutter's feed and discharge.

3 You will make a report on the topic "Mechanical processing of metal products." Tell us how you will formulate the main advantages of mechanical processing in the section "Conclusions."

4.8.1 Read the following phrases. They will help you understand the content of text 4.7

tool edge – режущая кромка инструмента, skin finish = surface finish, machining allowance – припуск на обработку, rigidity of setup – жесткость наладки, rate of metal removal – скорость резания, nodular iron – чугун с шаровидным графитом, flake-graphite iron – чугун с чешуйчатым графитом, rather than – а не..., abrasive action – истирающее воздействие

4.8.2 Read text 4.7 and determine:

a) in what aspect this text addresses the ability to be cut (first paragraph)?

b) how many factors affecting the cutting edge of the tool's service life are mentioned in the text?

c) which paragraph deals with the relationship between the structure and strength of the material being processed and the ability to be machined?

d) what property of the material related to the machined ability is considered in the last paragraph?

Text 4.7 Factors affecting machinability

Machinability is generally assumed to be a function of tool edge life. The main factors which influence the behavior, and thus the life of the edge of a cutting tool, are:

- the mechanical characteristics of the material being machined, such as its strength, hardness, and metallurgical structure;

– the state of the casting, involving the skin finish, critical dimensions, machining allowances, slag inclusions, the presence of scabs, rust, dirt, etc.;
– the nature of the machining techniques being used;
– the characteristics of the machine tool being used, such as machine efficiency, available power, and the rigidity of the setup.

Other factors aside, it is primarily the structure of the metal that determines its resistance to the tool's cutting action, i. e. the potential rate of metal removal and the resulting abrasion on the instrument, i. e., the life of the cutting edge.

Structure, strength, and machinability are interrelated to some extent – in general, increased strength implies reduced machinability. This fundamental relationship must be understood. Otherwise, difficulties may be experienced in the machine shop if the designer has specified material with a higher strength than is necessary. Nevertheless, care should be taken in rating machinability based on strength. For example, nodular irons usually are considerably more potent than flake-graphite types. Still, they are likely to be more accessible to machines. Therefore, it is recommended that structure, rather than strength, be adopted as the basis for machining practice.

The hardness provides a more reliable guide to machinability than strength, for hardness depends mainly on the casting's matrix structure. Again, however, the relation is general only. It is possible to have a metal that exhibits a low hardness value but has a very abrasive action on the cutting tool. For example, the presence of hard phosphide particles embedded in a soft, ferritic matrix reduces tool life considerably.

4.8.3 Find the answers to the following questions in text 4.7

1 What are the main factors influencing the tool edge life? 2 Does the material's structure influence machinability? In what way? 3 What does increased strength result in? 4 Why is hardness more reliable in determining a material's machinability than strength?

4.8.4 Using the information in text 4.7, fill in Table 14. (The (–) sign indicates the columns that do not require filling in)

a) Supplement table 15 by establishing the relationship between the properties of the material and its ability to be machined

b) Using the information in text 4.7 and tables 14 and 15, tell us about the relationship between the material's properties and its ability to be machined. Use the following verbs to indicate this relationship: to depend on, to affect (to influence), to imply (to mean)

Table 14 – Factors affecting machinability

Факторы, влияющие на способность подвергаться механической обработке		**Составляющие, из которых эти факторы складываются**	
the characteristics of the material			
the state of the casting			
the characteristics of the machine-tool			
the nature of the machining techniques		–	–

Table 15 – Material properties and effects on machinability

Свойство обрабатываемого материала		**Его влияние на способность (зависимость от способности) подвергаться механической обработке**	
increased strength			пониженная способность к механической обработке
	структура металла	the resistance to the cutting action of the tool	
hardness		the matrix structure of the casting	

