МЕЖГОСУДАРСТВЕННОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ
ВЫСШЕГО ОБРАЗОВАНИЯ
«БЕЛОРУССКО-РОССИЙСКИЙ УНИВЕРСИТЕТ»

Кафедра «Гуманитарные дисциплины»

АНГЛИЙСКИЙ ЯЗЫК

Методические рекомендации к практическим занятиям для студентов специальности 1-54 01 02 «Методы и приборы контроля качества и диагностики состояния объектов» очной и заочной форм обучения

ЗАДАНИЯ ДЛЯ ОБУЧЕНИЯ ПРОФЕССИОНАЛЬНО ОРИЕНТИРОВАННОМУ ЧТЕНИЮ НА АНГЛИЙСКОМ ЯЗЫКЕ

Могилев 2020

УДК 804.0
ББК 812.АНГ
А64

Рекомендовано к изданию
учебно-методическим отделом
Белорусско-Российского университета

Одобрено кафедрой «Гуманитарные дисциплины» «20» октября 2020 г., протокол № 4

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Задания для обучения профессионально ориентированному чтению на английском языке для студентов специальности 1-54 01 02 «Методы и приборы контроля качества и диагностики состояния объектов» очной и заочной форм обучения предназначены для формирования и развития навыков ознакомительного, поискового и изучающего чтения у студентов данной специальности, а также их рецептивных и продуктивных лексических навыков.

Учебно-методическое издание

АНГЛИЙСКИЙ ЯЗЫК

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Подписано в печать 31.12.2020 . Формат 60×84/16. Бумага офсетная. Гарнитура Таймс. Печать трафаретная. Усл. печ. л. 1,40 . Уч.-изд. л. 1,5 . Тираж 26 экз. Заказ № 761.

Издатель и полиграфическое исполнение:
Межгосударственное образовательное учреждение высшего образования
«Белорусско-Российский университет».
Свидетельство о государственной регистрации издателя,
изготовителя, распространителя печатных изданий
№ 1/156 от 07.03.2019.
Пр-т Мира, 43, 212022, Могилев.

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Unit 1. Detection and location of defects. Development of a system of quality assurance

1. Read the text. Write out the key terms related to the topic.

Detection and location of defects is a process of evaluating the technical condition of an object and is described by the term «diagnosing».

In accordance with the safety procedures, methods of nondestructive testing and diagnostics are subdivided into ecological, medical, technogenic, defense, service-life test, etc.

According to the type, size, etc., of the object, NDT&D examination or survey may be subdivided into local, regional, federal and global levels.

In order to obtain informational data, NDT&D uses all types of physical fields and radiations, chemical interactions and processes, monitoring with the use of transportation vehicles (road, air, sea, railroad, space), observation stations (stationary, mobile), portable devices, and a great number of computer technologies for data processing.

The overall result is determination of the residual life or risk of object operation by using corresponding instructions, methods and standards.

In line with the increase of scale of scientific and technological progress, frequent natural disasters (earthquakes, tsunamis, tornados, etc.), rapid growth of ecological problems in many regions, it is a must to establish uninterrupted cooperation of methods and means to determine the condition of large industrial facilities and the environment.

Diagnosing of facilities even with approximate accuracy cannot be fulfilled without study of the main affecting factors.

The larger the scale of the event that is expected, the more complicated should be physical diagnostics with a full set of various fields and radiations in terms of the nature and principles of interactions. It is not possible to limit oneself with vibroacoustic diagnosis in earthquake prediction.

Changes in electromagnetic radiation associated with accumulation of the Earth energy, survey of distribution of heat field, water level, gas analysis and many other accompanying (preceding) phenomena and geophysical fields should be studied, registered and mutually interconnected in order to draw up an important conclusion on the validity of an apparent anomaly in the environment.

Constant and periodic drive-out monitoring of the territory with the help of stationary and mobile diagnostic stations, laboratories, space satellites, air photography and so on should accumulate statistical multifunctional material. After mathematical processing it becomes possible to make final organizational solutions on ensuring the safety of people and structures.

Diagnostics of the ecological situation of the territory should become an integral part of life and development of all enterprises operating in the region.

There must be a direct systematic connection with the diagnosis of equipment and all workplaces inside the enterprise.

2. Practice reading of the following words and translate them into Russian, consult a dictionary when necessary:

approximate accuracy, affecting factors, scale, principles of interactions, earthquake prediction, mathematical processing.

3. Complete the following sentences with the following word combinations:

direct systematic connection, mathematical processing, physical diagnostics, statistical multifunctional material, affecting factors.

1. Constant and periodic drive-out monitoring of the territory with the help of stationary and mobile diagnostic stations, laboratories, space satellites, air photography and so on should accumulate … .
2. Diagnosing of facilities even with approximate accuracy cannot be fulfilled without study of the main … .
3. After ... it becomes possible to make final organizational solutions on ensuring the safety of people and structures.
4. The larger the scale of the event that is expected, the more complicated should be ... with a full set of various fields and radiations in terms of the nature and principles of interactions.
5. There must be a ... with the diagnosis of equipment and all workplaces inside the enterprise.

