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Л88 Методические указания по обучению чтению технической литературы на английском языке по специальности «Метрология, стандартизация и сертификация». Часть 1. – М.: Изд-во МГТУ им. Н.Э. Баумана, 2005. – 32 с.

Целью работы является развитие навыков поисково-ознакомительного и изучающего чтения. Система упражнений способствует лучшему усвоению специальной лексики и улучшению навыков перевода технической литературы. Тексты подобраны из оригинальной литературы и расположены в соответствии с нарастанием языковых трудностей.

Для студентов III курса факультета «Машиностроительные технологии» специальности «Метрология, стандартизация и сертификация».

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Часть 1

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UNIT 1

TIME TO REMEASURE THE METRE

I. Basic vocabulary:

fraction – дробь; часть; доля

to measure – измерять

to number – считать

to pinpoint – определять точное положение

accuracy – точность, правильность

exactly – точно

length – длина

wave – волна

to compare – сравнивать

uncertainty – неопределенность, неточность

to define – определять

weight – вес

in terms of – в терминах; с точки зрения

value – (числовое) значение (физической величины)

frequency – частота

precision – точность; прецизионность

order – порядок; последовательность

magnitude – величина

to ensure – обеспечивать, гарантировать

Vocabulary Practice

II. Read and translate the words without a dictionary:

international, metre, second, physicist, speed, distance, radio astronomers, position, confuse, telescope, laboratory, laser, absolute, conference, vacuum, interval, universal truth, constant, automatically.

III. Compare the following pairs of words and translate them:

write – rewrite, measure – remeasure, define – redefine, order – reorder, appear – reappear, number – renumber.

IV. Translate the following word combinations:

fraction of a second, speed of light, international agreement, laser beams, wavelengths of laser beams, the General Conference on Weights and Measures, time interval, universal constant, length of the path, defined value.

V. Translate the following nouns and give the corresponding verbs:

measurement, agreement, comparison, definition, restoration, calculation, information, discovery, travelling, knowledge, derivation, limitation.

VI. Guess the meaning of the following words with the prefix “inter”:

interchangeable, interconnect, interdependent, intercompare, interact, intercalibration, intermodulation.

VII. Look through the text and find the equivalents for the phrases:

достаточно точно; его дни были сочтены; определять точное положение звезд; за последние десять лет; неточности в измерениях метра; вычислить абсолютную длину волны; разрешила все эти проблемы; такой же точности; в терминах времени; определенное значение для скорости света; по определению.

VIII. Read and translate the following text:

Text 1A

Time to remeasure the metre. Part I

At last, by international agreement, the metre was deposited¹: it is now no more than a fraction of a second. From the time physicists

found they could measure the speed of light more accurately than they could measure the metre itself, its days were numbered.

Not long ago, scientists could measure the distance of the Moon from the Earth more accurately than they could measure the metre. Radio astronomers wanting to pinpoint the positions of the stars were confused because they did not know the length of the metre exactly enough to measure the distances between their radio telescopes here on Earth. In the laboratory physicists could intercompare the wavelengths of laser beams to a few parts in a hundred thousand million (10^{11}), but did not dare calculate the absolute wavelengths of any of their lasers because they did not know the metre to the same accuracy. Almost all the uncertainty quoted in measurements of the speed of light over the past decade stemmed not from limitations in the experiment, but from inaccuracies in measuring the metre.

The General Conference on Weights and Measures (CGPM) meeting in Paris solved all these problems. It redefined the metre, not as a simple length, but in terms of time. From now on², the metre is “the length of the path travelled by light in vacuum during a time interval of $1/299\,792\,458$ of a second”. From now on, the speed of light is a universal constant of nature whose value is known exactly and by definition ($299\,792\,458$ m/s). From now on, if a physicist should somehow discover that light is travelling faster than we had thought, then the metre will be lengthened automatically to restore the defined value for the speed of light.

Notes to the text:

¹ to depose – свергать, низлагать;

² from now on – впредь, в дальнейшем

IX. Answer the following questions:

1. Why was the metre deposed?

2. Why couldn't radio astronomers pinpoint the positions of the stars?

3. What problems did the physicists have?

4. How did the CGPM solve all these problems?

5. In what terms is the metre defined?

6. What is the speed of light now?

X. Discuss the necessity of remeasuring the metre.

XI. Translate the following sentences paying attention to "for" and "as":

1. The original motives for defining the metre as a universal standard were more prosaic than Earth – Moon distance measurement as there was no common system of weights and measures. 2. The French had enough difficulties accepting the metric system as it was. 3. For political reasons, Britain did not accede (присоединяться) to the Convention on the Metre until 1884. 4. The system of standards based on these rules remained unchanged for nearly 600 years. 5. As international trade developed in the 19th century, the need for a worldwide standard of measure became more and more apparent (очевидный). 6. Physicists could not calculate the absolute wavelengths of their lasers for they did not know the metre to the same accuracy. 7. The British Association for the Advancement of Science has for years been advocating the metric system. 8. The first practical spectroscope was designed in 1858. As originally constructed it was provided with a glass prism and used only for visible light. 9. No system of the past was as simple as the metric system.