4.8.5 Focusing on the main blocks of Figure 3, make a plan of the message on the topic 'Materials Technology'

4.7.6 Make a short message in English for each item of the plan, focusing on the 'sub-blocks' of Figure 3

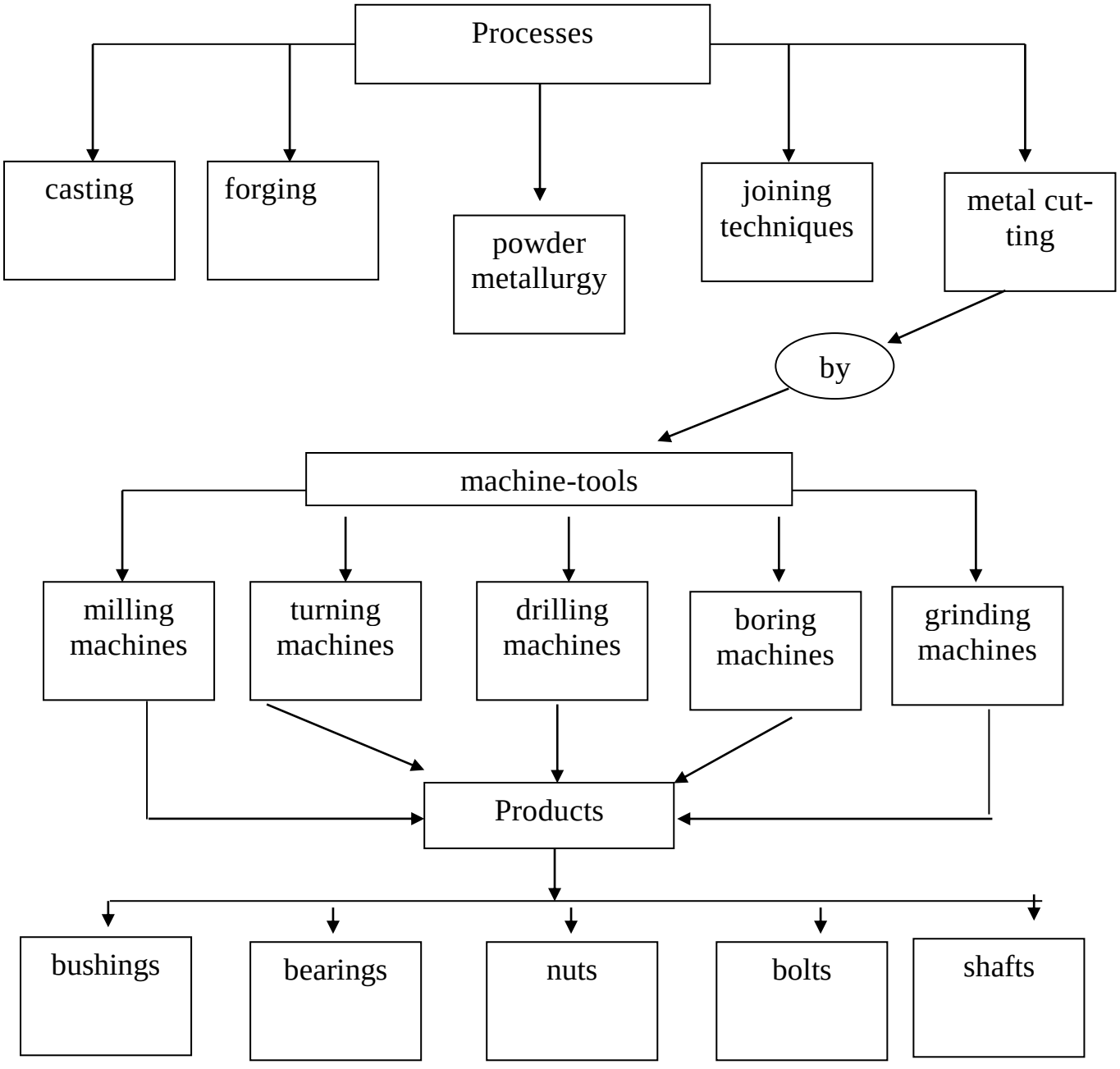


Figure 3 – Materials technology

5 Unit 5 Engineering materials

5.1.1 Translate the title of text 5.1. What information do you expect to find in the text?

5.1.2 Read text 5.1 and say:

a) in which paragraph it is said about the division of all metals into two types;

b) which non-metals are mentioned in the text

Text 5.1 Engineering materials

Engineers have to know the best and most economical materials to use. Engineers must also understand the properties of these materials and how they can be worked. There are two kinds of materials used in engineering – metals, and non-metals. We can divide metals into ferrous and non-ferrous. The former contains iron, and the latter do not have iron. Cast iron and steel, both alloys, or iron and carbon mixtures, are the two most critical ferrous metals. Steel contains a smaller proportion of carbon than cast iron. Certain elements can improve the properties of steel and are therefore added to it. For example, chromium may be included to resist corrosion and tungsten to increase hardness. Aluminum, copper, and alloys (bronze and brass) are common non-ferrous metals.

Plastics and ceramics are non-metals; however, plastics may be machined like metals. Plastics are classified into two types – thermoplastics and thermosets. Thermoplastics can be shaped and reshaped by heat and pressure. Still, thermosets cannot be reshaped because they undergo chemical changes as they harden. Ceramics are often employed by engineers when materials that can withstand high temperatures are needed.

5.1.3 Reread text 5.1 and write out the active words and phrases from it:

a) nouns denoting various materials;

b) phrases used in the classification of objects;

c) verbs and verb combinations that characterize materials.

5.1.4 Replace the selected words and phrases with words and phrases from text 5.1

Model: There are two kinds of *engineering materials.*

There are two kinds *of materials used in engineering.*

1 Nickel steel is *a mixture* of iron, carbon, and nickel. 2 Chromium *can be added to* steel to provide a good cutting edge. 3 There are many *kinds* of steel used in industry. 4 Ceramics *are used* by engineers where heat-resistant materials are needed. 5 Chromium steels *resist* corrosion.

5.1.5 a) Find in text 5.1 the sentences constructed according to the model can, may, must/have (has) to + V, and translate them.

b) Determine which of the statements correspond to the content of the text

1 Engineers must know the properties of engineering materials. 2 All materials can be classified as metals and non-metals. 3 Non-ferrous metals can contain iron. 4 Steels have to contain more carbon than cast iron. 5 Ceramics can resist high temperatures. 6 Thermosets may be machined. 7 Thermoplastics can be shaped and reshaped.

5.1.6 Connect pairs of sentences using: however – однако, therefore – следовательно, because – так как:

Model 1

(a) The copper does not rust.

(b) The copper corrodes.

(a + b) The copper does not rust; *however,* it corrodes.

Model 2

(a) Cast iron is a brittle metal.

(b) Cast iron is not used to withstand impact loads.

(a + b) Cast iron is a brittle metal, *therefore* it is not used to withstand impact loads.

Model 3

(a) Titanium is used for aircraft frames.

(b) Titanium is light and robust.

(a + b) Titanium is used for aircraft frames *because* it is light and strong.

1 Chromium resists corrosion. Chromium is added to steel to make them rust-proof. 2 Manganese steel is very hard. Manganese steel is used for armor plates. 3 Bronze has a low coefficient of friction. Bronze is used to make bearings. 4 Nylon is used to make fibers and gears. Nylon is strict and has a low coefficient of friction. 5 Tin is used to coat other metals to protect them. Tin resists corrosion. 6 Tin is expensive. The coats of containers applied to other metals are skinny. 7 Stainless steels require little maintenance and have high strength. Stainless steels are costly and difficult to machine at high speeds. 8 Nickel, cobalt, and chromium improve the properties of metals. Nickel, cobalt, and chromium are added to steels.

5.1.7 Connect the following sentences into one complex sentence using these connectors. You can omit words and make changes necessary to preserve the English sentence model

Model:

because/and/however

Plastics are used widely in engineering. They are cheap. They have a resistance to atmospheric corrosion. Plastics are not particularly strong.

Plastics are used widely in engineering *because* they are cheap *and* resistant to atmospheric corrosion; *however,* they are not particularly strong.

1 *and:* There are two types of plastics. Thermoplastics are plastics. Thermosets are plastics.

2 *and/whereas/and:* Thermoplastics will soften when heated. Thermoplastics will harden when cooled. Thermosets set on heating. Thermosets will not remelt.

3 *from/to:* Plastics are used to make a great variety of products. Plastics are used to make textiles. Plastics are used to make engineering components.

4 *such as:* Plastics are available in many forms. Plastics are available in the

form of sheets, tubes, rods, moulding powders and resins.