4. Match the first part of the sentence on the left with the correct ending on the right:

1. There must be a direct systematic connection with the diagnosis of equipment and ...	1. ... an integral part of life and development of all enterprises operating in the region.
2. Diagnostics of the ecological situation of the territory should become ...	2. ... cannot be fulfilled without study of the main affecting factors.
3. After mathematical processing it becomes possible ...	3. ... the more complicated should be physical diagnostics.
4. Diagnosing of facilities even with approximate accuracy ...	4. ... to make final organizational solutions on ensuring the safety of people and structures.
5. The larger the scale of the event that is expected ...	5. ... all workplaces inside the enterprise.

5. Agree or disagree with the following statements.

1. The larger the scale of the event that is expected, the more complicated should be physical diagnostics.
2. Constant and periodic drive-out monitoring of the territory with the help of stationary stations should accumulate statistical multifunctional material.

3. After mathematical processing it becomes possible to make final organizational solutions on ensuring the safety of people and structures.

4. Diagnostics of the ecological situation of the territory should become an integral part of life and development of all enterprises operating in the region.

5. There mustn't be a direct systematic connection with the diagnosis of equipment and all workplaces inside the enterprise.

6. Work in pairs. Take turns to ask as many questions to the text as possible and answer them. Use the following questions as models.

1. Can diagnosing of facilities even with approximate accuracy be fulfilled without study of the main affecting factors?

2. Is it possible to limit oneself with vibroacoustic diagnosis in earthquake prediction?

7. Discuss with your friend the ways of subdivision of methods of nondestructive testing and diagnostics.

Unit 2. Industrial radiography methods

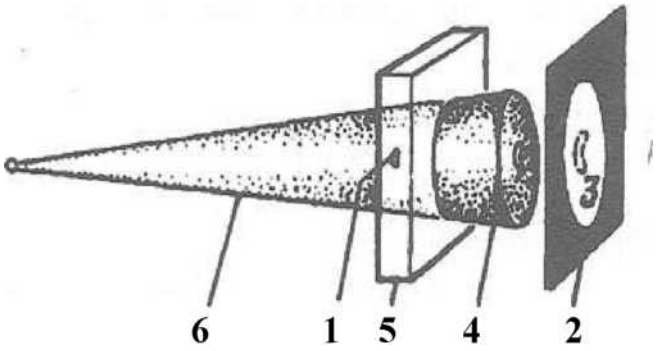
1. Read the text. Write out the key terms related to the topic.

The radioscopic method (radiation introscopy method) of nondestructive testing is based on converting the of radiation image of the object under test into a light image on the output screen of the radiation- optical converter, the defectoscopic analysis being performed in the process of testing.

By preserving such advantages of radiographic methods as the possibility of determining the character and shape of the defect, radioscopic methods make it possible to survey the object under test directly, at the moment of radiation. Therefore, the time between the beginning of testing and the moment of making a conclusion on the quality of the controlled object is reduced.

Thanks to the low response time of radioscopic systems, the object may be studied at various angles to the direction of radiation transmission. Simultaneously, the possibility of defect detecting is increased as well as the possibility of monitoring parts and assemblies in operation. Besides, many possibilities are opened.

This figure shows how principles of stereometry are employed (figure 1).



1 – defect; 2 – radiation converter; 3 – image of defect on the image converter; 4 – radiation image; 5 – object; 6 – radiation beam

Figure 1 – General Layout of X-Ray Imaging System

Table 1 presents several existing and potentially possible cases of using radiation introscopes in nondestructive testing.

Table 1

Application of device	Purpose of application
X-radiation and y-radiation	
Quality control of materials and items	Detection of defects in ingots, castings, welded and soldered joints
	Detection of defects associated with violation of integrity or positional relationship of parts in assemblies, mechanisms or appliances
Control of operation of assemblies and mechanisms	Survey of operation quality. Analysis of operation of mechanisms in case of vibration loading
Baggage and posting control	Revealing of illicit contents
Food control	Revealing of foreign substances
Study of art works, documents	Authentication. Study during restoration process
Scientific research	Registration of fast processes. Registration of physical phenomena in non-transparent media
Determination of quality of seed grain	Registration of distribution of seeds in sowing, quality of seeds
Neutron radiation	
Quality control of materials and items	Detection of defects in light materials located in massive items of heavy metals (lead, uranium, etc). Detection of defects in metal items of great thickness
Scientific research	Observation of motion of liquid hydrogen, lithium or boron containing materials through the walls of pipelines of heavy metals

Modern radiation introscopes are complicated devices allowing us to obtain information on the intrinsic structure of materials and objects and showing this information on the output screen of the radiation-optical converter in the form of light-shadow pictures.

2. Find the following words and word combinations in the text and the table:

превращатъ/конвертироватъ, время ответной реакции, деталь, сборка, продукт, запрещенное содержимое, установление подлинности

3. Give Russian equivalents to the following terms:

welded joint, soldered joint, ingot, foreign substances, casting, nontransparent media, seeds, intrinsic structure.