XII. Translate the following sentences paying attention to the construction "It is ... that / who" – «ИМЕННО, ТОЛЬКО»:

1. It was the laser's phenomenal accuracy that forced the CGPM to introduce a new definition of the metre. 2. It was a British metallurgist who made the platinum – iridium alloy bars (стержни) which carried the new international standard of the metre. 3. It was

J. Whitworth who introduced gauges into production. 4. It was not until 1897 that the use of metric units in trade became legal in Britain.

XIII. Read the text and discuss the concept of time using the following models:

In my opinion ... – По моему мнению ...

As far as I know ... – Насколько я знаю ...

As for me ... – Что касается меня ...

It is possible to say that ... – Можно сказать, что ...

This text deals with ... – В тексте говорится о ...

This fact permits to conclude ... – Этот факт позволяет сделать вывод ...

Text 1B

Time to remeasure the metre. Part II

We all think we understand fairly well¹ the concept of length. But time? Philosophers and ordinary folk down the ages have puzzled over² its nature. Why did the strict judges³ of the General Conference on Weights and Measures (CGPM) decide to define the metre as a fraction of a second?

In a sense⁴, they were forced to do it for scientists have been using time as a measure of length in practice for years. How do you measure the distance of the Moon from the Earth? Shine a laser beam at it and measure the time the beam takes to get there and back again. Multiply the time for a single journey by the speed of light and you have the distance in metres. Radio astronomers measure the distance between their telescopes in a similar way, when they want to do very long baseline interferometry. For the past decade or so physicists have been calculating the speed of light by measuring the frequency of a laser's radiation and multiplying it by the wavelength. Nowadays they even measure the laser's wavelength

by counting the beat frequency of interference between it and a standard light beam. So measures of both frequency and wavelength depend on time.

As far as physicists are concerned, time is the most accurately measurable of all physical quantities. Using the caesium clock adopted as the international standard in 1967 physicists can determine the second with an uncertainty of 1 part in 10^{13} – equivalent to about one second in 300,000 years.

Ironically, the decision by the CGPM to define the metre in terms of the second echoes one of the proposals that the Academy of Sciences rejected in 1791 in their search for a “natural” standard for the metre.

Notes to the text:

¹ fairly well – довольно хорошо;

² to puzzle over – ломать голову;

³ judge – судья, эксперт;

⁴ in a sense – в некотором смысле, до некоторой степени.

XIV. Translate the text below in writing (time limit 20 min.):

The main impetus for a redefinition of the metre has come from the increasing precision with which physicists over the past decade have been able to measure the speed of light. The 1960 standard based on the wavelength of a particular emission from a discharge lamp containing a particular isotope of krypton has lasted just 23 years. Ironically, 1960 was the year in which the laser was invented: it is the accuracy and reproducibility of the laser that has been the downfall of the krypton standard. Therefore, the CGPM wants the new standard to last longer than its predecessor. Physicists are studying new frequency-measuring techniques and atomic systems other than caesium, either of which could allow metrologists to define the unit of time, the second, with a precision

several orders of magnitude better than 1 part in 10^{13} that the caesium clock currently permits. If this happens, the latest definition of the metre should remain unaffected.

XV. Look through the text and comment on it:

Text 1C

Metric administration

In the middle of the 19th century, the need for a universal decimal metric system became very apparent, particularly during the first universal exhibitions. In 1875, a diplomatic conference on the metre took place in Paris where 17 governments signed the treaty «the Metre Convention». In the same year, the Convention on the Metre set up the International Bureau of Weights and Measures, whose task is to ensure worldwide unification of physical measurements. It is responsible for establishing the fundamental standards and scales of measurement, carrying out comparisons of national and international standards, and ensuring the coordination of measuring techniques. The bureau employs some 30 physicists and technicians and has an annual budget of more than US\$ 3-5 million. Its headquarters¹ are in the Parc de Saint-Cloud, near Paris, which the French government has put at its disposal in perpetuity².

