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АГРАРНЫЙ УНИВЕРСИТЕТ

Факультет экономики и управления

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Учебно-методическое пособие для бакалавров, магистрантов и аспирантов

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Учебно-методическое пособие предназначено для аудиторной и самостоятельной работы с учебным материалом профессиональной направленности на английском языке. Разделы пособия содержат текстовый материал профессионально-ориентированного характера. Издание призвано помочь студентам сформировать необходимые знания, умения и навыки: умение читать и анализировать тексты на английском языке с целью не только извлечения информации, но и приобретения навыков устной и письменной специализированной коммуникации. Учебный материал пособия может быть использован для самостоятельной работы студентов и в качестве заданий для промежуточной и итоговой аттестации по дисциплинам блока «Иностранный язык (английский)».

Пособие может быть использовано в качестве основной или дополнительной литературы для всего набора дисциплин блока «Иностранный язык» инженерных направлений подготовки бакалавриата, специалитета, магистратуры, аспирантуры очной и заочной форм обучения.

Утверждено и рекомендовано к изданию методическим советом Инженерного института (протокол №6 от 30 января 2024 г.).

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ПОЯСНИТЕЛЬНАЯ ЗАПИСКА

Данное учебное пособие предназначено, прежде всего, для бакалавров и магистрантов таких направлений подготовки Инженерного института, как «Агроинженерия» (профили: «Электрооборудование и электротехнологии», «Технические системы в агробизнесе») и «Эксплуатация транспортно-технологических машин и комплексов». Пособие может быть использовано в качестве дополнительной учебной литературы по всем направлениям подготовки Инженерного института очной и заочной форм обучения.

Пособие рассчитано на 60-70 уч. часов аудиторных занятий и 100-120 часов самостоятельной работы, что соответствует базовым стандартам ФГОС. Издание может быть использовано в научно-исследовательской работе магистрантов и при подготовке к сдаче кандидатского экзамена по английскому языку.

В основных разделах пособия представлены:

1) работа с текстовым материалом профессиональной направленности;

2) работа с текстовым материалом делового характера;

3) банк текстов профессиональной направленности для изучающего, ознакомительного чтения, подготовки презентаций, рефератов и научных докладов;

4) рекомендации и справочный материал для эффективной подготовки профессиональной и научной презентации;

5) методические указания по организации самостоятельной работы.

Раздел «Работа с текстовым материалом профессиональной направленности» представлен в 9 учебно-тематических блоках (Units), которые соответствуют уровню языковой подготовки A2-B1. Учебный блок открывается обширным тематическим вокабуляром и заданиями на его освоение. Текст для изучающего чтения каждого блока максимально насыщен профессиональной лексикой и представляет собой современный контент, отражающий специфику определённой инженерной отрасли. Текст для изучающего чтения сопровождается послетекстовыми заданиями на понимание содержания и закрепление специальной лексики (Comprehension Check). Завершающая часть блока – это упражнение на устную практику по тематике юнита в форме профессионального диалога (Speaking Practice). В каждом из блоков предусмотрены задания на самостоятельную работу – упражнения, ориентирующее студента на аналитическую работу с профессиональной лексикой, на поиск дополнительного материала в интернете и создание презентаций на его основе.

Раздел «Работа с текстовым материалом делового характера» содержит учебный материал по деловому английскому языку, который представлен в 4 учебно-тематических блоках и подборке текстов делового характера для перевода и работы со специальной лексикой. Цель раздела – обучить основам делового общения в устной и письменной формах. Тематика блоков определяется ситуацией устройства на работу, которая требует правильного заполнения типовых письменных форм и подготовки к устному собеседованию.

Раздел пособия «Банк текстов профессиональной направленности» представляет собой обширную подборку аутентичных текстов профессиональной тематики. Текстовый банк делится на три тематические части: 1) Electrical Engineering (21 текст), 2) Auto Electronics (16 текстов), 3) Auto Electrics (27 текстов). Представленная в пособии тематическая подборка Electrical Engineering – это современный профессиональный контент, связанный с работой инженера-электрика, специалиста в области электричества, электротехники, электромонтёра, электромеханика, электромонтажника.

Вторая и третья подборки – Auto Electronic, Auto Electrics позволяют подробно изучить довольно обширный пласт специальной лексики, номинирующий электронные системы для контроля работы двигателя, тормозов, рулевого управления; системы, обеспечивающие безопасное функционирование и защиту транспортных средств.

Раздел пособия «Банк текстов профессиональной направленности» содержит большое количество схем, рисунков, иллюстраций, которые помогают наглядно представить ряд сложных содержательных аспектов специализированного текстового материала.

Раздел «Инструкция для подготовки устной презентации текстового материала на английском языке» содержит методические рекомендации по общему алгоритму создания устных презентаций. Презентации могут выполняться студентами по текстам, представленным в текстовом банке. В разделе также содержится подробный справочный материал по компьютерным технологиям подготовки докладов и презентаций.

Раздел «Методические рекомендации по организации самостоятельной работы» ставит целью методическое обеспечение процесса самостоятельной работы и самоподготовки студентов. Как правило, самостоятельная работа студентов – это подготовка пересказа, реферата, аннотации, проекта. Подробные рекомендации по подготовке данных видов самостоятельной учебной деятельности представлены в разделе.

Основные навыки, освоение которых является первоочередной задачей данного пособия:

– навык корректного перевода текстов профессиональной направленности;

– навык академически правильного устного представления/презентации контента профессиональной направленности.

– формирование навыков устной и письменной профессиональной коммуникации.

Таким образом, каждый блок, через тексты и систему упражнений стимулирует интерес обучающихся к научной коммуникации на иностранном языке, повышает мотивацию к процессу обучения, способствует формированию основных и профессиональных компетенций:

– способность применять иностранный язык в сфере профессиональной деятельности;

– способность к письменной и устной профессиональной коммуникации на иностранном языке;

– способность использовать знание иностранного языка для получения профессиональной информации из иностранных источников.

Пособие может быть использовано в разнообразных условиях учебного процесса для развития базовой коммуникативной компетенции – умения получать, перерабатывать и передавать информацию на иностранном языке.

РАЗДЕЛ 1. РАБОТА С ТЕКСТОВЫМ МАТЕРИАЛОМ ПРОФЕССИОНАЛЬНОЙ НАПРАВЛЕННОСТИ

Тексты профессиональной направленности с практическими заданиями по инженерным направлениям подготовки

Part 1. Electrical Engineering

Unit 1. An electrician: job description

Exercise 1. Read and memorize the words and word combinations.

1. electrician электрик; инженер-электрик; специалист в области электричества, электротехники; электротехник, электромонтёр, электромеханик, электромонтажник
2. installation монтаж; установка; сборка; ввод в эксплуатацию
3. operation работа; эксплуатация
4. repair ремонт; восстановление
5. maintenance содержание и техническое обслуживание, уход; текущий ремонт
6. electrical system электрическая сеть
7. communication devices аппаратура связи
8. HVACR (heating, ventilation, air conditioning and refrigeration) system система отопления, вентиляции, кондиционирования воздуха и охлаждения
9. lighting system система освещения
10. control unit устройство управления; пульт управления; блок управления; устройство контроля; диспетчерский пульт
11. residential and commercial settings жилые и промышленные помещения
12. wiring проводка, электропроводка; система проводов; монтажная электрическая схема
13. circuit board монтажная плата; печатная плата
14. electronics электроника; электронные схемы; электронная аппаратура; электронные устройства; электронное оборудование
15. residential homes жилой комплекс (из многоквартирных домов); жилой дом
16. commercial building здание торгового назначения
17. industrial facility промышленное предприятие
18. outdoor space вне помещения; открытое пространство
19. indoors в помещении
20. outdoors на открытом воздухе; на улице
21. worksite место эксплуатации изделия; рабочее место
22. circuits цепь, контур; схема
23. outlet сетевая розетка
24. switch выключатель, переключатель
25. lighting fixture светильник; осветительный прибор
26. well-paid job высокооплачиваемая работа
27. training period период обучения
28. consumer потребитель, клиент, заказчик
29. interact взаимодействовать; сталкиваться
30. electricity электричество; электроэнергия
31. experienced опытный; сведущий; квалифицированный
32. lineman линейный монтёр (обслуживает линии связи и линии электропередачи)
33. nomenclature терминология
34. internal wiring внутренняя проводка; комнатная проводка

35. outside находящийся вне помещений
36. electrical line электролиния; кабель
37. power generation производство энергии; выработка электроэнергии
38. facility объект; оборудование; аппаратура; установка
39. high current сильный ток
40. dangerous опасный; рискованный
41. down обрывать
42. power line линия высокого напряжения; линия электропередачи
43. inclement and windy weather ненастная и ветреная погода
44. primary responsibility основная/главная обязанность
45. safe безопасный
46. efficient эффективный
47. functioning функционирование, работа, действие
48. expertise экспертные (специальные) знания, опыт, квалификация, компетентность; экспертная оценка; мастерство, умение
49. blueprint чертеж; проект
50. technical specifications (tech-spec) технические условия, технические спецификации, техническое задание, технические характеристики
51. local building code местные строительные нормы и правила
52. safety regulations правила безопасности, правила техники безопасности
53. adhere придерживаться, соблюдать
54. prevent предотвращать, предупреждать, не допускать
55. hazard опасность; риск; угроза
56. accident несчастный случай; травма; авария; поломка, выход из строя
57. electrical principle электрический принцип
58. circuitry схемы; цепи; компоновка схем; схематика
59. voltage напряжение (в вольтах)
60. requirements требования, технические требования или условия
61. troubleshoot отыскивать неисправности, диагностировать, устранять неполадки
62. faulty неисправный, повреждённый
63. connection соединение, связь, контакт
64. upgrading улучшение качества, модернизация, реконструкция
65. panel приборная панель, пульт управления; распределительный щит
66. structure строение; конструкция, здание, сооружение
67. conduit кабелепровод
68. electrical wiring электропроводка
69. heating and cooling systems системы охлаждения и обогрева
70. vent вентиляционный канал
71. piping трубопровод; система труб
72. socket патрон (электрической лампы); розетка
73. plug in включать в сеть, вставлять вилку в розетку
74. electrical equipment электрооборудование, электрическая аппаратура
75. light bulb (электрическая) лампочка
76. drain расходовать; потреблять (ток)
77. stove кухонная плита
78. heater калорифер; нагревательный прибор; обогреватель; (отопительный) радиатор
79. tool (рабочий) инструмент; оборудование; средство
80. breaker box коробка прерывателя; электрический щиток

81. voltage meter вольтметр
82. repair service ремонтное обслуживание; ремонтные услуги
83. malfunctioning неисправный; поломанный
84. aged старый
85. freelancer фрилансер; внештатный специалист
86. equipment оборудование; аппаратура
87. van автомобиль-фургон, (авто)фургон
88. truck грузовой автомобиль
89. distinct особый; отличительный, чётко выраженный
90. personality личность; индивидуальность; личные свойства
91. independent независимый, самостоятельный
92. stable устойчивый; решительный; целенаправленный
93. persistent настойчивый, упорный
94. genuine оригинальный; искренний
95. practical практичный; практикующий (реально работающий в какой-либо области)
96. thrifty бережливый, расчётливый, экономный; процветающий, удачливый
97. tactile осязаемый; тактильный, предназначенный для восприятия на ощупь
98. physical относящийся к физике, физический
99. athletic атлетический; подразумевающий физические нагрузки
100. mechanical технический (имеющий отношение к технике)
101. investigative любознательный
102. intellectual мыслящий человек, интеллектуал; разумный
103. introspective интроспективный, занимающийся самоанализом
104. inquisitive пытливый
105. trade school профессионально-техническое училище
106. apprenticeship обучение
107. electrical components электрические компоненты, электрические устройства устройства, работающие на электричестве
108. mentor ментор, наставник, руководитель
109. professional trade вид профессиональной деятельности
110. certification свидетельство; сертификат; удостоверение
111. license официальное разрешение, лицензия
112. conveniences (бытовые) удобства, комфорт
113. necessities предметы первой необходимости
114. lighting освещение, свет
115. heating обогрев; отопление; подогревание
116. air conditioning кондиционирование воздуха, регулирование влажности воздуха
117. refrigeration охлаждение; замораживание
118. communication system система передачи информации; система связи, система коммуникаций
119. alarm system система сигнализации; система аварийной сигнализации
120. electrical device электрическое (электротехническое) устройство
121. circuit breaker автоматический выключатель; прерыватель
122. conduit bender трубогиб
123. screwdriver отвёртка
124. drill дрель; перфоратор
125. ammeter амперметр
126. thermal scanner тепловой сканер; сканирующий тепловизионный прибор

127. cable tester кабельный тестер; прибор для проверки целостности кабелей
128. voltmeter вольтметр
129. National Electrical Code национальный/государственный электрический кодекс

Exercise 2. Read the international words and guess their meanings.

Electrician, specialize, installation, electrical system, motor, communication device, control, electronics, residential, commercial, industrial, components, period, electricity, regional, nomenclature, specialist, electrical line, functioning, expertise, interpret, diagrams, technical specification, plan, local, code, standard, principle, voltage, diagnose electrical problems, panel, role, structure, finished, specialized, voltage meter, service, professional, freelancer, van, realistic, individual, stable, practical, tactile, physical, athletic, mechanical, intellectual, introspective, mentor, certification, license, region, infrastructure, office, hospital, industry, modern, refrigeration, communication system, device, drill, scanner, voltmeter, cable, national.

Exercise 3. Read and translate Text 1.

Text 1. What Does an Electrician Do?

Sources: https://www.careerexplorer.com/careers/electrician/, https://www.practicaladultinsights.com/what-does-an-electrician-do.htm, https://www.neit.edu/blog/how-much-do-electricians-make#What_Exactly_Do_Electricians_Do

An electrician works full-time and specializes in the installation, operation, repair, and maintenance of various electrical systems, motors, communication devices, HVACR systems, lighting systems, and control units in residential and commercial settings. The electrical systems include wiring, circuit boards, and electronics. Electrical systems can range from residential homes to commercial buildings, industrial facilities, and even outdoor spaces. So, electricians work both indoors and outdoors, depending on the worksite and type of installation or maintenance work involved.

Electricians are trained to handle various components of electrical systems, such as wiring, circuits, outlets, switches, and lighting fixtures. In some parts of the world, it can be a rather well-paid job. A three-to-five-year training period is usually required for an electrician to be successful. Consumers interact with the work of electricians in their everyday life because they deal with electricity at homes and at work, and many people prefer to invite an experienced electrician for electrical repair.

Some people like to distinguish between an electrician and a lineman, depending on regional nomenclature. An electrician refers to a specialist who works on internal wiring in homes and other buildings, while a lineman works on outside electrical lines and in power generation facilities. As much higher currents involved in this work, being a lineman can be very dangerous, especially when linemen are sent out to repair the downed power lines and other emergencies which can occur in inclement and windy weather.

The primary responsibility of an electrician is to ensure the safe and efficient functioning of electrical systems. They use their expertise to interpret blueprints, diagrams, and technical specifications to plan and execute electrical installations.

Electricians are knowledgeable about local building codes and safety regulations, and they adhere to these standards to prevent hazards and accidents. They have a thorough understanding of electrical principles, circuitry, and voltage requirements, enabling them to troubleshoot and diagnose electrical problems accurately. Whether it's installing new wiring, repairing faulty connections, or upgrading electrical panels, electricians play a crucial role in ensuring that buildings have reliable and properly functioning electrical systems.

When a structure is built, an electrician is an important part of the building team. He or she installs conduit in the walls as they are built for the purpose of running electrical wiring. If heating and cooling systems are installed, an electrician installs vents and piping for these systems. As the house is finished, the electrician installs electrical sockets for the purpose of plugging in electrical equipment and installing light bulbs. Specialized circuits may also be installed for equipment which drains power, such as stoves and heaters.

Electricians may also install complex electrical equipment, and they are familiar with the operation of electronics and various tools such as breaker boxes, voltage meters, etc. that they use in their work. Maintenance and repair services are also offered by professional electricians, ranging from troubleshooting malfunctioning electric stoves to replacing aged wiring. Many electricians work as freelancers, carrying their equipment with them in vans or trucks and traveling to sites as needed.

Electricians have distinct personalities. They tend to be realistic individuals, which means they're independent, stable, persistent, genuine, practical, and thrifty. They like tasks that are tactile, physical, athletic, or mechanical. Some of them are also investigative, meaning they're intellectual, introspective, and inquisitive.

Someone who wants to become an electrician should plan on going to trade school or serving a professional apprenticeship. During apprenticeship, he or she will learn about how to safely handle electricity and how to install electrical components. Training also includes familiarization with prevailing local codes, and a mentor may also offer training in dealing with various other professional trades in the capacity of an electrician. Once training is complete, a journeyman electrician can get professional certification or license, if required in his or her region.

Summing up, electricians are responsible for maintaining the electrical infrastructure that powers our homes, offices, schools, hospitals, and industries. Without electricians, we would be unable to enjoy the conveniences and necessities of modern life, such as lighting, heating, air conditioning, refrigeration, communication systems, alarm systems and countless other electrical devices.

Exercise 4. Answer the questions.

1. What does an electrician specialize in?
2. Where can the electrical systems be found?
3. What are the components of electrical systems?
4. Do electricians have a high salary?
5. How long is a training period?
6. Why do most people invite experienced electrician for electrical repair?
7. What is the difference between an electrician and a lineman?
8. What is the electrician's primary responsibility?
9. How do electricians use their expert skills and knowledge?
10. What are electricians well-informed about?
11. Why do electricians adhere to safety standards?
12. What knowledge helps electricians to troubleshoot and diagnose electrical problems without any mistakes?
13. What kind of tasks do electricians have to do?
14. What activities do electricians perform at the construction site?
15. What tools do electricians use?
16. Can electricians work as freelancers?
17. What are characteristics and qualities that form a typical electrician's distinctive character?
18. What kind of activities do electricians usually like?

19. Which educational institutions offer training for electricians?
20. What do students learn during apprenticeship?
21. Do all electricians need to get professional certification or license?
22. What does the electrical infrastructure power?
23. What conveniences and necessities of modern life do electricians maintain and repair?

Exercise 5. Read about an electrician's responsibilities and complete the gaps (1-7) with the words given in the box.

Adhering, transformers, screwdrivers, blueprints, testing, tools, wiring

Information source: https://www.neit.edu/blog/how-much-do-electricians-make#What_Exactly_Do_Electricians_Do

As an electrician, you are responsible for:
– Reading structural 1) … and technical diagrams.
– Planning layouts for electrical 2) … for new buildings.
– Inspecting electrical components like circuit breakers and 3) … .
– Using 4) … devices to identify common electrical issues.
– Troubleshooting problems by using various tools like conduit benders, 5)… , and drills.
– Using 6) … like ammeters, thermal scanners, cable testers, and voltmeters.
– Repairing, maintaining, and replacing wiring and components.
– 7) … to building regulations under the National Electrical Code.

Exercise 6. Match the electricians' key duties and responsibilities (1-6) with their descriptions (a-f).

Information source: https://www.careerexplorer.com/careers/electrician/

1. Electrical installations	a. When electrical systems malfunction or components fail, electricians are called upon to diagnose and repair the issue. They use specialized tools and testing equipment to identify faulty wiring, damaged circuits, or malfunctioning electrical devices. Electricians may replace damaged components, rewire circuits, or repair electrical fixtures to restore the proper functioning of the system.
2. Electrical repairs	b. Electricians adhere to local and national electrical codes and safety regulations to ensure that electrical systems meet the required standards. They are knowledgeable about safety protocols and take precautions to prevent electrical shocks, fires, and other hazards. Electricians are responsible for grounding systems, installing protective devices like circuit breakers and surge protectors, and ensuring proper insulation and wiring practices.
3. Maintenance and upgrades	c. Electricians possess a strong understanding of electrical systems and are skilled at troubleshooting electrical issues. They use their knowledge of electrical principles and circuitry to identify the root cause of problems and develop effective solutions. Electricians may use diagnostic tools and equipment to test electrical components, measure voltage levels, and trace electrical pathways to pinpoint the source of the issue.
4. Compliance with electrical codes and safety standards	d. Electricians are responsible for installing electrical systems in new construction projects or during renovations. They read and interpret blueprints, technical diagrams, and electrical codes to determine the layout and placement of wiring, outlets, switches, and

	lighting fixtures. They handle tasks such as running wires, connecting circuits, and ensuring proper grounding to establish a functional and safe electrical infrastructure.
5. Troubleshooting and problem-solving	e. Electricians often work in collaboration with other professionals, such as architects, engineers, contractors, and building inspectors. They communicate effectively to understand project requirements, provide input on electrical system designs, and ensure that installations meet specifications. Electricians may also interact with clients or end-users, offering guidance on electrical usage, safety precautions, and energy-saving practices.
6. Collaboration and communication	f. Electricians conduct routine maintenance checks on electrical systems to identify potential problems and prevent future issues. They inspect electrical equipment, such as circuit breakers, panels, and transformers, to ensure they are in good working condition. Electricians also perform upgrades and modifications to electrical systems to accommodate changing needs, such as installing additional outlets, upgrading electrical panels, or incorporating energy-efficient lighting solutions.

Exercise 7. Mark the following sentences as True or False.

Information source: https://www.foundit.in/career-advice/electrician-job-description/

1. An electrician is in charge of ensuring that electricity reaches the homes and businesses that need it. 2. The duties and responsibilities of this position include designing new buildings' electrical systems, such as where to place electrical outlets, light fixtures, heating outlets, and ventilation systems. 3. Understanding architectural plans, circuit diagrams, and other technical documentation is not important for an electrician. 4. According to municipal codes and safety regulations, new and existing buildings must have wiring, lighting, and control systems installed in accordance with the required standards. 5. Electricians must detect malfunctions in electrical items and systems by using testing devices. 6. Faulty or outdated electrical equipment, fixtures and wiring may be repaired or replaced. 7. Growing demand for electricians is in part due to the fact that there is a constant demand for their services.

Exercise 8. Read and translate the dialogue between two friends. Act it out.

Friend 1: Hello, Mikhail! How are you?

Friend 2: Hi, Max! Fine. I've just entered the university, the Electrical Technology and Equipment department.

F. 1: Cool! And why did you decide to be an electrician?

F. 2: Well, my Dad is a journeyman electrician. He specializes in the installation, operation, repair, and maintenance of electrical systems. It's a very challenging and rewarding career. It's also a great way to help people. My Dad allows me to assist him sometimes. I really enjoy watching him using hand and power tools when dealing with wiring, circuit boards, and electronics. He's taught me some basic things.

F. 1: I see. And how long is the training course?

F. 2: It normally takes four-to-six years.

F. 1: And are qualified electricians in high demand nowadays?

F. 2: Yes, they are. Many people prefer to invite a certificated electrician for electrical repair around homes and businesses to make sure the job is done accurately.

F. 1: It must be a well-paid job.

F. 2: Yeah, you're right. Highly-qualified electricians earn a lot of money. Personally, I want to become a master electrician.

F. 1: A master electrician? What does it mean?

F. 2: Master electricians have to obtain additional certifications and licenses so that they can manage large electrical projects, design electrical systems, provide guidance and mentorship to other electricians, and handle complex electrical installations or repairs. I find that kind of things so exciting!

F. 1: Sounds great! Good luck!

Exercise 9. Search the Web for an electrician job profile in Russia and make a presentation about it.

Exercise 10. Look through Unit 1 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 2. Types of Electrician jobs and their workplaces

Exercise 1. Read and memorize the words and word combinations.

1. workplace/worksite рабочее место
2. apprentice ученик (электрика); подмастерье; стажер
3. full-time job работа на полный рабочий день
4. employment работа (по найму); трудоустройство
5. construction engineer инженер-строитель
6. architect архитектор; разработчик; конструктор
7. construction management управление строительством
8. design and develop проектировать и разрабатывать
9. residential buildings жилые помещения
10. independent consultant независимый консультант
11. electrical contractor подрядчик на установку электрооборудования
12. construction project строительный проект; объект капитального или некапитального строительства
13. elevator installer монтажник лифта
14. HVAC (heating, ventilation and air conditioning) system система ОВКВ (отопление, вентиляция, кондиционирование воздуха)
15. helper помощник; подсобный рабочий, подручный
16. enrol записываться, поступать
17. associate degree диплом младшего специалиста; степень специалиста (степень, полученная после окончания двухгодичного курса обучения в ВУЗе США; позволяет продолжить обучение для получения степени бакалавра)
18. electrical technology электротехника
19. bachelor's degree степень бакалавра
20. industry apprenticeship обучение на производстве/на рабочем месте
22. area of expertise область знаний; специализация
23. responsibilities обязанности
24. residential electrician электрик жилого сектора
25. electrical work электротехнические работы
26. residential properties жилые здания
27. handle tasks решать задачи; выполнять работу
28. wiring электрическая проводка, электропроводка
29. outlet розетка
30. switch выключатель, переключатель

31. lighting fixture светильник; осветительный прибор
32. residential building жилое здание, жилой дом
33. renovation project проект ремонта
34. electrical repair ремонт электрооборудования
35. compliance выполнение, соблюдение
36. residential electrical codes правила электроснабжения в жилых помещениях
37. commercial electricians электрик коммерческих объектов
38. commercial building промышленное здание
39. retail store розничный магазин
40. large-scale значительный; крупномасштабный, большой
41. installation монтаж; ввод в эксплуатацию
42. complex wiring systems сложные системы электропроводки
43. panel приборная панель; распределительный щит
44. commercial lighting освещение коммерческих объектов
45. troubleshooting поиск, обнаружение и локализация неисправностей, диагностика, устранение неполадок
46. maintenance содержание и техническое обслуживание, уход; текущий ремонт
47. commercial electrical codes and regulations электротехнические нормы и правила для зданий коммерческого назначения
48. industrial electrician электрик промышленного сектора
49. industrial settings промышленные условия
50. manufacturing plant производственное предприятие; завод
51. warehouse склад
52. high-voltage высоковольтный
53. electrical equipment электрооборудование
54. machinery оборудование, машинное оборудование; механизмы
55. control system система управления; система контроля
56. knowledgeable хорошо разбирающийся
57. electrical components электрические компоненты, электрические устройства
58. motor control блок или устройство управления электроприводом
59. transformer трансформатор
60. programmable logic controller (PLC) контроллер с программируемой логикой, программируемый логический контроллер, ПЛК
61. smooth operation бесперебойная работа
62. industrial environment промышленное оборудование, промышленное цеховое оборудование
63. marine electrician электрик на морских судах
64. marine vessel морское судно; морской транспорт
65. ship корабль, судно
66. boat катер
67. yacht яхта
68. navigation system система ориентации; навигационная система
69. communication equipment аппаратура связи
70. power distribution system система энергоснабжения; схема распределения электроэнергии; система распределения мощности
71. marine environment морские условия; акватория моря
72. maintenance electrician электрик по техобслуживанию
73. regular inspection регулярная проверка
74. identify выявлять, устанавливать; определять
75. fix устранять

76. prevent breakdown предупреждение поломки
77. system performance производительность системы; показатели работы системы
78. downtime непроизводительная потеря времени; время простоя, простой; время работы вхолостую (из-за неисправности)
79. journeyman electrician подмастерье-электрик
80. apprenticeship обучение, учение, срок учения, период обучения
81. extensive knowledge обширные знания
82. extensive experience богатый опыт
83. task работа
84. wide range широкий спектр
85. skill практический опыт; умение; квалификация; мастерство
86. autonomy автономность, автономия, независимость
87. master electrician мастер-электрик
88. advanced передовой; углубленный; современный
89. additional дополнительный
90. oversee наблюдать, осуществлять надзор, контролировать
91. manage руководить, управлять; стоять во главе
92. design разрабатывать; проектировать
93. guidance руководство; управление
94. mentorship наставничество
95. work environment условия труда
96. power system technician техник по обслуживанию, эксплуатации и ремонту электрических сетей
97. electrical relay technician техник по обслуживанию и ремонту оборудования релейной защиты электрических сетей
98. electrical research technician инженер-исследователь в области электротехники
99. electro-mechanical technician электромеханик
100. control engineer специалист (инженер) по системам управления

Exercise 2. Read the international words and guess their meanings.

Start, engineer, architect, management, company, design, electrical system, residential, commercial, consultant, construction, project, elevator, specialist, technology, program, Bachelor, industry, assistant, specialized types of electricians, expertise, specific, apartments, project, code, commercial electrician, focus, office, restaurant, complex, panel, industrial electrician, control, component, motor, transformer, programmable, logic, controller, navigation system, communication, regular inspection, identify, electrical problem, optimize, minimize, license, certification, master, typically, technician, relay, electro-mechanical.

Exercise 3. Read and translate Text 1.

Text 1. Types of Electrician Jobs

Source: https://www.neit.edu/blog/how-much-do-electricians-make#What_Exactly_Do_Electricians_Do, https://www.careerexplorer.com/careers/electrician/

An electrician generally starts as an apprentice before moving on to a full-time job. Electricians with the right experience may find employment with construction engineers, architects, and construction management companies to help design and develop the electrical systems for various residential and commercial buildings. They may also become independent consultants or electrical contractors for construction projects or work hand-in-hand with elevator installers and HVACR specialists. If electricians work at a bigger com-

pany, they are part of a team that carries out daily tasks at different worksites and supervises helpers and apprentices to complete jobs.