5 *to:* Various methods are used. These methods convert raw plastic into finished products. Compression moulding is a common method. Compression moulding is used for shaping thermosets.

6 *with/which:* The equipment consists of a press. The press has two heated platens. The two heated platens carry an upper and a lower mould.

7 *then:* Powder is placed in the lower mould. This is moulding powder. The upper mould is pressed down on the lower mould.

8 *to/which:* The pressure and the heat change the powder. The powder becomes liquid plastic. The liquid plastic fills the space between the moulds.

9 *when/and:* The chemical changes have taken place. The mould is opened. The moulding is extracted.

10 *by:* Plastic bowls are made. The compression moulding method is used.

5.1.8 Find complex sentences in the last paragraph of text 5.1 and explain their construction's logic, focusing on the connectors. Translate the last sentence of the paragraph into Russian

5.1.9 Remember the meaning of the following semi-suffixes:

-tight – характеризует качество соединения *-proof, -resistant* – характеризуют свойства материалов. Например:

an air-tight connection – a connection which air cannot pass through a heat-resistant material – a material which is not damaged by heat a moisture-proof coating – a coating which moisture cannot pass through an acid-proof cement – a cement which is not damaged by acid

Translate the following combinations

a gas-tight seal, an oil-proof cement, a water-resistant grease, a light-proof coating, a water-tight connection, a sound-proof engine cladding, a rust-proof surface, a shock-proof mounting, corrosion-resistant steel, a weather-proof surface

5.1.10 Find in the first paragraph of text 5.1 adjectives denoting a superlative degree of quality and give the original forms of these adjectives

5.1.11 Find the substitute words in the same paragraph and specify which words from text 5.1 they replace

5.1.12 Find the sentences in text 5.1 that refer to the classification of materials and translate them into Russian. Use table 16

Table 16 – Classification of materials

<table>
<tr><td colspan="2">There are</td><td>two
three
several
many</td><td colspan="2">types
kinds
sorts</td><td>of materials</td></tr>
<tr><td>Materials</td><td>are of</td><td rowspan="2"></td><td colspan="2" rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td></td><td>fall into</td></tr>
<tr><td>We can</td><td>classify
divide
split</td><td>materials</td><td>into several</td><td>classes
categories
groups
types</td><td>according to...</td></tr>
<tr><td colspan="2">Engineering materials</td><td colspan="2">consist of
include</td><td colspan="2">metals and non-metals</td></tr>
</table>

5.1.13 a) using the information in text 5.1, complete Figure 4

b) make at least eight sentences using Figure 4

For example:

1 Steel is a ferrous metal. 2 Iron and steel are ferrous metals.

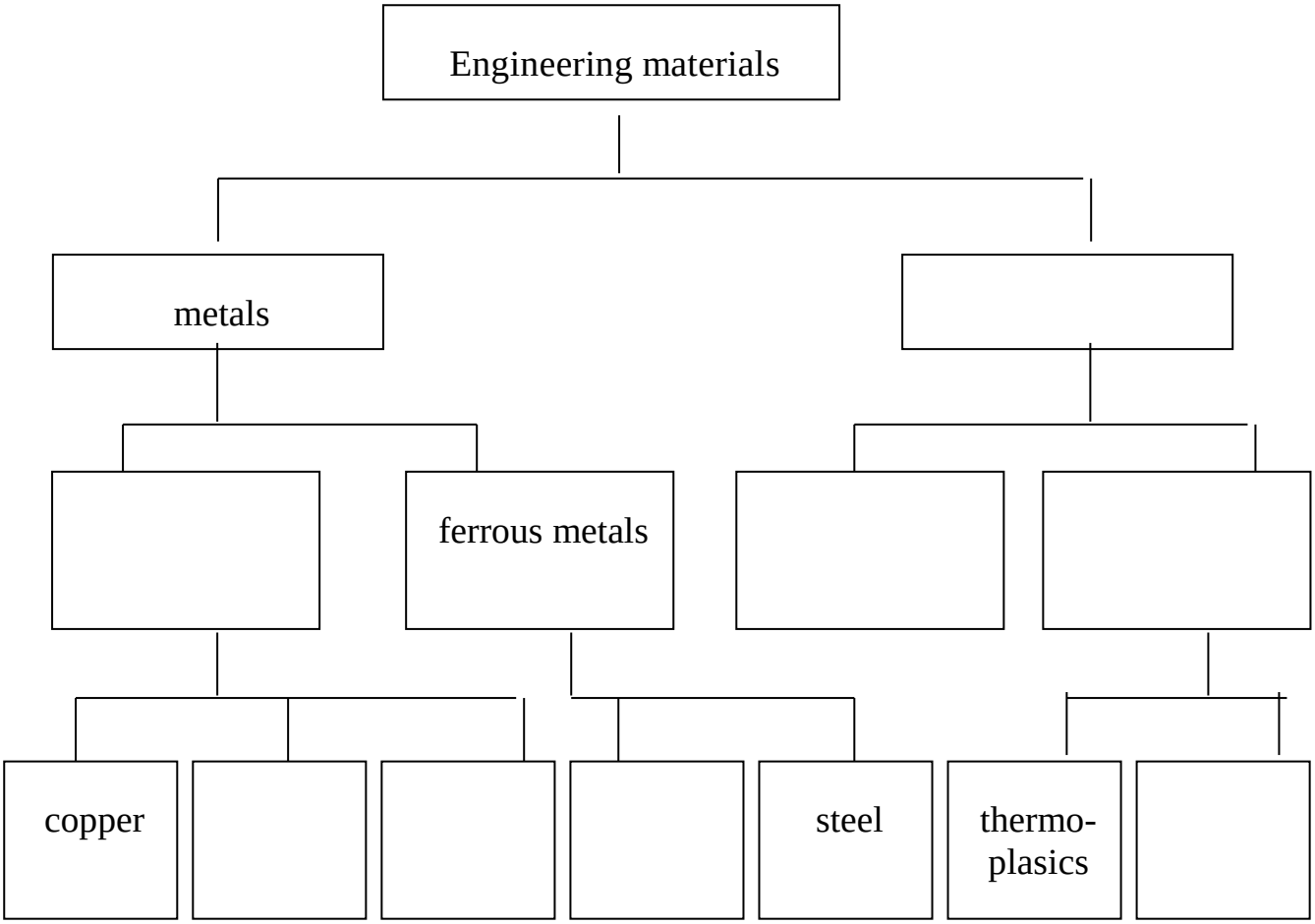


Figure 4 – Classification of Engineering Materials

5.1.14 a) draw diagrams that reflect the relationship between the following objects