4. Choose the right variants to finish the sentences.

1. The radioscopic method of nondestructive testing is based on ...
   a) converting a light image into a radiation image;
   b) converting a radiation image into a light image;
   c) the defectoscopic analysis.

2. Radioscopic methods make it possible to survey the objects under test ...
   a) indirectly;
   b) directly;
   c) at the moment of radiation.

3. The time between the beginning of testing and the moment of making a conclusion … .
   a) is increased;
   b) is reduced;
   c) is not significant.

4. The object may be studied at …
   a) different angles to the direction of radiation transmission;
   b) one angle to the direction of radiation transmission;
   c) 90° to the direction of radiation transmission.

5. The possibility of defects detecting is …
   a) reduced;
   b) increased;
   c) increased as well as the possibility of monitoring parts and assemblies in operation.

5. Study figure l carefully. Describe the general layout of X-ray imaging system.

6. Read and translate Table 1. Consult a dictionary if necessary.

7. Write nine sentences giving the summary of industrial radiography methods application. Discuss it with your friend.

Model: 1. Industrial radiography methods are used in quality control of materials and items for detection of defects in ingots, castings, welded and soldered joints.

Unit 3. Parameters of testing facilities

1. Read the text. Write out the key terms related to the topic.

All radiometric flaw detectors and thickness meters are devices in which the radiation beam changes by action of the quantity to be measured and then gets into the radiation detector; the beam is an aggregate of interconnected elements.

The main elements of any radiometric device are: radiation source; radiation receptor (detector); registration device (electronic circuit) which registers or amplifies the detector signal; and a secondary device. Used as radiation detectors are ionization chambers, gas and scintillation counters, and semiconductor detectors. The power of detector signals is small and therefore corresponding amplifier equipment is used to amplify these signals.

Depending on the type of signals picked up from detectors, registration devices are subdivided into analog and discrete devices.

With the current mode, a certain averaged analog signal is used, appearing at the output of the detector when a great amount of nuclear particles or photons get into it.

Thus, classified as analog registration devices are DC amplifiers, for instance, amplifiers of signal in the ionization chamber or voltage of the integrating circuit.

With pulse mode, separate signals are used, separated in time and appearing at the output of the detector each time a nuclear particle or photon gets into it. Therefore, a discrete registration device usually consists of a counter that ensures the counting of pulses within a definite time interval.

From the registration device the signal is fed to the secondary device (measuring, recording, registering), the readings of which are proportional to the radiation intensity as detected by the detector. Secondary devices, as a rule, are chosen from general-purpose industrial products.

The main parameters of flaw detectors and thickness meters are sensitivity, productivity, accuracy of determination of defect dimensions, resolution, and stability of operation. Dimensions of collimator slit, measurement time, energy and activity of source are design parameters. The material and thickness of the item are usually predetermined.

2. Try to guess the meanings of the following word combinations. Use the dictionary in case you need it:

radiometric flaw detectors, radiation beam, radiation receptor, ionization chambers, analog and discrete devices, general-purpose.

3. Rearrange the letters in the brackets to complete the following sentences.

1. The (MAEB) is an aggregate of interconnected elements.
2. Used as radiation detectors are ionization chambers, gas and scintillation counters, and (MISECONTORDUC) detectors.
3. The power of detector signals is small and therefore corresponding (AMFIERPLI) equipment is used to amplify these signals.
4. A discrete registration device usually consists of a (COURETN) that ensures the counting of pulses within a definite time interval.
5. Secondary devices, as a rule, are chosen from (GERALEN- PURSEOP) industrial products.

4. Work in pairs and decide if these sentences are true or false:

1. The power of detector signals is big and therefore corresponding amplifier equipment is used to amplify these signals.
2. With the current mode, a certain averaged analog signal is used, appearing at the output of the detector when a great amount of nuclear particles or photons get into it.
3. All radiometric flaw detectors and thickness meters are devices in which the radiation beam changes by action of the quantity to be measured.
4. Thus, classified as analog registration devices are DC amplifiers, for instance, amplifiers of signal in the ionization chamber or resistance of the integrating circuit.
5. Dimensions of collimator slit, measurement time, energy and activity of source are design parameters.

5. Make your own sentences with the following words:

registration devices, radiation source, secondary device, definite time interval, collimator.

6. Discuss the following questions with a partner.

1. What are the main elements of any radiometric device?
2. For what purpose is corresponding amplifier equipment used?
3. Registration devices are subdivided into analog and discrete devices, aren't they?
4. Are sensitivity, productivity, accuracy of determination of defect dimensions, resolution, and stability of operation the main parameters of flaw detectors?
5. Where is the signal from the registration device fed to?

Unit 4. RADIATION MONITORING

1. Read the text. Write out the key terms related to the topic.

Radiation monitoring of objects of natural environment (soil, atmospheric air and surface waters) is carried out by measuring the dose rate of g-radiation, selection of samples and measurement of total beta activity of atmospheric precipitates and water in main water bodies, and measurement of concentrations of radioactive aerosols in the bottom layers of the atmosphere. This monitoring should have a regular character and perform tasks of early warning in case of nuclear emergencies.