The first step to become an electrician is getting an education. You can enroll in an Associate Degree in Electrical Technology program or a Bachelor's Degree in Electrical Technology. Alternatively, you could also seek out an industry apprenticeship. Apprenticeship programs allow you to learn on the job as an assistant for four or five years.

There are several specialized types of electricians, each with its own area of expertise and specific job responsibilities. Here are some of the main types of electricians and a brief description of what they do:

– Residential Electricians: Residential electricians specialize in electrical work related to homes, apartments, and other residential properties. They handle tasks such as installing wiring, outlets, switches, and lighting fixtures in residential buildings. They may also work on home renovation projects, perform electrical repairs, and ensure compliance with residential electrical codes.

– Commercial Electricians: Commercial electricians focus on electrical systems in commercial buildings such as offices, retail stores, restaurants, and schools. They are experienced in handling larger-scale electrical installations, such as complex wiring systems, electrical panels, and commercial lighting. They may also work on troubleshooting electrical issues, performing maintenance, and ensuring compliance with commercial electrical codes and regulations.

– Industrial Electricians: Industrial electricians specialize in electrical systems found in industrial settings, such as factories, manufacturing plants, and warehouses. They work with high-voltage electrical equipment, machinery, and control systems. Industrial electricians are knowledgeable about industrial electrical components, motor controls, transformers, and programmable logic controllers (PLCs). They are responsible for installing, repairing, and maintaining electrical systems to ensure smooth operations of industrial environments.

– Marine Electricians: Marine electricians are specialized electricians who focus on electrical systems and equipment in marine vessels, such as ships, boats, and yachts. They are responsible for installing, maintaining, and repairing electrical systems, including wiring, lighting, navigation systems, communication equipment, and power distribution systems, specifically designed for marine environments.

– Maintenance Electricians: Maintenance electricians are responsible for the ongoing maintenance and repair of electrical systems in various settings, including residential, commercial, or industrial. They perform regular inspections, identify and fix electrical problems, and ensure that electrical equipment is operating efficiently. Maintenance electricians play a crucial role in preventing breakdowns, optimizing system performance, and minimizing downtime.

– Journeyman Electricians: Journeyman electricians have completed their apprenticeship training and acquired the necessary licenses and certifications. They have extensive knowledge and experience in various electrical tasks. Journeyman electricians can perform a wide range of electrical work, including installations, repairs, troubleshooting, and maintenance, with a high level of skill and autonomy.

– Master Electricians: Master electricians have advanced knowledge and experience in electrical systems and have typically obtained additional certifications and licenses. They often oversee and manage electrical projects, ensuring compliance with electrical codes and regulations. Master electricians may design electrical systems, provide guidance and mentorship to other electricians, and handle complex electrical installations or repairs.

Other electrician jobs include a power system technician, an electrical relay technician, an electrical research technician, an electro-mechanical technician, and a control engineer.

Exercise 4. Answer the questions.

1. Where do electricians generally start working before getting a full-time job?
2. Where may electricians work?
3. What is the first step to become an electrician?
4. What is an alternative to an Associate Degree or a Bachelor's Degree?
5. Which specialized types of electricians do you know?
6. What do residential electricians specialize in?
7. What do commercial electricians focus on?
8. What do industrial electricians deal with?
9. What are marine electricians responsible for?
10. What do maintenance electricians do?
11. What electrical work do journeyman electricians perform?
12. What activities are master electricians engaged in?
13. What do other electrician jobs include?

Exercise 5. Read about types of electrician jobs and complete the gaps (1-9) with the words given in the box.

Industrial, residential, regularly, equipment, codes, traffic, electrical, electronics, commercial

Information source: https://www.neit.edu/blog/how-much-do-electricians-make#What_Exactly_Do_Electricians_Do

When it comes to selecting a speciality, you'll need to choose between becoming a low-voltage and high-voltage electrician.

A low-voltage technician installs, maintains, repairs, and troubleshoots low-voltage electrical systems in 1) … and commercial buildings (homes, office buildings, complexes, factories, etc.). Low-voltage electricians are in high demand because electrical wiring and systems are the lifeblood of any building from both a safety and functionality perspective. Some popular types of low-voltage electricians include:

– Residential Electricians: They work with 2) … systems within a home (houses, apartments, condos, etc.), including lighting and HVACR systems.

– Commercial Electricians: They work in 3) … buildings (offices and hotels) and are responsible for installing electrical circuits, security systems, and HVAC systems.

– Installation Electricians: They set up electrical 4) … and wiring for systems in residential, commercial, and industrial projects.

– Construction Electricians: They perform electrical work in new buildings. Construction electricians must have adequate knowledge of state and local building 5) … and safety procedures.

– Automotive Electricians: They install and maintain the electrical systems in motor vehicles and work with automotive concepts like vehicle diagnostics and performance 6) … .

High-voltage electricians maintain underground, overhead, power plants, and other central electrical systems with charges over 600 volts. All cities and states need skilled high-voltage electricians to ensure that underground transportation systems and other large infrastructures run smoothly. You will find the following job titles listed under the high-voltage umbrella:

– Industrial Electricians: They work on large-scale projects across 7) … facilities like factories, manufacturing facilities, and power plants, using large machinery and complex computer systems.

– Maintenance Electricians: They are in charge of installing, maintaining, repairing, replacing, and 8) … inspecting electrical systems and equipment in manufacturing plants.

– Highway Systems Electricians: They install, maintain, and upgrade the electrical infrastructure on roads to ensure a safe and sustainable transportation system. This includes 9) … lights, streetlamps, digital signage, etc.

Exercise 6. The workplace of electricians can vary depending on the type of electrical work they specialize in. Match the types of electricians (1-3) with their typical workplace descriptions (a-c).

Information source: https://www.careerexplorer.com/careers/electrician/

1. Residential electricians	a. These electricians typically work in commercial buildings, such as offices, retail spaces, restaurants, or schools. They may collaborate with other professionals, such as architects, engineers, or contractors, to design and implement electrical systems that meet the specific needs of the building. These electricians can be found working in different areas of the building, including utility rooms, mechanical rooms, or above ceilings, where they handle complex wiring systems, electrical panels, and other electrical components.
2. Commercial electricians	b. These electricians work in industrial settings like factories, manufacturing plants, or warehouses. Their workplace can involve large machinery, heavy equipment, and high-voltage electrical systems. They may spend their time in industrial production areas, equipment rooms, or control rooms, where they install, maintain, and repair electrical systems associated with industrial processes. These electricians often work in collaboration with maintenance personnel and engineers to ensure the uninterrupted operation of electrical equipment and systems.
3. Industrial electricians	c. These electricians often work in homes, apartments, or housing complexes, where they may be involved in new construction projects or renovations. They can be found working in various areas of the building, such as basements, attics, or electrical utility rooms, where they install wiring, outlets, switches, and lighting fixtures. These electricians may also spend time outdoors, working on electrical connections for outdoor lighting or power sources.

Exercise 7. Read about electricians' work environment and complete the gaps (1-6) with the words given in the box.

Complexity, spaces, safety, team, equipment, outdoor

Information source: https://www.careerexplorer.com/careers/electrician/

Regardless of the specific type of electrician, their work environment can involve both indoor and 1) … settings. They may work in confined 2) …, on ladders, or in elevated areas, depending on the task at hand. Electricians frequently handle tools, testing 3) …, and electrical components, emphasizing the importance of adhering to 4) … practices and wearing appropriate protective gear. Additionally, electricians may work independently or as part of a 5) …, depending on the size and 6) … of the project.

Exercise 8. Work in pairs. Read and translate a dialogue between an interviewer and an applicant for the job of an electrician. Act it out.

Information sources: https://englandlearn.com/dialogi/sobesedovanie, https://resumecat.com/interview-questions/electrician#what-experience-do-you-have-as-an-electrician?

Interviewer: Good morning, Michael. I'm Phil Richards from the personnel department.

Applicant: Good morning, Mr. Richards. Nice to meet you.

I.: Nice to meet you, too. Well, let's start our interview. We've got your CV last week and we thought you are the right person for this position. However, I need to clarify some areas. First of all, can you tell me a bit more about your education and previous experience of work as an electrician?

A.: Yes, of course. I have a Bachelor Degree in Electrical Engineering, majoring in the Electrical Technology and Equipment. And I've got all the necessary licenses and certifications to work as a journeyman electrician. I've been working as an electrician for over 5 years. I have experience in various settings, including residential and commercial. I'm knowledgeable in all aspects of electrical work. I mean installation, repair, and maintenance. I'm also familiar with a variety of electrical code requirements.

I.: Fine! And what is your favorite part of the job?

A.: Well, there are many things that I enjoy about being an electrician. Firstly, I like the feeling of working with my hands and being able to see the results of my work at the end of the day. Secondly, I enjoy the challenge of troubleshooting and repairing electrical problems. Thirdly, I like communicating with my colleagues and being a part of the professional team. And, finally, it's the chance to get promoted, I mean career development.

I.: Have you ever been promoted, Michael?

A.: Yes, twice during my work at the previous place.

I.: That's good to hear. And what is the most challenging part of the job from your point of view?

A.: Personally, I believe that working in confined spaces is the most challenging. This can be difficult and dangerous because there is often little room to move around, and you may be working with high-voltage equipment.

I.: I see. What do you think is the most important skill for an electrician?

A.: It is the ability to read and interpret blueprints and electrical schematics. Other important skills include the ability to use hand and power tools, to work in confined spaces, and to work safely around electricity.

I.: Very well. I have a few more questions for you, Michael. What do you think sets you apart from other electricians?

A.: I'm sure that my attention to detail and my dedication to customer satisfaction sets me apart from other electricians. I always make sure that every job is done right the first time, and I go above and beyond to make sure that my customers are happy with the work I've done. I'm also always available to answer any questions they may have about their electrical system.

I.: And the last question. What are your goals for the future?

A.: I want to continue working as an electrician and to eventually become a master electrician. I would also like to continue my education and obtained several additional certifications and licenses to work in industrial settings as well.

I.: Sounds great! You have everything we're looking for. When are you ready to start the job?

A.: Any moment, Mr. Richards. I can start from Monday, if you wish.

I.: Yes, you can start from the next week. My secretary will send you the employment contract. The first three months are going to be probationary for you, but I'm sure you'll be fine.

A.: Thank you, Mr. Richards. I'm happy to become a part of your company now.

Exercise 9. Search the Web for types of electrician jobs in Russia and descriptions of their workplaces. Make a presentation.

Exercise 10. Look through Unit 2 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 3. Pros and Cons of Being an Electrician

Exercise 1. Read and memorize the words and word combinations.

1. pros and cons доводы «за» и «против»; преимущества и недостатки; плюсы и минусы
2. rewarding достойный (в материальном плане)
3. fulfilling приносящий удовлетворение
4. career path путь в профессию; карьера
5. electrical system электрическая система
6. industry промышленность; отрасль промышленности
7. significant advantage важное преимущество
8. stable employment стабильная работа
9. job security гарантия занятости, обеспеченность работой
10. demand потребность; спрос
11. skilled (высоко)квалифицированный, опытный
12. consistently high неизменно высокий
13. integral неотъемлемый
14. construction строительство
15. manufacturing производство; обрабатывающая промышленность
16. maintenance техническое обслуживание
17. job opportunities возможности трудоустройства, вакансии
18. residential settings жилой сектор
19. commercial settings коммерческий сектор
20. industrial settings промышленный сектор
21. financial well-being финансовое благополучие
22. career advancement карьерный рост; продвижение по карьерной лестнице
23. professional growth профессиональный рост
24. apprentice подмастерье, ученик
25. experience and expertise опыт и знания
26. continued learning and certification постоянное обучение и сертификация
27. journeyman electrician электрик-подмастерье
28. master electrician мастер-электрик
29. higher-paying positions более высокооплачиваемые должности
30. run вести (бизнес)
31. electrical contracting заключение контрактов на выполнение подрядных работ (по проектированию, монтажу и техническому обслуживанию электрических и кабельных систем коммерческих, промышленных и жилых зданий)
32. varied различный, разнообразный; меняющийся
33. challenging стимулирующий; перспективный; многообещающий
34. advancement прогресс; продвижение вперед; достижение, успех
35. electrical technology электротехника; электротехнология
36. ongoing learning непрерывное обучение
37. skill development совершенствование навыков и умений
38. intellectually stimulating интеллектуально стимулирующий
38. electrical industry электротехническая промышленность; энергетическая промышленность; электропромышленность
39. evolving развивающийся
40. competitive конкурентный; конкурентоспособный; соперничающий
41. put in прилагать усилия; добиваться успехов
42. keep up-to-date владеть полной информацией о текущем состоянии дел; не отставать от жизни; отвечать уровню современных требований; освежать; пополнять

последними данными; идти в ногу с современностью

43. regulations and codes правила и нормы
44. safety standards правила/нормы техники безопасности
45. accident несчастный случай; травма; авария; поломка, выход из строя
46. incident случайный отказ; аварийная ситуация; инцидент; происшествие
47. environmental impact воздействие на окружающую среду
48. energy-efficient с низким энергопотреблением; энергосберегающий
49. carbon footprint «углеродный след» (выброс диоксида углерода в атмосферу, связанный с деятельностью отдельного человека или организации); негативные экологические последствия какой-либо деятельности
50. respect уважение; признание; почёт, почтение; почтительное отношение
51. society общество
52. provide предоставлять
53. vital service жизненно важные услуги
54. keep safe and comfortable обеспечивать безопасность и комфорт
55. tradespeople люди рабочих профессий (plumber, electrician, glazier)
56. drawback недостаток, отрицательная сторона
57. challenge сложная задача, проблема; трудность; проверка сил
58. physically demanding физически сложный
59. confined space ограниченное/замкнутое пространство
60. challenging environments сложные условия
61. lifting поднимание, подъём, поднятие
62. heavy equipment тяжелое оборудование
63. bending сгибание
64. kneeling необходимость становиться на колени/стоять на коленях
65. climbing ladder подъем/лазанье по лестнице
66. inherent risk неизбежный/неминуемый риск
67. safety protocol протокол/правила безопасности
68. accident несчастный случай; травма
69. electrical shock поражение электрическим током, электрический удар
70. hazard опасность; опасная ситуация; фактор риска
71. downside непривлекательная сторона; недостаток
72. irregular work schedule ненормированный график работы
73. emergency авария; аварийная ситуация; внеплановая работа
74. urgent repair срочный ремонт
75. be available for on-call or shift work быть доступным для обслуживания по вызову или работы посменно
76. disrupt нарушать
77. flexibility and adaptability гибкость и способность к адаптации
78. meet the demands удовлетворять требованиям
79. dangerous опасный
80. safety hazard опасность травмирования; угроза безопасности
81. electrocution поражение электрическим током, смертельная электротравма
82. gear снаряжение; экипировка
83. repairs ремонтные работы
84. cut порез; глубокая рана
85. burn ожог
86. scrape царапина; ссадина
87. confident уверенный
88. rely on полагаться

89. crew бригада
90. teleworking удалённая работа, работа на дому
91. commute ездить к месту работы
92. remotely удаленно
93. household chores домашние заботы; работа по дому
94. rapid technological development быстрое техническое развитие
95. refresh обновлять; освежать
96. gold standard золотой стандарт; эталон
97. outdated устаревший; несовременный
98. certain way проверенным способом; определённым образом

Exercise 2. Read the international words and guess their meanings.

Electrician, career, interested, electrical systems, functioning, industry, profession, potential, stable, security, integral, sector, construction, manufacturing, residential, commercial, industrial settings, stability, financial, professional, typically, start, progress, expertise, master, certification, position, contract, business, technology, intellectually, stimulating, evolve, safe, comfortable, efficiently, code, effectively, standard, incident, climate, energy, method, material, minimize, physically, nature, maneuvering, risk, protocol, shock, weekend, aspect, personal, adaptability, minus, electricity, basis, chance, training, client, person, finally, technological, standard.

Exercise 3. Read and translate Text 1.

Text 1. Pros and Cons of Being an Electrician

Source: https://www.careerexplorer.com/careers/electrician/, https://thenextfind.com/pros-cons-being-electrician/, https://careers.alot.com/career-paths/pros-and-cons-of-being-an-electrician--13827, https://resumecat.com/interview-questions/electrician#what-experience-do-you-have-as-an-electrician?

Becoming an electrician can offer a rewarding and fulfilling career path for those interested in working with electrical systems and contributing to the functioning of various industries. However, like any profession, there are pros and cons to consider.

Pros: One of the significant advantages of being an electrician is the potential for stable employment and job security. The demand for skilled electricians remains consistently high, as electrical systems are integral to numerous sectors such as construction, manufacturing, and maintenance. Electricians often benefit from a steady stream of job opportunities in residential, commercial, or industrial settings. This stability can provide a sense of security and financial well-being.

Another pro of being an electrician is the opportunity for career advancement and professional growth. Electricians typically start as apprentices and progress through various levels, gaining experience and expertise along the way. Electricians can become journeyman electricians or master electricians with continued learning and certification, which opens doors to higher-paying positions and the possibility of running their own electrical contracting businesses.

One more plus is that the job is varied and challenging. The constant advancement of electrical technology also ensures ongoing learning and skill development, making the profession intellectually stimulating. The electrical industry is constantly evolving and changing. It is also becoming more competitive. So, it offers a lot of potential for those who are willing to put in the work. With new technologies and advances in the field, and new equipment being developed all the time, electricians need to be constantly learning and keeping up-to-date with the latest advancements in order to be able to do their job effectively. Also, electricians need to comply with the increasing number of regulations and codes.

As safety standards become stricter, electricians need to make sure that they are up-to-date with the latest requirements in order to avoid any accidents or incidents. In addition, electricians need to be aware of the environmental impact of their work. With more and more people becoming concerned about climate change, electricians need to make sure that they are using energy-efficient methods and materials whenever possible in order to minimize their carbon footprint. Besides, they install and maintain electrical equipment and machines in factories and a wide range of other businesses. Thus, it is not a job that will become boring because electricians do problem-solving, troubleshooting and face new situations and challenges at every job site and need to stay up-to-date on the latest advancements and learn new skills.

Finally, electricians receive a lot of respect in their career. Electricians play an important role in society by providing a vital service that helps to keep people safe and comfortable. They install, maintain and repair electrical systems and equipment, ensuring that they are operating safely and efficiently. Electricians also work closely with other tradespeople to ensure that electrical installations are completed correctly and to code.

Cons: There are some drawbacks to consider. One challenge of being an electrician is the physically demanding nature of the work. Electricians often spend long hours on their feet, maneuvering in confined spaces, and working in challenging environments. The job may require lifting heavy equipment, bending, kneeling, and climbing ladders. Additionally, working with electrical systems carries inherent risks, and electricians must strictly adhere to safety protocols to prevent accidents, electrical shocks, or other hazards.

Another potential downside is the irregular work schedule that electricians may face. Emergencies and urgent repairs can arise at any time, requiring electricians to be available for on-call or shift work, including nights, weekends, and holidays. This aspect can disrupt personal and family life and may require flexibility and adaptability to meet the demands of the job.

One more minus of the job is that working with electricity can be dangerous. Electricity is a safety hazard. An electrician has to work with electricity multiple times a day and face dangers on a daily basis. The chances of electrocution are always high irrespective of the experience one has or the gear one wears. Also, there are dangers that come from working up high. Electricians must learn the electrical codes during training and be very careful when doing repairs. They may get cuts, burns, and scrapes that happen easily when working with heavy equipment and specialty tools. It's important for an electrician not only to be self-confident but also to be able to rely on his team and to be prepared to work quickly, but efficiently, so that neither he nor his crew are in danger.

Some people may regard as a disadvantage the fact that teleworking is not possible. Electricians cannot work from home. They have to be present at their clients' buildings in person and often have to commute for quite a long time. Consequently, they will have to waste plenty of time that other people who are able to work remotely can use for doing their household chores.

Finally, electricians always have to improve skills. Some people may consider it to be an advantage but others refer it to minuses. An electrician's work changes due to rapid technological development. So, electricians have to refresh their knowledge at a rather quick pace since something that has been the gold standard for many years may be outdated just a few years from now. This can be a challenge, especially for those who have been in the industry for many years and are used to doing things a certain way.

Exercise 4. Answer the questions to Text 1.

1. What is one of the main pros of being an electrician?

2. What opportunities do electricians have for their career advancement and professional growth?

3. How does the current state of the electrical industry motivate electricians to stay up-to-date on the latest advancements and learn new skills?
4. Why do electricians play an important role in society?
5. Why is an electrician's work regarded as physically demanding?
6. Do electricians have a nine to five job?
7. What makes an electrician's job hazardous?
8. Why can't electricians work remotely?
9. Why may the necessity to improve skills be a challenge for some electricians?

Exercise 5. Read about some more advantages of being an electrician. Match the advantages (1-5) with their descriptions (a-e).

Information source: https://thenextfind.com/pros-cons-being-electrician/, https://careers.alot.com/career-paths/pros-and-cons-of-being-an-electrician--13827

1. No compulsory educational requirement	a. Electricians easily become entrepreneurs. Like other trades such as plumbers, electricians are often self-employed, working as contractors or owners of small electrical contracting companies that employ other people.
2. Work and earn while train	b. Apprenticeships have an attractive advantage. Many programs are separated into two types to choose from. An apprentice can become an industrial electrician or an electrician that focuses on construction. The industrial electrician works in technical, support, and administrative services, while the construction electrician focuses on service and installation needs.
3. Possibility of self-employment	c. There is no requirement for an educational degree for working as an electrician in some countries. While many professions require a person to attend school for a few years and get formal training, electricians often learn through apprenticeship. This can often be done in as little as four years. Also, a person may take some training and get the basics of an electrician. But any electrician must be aware of safety protocols and need to take a test to become a real electrician in the end.
4. Chance to follow different career paths	d. Most electricians have a relaxed life. While many other people have to work long hours every day; electricians have short workdays. They can make nice weekend trips or enjoy leisure with the things they like.
5. Low workload	e. Apprenticeships take years to complete, and it allows earning a stipend while learning. It includes hands-on training for which apprentices get paid. This means that apprentices get paid while they work under a qualified electrician who helps them understand the ins and outs of the job. They usually start their work by reading blueprints – technical diagrams that show the locations of circuits, outlets, load centers, panel boards, and other equipment. And after determining where all the wires and components will go, electricians install and connect the wires to circuit breakers, transformers, outlets, or other components and systems.

Exercise 6. Read about some more disadvantages of being an electrician. Match the disadvantages (1-4) with their descriptions (a-d).

Information source: https://careers.alot.com/career-paths/pros-and-cons-of-being-an-electrician--13827

1. Be liable for mistakes	a. An electrician has a low social standing. Even friends may not understand why one wants to go for an electrician career instead of going to college and getting a certificate of degree.
2. No chance to learn many digital skills	b. Any electricity expert always has clients who need help. Though it can be nice to help others, it can also become really annoying if electricians have to spend all their leisure solving their clients' issues. Often, electricians do the same job for decades without ever getting into a higher position. Therefore, salary does not increase that much and it can be really frustrating to put in the hard work without seeing any progress in this regard.
3. Annoying	c. Electricians are often liable for mistakes. Many mistakes can be quite costly and cause serious financial damages to homeowners. It may take plenty of time to fix the issues. Some people may even lose their lives through an electrician's fault.
4. Low social standing	d. Electricians do not learn that many digital skills. Often, they do their work in a rather manual manner and even though they become experts in how to fix electrical devices, they do not learn many digital skills that are of high value in the job market right now. It means that electricians may also have a hard time getting out of their scope of activity.

Exercise 7. Read about electricians' job prospects and complete the gaps (1-6) with the words given in the box.

Work, offices, salary, career, apartment, demand

Information source: https://careers.alot.com/career-paths/pros-and-cons-of-being-an-electrician--13827

The entire nation relies on electricity – not just at home, but at their 1) … and factories. The Bureau of Labor Statistics (BLS) in the USA reports that electricians will have a greater than average job growth rate of 14% over the next 10 years. This means electricians are going to be in high 2) … for some time to come. There's also a wide range of jobs that electricians can hold. In addition to working for a power company, some 3) … complexes, stadiums and other companies may keep their own electricians on hand.

Electricians can make a very decent living. They don't make money like doctors, but it can still be a comfortable living. The BLS reports the average pay for electricians is about $50,000 a year depending on their 4) … experience and the exact aspect of the area they deal with. The lowest 5) … is about $30,000 per year; the highest one is close to $90,000 a year. That's a big difference. So, people who choose the 6) … of an electrician should decide what kind of electrician they want to be.

Exercise 8. Work in pairs. Read and translate a dialogue between an interviewer and an applicant for the job of an electrician. Act it out.

Information sources: https://englandlearn.com/dialogi/sobesedovanie, https://resumecat.com/interview-questions/electrician#what-experience-do-you-have-as-an-electrician?

Interviewer: Good morning! Welcome to our company, David. I'm Tom. I'm the manager of the Electrical Technology and Equipment department.

Applicant: Morning! It's nice to meet you.

I.: Nice to meet you, too. I hope we didn't keep you waiting for long?

A.: No, I had the chance to talk to one of your electricians while waiting.

I.: That's good. David, shall we start?

A.: Yeah, sure.

I.: First of all, let me tell you a few words about our department. We deal with the application of up-to-date technologies and sources of renewable energy in the electrical industry. We currently have several ongoing projects and the team is working hard. But we have one open position of electrician, so we have been interviewing applicants to fill the position as quickly as possible.

A.: Yes sir, I read about the position on your website, and I think I am a good fit.

I.: Yes, I've studied your resume and I believe you are the right person for this position. However, I need to clarify some areas. Well, may I ask you a few questions about the electrical industry? What do you think about new technologies and their impact on the electrical industry?

A.: The electrical industry is constantly evolving and new technologies are emerging all the time. While some of these technologies may have a positive impact on the industry, others may not be so beneficial. I believe it's important to stay up-to-date on new developments in the electrical industry in order to make informed decisions about which products and services to use.

I.: Fine! And what do you think about the future of the electrical industry?

A.: Well, it looks very promising. With the ever-growing demand for electricity, the industry is expected to grow at a steady pace. This will create new opportunities for electricians to work in a variety of settings, including residential, commercial, and industrial ones.

I.: Thank you. And what are your thoughts on renewable energy and its impact on the electrical industry?

A.: Personally, I think that this impact is significant, as it provides a cleaner, more sustainable source of power that can help to reduce emissions and protect the environment. Renewable energy is also becoming increasingly cost-effective, making it a viable option for businesses and households alike. With the right policies in place, renewable energy can play a major role in transforming the electrical industry and helping to create a cleaner, more sustainable future.

I.: I see. And the last question. What do you think about the role of electricians in the future of the energy industry?

A.: Well, their role will become increasingly important as the world moves towards cleaner and more sustainable forms of energy. Electricians will not only be responsible for installing, maintaining and repairing electrical systems that power homes, businesses and other buildings, but also they will play a key role in helping to transition the energy grid to newer, cleaner technologies such as solar and wind power. As the demand for renewable energy grows, so the need for qualified electricians will grow, too.

I.: Very well. Now, do you mind working overtime? I mean sometimes we get overwhelmed with heavy workload.

A.: No, I don't. I understand that's the nature of the job. I used to work overtime at my previous job. And, I handled that situation very well.

I.: That's good to hear. Thank you very much. I can tell that you are a good candidate. Expect to hear from us within a week or so about the job.

A.: Great! Thank you for your time, Tom.

I.: Thank you for coming, David. Good-bye.

A.: Bye!

Exercise 9. Search the Web for pros and cons of being an electrician in Russia and make a presentation about it.

Exercise 10. Look through Unit 3 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 4. Electrician Tools

Exercise 1. Read and memorize the words and word combinations.