1 alloys, copper, brass, pure metals, aluminum, metals;

2 milling machines, copy-miller, shaping machines, drilling machines, vertical shaper, radial arm drill, machine tools;

3 petrol engines, external-combustion engines, diesel engines, heat engines, steam turbines, internal-combustion engines

b) make at least ten sentences using your diagrams

For example:

1 Metals can be classified as pure metals and alloys.

2 Copper and aluminum are pure metals, and brass is an alloy.

5.1.15 Answer the questions

1 What kinds of materials are used in engineering? 2 How are metals classified? 3 What's the difference between ferrous and non-ferrous metals? 4 For what purpose are some elements (such as chromium and tungsten) added to steel? 5 What kinds of non-metals do you know? 6 What can you say about the classification and properties of plastics? 7 In what cases are ceramics used?

5.1.16 Prepare a report on the topic "Engineering Materials"

5.1.17 Situations for discussion:

a) you are a metallurgical engineer. Your task is to get high-quality alloy steel. Tell us how you can achieve this;

b) your laboratory conducts experiments at high temperatures. Tell us what qualities laboratory equipment should have and what materials can be used for its manufacture

5.2.1 Review text 5.2 and determine:

a) which paragraphs describe the technology for producing various types of plastic;

b) what paragraph describes the properties of plastic;

c) the main steps of the activity of the inventor, after whom Bakelite is named

Text 5.2 The plastic age

It's in our homes. It's the most common material in the workplace. Sometimes it's even in our bodies. We may be moving into the Information Age, but it's hard to believe that we are not living in the Plastic Age.

The very name "plastic" means versatility. You can bend it, mold it, model it, twist it and ply it in several different ways. The finished product can be a soft and airy foam or a complex and robust compound rivaling the sturdiest metal alloys. In its many forms, plastic has forever changed the way we live.

The first in the long line of human-made plastics was called Bakelite, after its

inventor, Leo Baekeland.

Many years of work in his chemistry lab in Yonkers, New York, led him in 1907 to the invention of the first synthetic polymer (plastic), made by linking small molecules together to make large ones.

Baekeland made his new material by mixing the carbolic acid (phenol) with the strong-smelling formaldehyde to make a third material that was nothing like the original two. It turned out to be a substance that would change the world.

Some of the early uses for plastic were to make things like radio cabinets, buttons, billiard balls, pipestems, toilet seats, airplane parts, and the object of Baekeland's research, shellac.

Baekeland's trick was to take the resin produced by the two chemicals and heat it under pressure to create a soft solid that could be molded and hardened or powdered and set under pressure. With this innovation, the plastic revolution was underway.

carbolic acid – карболовая кислота

formaldehyde – формальдегид

shellac – шеллак

5.2.2 Prepare a message on the topic "The substance that changed the world" according to the plan:

а) properties of plastics;

б) the first artificial plastics;

в) the early uses for plastic.

5.2.3 Make a scheme in English for obtaining a) Bakelite, b) shellac

5.3.1 Translate the title of text 5.3

5.3.2 Briefly review text 5.3 and say:

a) in which paragraph the requirements for modern structural materials are summarized. Do the data in Table 17 correspond to the facts from text 5.3?

b) in which two paragraphs we are talking about the properties of steel

Text 5.3 New steels meet changing needs

As a structural material, steel has two drawbacks: its weight and its susceptibility to rust. However, due to its advantages, steel has long been used in large quantities in structural applications, from bridges and buildings to ships, automobiles, and household appliances.

Steel is superior to other structural materials in strength, toughness, workability, and other critical properties for such applications. It is mass-produced with uniform, reliable quality and at low cost.

Since steel is the most popular structural material available, steelmakers make every effort to meet the changing needs of these markets. New, more sophisticated steelmaking processes and treatment have led to higher grade steel products and greater variety.

Yet, it can no longer be said that a steel product is satisfactory if it is simply an excellent structural material. Today's market needs can be classified broadly as:

1) the need for lighter weight;

2) the need for new properties;

3) the need for maximum performance;

4) the need for cost reduction.

The need for lighter weight requires materials with higher specific strength (strength/specific gravity). Materials offering new properties not found in conventional materials will include new breeds of steel, hybrid materials, and truly novel materials such as amorphous metal.

The need for maximum performance calls for materials approaching the limits of durability, toughness, and the like. Finally, the need to reduce costs leads to materials diversification in which steel materials precisely suited to a specific application are developed.

New families of steel products are steadily emerging to meet these needs.

Let us look at how steel needs have changed in the automotive industry and how steelmakers have met these needs.

Table 17 – What is needed in new steels by automotive industry?

Changes in the auto industry's environment	**New requirements for steel by the auto industry**	**Steels that meet the auto industry's requirements**
Fuel efficiency Durability Exhaust gas restriction Noise restriction Safety requirements	Weight reduction, lighter gauge of steel Corrosion resistance Heat resistance Noise reduction Rigid structure	High strength sheets with good formability (dual-phase steel) Coated sheets (one-side galvanized sheets) Heat-resistant stainless sheets, aluminized sheets Vibration-damping sheets High-strength low-alloy steel

5.3.3 Write out the English words and phrases from the first paragraph that express the concepts associated with modern steels' drawbacks and their advantages. Using the Polytechnic dictionary, fill in the resulting scheme in Figure 5 with Russian phrases