Measurements performed under this type of testing are referred to as monitoring types of measurements and are conducted at stationary posts and weather stations. Radiation monitoring of agricultural soils, plant cultivation products, forage and fertilizers is also performed.

The radiation monitoring of objects is executed according to corresponding techniques:

1. Measurement of values by definite methods and measurement means;
2. Sampling;
3. Preparation of counting samples.

A dosimeter is a device or installation for the measurement of ionizing radiations. It is designed for obtaining measurement information on the exposure rate of photon radiation and/or energy transferred by the ionizing radiation or transmitted to the object located in the field of radiation.

Dosimeters are the most widely used devices in radiation monitoring, since they make it possible to quickly and accurately obtain information on the hazards of a definite object to human health.

A radiometer is a device or installation for the measurement of ionizing radiations. It is designed for obtaining measurement information on the activity of a radionuclide in the source or sample, derivative values, and flux density and/or fluency (transfer) of ionizing particles.

Portable flux radiometers are used mainly for indication of presence of radioactive pollution on various objects and surfaces or for determination of correspondence of surface to the norms of contamination.

Alpha radiometers are widely used, employing a scintillation detector on the basis of ZnS or CaF.

Activity radiometers are used for performing tasks of measurement of specific, volumetric and total activities. Activity radiometers are subdivided into gamma, beta and alpha radiometers.

A spectrometer is a device or installation for the measurement of ionizing radiations. It is designed to obtain information on the distribution of ionizing radiation as per one or more parameters characterizing sources and fields of ionizing radiations.

The radiochemical method of analysis of samples of the environment consists of the following stages:

1. Obtaining initial solution;
2. Separation of the radionuclide to be studied from the mass of

macrocomponents and disturbing radiators;

3. Final purification of the radionuclide to be studied;

4. Quantitative measurements of radioactive radiation.

One of most the important methods of radioactive pollution diagnostics is the gamma spectrometry method.

2. Find the sentences with following words and word combinations in the text. Translate them into Russian.

измерять, нижние слои атмосферы, установка, распределение, получать, первоначальный результат, очищение.

3. Complete the sentences with the word combinations given above:

portable flux radiometers, gamma spectrometry method, monitoring types of measurements, scintillation detector, exposure rate of photon radiation.

1. Measurements performed under this type of testing are referred to as ... and are conducted at stationary posts and weather stations.
2. A radiometer is designed for obtaining measurement information on the ... and/or energy transferred by the ionizing radiation or transmitted to the object located in the field of radiation.
3. ... are used mainly for indication of presence of radioactive pollution on various objects and surfaces or for determination of correspondence of surface to the norms of contamination.
4. Alpha radiometers are widely used, employing a ... on the basis of ZnS or CaF.
5. One of most the important methods of radioactive pollution diagnostics is the ... .

4. Match the following words and word combinations with their definitions.

A dosimeter is ...	...a device or installation for the measurement of ionizing radiations. It is designed to obtain information on the distribution of ionizing radiation as per one or more parameters characterizing sources and fields of ionizing radiations.
A radiometer is ...	... used for performing tasks of measurement of specific, volumetric and total activities.
A spectrometer is ...	...a device or installation for the measurement of ionizing radiations. It is designed for obtaining measurement information on the activity of a radionuclide in the source or sample, derivative values, and flux density and/or fluence (transfer) of ionizing particles.
An activity radiometer is ...	. . . a device or installation for the measurement of ionizing radiations. It is designed for obtaining measurement information on the exposure rate of photon radiation and/or energy transferred by the ionizing radiation or transmitted to the object located in the field of radiation.

5. Work in pairs and decide if these sentences are true or false. Correct the false ones.

1. Dosimeters are the most widely used devices in earthquake prediction.
2. Portable flux radiometers are used mainly for indication of presence of radioactive pollution on various objects and surfaces.
3. Radiation monitoring should have a regular character and perform tasks of early warning in case of nuclear emergencies.
4. The radiation monitoring of objects is executed according to corresponding techniques:

– measurement of values by definite methods and without measurement means;

– sampling;

– preparation of counting samples.

5. Activity radiometers are subdivided into gamma, beta and delta radiometers.

6. Complete the following sentences. Use them to make a summary of the text.

1. Radiation monitoring of objects of natural environment (soil, atmospheric air and surface waters) is carried out by ... .
2. The radiation monitoring of objects is executed according to corresponding techniques . . . .
3. The radiochemical method of analysis of samples of the environment consists of the following stages . . . .
4. Measurements performed under this type of testing are referred to as ... .
5. One of most the important methods of radioactive pollution diagnostics is ... .

7. Discuss the following statements.

1. What are basic devices or installations for the measurement of ionizing radiations?
2. What are fundamental functional characteristics of installations for the measurement of ionizing radiations?