1. tool инструмент
2. tool box ящик для инструментов
3. electric tools (power tools) электроинструменты
4. electrician tools инструменты электрика
5. repair ремонт
6. improvement благоустройство, улучшение
7. depend on зависеть
8. range диапозон, ряд
9. heavy-duty сверхпрочный
10. insulated изолированный
11. encounter сталкиваться, встречаться
13. hardware store хозяйственный магазин
14. electrical supply store магазин электротоваров
15. pliers плоскогубцы
16. bend and to twist wires сгибать и скручивать провода
17. screw-terminal винтовая клемма
18. tip кончик
19. screwdrivers отвертки
20. screw привинчивать
21. metal rod металлический стержень
22. fit into помещаться на
23. use использовать, применять
24. loosen and fasten ослабить и закрепить
25. hardware оборудование, техника
26. hammer молоток
27. claw hammer молоток-гвоздодер
28. fibre glass handle ручка из стекловолокна
29. rubber-coated grip рукоятка с резиновым покрытием
30. contractor подрядчик, исполнитель
31. drive забивать
32. wire staples проволочные скобы
33. anchor закреплять
34. framing members элементы каркаса
35. tape measure рулетка
36. measure измерять
37. flexible ruler with a case гибкая линейка с футляром
38. thumb lock фиксатор большого пальца
39. tape лента
40. hook крючок
41. belt clip зажим для ремня
42. measurement измерение
43. switch переключатель
44. cutout выключатель, вырез
45. multi-step lock многоступенчатая блокировка, фиксатор
46. feature особенность, функция
47. electrical tape изолента
48. insulate изолировать

49. conduct проводить
50. fish tape/draw wire/draw tape/an electrician's snake проволока для протаскивания электропроводов (кабелей) через трубы
51. conduit трубопровод, кабелепровод
52. be housed размещаться
53. a retractable coil выдвижная катушка
54. be fed through быть пропущенным через, подаваться по
55. conduit piping соединительный трубопровод
56. cable ties кабельные стяжки
57. hose tie стяжка для шланга
58. zip tie стяжка на молнии, кабельная стяжка
59. fastener крепеж, крепление
60. for holding для скрепления
61. space пространство
62. neat аккуратный, чистый, опрятный
63. level уровень
64. installing установка
65. lighting fixture осветительный прибор
66. ensure убедиться
67. wire and cable lugs наконечники для проводов и кабелей
68. run side by side проходить бок о бок
69. tied связанный
70. bent согнутый
71. braided оплетенный
72. electrical assembly электрическая сборка, электрический узел
73. equipment оборудование
74. surface поверхность
75. jumper cables соединительные кабели, кабельные перемычки
76. battery батарея, аккумулятор
77. appliances бытовые приборы
78. power сила, мощь, электропитание
79. clamp зажим
80. battery jumper cable соединительный кабель аккумулятора
81. flashlight фонарь
82. crucial ключевой, важнейший, критически важный
83. provide обеспечивать
84. battery cells элементы питания
85. involve включать
86. basement подвал
87. cavity полость
88. convenience удобство
89. handheld портативный, ручной
90. DIY изготовленный своими руками
91. utility knife универсальный нож, канцелярский нож
92. sheathing оболочка
93. cardboard картонный
94. cutting and stripping cables резка и зачистка кабелей
95. allen wrench set набор шестигранных гаечных ключей
96. hex key шестигранный ключ
97. turn bolts and screws заваричивать болты и шурупы

98. hexagonal sockets шестигранные гнезда
99. tighten hex-head screws затягивать винты с шестигранной головкой
100. ceiling fan потолочный вентилятор
101. light fixture светильник
102. coax connector коаксиальный разъем
103. customers' needs потребности клиентов
104. to maintain the shielding on the cable поддерживать экранирование кабеля
105. reliable надежный
106. long-lasting продолжительный, долговечный
107. wire stripper устройство для зачистки проводов
108. remove снимать, удалять
109. replace заменять
110. reveal раскрыть, обнажить
111.voltmeter or multimeter вольтметр, мультиметр
112. read voltage levels считывать уровни напряжения
113. verify проверить
114. voltage meter измеритель напряжения
115. circuit цепь, электрическая цепь
116. direct current (DC) постоянный ток
117. alternating current (AC) переменный ток
118. amperage сила тока
119. resistance сопротивление
120. DC voltage напряжение постоянного тока
121. DC amperage сила постоянного тока
122. DIYers мастера-изготовители
123. wire crimper обжимные щипцы
124. non-contact voltage tester бесконтактный тестер напряжения
125. detect определять
126. touching касание, прикосновение
127. built-in sensor встроенный датчик
128. supply cord шнур питания
129. electrical outlet электрическая розетка
130. bit долото
131. reaming bit расширяющее долото
132. wiring route маршрут подключения, трасса электропроводки
133. drill дрель
134. hole отверстие
135. enlarge увеличивать
136. finish holes обработать отверстия
137. dimensions размеры
138. conduit bender сгибатель труб, устройство для гибки проводов
139. lever рычаг, рукоятка
140. bend
141. angle угол
142. curve изгибать, изогнуть
143. adjust корректировать
144. obstacle препятствие
145. splicing connector соединительный разъем для сращивания
146. clip зажим, скоба, клипса, фиксатор
147. sharp острый

148. insert вставка
149. insulating jacket изолирующая оболочка
150. circuit analyzers анализаторы цепей
151. fittings арматура, фитинги
152. arc faults неисправности дуги, дуговые замыкания
153. polarity reversal изменение полярности
154. circuit finders устройства для поиска цепей
155. outputs выходы
156. transmitter передатчик
157. receiver приемник
158. hook up подключиться
159. breaker выключатель

Exercise 2. Read the international words and guess their meanings.

Electrical, project, comfortable, effectively, discuss, basic, start, electrician, detailed, connection, center, metal, identical, contractor, cable, distance, process, plastic, vinyl, materials, electricity, professional, typically, type, object, system, battery, non-metallic, specially, style, regularly, voltmeter, multimeter, instrument, tester, non-contact, section, component, finish, telephone.

Exercise 3. Read and translate Text 1.

Text 1. Types of Electrician Tools

Source: https://www.theengineerspost.com/electrician-tools/

As with any other repair or improvement project, you will need some necessary tools to perform electrical work in your home. A safe, comfortable, and accurate electrician's work depends on the tools he uses.

It is essential for electricians to have a range of heavy-duty, insulated hand tools and high-tech tools in their toolbox to do their job effectively and safely. There are several essential hand tools that you'll need for a residential electrical project, such as a hammer, tape measure, level, and screwdriver.

Additionally, there are many other tools that you may not have encountered before. Special electrical tools are readily available at most home centers, hardware stores, and electrical supply stores. So now we will discuss the most basic and essential tools every electrician needs. Let's start.

Pliers, also known as cutting pliers or lineman's pliers, are used to bend and twist wires whenever you make a screw-terminal connection. The long and narrow tip of the pliers makes it an excellent tool for the detailed work of electricians.

A screwdriver is a portable device that allows you to screw and unscrew easily. It usually consists of a metal rod with a flat end that fits into the top of the screw. Electricians use various high-quality insulated screwdrivers to loosen and fasten multiple pieces of hardware.

Electrician hammers look almost identical to claw hammers. An electrician hammer has an insulated fibre glass handle with a rubber-coated grip, making it safe for electrical work. Its long, striking face allows contractors to work in tight areas. A hammer is essential for driving wire staples when anchoring new electrical cables to framing members.

Tape measure is a hand tool commonly used to measure distance or size. It is like a long flexible ruler with a case, thumb lock, tape, hook, and sometimes a belt clip. A tape measure can have an Imperial reading, a metric reading, or both. A standard tape measure is used for all area measurements, such as setting heights for switches and marking surfaces for cutouts. Tape measures with magnetic tips, multi-step locks, and other features

make the process easier.

The primary purpose of electrical tape worldwide is to insulate and protect wires and other connections. The electrical tape is made of plastic, vinyl, or fiber glass fabric, which is sensitive to pressure and is needed for insulating wires or other materials that conduct electricity.

Almost every electrician, from beginner to professional, uses fish tape. A fish tape pulls the electrical or other wires through the conduit. It is typically housed in a retractable coil and can be fed through installed conduit piping.

Cable ties are also known as a hose tie or zip tie, it is a type of fastener for holding objects together, primarily electrical cables and wires. Every electrician should keep the electrical space neat and organized with cable ties.

A level is essential when installing lighting fixtures, finding the exact point for placement. The level is also considered an electrician's tool, as it helps the electrician ensure that fixtures, screws, and other installations are placed where they should be.

A cable is two or more wires that run side by side and are tied, bent or braided together to form a single electrical assembly. Cable lugs are devices used to attach cables to electrical equipment, other cables, surfaces, or systems. Similar to jumper cables and car batteries, wires, and cable lugs connect wires to appliances, cables, and other devices that require power. Clamps connecting wires to an automotive battery are a typical example of a cable lug, as are the ends of a battery jumper cable.

Flashlights are crucial devices that provide illumination by using some battery cells. Sometimes the electrical repair work involves many dark areas, from basements to wall and ceiling cavities, to the inside of electrical boxes. A flashlight is needed for security as much as it is for convenience. A few handheld flashlights and a headlamp are excellent for a DIY electrician's toolbox.

A utility knife is handy for cutting sheathing from non-metallic cables, cutting electrical tape, and opening cardboard boxes. In addition, it also serves many functions, including cutting and stripping cables, cutting electrical tape and insulation, and cutting and opening tool boxes and packages.

An allen wrench set is also known as a hex key. It is a small handheld tool used to turn bolts and screws with hexagonal sockets. Allen wrenches tighten hex-head screws, sometimes found on ceiling fans, light fixtures, and appliances.

A coax connector is an electrician's tool used to connect cables to other equipment and is specially designed to maintain the shielding on the cable. Different connectors are available, and having variety on hand ensures that you always meet your customers' needs. High-quality connectors provide reliable, long-lasting connections. There are two different connector styles available that are; male and female.

A wire stripper is a portable handheld tool used by electricians to remove the protective coating of an electrical wire to replace or repair a wire. Professional electricians regularly strip plastic sheathing from wires to reveal copper and make customized connections.

Voltmeters read voltage levels and verify whether circuits are ‘live’ or off. Also known as a voltage meter, it is an instrument used to measure the potential difference between two points in an electrical or electronic circuit. Some voltmeters are used for direct current (DC) circuits; Others are designed for alternating current (AC) circuits. More forms of this instrument are known as multimeters, and they can read not only voltage levels but also amperage, resistance, and DC voltage and amperage. Advanced DIYers and professional electricians mainly use it.

A voltage tester is used for a quick safety check to ensure there is no voltage across an electrical wire or appliance before you start working on it. Non-contact voltage testers run on batteries and are the simplest and safest type of tester because they can detect pow-

er simply by touching the wire. It has a built-in sensor at the tip of the tester that detects the presence of voltage when a conductor, outlet, or supply cord is touched.

Installing a new conduit or replacing old ones means connecting different piping sections to form a wiring route between electrical components. A reaming bit connects to an electric drill. Remember that a reamer cannot be used to make a hole. It enlarges the opening at one end of the piping, allowing it to connect to another section of piping and complete a safe conduit. In addition, they are used to finish holes of the exact dimensions that have been drilled, bore, or cored.

A conduit bender is a device made with a very long lever, which is used to bend angles in a conduit into which electrical wires are placed. When choosing a wiring route, electricians often run wires along the wall's corner or in other hidden areas. They curve conduit piping to adjust these routes and ensure that conduit is laid non-intrusively and efficiently in the customer's home. Also, it is used to bend the pipe in different directions and around obstacles instead of making fittings.

A splicing connector consists of a plastic clip with a sharp metal insert that will cut securely through the plastic insulating jacket of the two wires and crimp them together. A splice connector can be used with many cables, including device wires, telephone cables, and electrical cables.

A circuit analyzer is a digital handheld electrician tools that determine whether an output is wired correctly or not. The circuit analyzer checks for various conditions, including correct wiring, polarity reversal, no ground, and tests for arc faults.

Modern electricians use a circuit breaker finder to find out which ouputs are connected to which circuit in the work area. It is a small battery-powered electronic device consisting of two parts transmitter and receiver. When an electrician hooks up the transmitter to a circuit in the breaker, the device sends a signal to the receiver about which circuit the outlet belongs to

Exercise 4. Answer the questions.

1. What does the safe, comfortable and accurate work of an electrician depend on?
2. What essential hand tools will you need for a residential electrical project?
3. Where are special electrical tools readily available?
4. What tool is used to bend and twist wires whenever you make a screw-terminal connection?
5. What is a screwdriver?
6. What purpose do electricians use various high-quality insulated screwdrivers for?
7. What is a hammer essential for?
8. What instrument is like a long flexible ruler with a case, thumb lock, tape, hook, and sometimes a belt clip?
9. What do electricians apply to insulate and protect wires and other connections?
10. Why is the electrical tape made of plastic, vinyl, or fiberglass fabric?
11. What does a fish tape do?
12. What instrument is a type of fastener for holding objects together, primarily electrical cables and wires?
13. What helps the electrician ensure that fixtures, screws, and other installations are placed where they should be?
14. Cable lugs are devices used to attach cables to electrical equipment, aren`t they?
15. What kind of crucial devices provide illumination by using some battery cells?
16. What functions does a utility knife serve?
17. What is the name of the tool used to turn bolts and screws with hexagonal sockets?

18. What is the electrician's tool used to connect cables to other equipment and is specially designed to maintain the shielding on the cable?

19. What is a wire stripper?

20. This is an instrument used to measure the potential difference between two points in an electrical or electronic circuit. What is it?

21. What tool has a built-in sensor at the tip of the tester that detects the presence of voltage when a conductor, outlet, or supply cord is touched?

22. Can a reaming bit be used to make a hole?

23. Is a conduit bender used to bend angles in a conduit into which electrical wires are placed?

24. What does the splicing connector consist of?

25. What does the circuit analyzer check for?

26. What is a circuit finder?

Exercise 5. Read the employee manual of Talbot Electrical Services company about basic tools of electrician and complete the gaps (1-8) with the words given in the box.

Wire strippers, utility knife, tool kits, pliers, side, screwdrivers, measuring tape, long nose

Source: Virginia Evans. Career Paths: Electrician/ Virginia Evans, Jenny Dooley, Tres O`Dell. - Newbury.: Express Publishing, 2012.- p.4

All employees of Talbot Electrical Services will bring their own tool 1)…. Tool kits need to contain the basic tools needed for electrical jobs. These basic tools are sold at most hardware stores. 2)… are needed for pulling and cutting wires. Your kit needs to include 3) … pliers and end cutting pliers. 4) … cutters and diagonal cutters are recommended. You must have 5) … in your kit. Make sure they are able to strip the most common wires. You will also need several types of 6) … on the job. A flashlight, 7) … and 8) … will round out your kit.

Exercise 6. Match the types of electric tools (1-6) with their definitions (a-f).

Source: Virginia Evans. Career Paths: Electrician/ Virginia Evans, Jenny Dooley, Tres O`Dell.- Newbury.: Express Publishing, 2012.- p.4

1. tool kit	a. a tool with blades able to grip or cut wires
2. side cutters	b. a tool used to tighten or loosen screws
3. screwdrivers	c. a tool for cutting, twisting or pulling wires
4. long nose pliers	d. a tool used to pull the covering off of wires
5. measuring tape	e. a tool used for finding the length of an object
6. wire stripper	f. a bag or box used to hold a set of tools

Exercise 7. Read information from catalog about drills and saws and complete the gaps (1-6) with the words given in the box.

Saws, jigsaw, drill, wood augers, bits, reciprocating saw

Source: Virginia Evans. Career Paths: Electrician/ Virginia Evans, Jenny Dooley, Tres O`Dell. - Newbury.: Express Publishing, 2012.- p.8

Electricain`s Drill Bit Kit $59.95

All electricians need a high-quality drill. Along with it, they need lots of 1) … bits. The Electrician's Drill Bit Kit has everything you need. It contains several spade 2) … . These bits are perfect for most jobs. For other jobs, the kit has auger bits, hole saw bits and 3) … . Also included are twelve twist bits.

Electricain`s Power Saw Set $169.99

This set includes three 4) … all electricians should have. The tough circular saw cuts through anything! The powerful 5) … comes with five blades. Finally, the 6) … is perfect for cutting.

Exercise 8. Work in pairs. Read and translate the dialogue between a husband and a wife buying tools at a hardware store. Act it out. Then compose and act your own dialogue out, using new words on the theme Electrician Tools.

Source: https://englishtopic.ru/buying-tools-at-a-hardware-store-2/

Chuck: Just remember that we have a lot to accomplish today, so let's just get what we need and go, okay?

Ayaka: Sure, we just need a few tools for our DIY project. The power tools are over there.

C.: Whoa, we're not getting power tools. We just need a few simple hand tools: a hammer, a wrench, a chisel, some pliers – and maybe an extra screwdriver or two.

A.: We would get the job done so much more quickly if we had power tools. Instead of a hammer, we should get a nail gun. We also need a power drill, and hey, a sander and a table saw.

C.: A table saw?! We're doing some simple repairs, not remodeling our house.

A.: You never know when you need a good saw and I've always wanted a table saw.

C.: Other women want clothes and jewelry, and you want power tools?

A.: That right. You should be counting your lucky stars!

Exercise 9. Search the Web for electrician tools you consider the most important for a highly qualified electrician and make a presentation about it.

Exercise 10. Look through Unit 4 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 5. Electrical Safety

Exercise 1. Read and memorize the words and word combinations.

1. electrical safety электрическая безопасность
2. rule правило, норма
3. essential существенный, основной
4. pose v. излагать, формулировать
5. hazard опасность, риск, угроза
6. injury травма, ушиб, рана
7. burn n. ожег
8. electrocution поражение электрическим током
9. death смерть
10. crucial важнейший, крайне важный, критический
11. prevent предотвращать
12. ensure обеспечить
13. efficiently эффективно
14. proper правильный
15. precaution меры предосторожности
16. guideline инструкция, руководство
17. property собственность
18. environment окружающая среда

19. measure мера
20. explosion взрыв, вспышка
21. malfunction неисправность, сбой
22. in addition в дополнение, вдобавок, кроме того
23. electrical safety regulations правила электробезопасности
24. electrical safety standards стандарты электробезопасности
25. be designed быть спроектированным, быть сконструированным
26. be installed быть установленным
27. be maintained поддерживаться в рабочем состоянии
28. compliance соответствие, соблюдение требований
29. reliable надежный
30. efficient эффективный
31. familiarize ознакомиться
32. basics основы
33. fundamentals основы, основные принципы, положения
34. attempt v пытаться, пробовать
35. repair ремонт
36. knowledge знание
37. recognize распознавать
38. avoid избегать
39. dangerous опасный
40. grasp понять, осознать, уяснить
41. current ток, сила тока
42. voltage напряжение
43. resistance сопротивление
44. circuit схема, электрическая цепь
45. grounding заземление
46. fuse предохранитель
47. circuit breaker автоматический выключатель
48. insulation изоляция
49. electric shock электрический шок, электрический удар
50. gaining получение
51. be broken down into быть разбитым на
52. device устройство
53. compatibility совместимость
54. compatible совместимый, сочетаемый
55. be connected to быть связанным с
56. voltage compatibility совместимость по напряжению
57. wattage мощность
58. current capacity пропускная способность, существующая мощность, существующий потенциал
59. plug штекер, вилка, розетка
60. connector разъем, розетка
61. damaged поврежденный
62. cord шнур, кабель, провод
63. outlet розетка
64. safety features средства безопасности
65. appropriate соответствующий, надлежащий
66. tool инструмент
67. success успех, удача, достижение

68. perform the job выполнить работу
69. accident несчастный случай, авария, катастрофа
70. insulated изолированный
71. in good condition в хорошем состоянии
72. safety gear защитной снаряжение
73. avoid избегать
74. overloading перегрузка, чрезмерная нагрузка
75. unplug отключить, отсоединить
76. temporary временный
77. solution решение
78. **s**ubstandard нестандартный, некачественный
79. high-quality высококачественный
80. reduce уменьшать, сокращать
81. meet requirements отвечать требованиям
82. inferior низкий, некачественный
83. increase увеличивать, возрастать
84. cautious осторожный, внимательный
85. counterfeit подделка, фальшивка, контрафакт
86. packaging упаковка
87. labeling маркировка
88. modify модифицировать, видоизменять
89. alter изменять
90. void аннулировать
91. purchase покупать
92. manufacturer instructions инструкции производителя
93. DIY repair ремонт своими руками
94. be wary of опасаться чего-либо
95. electrocution поражение электрическим током
96. source источник
97. ground fault circuit interrupter выключатель системы короткого замыкания на землю
98. outdoor equipment наружное оборудование
99. be aware of быть осведомленным
100. damp влажный
101. warning sign предупреждающий знак
102. concise краткий, лаконичный
103. graphics графика, рисунки
104. replace заменить
105. prominent location видное место
106. insulated rubber gloves резиновые изоляционные перчатки
107. goggles защитные очки
108. non-conductive неэлектропроводный
109. footwear обувь

Exercise 2. Read the international words and guess their meanings.

Electricity, form, energy, accident, result, electrical, system, effectively, risk, minimize, procedure, potential, regulation, standards, situation, concept, ampere, volts, ohm, shock, inspect, test, product, certification, extremely, correctly, regularly, manufacture, location, personal, non-conductive.

Exercise 3. Read and translate Text 1.

Text 1. Electrical safety rules

Source: https://www.hseblog.com/electrical-hazards-and-the-injuries/

Electricity is one of the most essential forms of energy used in our daily lives. While it makes life easier, it also poses a significant risk of electrical hazards. Electrical accidents can result in severe injuries, including burns, electrocution, and even death. Electrical safety is crucial to prevent accidents and ensure electrical systems operate efficiently and effectively. To minimize the risk of electrical hazards, it's important to follow the proper safety rules and precautions.

Following electrical safety guidelines and procedures can prevent accidents, which helps protect people, property, and the environment. Electrical safety measures also help minimize the risk of fires, explosions, and other potential hazards resulting from electrical malfunctions.

In addition, electrical safety regulations and standards ensure that electrical systems are designed, installed, and maintained according to safety standards and that electrical workers are properly trained to work safely with electricity. Compliance with these standards ensures that electrical systems are reliable, efficient, and safe for everyone who uses them.

Here are ten electrical safety rules you need to know:

1. Familiarize yourself with the basics: Understanding the fundamentals of electricity and electrical safety is crucial before attempting any electrical work or repairs. This knowledge will help you recognize potential hazards and avoid dangerous situations. Here are some key concepts to grasp: electrical current (measured in amperes A); voltage (measured in volts V); resistance (measured in ohms Ω); circuit; grounding; fuses and circuit breakers; insulation; and electric shock.

2. Understand your equipment: Gaining a thorough understanding of your equipment is essential for electrical safety. This rule can be broken down into two aspects: know how your equipment operates; ensure compatibility of equipment.

Before using electrical devices or appliances, ensure they are compatible with each other and the electrical system they are connected to. This includes: voltage compatibility; wattage and current capacity; and plugs and connectors.

3. Inspect before you use: Inspecting electrical equipment thoroughly before use is crucial in ensuring safety. Damaged or malfunctioning devices can lead to accidents, electric shocks, or fires. Follow these guidelines when inspecting electrical equipment: check cords and plugs; inspect power outlets; examine the equipment; and test safety features.

4. Use the right tools for the job: Using appropriate tools and safety equipment for electrical work is essential for your safety and the task's success. The right tools can help you perform the job effectively and minimize the risk of accidents. Follow these guidelines when selecting and using tools for electrical work: choose insulated tool; select the correct size and type; keep tools in good condition; and use appropriate safety gear.

5. Be careful with extension cords: Using extension cords safely is essential to prevent electrical fires and accidents. Follow these guidelines when using extension cords: choose the right cord; avoid overloading; unplug correctly; keep cords visible; inspect cords regularly; and use temporary solutions.

6. Do not use substandard products: Using high-quality certified electrical products is crucial for ensuring safety and reducing the risk of accidents or fires. Substandard products may not meet safety requirements or be made with inferior materials, increasing potential hazards. Follow these guidelines when selecting electrical products: look for safety certifications; be cautious of counterfeit products; check for recalls; inspect packaging and labeling.

7. Do not modify electrical products: Modifying electrical products can be extremely dangerous and may result in electrical shock, fires, or other accidents. Altering a prod-

uct can also void its safety certifications, such as UL or ETL approval. Follow these guidelines to avoid modifying electrical products: purchase products that meet your needs; do not modify products; follow manufacturer instructions; and be cautious of DIY repairs.

8. Be wary of water: Water is a conductor of electricity, and mixing water with electrical equipment can lead to electrical shock or even electrocution. Follow these guidelines to minimize the risk of electrical hazards around water: keep electrical equipment away from water sources; use ground fault circuit interrupters (GFCIs); be cautious with portable devices; protect outdoor equipment; and be aware of damp conditions.

9. Install warning signs: Installing warning signs in areas where electrical hazards may be present can help prevent accidents and injuries. Follow these guidelines when installing warning signs: identify potential hazards; use clear and concise language; use appropriate graphics; place signs in prominent locations and replace damaged or missing signs.

10. Use personal protective equipment (PPE): When working on electrical circuits or equipment, it's important to use PPE to minimize the risk of electrical shock or injury. Follow these guidelines when using PPE: use insulated rubber gloves; wear goggles; use non-conductive footwear; wear appropriate clothing; and follow manufacturer instructions. Using appropriate PPE can help protect yourself from electrical hazards and minimize the risk of injury or electric shock.

Exercise 4. Answer the questions.

1. What is one of the most essential forms of energy used in our daily lives?
2. What can electrical accidents result in?
3. What is important to follow to minimize the risk of electrical hazards?
4. What ensures that electrical systems are reliable, efficient, and safe for everyone who uses them?
5. Could you list electrical safety rules that are mandatory for any electrician during work?
6. What is crucial to know for recognizing potential hazards and avoiding dangerous situations?
7. What should you do before using electrical devices or appliances?
8. What does the compatibility with devices and the electrical system include?
9. Damaged or malfunctioning devices can lead to accidents, electric shocks, or fires, can`t they?
10. What guidelines should you follow when inspecting electrical equipment?
11. Do you have any recommendations for a person selecting electrician tools for work?
12. What is important to know when using extension cords?
13. What products are crucial to use for ensuring safety and reducing the risk of accidents or fires?
14. What can be extremely dangerous and may result in electrical shock, fires, or other accidents?
15. Is it safe or dangerous to mix water with electrical equipment?
16. What signs can help prevent accidents and injuries?
17. Could you enumerate personal protective equipment (PPE) minimizing the risk of electrical shock or injury?

Exercise 5. Read about types of electrical hazards and complete the gaps (1-8) with the words and word combinations given in the box.

Requirements, flammable vapors, equipment, incidents, damage, thermal radiation, significant, electrical wires

Source: https://studyelectrical.com/2022/01/electric-safety-5-rules-you-need-to-know.html

Types of electrical hazards

Electricity is widely recognized as a severe hazard, whether at home or office. The cause of electrical 1) … usually varies; however, further studies revealed that the underlying reason for such incidents is a combination of three primary factors, including unsafe work equipment, environment, and practices.

You can identify faulty electrical 2) … and installations by checking for any signs of damage such as improper grounding, loose connections, defective parts, unguarded live parts, etc. Unsafe working conditions primarily revolve around employees working with hazardous materials, including 3) …, liquids, or gases, and working in areas with a corrosive atmosphere and humid regions.

The human body is an excellent electrical conductor, so people are more conductive than the ground. Injuries happen when people become part of the electrical circuits, and each 4) … can occur in various ways:

– Electric-powered shocks occur when the human body becomes a path through which electrons can pass. The effect may either be direct or indirect.

– Burning injuries happen when a person has direct contact with improperly installed 5) … or equipment. This type of injury usually occurs on the hands.

– Arc blasts result from high temperatures from high voltage current arcing through the person's immediate surroundings. Several factors cause arc blasts, but the most common ones were when two energized points contact and worker incidents caused by faulty equipment and wiring. There are three primary risks involving arc blasts: 6) …, pressure wave, and projectiles.

– Explosions occur when electricity provides an ignition source for nearby explosive materials. Electrical ignition usually comes from overheated conductors, equipment, or normal arcing (sparking) at switch contacts. Due to the severity of explosion accidents, the National Electrical Code and OSHA have specific 7) … for electrical systems in explosion-prone areas.

– Electrical accidents usually lead to fires in the home and workplace. One of the 8) … causes of electricity-related fires is defective and misused electrical equipment or appliances.

Exercise 6. Match the safety tools of electricians (1-7) with their descriptions (a-g).

1. arc shield	a. trousers, shirts, jackets, and shoes protecting from shocks or explosions
2. electrical hot gloves	b. are forms of protective eyewear that usually enclose or protect the area around the eyes to prevent particles, water, or chemicals from hitting the eyes
3. rubber mat	c. plastic shield protecting eyes and face
4. arc flash blanket	d. gloves made of special dielectric material that protect electrician from shocks
5. hot stick	e. a mat made of rubber allowing the electrician to stand on it without danger
6. arc flash clothing	f. a fiberglass rod protecting from shocks
7. safety glasses	g. a blanket used to protect from explosions or electrical shock

Exercise 7. Read the paragraph about safety measures in domestic installations and complete the gaps (1-10) with the words and word combinations given in the box.

Electricity, plugs, insulation, interference, fuse wire, conduit pipes, crude, sockets, fire extinguisher, appliances

Information source: https://industrialsafetyguide.com/electrical-safety-at-home/

Safety Measures in Domestic Installations

– Do not tamper with meter boards and cutouts that are sealed by the supplier. 1) … with these is an offense under the law.

– Do not touch an electric switch or 2) … when your hands are wet or bleeding from a cut or an abrasion.

– Do not be absent-minded while replacing the fuse or inserting 3) … for fans, heaters, etc.

– Do not use copper wire as a substitute for 4) … .

– Do not renew a blown-out fuse until you are satisfied as to the cause and have it rectified for any irregularity.

– Do not use wires with poor 5) … .

– Do not wear loose clothing. Metal watch straps, bangles, or finger rings while working on electrical appliances.

– Do not hang clothes and such other things on electrical fittings.

– Do not hang wet clothes for drying on the service lines or the 6) … .

– All the electrical appliances such as electric iron, toasters, grinders, hot plates, etc. should be connected to the 3-pin plugs and 7) … which have one of its terminals connected to the earth.

– Temporary extension of wires should be avoided.

– The use of 8) … and improvised heating elements for boiling water should be avoided.

– It is safe to use rubber slippers while handling the switches etc. during the replacement of fuses or minor repairs.