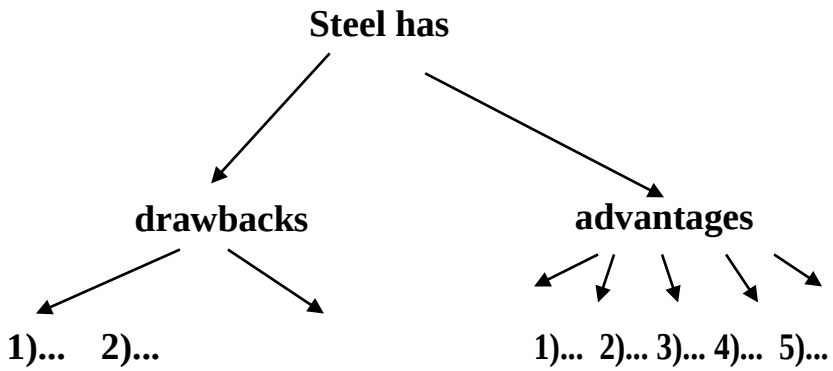


Figure 5 – Drawbacks and advantages of steel

5.3.4 a) Write out from the third paragraph of text 5.3 the phrases that express the requirements for structural steels at the present stage

b) Find in the fourth paragraph and write down the parameters (phrases) that

meet these requirements. The diagrams should be written in English and Russian

1) need for lighter weight ⟶ highest specific strength

2) … ⟶ new …

3) … ⟶ limits of …

4) … ⟶ … diversification

5.3.5 Below is a table of metals properties not mentioned in text 5.3. Select the properties of metals from the first paragraph of the text and based on the data from Table 18, make a description of these properties

Property

Every engineering material possesses specific properties, or characteristics, or qualities which we can find by experiment; these properties may make the material suitable or unsuitable for any particular purpose.

Here are some of the properties which metals may have:

Table 18 – Properties of metals

Property				**Definition**
The metal is	fluid.	It has	fluidity.	It flows easily when it melts.
	plastic.		plasticity.	It pulls out of shape without breaking.
	elastic.		elasticity.	It always returns to its original shape.
			ductility.	It can be stretched without breaking.
			malleability.	It can be hammered out of shape without breaking.

5.3.6 Translate the following words and phrases into Russian, name the meanings of the international words in italics. The words in bold are 'false translator friends.' Check their meanings in the dictionary and specify the meaning in this phrase

structural *material, application,* **critical** properties, **uniform** properties, **popular** *material, steel product, to classify,* **specific** strength, *hybrid material,* **specific** application, **automotive** *industry*

5.3.7 a) Read the first paragraph of text 5.3 and name the function of the pronoun 'it' in each sentence. Determine which word replaces it in each case.

b) Read the third paragraph of text 5.3. What functions does it perform, and how is it translated in the first sentence of the paragraph?

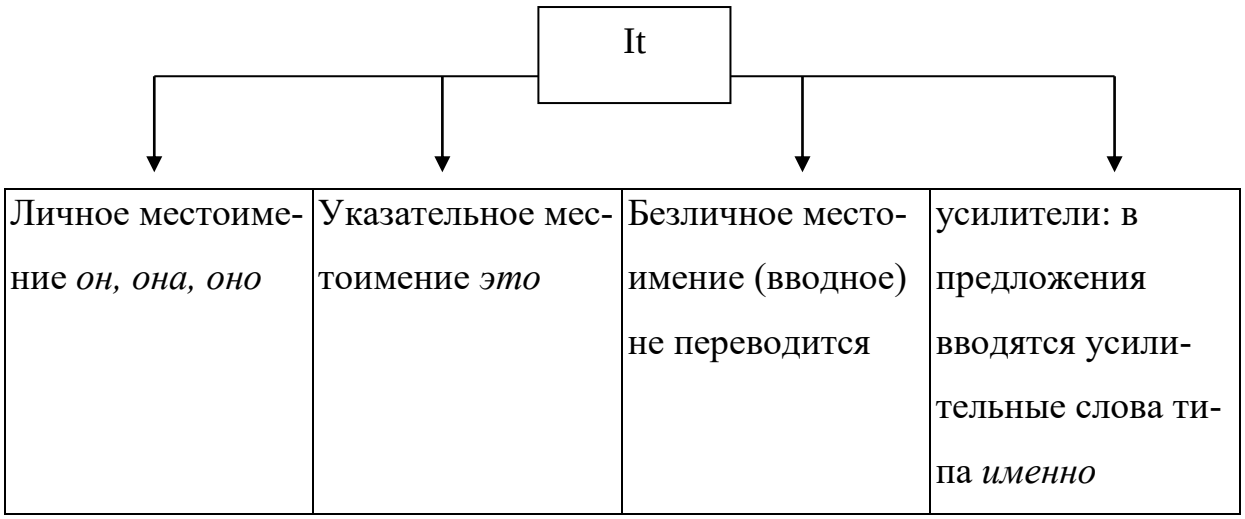


Figure 6 – Functions of 'it' in a sentence

5.3.8 a) Study Figure 6 and translate the fragments of sentences into Russian

1 ...materials having higher specific strength... 2 Materials offering new properties... 3 ...materials approaching the limits of...

b) Translate the third paragraph of text 5.3 into Russian

Причастие (Participle)

Это неличная форма глагола, выражающая процесс действия и совмещающая в себе свойства глагола, прилагательного и наречия. Основные значения и формы отражены в таблице 19.

Table 19 – Participle

Значение	**Форма**	
Причастие	**Активный залог**	**Пассивный залог**
Participle 1 Indefinite) выражает действие, одновременное с действием сказуемого предложения	**Ving** *using* Употребление: а) в позиции прилагательного (Adj); перевод: *использующий, использовавший* (определение) б) в позиции наречия (Adv); перевод: *используя* (обстоятельство)	**being Ved** *being used* Употребление: а) в позиции прилагательного (Adj); перевод: *используемый, использующийся, который используется* (определение) б) в позиции наречия (Adv); перевод: *будучи использован; когда (его) использовали* (обстоятельство)
Participle I (Perfect) выражает действие, предшествующее действию сказуемого предложения	**having + Ved** *having used* Употребление: в позиции наречия (Adv); перевод: *использовав, когда (он) использовал* (обстоятельство)	**having been** + **Ved** *having been used* Употребление: в позиции наречия Adv; перевод: *когда (его) использовали* (обстоятельство)
Participle II		**Ved** *used* Употребление: а) в позиции прилагательного (Adj); перевод: *используемый, использованный* (определение) б) в позиции наречия (Adv); перевод: *когда (его) использовали* (обстоятельство)

5.4.1 Find the participial phrases in text 5.3 and replace them with subordinate clauses without violating the meaning of the sentence

5.4.2 Group the proposals according to the position of the proposal occupied by Participle I

1 We were demonstrated an operating engine. 2 Designing new systems we can

use electronic computers. 3 Having finished the experiment the engineers started a series of new tests. 4 A barometer is an instrument measuring atmospheric pressure. 5 Metals being used in industry in the form of alloys have better properties than pure metals. 6 Having done many experiments, scientists proved that electricity had an atomic character. 7 Being the cheapest of the metals, cast iron is widely used everywhere. 8 A neutron is a particle having the same mass as a proton but carrying no electrical charge.