Unit 5. Radiation detectors and image converters

1. Read the text. Write out the key terms related to the topic.

A radiation detector (RD) is an important part of any optical testing instrument. Radiation detectors are usually subdivided into the following main groups: single-element and array (as per geometric features), and quantum and heat. Quantum photoelectric detectors have found the widest application in optical nondestructive testing. They are characterized by selectivity of spectral sensitivity (photodiodes, photoresistors, photoelectric multipliers, CCD arrays). Heat radiation detectors (bolometers, pyrovidicons) have a wide spectrum sensitivity range. They are used mainly in devices with infrared radiation.

Signal processing systems in radiation detectors are analogous to the circuits used in the traditional optoelectronic apparatus. It is worth noting that in optical nondestructive testing systems it is often necessary to use logarithmic amplifiers (for optical absorption thickness gaging, concentration metering, etc.).
Photodiodes, particularly silicon photodiodes, possess good linear light characteristics in the range of 6 - 8 orders, are resistant to flare, and have high sensitivity and high speed of operation (up to 10^6 Hz). The size of the receiving area is from 1 to 10 mm. Photodiodes are produced for various spectrum sensitivities. Multi-element and position-sensitive photodiodes have been developed.

2. Study the following words and translate them into Russian:

quantum photoelectric detectors, spectral sensitivity, photodiodes, photoresistors, photoelectric multipliers, logarithmic amplifiers, concentration metering.

3. Match the first part of the sentence on the left with the correct ending on the right.

1. Quantum photoelectric detectors have found the widest application in ...	1. ... the circuits used in the traditional optoelectronic apparatus.
2. Signal processing systems in radiation detectors are analogous to the circuits used in the traditional optoelectronic apparatus ...	2. ... high sensitivity and high speed of operation (up to 10^6 Hz).
3. A radiation detector (RD) is an important part of ...	3. ... from 1 to 10 mm.
4. Photodiodes, particularly silicon photodiodes, possess good linear light characteristics in the range of 6 - 8 orders, are resistant to flare, and have	4. ... any optical testing instrument.
5. The size of the receiving area is ...	5. ... optical nondestructive testing.

3. **Complete the sentences with the following word combinations:**

quantum photoelectric detectors, logarithmic amplifiers, spectrum sensitivities, optical testing instrument, linear light characteristics.

1. A radiation detector (RD) is an important part of any ... .
2. In optical nondestructive testing systems it is often necessary to use ... (for optical absorption thickness gaging, concentration metering, etc.).
3. ... are characterized by selectivity of spectral sensitivity (photodiodes, photoresistors, photoelectric multipliers, CCD arrays).
4. Photodiodes, particularly silicon photodiodes, possess good ... in the range of 6-8 orders, are resistant to flare, and have high sensitivity and high speed of operation (up to 10^6 Hz).
5. Photodiodes are produced for various … .

5. Work in pairs and decide if these sentences are true or false. Correct the false ones:

1. Radiation detectors are usually subdivided into the following main groups: single-element and array (as per geometric features), and quantum and heat.
2. Quantum photoelectric detectors have found the widest application in optical destructive testing.
3. Heat radiation detectors (bolometers, pyrovidicons) are used mainly in devices with ultraviolet radiation.
4. Signal processing systems in radiation detectors are analogous to the circuits used in the traditional optoelectronic apparatus.
5. Photodiodes are produced for various spectrum sensitivities.

6. Work in pairs. Take turns to ask as many questions to the text as possible and answer them. Use the following questions as models:

1. Are radiation detectors usually subdivided into single-element and array (as per geometric features), and quantum and heat?
2. Are photodiodes are produced for various spectrum sensitivities?

Unit 6. Size control devices

1. Read the text. Write out the key terms related to the topic.

Visual and optical devices. A simple and convenient means of size control are laid-on (contact) measuring magnifiers. They consist of a glass flat scale (usually 15 mm long with scale-division value of 0,1 mm) laid on the object and viewed through the eyepiece lens with magnification 10^x.

Measuring microscopes (including portable laid-on types) contain a set of measuring scales located in the microscope objective image plane and allowing the checking of linear dimensions of parts, radii, tool angles, etc. The field of view of such microscopes is usually 1-20 mm. Many measuring microscopes are equipped with devices for precision displacement of items in the object plane of the microscope objective lens with the possibility of coordinate reading. This expands the range of measurement by preserving high accuracy (range of displacement is 50-200 mm, error reading up to 1 mm). Magnification and, correspondingly, depth of sharpness of microscopes are chosen depending on the shape of the items. Many models of modem microscopes are equipped with devices for measuring vertical displacement of the microscope objective lens, i.e ensure three-dimensional measurement of objects.

Projectors are used for various items testing: tools, threaded parts, toothed wheels, machine-printing stones, objects of complicated shape (forinstance, turbine blades), as well as items of fragile and easily deformable materials, etc.

There are two main methods of design in reflected and transmitted rays (epiprojections and diaprojections).

Sources of light in projectors are usually halogen lamps with power from 100 to 500 W cooled by air ventilation. The optical system, as a rule contains a heat filter to eliminate the effect from powerful heat radiation from these sources.