– Always have a 9) … handy in the house. (Carbon dioxide extinguishers (CO2) and Powder extinguishers are used to extinguish the electrical fire)

– Never use water while the power is on. Water is a natural conductor of 10) … and if you throw water on an electrical fire, you can get shocked.

Exercise 8. Work in pairs. Read and translate the dialogue between a student and an experienced electrician talking about rules for work in the city. Act it out.

Information sources: https://en.satta-baba.com/tehnika-bezopasnosti-elektrika-sdacha-ekzamena-po-tehnike-bezopasnosti-po-elektrike-nabor-dielektricheskogo-read-383644

Student: Good morning, Mr. Philips.

Electrician: Good morning, Andrew. How are you doing?

S.: I am fine, thanks. And you?

E.: Me too, thanks. As I know, you are studying at the university now.

S.: That's true. My future profession is an electrician and I would like to ask you some questions about electrical safety. It is really important for me to know how to work safely especially in the city.

E.: Well, an important role is played by the categories of an electrician for repair and maintenance of electrical equipment. If a specialist has a low discharge, then he cannot work with high-voltage lines.

S.: Why?

E.: The fact is that in the city the safety rules are somewhat different, and therefore they need to be known in a strict manner. This is especially true for those who work with electrical installations from 1000 volts.

S.: What must a qualified specialist do if he detects malfunctions in the operation of the equipment?

E.: If malfunctions are detected in the operation of the equipment or in the safety rules, then electricians are required to independently take measures to prevent accidents.

When this is not possible, it is necessary to notify the authorities as soon as possible so that it takes action.

S.: Mr. Philips, I am convinced that an excellent electrician must be a responsible, an attentive and a careful person! I heard that electricians of urban networks after having completed training and confirmed their knowledge, receive a qualification group for safety measures, according to which they work in the future, don't they?

E.: Yes, that's right. Besides, personnel who work with voltages above 1000 volts are assigned a specific tolerance group.

S.: How many specific tolerance groups are there?

E.: It is a good question. There are five of them. The first group is given to construction workers, students of electricians, and general laborers. The second group includes assistants to electricians, electricians, and electricians who supervise the routes.

S.: And what about the rest groups?

E.: As for the third group, it is assigned to electricians and electricians. Senior electricians and electricians get a fourth group. The fifth one goes to engineers, craftsmen, technicians.

S.: Thanks a lot for information. I will have an exam in three weeks. I must go home to read for it.

E.: No, problem. You are welcome. Good luck at the examination!

Exercise 9. Search the Web for the main electrical safety rules in Russia. Make a presentation.

Exercise 10. Look through Unit 5 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Part 2. Auto Electrics and Electronics

Unit 1. *Car Electrical System: Function, Subsystems and Parts*

Exercise 1. Read and memorize the words and word combinations.

1. electrical system электрическая сеть
2. circuit контур; схема; цепь
3. voltage вольтаж, электрическое напряжение
4. electrics электрооборудование
5. electric wiring электропроводка
6. alternator генератор переменного тока
7. electric current электрический ток
8. actuator привод; исполнительный механизм; управляющее устройство; выключатель; переключатель
9. power window электрический стеклоподъёмник
10. metal body металлический кузов
11. subsystem подсистема
12. ignition system система зажигания
13. charging system система подзарядки
14. starting system пусковая система, система пуска
15. fuel system система подачи топлива; топливная система
16. lighting system система освещения
17. electrically электрически; электрическими средствами
18. electronically электронно; при помощи электронных устройств, компьютера; на основе электроники

19. fuse предохранитель, плавкий предохранитель
20. relay реле
21. battery аккумулятор; (аккумуляторная) батарея
22. starter motor стартерный электродвигатель, стартёр
23. safety device защитное (предохранительное) устройство
24. short circuit короткое замыкание
25. predetermined заданный, предопределённый
26. current value значение тока
27. overload перегрузка; перенапряжение
28. blow плавиться (о предохранителе); перегорать
29. fuse terminal клемма предохранителя; плавкий контакт
30. encased помещенный в корпус
31. resistive material резистивный проводниковый материал
32. soldered запаянный; припаянный, спаянный
33. fuse box блок плавких предохранителей
34. aftermarket вторичный рынок дополнительной периферии, запасных частей, аксессуаров и т.п.
35. in-line fuse предохранитель проводки
36. trigger триггер; пусковая схема
37. electromagnetic switch электромагнитный выключатель
38. cooling fan охлаждающий вентилятор
39. ABS (antilock brake system) антиблокировочная тормозная система, АБС
40. horn клаксон
41. three-pin трёхконтактный, трёхштырьковый
42. low amperage circuit слаботочная цепь
43. coil circuit контур катушки; цепь катушки
44. high amperage высокая сила тока
45. DIN (Deutsche Industrie Norm) немецкий промышленный стандарт; стандарт DIN
46. pin штырь; контакт
47. electrochemical электрохимический; электролитический
48. power bank банк мощности
49. lead-acid battery свинцово-кислотная батарея
50. lead plate листовой свинец, рольный свинец
51. submerged затопленный; погружённый
52. sulfuric acid серная кислота
53. stabilizer стабилизатор
54. voltage spikes выброс напряжения; импульсные скачки напряжения
55. electromechanical device электромеханическое устройство
56. engine belt ремень двигателя/мотора
57. AC (alternating current) переменный ток
58. DC (direct current) постоянный ток
59. rectifier ректификатор; выпрямитель (тока)
60. excitation намагничивающая сила; намагничивание (током)
61. exciter wire провод возбудителя
62. non-self-exciting alternator генератор без самовозбуждения
63. excitation current ток возбуждения; ток намагничивания
64. self-starter автоматический завод, стартёр, самопуск
65. crank заводить, запускать
66. engine casing машинный кожух; кожух двигателя

67. transmission housing корпус коробки подач
68. starter motor armature якорь стартёра
69. commutator коллектор
70. brush щётка
71. pinion gear ведущая шестерня
72. overrunning clutch муфта свободного хода; муфта Бендикса; бендикс
73. field coil катушка
74. permanent magnet постоянный магнит
75. planetary gear set планетарная передача
76. solenoid соленоид, электромагнитная катушка
77. motor assembly силовой узел; силовой блок
78. electromagnetic switch электромагнитный выключатель

Exercise 2. Read the international words and guess their meanings.

Basic, function, electrical system, generate, distribute, voltage, electrical components, electrics, battery, starter, sensors, computers, sensors, radio, starter motor, metal, starting system, harmoniously, electrically, electronically, relay, principle, effect, designed, situation, metal element, plastic, resistive material, zinc, aluminum, cabin, control, trigger, electromagnetic, maximum, conditioner, types, automobile industry, amperage, standard, electrochemical device, bank, chemical form, convert into electrical form, reservoir, stabilizer, regulate, electro-mechanical device, mechanical energy, electrical energy, rectifier, transmission, armature, commutator, magnet, solenoid.

Exercise 3. Read and translate Text 1.

Text 1. Car Electrical System: Function, Subsystems and Parts

Source: https://www.easycarelectrics.com/how-car-electrical-system-works/

In the early time, most of the vehicle's circuits were simple, containing a few basic circuits such as lighting, wiper, etc. Over time the vehicle's circuits got updated, which increased its complexity.

The function of a car's electrical system is to generate, store and distribute voltage to all of the electrical components in the vehicle. The vehicle electrics is the system of electric wiring and a number of different parts, including the battery, alternator, starter, and various sensors and switches. The vehicle electrics interconnects all the car's electrical parts with each other by carrying electric current and voltage to all the parts such as various computers, sensors, actuators, motors, gauges, power windows, radio, headlights, sunroof, starter motor, and many other electrical components. All the electrical components receive voltage from the battery and return it to the battery through the car's metal body.

The car's electrical system consists of several smaller electrical subsystems such as an ignition system, a charging system, a starting system, a fuel system, a lighting system, etc., which work together harmoniously. In all electrical subsystems, one thing is a must, and that is the need for voltage.

Every part in a vehicle that operates electrically or electronically is called a vehicle electrical system's part. A car's electrical system has hundreds of electrical and electronic parts. The major car electrical system parts are a fuse, a relay, a battery, an alternator and a starter motor.

The ***fuse*** is the most essential part of the car's electrical system. It is a safety device used to protect electrical wiring from damage in the event of a short circuit. A fuse kills itself when the current exceeds its predetermined current value. Ideally, every electrical circuit in a car should have a fuse to protect the circuit from damage in an overload event. The fuse's working principle is based on the heating effect of the current. It is designed to

blow into an overload situation and break the connection. A fuse contains a metal element and two terminals encased by a plastic housing body. The metal element is a resistive material made from zinc, copper, or aluminum, which produces heat when the current flows through it. When the current exceeds its predetermined current value, too much heat is produced in the fuse element, which causes the fuse to blow. The fuse element is soldered to the fuse terminals. Fuses are located in the fuse box inside the cabin or outside the engine compartment. Some aftermarket circuits use an inline fuse.

The ***relay*** is a very important car electrical system part. It can control many electrical circuits with a single trigger. A relay is an electromagnetic switch used to connect and disconnect the electrical circuit. It is mostly used in heavy circuits, which consume a tremendous amount of current. The relay controls a large amount of current by using a small amount of current to avoid a load on the wire. The engine cooling fan uses a relay to provide a high amount of current to the cooling fan for maximum cooling. The car air conditioner, ABS motor, headlight, starter motor, horn, etc. use a relay in the same way. Relays are fitted alongside fuses in the fuse box. Usually, there are three types of relays used in the automobile industry; they are the three-pin, four-pin, and five-pin relays. The four and five-pin relays are the most common in a vehicle. A relay has two circuits, a low amperage circuit (coil circuit) and high amperage circuit. Moreover, the pins of a relay are numbered 85, 86, 30, 87, and 87a according to the DIN standard. Pins number 85 and 86 are considered low amperage circuit (coil circuit) pins, while 30, 87, and 87a pins are considered high amperage circuit ones.

The ***battery*** is the heart and most necessary part of a car's electrical system. It is the basic source of electricity in the car's electrical system. The battery provides electric current through the wires to all the electrical components. The battery is an electrochemical device and a power bank, which stores the electrical current in chemical form and converts it into electrical (electric current) form when required. With the engine OFF, the battery provides the current to all the electrical circuits, including the ignition and starting circuit to start the engine. And when the engine starts, then the alternator supplies the current to all the electrical circuits. The lead-acid battery is one of the most common batteries in the car. It contains lead (Pb) plates submerged in sulfuric acid (H_2SO_4). The battery acts as a reservoir when the current demand is higher than the alternator produces, the battery provides additional current to the electrical circuits. Similarly, the battery acts as a stabilizer, it regulates damaging voltage spikes when the engine is running.

The ***alternator*** is one of the essential parts of the car's electrical system. The alternator is an electro-mechanical device, which converts mechanical energy into electrical energy driven by the engine belt. The alternators produce AC that is converted to DC by a rectifier. The alternator provides electrical power to the car's electrical system and battery while the engine is running. It initially needs the current to start producing the electric current. This initial current is known as excitation, in which the alternator is excited by the battery ignition switch through the exciter wire. The type of alternator, which needs an excitation from the battery to start producing electric current, is called a non-self-exciting alternator. Some alternators do not need an excitation current; those types of alternators are called self-exciting alternators. A fully charged battery gives almost 12.6 volts (with the engine off), and a good working alternator produces almost 14 to 14.6 volts.

The ***starter motor*** is an electrical component of the car's electrical system that helps in starting the car. The starter motor, also called a starter or self-starter, is a device used to crank the engine. It converts electrical energy into mechanical energy in an internal-combustion engine. It is mounted on the back of the engine casing or in front of the transmission housing. The starter motor consists of several parts such as an armature, a commutator, brushes, a pinion gear, an overrunning clutch, a field coil or a permanent magnet,

and a planetary gear set. All these parts get combined, creating the starter motor. A solenoid fits on the starter motor assembly, which acts as an electromagnetic switch. The solenoid connects and disconnects the battery to the starter motor.

Exercise 4. Answer the questions.

1. What is the function of a car's electrical system?
2. What is a vehicle electrics?
3. What car parts does the vehicle electrics interconnect?
4. What smaller electrical subsystems can you name?
5. What vehicle electrical and electronic parts do you know?
6. What is a fuse?
7. How does the fuse function?
8. What is a relay?
9. How does the relay work?
10. What types of relays are used in cars?
11. What is a battery?
12. What role does the battery play in the car's electrical system?
13. What is an alternator?
14. What is the principle of operation of alternators?
15. What is a starter motor?
16. What does the starter motor do?
17. What parts does the starter motor consist of?

Exercise 5. Match the electrical subsystems (1-4) with their descriptions (a-d).

1. The ignition system	a. This system provides electricity to your car's electrical system. It provides the current to your car's electrical systems and components such as starting system, ignitions system, fuel system, lighting system, radio, air conditioner, washer pump, etc. The alternator is the main component of this system. It supplies the charge to the battery and accessories. The battery stores the electrical current and initially provides the current to the car's electrical system when the engine is OFF. As the engine has been started, and the alternator starts to produce the electrical current, then the current starts to flow from the alternator to the car's electrical system.
2. The charging system	b. This subsystem is an electrical system that provides fuel to the engine cylinder. In the past, this system was mechanical – a mechanical fuel pump was used to send the fuel to the engine cylinder. Due to advancements in technology, this system started to operate electrically. The fuel tank stores the fuel that is pumped by the fuel pump through fuel pipelines to the engine cylinder. This system consists of a fuel pump, a fuel filter, an inertia safety switch, a fuse, and a relay.
3. The starting system	c. This is one of the electrical systems which function is to provide a continuous spark to the spark plug in the compression stroke of the gasoline engine cylinders. Its job is to ignite the air-fuel mixture in a gasoline engine cylinder. This system consists of many components such as ignition coils, spark plugs, batteries, fuse, and relay. The ignition coil converts the normal battery voltage to a high-voltage pulse that goes into the engine cylinder to ignite the air-fuel mixture.
4. The fuel system	d. This subsystem is an electrical system that works on the principle of converting electrical energy into mechanical energy. In the early days, the car was used to start with a mechanical hand crank. Later in 1912, the electrical ver-

	sion of this system was introduced to start the car. The function of this system is to provide an engine start. The starter motor is the main basic component in the system. It uses electrical energy and converts it into rotational energy.

Exercise 6. Work in pairs. Read and translate a dialogue between a customer and a salesman. Act it out.

Salesman: Hello! How can I help you?

Customer: Hi! I need to replace a fuse.

S.: This way, please. We have got a large selection of fuses in our shop. I think the best one in our city. Do you need a blade fuse or a tubular one?

C.: Hmm… I have no idea how it's called. But it's plastic with two metal blades.

S.: I see. Do you happen to have your burned-out fuse with you?

C.: Yes, I do. Here it is.

S.: Fine. Let's compare it with the ones we have. I guess, this one will be the right replacement.

C.: Thank you! Where's the cash desk?

S.: It's over there.

Exercise 7. Search the Web for a car electrical wiring and make a presentation about it.

Exercise 8. Look through Unit 1 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 2. Car's Basic Electrical Terminology

Exercise 1. Read and memorize the words and word combinations.

1. particle of matter элементарная частица
2. negative electrical charge отрицательно заряженный
3. flow of electrons поток электронов
4. current ток
5. electrical circuit электрическая схема
6. flow поток; движение; течь; передвигаться; перемещаться
7. power source источник питания
8. load нагрузка сети электропитания (компонент электрической сети, рассеивающий мощность, забирающий у неё часть энергии)
9. light illumination освещение
10. negative terminal отрицательный вывод, полюс аккумуляторной батареи; отрицательная клемма
11. ampere ампер, А в системе СИ – единица измерения силы электрического тока (6,25 x 10^{18} электронов в секунду), названа в честь французского физика Андре Мари Ампера
12. coulomb (C) кулон, Кл в системе СИ – единица измерения величины электрического заряда (количества электричества, unit of electrical charge), равная 6,25 x 10^{18} электронов, названа в честь французского инженера и физика Чарльза Кулона
13. direct current (DC) постоянный ток
14. go in unidirectional перемещаться только в одном направлении
15. polarity полярность
16. positive pole положительный полюс
17. negative pole отрицательный полюс
18. alternating current (AC) переменный ток

19. flow in the opposite direction изменить своё направление на противоположное
20. voltage вольтаж, электрическое напряжение
21. electromotive force электродвижущая сила
22. in a fraction of a second за долю секунды
23. positive terminal положительный вывод, полюс аккумуляторной батареи; положительная клемма
24. unit единица измерения
25. volt (V) вольт, В – единица измерения электродвижущей силы, названа в честь итальянского учёного Александра Вольта
26. joule (J, j) джоуль, Дж в системе единиц СИ – единица измерения энергии, работы и количества теплоты, эквивалентная 1 ватт/с
27. potential difference разность потенциалов
28. ignition coil катушка зажигания
29. electrical resistance электрическое сопротивление
30. material property свойство материала
31. ohm Ом – единица измерения электрического сопротивления, названа в честь Георга Ома
32. ohmmeter омметр (прибор для измерения электрического сопротивления)
33. multimeter авометр, амперовольтомметр, мультиметр
34. insulator изолятор (материал, плохо проводящий электрический ток, т.е. обладающий очень высоким электрическим сопротивлением)
35. current flow электрический ток
36. cross-sectional area площадь поперечного сечения
37. connector соединительный элемент; соединитель; разъём
38. pin terminal штырьковый вывод
39. round rod круглый стержень
40. battery plate аккумуляторная пластина
41. electrical polarity электрическая полярность
42. electrical potential электрический потенциал
43. electric current электрический ток
44. conventional current flow условный электрический ток (поток положительных зарядов от узла с положительным потенциалом к узлу с отрицательным потенциалом, то есть в противоположном направлении по отношению к реальному току)
45. power source источник питания
46. earth заземление, ‘земля’
47. post клемма
48. live wire провод под напряжением
49. light bulb (электрическая) лампочка
50. switch выключатель; прерыватель, коммутатор
51. hot wire фазный (фазовый) провод, провод фазы
52. earthing wire провод заземления, заземляющий провод
53. conductor проводник
54. electric shock электрический удар, поражение электрическим током
55. tungsten вольфрам
56. solid metal твёрдый металл; цельнометаллический
57. molded изготовленный в форме

Exercise 2. Read the international words and guess their meanings.

Terminology, definition, basic, electron, atom, negative, symbol, energy, battery, positive, illumination, metal, ampere, polarity, automobile industry, electrochemically, voltage,

electrical pressure, billions, second, joule, volt, electric, potential energy, electrical systems, components, 12-volt system, accessories, sensors, hybrid, electrical resistance, material, ohm, Greek, Omega, ohmmeter, multimeter, plastic, minimal, factors, temperature, corrosion, corroded, electrical potential, diameter, chassis, activate, deactivate, lamp.

Exercise 3. Read and translate Text 1.

Text 1. The Car's Basic Electrical Terminology and Definitions

Source: https://www.easycarelectrics.com/how-car-electrical-system-works/

An ***electron*** is a tiny particle of matter that is smaller than an atom and has a negative electrical charge. The flow of electrons is called a ***current***. The current is the basics of an electrical circuit. Without it the electrical circuit doesn't work. The symbol of the current is the uppercase letter 'I'. The electrons carry energy which they utilize in the circuit. When the electrons flow from the battery's positive power source to a load of supposing bulb, the electrons lose energy in the form of light illumination in the bulb. And the energy-less electrons go back to the battery's negative terminal through the metal frame.

An ***ampere*** or ***amp*** is the unit for measuring the electrical current. One ampere is equal to one ***coulomb***. You need to know that one coulomb is equal to 6.25 x 10^{18} electrons.

There are two types of currents – a direct current and an alternating current. A ***direct current*** or DC is a current which goes in unidirectional in a circuit. It does not change its polarity. In an automobile, the direct current goes from the battery's positive pole to the negative pole. Its polarity remains the same throughout the circuit. The DC occurs when there are more electrons on one pole and fewer electrons on another pole. It is mostly used in the automobile industry. It can be stored electrochemically in batteries.

An AC or ***alternating current*** is a current which changes its polarity in a circuit. The AC flows in one direction and then in the opposite direction when the polarity is reversed. The AC current is not common in the automobile industry.

A ***voltage*** is an electrical pressure (electromotive force) that pushes electrons around the circuit. This force is created by the difference between the quantity of positive and negative electrons on the battery's negative and positive poles. There are billions of billions of electrons flowing from the battery's negative pole to the positive pole in a fraction of a second. This difference between both poles pushes the electrons from the battery's negative terminals to the positive terminal. The more the difference is, the higher the pressure (voltage) is. The unit of voltage is ***volt***. 1 volt equals 1 joule/coulomb. The ***joule*** is the unit of energy. The coulomb is the unit of current. So, one volt means that every coulomb of charge can carry 1 joule of electric potential energy from the battery positive terminal to the battery negative terminal. The voltage is also called a ***potential difference***. It means the difference in the amount of energy the charge can potentially carry from the battery positive terminal to the battery negative terminal.

Most cars' electrical systems and their components run on a 12-volt system, such as lighting systems, power windows, and other accessories. Many vehicles' sensors use 5-volt voltage while the ignition coil uses high voltage almost from 5,000 to 30,000 volts to fire the spark plugs. Some vehicles, especially military trucks use the 24-volt system, while newer cars have an additional 48-volt power system. Hybrid vehicles use a voltage of 140 to 300 volts.

An ***electrical resistance*** or resistance is a material property to resist the flow of current in a circuit. Its unit is Ohm described by the Greek word Omega (Ω). It is measured by an ohmmeter or a multimeter having the function of an ohm checking. All the circuits have some degree of resistance. The materials with a high level of resistance such as rubber, glass, plastic, etc. are called ***insulators***. The current flow in insulators is minimal. On

the contrary, the current flow is high in such materials as copper, silver, and gold due to their low level of resistance.

Such factors as temperature, length, corrosion, and size affect the resistance of a wire while the current is flowing in it. The electrical resistance of a wire increases with an increase in temperature, and vice versa. Similarly, the resistance of a wire would be higher for a longer wire, and lesser for a wire of a larger cross-sectional area. As to corrosion, a component may not work or may work randomly just because the connectors or pin terminals were corroded.

A ***pole*** means a round rod of metal placed at the end of the battery plate. There are two types of poles in a car battery – a positive pole and a negative one.

A ***polarity*** or an ***electrical polarity*** is used to represent the electrical potential at the end of the battery. In batteries, one pole has more electrons than the other one. The pole with more electrons has a negative polarity. The pole with fewer electrons has a positive polarity. When a circuit is closed, the two poles are connected by a wire, electrons flow from the negative pole toward the positive pole in one direction. This flow of electrons is called an ***electric current***. Although electrons flow from the negative pole to the positive pole, keep in mind that we assume that the electrons flow from the battery positive pole to the battery negative pole. This is called ***conventional current flow***. In cars, the battery's positive polarity is considered a hot power source, and the battery's negative polarity is considered earth. The battery positive pole is marked (+), which has a larger diameter post, and a negative pole is marked (-) and has a smaller diameter post. In a modern car, the battery negative pole is connected to the chassis and engine, which is called the earth, and the positive pole provides live wire to components. But in older cars, the polarity was opposite where the battery positive pole was connected to the chassis and engine, and the negative pole was the live wire connected to the components.

An ***electrical circuit*** is a closed route or path that allows the current to flow from the battery positive pole to the battery negative pole. A fully functioning circuit contains a power source (a battery), a load (a light bulb), and wires. The switch is used to activate and deactivate the electrical circuit. One wire goes from the battery positive power source to the load. This wire is called a ***hot wire***. The second wire goes from the load back to the battery negative power source. This wire is called an ***earth wire***. You can use the switch on any wire (a hot wire or an earth one) in the circuit. Some switches in the vehicle can be installed on the hot wires (e.g., windscreen wipers). But usually, the switches are installed on earth wires (e.g., headlights, horns, etc.). A simple form of the car electrical circuit is a headlight circuit, in which the current flows from the battery positive terminal to the component where it brightens the lamp, then the current returns back to the battery negative terminal through the earth wire.

Exercise 4. Answer the questions.

1. What does the term 'an electron' mean?
2. What is a definition for the term 'a current'?
3. What is an ampere?
4. What are the two types of currents?
5. How can you define a direct current or DC?
6. What is the meaning of an AC or alternating current?
7. Which type of current is common in the automobile industry?
8. What is a voltage?
9. What is the unit of the voltage?
10. How many joules/coulombs are there in 1 volt?
11. What is a joule?

12. What is a coulomb?
13. Why is the voltage called a potential difference?
14. What is an electrical resistance?
15. What is the unit of the resistance?
16. What can be measured by an ohmmeter or a multimeter?
17. How do we call the materials with a high level of resistance?
18. What materials in cars have a low level of resistance?
19. Which factors affect the resistance of a wire?
20. What does a pole mean?
21. How many poles are there in a car battery?
22. What is a polarity?
23. What is an electrical circuit?
24. What is a hot wire?
25. What is an earth wire?

Exercise 5. Match the words (1-6) with their definitions (a-f).

1. A direct current	a. It's a unit used for measuring electric current; it's equal to a flow of one coulomb per second
2. An electrical circuit	b. It's an electromotive force or potential difference expressed in volts
3. An ampere	c. It's a complete route which an electric current can flow around
4. A resistance	d. It's a substance that electricity can pass through or along
5. A conductor	e. In electrical engineering or physics, it's the ability of a substance or an electrical circuit to stop the flow of an electrical current through it
6. The voltage	f. It's an electric current that always flows in the same direction

Exercise 6. Read about the resistance in materials and complete the gaps (1-6) with the words given in the box.

Conduct, atom, shields, composed, insulator, conductor

Information source: https://www.easycarelectrics.com/how-car-electrical-system-works/

An 1) … is a material that does not allow electrons to flow or has too much resistance to an electron flow. This means that such materials do not readily 2) … electricity. Insulator materials include paper, plastic, rubber, glass, air, etc. The material around the wires is an insulator. It 3) … the wire conductor to prevent electric shock. A 4) … is a material that does not resist or has the least amount of resistance to the flow of electrons. In conductors, the electrons can easily move from one 5) … to another atom when voltage is applied. Some best conductor materials are copper, silver, gold, aluminum, tungsten, iron, and steel. In the vehicle electrical systems, the conductors are 6) … of solid metals molded into wires.

Exercise 7. Work in pairs. Read and translate a dialogue between two students. Act it out. Then choose other terms from Text 1 and make a similar dialogue.

Student 1: We're having a test on a car electrical system terminology tomorrow. Here is a list of questions. Let's revise it together.

Student 2: Okay. The first question is about the definition of a current.

S. 1: Well. An electric current is a flow of electricity through a wire or circuit.

S. 2: Good. And now list two types of the electrical currents.

S. 1: They are a direct current and an alternating current.

S. 2: And which type of these currents always flows in the same direction?

S. 1: Hmm, well, I think that's AC.

S. 2: That's not correct. Actually, it's DC. An AC continually changes direction as it flows.

S. 1: Oh, I always confuse them! Now, it's my turn to ask the questions. The next one is about types of electrical measurements. How many do you know?

S. 2: There are three of them. They are voltage, ohm, and amp.

S. 1: Correct. What does an ohm measure?

S. 2: I know this; an ohm is used to measure electrical resistance.

S. 1: Exactly. What about an amp?

S. 2: An ampere is used for measuring electric current.

S. 1: Good. So, what is the voltage of an electrical current?

S. 2: Well, it is an electromotive force measured in volts.

S. 1: And how many joules are there in 1 volt?

S. 2: 1 volt equals 1 joule, doesn't it?

S. 1: That's correct.

Exercise 8. Search the Web for the types of electrical circuits (a parallel circuit, a series circuit, an open circuit, a closed circuit, a short circuit). Choose one of them and make a presentation about it. As an option, you may make a presentation about the electric system diagram from your car's manual.

Exercise 9. Look through Unit 2 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 3. Starting system: components and functions

Exercise 1. Read and memorize the words and word combinations.

1. starting system пусковая система, система пуска
2. starter motor стартерный электродвигатель, стартёр
3. working cycle рабочий цикл
4. resume возобновлять(ся), продолжать; начинать снова
5. starter стартёр (для пуска двигателя)
6. integrated control встроенный контроль; интегрированное управление
7. electronic control unit электронный блок управления
8. condition monitoring мониторинг текущего состояния
9. fault diagnosis диагностика сбоев или неисправностей
10. ignition switch замок зажигания
11. safety switch предохранительный выключатель; предохранительное реле
12. energize подавать напряжение; подавать питание
13. circuit контур; схема; цепь
14. current ток
15. control circuit управляющая цепь (цепь слабого тока)
16. heavy electric starter motor circuit цепь питания электростартёра (цепь большого тока)
17. instrument panel приборный щиток; приборная панель
18. voltage drop падение напряжения
19. terminal вывод; зажим; клемма
20. solenoid соленоид; электромагнитный переключатель
21. motor assembly силовой узел; силовой блок
22. gauge калибр; размер; толщина
23. fuse плавкий предохранитель; предохранитель

24. fuse box блок плавких предохранителей
25. heavy current ток большой силы; большой ток
26. large diameter cable провод большого сечения
27. keyless заводящийся без ключа
28. clutch pedal педаль сцепления
29. open contact разомкнутый контакт
30. closed замкнутый (контакт)
31. gear shift lever рычаг переключения передач
32. gearbox case картер коробки передач
33. ECU (Engine Control Unit) блок управления двигателем
34. earth заземление
35. cam кулачок; эксцентрик; выступ на валу
36. crankshaft position sensor датчик положения коленчатого вала
37. fuel pump топливный насос
38. electromagnetic switch электромагнитный переключатель
39. armature якорь
40. commutator коллектор
41. brush щётка
42. pinion gear ведущая шестерня
43. overrunning clutch муфта свободного хода; муфта Бендикса; бендикс
44. planetary gear set планетарная передача
45. torque крутящий момент
46. mesh зацепление; входить в зацепление; сцепление
47. engine flywheel маховик двигателя
48. crank заводить(ся)
49. flywheel ring gear зубчатый венец маховика
50. overspeeding превышение допустимой частоты вращения
51. burnout пережог; выгорание контактов

Exercise 2. Read the international words and guess their meanings.