5.4.3 Translate the sentences into Russian, paying attention to the past participles

1 An automobile begins its life in the fully mechanized assembly department. 2 The area of the car works built on the Kama river is almost 1000 hectares. 3 The cars are going through special tests called “the Belgian road” and the washboard road. 4 The results obtained were carefully studied. 5 When frozen, water is a colorless solid known as ice. 6 The steering system used has been tested by the research engineers of the safety device laboratory. 7 When assembled, the car undergoes various tests.

5.4.4 Connect the following sentences, preserving the logic of the text and using the appropriate connector: yet-however (opposition), since (reason), if (condition)

1 Steel has some drawbacks. Steel has long been used as a structural material *(since, yet)* 2 Steel is superior to other structural materials. Steel has long been used as structural material *(since, yet)* 3 Steel is the most popular structural material. Steelmakers create new processes for steelmaking *(since, yet)* 4 Steel product is not satisfactory. Steel product is simply an excellent structural material *(if, since, yet)* 5 The need for maximum performance will be met. The materials approach the limits of toughness. *(if, yet)* 6 The need to reduce costs has not yet been met. The materials precisely suited to a specific application are not developed *(if, since)*

5.4.6 Answer the following questions

1 What are the two drawbacks of modern steel materials? 2 What are the advantages of steel over other metals? 3 In what fields of engineering has steel been long used? 4 What are the modern needs for steel development? 5 How could these needs be met? 6 How have modern steel needs changed in the automotive industry?

5.4.7 Prepare reports on the following topics

a) advantages and disadvantages of modern structural steels;

b) requirements for modern structural steels;

c) trends in the modern development of steels;

d) trends in the development of steel in the automotive industry.

5.5.1 Read text 5.4 and tell us what it is about

5.5.2 Decipher the data describing the various materials. At the same time, pay attention to the dimension: 1) weight; 2) melting point; 3) metal content in the ground, in seawater

5.5.3 The section 'Aluminum' reports on the properties of pure aluminum and its alloys and the improvement of these properties during processing:

a) name these properties;

b) tell us what elements aluminum is fused with;

c) what processes improve the properties of aluminum and its alloys.

Text 5.4 Non-ferrous metals

Although ferrous alloys are specified for more engineering applications than all non-ferrous metals combined, the large family of non-ferrous metals offers a wider variety of characteristics and mechanical properties. For example, the lightest metal is lithium, 0.53 g/cm the heaviest, osmium, weighs 22.5 g/cm^3 – nearly twice the lead weight. Mercury melts around – 38°F, and tungsten, the metal with the highest melting point, liquefies at 6,17°F.

Availability, abundance, and the cost of converting the metal into valuable forms – all play essential parts in selecting a non-ferrous metal. One ton of earth con-

tains about 81,000 g of the most abundant metal of land, aluminum. On the other hand, one ton of seawater contains more magnesium than any other metal (about 1,272 g). All sources combined, magnesium is the most abundant metal on earth. But because magnesium is difficult to convert to a valuable metal, it may cost several times that of the least expensive and most easily produced metal, iron billet.

Although nearly 80% of all elements are called ‘metals,’ only about two dozen of these are used as structural engineering materials. However, of the balance, many are used as coatings, in electronic devices, as nuclear materials, and as minor constituents in other systems.

Aluminum

Aluminum is lightweight, strong, and readily formable. Aluminum and its alloys, numbering in the hundreds, are available in all standard commercial forms. Because of their high thermal conductivity, many aluminum alloys are used as electrical conductors.

Commercially pure aluminum has a tensile strength of about 13,000 psi. Cold working the metal approximately doubles its power. For greater strength, aluminum is alloyed with other elements such as manganese, silicon, copper, magnesium, or zinc. Some alloys are further strengthened and hardened by heat treatments. Most aluminum alloys lose strength at elevated temperatures, although some retain significant power to 500°F.

5.5.4 Answer the following questions

1 Which of the non-ferrous metals is the most abundant metal of earth? 2 Which is the most abundant metal of land? 3 What factors define the selection of materials? 4 Why is magnesium so expensive? 5 Name the properties of pure aluminum. 6 How are the properties of pure aluminum improved?

5.6.1 Read text 5.5 and tell us in which paragraph

a) the requirements for plastics are described;

b) characteristics and application of plastics;

c) definition of the concept of 'plastic' and methods of its production;

d) different views on the possibilities of using plastics and confirmation (refutation) of these views (two paragraphs).

5.6.2 Using the answers to task 5.6.1, build a diagram that reflects the logical structure of text 5.5

Text 5.5 Plastics

Plastics are a large and varied group of materials consisting of combinations of carbon and oxygen, hydrogen, nitrogen, and other organic and inorganic elements. While solid in its finished state, plastic is at some stage in its manufacture, liquid, and capable of being formed into various shapes.

Forming is most usually done through the application, either singly or together, of heat and pressure.

There are over 40 different plastics families in commercial use today, and each may have dozens of subtypes and variations.

A successful design in plastics is always a compromise among highest performance, attractive appearance, efficient production, and lowest cost.

Achieving the best compromise requires satisfying the part's mechanical requirements, utilizing the most economical resin or compound that will perform satisfactorily, and choosing a manufacturing process compatible with the part design and material choice.

Most people have now outgrown the impression that plastics are low-cost substitute materials. Those who still view plastics as cheap and unreliable have not kept up with polymer technology developments for the past ten years.

Many plastics did indeed evolve as replacements for natural products such as rubber, ivory, silk, or wool, which became unavailable or in short supply.

But the new materials did not necessarily replace the older ones permanently nor made them obsolete. In many cases, they met an increased demand that could not be completed by the natural product alone.