Most projectors have measuring functions. Measurements are performed when comparing the image of the test object with its drawing or template made to the

projection scale and fixed to the screen, or by displacing the object table with microscrews to match the image of the contours of the part with the markings on the screen. The size of the part is determined as the difference of the corresponding readings of the microscrews.

Many measuring projectors have photoelectric or magnetic sensors permitting the registration of displacements of the table on the digital indicator annunciator with accuracy of up to 0,001 mm. With the help of some projectors it is possible to determine polar coordinates of defects.

2. Try to guess meanings of the following word combinations. Use the dictionary in case you need it:

measuring scales, linear dimensions, precision displacement of items, high accuracy, template, projection scale.

3. Complete the sentences with the following word combinations:

depth of sharpness, projection scale, a set of measuring scales, powerful heat radiation.

1. Measuring microscopes (including portable laid-on types) contain ... located in the microscope objective image plane.
2. Magnification and, correspondingly, ... of microscopes are chosen depending on the shape of the items.
3. The optical system, as a rule contains a heat filter to eliminate the effect from ... from these sources.
4. Measurements are performed when comparing the image of the test object with its drawing or template made to the ... and fixed to the screen.

4. Match the first part of the sentence on the left with the correct ending on the right.

1. Many measuring microscopes are equipped with ...	1. ... devices for measuring vertical displacement of the microscope objective lens, i. e. ensure three- dimensional measurement of objects.
2. Many models of modern microscopes are equipped with ...	2. ... photoelectric or magnetic sensors permitting the registration of displacements of the table on the digital indicator annunciator with accuracy of up to 0.001 mm.
3. Sources of light in projectors are ...	3. ... devices for precision displacement of items in the object plane of the microscope objective lens with the possibility of coordinate reading.
4. Many measuring projectors have ...	4. ... to determine polar coordinates of defects.
5. With the help of some projectors it is possible ...	5. ... usually halogen lamps with power from 100 to 500 W cooled by air ventilation.

5. Work in pairs. Take turns to ask as many questions to the text as possible and answer them. Use the following questions as models:

1. What do measuring microscopes contain?

2. Sources of light in projectors are usually halogen lamps with power from 100 to 500 W cooled by air ventilation, aren't they?

Unit 7. Devices for holographic testing

1. Read the text. Write out the key words related to the topic.

The high coherence and monochromaticity of laser radiation make it possible to record a volumetric image (hologram) of any object.

The hologram is obtained as a result of the interference between two portions of monochromatic flux of optical laser radiation: one portion is dispersed by the test object and the other portion (reference beam) is directly passing to the photographic plate, bypassing the object. The hologram contains all the required information on the object. In order to restore the image recorded on the photographic plate, the hologram is illuminated only by the reference beam. As a result, two volumetric images of the object appear visible: real and virtual.

Holographic defectoscopy setups for holography in opposing beams and focused-image holograms (FIH) are widely used.

Holograms obtained with these setups possess high selective properties with respect to the wavelength of the restoring radiation and enable the observation of the object image in the rays of a source with a continuous radiation spectrum (sun, filament lamp).

Holography of phase objects is particularly convenient with the use of disperser (diffusers) installed before or after the objective lens (as per the light path). During restoration visibility losses of the holographic fringe pattern are avoided in a large area of the hologram.

It should be noted that one unique feature of the holographic method is the possibility of obtaining image of objects behind turbid media, for instance milk glass, due to the following spatial filtration of the image that masks the object.

Most applications of holography in nondestructive testing are related to registration of phase distortions introduced by the object into the signal beam due to either local changes of the refraction coefficient in transparent objects or reflection from the test object surface topography.

2. Match the following English terms with their Russian equivalents.

1	coherence	a) рассеиватель/диффузор
2	monochromatic flux	b) объемное изображение
3	to restore the image	c) мутная среда
4	wavelength	d) освещать
5	filament lamp	e) прозрачный предмет
6	disperser/diffuser	f) голографическая установка
7	objective lens	g) пространственная фильтрация
8	holographic fringe pattern	h) восстанавливать образ
9	turbid media	i) длина волны
10	spatial filtration	j) голографическое окаймленное изображение
11	transparent object	к) линза объектива
12	volumetric image	1) монохроматический одноцветный поток
13	to illuminate	т) связь, согласованность
14	holographic setup	п) лампа накаливания
15	distortion	о) искажение, искривление

3. Use the words from task 1 to fill in the gaps in the following sentences.

1. Holograms possess high selective properties with respect to the … .
2. One feature of the holographic method is the possibility of obtaining image of objects behind … .
3. Holography of phase objects is convenient with the use of ... / ... installed before or after the ... .
4. Most applications of holography testing are related to registration of phase ... .
5. The refraction coefficient changes in ... .