Principle, chemical energy, electrical energy, mechanical energy, starter motor, initiate, cycle, inertia, model, starting systems based on an integrated control method, electronic control, potential, real, monitoring, diagnosis, components, starter relay, energize, cable diameter, instrument panel, voltage, solenoid, start position, start, stop, automatic transmissions, locations, contacts, press the pedal, result, activated, park, neutral, signal, position sensor, calculate, electromagnetic, magnetism, planetary, resistance.

Exercise 3. Read and translate Text 1.

Text 1. Principle of Operation of Car Starting System

Source: https://www.easycarelectrics.com/car-starting-system-working-parts/

The ***car starting system*** is a crucial system for the car. It is based on converting the chemical energy stored in the battery into electrical and then into mechanical energy in the starter motor. The starter motor is placed on the back of the engine casing or on the transmission housing where the engine and transmission meet. It is an electro-mechanical device. The starter motor's job is to start the engine. An internal combustion (IC) engine cannot start itself. It needs external help to set the engine in motion before it can power itself. Thus, a starter motor is used to initiate the first working cycle of an IC engine. As soon as, the engine has started, then it relies on inertia from each working cycle to initiate the next working cycle, so the cycle resumes and the engine continues to start running.

The latest model cars have starting systems based on an integrated control method by the electronic control unit. Such starting systems have the potential to be used for real-time condition monitoring and fault diagnosis of vehicles.

The starting system consists of several components. They are a battery, an ignition switch, a starter relay, a starter safety switch and a starter motor.

The ***starter*** consists of a solenoid and a motor assembly. The starter is a large electric current consumer from the ***battery*** to energize the starter motor. So, the starter circuit requires a large diameter cable to carry the current. The starter cable usually becomes rusted with age and usage, which causes increases in the voltage drop and decreases the current flow to the starter motor. It is recommended to replace the cable when it is corroded as it can give problems in starting the car. Usually, cables should be replaced somewhere from 50,000 to 100,000 miles.

The starting system circuit is divided into two sub-circuits – the starter control circuit and the heavy electric starter motor circuit.

Using a large diameter cable from the instrument panel to the starter motor can increase the voltage drop and also cost. The ***starter control circuit*** goes on a long route from the instrument panel to the starter solenoid ignition switch terminal. This circuit only turns on and off the starter solenoid that acts as a bigger relay. And the solenoid further energizes and de-energizes the starter motor assembly. The starter control circuit consumes less power and has normal gauge cables. It starts from the ignition switch and goes to the starter fuse, then to the starter safety switch. Then the circuit continues from the safety switch to the starter relay in the fuse box and finally to the starter solenoid.

The second circuit is a ***heavy electric starter motor circuit*** that draws heavy current directly from the battery through a heavy current cable and is controlled by the solenoid. This circuit goes directly from the battery through a large diameter cable to the starter solenoid and then to the starter motor assembly.

When the ignition key is turned to the start position or a start/stop button is pushed in the keyless car, the current flows from the ***ignition switch*** to the starter fuse and then to the ***starter safety switch***. The automatic and manual transmissions use two different types of safety switches placed in different locations. In a manual transmission, the safety switch is located at the clutch pedal end and its contacts are open, and will only be closed when the driver presses the clutch pedal. When the pedal is pressed, the current starts to flow to the ***starter relay***, as a result, the relay is activated. On the other hand, in an automatic transmission, the park/neutral safety switch is located under the gear shift lever or at the gearbox case. In an automatic transmission, the Engine Control Unit (ECU) sends an earth signal to the relay to energize it. The ECU will only allow an earth signal to the starter relay when it detects the safety switch in the park or in neutral. The ECU takes input from the cam or crankshaft position sensor and some other sensors and calculates them together, through which the ECU decides to send an earth signal to the starter relay and fuel pump relay. So, when the starter relay is activated, a large amount of current goes from the battery to the starter solenoid.

The ***starter solenoid*** is an electromagnetic switch, which acts as a bigger relay allowing and disallowing a large amount of current from the battery to the starter motor assembly. As the solenoid is energized, it also energizes the starter motor assembly.

The ***starter motor assembly*** consists of an armature, a commutator, brushes, a pinion gear, an overrunning clutch, and a planetary gear set. The ***commutator*** takes the current from the ***brush*** and sends it to ***the armature*** where the magnetism is created and as a result, the starter motor turns. The ***planetary gear set*** is used to increase its torque to overcome the resistance of the piston's up-down movement. As the armature starts to rotate, the ***pinion gear*** is pushed forward by the solenoid to mesh with the engine flywheel. Thus, the engine is cranked and gets started. As to the ***overrunning clutch***, it disconnects the

starter motor armature from the flywheel ring gear. This is done to protect the armature from overspeeding and burnout.

Exercise 4. Answer the questions.

1. What is a car starting system based on?
2. What does a starter motor do?
3. What is the advantage of starting systems based on an integrated control method by the electronic control unit?
4. What are the components of the starting system?
5. What is a starter?
6. What kind of cable is used in a starter circuit?
7. Why is it recommended to replace the cable after 50,000 miles?
8. What are the sub-circuits of the starting system circuit?
9. How does a starter control circuit work?
10. How does a heavy electric starter motor circuit function?
11. What happens when an ignition key is turned to the start position?
12. Where is a safety switch located in cars with a manual transmission?
13. Where is a park/neutral safety switch located in cars with an automatic transmission?
14. What is the role of an Engine Control Unit?
15. What is a starter solenoid?
16. What does a starter motor assembly consist of?
17. What does each of the starter motor assembly component do?

Exercise 5. Match the components of the car starting system (1-5) with their descriptions (a-e).

Information source: https://www.easycarelectrics.com/car-starting-system-working-parts/

1. A car battery	a. This component of a car starting system is an electromagnetic switch that connects and disconnects an electrical circuit by using a small amount of current to control a large amount of current. The starter motor uses 250+ amps of current, which is a large amount of current. Such a huge amount of current can't be controlled directly from the ignition switch. That's why this component is used in the starting control circuit.
2. An ignition switch	b. There are two different types of this component. It is a part of the transmission range switch that prevents the starting system operation when the car is in gear (in the automatic transmission), or the clutch pedal is not pressed (in the manual transmission).
3. A starter relay	c. This is one of the starting system components. It makes and breaks all electrical circuits. It is the gateway of the electrical circuits and distributes the electrical power throughout the car where needed. This part has four basic positions (Off, Accessory, Run/ON, Start) but the newer cars have an extra built-in Lock position to lock the steering wheel.
4. A starter safety switch	d. This is an essential part of the starting system. It is mounted on the back of the engine casing or on the transmission housing where the engine and transmission meet. It is an electro-mechanical device that converts electrical energy into mechanical energy in I.C. engines. It consists of a solenoid and a motor assembly. The motor assembly consists of an armature, a commutator, a brush, a pinion gear, an overrunning clutch, etc.
5. A starter motor	e. This component is also known as a power bank. It is an electrochemical device that stores the current in a chemical form and converts it into an electrical current when needed. It is the heart of the car's electrical

	system and is usually placed in the engine compartment. It provides electrical current to all the circuits and components when required once the engine has started and the alternator is able to produce the current. Then the current is supplied by the alternator. This part also provides additional current when the current demand is greater than the alternator can supply.

Exercise 6. Match the five positions of the ignition switch (1-5) with their descriptions (a-e).

Information source: https://www.easycarelectrics.com/car-starting-system-working-parts/

1. A lock position	a. This is the first turn. In this position, the current is supplied to all the accessories (components) except starting and ignition system. In this position, the current is allowed only to accessories such as radios, cigarette lighters, windows, etc.
2. An off position	b. This is the position in which the key remains, once the engine has started. In this position, all the electrical systems are activated except starting system. The current is supplied to all the components including the fuel pump, fuel injectors, various sensors, ABS motors, airbag, dash lights, etc. In the vehicles equipped with a Push/Start button this position may be combined with the accessory position, so it's activated with the first push of the button.
3. An accessory position	c. This is the position in which the key is inserted but not yet turned. In this position, all the electrical circuits are off (no current flow) and the steering wheel is locked. Some cars have this position and the off position built in together in the same position.
4. A run/ON position	d. This is the last position of the key rotary ignition switch. It's a spring-loaded returnable position, which returns to the Run/ON position when the key is released. In this position, the current is supplied to only the starting and ignition system, and the current is cut off from all the accessories. That's why the radio, windows, and other accessories stop working while the engine is being started. It's to ensure the maximum cranking capacity of the battery.
5. A start position	e. It's the default position. In this position, all the electrical circuits are off (no current is supplied). The steering wheel is free to turn, but the key cannot be extracted.

Exercise 7. Read about the functions of the starting system components and complete the gaps (1-9) with the words given in the box.

Reservoir, safety, consists, stabilizer, functions, torque, starter, starting, switch

Information source: https://www.easycarelectrics.com/car-starting-system-working-parts/

The 1) … system works on the principle of converting electrical energy into mechanical energy. It converts the electrical energy of the battery into starting the engine. The starting system 2) … of a battery, an ignition switch, a starter relay, a starter safety switch and a starter motor. The battery in the car has four 3) … . First, it provides the current to all the circuits and components when the engine is off. Second, it acts as an electrical current 4) … . Third, it supplies extra current when the electrical requirement is higher than the alternator produces. And finally, the battery acts as a 5) … regulating potentially-damaging voltage spikes while the engine is running. The function of the ignition 6) … is to control the flow of electric current to all the electrical circuits in the car and distribute it where it is needed. The function of the 7) … relay is to control a larger current by using a smaller current. The function of the starter 8) … switch is to prevent the car from an acci-

dental start-up with the car in the gear or clutch not depressed, as it can damage the transmission by jerking forward or backward. The function of the starter motor is to create 9) … to rotate the engine flywheel and get the car cranked.

Exercise 8. Work in pairs. Read and translate a dialogue between a new mechanic and an experienced mechanic. Act it out.

Information source: https://www.easycarelectrics.com/car-starting-system-working-parts/

Mechanic 1: May I ask you a few questions about a car battery construction?

Mechanic 2: Yeah, sure. What exactly do you want to know?

M. 1: Well, I know that there are many types of car batteries but which is the most common type?

M. 2: Hmm… I think it's the lead-acid battery. It's called so because it contains lead (Pb) plates that are submerged in a sulfuric acid (H2SO4).

M. 1: The sulfuric acid? And what is the electrolyte then?

M. 2: It's the liquid inside the battery. It's a mixture of the sulfuric acid and water. A fully charged lead-acid battery consists of 40 percent of the sulfuric acid and 60 percent of water.

M. 1: Okay. And does a car battery store electric current directly?

M. 2: Oh, no, it doesn't. No battery in the world can store electric current directly! It stores the energy in the chemical form and, when needed, it converts that chemical energy into the electrical energy. I mean the lead plate and electrolyte create a chemical reaction, which releases energy and gives us the electric voltage and current.

M. 1: Oh, I see. And is a lead-acid battery rechargeable?

M. 2: Yes, but it isn't a deep cycle rechargeable battery. I mean the battery should not be discharged more than 70 percent, which is harmful to the health of the battery and can reduce its lifespan. By the way, keep in mind that a hydrogen gas emits while charging the battery. It's highly vulnerable to sparks and flames, so be careful while charging the battery.

M. 1: Okay. And why is the battery measured in cold cranking amps?

M. 2: To determine its ability to start the engine at cold temperatures.

M. 1: Oh, I see. You mean, in a cold climate, the chemical reaction in the battery slows down. So, it reduces the battery strength and minimizes the ability to produce maximum current.

M. 2: Exactly! That's why a good battery is considered the one, which cranks the engine for 30 seconds at 0 Fahrenheit temperature while still maintaining a voltage equal to or higher than 1.20 volts per cell or 7.2 volts for the whole battery.

M. 1: Very interesting! Thanks a lot! Now I've got a much better idea of the battery.

Exercise 9. Search the Web for more information about the components of the starting system and make a presentation about them.

Exercise 10. Look through Unit 3 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 4. Car Air Conditioning, Heating and Ventilation Systems

Exercise 1. Read and memorize the words and word combinations.

1. saloon салон (автомобиля)
2. air conditioning (AC) system система кондиционирования воздуха
3. heating system система подогрева
4. ventilation system система вентиляции

5. defogging устранение запотевания (стекла)
6. windscreen/windshield ветровое стекло; переднее стекло
7. severe winter суровая зима
8. distraction отвлечение внимания
9. legitimate health concern настоящая забота о здоровье
10. throughflow поток
11. mist/misting запотевание
12. duct канал; проход; воздуховод; направлять по трубе, каналу
13. entry point вход
14. heater нагреватель; нагревательный прибор; обогреватель; подогреватель; отопитель
15. grille решётка
16. bonnet капот
17. foot well углубление для ног в полу кузова
18. vent вентиляционное отверстие
19. dashboard приборная доска; панель приборов; приборный щиток; перегородка между двигателем и кабиной водителя
20. slot щелевое отверстие
21. ledge выступ; край
22. side window боковое окно
23. flap заслонка; створка
24. extract air отработавший воздух
25. water-cooled с водяным охлаждением
26. casing корпус
27. matrix решётка
28. hose шланг
29. water-heated с водяным обогревом
30. electric fan электрический вентилятор
31. stationary неподвижный
32. adjust настраивать; регулировать; устанавливать; выставлять
33. heat control регулирование подачи тепла; регулирование нагрева
34. water valve водяной кран; водяная задвижка
35. air-blending смешивание воздуха
36. temperature-controlled с регулируемой температурой
37. temperature control терморегулятор; регулятор температуры
38. air control регулирование подачи воздуха
39. knob кнопка
40. control panel приборный щиток
41. power-assisted control непрямое регулирование; управление с усилителем; регулятор с использованием вспомогательного источника энергии
42. air-cooled engine двигатель с воздушным охлаждением
43. fin ребро, пластина
44. exhaust manifold выпускной коллектор; выпускной трубопровод
45. heat-sensitive теплочувствительный, термочувствительный
46. electrically ignited с электрическим зажиганием
47. petrol-burning heat exchanger бензиновый радиатор отопителя салона
48. emit coolness охлаждать
49. compressor компрессор
50. condenser конденсатор
51. receiver/dryer осушитель

52. accumulator аккумулятор
53. thermal expansion valve терморегулирующий расширительный клапан; терморегулирующий вентиль
54. orifice tube дроссель
55. evaporator испаритель
56. refrigerant хладагент
57. circulate циркулировать по кругу; обращаться в замкнутой системе
58. closed-loop system замкнутая система
59. pressurize осуществлять нагнетание
60. gaseous газообразный
61. produce a pressure создавать давление
62. get hot разогреваться
63. high-pressure pipe магистраль высокого давления
64. front передняя часть
65. radiator радиатор системы охлаждения
66. lookalike аналог
67. state of aggregation агрегатное состояние
68. transit переходить (в другое состояние)
69. gaseous state газообразное состояние
70. liquid state жидкое состояние
71. heat removal отвод тепла
72. air stream поток воздуха (при движении автомобиля)
73. air current воздушный поток
74. forcibly принудительно
75. fan вентилятор
76. system with a climate control система с климат-контролем
77. inlet point впускное отверстие, входное отверстие
78. outlet point выпускное отверстие, выходное отверстие
79. inbound входящий; прибывающий; поступающий
80. high-pressure liquid жидкость под высоким давлением
81. contaminant загрязняющее вещество; примесь
82. dust пыль
83. dirt грязь; загрязнение
84. particle частица; крупица; кусочки
85. equalizing reservoir компенсационный резервуар
86. excess избыток; излишек, излишнее количество
87. process of the refrigerant evaporation процесс испарения хладагента
88. process of the refrigerant transition процесс перехода хладагента
89. take charge of осуществлять контроль
90. absorb heat поглощать тепло
91. evaporate испаряться
92. condensate on the surface конденсат на поверхности
93. equipped with оснащен
94. drainage system система дренажа
95. moisture влага
96. low-pressure pipe магистраль низкого

Exercise 2. Read the international words and guess their meanings.

Systems, microclimate, saloon, ventilation system, conditioning, passengers, comfortable, normal, discomfort, risky situations, functioning, comfort, detail, interior atmos-

phere, temperature, occupants, radiator, electric, stationary, extra ventilation, methods, control, regulate, constant temperature, mix, type, mechanically, control panel, cables, components, blend, function, compressor, accumulator, thermal, cycle, convert, process, start, gaseous, condenser, mini-radiator, aggregation, transit, transfer, model, filters, metal, expansion, reservoir, freon, monitor, calculate, absorb, condensate.

Exercise 3. Read and translate Text 1.

Text 1. Car Air Conditioning, Heating and Ventilation Systems

Sources: https://www.howacarworks.com/basics/how-car-heating-and-ventilation-systems-work, https://studentlesson.com/automobile-air-conditioning-system/, https://airconditionerlab.com/how-does-car-air-conditioning-work/

There are three systems in modern cars that provide a microclimate in a saloon. They are a ventilation system, a heating system and an air conditioning system. These systems provide a driver and passengers with a comfortable environment to travel in. They heat up the car in the winter, and they cool it down in the summer. It's normal for the windshield to fog up during the colder months, making it hard to see a road while driving. These systems can remove the fog by defogging the windshield and windows. Keeping a car cool during the warm season and keeping a car warm during severe winters ensures safer driving. Discomfort caused by heat and cold can create distractions and lead to risky situations. It means that a functioning of these systems isn't just a matter of comfort or convenience, but it's a legitimate health concern. This is particularly true for elderly drivers, drivers with children, or anyone sensitive to heat or frost.

Let's consider all three systems in detail. Modern cars have a ***ventilation system*** that provides a constant throughflow of fresh air that keeps the interior atmosphere pleasant even with all the windows shut. The incoming air can be also heated by the engine to keep the windows clear of mist and to maintain a chosen temperature inside the car. Air enters a large duct at the front of the car, placed so that when the car is moving the entry point is in a high-pressure area and air is forced in. From there it goes to the ***heater***, which warms it, if required. Another common entry point is through the grilles on top of the bonnet. Air enters the car interior through the front footwells and through vents on the dashboard. The vents can be adjusted to point at the faces of the front seat occupants. Some cars also have ducts to the rear seat area. Slots in the ledge at the bottom of the windscreen or by the front side windows allow a stream of warm air to be blown on to the glass to prevent misting. On later cars, all the entry points have flaps for opening and closing them as needed. At the rear, there are exit vents for the extract air to go outside.

In water-cooled cars, the heater casing contains a matrix like a small radiator that takes hot water from the engine through a hose. The incoming air goes through the water-heated matrix and is warmed. There is also an electric fan, which can be switched on to blow air through the system when the car is stationary, or when extra ventilation is needed. The fan can be adjusted to run at different speeds, according to the needs.

There are two methods of heat control. They are a ***water-valve heating system*** and an ***air-blending heating system***. In a heater worked by a water valve, all the air goes through the matrix. The matrix temperature is controlled by regulating the amount of hot water going through it. In an air-blending heater the matrix is at a constant temperature; the warm air from it is mixed with the cool air as temperature-controlled flaps open and close. The temperature to which the air is warmed is controlled by either a water valve or an air-blending system. The water-valve type is found mainly on earlier cars. The temperature control on the dashboard works as a tap which lets either more or less hot water through the matrix. The setting is slow to respond to change and difficult to regulate exactly. The air-blending system has a matrix that is heated constantly. The temperature control

opens and closes flaps that blend the heated air with the cold air from outside. With either system there may be extra flaps to admit a separate supply of the cold air to the face vents, even when the rest of the system is supplying warm air. The air control flaps inside the heater box may be moved mechanically by sliding knobs on the control panel, which are linked to the flaps by cables. More expensive cars may have power-assisted controls worked by the vacuum in the inlet manifold acting on a diaphragm, as in a power brake servomechanism.

In cars with air-cooled engines, the air for the interior heater can be warmed by ducting it around fins on the hot exhaust manifold. The warmed air is mixed to the right temperature by an air-blending system, including a heat-sensitive valve that keeps the temperature steady and at a comfortable level for the occupants. If necessary, the air may be warmed further by an electrically ignited petrol-burning heat exchanger.

A ***car air conditioning (AC) system*** is a set of components that function together to emit coolness to a car's interior. It consists of a compressor, a condenser, a receiver/dryer or an accumulator, a thermal expansion valve or an orifice tube and an evaporator. These parts work together circulating a substance known as refrigerant through a high pressure or low pressure closed-loop system.

The process starts in the ***compressor*** which pressurizes the gaseous refrigerant (freon) by producing the pressure so that the refrigerant gets hot. After that the compressor moves the gaseous refrigerant through the high-pressure pipe to the condenser.

The ***condenser*** in the car AC system is located at the front of the radiator. It is known as a mini-radiator because it is a lookalike of a radiator. Its function is to change the state of aggregation of the refrigerant. Thus, the refrigerant transits from its gaseous state to a liquid state in the condenser. The condenser provides heat removal. An air stream flows around the condenser, cooling the refrigerant as it passes through. If there is not enough air current, it is produced forcibly with the help of fans. The condenser transfers the cooled liquid refrigerant to the receiver/dryer or accumulator.

A vehicle can use either a ***receiver/dryer*** or an accumulator depending on its model. The receiver/dryer is used in vehicles that have a thermal expansion valve, while an accumulator is found in vehicles' systems with a climate control that use an orifice tube. The receiver has an inlet point and an outlet point. The inlet takes inbound high-pressure liquid from the condenser and sends it through a series of filters to remove such contaminants as dust, dirt, water and metal particles. Then, the refrigerant is sent to the thermal expansion valve via the outlet point.

The ***thermal expansion valve*** or the ***orifice tube*** is located between the condenser and evaporator. The thermal expansion valve controls how much refrigerant is allowed to continue through the AC system. This process reduces pressure and rapidly cools the refrigerant. The AC system with the orifice tube replaces the receiver/dryer with the accumulator. The accumulator is an equalizing reservoir that controls and monitors the amount of refrigerant that goes into the evaporator. It keeps an excess of freon. The main difference between the orifice tube and the thermal expansion valve is the type of device used to lower the refrigerant pressure. Their purpose is the same – to monitor the amount of pressure and temperature of the system and to calculate the amount of the refrigerant that can go into the evaporator with no harm. The process of the refrigerant evaporation or the process of the refrigerant transition into a gaseous state starts. Now the refrigerant is nearly ready to cool a car, and after the thermal expansion valve it goes to the evaporator.

The ***evaporator*** is one more radiator located right behind the dashboard as it takes charge of cooling the air with the refrigerant before it is blown into the saloon of the vehicle. The evaporator is similar to the condenser; it also contains lines that the refrigerant flows through. The evaporator absorbs heat, lowering the temperature to about 32 degrees. The re-

frigerant evaporates absorbing even more heat. In order to protect the saloon from the condensate which appears on the surface of the evaporator, the evaporate is equipped with a drainage system which helps this moisture to go out of the car (normally it streams under a car).

After the evaporator, the refrigerant in a gaseous state flows through a low-pressure pipe back into the AC compressor to start the process over again.

Exercise 4. Answer the questions.

1. Which three car systems provide a good microclimate in a saloon?
2. What role do they play in wintertime and summertime?
3. How does a ventilation system work?
4. What's the difference in the principle of operation of a heater in water-cooled cars and in cars with air-cooled engines?
5. How many methods of a heat control do you know?
6. How does a water-valve heating system function?
7. How does an air-blending heating system operate?
8. What is the function of an AC system?
9. What components does the AC system have?
10. What does each component (a compressor, a condenser, a receiver/dryer with a thermal expansion valve, an accumulator with an orifice tube, an evaporator) do?

Exercise 5. Match the words in English (1-15) with their Russian equivalents (a-o).

1. heating system	a. с воздушным охлаждением
2. fan	b. дроссель
3. thermal expansion valve	c. осушитель
4. evaporator	d. система подогрева
5. air-blending	e. хладагент
6. high-pressure pipe	f. магистраль низкого давления
7. gaseous state	g. вентиляционное отверстие
8. orifice tube	h. жидкое состояние
9. air-cooled	i. магистраль высокого давления
10. low-pressure pipe	j. с водяным обогревом
11. liquid state	k. испаритель
12. vent	l. вентилятор
13. refrigerant	m. газообразное состояние
14. receiver/dryer	n. терморегулирующий вентиль
15. water-heated	o. смешивание воздуха

Exercise 6. Match the terms (1-7) with their definitions (a-g).

1. refrigerant	a. a device for drying
2. compressor	b. a device that helps a liquid to change from a liquid state to a gas
3. condenser	c. the provision of fresh air to the interior of the vehicle
4. dryer	d. a device used to supply gas at increased pressure
5. evaporator	e. a device for warming the air or water
6. ventilation	f. a substance used for cooling
7. heater	g. a device that cools gases into liquids

Exercise 7. Read about some common signs of a faulty car AC system. Complete the gaps (1-7) with the words given in the box.

Symptoms, accumulate, noises, blow, replaced, water, conditioning

Information source: https://airconditionerlab.com/how-does-car-air-conditioning-work/

Knowing if your air 1) … is faulty isn't as difficult as you may thought. Here are three of the most common 2) … of a bad AC compressor. The first symptom is an AC which does not 3) … cold air. There could be three reasons for that. You could have a low level of the refrigerant, your refrigerant could be leaking, or your compressor could be going bad and needs to be 4) … . Loud noises when your AC turns on are another potential symptom of a bad AC compressor. If any interior components of the system break or the compressor's internal bearings fail, all kinds of easily heard 5) … can be produced. The best thing to do is to replace the entire AC compressor. The third symptom is a water leak. Your AC system is designed to drain 6) … out through the bottom of your car. The drain line can become clogged, causing water to 7) … inside your vehicle.

Exercise 8. Work in pairs. Read and translate a dialogue between a new mechanic and an experienced mechanic. Act it out.

Information sources: https://studentlesson.com/automobile-air-conditioning-system/, https://airconditionerlab.com/how-does-car-air-conditioning-work/

Mechanic 1: I can't understand what's wrong with this car air conditioning. The car owner says about a reduced functionality of the AC system. At first, I suspected a refrigerant leak. I used a detector but everything was fine. The blower motor and resistor are okay, too. Can you help me?

Mechanic 2: Yes, sure. What exactly does the owner say about the trouble?

M. 1: Well, the AC system cools at first and then gets warm very quickly.

M. 2: Hmm. This may be caused by the various issues. For example, it can be the fuse that powers the AC system.

M. 1: I've checked it. It's okay.

M. 2: What about the expansion valve? It can be clogged. In this case the refrigerant can't flow into the evaporator. And if there is also some moisture, the refrigerant even begins to freeze.

M. 1: I've inspected it as well. It's clean.

M. 2: Then it must be a faulty compressor clutch.

M. 1: The compressor clutch? I haven't thought about it.

M. 2: Yeah, when the clutch gets stuck, the compressor can't maintain the correct pressure. This results in hot air.

M. 1: Oh, I see now. Thanks. I'll check it. And the owner also says that there is an unpleasant odor from the AC vents.

M. 2: That's easy. It can be caused by a moldy evaporator case or a dirty and old air cabin filter.

M. 1: Good. I'll have a look at them.

Exercise 9. Search the Web for more information about the malfunction and repair of an automobile ventilation, heating and air conditioning systems and make a presentation.

Exercise 10. Look through Unit 4 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

РАЗДЕЛ 2. BUSINESS ENGLISH

2.1. Тексты делового характера для изучающего чтения и пересказа

Unit 1. Applying for a Job

Text 1. Applying for a Job, Recommending for a Job

1. Read and translate the text using a dictionary.

When you request employment (= apply for a job), your primary objective is to interest a prospective employer enough so that he/ she will schedule interview with you.

This can be done by sending an application form or a letter of application to the prospective employer. Applications for jobs are most often made in form provided by the commercial organization or the manufacture company to which the application is being made. For more senior appointments, however, applicants are often expected to write a letter which contains all the relevant information about the training, qualifications, reasons for applying and so on. Before you write a letter of application you will have to collect all the information you will need for your letter education, previous employment, employer, dates, etc.

Normally your letter of application presents not only your qualifications but your interest in a specific job. Include the exact job title, use a standard area titles such as 'finance', 'sales' or 'research'. Include the field you were trained in. This is especially applicable to those in technical fields. It is especially important to include the functional area of the company where you want to work. Examples of these company divisions are: 'research and development', 'production', 'marketing and sales', 'administration and finance'.