Today's engineering resins and compounds serve in the most demanding envi-

ronments. Their toughness, lightness, strength, and corrosion resistance have won many significant applications for these materials in transportation, industrial, and consumer products.

The engineering plastics are now challenging the domains traditionally held by metals: truly load-bearing, structural parts.

5.6.3 Translate the following words and phrases; divide them into thematic groups and place them in the appropriate cell of the table

a) nouns:

carbon, forming, manufacture, performance, production, appearance, resin, compound, oxygen, hydrogen, inorganic element, polymer technology, rubber, silk, wool, toughness, nitrogen, transportation, consumer goods, lightness, corrosion resistance, strength, heat, pressure, commercial use

b) verbs:

to achieve, to require, to satisfy, to outgrow, to keep up, to become, to replace, to meet demands, to increase demands, to win

c) adjectives:

solid, liquid, satisfactory, high, attractive, efficient, economical, cheap, unreliable, available, significant

Possible titles of the corresponding columns of the table:

1 types of materials, elements;

2 characteristics of materials (plastics);

3 areas of application of plastics;

4 conditions for the manufacture of the plastics;

5 progress in the new materials development (for verbs);

6 physical condition of materials (for adjectives);

7 advantages of plastics.

Check the correctness of the selected meanings of words and phrases in the context

5.6.4 Write down from text 5.5 the phrases that express the concepts that define the requirements for plastic products design. Find and write down from the same paragraph phrases that define how to meet these requirements. The diagrams should be written in English and Russian

For example:

1 highest performance ► mechanical requirements of the part

высшие характеристики ► механические свойства детали

2 _____ ► _____

3 _____ ► _____

4 _____ ► _____

Translate the following words and phrases into Russian. Name the meanings of the italicized international words. The meaning of the words in bold should be clarified by the context

group, combination, organic element, **finished** state, **forming, commercial** use, *compromise, efficient production, mechanical* requirement, *substitute material,* **natural** *product, transportation,* **structural** part

Герундий (Gerund)

Это неличная форма глагола, выражающая процесс действия и совмещающая в себе свойства глагола и существительного, что отражено в таблице 20. Употребление, функции и способы перевода герундия отражены в таблице 21.

5.7.1 a) Group the sentences according to the use of the gerund; b) Translate the sentences into Russian

1 Casting is a process of forming metal objects.

2 The open-hearth process is one of the essential methods of making steel.

3 Numerous methods have been developed for producing metal castings.

4 The test needed to increase the temperature of the molten metal.

5 There are some ways of obtaining high-quality alloys.

6 After pouring, the molten metal is allowed to solidify in a mold.

7 Aluminum has a melting point of 658,7°C.

Table 20 – Gerund

Значение	**Форма**	
Герундий	Активный залог	Пассивный залог
Gerund Indefinite выражает действие, одновременное с действием сказуемого	**Ving** **using**	**being** + **Ved** **being used**
Gerund Perfect выражает действие, предшествующее действию сказуемого	**having + Ved** **having used**	**having been +Ved** **having been used**

Table 21 – The use, functions of gerund, and methods of its translation

Употребление	**Функции**
1 в позиции существительного (N): а) перед глаголом; б) после глагола без предлога; в) после глагола с предлогом; г) в позиции после глагола-связки; 2 в позиции прилагательного (Adj) 3 в позиции наречия (Adv)	a) *Reading* is my hobby, (подлежащее) b) I like *reading*, (прямое дополнение) c) I am fond of *reading*, (предложное дополнение) d) My hobby is *reading*, (именная часть сказуемого) There are different ways of *reading*, (определение) After *reading* the book he went to bed. (обстоятельство)
Способы перевода	**Примеры**
1 существительное 2 инфинитив 3 деепричастие 4 придаточное предложение	*Reading* is useful. *Чтение* – полезно. He finished *reading this book.* Он закончил *читать эту книгу.* *After reading this book* he gave it to me. *Прочитав эту книгу,* он дал ее мне. I thanked him for *giving me this book. Я* поблагодарил его за то, *что он дал мне эту книгу.*

5.7.2 Translate groups of words and sentences. Note the use of prepositions before the gerund: *in – при; on, upon – по, после, при; by – путем, посредством, при помощи; without – без*

in building, in melting; on heating, on completing, on melting; by introducing; without employing, without machining

1 In building new metallurgical works, engineers have to solve many different problems.

2 In melting steel, foundrymen use electric furnaces, crucible furnaces, and converters.

3 Liquids and gases expand on heating.

4 On completing the construction, the dome was tested in operation.

5 Casting is a process of forming metal objects by melting metal and pouring it into molds.

6 By introducing new foundry methods, the engineers improve the quality of castings and manufacture speed.

Сложный герундиальный оборот

Сравните:

1 I insist on **his** doing the work.

Я настаиваю на том, чтобы он сделал эту работу.

2 I insist on Mr. Black’s doing the work.

Я настаиваю на том, чтобы мистер Блэк сделал эту работу.

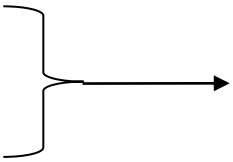
3 I insist on **his firm doing** the work.

Я настаиваю на том, чтобы его фирма сделала эту работу.

Предложения с герундиальными оборотами порождаются из простых предложений, одно из которых становится как бы матричным предложением, а второе сворачивается в герундиальный оборот и вставляется в матричное предложение.

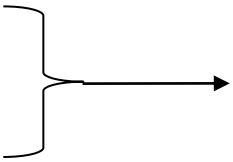
S1 – *You are working at the plant.*

S2 – It helps you to know technical subjects better.



You are working at the plant. ► *Your working* at the plant

It helps you to know technical subjects better.



Your working at the plant helps you to know technical subjects better.

То, что вы работаете на заводе, помогает вам лучше знать технические дисциплины.

5.7.3 Find the gerundial constructions and translate the sentences into Russian

1 We know of Newton's having developed principles of mechanics. 2 Mankind is interested in atomic energy being used only for peaceful purposes. 3 We know of the Russian metallurgical industry having made significant progress. 4 We speak about cupolas being used for melting cast iron. 5 Great attention is paid to the metal being heated to the proper temperature. 6 That sand molds are the oldest method for producing metal castings is a well-known fact.