The bureau's scientific work is directed by the International Committee for Weights and Measures, an international group of 18 scientists. In its turn the committee reports every four years to the General Conference on Weights and Measures (Conférence Générale des Poids et Mesures, CGPM).

The CGPM consists of delegates from all the member countries of the Convention on the Metre, who meet every four years to discuss and initiate the arrangements required to ensure the propagation and improvement of the International System of Units

the SI System), which is a modern form of the metric system. The CGPM is a policy-making body rather than a scientific one: the science is done by the bureau under the direction of the international committee.

Notes to the text:

¹ headquarters – штаб-квартира;

² in perpetuity – навсегда, навеки.

XVI. Answer the following questions:

1. What is the International Bureau of Weights and Measures responsible for?
2. How many people are there in the bureau?
3. Where are its headquarters situated?
4. Who directs the bureau's scientific work?
5. How often do the delegates of the CGPM meet?
6. What kind of organization is the CGPM?

UNIT 2

FROM THE HISTORY OF ENGINEERING METROLOGY

I. Basic vocabulary:

feeler – щуп, чувствительный элемент, калибр толщины;

calliper – измерительный инструмент (напр., штангенциркуль, кронциркуль, нутромер)

to rely on – полагаться на

skill – умение, мастерство

refinement – усовершенствование

division – деление

assembly – сборка

to fit – подгонять, собирать, устанавливать

clearance – зазор, промежуток

to determine – определять
degree – степень
interference – натяг
replacement – замена
replacement parts – запасные части
gauge – измерительный прибор; калибр; мера; размер
fine – точный; мелкий
essential – существенный, составляющий сущность
(чего-либо)
ultimate – окончательный; основной
to refer to – ссылаться на
pitch – шаг (например, резьбы)
dimension – размер; измерение; размерность
micrometer screw – микрометрический винт
conventional – обычный, общепринятый
vulgar fractions – простые дроби
tap – метчик (для нарезания внутренней резьбы)
die – плашка (для нарезания наружной резьбы)
thread – резьба
table – таблица
to decimalize – переводить в десятичную систему
to check – проверять, контролировать

Vocabulary Practice

II. Read and translate the words without a dictionary:

metrology, progress, sense, method, pioneer, idea, production, innovator, instrument, dispute, periodic, micrometer, calibration, system, standard, diameter, gradation, metric.

III. Underline the suffixes and say what parts of speech the words belong to:

sensitivity, expression, reference, pioneer, fitness; suitable, constant, increased, dimensional, active; efficiently, directly, especially.

IV. Translate the following verbs and give the corresponding nouns:

divide, require, determine, replace, create, introduce, produce, found, propose, graduate, refer, express, operate, develop, correspond.

V. Translate the combinations with nouns:

engineering measurement, manual dexterity (ловкость), rule divisions, numerical terms, engineering assembly, required degree of clearance, replacement parts, original fitting operation, accurate measurement, production engineer, ultimate reference, dimensional uncertainty, pitch error, decimal scale, conventional fractions, graded decimal steps, standard range of threads, fractional sizes.

VI. Translate the following sentences paying attention to modal verbs and their equivalents:

1. You had to take into account (принимать во внимание) the data referred to in this article. 2. Callipers are to be used chiefly for determining diameters. 3. It is very important that you should know the names and uses of the tools you have to deal with. 4. Industry would not buy Whitworth's gauges because they would not accept other than fractional sizes and he had to withdraw them. 5. Production engineers ought to specify the exact sequence in which manufacturing processes are to be performed. 6. Practically all engineering processes might be considered under two broad classifications: large-quantity and small-quantity production of parts, devices and machines. 7. These classifications may be referred to as the mass-production system and the unit-production system (единичное производство). 8. The significance of any

measurement is determined by the degree of accuracy to which elements and parts are to be measured. 9. The vernier calliper (штангенциркуль с нониусом) consists of a primary scale along which two heads may be moved. 10. This error is of little significance in ordinary industrial practice and can be ignored for convenience (удобство). 11. It may seem rather strange that where certain materials have to be softened, others have to be hardened.

сделать

VII. Translate the sentences where the Infinitive is used as an attribute:

1. France was not the first country to go metric: the Netherlands adopted (принимать) the system in 1820 and Greece in 1836. 2. They were the first to observe the wave nature and measure the wave-length of the electron. 3. This is the last factor to be taken into consideration. 4. J. Whitworth was the first to introduce gauges into production.