Begin your letter by stating the subject of the letter, which job you are applying for and where you heard about it – in a newspaper, in a journal, from the employment agency, from a friend. End your introduction with a statement of your ability to do the job.

The body of your letter should provide the information that will convince your reader of your qualifications. Mention any relevant courses you took and any pertinent job experience. Take care to refer to any specific information mentioned in the advertisement.

Above all, emphasize your 'strengths' (strong points). If you are applying for a sales job, for example, you'd better stress your ability to communicate effectively, not your limited experience. If you have special skills or training, such as word processing, be sure to mention it.

Conclude your letter of application by referring to your resume (curriculum vitae – BrE). State that you are available for interview, list any dates on which you cannot be available. As always, your letter must be smooth, natural and free of errors.

2. Match the following words with their meaning.

1) to request employment	a) главная задача/цель
2) employer	b) опыт
3) previous employment	c) запланировать собеседование
4) relevant	d) анкета
5) standard area title	e) гладкий и естественный (о стиле письма)
6) to convince	f) значимый/значительный
7) strong points	g) руководящая должность
8) primary objective	h) работодатель
9) company division	i) иметь возможность прийти на собеседование
10) application form	j) обращаться с просьбой о приёме на работу
11) to schedule interview	k) прежнее место работы
12) body of a letter	l) стандартное название сферы деятельности
13) senior appointment	m) сильные стороны
14) experience	n) основная часть письма

15) available for interview	o) убедить
16) smooth and natural	p) подразделение компании

3. Complete the sentences with the prepositions given in the box.

3.1. Read and translate the application letter.

3.2. Fill in each blank in the application letter with a preposition from the following list:

With, in, for, at, of

Dear Sir,

I am interested 1) … applying 2) … the post of Marketing Manager 3) … your company.

The vacancy was advertised in last week's 'Evening News' and I hope it is not too late to apply 4) … the position.

I am at present working as Assistant Marketing Manager 5) … Yorkshire Engineers, Ltd. My duties and responsibilities include all types of administrative work, drawing up marketing plans, product development, organizing and directing the presentation 6) … goods, working 7) … clients and solving problems that arise.

Although I enjoy working 8) … Yorkshire Engineers and have an excellent relationship 9) … my present employers, I feel that 10) … this stage 11) … my career I would like more responsibility and greater scope 12) … putting into effect some of the up-to-date ideas that are now being developed and applied 13) … marketing. I also feel that my prospects 14) … promotion are limited and that there would be more scope 15) … my skills and talents if I join a larger, more dynamic company.

I have strong communication and leadership skills, I have proven experience 16) … leading groups and working 17) … the public, I have all assets that are helpful 18) … marketing management I enclose my resume 19) … your convenience and the names of two people who are prepared to act as my referees.

If you consider that my qualifications and experience are suitable 20) … filling in this vacancy, I would be available 21) … interview 22) … any time.

Yours sincerely,

Robert Dean

4. Match the jobs and professions in list 2 to the activities in list 1. Make up sentences according to the model:

e.g. A manager is a man who conducts and controls a business.

List 1 – activity:

1. coordinating the activities of lower-level managers in promoting goods and services;
2. producing brochures and leaflets when making something for sale known to the public;
3. prescribing medicines;
4. dealing with correspondence, keeping records, making arrangements and appointments for the boss;
5. hiring and training all the people employed by a company;
6. buying and selling business shares;
7. providing safeguard against damage or loss, making contracts that promise to pay a sum of money in case of accident, injury or death;
8. designing and making bridges, buildings, roads;
9. keeping and examining business accounts.

List 2 – jobs and professions:

private secretary
doctor
personnel manager
accountant
insurance agent
marketing director
advertiser
stockbroker
construction engineer

5. Make up your own list of key-words and expressions to the text 'Applying for a Job. Recommending for a Job' and to the application letter of task 3. The list should include not less than 15 items. The list can be presented in the form of a table.

6. Explain the meaning of the following words and expressions.

To advertize a vacancy, administrative work, up-to-date ideas, prospects in promotion are limited, primary objective, to schedule interview, lower-level managers, referees.

Speaking Practice

1. Find the answers to the questions in the text 'Applying for a Job, Recommending for a Job'.

1. What is your primary aim when you apply for a job/ put in a request for employment/ make a request for a job?
2. In what cases sending a letter of application is preferable?
3. What kind of information do you have to gather before writing a letter of application?
4. In what way should you express your interest in a specific job?
5. How do you usually learn about job vacancies?
6. When you introduce yourself to a prospective employer, what information matters most/is the most important?

2. Discuss the content of the text in the form of a dialogue using the set of questions given above. Use communicative signal words (SW) and expressions for the questions and answers.

Question SW	Answer SW
First of all…	It is evident that…
Can you tell me…	We can state that…
It is interesting to know…	As for _____we can say that…
I would like to ask you…	I am sure that…
Can I ask you…	To my mind/in my opinion…
One more question is…	It seems to me that…
Do you know…	I would like to say that…
Have you got any information …	If I am not mistaken…
How do you think…	Above all…
To conclude…	You see…

3. Present the general ideas of the text in the form of oral retelling. Make use of the information given below.

1. Structural expressions for the introductory part of your retelling:

The article (text) is called…

The title of the article (text) is…
The article (text)is published in…
The article is printed in…
The article consists of…
The article is devoted to…
The text touches upon the problem…
In the introductory part the author points out…

2. Structural expressions for the body of your retelling:

The author raises the problem of…
The main part of the text informs about…
The article contains statistics about…

3. Structural expressions for the concluding part of your retelling:

In the concluding paragraphs it is pointed out…
Summing up the information, it is important to say that…
Generalizing the information, it is necessary to say that…

Writing Practice

1. Read and translate the following sample letters of application. Fulfill the tasks on the letters' vocabulary.

Sample Letter of Application (1)

the sender's address
the inside address

Dear Mr Bowers,

I am writing to confirm my wish to apply for the position of computer engineer with your company. I am pleased to accept your offer. Sure, I'd like to meet you to discuss some technical matters, especially concerning your computer facility.

I wonder if there is a probationary period during which the position and the salary will be reviewed.

I look forward to joining your company and to contributing to the company's work.

Signature

1.1. Find the words or phrases in Sample Letter of Application (1) that tell you the following.

1. to give support or certainty to a fact, statement – …
2. a proposal – …
3. in connection with – …
4. a system that makes a particular activity possible – …
5. the time during which the applicant is tested for the job – …
6. to re-examine/ re-consider – …
7. to help the company to work successfully – …

Sample Letter of Application (2)

Flat 8, 34 River Street Gosport
Co Hampshire PO 56 BL
England
15 May 2018

Mr C Farham
Personnel Manager
Milco Ltd
26 Beacon Street
Halifax HX 57 Pt
England
Dear Mr Farham

Application for the post of Divisional Software Engineering Manager

Further to our telephone conversation last Friday, I can confirm that I wish to apply for this post. I enclose a copy of my curriculum vitae.

You will see that I have added some information about my previous experience: I worked for one year with a company in Paris called ILE as a Systems Analyst, then I came to England to work for Top Systems Co as a Client Consultant, but last November I was promoted to Senior Software Development Engineer.

I have also added the name of one of my referees, Mr John Andrews. You may contact him at any time. If you require any other references, perhaps you will be so kind as to let me know. I can come to Halifax for interview at almost any time. The only date when I am not available for interview is May 27th.

Yours sincerely,
John Tomlinson

1.2. Find the words or phrases in Sample Letter of Application (2) that tell you the following.

1. the person who is concerned with hiring and discharging employees – …
2. position/ job/ employment – …
3. continuing the subject of – …
4. John was given a higher position – …
5. a person who provides written information about someone's character, ability, skills, etc. – …
6. a piece of written information about someone's character, ability, skills – …

2. Imagine that you are an applicant for a job. Write your own letter of application (120-150 words) for a job in English. Choose an appropriate job title from the list below. Follow these guidelines:

1. Introduce yourself: name, age, nationality.
2. Mention the source of information about the job vacancy.
3. Describe your relevant work experience or justify your lack of experience.
4. Describe your qualifications and skills.
5. Mention the reasons for seeking employment with the company/ for joining this company.
6. Describe how you meet the requirements of the job.
7. Mention your personal qualities – ability to communicate, to deal effectively with difficult situations, to work long hours, to cope with pressure, to be part of a team, etc.
8. Say whether you are fluent in at least one foreign language.
9. Ask if the job you apply for involves a lot of travelling abroad, if it requires a lot of organizing meetings and conferences.
10. Say when you are available for interview.
11. Mention any enclosures (references, your resume (C.V.), an official letter of recommendation).

Job Titles

financial analyst	специалист в области финансов
marketing research analyst	специалист по изучению рынка сбыта
business analyst	специалист по вопросам конъюнктуры
production engineer/ manager	инженер/менеджер по организации производства
sales manager	менеджер по продажам
securities analyst	специалист по ценным бумагам
designing engineer	инженер-конструктор
mechanical engineer	инженер-механик
software engineer	инженер-программист
software development engineer	инженер-разработчик программного обеспечения
marketing manager	менеджер по маркетингу
export sales manager	управляющий экспортными операциями
managing director	директор-распорядитель
accounting manager	главный бухгалтер

3. Write a letter (120-150 words) recommending your friend (your group-mate/your business partner) as a suitable candidate for one of the following positions: a secretary/ a teacher/ a training program participant/ a managing director/ an adman/ a sales representative. Study the information given below.

When people apply for jobs or professional training programs, the application process usually includes at least two recommendations from colleagues, professors or friends who can honestly evaluate the applicant's professional ability and potential.

Here are some important points to remember in writing the letter of recommendation:

1. How long have you known the applicant and in what capacity (as a coworker, business partner, teacher, etc.).

2. Mention specifics, not generalizations. It is good to write that someone is hard-working and organized, but you need to support these statements with concrete examples.

3. Write about what the applicant is capable of doing, what makes him/her special.

4. Evaluate the applicant by comparing him/her with others you have observed in your work.

5. Your evaluation of the applicant may be based on the following categories, each of which can be described as 'excellent', 'very good', 'average', 'below average':

– Intellectual Ability
– Work Habits
– Business Practice
– Seriousness of Purpose
– Entrepreneurial Potential
– Managerial Skills
– Emotional Maturity
– Resourcefulness and Initiative
– Adaptability to New Situations
– Motivation
– Leadership Qualities

6. One page is sufficient. Quality, not quantity, is what is important. Do not put something in if an immediate connection cannot be made between the information you give and the applicant's ability to do the job or to participate in the training program.

Unit 2. Resume

Text 1. Writing a Resume

1. Read and translate the text using a dictionary.

When you are looking for a new job, you must prepare a short-written account of your education and work experience. It is called 'curriculum vitae' (also C.V) in British English and resume in American English.

Many companies expect all your personal information to be entered on a standard application form. Unfortunately, no two application forms are alike, and filling in each one may present unexpected difficulties. Some personnel departments believe that the resume (CV) and application letter give a better impression of a candidate than a form.

The resume that accompanies the letter provides an overview of what you have already done. The resume should create one dominant impression: that you are a highly motivated person who has the ability and maturity to do a job well. Before you compose your resume list all of the pertinent information about your education, your job experience, your goals and your personal interests.

Then select the information that is appropriate for the job you want emphasizing the accomplishments that differentiate you from other candidates. If you have received academic honours or awards, or you have financed your own education, include this information as well.

Remember, the resume is a screening device. Big corporations get hundreds of thousands of them every year. The personnel manager or the staff officer has to read a lot of them a day. So, you have got ten, may be twenty seconds, to show him/ her that your resume is worth a second look.

There is no single correct format for a resume (curriculum vitae). Whatever its layout it should be brief – one or two pages are sufficient – easy to read, and well organized. An employer should be able to see at a glance what your qualifications are. Many resumes contain the following sections: personal information, education, languages you speak (if necessary), work experience, interests, referees.

2. Match the following words with their meaning.

1. a short written account	a) отличия и награды за успешную учёбу
2. work experience	b) подходящий, соответствующий требованиям
3. personal information	c) стандартная форма анкеты
4. personal manager	d) опыт работы
5. personnel department	e) высокомотивированный
6. to create an impression	f) краткое описание/информация в письменном виде
7. to list	g) создать впечатление
8. appropriate	h) сотрудник отдела кадров
9. maturity	i) перечислить
10. accomplishments	j) письмо-заявка об устройстве на работу
11. academic honours/awards	k) зрелость/опыт
12. a screening device	l) отдел кадров
13. application letter	m) анкетные данные соискателя
14. highly motivated	n) средство отбора/проверки
15. standard application form	o) достижения

3. Complete the sentences with the prepositions given in the box.

3.1. Read and translate the letter of application.

3.2. Fill in each blank in the application letter with a preposition from the following list:

At, after, for, in, of, on, to

Dear Sir/Madam,

May I introduce myself 1) … you? I have studied 2) … Gottingham and Leeds Universities and now I am a final year student … Leeds University, where I will graduate … July 2021. I would like to spend next year improving my Russian; therefore, I would like to stay … Russia … some time. I have learnt Russian … about five years … evening classes once a week … University.

Since I am bilingual … both English and German I might use these language skills to teach. Would you require someone as a language and teaching assistant … your foreign languages department?

As to my qualification and previous work experience, I will have an English law degree and I would get the TEFL (Teaching English as a Foreign Language) qualification … a one-month course, which I intend to do over the summer. I have taught German … foreign students in Germany and I had plenty … opportunity to practice my communication and translation skills.

I would be very grateful if you could offer me such work, even … a semi-voluntary basis.

Yours faithfully,

Julia Glazer

4. Make up your own list of key-words and expressions to the text 'Writing a Resume' and the letter of application from task 3. The list should include not less than 15 items. The list can be presented in the form of a table.

5. Explain the meaning of the following words and expressions.

Previous work experience, achievements and accomplishments, resume as a screening device, communication and translation skills, personal information, to be appropriate for a job, to improve a foreign language, to have the ability and maturity to do a job well.

Speaking Practice

1. Find the answers to the questions in the text 'Writing a Resume'.

1. What is British English for resume?
2. What application documents are required of those who apply for a job?
3. What information should be listed in your resume?
4. What kind of impression should a resume make on the reader (the staff officer)?
5. What is the main objective of a resume?
6. Who is usually responsible for looking through resumes received by a company?
7. What kinds of sections does a resume usually consist of?
8. Why should the layout of a resume be well organized and brief?

2. Discuss the content of the text in the form of a dialogue using the set of questions given above. Use communicative signal words (SW) and expressions for the questions and answers.

Question SW	Answer SW
First of all…	It is evident that…
Can you tell me …	We can state that…
It is interesting to know…	As for we can say that…
I would like to ask you…	I am sure that…
Can I ask you…	To my mind/in my opinion…
One more question is…	It seems to me that…
Do you know…	I would like to say that…
Have you got any information …	If I am not mistaken…

How do you think…	Above all…
To conclude…	You see…

Writing Practice: Resume Construction

1. A resume (C.V.) will be the first impression an employer has of you. Imagine that you are a job applicant. Before writing your own resume, you should:

1.1. Draw the pattern of your resume:

1. Personal information (name, nationality, date of birth, marital status, permanent address, current address).
2. Education and languages.
3. Work experience.
4. Interests/hobbies.
5. Referees.

1.2. Translate and analyze the sample variant of the resume.

Name	Julia Glazer
nationality	German
date of birth	06/12/96
marital status	Single
current address	16, Cooking Street Leeds L52 UK
education	4. School 2004-2014 Bolz Gymnasium Rottenburg, Germany 2. University a) Sept. 2014 – Oct. 2015 – Gottingham University b) since Oct. 2015 – Leeds University law student
languages	German (mother tongue) English (advanced level) Russian (intermediate level)
work experience	4. June – Sept. 2014, Rottenburg, Position: assistant accountant in a medium-sized firm. Skills: computing skills; given tasks to work independently, I was left on my own to find my way through various computer programmes. 2. Sept. 2014- March 2016, Leeds Position: community Services volunteer, personal care assistant. Skills: I had to cope with long hours and almost no spare time for myself; the commitment and responsibility involved were a very valuable experience. 3. Sept./Dec. 2016 – German Embassy, Washington DS, USA Position: internship at press office. This involved teamwork, helping to produce press releases and to organize press conferences, answering phone calls and letters, news presentations at the morning conferences, legal research, translating. Skills: I improved my communication and presentation skills in public

	relation duties. I had to deal with vast amount of text and paperwork.
Interests	Travelling, horse-riding, river-trips
referees	Dr. H. Storey Mr W. Hinds Mrs A. Lawson Law Faculty University of Leeds, Leeds L52

1.3. Find English equivalents to the following Russian word combinations. Consultthesample (1.2.).

Помощник бухгалтера, работать самостоятельно, самостоятельно разбираться в чём-либо, доброволец местной социальной службы, помощник по уходу за инвалидом, справляться, взятые на себя обязательства и ответственность, стажировка в пресс-службе, работа в команде, поиск обоснований юридического характера, иметь дело с …/ обращаться с … .

1.4. Study the Language Bank below.

1. устроить, организовать (что-либо)	to arrange (meetings/ conferences/ shows) to make arrangements for (meetings/ presentations/ press conferences) to work out arrangements for … to successfully arrange (meetings/ presentations) to be successful in arranging meetings/ conferences)
2. договориться (о чем-либо)	to arrange for (an interview/ an appointment)
3. анализировать/ изучать	to analyse/ examine
4. применять	to apply (new ideas to practice/ theory to practice/ new developments to practice
5. заниматься (чем-либо)/ выполнять (задание/ работу по долгу службы)	to deal with to handle to do one's job to perform one's duties to be concerned with …
6. осуществлять/ выполнять	to carry out (sales analysis/ production analysis/ one's duties)
7. проводить/ осуществлять (анализ/ исследование чего-либо)	to conduct/ to do/ to make (a survey/ marketing research
8. управлять/ руководить	to manage successfully effectively efficiently (people/ money/ a business/ the company/ products)
9. разрабатывать/ проектировать	to develop (a product/ the company's marketing strategy/ plans/ programmes) to design (a machine/ a new building)
10. составлять/ разрабатывать (планы)	to draw up (marketing plans)
11. содействовать (чему-либо)	to promote (sales/ production of…)

12. заведовать/ руководить (чем-либо)/ отвечать по службе (за что-либо)	to manage (a factory) to be in charge of (a factory/ a department) to head (a team of 20 people/ a department) to be responsible for (recruiting personnel/ employing people) to be at the head of (a company/ an organization)
13. работать в качестве (кого-либо)	to work as (a consultant for a company)
14. осуществлять контроль/ наблюдать за работой (за деятельностью кого-либо)	to supervise (the work of 30 operating employees/ a team of 20 people)
15. получать/ приобретать опыт (в чем-либо)	to gain experience of presenting new products/ of conducting press conferences
16. находиться в постоянном рабочем контакте (с кем-либо)	to keep closely in touch with smb.

1.5. Translate the sentences from Russian into English using information of the Language Bank (1.4.).

1. У меня есть опыт в организации презентаций и пресс-конференций.
2. Вам необходимо разработать план организации данной встречи.
3. Есть ли у Вас опыт проведения рекламных компаний?
4. Можете ли Вы провести исследование современных тенденций на рынке сельскохозяйственной продукции?
5. У меня есть обширный опыт в составлении бизнес-планов.
6. Работая в качестве помощника руководителя, я находился в постоянном рабочем контакте с юристами и представителями различных банковских организаций.
7. Мне бы хотелось проявить свои навыки в разработке маркетинговых исследований.
8. Мне приходилось успешно осуществлять контроль за деятельностью команды из 10 человек.
9. Моя работа была связана с применением новых маркетинговых стратегий.
10. Мне бы хотелось эффективно применить свой опыт и знания, а также иметь возможность карьерного роста (to have a career opportunity).

1.6. Write a resume as if it were your own resume.

Unit 3. Interviewing Applicants for Jobs

Text 1. Interviewing Applicants for Jobs

1. Read and translate the text using a dictionary.

In different companies and organizations, different conventions apply to the process of recruiting, selecting and hiring prospective employees.

Many companies expect all personal information of the applicant to be entered on a standard application form. Unfortunately, no two application forms are alike, and filling in each one may present unexpected difficulties. Some personnel departments believe that the CV (the resume) and application letter give a better impression of a candidate than a form. But it is well known that the applicant usually tries to make a good impression on the personnel officer in his/her application letter, the applicant may often look good on paper. In order to take the final decision staff officers or personnel managers often invite the

shortlisted applicants for interview.

There are different kinds of interviews: traditional one-to-one interviews, board or panel interviews where one or more candidates (group interview) are interviewed by a panel of interviewers and even ‘deep-end’ interviews where applicants demonstrate how they can cope in actual business situations. The atmosphere of an interview may vary from the informal to the formal and interviewers take a friendly, neutral or hostile approach. Different interviewers use different techniques and the only rules that applicants should be aware of may be: ‘Expect the unexpected’ and ‘Be yourself’.

The interviewers are usually interested in educational background and qualifications of the applicant, his or her previous work experience, the reasons the applicant applies for a new job, if the applicant is highly motivated or not, if he or she is good at working with people.

The applicant for the job wants to know if there are choices of promotion, if there is a probationary period, if there are transport facilities to or from work, if the job entails job-related travel, if there are some extra benefits such as company cars, company organized holidays and trips, children’s holiday camps.

Although interviews have widespread use in selecting staff many problems exist:

1) reliability of most interviews is very questionable;

2) conclusions about the applicant are often made within the first 10 minutes of the interview and that is why any additional relevant information about the applicant is either overlooked or ignored;

3) merely having a pleasant personality does not necessarily ensure that the person will be a good employee;

4) interviewers have personal prejudices and these prejudices may play a role in the interviewing process.

But all these disadvantages of a job interview may be rejected as insignificant against the statement that many applicants look quite good on paper.

2. Match the following words with their meaning.

1) recruiting, selecting and hiring	a) претендент, включённый в окончательный список для собеседования
2) staff officer	b) значимая информация
3) conventions	c) недостатки
4) shortlisted applicants	d) благоприятное впечатление
5) panel interview	e) сотрудник отдела кадров
6) job-related travel	f) уровень образования
7) probationary period	g) набор, отбор и наём (кандидатов на работу)
8) deep-end interview	h) групповая форма собеседования
9) educational background	i) дополнительные услуги, доступные работникам компании/фирмы/учреждения
10) questionable	j) служебный транспорт
11) favorable impression	k) нормы, сложившаяся практика
12) relevant information	l) утверждение/убеждение
13) extra benefits	m) испытательный срок
14) company cars	n) собеседование «с погружением» в реальные рабочие ситуации
15) disadvantages	o) спорный
16) statement	p) командировка

3. Re-read text 1 and answer the questions.

1. Why do personnel managers believe that inviting job applicants for interview makes selection procedure more reliable and trustworthy?
2. Are job interviews conducted on the same pattern? If not, what makes them typical in some respect?
3. What is the applicant usually interested in when interviewed?
4. Which of the disadvantages of a job interview would you mention as especially damaging?

4. Explain the meaning of the following words and expressions.

Reliable and trustworthy, personal information of an applicant, unexpected difficulties, to look good on paper, hostile approach, expect the unexpected, chances of promotion, relevant information about the applicant.

5. Read and translate the text using a dictionary.

Text 2. Interviewing, Screening and Hiring

It is not an easy task to find someone suitable for the job. Recruiting and selecting people involves careful analysis. The candidate's abilities, attitudes and interests are matched to the requirements of the job. Interviewing, screening and hiring are done in the best interests of both parties.

Applicants for a management training program or for an internship abroad are asked a lot of questions concerning the profile of the company the applicant is currently working for. The interviewers want to know how successful his/her company, is, what sort of problems or unpleasant situations it faces They may be interested in the company's annual output, annual turnover, number of employees in the company, its international contacts or long-term foreign partners.

Some interviewers give candidates a hard time by asking them difficult and confusing questions: What do you think are your strengths and weaknesses? Which is more important for you – status or money? How long do you think you'd stay with us if you were appointed? How would you rate your present boss? Why do you want to leave your present job?

Now it is quite common for companies to hold progress interviews (staff assessment interviews) to see how their employees are getting on in their jobs. Progress interviews are conducted at least once a year. Employees' performance and the development of their career are discussed at such interviews. Participants on training courses often take part in similar mid-course/mid-term interviews too.

Employees usually take advantage of staff assessment interviews to find out what the boss thinks of them, to discover their own weaknesses, to have the opportunity to discuss their work in detail with the boss, to find out how to work more effectively and efficiently, to discuss their future with the company or organization, to see how their careers are developing, etc.

The company and the managers take advantage of these progress interviews to find out what their employees do well and could do better, to benefit from closer contact with individual employees and create closer relationships, to find out which people should be promoted and which employees can benefit most from further training, etc.

The interview situation as such should be considered from the point of view of both interviewer and candidate/interviewee. During the interview, the interviewer makes notes on each candidate's experience or potential. The checklist for interviewers usually contains the following headings:

Working with other people (being part of a team)

Working under stress
Dealing with people in English
Working experience
Learning something new/being able to learn new things
Education and training
Health
Present job/job satisfaction
Personality
Being able to delegate responsibilities to subordinates

The candidate when preparing to attend the job interview should rehearse some of his/her answers at home, find out as much as possible about the company or the training institution, prepare some questions to ask about the organization or company.

6. Find in text 2 the English equivalents for the following key words and expressions.

1. набор кадров	
2. проверка, отбор кадров	
3. наем на работу	
4. стажировка	
5. столкнуться с какой-либо проблемой	
6. причинять беспокойство/ доставлять неприятности	
7. организовать/ провести собеседование/интервью	
8. исполнение служащими своих обязанностей	
9. получить пользу от дальнейшей подготовки	
10. перечень, памятка (для проведения собеседования)	
11. индивидуальность (кандидата/ претендента)	
12. давать поручения подчиненным	

7. Make up your own list of key-words and expressions to texts 'Applying for a Job, Recommending for a Job' and 'Interviewing, Screening and Hiring'. The list should include not less than 15 items. The list can be presented in the form of a table.

Writing Practice

1. Here is some advice that might be given to an inexperienced interviewer. Use the given tips in the text, in which you describe the standard interviewer's activity.

1. Make sure you are not interrupted or phoned during the interview.
2. Read the candidate's CV and application letter before the interview begins.
3. Ask the candidate to explain why he/she keeps changing jobs.
4. Make sure you have a clear picture of the nature of the job.
5. Ask each candidate the same questions.
6. Decide on a maximum of four key qualities required for the job.
7. Make sure the candidate has an uncomfortable, low chair.
8. Ask the candidate about his political and religious beliefs.
9. Only trust a candidate who looks you straight in the eye.
10. Trust your first impressions.

You can make use of the following modal constructions in your text:

First of all, you should…
You'd better…
It seems to me, you ought to…
You shouldn't

You may or you may not…
It is evident, that you should…
Whether you like it or not, but you have to…
Before the interview you are to…
You are allowed to…

Speaking Practice

1. Find the answers to the questions in the text 'Interviewing, Screening and Hiring'.

1. What is expected from an applicant for a training program when he/she has an interview for an internship abroad?
2. What questions would you consider difficult and confusing when interviewed? Why?
3. What are the main differences between a job interview and a staff assessment interview?
4. What kind of preparatory work does a job interview involve from the viewpoint of both parties – the interviewer and the applicant?

2. Work in pairs. Discuss the content of text 2 in the form of a dialogue using the sets of questions given above. Use communicative signal words (SW) and expressions for the questions and answers.

Question SW	Answer SW
First of all, …	It is evident that…
Can you tell me…	We can state that…
It is interesting to know…	As for _____we can say that…
I would like to ask you…	I am sure that…
Can I ask you…	To my mind/in my opinion…
One more question is…	It seems to me that…
Do you know…	I would like to say that…
Have you got any information …	If I am not mistaken…
How do you think…	Above all…
To conclude…	You see….

3. Arrange the most important things for you in your future work in order of importance (the list of opinions is given below). Express your own opinion in the form of an oral essay. Make use of the relevant expressions from the box below.

Job satisfaction

– being able to learn new things
– earning plenty of money
– being part of a team
– meeting people through work
– having pleasant colleagues
– being praised by my superiors
– a pleasant working environment
– using a foreign language
– financial independence
– good chances of promotion
– professional growth
– being a boss/exercising power
– status of my organization

The most important thing for me is … The second important thing for me is … I don't consider this aspect of my job very important. I am afraid you are mistaken/wrong when you… I think your opinion is absolute nonsense. It matters very little for me/very little in my job. … is less significant than … … is more significant/more important than… I don't attach too much importance to …

4. Talk about job satisfaction or job dissatisfaction as any talk to a counselor in a job agency is centered round job satisfaction or job dissatisfaction.

Work with a partner. Make conversations in which (A) is trying to find out reasons for changing the job or job preferences while (B) is giving his/her reasons or explanations.

First make sure you are familiar with the relevant vocabulary then talk on the topic using prompts in columns (A) and (B).