5.7.4 Translate the sentences into Russian. Name the gerund forms and functions in the sentence

1 Melting may be done in cupolas, air furnaces, electric furnaces, etc.

2 Some metals require treatment before being placed in the melting furnace.

3 Carrying molten metal is usually performed in crane ladles.

4 The most favorable characteristic of sand casting is its good retaining strength at moderately elevated temperatures.

5 Melting is very important in the production of high-quality castings.

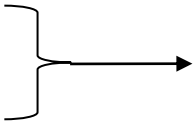
6 We know of electric furnaces being used for the production of high-grade castings.

7 A foundry cannot operate without employing proper foundry materials.

5.7.5 Convert simple sentences into a participial sentence by following the model

Plastics are a large group of materials.

This group *consists of a* combination of different elements.



Plastics are a large group of materials *consisting of* a combination of different elements.

1 Plastics are a group of new materials. These materials replace natural products.

2 Plastics achieve high toughness, lightness, and strength. These properties win many significant applications for these materials.

3 A successful plastics design is a compromise among highest performance, attractive appearance, efficient production, and lowest cost. This compromise needs to satisfy the part's mechanical requirement, utilizing the most economical resin and meeting other requirements.

5.7.6 Study Table 22 and translate the sentences into Russian. State if the '-ing' forms are a participle or a gerund

1 Heating the gas increases the speed of the molecules.

2 Having experimented, the research engineer recorded the data.

3 Translating from one language to another we can use electronic computers.

4 An automatic computer has accomplished translating from one language to another.

5 The failure was due to the operator's having been careless in using the instrument.

6 The dome is the most generally used melting process for cast iron, the fuel economy being highest and ease of manipulation greatest.

7 The Bessemer converter is used in steel making.

8 Cupola melting is continuous.

9 All non-ferrous alloys having a lower melting temperature than iron alloys

are melted in crucible furnaces, open-flame furnaces, and electric furnaces.

Сопоставление причастия I и герундия

Сравнительный анализ причастия I и герундия представлен в таблице 22.

Table 22 – Comparison of participle I and gerund

Употребление в позиции	Gerund	Participle I
1 существительного N а) перед глаголом (подлежащее) б) после глагола-связки (именная часть сказуемого) в) после глагола (дополнение) 2 глагола V (сказуемое) 3 прилагательного Adj (определение) 4 наречия Adv (обстоятельство)	**Melting** is performed in melting furnaces. The best way to solve this problem is **experimenting.** The foundrymen completed **melting** in time. The **principle of operating** this mechanism is simple. **After being subjected** to all tests the machine was stopped.	The engineer is **preparing** a series of experiments. We were demonstrated an **operating** furnace. **Having been subjected** to all tests the machine was stopped.

Table 23 – Distribution of participle I and gerund by text 5.5

Participle I	Gerund

5.7.7 Find the '-ing' forms in text 5.5 and distribute them in table 23

5.7.8 Determine which of the statements correspond to the content of the text:

1 a) Plastics *evolved* as replacements for natural products, b) Plastics *have*

evolved as replacements for natural products.

2 a) Those people who considered plastics unreliable did not keep up with the developments in polymer technology in the past, b) Those people who consider plastics unreliable have not kept up with the developments in polymer technology for the past ten years.

3 a) Plastics properties won many applications for these materials in the past, b) Plastics properties have won many applications for these materials.

5.7.9 Find the sentences in text 5.5 that use the constructions "either... or" and "such as"; translate them into Russian

5.7.10 Connect the following sentences using the connectors: that is why – вот почему, however – однако, thus – следовательно, таким образом.

1 Plastics are solid in the finished state. Plastics are liquid at some stage in manufacture *(that is why, however)*

2 Plastics are light, strong, corrosion resistant. They have won many significant applications in industry and transportation *(thus, however)*

5.7.11 Find in text 5.5 adjectives denoting comparative and superlative degree and give the original forms of these adjectives

5.7.12 Find the replacement words in text 5.5 and specify which words from the text they replace

5.7.13 Put all possible questions to all the sentences of the last paragraph of text 5.5, using the question words: what, what kind of, where, which, how many, when

5.7.14 Retell text 5.5, having previously drawn up and using a plan for retelling

5.8.1 Read text 5.6 and say:

a) which two fiber groups are mentioned in it;

b) in which paragraph we are talking about the types of synthetic fiber;

c) which two aspects related to fiberglass are discussed in the last paragraph

Text 5.6 Fibers

Fibers are probably the oldest engineering materials used by man. Since antiquity, jute, flax, and hemp have been used for ‘engineered’ products such as rope, cordage, nets, water hose, and containers. Other plants and animal fibers have been used for felts, paper, brushes, and heavy structural cloth.

The fiber industry is divided between natural fibers (from plant, animal, or mineral sources) and synthetic fibers.

Many synthetic fibers have been developed specifically to replace natural fibers because synthetics often behave more predictably and are usually more uniform in size.

For engineering purposes, glass, metallic, and organically derived synthetic fibers are most significant. Metal fibers are used in high-strength, high-temperature, lightweight composite materials for aerospace applications. Fiber composites improve the strength-to-weight ratio of base materials such as titanium and aluminum. Metal-fiber composites are used in turbine compressor blades, heavy-duty bearings, pressure vessels, and spacecraft re-entry shields. Boron, carbon, graphite, and refractory oxide fibers are common materials used in high-strength fiber composites.

Glass fibers are probably the most common of all synthetic engineering fibers. These fibers are the finest of all fibers, typically one to four microns in diameter. Glass fibers are used for heat, sound, electrical insulation; filters; reinforcements for thermoplastics, and thermoset resins and rubber (such as in tires); fabrics, and fiber optics.

5.8.2 Fill in Table 24

Table 24 – Type, properties and application of fiber

Вид волокна		**Свойства**		**Применение**	
metal **fiber**	---	fine	тонкий	space	
glass fiber	стекловолокно	---	---	---	

5.8.3 What types of fibers do you know? Tell us about the properties and applications of fiberglass. Use Table 24

5.8.4 Make a plan of the report on the topic "Engineering materials"

5.8.5 Make a short report in English, focusing on the plan from exercise 5.8.4

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