VIII. Look through the text and find equivalents for the following phrases:

все еще полагаясь, в основном, на мастерство, ловкость рук и ощущения; измерения в числовых величинах не выражали истинной точности, получаемой при технической сборке; требуемая степень зазора или натяга; запасные детали приходилось подгонять таким же образом; стандартная десятичная мера длины; погрешность шага микрометрического винта; вместо обычных простых дробей; точно соответствует по диаметрам и шагам; инженеры-стандартизаторы были слишком привязаны к фракционной системе, чтобы перейти полностью на десятичную систему.

IX. Read and translate the text:

Text 2A

Engineering measurement

From fingers as feelers, engineering measurement progressed to the rule and calliper, still relying very much on the skills of manual dexterity and sensitivity of feel. Such methods remained in use up to the nineteenth century when expressions like “a full eighth” or “a bare sixteenth”¹ represented some refinements of rule divisions. Even as late as the 1830s, Whitworth’s foot rule divided into thirty – seconds of an inch (0.8 mm approx.) was regarded as an unnecessary refinement. Measurement in numerical terms did not, however, represent the true accuracy obtained in engineering assembly. Parts of a machine or mechanism were fitted together with the required degree of clearance or interference determined by feel and experience. Replacement parts had also to be fitted in the same way, a job requiring even more skill than the original fitting operation. Joseph Whitworth, born in 1803, is often credited with the innovation of engineering metrology. In Britain, he was the first to introduce gauges into production and presented a paper to the Institution of Mechanical Engineers “On a standard decimal measure of length for mechanical engineering work, etc.”. But industry would not buy his gauges because they would not accept other than fractional sizes. He was a brilliant engineer and pioneer in accurate measurement but much that he did was to develop ideas he had learned from others, especially Henry Maudslau.

Henry Maudslau, born in 1771, was essentially a production engineer but his constant striving for accuracy entitles him to be the first true British engineering metrologist. One of Maudslau’s achievements in the field of metrology was to make a fine measuring machine which he called his “Lord Chancellor” because it was the ultimate reference in any dimensional dispute or uncertainty. This instrument was tested at the National Physical Laboratory in 1918 when the pitch error of the micrometer screw

was found to be 0.0017 in per inch with a periodic error of 0.0002 in. No further calibration was carried out at that time.

Whitworth campaigned vigorously for the use of the decimal system in measurements instead of conventional vulgar fractions. He proposed a decimal scale which included a table of sizes for taps and dies. In this table, sizes started at 0.100 in and increased in graded decimal steps up to 6 in. The modern British Standard Whitworth range of threads² corresponds to this table exactly in diameters and pitches, but only at certain points – the fractional sizes. Admittedly Whitworth's gradations were too fine but it proves that even in the 1900s standardizing engineers were too wedded to the fractional system to decimalize entirely. Today we can see similar reluctance to change completely to the metric system.

Notes to the text:

¹ “a full eighth” or “a bare sixteenth” – «полная восьмая часть», или «не более шестнадцатой части»;

² BSW thread – британская нормальная резьба Витворта.

X. Answer the following questions:

1. How did engineering measurement progress in course of time?
2. What methods of measurement did engineers rely on up to the nineteenth century?
3. How were parts of a machine or mechanism fitted together?
4. Who is considered to be a pioneer in accurate measurement?
5. What is he famous for?
6. Who was the first true British engineering metrologist?
7. What kind of measuring instrument did he make?
8. Where was his “Lord Chancellor” tested?
9. What did Whitworth campaign for?

10. What kind of scale did he propose?

11. What was the pitch error of the micrometer screw?

12. Is Whitworth's table of sizes still in use today?

XI. Speak about the progress of engineering measurement.

XII. Translate the sentences paying attention to Infinitive constructions:

1. A digital reading micrometer of 0.5 in. capacity was made in 1893. But it did not appear to be put into production. 2. Metric micrometers overall error was found to be about 0.015 mm over 25 mm. 3. The method is known to have been used as far back as the 17th century. 4. The British are reported to have done considerable work in accurate measurement. 5. One may expect this prediction to be quite reliable. 6. The idea to derive (выводить) the metre standard of length from the Earth's circumference proved to be impractical and soon disappeared. 7. This method does not seem to offer any advantages over the one discussed above. 8. He considered the data obtained by the previous authors to be inaccurate. 9. In the old standard the unit of length was believed to be the distance between the end-faces of the platinum bar. 10. The Netherlands appeared to be the first country to adopt the metric system.