Relevant vocabulary:

promotion, chances of promotion, prospects of promotion
great/heavy responsibilities, is responsible for…
independence, making independent decisions
challenging job/job is challenging
varied/exciting job/experience
demanding boss/manager
monotonous/boring job
to work long hours
exciting experience
creative abilities
interesting job
demanding job

Prompts:

A	**B**
Why did you change your job? Didn't you like your job? Why? Why did you leave the company for which you worked so long? Why did you leave your job? What didn't you like in your job? Did your job become too boring, too monotonous? Were there any prospects of promotion in the company you worked for?	I had to change my job because… there wasn't inner freedom, the salary was… the working hours were… the journey to work was… the job was too… my responsibilities were too… I was responsible for too many… I wasn't earning a good… the money wasn't good enough. I didn't have enough time. There wasn't enough… I didn't have enough responsibility.
Do you like working: in a team? Alone? Indoors/outdoors?	I like/don't like: being away on a business trip (at least) once a month I'd like to:

With computers? Long hours? In a big company?	start my own advertising company, do consultancy work in computers, have a lot of responsibility and a lot of freedom.
What kind of job do you think is suitable for you? What job suits you best?	I enjoy: having responsibility for… taking decisions on my own. Having more independence. Working in a small-sized company. Working with computers. Working in a team. Doing a challenging job.

5. Get ready for the job interview simulation. Make use of the model questions in A and prompts in B. Remember: this should be a step-by-step (section-by-section) discussion. You can also use the information presented in task 3 in the simulation.

(A) model questions	(B) prompts for answers
Personal information	
When were you born? Can I have your date of birth? What's your marital status? Where do you live? What's your present address?	I was … on … in 19… . I am married/single… . I got married in … . I am married with one child. I am not married yet. I am going to get married next… . My home address is …, but my present address is…. I have lived in … for … years/ since … . We moved to … in … .
Education	
And what about your education? – Secondary education, I mean. In how many subjects did you take secondary school diploma exams? Did you do well in your exams? What marks did you get in …? Have you ever failed an exam? What qualifications did you get when you finished school? What about your further education? Did you go to university? What subjects did you specialize in? What was your major at university? Did you get a university degree? Did your studies at university lead to a degree? Did you graduate with honours? Did you get a distinction diploma?	I went to two secondary schools from … to … . I attended … from … to… . I took my school-leaving exams in … . 1 did well/ badly in … . Yes, I have. I failed my mathematics exam in … . I got the high school Graduation certificate/ school-leaving certificate/ secondary school graduation certificate. For 5 years, from … to … . I was at university/ at college in … . I specialized in … My major at university was …. I was an economics major. My studies at… led to a Bachelor's/Master's degree in … . I got my specialization diploma in … Yes, I did. I was good at most subjects. I graduated from …with…

Work Experience, Abilities and Skills	
Have you ever got a job? When exactly was that? When did you start work? What posts did you hold? When were you promoted to this position?	I got a job as a … for … company. I worked there for … years. I worked for … years with a company in … . I held two posts there. I held a key management position in … company. I was promoted to this position/ to this department in …
What companies have you worked for? Have you ever worked with a volunteer organization?	I have worked for …/with… .
What jobs did you apply for, when you came to …? What department did you work in?	When I came to … I started work for… company.
What skills did you acquire while working for/ with … company? What were your professional responsibilities and duties?	I acted as … when he/ she was on vacation, carried out several… projects, was responsible for …, took part in… I acquired leadership qualities, I acquired ability to communicate and work in a team, to arrange business meetings. I did the typing, the filing, the photocopying sorted out mail…, did most of the secretarial work in the office. I improved my communication skills.
Are you skilled in statistics/ using a computer/ marketing/ programming/ business accounting? Are you good at dealing with difficult people? Do you have the skill to cope with a difficult job? Have you ever been involved in managerial functions? Do you have any managerial skills? Are you good at delegating responsibilities to subordinates?	I don't think I am very skilled in … but I am hard-working. When I worked for … company, I was involved in a number of projects which required management skills. I have got some experience at delegating some responsibilities to the members of the department/to my group-mates/ to the members of a team/
Other Information and Recommendations	
Do you know how to use a PC/ how to work with PC/ how to operate a PC/ how to handle a PC?	Yes, I do. I did a two-months advanced computer course when I was at school/ ft the university.
What languages do you speak? Are you fluent in English/ German/ French?	I am fairy fluent in … . My written/ spoken English/German/ French is fairly good. I can make myself understood in….
Can you provide references from at least two referees?	Yes, I can. I am sure they will confidently recommend me.

Unit 4. Business Letters

Text 1. Writing Business Letters

1. Read and translate the text using a dictionary.

Everyone writes business letters from time to time – to request information, to order a product, to complain about something, to apply for employment or to a training programme. Examples are: letters of application for jobs, scholarships, etc.; letters asking for information about courses, services, etc.; letters demanding money (which include complaints, a demand for a refund).

Before you sit down to write a business letter you should think carefully about your purpose. Decide in advance, why you are writing your letter.

Most businesses receive hundreds of letters each day, so your letter should be brief and to the point, it should be well organized and laid out very clearly. Important information should appear early in the letter and you should not digress from the main subject. Be concise and try to sound as natural as possible. Stilted, very formal, unnatural or flowery language very often gets in the way of clear communication.

The first paragraph of your letter should introduce your subject and mention any relevant previous correspondence or conversation. The rest of your letter should present your reader with the fact needed to understand what you are saying. Your conclusion should reinforce your message.

When typing your business letter or composing it on a computer, leave wide margins, at least an inch (=2.54 cm) all around. Type your letter single-spaced and use an acceptable format. One of the most common is the block format. The block format letter begins every line at the left-hand margin and separates paragraphs with a double space. If you use letterhead paper, supply only the date typing it two spaces below the letterhead.

The style of business letters is changing rapidly. Every year it gets simpler and less formal. Except for a few firms, business correspondents prefer simple English to express what they want to say as effectively as possible. Time is more precious than ever to a busy executive and he does not want to have to read a lot of unnecessary words. But the writer of a business letter must create a good impression, especially if he is writing a letter of application, so a few words to promote a feeling of exactness and goodwill are quite appropriate. However, compliments must not be exaggerated, as they may produce the opposite effect, and the reader may feel that the writer is being insincere. In other words, the style of a business letter need not be very formal, but on the other hand it must not be too informal and chatty.

2. Match the following words with their meaning.

1) to promote a feeling of…	a) отклоняться/ уходить в сторону от основного предмета (письма)
2) to reinforce one's message	b) фирменный бланк
3) to get in the way of…	c) запрашивать информацию, сведения
4) purpose/ aim	d) жаловаться, подавать жалобу
5) to digress from the main subject	e) ввести/ представить тему или предмет (письма)
6) to introduce one's subject	f) преувеличивать
7) letterhead paper	g) решить заранее
8) to complain	h) мешать/ препятствовать/ быть помехой
9) to exaggerate	i) стимулировать ощущение/ способствовать ощущению …
10) to decide in advance	j) поле (страницы)

11) concise	k) точность/тщательность
12)stilted	l) представить/сообщить читателю о …
13) margin	m) слишком официальный
14) exactness	n) усилить содержание сообщения
15) to request information	o) цель
16) to present the reader with …	p) краткий и точный

3. Complete the sentences with the prepositions given in the box.

3.1. Read and translate the application letter.

3.2. Fill in each blank in the application letter with a preposition from the following list.

With, in, for, at, of, from

Dear Mr Foster,

Applying ____ the post of Marketing Manager

I noted _____ interest your advertisement in yesterday's Daily World.

You will see _____ the enclosed resume that I have four years experience in marketing. My duties are concerned_____sales promotion. My responsibilities have included all types ____ administrative work, product development, arranging and attending sales conferences and presentations, working_____clients and solving problems.

Although I have an excellent relationship with my present employers, Sunshine Communication, which I joined five years ago, I feel that my prospects with them are limited and there are no opportunities ____ promotion ____ Sunshine. I am convinced that there would be more scope _____ my talents and skills with a larger, more dynamic company.

If you consider that my qualifications and experience are suitable, I would be available ____ interview_____any time.

Yours sincerely,

John Raser

4. Read and translate the text using a dictionary.

Text 2. Business Letter Pattern

Business Letters are usually quite formal in format and style. The different parts of a business letter are:

1. the heading (= the sender's address)
2. the recipient's name, position and address (= the inside address)
3. the salutation (= the greeting)
4. the body of the letter
5. the closing salutation (= the farewell = the complimentary close)

The Heading consists of the sender's return address and the date or the company letterhead or sometimes the company logo. When writing the heading spell out words like *street, avenue, drive, east, west* in full. (Note: in the USA abbreviations 'St' and 'Ave' for *street* and *avenue* are often used. You may, however, abbreviate the names of counties and the names of the states

e.g. Ca/CA – California, Pa/PA – Pennsylvania, in the USA).

When writing your Russian address for a foreign correspondent, do not translate street or city names into English: 'Prospect Mira' but not 'Peace Avenue'. You should write: 'dom', 'korpus', 'kvartira'.

The Dates in the heading are written and spoken in the following way:

e.g. 2 March 1998 – the second of March, nineteen ninety-eight = March the second,

nineteen ninety-eight.

Be careful! Dates are sometimes written in number form only: 2.03.98. In Britain this would mean ‘the second of March, nineteen ninety-eight’. In the USA, and on many computers, it would mean ‘the third of February, nineteen ninety-eight’.

The Inside Address begins at the left margin, four to six lines below the heading, with an appropriate title: ‘Mr’ (for a man who has no other title), ‘Mrs’ (shortened from ‘Mistress’, for a married woman), ‘Miss’ (placed before I lie name of an unmarried woman or girl), ‘Ms’ [miz] (for a woman who does not wish to be called either ‘Miss’ or ‘Mrs’), ‘Dr’ [dokte] (for a person holding one of the highest degrees given by a university, such as PhD – Doctor of Philosophy).

(Note, in American English after ‘Mr’ or ‘Mrs’ comes a full stop: ‘Mr.’, ‘Mrs.’, ‘Mrs’ or ‘Mr’ without a full stop at the end is British English).

e.g. Mrs. Helen Tomlinson
Personnel Manager
109 East Jones Street
Raleigh, North Carolina 27611
USA

The Greeting appears two spaces below the inside address:

e.g. Dear Mr South, Dear Sir(s), Dear Dr. Murphy, Dear Sir or Madam.

The Body of a business letter consisting of introductory, main and concluding paragraphs contains your message. If your letter takes more than one page, place the addressee’s name, the date and the page number in the upper left-hand corner of the second page.

The way you begin your letter is very important. You should make the subject of your letter clear immediately:

e.g. Thank you for your letter dated 24 November.

Благодарю Вас за письмо от 24 ноября.

e.g. I was delighted to receive your letter of 20 January.

Я был очень рад получить ваше письмо от 20 января.

e.g. I am writing to tell you that I have decided to accept your offer of employment.

Сообщаю Вам, что я решил принять ваше предложение о работе.

e.g. Further to my last letter/ to our telephone conversation I am writing to tell you that…

В дополнение к моему последнему письму/ к нашему телефонному разговору сообщаю вам, что …

e.g. We are interested in the new training programme.

Нас интересует новая учебная программа.

e.g. In reply to your letter of 9 January …

В ответ на ваше письмо от 9 января …

e.g. I am writing to confirm my wish to apply for the post of…

Настоящим сообщаю о своем желании подать заявление о приеме на должность.

The Concluding Paragraph is the last thing your correspondent will read, and the last impression you produced on him/her. It should also contain typical phrases of the kind:

e.g. I would appreciate any suggestions/ offers.

Я был бы признателен за любые советы/ предложения.

e.g. Thank you for your time and trouble.

Спасибо за время, которое вы мне уделили и взятые на себя хлопоты./ Спасибо за потраченное время и хлопоты/ внимание.

e.g. We would be grateful to receive a prompt reply.

Мы были бы благодарны за получение ответа в ближайшее время.

The Closing Salutation appears two spaces below the body of the letter. The most common complimentary close is ‘Yours sincerely (BrE) or Sincerely yours’ (AmE). More formal letters to high government officials might call for ‘Respectfully yours’.

The Material Enclosed along with the letter is called ‘enclosures’ (usually shortened to ‘enc’).

5. Find in text 2 the English equivalents for the following key words and expressions.

1. структура, построение (письма)	
2. обратный адрес	
3. текст письма	
4. фирменный знак/ символ	
5. сокращения (в написании слов)	
6. получатель (письма)	
7. приветствие	
8. заключительное приветствие	
9. подпись	
10. «с уважением к вам»/ «искренне ваш»	
11. приложение (к письму)	
12. сообщение	

Speaking Practice

1. Find the answers to the questions in the texts ‘Writing Business Letters’ and ‘Business Letter Pattern’.

1.1. Questions to the text ‘Writing Business Letters’.

1. Why do people write business letters?
2. Is a business letter usually long and very formal?
3. Do you have to follow any rules while typing or composing a business letter on a computer?
4. What is the block format of a business letter?
5. What makes a business letter stylistically balanced?
6. What can create a favorable impression if you write a letter of application?

1.2. Questions to the text ‘Business Letter Pattern’.

1. What does the heading of a business letter include?
2. Is there any deference in writing dates in British and American English?
3. In what way should you write your Russian address for a foreign correspondent?
4. If the greeting at the beginning of a business letter is ‘Ms’, what does it mean?
5. How does the greeting end in business letters?
6. What does the body of a business letter consist of?
7. Do you think the beginning of a business letter is very important? Why?
8. What do you usually write in conclusion?
9. What is the most common closing salutation?
10. What is the shortened form of the word ‘enclosure(s)’?

2. Work in pairs. Discuss the content of texts 1 and 2 in the form of a dialogue using the sets of questions given below. Use communicative signal words (SW) and expressions for the questions and answers.

Question SW	Answer SW

First of all…	It is evident that…
Can you tell me…	We can state that…
It is interesting to know…	As for we can say that…
I would like to ask you…	I am sure that…
Can I ask you…	To my mind/in my opinion…
One more question is…	It seems to me that…
Do you know…	I would like to say that…
Have you got any information …	If I am not mistaken…
How do you think…	Above all…

Writing Practice

1. Translate the following sample letter concerning methods and terms of payment.

1 Metalexport Ltd
43 Ulyanova St
109189 Moscow, Russia

2 23 January 2019

3 Mr James Bowers
Managing Director
Electroscan plc.
26 Orchard Road
Halifax HX2 5PJ, UK

4 Your ref. MS/SN 22/95
Our ref. 20/2009/95

5 Dear Mr Bowers,

6 Much to our regret we have to inform you that so far we have not received a bank guarantee from you. In view of the above we would like to remind you of your letter of November 5, last year, in which you asked us to change the Letter of Credit (L/C) method as inconvenient owing to the difficulties and extra expenses incurred

7 Being aware of your difficulties our firm made a concession by suggesting payment for collection terms. You accepted the suggested method of payment and undertook to submit within three weeks a first-class bank guarantee for 80% of the contract value. However, as we are still without your bank guarantee, we have had to give instructions to suspend shipment of sheet iron. At present over 40 tons of sheet iron are at the port causing storage expenses which we feel should be charged to your account. We enclose herewith a list of current storage prices.

8 We would, therefore, be grateful if you could advise us at your earliest convenience when the bank guarantee will be submitted and also let us have your consent to covering the above storage expenses.

9 Yours sincerely,

10 Ю. Борисов
Yu. Borisov

11 Export and Sales Manager

12 Enc

2. Match the numbers standing for the parts of the letter with the English equivalents choosing the words from the box below.

References, date, concluding paragraph, signature, typed signature, position/title, enclosures, salutation, sender's return address, closing salutation, introductory paragraph, reader's name, position and inside address, main paragraph

3. Find English equivalents to the following Russian word combinations. Consultthesampleletter.

Закрытая (частная) компания с ограниченной ответственностью, аккредитив, принятые на себя расходы, к нашему сожалению, благодаря/по причине, открытая (публичная) компания с ограниченной ответственностью, предоставить подтверждение, расходы по хранению, условия платежа на инкассо, задержать отгрузку, в свете вышесказанного, расходы должны быть отнесены на ваш счёт, согласие на покрытие расходов по хранению, банковские гарантии, пойти на уступку, как только вам будет удобно, стоимость контракта, к настоящему (письму) прилагается.

4. Match the common abbreviations (A) used in business letters to their longer words equivalents (B).

A	B
1)& Co	a) trademark
2) @	b) Post Office Box
3) scillo.	c) per annum (per year)
4) attn.	d) Incorporated
5) Corp.	e) at (a price of…)
6) dept.	f) copyright
7) enc. Or encl.	g) Public Limited Company
8) etc.	h) Managing Director
9) Inc.	i) and Company
10) incl.	j) approximately
11) Ltd.	k) for the attention of…
12) MD	l) Limited
13) p.a.	m) reference (number)
14) pic. Or p.l.c.	n) Corporation
15) POB	o) enclosures
16) ref.	p) registered trademark
17) ®	q) including/inclusive
18) ©	r) department
19) TM	s) et cetera/ and so on

5. Match the patterned business letter phrases and sentences with the content points of a business letter.

1. With regard/reference to your letter of 21/8/19…
2. If you don't pay a refund for … I shall be obliged to take legal action.
3. I apologize for my delay in replying to your letter of 19/7/99.
4. I look forward to hearing from you soon.
5. I am writing in order to …
6. I am writing in reply to your letter of 20/8/19.
7. We regret to inform you that your name has not been placed on our short list for the post of manager…
8. We should/would like to draw your attention to the fact that …
9. I am writing to confirm my wish to apply for the post of…
10. I enclose my curriculum vitae (CV).
11. I would be very grateful if you would/could send me an application form.
13. We are interested in the new training programme.

14. We would be grateful to receive a prompt reply.
15. Failing this, I shall have no alternative but to refer the matter to my solicitor.
16. We apologize for any inconvenience you may have been caused …
17. I would like to apply for …
18. I am pleased to inform you that your application for … has been approved.
19. Attached you will find a detailed account of what happened …
20. Further to our conversation / my fax of 18/8/19 …
21. Thank you in advance for your help.
22. I insist on an immediate apology …
23. We should be glad, if you would confirm this booking as soon as possible.
24. I would like to confirm the booking made by phone today for a double room.
25. I look forward to joining your company.
26. I am pleased to accept your offer.
27. With reference to your recent letter I am instructed to inform you …

1. Saying why the letter is being written.	
2. Referring to previous contact.	
3. Making a request.	
4. Sending something with the letter.	
5. Rejecting/accepting applications/offers.	
6. Looking forward to the reply.	
7. Threatening/expressing a threat against someone.	
8. Making an apology.	

2.2. Тексты делового характера для перевода и работы со специальной лексикой

1. Translate the text.

2. Make up the vocabulary of specialized key-words and expressions marked in the text.

3. Choose 5 specialized key-words or expressions and explain their meaning in English.

4. Prepare mini presentation on the content of a text given below.

Text 1. Contemporary Organization Theory

The literature on various contemporary theories of organization is vast. But perhaps the underlying factors most commonly found in almost all of them include the significance of external environment and its impact on organizations, the utility of managerial feedback, the importance of strategic planning and top managerial decision making, the role of technology and resource dependence, the necessity of worker cooperation, and the desire for a participative management, as well as a host of other variables representing managerial and individual employee perspectives. These theories reflected the post – World War II relative economic prosperity followed by the increasing social, political, racial, and economic conflicts, that dominated the periods of the 1950s and 1960s. Attention was shifted toward strategic, environmentally conscious, and globally motivated decisions with managerial innovations for meeting the ideological challenges of the Cold War period both politically and economically. Organizational planning was generally discouraged because of its being socialistic in nature, therefore restricting individual freedom of choice.

Text 2. Market Model of Organization Theory

The market theory of organization is derived primarily from economic theory and secondarily from sociology. Based on the neoclassical economic theory, the market theory is based on the economic, rational assumptions that man is a self-interested, rational animal seeking to maximize individual interests in the marketplace. Bargaining, exchange, and strategies to minimize transaction and exchange costs and to maximize benefits are central to the market theory of organization. Modern organizations are seen as rationalizing institutions of exchange and transactions of the free market system in which individuals trade and exchange their goods and services for something in return.

Mainly developed for application in the private sector, the market theory of organization and administration has found its way into public administration and organization theories.

Several principles form the foundations of the market theory, also called 'public choice' theory. These include individual choice as the basis for organizational or 'collective actions', individual preferences as expressions of individual choices, rules to facilitate and assure order and stability in organizations and society.

Text 3. Chaos Theory

The notion of chaos denotes crisis and disorder, a state of nonequilibrium, instability, turbulence, rapid or rupturing changes that scramble plans and cause unpredictability, with consequences of anxiety, fear of the unknown, and triggering effects of destruction and system breakdowns. A key question for social and natural scientists is how to control chaos so that its destructive effects could be eliminated or minimized. This is a notion that has until recently prevailed in traditional ways of thought and action in social science. However, as explained by chaos theory, social and natural phenomena do not exist or develop or evolve on strictly linear paths so that we can predict crises that would need to be avoided or controlled. The essence of chaos theory is that of the law of nature, as explained over a century and a half ago by Marx and Engels and long before them by earlier philosophers of the East as well as of the West. Examples of chaotic events or systems breakdowns in the world are many, and they may be found at macro and micro levels. Contemporary scientists have grouped these crises or systems breakdowns into two types: microcosmic and macrocosmic.

The microcosmic social realities of crises have worldwide impacts. Examples include financial crises, population crises, global environmental crises, world population explosion pressures, desertification of productive lands, crisis of the widening gap between rich and poor countries, and the possibility of nuclear wars, institutional crises, and a host of other crises. These crises and pressures 'drive the breakdowns of systems that lead to states of social chaos'. These so-called 'microcosmic' crises or social breakdowns are considered short-term process events, with many more micro-oriented crises that affect open system organizations and living systems.

The second type of chaos-oriented forces that are long-term with accelerated shifts are macrocosmic. Macrocosmic crises are the great changes of history and acceleration of evolutionary forces that has led to disintegration, social shifts, and longwave crises that threaten the whole global planet, a fundamental concern of the future that calls for present decision and social action.

Text 4. Power Elite Model of Organization Theory

Shared objectives, values, wealth, and educational and social backgrounds hold the power elite groups together. There are extensive positional overlaps, interlocks, and interchanges among the uppermost elites. The executive cabinet members and top political elites appear to be centrally located, with legislators and high-level politically appointed officials taking secondary seats just below the first inner circle group. The first group of uppermost elites generally sets the broad parameters and boundaries of the political and governmental system, allowing the secondary level of non-inner circle elites to interact and function on the plural model. Should the secondary level elites step beyond the boundary limit, they will be subject to sanctions, including removal from membership.

Autonomy of the first elite group from the state is expected, and the state actually is dependent on this elite. Mills (1956) calls this group the 'power elite', whereas Hunter (1953) calls it the 'power structure', which conditions the structural parameters and their boundaries in society. This model can be applied to many countries in the developed and developing world, but it does not seem to apply to some, especially revolutionary societies such as Iran, Nicaragua under the Sandanistas, and elsewhere, where the lower middle class, including members of the peasantry and some professional groups, actually governs the society and dominates the politics and administration, although the economic elite may still hold considerable bargaining power.

Text 5. Significance of Power Elite Model

The power of organizational elite theory is significant in several ways. First, the theory is descriptive. It not only explains the organizational power structure, it also explains the external power structure that more or less sets the parameters for organizational power and functions.

Second, the theory also focuses attention on what ought to be done by making suggestions regarding elite configuration and reconfiguration, elite recruitment from masses, elite benevolence, and elite decisions on strategic choices that affect both the elites and nonelites. Therefore, the elite theory of organization contributes to the normative theory of organization not only by building on descriptive aspects of organizational power, politics, and administration (e.g., how organizations function and who is in charge). It also considers alternative modes of power structure in organizations (what ought to be done or who can or should take power, or how power should be distributed).

Furthermore, by analyzing the existing situation, the elite theory attempts to predict possible outcomes of policy choices and to recommend corrective actions at strategic levels both inside and outside of organizations.

Organizational elite theory uses a dialectical approach as a method of analyzing organizations, the relationship between the leaders and the led, management and labor, and the elites and the masses, because without one the other is inconceivable. The dialectal process is a method of analysis of interaction between masses and elites, and between elites and counter elites at all levels of organization and society. Such dialectical interactions are key ingredients of the elite theory in general and of the organizational elite in particular. As long as the relationship between organizational members and elites is not antagonistic and hostile, elites are able to manipulate smoothly the environment under their control.

Text 6. Theoretical Approaches to the Public Sector Reforms

There are at least three alternative theoretical positions useful for understanding reform and reorganization efforts in the public sector. We will describe briefly these three fundamental positions, along with the various subsets contained within each. We will also discuss how each of the approaches might be applied in the public sector and how we might decide among them as ways of understanding what has been happening in public administration. There may even be a case to be made for the ability of several of the approaches to predict what might transpire in any prospective administrative reforms.

One major weakness in most public administration literature is the inability to predict the logical outcomes of emerging situations and opportunities in the public sector. As a consequence, most administrative analysts postdict rather than predict, outcomes in the public sector; these ex-post analyses will always be correct, but not particularly useful for the practical policymaker. The approaches which will be discussed here are by no means predictive models, but there are at least some inklings of movement in that direction.

As we discuss theories in reorganization, we will need to be extremely careful to distinguish the theories (implicit or explicit) that have guided practitioners who constructed the reorganizations from those theories that political scientists and other organizational analysts have utilized in their attempts to understand, ex post, the changes imposed. In some instances, the two bodies of theory may be synonymous, while in other cases there are marked differences. Several of the more abstract theories of the analysts may in fact be useful for informing practical reform efforts.

РАЗДЕЛ 3. БАНК ТЕКСТОВ ПРОФЕССИОНАЛЬНОЙ НАПРАВЛЕННОСТИ

3.1. Electrical engineering

Text 1. Employment Prerequisites for an Electrician Job

Source: https://www.foundit.in/career-advice/electrician-job-description/

Due to their work's complexity, as well as its inherent dangers, electricians must undergo specialized training. In most cases, this can be done through an apprenticeship, but a technical school education is also an option. It may be necessary to take continuing education classes to keep up with technological advancements and changes in the electrical code or safety standards.

As to accreditation and training for electrician job, a high school diploma or its equivalent is normally required before beginning training as an electrician. Other requirements include passing an aptitude test and drug screening as well as having a year of algebra in their high school education. Apprenticeship programs, which often run for four or five years and are sponsored by unions and contractor organizations, are the primary training method for many. At the absolute least, a year of formal education provides 144 hours' worth of technical training including math, blueprint reading, electrical code, electrical theory, and safety rules.

Other specializations, such as communications, fire safety systems, and soldering, are accessible to students. Apprentices must also complete around 2,000 hours of paid on-the-job training each year to complete their training. After completing their training programs, apprentices can enter the industry as journey workers, which means they no longer need the supervision of a more experienced electrician to carry out their job.

Concerning salary, it should be mentioned that those who work in skilled occupations can expect to make a lot of money, as many of these 2020 averages show. Regardless of whether they work for a company or are self-employed, electricians have consistently ranked as one of the highest-earning crafts. Inexperienced electricians should expect to earn less money than those working in the field for a long time and have a high level of education and training. With five to nine years of experience, a mid-career Electrician makes an average total salary of $273,899. Based on 133 salaries, the average total salary for an experienced Electrician with 10-19 years of experience is 303,343. Employees who have worked for the company for more than 20 years may expect to make an average of $353,749 each year.

Essential skills for your resume and career in electrician job are:

– Thinking critically. If you're an electrician, you'll need to know how to use a multimeter to check wiring and then figure out the best method to repair it.

– Perception of color. Electrical components, such as wires, are color-coded, and different discerning colors is essential.

– Strength and endurance. While running wires, electricians may be required to stand for lengthy periods of time, and they may also be forced to stoop or crouch while installing fixtures in tight places.

– You must do your task in a timely manner if you want to accomplish your projects on time.

– As an electrician, you're constantly at risk of being shocked or burned, so you need to be aware of your surroundings.

– After doing product and system testing, electricians use the information gathered to evaluate problems and choose the best course of action for each situation.

– Skills in logical problem-solving. It is imperative for electricians to think logically while dealing with electrical malfunctions.

– An electrician must be able to deal with both residential and commercial customers with a friendly approach.

Electricians undertake a highly technical job, and the work requires skill and care. While homeowners will often undertake DIY jobs like framing in a new room or installing new cabinets, they normally employ a professional to complete electrical work.

To sum up, strong job growth and the prospect of a long, steady career in the electrical industry draw high school graduates to the field. To become an electrician, you'll need an analytical mind and a strong grasp of maths and physics. When it comes to electricity, there is no job that master electricians can't do. A master electrician is considered to be at the top of their field. We rely heavily on electricity in our daily lives, and new electrical technologies are always being developed to meet our needs. It is the responsibility of licensed electricians to complete the installation of modern technology in residential and commercial facilities.

Text 2. Electrical Engineering

Source: https://notesread.com/electrotechnics-all-the-information/

Electrical engineering is the study of electrical processes. It deals with the analysis, operation and control of electrical signals. This field encompasses a variety of subfields such as communication, signal processing, power electronics, and digital signal processing. Electrical engineers combine their knowledge of mathematics, physics, and chemistry with electronic principles to develop solutions to electrical problems. Engineers are problem solvers who must think critically to solve difficult problems. If you're interested in a career that involves working with electricity on a daily basis and troubleshooting machines when they break down, an electrical engineering degree will prepare you for the future.