4. Work in pairs. Discuss with your partner whether the following statements are true or false.

1. The high coherence and monochromaticity of laser radiation make it impossible to record a volumetric image (hologram) of any object.
2. The hologram is obtained as a result of the dispersion between two portions of monochromatic flux of optical laser radiation.
3. The hologram contains all the required information on the object.
4. Holograms enable the observation of the object image in the rays of a source.
5. Dispersers (diffusers) are installed close to the objective lens.

5. Answer the following questions.

1. How is the hologram obtained?
2. Why is the hologram illuminated?
3. What holographic setups are used in defectoscopy?
4. Why is holography of phase objects particularly convenient?

5. What are most applications of holography in nondestructive testing related to?

6. Use your answers to give a short summary of the text.

Unit 8. Quality control process line for products of metallurgical works

Part I

1. Read the text. Write out the key terms related to the topic.

Item quality complex nondestructive testing process lines are used in automated production. The peculiarity of design and use of these lines is in the combination of various physical methods for simultaneously measuring several item quality characteristics during their production using full automated testing and sorting out processes. When such lines are designed as per one-type projects, maintenance of the system is made much easier, the production area at processing stations is reduced, and it becomes possible to change to automatic control of technological processes by evaluating the results of item quality control.

Specialized lines are developed for complex quality testing of hot rolled pipes in pipe mill 30-102. Pipe diameter is 30-102 mm; wall thickness is 3-8 mm; material is steel 10, 20, 35, 45; testing velocity is 3 m/s.

The complex of nondestructive testing means comprises an equipment portion, auxiliary devices, and has both mechanization and automation capabilities. The equipment part of the complex includes a device that determines the steel grade, two devices for measuring the outside diameter of the item, an electro-magneto-acoustical meter for measuring the wall thickness, a detector for detecting defects of the discontinuity type, a counter of the number of pipes and a total pipe length meter.

Operation of the devices that sort out pipes is based on the registration of changes in the electromagnetic field caused by redistribution of eddy currents in the test object depending on the chemical composition of the material: steel grade check is performed with an integral method by an eddy current transducer that compares the magnetic and electric properties of the reference standard specimen and the tested item.

Testing of the outer diameter of pipes is conducted with photo pulse devices in two mutually perpendicular planes. The optical system makes a shadow image of the pipe, the size of which is determined with the help of a slit diaphragm scanning system and a photomultiplier.

Defects of the discontinuity type are determined by a magnetic method.

2. Make word combinations and translate them.

1	metallurgical	a) area
2	nondestructive testing	b) of the material
3	item quality	c) grade
4	sorting out	d) works
5	production	e) devices
6	evaluating	f) of discontinuity type
7	auxiliary	g) transducer
8	steel	h) planes
9	outside	i) process
10	defects	j) of the reference standard specimen
11	redistribution of	k) process
12	chemical composition	1) pipe
13	eddy current	m) the results
14	perpendicular	n) diameter
15	shadow image of the	o) characteristics
16	magnetic and electric properties	p) eddy currents

3. Fill in the gaps using the words from the box.

maintenance, electro-magneto-acoustical meter, steel grade, hot rolled pipes, counter, eddy currents, automated production, meter, electromagnetic field

1. Item quality complex nondestructive testing process lines are used in ... .
2. ... of the system is made much easier.
3. Specialized lines are developed for complex quality testing of ... .
4. The equipment part includes a device that determines the ... , an ... for measuring the wall thickness, a ... of the number of pipes and a total pipe length ….
5. Operation is based on the registration of changes in the ... caused by redistribution of ... .

4. Discuss with a partner.

1. What are the advantages of nondestructive testing process lines?
2. For what purposes are specialized lines developed?
3. What does the complex of nondestructive testing means comprise?
4. What is operation of the devices based on?
5. How is testing of the outer diameter of pipes conducted?

5. Use your answers to make a short summary of the text.

6. Say what particular operation of a nondestructive testing process line you would like to deal with. Give your reasons.

Unit 9. Quality control process line for products of metallurgical works.

Part II

1. Read the text. Write out the key terms related to the topic.

Piping length is measured by counting the number of pulses from the photoimpulsator connected with the measuring magnetic roller, which is attracted to the pipe under the action of the magnetic field created by the special winding. As a result of rotation, the photoimpulsator produces pulses (one pulse per 10 m of pipe length). The electronic switch starts passing the count pulses only after the pipe blocks the two photorelays installed at a base distance equal to 3 m and the constant part of the length base is recorded. Thanks to registration of the base distance, the accuracy of measurement is increased and errors due to roller slippage, change of pipe movement velocity, etc., are eliminated.

Counting stops when the rear end of the pipe opens the first photorelay.

Auxiliary equipment includes marking devices and pipe tracking and sorting out systems.

The pipe tracking and sorting out system is designed to keep track of rejected pipes as per the results of quality control, to track these pipes to the stowage place and to generate commands required for sorting the pipes according to the types of defects. The system ensures automatic sorting out of pipes into four groups: one is the acceptance group, and three groups are divided according to the types of defects.