XIII. Translate the text below in writing (time limit 20 min.):

Micrometers

Various devices which could be classed as micrometers were made during the nineteenth century. The micrometer of Whitworth's machine had a pitch of 0.05 in and a worm wheel¹ was fitted to the end of the micrometer spindle. It was engaged with a worm shaft carrying the measuring wheel graduated in microinches. It took 40 turns of this wheel to advance the micrometer 0.01 in. Time would allow only one pitch of the

micrometer screw to be checked and the error found was 0.0001 in (over 0.05 in.). Hand micrometers, much as we know them today, were being made in the latter half of the century, mainly by Brown and Sharpe in the USA. Several of these are in the Science Museum, some of them being in metric measure. One of these metric micrometers was checked at the National Physical Laboratory (NPL) in 1978 and its overall error was found to be about 0.015 mm over 25 mm, although most of the run was accurate to 0.005 mm.

Notes to the text:

¹ worm wheel – червячное колесо.

XIV. Read the text and comment on it. Memorize the following terms:

block gauge – плоскопараллельная концевая мера длины, плитка Йогансона

slip gauge – то же самое, что и block gauge

end bar – концевая мера длины

wrung – зд.: притертый

jig – зажимное приспособление, шаблон

shortcoming – недостаток, дефект

flat – плоский, ровный

Text 2B

Gauges

Today production engineers, toolmakers, inspectors and many other technologists are familiar with gauge blocks or slip gauges. Together with end bars for larger sizes, they are used as standards in industry for the control and checking of dimensions of components. The important feature of gauge blocks, which have flat and parallel measuring faces, is that they can be calibrated to micro inch

(0.02 μm) accuracy and a number of gauges can be wrung together, so that their combined size is equal to the sum of their individual sizes to the same degree of accuracy.

Carl Edvard Johansson worked as an armourer inspector at the rifle factory in Eskilstuna, Sweden. Sweden was then, as it is now, a highly advanced production engineering country and the factory was well tooled up with jigs, fixtures and gauges. The gauges were all fixed dimension callipers and gauge blocks, and Johansson became keenly aware of the shortcomings of dimensional control in the factory. In 1895 he was sent to the Mauser works in Germany as resident inspector for the Eskilstuna factory who were to make a new Mauser rifle under licence. He found that Mauser were using the same gauging system and he realized that large numbers of new gauges would be needed before Swedish manufacture could be started. The idea of combination gauge blocks had been in his mind for some time, and, during his train journey home, he finally arrived at the specification of number and sizes of gauges needed in a combination set. He concluded that 102 metric gauges would be required, ranging from 1 mm to 100 mm. The modern internationally agreed metric set contains exactly the same gauges with the addition of nine in steps of 0.001 mm and one of 0.5 mm, making 112 gauges in all.

Later Johansson's gauges were used in many countries and there can be little doubt that he made a greater contribution than anyone else to accuracy in manufacture.

XV. Answer the following questions:

1. What are slip gauges used for?
2. What is the most important feature of gauge blocks?
3. What did you learn about Carl Edvard Johansson?
4. What contribution did he make to accuracy in manufacture?

XVI. Read the text and comment on it. Memorize the following terms:

- 1) comparator – компаратор (прибор для сличения концевых и штриховых мер длины)
- 2) robust – робастный, устойчивый
- 3) surveying – топографический
- 4) suitable – пригодный
- 5) rigidity – жесткость
- 6) magnification – увеличение, усиление
- 7) adjustment – регулировка; юстировка
- 8) finish – шероховатость; чистовая обработка
- 9) roughness – шероховатость
- 10) amplification – усиление

Text 2C

Optics and electronics

The period from the end of World War I to the present time has seen tremendous developments in metrology in industry. The two most significant fields these developments have been based on are obviously optics and electronics. Increases in production volume and the introduction of automation have only been possible with the close control of dimensional accuracy in all components. The idea of the individual fitting of parts in an assembly had disappeared by 1939, except in a very few cases of special manufacture. We realize the importance of optics in the light of the design of modern equipment when almost any required function can be achieved with a few transistors, micro-circuits and, sometimes, quartz crystals. Nevertheless, in its time, the use of optics revolutionized the control of accuracy to a similar or greater extent.

In the 1920 Leipzig Fair, the firm of Carl Zeiss of Jena, Germany, exhibited several instruments including a screw-thread measuring microscope and an optical comparator which they called the «Optimeter». These differed from the early NPL instruments in

having robust enclosed optical systems suitable for use in inspection departments and toolrooms, as well as in metrology laboratories.

Another highly successful development was the incorporation of surveying instrument techniques in industrial equipment. In this way, the optical circular dividing head and dividing tables were introduced. Many other instruments, mainly optical, were made by Zeiss and these were the mainstay of industrial metrology all over the world during the 1930s.

As for electronics, various small companies made comparators with huge magnifications, simply by stringing together rows of valve amplifying stages¹. Most of these were unreliable electronically, but worse, their designers had little idea of the mechanical stability and rigidity, or the fine mechanical adjustments, also necessary with such equipment. Two companies, Sigma Instruments Ltd and Taylor, made very good electrical comparators and various electronic instruments were developed later.

During the late 1930s, the problems of measuring the finish or texture of machined surfaces began to arise. The performance of engineering products, particularly aeroengines, depended more and more critically on precise surface finishes and not always «the finer the better». Richard E. Reason made an instrument which measured surface roughness in numerical terms and he developed the range of Talysurf instruments which, with later developments, have had world-wide success ever since. He was not the first; a good deal of work had been going on in America, but his machine was the first to trace over a surface with a fine diamond point and, through electronic amplification, produce a profile graph of the surface.

Notes to the text:

¹ by stringing together rows of valve amplifying stages – соединяя последовательно ряды ламповых усилителей.

XVII. Translate the text below in writing (time limit 20 min):

Measuring a length or a distance seems now to be an easy task: one takes a pulse of light and measures the time of flight between the two end points. Indeed, there are instruments based on this technique, mainly used for surveying (industrial, construction) and military applications (range-finders). As an example, the DISTO is a hand-held distance meter, which measures indoor and outdoor distances up to 100 m with an accuracy of ± 3 mm. However, because the light travels at about 300 000 km/s, which makes 30 cm in 1 ns¹ or 3 mm in 10 ps², time of flight measurements are limited by the temporal resolution of optoelectronic detection and signal processing to the millimeter range. Therefore, other methods have to be employed to get the required resolution and accuracy for industrial measurements in the micrometer range.

Notes to the text:

¹ ns – наносекунда (10^{-9} с);

² ps – пикосекунда (10^{-12} с).

XVIII. Speak on the developments in industrial metrology during the period from the end of World War I to the present time. Use the following models if necessary:

1. I'd like to draw your attention to ... – Я хотел бы привлечь ваше внимание к...
2. I can't agree with you ... – Я не могу согласиться с вами...
3. It is considered that ... – Считается, что...
4. I am of the same opinion ... – Я того же мнения...
5. Summing it up ... – Подводя итог...

UNIT 3

TOLERANCES

I. Basic vocabulary:

workpiece – обрабатываемое изделие, деталь

tolerance – допуск

tolerance range – поле допуска

comprehensive – всесторонний; исчерпывающий

thorough – основательный, доскональный

allowance – допуск; поправка; зд.: отклонение

grade – класс; разряд; степень; зд.: качество

relative – относительный

shaft – вал

hole – отверстие

magnitude – величина

fit – посадка

transition fit – переходная посадка

axis – ось

disparity – несоответствие, неравенство, несообразность

irregularities – неровности

deviation – отклонение

waviness – волнистость

susceptible – чувствительный; поддающийся

depth – высота

character – отличительный признак; характерная особенность

wear – износ

friction – трение

durability – продолжительность службы, долговечность; прочность

to specify – точно определять

relationship – связь; отношение; соотношение

to suit – удовлетворять требованиям
cutting tools – режущие инструменты
to treat – обрабатывать
to designate – определять, обозначать
quality – качество, характеристика; класс точности,
КВАЛИТЕТ
to distinguish – распознавать; выявлять

Vocabulary Practice

II. Read and translate without a dictionary:

ideal, production, geometry, fact, specification, practice, identical, modern, class, position, figure, base, technical, limit, standard, perpendicular, profile, finish, element, function, subjective, configuration, periodic, section.

III. State what part of speech the words belong to. Translate them:

roughness, steadily, importance, essential, character, dimensional, reference, designer, frequently, measurable, judgment, simplification, resultant, preferable.

IV. Translate the following word-combinations:

corresponding hole dimensions, magnitude of the tolerance grade, possible production conditions, complete understanding of the surface geometry of workpieces, production engineering, specified surface, suitable measuring instruments, degree of accuracy, in response to functional requirements, geometrical element under investigation.

V. Translate the following pairs of synonyms:

apply – use; reason – cause; requirement – demand; characteristic – performance; principal – main; deal with – consider; major – principal; error – mistake; method – technique; cause – give rise; suit – satisfy; variable – changeable; certain –

definite; a great deal of – a lot of; accurate – precise; happen – occur, method – way.

VI. Give the nouns corresponding to the adjectives and translate them:

precise, fine, natural, accurate, rough, long, durable, skillful, original, robust.