Pipes made of steel of unspecified grade, independent of other parameters, are segregated from others into the first reject cradle or bin. Pipes with inadmissible linear dimensions in diameter and wall thickness are collected into the second reject bin. Pipes with defects on the outer and inner surfaces are piled into the third reject bin. Information on pipe defects is automatically introduced into the tracking system by closing relay contacts of the corresponding testing devices. It is also possible to introduce the information manually from the operator’s panel at the moment when the pipe passes the corresponding testing device.

Signal passage and serviceability of the system transducers are checked with the help of a symbolic circuit and signal lamps located on the front panel of the control unit.

The marking devices are designed for marking defect positions on pipes with the help of paint or ink. Marking is performed with paint ejected by the spray gun under action of compressed air furnished via air ducts upon operation of the valve by the signal produced by the devices.

2. Match the following words and word combinations with their Russian equivalents.

1	to attract	a) устранять
2	winding	b) приём(ка)
3	slippage	c) обмотка
4	to eliminate	d) складывать, штабелировать
5	rejected pipes	e) люлька для бракованных труб
6	stowage	f) эксплуатационная надёжность
7	acceptance	g) скольжение
8	reject cradle (or bin)	h) недопустимые размеры
9	inadmissible dimensions	i) бракованные трубы
10	to pile	j) притягивать
11	serviceability	k) воздушный канал, воздуховод
12	air duct	1) складирование, укладка, погрузка

3.Use the terms from Task 1 to fill in the gaps in the following sentences.

1. The pipe tracking system is designed to keep track of ... .
2. Pipes made of steel of unspecified grade are segregated from others into the first … .
3. Pipes with defects on the outer and inner surfaces are ... into the third reject bin.
4. ... of the system transducers is checked with the help of a symbolic circuit and signal lamps.
5. Pipe length is measured by means of a magnetic roller which is ... to the pipe.

4. Arrange the sentences from Task 2 into the right order to make a plan of the text.

5. Work in pairs. Ask your friend for more information about nondestructive testing.

1. **how** piping length is measured.
2. **what** auxiliary equipment includes.
3. **for what purpose** the pipe tracking and sorting out system is designed.
4. **how** the pipes are grouped.
5. **whether** marking is performed manually or automatically.

6. Describe the following production processes in minigroups.

1. Pipe measuring.
2. Pipe tracking and sorting out system.
3. Collecting rejected pipes.
4. Possibilities of introducing information on pipe defects.
5. Marking and marking devices.

7. You are a chief engineer at a quality control process line for products of metallurgical works. Organize a team of engineers out of your friends, share responsibilities and let them discuss their particular production process.

Unit 10. Destructive testing

1. Read the text. Write out the key words related to the topic.

In destructive testing, or (Destructive Physical Analysis DPA) tests are carried out to the specimen's failure, in order to understand a specimen's structural performance or material behavior under different loads. These tests are generally much easier to carry out, yield more information, and are easier to interpret than nondestructive testing. Destructive testing is most suitable, and economic, for objects which will be mass-produced, as the cost of destroying a small number of specimens is negligible. It is usually not economical to do destructive testing where only one or very few items are to be produced (for example, in the case of a building).

Analyzing and documenting the destructive failure mode is often accomplished using a high-speed camera recording continuously (movie-loop) until the failure is detected. Detecting the failure can be accomplished using a sound detector or stress gauge which produces a signal to trigger the high-speed camera. These high-speed cameras have advanced recording modes to capture almost any type of destructive failure.

After the failure the high-speed camera will stop recording. The capture images can be played back in slow motion showing precisely what happen before, during and after the destructive event, image by image.

Some types of destructive testing:

Stress tests. Stress is physical pressure put on something that can make it change its shape or break.

Crash tests. Crash is an accident that happens when a moving vehicle hits something, causing damage e.g. a plane/car/train crash.

Hardness tests. Hardness is a measure of how resistant solid matter is to various kinds of permanent shape change when a compressive force is applied. Some materials, such as metal, are harder than others. Macroscopic hardness is generally characterized by strong intermolecular bonds, but the behavior of solid materials under force is complex; therefore, there are different measurements of hardness: *scratch hardness*, *indentation hardness*, and *rebound hardness.*

Metallographic tests. Metallography is research and control of metallic materials.

2. Guess the meaning of the following terms from the contents of the text.

destructive testing, specimen's failure, yield information, cost of destroying, economical, advanced recording modes.

3. Use the terms from Task 1 to fill in the gaps in the following sentences.

1. In ... tests are carried out to the ..., in order to understand a specimen's structural performance or material behavior under different loads.

2. These tests are generally much easier to carry out, ... more ..., and are easier to interpret than nondestructive testing.

3. It is usually not ... to do destructive testing where only one or very few items are to be produced.

4. The ... of a small number of specimens is negligible.

5. The high-speed cameras have ... to capture almost any type of destructive failure.

4. Are the sentences from Task 2 arranged in the right order? Discuss it with your friends. Rearrange them if necessary.

5. Work in minigroups. Find in the Internet a video showing a crash test. Make a presentation and discuss it with y o u r friends.

6. Give your reasons to prove that destructive testing is more economical than nondestructive testing.

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