VII. Translate the following sentences, where Participle II is used as an attribute:

1. The terms (условия) insisted upon are difficult to fulfil. 2. The method followed by us was accurate. 3. The data referred to in this paper are quite reliable. 4. 10^8 (ten to the eighth power) is a number expressed by one followed by eight zeroes. 5. Let us suppose we have an electron of mass m acted upon by a force, say f , and given thereby an acceleration, say a .

VIII. Translate the sentences paying attention to the Absolute Participle Construction:

1. Now hand micrometers made by Brown and Sharpe in the USA are in Science Museum, some of them being in metric measure. 2. The speed of light being extremely great, we cannot measure it by ordinary methods. 3. Up to 1918 there were two departments at the National Physical Laboratory, Physics and Engineering metrology being carried out in the Physics Department. 4. Besides Zeiss, Adam Hilger of London made a few optical instruments, his projects being quite widely used in industrial metrology. 5. The results of the measurement being inaccurate, physicists did not use this value. 6. There exist, of course, various kinds of light, each corresponding to some definite "color".

IX. Look through the text and find equivalents for:
производить детали с идеальной геометрической формой;
предельные размеры (допуски размеров); основные откло-

нения; величина допуска по качеству; поля допусков отверстий и валов в системе ISO; посадки с зазором, посадки с натягом и переходные посадки; допуски формы и расположения; чтобы отвечать функциональным требованиям, взаимозаменяемости и условиям производства; в пределах поля допуска; все отклонения реальной поверхности от ее идеальной геометрической формы; виды отклонений и их возможные источники; отклонения формы; волнистость; шероховатость; рассматриваемый геометрический элемент.

X. Read and translate the following text:

Text 3A

Tolerances

As it is not possible to produce geometrically ideal workpieces, dimension limits (dimensional tolerances) are defined for production. The ISO¹ Tolerance System is the most modern of published tolerance systems and is certainly the most comprehensive and thorough. It is now the basis of a truly international standard. ISO tolerance classes are indicated by letters for basic allowances and numbers for basic tolerance grades. The letters A to Z indicate the position of the tolerance range relative to the base line; small letters are used for shafts, capital ones for holes. The numbers 01 to 18 indicate the magnitude of the tolerance grade.

The ISO tolerance ranges for shafts and holes can be combined as desired to give fits, the basic hole and basic shaft systems of fits being preferable. There are 3 grades of fits: clearance fits, interference fits and transition fits.

Tolerances of form and position should be specified only where required, e.g. in response to functional requirements, interchangeability and production conditions. An element's

geometrical and positional tolerance defines the zone within which it must be located (surface, axis or generating line). Within the tolerance zone the tolerated element may have any desired form or directional orientation. The tolerance applies to the entire length or surface of the tolerated element.

The term “geometrical deviation” refers to all disparities between the actual surface and its ideal geometrical configuration. To help distinguish between the different types of geometrical deviation DIN 4760 defines a classification system including examples of deviation types and their possible sources.

Formal deviations are the 1st order geometrical irregularities susceptible to detection when an entire surface area is examined. Usually, the general relationship between formal deviation intervals and depths is $>1000:1$.

Waves or waviness, are geometrical irregularities of the 2nd order. These essentially periodic irregularities are defined using a representative section of the actual surface area on the geometrical element under investigation.

Roughness consists of geometrical irregularities of orders 3 through 5. It is characterized by periodic or irregular formal deviations in which the deviation intervals are a relatively low multiple of their depth.

Such are the different parameters of geometrical precision.

Notes to the text:

¹ ISO (International Standardization Organization) – Международная организация по стандартизации.

XI. Answer the following questions:

1. What are dimension limits defined for?
2. How are ISO tolerance classes indicated?
3. How many grades of tolerances does the system consist of?
4. What do the numbers 01 to 18 indicate?

5. What do the letters A to Z indicate?
 6. What are the different grades of fits?
 7. What fits are preferable?
 8. In what case should tolerances of form and position be specified?
 9. What does the term "geometrical deviation" refer to?
 10. What is waviness?
 11. What is roughness?
- XII. Speak about different parameters of geometrical precision.
- XIII. Read and translate the following text:

Text 3B

Surface roughness problems have, from a very modest start in the mid-thirties, attracted attention at a steadily increasing rate. Since then the surface geometry has become a field of major technical importance. A complete understanding of the surface geometry of workpieces, both the macro- and micro-geometry, is essential in mechanical as well as production engineering. It is obvious that the magnitude as well as the character of the roughness and waviness of machined parts have a great influence on the wear, friction and durability. Other quantities such as tolerances and precise fitting are also influenced by the surface geometry. These facts, which in the main refer to the function of various machined parts, will be of interest mostly to designers, who during design should devote the necessary attention to the surface geometry by specifying the requirements for the final surface on the drawings. As this is a new field, the various relationships are only clarified to a small extent and a great deal of important research work remains to be done. It is therefore frequently difficult to lay down¹ exact specifications for surfaces intended for a particular function.

In workshop practice the specification for the surface is of great importance, for only in this way can exact information be given on the finish of the final surface. Such information obviously should be given and ought to be placed on level with such data as diameter, length, tolerance, etc. A subjective judgment of a surface in modern production conditions will no longer suffice. Also for the inspection department it means considerable simplification as a subjective judgment is replaced by measurable quantities which can be expressed in figures. Additionally, surface specifications should give a hint to which method of production should be employed and to what kind of machines and cutting tools are most suitable. Finally a thoroughly specified surface will give a more exact basis for piece-work² calculations, as all production workers will know in advance to what degree the given surface should be treated as the quality will be designated by means of a figure.

Notes to the text:

¹ to lay down – устанавливать;

² piece-work – сдельная, штучная работа.

XIV. Answer the following questions:

1. Why has the surface geometry become a field of major technical importance?
2. Why is the specification for the surface of great importance in workshop practice?
3. What is a subjective judgement of a surface replaced by in modern production conditions?
4. What additional information should surface specifications give?

XV. Think of a suitable title for Text 3B.

XVI. Read the following text and comment on it:

Text 3C

Basic Measuring Systems

Machined surfaces which are of particular interest for measurements display a great variety of both macrogeometrical dimensions. The magnitude of the values which it may be necessary to record may in many cases be in the order of 0.01 mm or even smaller, i.e. they are considerably smaller than the quantities which can be measured within normal workshop accuracy, they actually approach the lower limits of possible laboratory measurement. When such minute quantities are considered, it is obvious that visual inspection or sensing by means of a finger are futile.

Thus for exact specification of a particular surface there exists a requirement for a special measuring system with many new conceptions. Such systems have been developed in a number of countries in the form of surface specification standards and endeavors are being made to lay down an international standard in this field.

Any measurement of surface data is based on the geometrical surface of the test specimen. The effective surface is then compared to the geometrical surface. Commencing with the effective surface and then analysing various deviations between this and the geometrical surface, the resultant deviations can be placed in various categories. Deviations of the first order include errors of form and are macrogeometrical. Deviations of the second order are waves (waviness), while the deviations commonly referred to as surface roughness include deviations of a third and higher order. In the measurement of surface roughness only deviations of the second and higher order (waviness and roughness) are of interest. Actually the measurement of any surface should be three-dimensional. However, the difficulties involved in making such measurements cause the various definitions to be

transformed into a two-dimensional plane, where they are easier to overlook. For this purpose the surface being investigated is cut by a plane which, unless specified, is perpendicular to the geometrical surface of the test specimen. The line of intersection between the cutting plane and the real surface is called the real profile. This profile is an imaginary one, but the closest possible approximation to it obtained by a recorder or other kind of measuring instruments can be made visual and is called the effective profile. Within a certain length of this profile, the sampling length, the surface is then investigated. This method of investigation exactly corresponds to what happens when the surface is investigated by means of a stylus¹ type instrument. For here the stylus is moved with a constant velocity in a straight line over a particular length of the real surface. The up-and-down movement of the stylus relative to a suitable datum will, when suitably magnified, then depict the deviation of the real surface from the geometrical surface within the accuracy of the instrument. In the various national standards two basic measuring systems are used, the M (mean line) system and the E (envelope) system. Up to now the M-system is used in the majority of countries and only a small number have based their standard on the E-system. Some countries have in their standards included the M- as well as the E- system and defined the various surface measures under both systems, even if they seem to prefer the one or the other.

Notes to the text:

¹ stylus — измерительный шуп.

XVII. Answer the following questions:

1. What is any measurement of surface data based on?
2. What are the various categories of deviations?

3. Are there any difficulties in making measurements of a surface?

4. What is called the real profile?

5. What is called the effective profile?

6. How does a stylus type instrument work?

7. What measuring systems are used in various national standards?

XVIII. Speak about the basic measuring systems using the following models if necessary:

1. This technique is based on... – Этот метод основан на...

2. This method permits... – Этот метод позволяет...

3. These results should be of interest to... – Эти результаты должны представлять интерес для...

4. The fact is that... – Дело в том, что...

5. Significant advantages... – Значительные преимущества...