Let's find out more about what this degree entails and if it's right for you. We start with the answer to the question: 'What does an electrical engineer do?' An electrical engineer solves design problems related to electricity. Electrical engineering is a diverse field, with specialties in areas such as automation, robotics, and computer science. Electrical engineers are responsible for the design, implementation, and maintenance of electrical equipment and systems. They can work in many sectors, such as communications, healthcare, and manufacturing. Engineers work closely with other engineers, scientists, and designers in teams to research and design products such as cars, computers, and medical devices. Electrical engineers may research and develop new technologies related to electricity, or they may work with a team of engineers to design products such as a new car or a smartphone.

And now let's find out why one should study electrical engineering. Electrical engineers work in a wide variety of industries, solving power generation, transmission and distribution problems. They also solve manufacturing, instrumentation and control, computer systems, and communications problems. Electrical engineers also design and test electrical equipment such as power plants, transmission lines, or computer systems. Electrical engineers can also work in research and development, as well as teaching. Electrical engineers design and develop electrical products, such as computer devices and systems, communications networks, or power generation and transmission systems. This field is expected to grow due to the increasing demand for new technologies. Many electrical engineers work in research and development or design.

Text 3. Types of Electrical Engineering

Source: https://notesread.com/electrotechnics-all-the-information/

Most electrical engineering programs include courses in mathematics, physics, programming, and engineering design. In many cases, you'll also need to complete a hands-on design project in which you'll apply what you've learned to a real-world problem. Engineers typically specialize in a certain type of electrical engineering once they begin their career. Here is a brief summary of some of the more common specialties:

– Communications Engineering: It focuses on how electrical signals can be transmitted between two devices, such as a radio tower and a mobile phone. Communications engineers may also design the hardware that sends data over the Internet.

– Control Engineering: They use electrical and computer systems to manage automated processes. A controls engineer can design and implement systems that manage the machines in a factory, such as a production line or a robotic system.

– Electrical Engineering: It deals with designing electrical systems and devices that use energy, such as power plants, transmission systems, and electrical networks.

– Computer Engineering: It combines computer science and electrical engineering to design computer hardware and software systems. These are just some of the specialties of electrical engineers.

As to an electrical engineering program, all Bachelor Programs in electrical engineering include a core curriculum that focuses on the fundamentals of the field. In many programs, you will also be able to choose a specialty concentration in one of the subfields listed above. Electrical engineering bachelor's programs are designed for students who want more hands-on experience than is typically offered in an electrical engineering associate degree program. Electrical engineering programs typically include laboratory research projects and field trips to local engineering facilities. Many programs also offer elective courses in fields such as computer science and business. At the end of your program, you will complete a design project where you will have the opportunity to apply your skills to a real-world problem.

Text 4. Career Options for an Electrical Engineer

Source: https://notesread.com/electrotechnics-all-the-information/

An electrical engineer, or electrical engineering expert, may specialize in a specific area, such as software or project management. In some cases, an electrical engineer may also need software development skills, such as coding, or another non-electrical engineering position to advance her career. Here are some career options for an electrical engineer:

– Aerospace industry: Aerospace engineers design airplanes and spacecraft in which there are many electronic devices to design.

– Biomedicine: Biomedical engineers are dedicated to designing medical equipment. This may include equipment for surgery, prosthetics, or medical diagnostics. Biomedical engineers also research new medical technologies.

– Computer hardware: Computer hardware engineers design and build computer and networking hardware, such as routers and circuit boards. They can also try out new hardware designs. They may also provide software support for the hardware. Computer hardware engineers may specialize in a specific area, such as data centers, computer architecture, or Internet security. They often work with other computer engineers and technicians. Computer hard are engineers typically work long hours. They can work in noisy environments. This can pose a risk to hearing health.

– Electronics: Electronics manufacturing engineers design, test and manage the production of electronic equipment. This can include anything from computer chips to circuit

boards. Some electronics manufacturing engineers specialize in a specific industry, such as automotive or medical. Electronic manufacturing engineers lead large teams of technicians. They make sure products meet quality, budget, and time requirements. They may also research new production methods and equipment. Electronics manufacturing engineers work with engineers, technicians, and other manufacturing personnel. They may also work with business managers and marketing teams. Electronics manufacturing engineers typically work long hours. They can work in noisy environments. This can pose a risk to hearing health. The job may also require the use of safety equipment. Electronic manufacturing engineers can earn a high salary, especially in specialized industries.

– Environment: Environmental engineers design and operate structures that control water, air, and soil pollution. They can also design and build electrical or electronic installations for waste treatment plants, etc.

– Software: Video game programmers and software developers design and test game software with controllers and new controllers that are designed electronically.

– Industrial automation: Industrial automation engineers design and manage industrial automation systems. Industrial automation systems manage the automation of machines or processes. This can include jobs such as assembly lines.

Text 5. Need of Electronics and Its History

Source: https://www.codrey.com/dc-circuits/electronics-and-its-applications/

Electronics is an applied form of science that deals with electrons. It handles electric circuits containing active elements, passive elements and other underlying techniques making it as an important part of engineering. The world is growing at a fast rate and it is relevant for the technology enthusiast to upgrade with latest changes happening in the society. Moreover, it is difficult to spend few hours without electronics gadgets and they had become an important part of our everyday routine.

We are living in an electronic era where machine robots are capable to do human work with more ease and high efficiency. Capsules and tablets contain wireless sensors that collect information from the body to diagnose. Transparent smartphones will exist in the coming days, we can see through them and they may lead to the use of windows or mirrors in our home to be used as PC screens and TV monitors. Sensors are placed on the plants to detect the shortage of water and alert the farmers.

There are other numerous electronic applications that change our daily lives in the nearby future. Electronic devices are made up of active and passive elements and smaller IC memories. The ICs, diodes, and transistor are made of semiconductor materials and their working is dependent on current flow through them.

As to history of Electronics, let’s consider the most important inventions related to it.

– A vacuum diode: It was invented by John Ambrose Fleming. Electronics era came into existence with the invention of vacuum diode in the year 1897. Vacuum tube essentially consists of two electrode plates i.e., an anode and a cathode. This allows current direction in one direction. But this diode is not able to control the current flow. In 1906 Lee De Forest modified and named it as a vacuum triode. The triode has 3 terminals: an anode, a cathode and a grid terminal. The grid electrode controls the current flow from anode to cathode. This feature could boost the power of electrical signals. Also, a tetrode and a pentode had evolved.

– A transistor: It was invented by John Bardeen, Walter Brattain and William Shockley. The real development started with the invention of the transistor in 1948 in Bell Laboratories. Large bulky vacuum diodes are replaced with junction transistor. Transistors are initially made with germanium material, later on, silicon BJTs (Bipolar junction tran-

sistors) are grown up. Most of the devices developed today are made up of silicon only due to its low cost.

– An IC (integrated circuit): It was invented by Jack Kilby. To reduce the size and cost of the entire circuit Jack Kilby introduced a new concept. This idea entirely changed the world. The complete interconnected circuit is placed on a single chip commonly called VLSI (Very large scale integrated). Computer processors used today are made up of billions of transistors integrated on a single IC.

Text 6. Consumer Electronics

Source: https://www.codrey.com/dc-circuits/electronics-and-its-applications/

Electronics, as the name implies relating to electrons. The word electronics arrived from electron mechanics (Behaviour of the electron when it is subjected to externally applied fields).

The definition of electronics technically says: 'Electronics is an engineering branch that concerns with the flow of current through semiconductor, gas or any form of matter.'

Consumer Electronics is most applicable to the common people. This industry produces devices and equipment meant for everyday use. It has a few categories:

– Office gadgets such as calculators, personal computers, scanners and printers, FAX machines, front projectors, etc.

– Home appliances such as washing machines, refrigerators, air conditioners, microwave ovens, vacuum cleaners, dishwashers, etc.

– Audio and video systems such as headphones, VCRs, DVD players, color TVs, microphones and loudspeakers, video game consoles.

– Advanced consumer devices such as setup boxes, ATM, smart phones, PDA (a personal digital assistant), barcode scanners, POS terminals.

– Storage devices for optical playback and taping, and portable infotainment. Examples are DVDs, HDD jukeboxes, Portable MP3 players.

Text 7. Industrial Electronics

Source: https://www.codrey.com/dc-circuits/electronics-and-its-applications/

This industry is powerful in making real-time automation. This includes an industrial automation and motion control, a machine learning, a motor drive control, a mechatronics and robotics, power converting technologies, photo voltaic systems, renewable energy applications, a power electronics, and biomechanics.

– Smart grid systems: Smart electric systems collect information from the communication technology and react accordingly based on power consumption. It is an application of intelligence, computing, and networked electricity systems. A smart meter is one of the examples.

The features of smart grid are a digital system based on two-way communication, interactive sensors, self-monitoring and debugging, the valid distribution of electricity.

– Industrial automation and motion control: Machines are replacing humans these days with increased productivity, time and cost. Moreover, safety is also considered for unmanageable works. Hence to substitute the humans, automation has become the preferable choice for industries.

– Image processing: 3D world has been evolved from a single or multiple 2D images. Various algorithms are developed to extract 3D information from 2D patterns. Moreover, image processing is used in the computer graphics, an artificial intelligence, the robotics for navigation, an inspection and assembly, a computer vision for a face and gesture recognition, a virtual reality, and medical analyses.

Text 8. Automotive, Medical, Meteorological, Oceanographic, Defence and Aerospace Applications of Electronics

Source: https://www.codrey.com/dc-circuits/electronics-and-its-applications/

As to automotive applications of electronics, it is used in different parts of an automobile. For example, in an anti-collision unit, an infotainment console, an anti-lock braking system, a cruise control, a traction control, window regulators, an electronic control unit (ECU), an airbag control, etc.

Concerning medical applications of electronics, it is important to say that advanced sophisticated instruments are being developed for data recording and physiological analysis. They are proven to be more useful in diagnosing diseases and for healing purposes.

Some of the medical devices and equipment used are:

– A stethoscope that is a medical instrument for listening to the action of human's or animal's heart or breathing.

– Respiration monitors for knowing the patient condition due to change of a body temperature, pulse, respiration and blood flow.

– A defibrillator is a machine that starts the heart beating normally again after a heart attack, by giving it an electric shock.

– A glucose meter for measuring sugar levels in the blood.

– A pace maker for reducing and increasing the count of the heart beats.

Regarding meteorological and oceanographic applications of electronics, it should be mentioned that environmental monitoring is done through various sensors and automatic weather stations. Some of them are:

– A barometer which is an instrument that measures air pressure and shows when the weather is changing. It is used for predicting if the weather is good or bad. It gives an atmospheric pressure level as an indication. If the pressure level is high, the weather is good and, if the pressure is low, it means the weather is bad.

– An anemometer which is an instrument for measuring the speed of the wind, or of any current of gas, and the direction of the wind.

– A tipping bucket rain gaugewhich is needed for measuring the rainfall periodically stored in the automatic weather station such as a data logger.

– A hygrometer which is an instrument for measuring the humidity of the air or a gas.

– A drifter buoy that measures the current, temperature, and pressure levels in the ocean.

– A data logger which is utilized for storing the data collected from various sensors like the humidity, temperature, wind speed and direction, solar radiation, and rain scale.

Defence and aeronautical applications of electronics include missile launching systems, rocket launchers for space, aircraft systems, cockpit controllers, military radars and boom barriers for military applications.

Text 9. Basics of Electrical Machines

Source: https://www.etechnog.com/2022/01/what-is-electrical-machine-electrical.html

An electrical machine or electric machine is anything that reduces human effort with the help of electrical energy and converts electrical energy into mechanical energy or mechanical energy into electrical energy.

The principle of operation of the most of the electrical machines is based on electromagnetism or electromagnetic induction or electrostatic energy or electromechanical

force. Among others, electrical energy provides the most advantages. It is easy to transfer, convert, and even store. The electrical machine or electromechanical machine allows having more precise control over pure mechanical machines.

As the electrical machine converts electrical energy into mechanical energy or mechanical energy into electrical energy, it has an arrangement where the electric current can flow. An electrical machine also may have mechanical parts. The electric machine can operate with a single principle or the combination of different principles. The electric machine cannot be a stand-alone device. It is a circuit, a large arrangement, etc.

According to the power supply required for operation, electrical machines are divided into three major groups – AC machines, DC machines and universal machines. AC machines are those that operate with an alternating current or AC power supply and DC machines are those that operate with a direct current or DC power supply. As to universal machines, they can operate with both AC and DC power supplies.

According to the function, electric machines can divide into two major types – static machines and rotating machines. Static machines are those that have no rotating parts such as a transformer and the rotating machine are those that have rotating parts such as electric motors. The transformer basically works on the principle of electromagnetic induction. Here two coils are magnetically linked to each other. Electrical energy is transmitted from one coil to another coil by changing voltage and current but keeping constant power and frequency.

The common and well-known examples of electrical machines are an electric motor, an electric generator and an electric transformer.

Text 10. Types of Electrical Machines

Source: https://allabouteng.com/types-of-electrical-machines/

A device capable of inter-conversion between electrical energy and mechanical energy is called Electrical Machine. In simple words, an electrical machine converts electrical energy into mechanical energy and vice versa. A transformer is also a kind of an electrical machine with an exception that it converts voltage and current levels.

Electrical machines are classified into two main types – stationary electrical machines and dynamic electrical machines. A stationary electrical machine is such kind of machine which does not have any moving parts; in other words, they remain stationary throughout its operation. A transformer is a stationary electrical machine, which does not have any moving parts. It is a machine because there is a conversion between electrical and magnetic energy between the windings of the transformer. It converts electrical energy into magnetic energy and again into electrical energy with increasing or decreasing the AC voltage/current level and maintaining the electrical frequency constant. It has two windings – a primary winding and a secondary one. Both windings are wounded around a stationary iron core. The varying AC current is applied to the primary winding, which creates a varying magnetic flux in the core of the transformer. This varying magnetic flux induces an EMF in the secondary winding of the transformer, resulting in an AC current at the output.

Dynamic electrical machines consist of moving parts as well as stationary parts. There are two types of dynamic electrical machines – an electrical motor and an electrical generator. An electrical motor is a type of dynamic machine which converts electrical energy into mechanical energy. Electrical motors have a moving part called rotor and a stationary part called stator. Electrical motors generate a mechanical force due to the interaction between the magnetic field and current in a conductor. There are two main types of electrical motors – a DC motor and an AC motor. As to DC motors, wherever a current-

carrying conductor is placed inside a magnetic field, it experiences a mechanical force. The DC motor operates on this principle. The rotor is made up of multiple loops of conductors, which is supplied by a DC source. The rotor is placed in a magnetic field. The conductor experiences a force due to which the rotor rotates.

In AC motors, the stator is made up of winding which is connected to the AC voltage supply. It creates a rotating magnetic field. The rotor is made up of a conductor which can easily conduct electricity. The rotor is placed inside the stator. Unlike DC motors, the electrical supply is connected with the stator of AC motors. Due to the rotating magnetic field produced by stator winding, an emf is induced in the rotor. This, in turn, creates its own magnetic field opposing the stator's magnetic field according to Lenz's law. This magnetic field tries to cancel out the stator's rotating magnetic field by rotating the rotor with exact same rotation speed.

Electrical generators are such types of electrical machines which convert mechanical energy into electrical energy. Their operation is exactly opposite to the electrical motor. According to Faraday's law, a conductor placed inside a varying magnetic field will experience an induced emf. In other words, moving a conductor in a static magnetic field will induce emf in the conductor. The rotor is rotated inside a magnetic field by any means known as a prime mover. The resultant induced current (electrical energy) flows out through the conductor.

Text 11. Electric Motor, Electric Generator and Transformer

Source: https://www.etechnog.com/2022/01/what-is-electrical-machine-electrical.html

An electric motor is a machine that converts electrical energy into mechanical energy. Basically, it creates a rotating motion when electrical power is applied to it. The electric motor has a stator part and a rotor part. The rotor parts rotate. There are a lot of types of electric motors that have different principles of operation. But the primary principle is electromagnetism and electromagnetic induction.

An electric generator is a machine just opposite to an electric motor. It converts the mechanical energy into electrical energy. When the rotor of the generator is rotated using a prime mover it generates electricity in the form of alternating current or direct current. A DC generator generates electricity in the form of the DC supply whereas an AC generator generates electricity in form of the AC supply.

A transformer is also an electrical machine that transfers electrical energy by changing the voltage level. It is a static machine that means it does not have any rotating parts. Basically, it has two inductive coils or a winding that are a primary winding and a secondary winding. The primary winding is connected to the power supply and the secondary winding is connected to the load. There is no electrical connection between the primary winding and the secondary winding. Electrical energy transfer with the help of the mutual inductance.

Some other examples of electric machines are an eddy current dynamometer, an eddy current clutch and an eddy current brake.

Electric machines are used everywhere – from our home appliances and kitchen appliances to industrial appliances. For example, an electric motor is used in a mixer grinder. The electrical motor is utilized in cranes, elevators, lifts, lathe machines, etc. Electrical transformers are used in substations, power generating stations, electrical appliances, etc. The electric generator is used in power plants for electrical power generation purposes. Some small generators are also used for the household management purposes.

Text 12. Main Types of Electrical Power Supply

Source: https://www.etechnog.com/2019/11/electrical-power-supply-types-and-their.html

As to types of an electrical power supply, their applications and uses, there are different types of electrical and electronics circuits we use to perform various types of tasks. Electronics circuits do not use the same type of a power supply.

According to the polarity of the voltage and direction of current there are two main types of the power supply – one is an AC power supply and another one is a DC power supply.

As to the AC power supply, an AC or alternating current has no polarity. Its polarity changes according to its frequency. In the AC power supply, the magnitude and direction of the current also changing with time. The main source of the AC power supply is the alternator which is an electrical machine that can convert mechanical energy into electrical energy in the form of alternating nature. The AC power supply with a standard voltage and frequency is mainly used to operate electrical appliances such as electrical motors, electrical fans, air conditioners, pumps, refrigerators, etc.

The DC power supply has a fixed polarity. In the DC power supply, the magnitude and direction of the current do not change with time. The DC has no power factor and no frequency. The sources of the DC power supply are a battery, a solar panel, etc. Also, we can convert the AC into the DC using the rectifier circuit. The DC power supply is mostly used in computers, printers, televisions, music players, etc.

Text 13. Other Types of Electrical Power Supply

Source: https://www.etechnog.com/2019/11/electrical-power-supply-types-and-their.html

Depending upon the voltage, current limit, size of the circuit, efficiency, noise, there are different types of electrical power supplies we design according to our requirement. Some important types of the electrical power supply include a transformerless power supply, a switched mode power supply, an uninterruptible power supply, a regulated power supply and a linear power supply.

The transformerless power supply has no transformer for the voltage step down purpose that's why it is called a transformerless power supply. A series capacitor is used to step down the 230V AC supply into our required voltage level. The series capacitor drops the voltage. A bridge rectifier circuit using the PN junction diodes is used to convert the AC into the DC. The transformerless power supply is generally used in low-cost electronic devices such as rechargeable lights, DC fans, music systems, etc. The main advantage of the transformerless power supply is that it is very small in size and low-cost. It can give up to 80% efficiency.

The switched mode power supply or SMPS is an electronic power supply where semiconductor devices, such as a MOSFET (metal-oxide semiconductor field-effect transistor), a IGBT (insulated-gate bipolar transistor), convert the AC to the DC or the DC to the AC by high-speed switching mechanism. In the SMPS, a pulse width modulation (PWM) technique is used for high-speed switching purposes. By varying the duty cycle, the output voltage can be changed according to our requirements. The switched mode power supply is used in the electronic devices or circuits where more than one power supply is required. For example, in a computer different circuits are used which take the different voltage and current. So, the SMPS provides power to them at different voltage and current as required. The advantage of the switched mode power supply is that it dissipates

very low power, in fact, an ideal SMPS circuit dissipates no power. It also has a high efficiency, a very good voltage regulation, a lighter weight, etc.

The uninterruptible power supply (UPS) is an electrical power supply which is designed to provide power to a load during emergency purpose or when the main input power supply fails. This power supply system uses electrical energy storage devices such as batteries, supercapacitors to store electrical energy. The UPS system is used when a continuous power supply is needed. They are utilized in computers, servers, the electronic testing machinery, the telecommunication equipment, etc.

The regulated power supply (RPS) is an electronic circuit that is designed for variable loads to deliver a stable direct current and keep the constant voltage across the load. The regulated power supply circuit always keeps the constant voltage across the load by changing the input current. The RPS is generally used in amplifier circuits, oscillator circuits, DC motors, etc.

The linear power supply is an electronic circuit that is designed to convert a variable DC supply into a constant DC supply. It takes the variable DC supply in input and provides the stable DC supply in output. The linear power supply circuit has also a current limiting function. The linear power supply is mainly used to provide power to electronic ICs (integrated circuits).

Text 14. Electrical Hazards and Electrical Safety

Source: https://safetyculture.com/topics/electrical-hazards/

Electrical safety is a general practice of workers who are exposed to handling and maintaining electrically powered equipment. It is a set of guidelines they follow to mitigate electrical hazards and prevent its dangerous effects in case of an incident. If workers do not adhere to electrical safety, it can lead to accidents, near misses, or even fatalities.

Working around electricity can be very safe on the job site when workers properly identify and control hazards. But, inadequate training, lack of experience, and failure to recognize potential hazards could result in electric shock or death.

The construction industry is most in danger from electrical hazards, accounting for 52 percent of all electrical fatalities in the workplace in the US. Most of these incidents and fatalities were caused by direct worker contact with overhead power lines and contact with machines, tools, and hand-carried metallic objects. So how can we protect ourselves against these dangers?

Let’s have a closer look at electrical safety precautions and electrical safety equipment.

Electrical safety precautions are specific control measures implemented to remove electrical hazards and mitigate the risks of electrical accidents and injuries. Safety precautions for working with electricity depend on the worker’s job instructions and their working environment. However, the most basic electricity safety precautions include clearly understanding how electricity works, identifying and eliminating electrical hazards such as poor cable management and lack of proper housekeeping, and wearing the appropriate electrical personal protective equipment (PPE).

Electrical safety equipment is specialized PPE designed to protect workers from general and specific electrical hazards. Generally, the most used electrical safety equipment is insulated tools and PPEs like insulated gloves, mats, eye protection gear, and ladders. Electrical safety equipment should also be used when doing specific types of electrical testing, repair work, installation, machine tasks, or maintenance such as arc flash and customized earthing and short-circuiting, among others. And for an extra layer of safety, it helps to verify if your electrical equipment is certified by a nationally recognized testing laboratory.

Text 15. Examples of Electrical Hazards and Tips for Safety

Source: https://safetyculture.com/topics/electrical-hazards/

Electrocution is one of the most common hazards across construction sites according to Occupational Health and Safety Act (OSHA). Identifying electrical hazards can help raise awareness of the risks, their severity, and how they can harm workers.

Here are common electrical hazards in the workplace and electrical safety tips on what you can do to mitigate these risks:

1. Overhead Power Lines: Overhead powered and energized electrical lines have high voltages which can cause major burns and electrocution to workers. Remember to maintain a minimum distance of 10 feet from overhead power lines and nearby equipment. Conduct site surveys to ensure that nothing is stored under overhead power lines. Also, safety barriers and signs must be installed to warn nearby non-electrical workers of the hazards present in the area.

2. Damaged Tools and Equipment: Exposure to damaged electrical tools and equipment can be very dangerous. Do not fix anything unless you are qualified to do so. Thoroughly check for cracks, cuts, or abrasions on cables, wires, and cords. In case of any defects, have them repaired or replaced. Lock Out Tag Out (LOTO) procedures should be performed at all times before commencing electrical maintenance and repairs. LOTO procedures are there to protect all workers on a worksite.

3. Inadequate Wiring and Overloaded Circuits: Using wires of inappropriate size for the current can cause overheating and fires to occur. Use the correct wire suitable for the operation and the electrical load to work on. Use the correct extension cord designed for heavy-duty use. Also, do not overload an outlet and use proper circuit breakers. Perform regular fire risk assessments to identify areas at risk of bad wiring and circuits.

4. Exposed Electrical Parts: Examples of exposed electrical parts include temporary lighting, open power distribution units, and detached insulation parts on electrical cords. These hazards can cause potential shocks and burns. Secure these items with proper guarding mechanisms and always check for any exposed parts to be repaired immediately.

5. Improper Grounding: The most common OSHA electrical violation is the improper grounding of equipment. Proper grounding can eliminate unwanted voltage and reduce the risk of electrocution. Never remove the metallic ground pin as it is responsible for returning unwanted voltage to the ground.

6. Damaged Insulation: Defective or inadequate insulation is a hazard. Be aware of damaged insulation and report it immediately. Turn off all power sources before replacing damaged insulation and never attempt to cover them with electrical tape.

7. Wet Conditions: Never operate electrical equipment in wet locations. Water greatly increases the risk of electrocution especially if the equipment has damaged insulation. Have a qualified electrician inspect electrical equipment that has gotten wet before energizing it.

Text 16. Apps for Electrical Inspections

Source: https://safetyculture.com/topics/electrical-hazards/

Electrical inspections are conducted by electrical servicing companies to ensure a property's compliance with electrical safety laws and regulations. An electrical app aids these firms to simplify their processes, from scheduling inspections to the issuance of an electrical Certificates of Compliance (COC).

During an electrical inspection, a property's electrical equipment undergoes quality and safety checks to ensure that they are in working condition before being operated. In-

spections are often accompanied by site walkthroughs to detect and record electrical hazards. Reports generated after electrical inspections should provide an overall assessment of the worksite, training provided, and equipment used and present general recommendations on areas for improvement. Failure to conduct regular electrical inspections can lead to accidents caused by electric shock or even death.

Traditionally, the electrical inspector's findings and observations are recorded manually on paper. Further, they have to go back to the office, review all observations, and create an electrical COC if the client's property has been proven to be compliant. This cumbersome process makes critical data susceptible to damage and loss, in addition to the storage and organization issues it presents.

A good electrical inspection software can solve this problem by converting paper forms into digital ones. The convenience of using digital checklists can speed up and improve the overall inspection and reporting process. As technology evolves, the electrical inspection service industry has turned to digital and mobile solutions to improve its inspection workflows. Electrical apps have made the management of electrical inspections, from scheduling to the issuance of electronic COCs, more efficient and systematic. Such apps yield businesses invaluable time savings, productivity boosts, improved communication, and upgrades in operational efficiency.

Text 17. Basic Electrical Safety

Source: https://www.ehs.washington.edu/fire-life/basic-electrical-safety

We rely on electricity, but sometimes underestimate its capability of causing injury. Even household current (120 volts) can stop your heart. UW personnel need to be aware of the hazards that electricity poses, such as shock, fire and explosion, and either eliminate or control those hazards.

1. Shock: Electrical shock happens when current passes through the body. Electricity travels through closed circuits, and people, sometimes tragically, can become part of the circuit. When a person receives a shock, electricity flows between parts of the body or through the body to a ground. This can happen if someone touches both wires of an energized circuit, touches one wire of the circuit while standing unprotected or touches a metal part that has become energized.

Electrocution refers to the injury or lethal dose of electrical energy. Electricity can also cause forceful muscle contraction or falls. The severity of injury depends on the amount of current flowing through the body, the current's path through the body, the length of time the body remains in the circuit and the current's frequency.

2. Fire/Explosion: Electrical fires may be caused by excessive resistance that generates heat from any of the following:

– Too much current running through wiring where overcurrent protection fails or does not exist.

– Faulty electrical outlets resulting in poor contact or arcing.

– Poor wiring connections and old wiring that is damaged and cannot support the load.

An explosion can occur when electricity ignites a flammable gas or combustible dust mixture in the air. Ignition from a short circuit or static charge is possible.

Here are the electrical safety basics:

– Don't work with exposed conductors carrying 50 volts or more.

– Make sure electrical equipment is properly connected, grounded and in good working order.

– Extension cords may not be used as permanent wiring and should be removed after temporary use for an activity or event.

– Surge suppressors with built-in circuit breakers may be used long-term and are available with three-, six- and 15-foot-long cords.

– High amperage equipment such as space heaters, portable air conditioners and other equipment must be plugged directly into permanent wall receptacles.

– Do not access, use or alter any building's electrical service, including circuit breaker panels, unless you are specifically qualified and authorized to do so.

– Wet environments can increase the risk of an electrical shock. When using electricity in a wet or damp location, including outdoor locations, a Ground Fault Circuit Interrupter (GFCI) must be used. The GFCI ensures that any electrical shock is brief. Although painful, it wouldn't be fatal because the GFCI creates a ground fault or leak in the current.

– To prevent electrical hazards, always make sure equipment is properly grounded. Electrical grounding provides an alternate path for electricity to follow, rather than going through a person. Equipment with a grounding prong must be plugged into an extension cord with a ground; the grounding plug should not be removed from the equipment.

– Maintain at least 30 inches of clearance in front of electrical panels to ensure a safe environment for facilities workers.

– Make sure that all junction boxes are covered.

– Avoid activities that require training. They include: working with exposed conductors carrying 50 volts or more; making repairs or alterations to any electrical equipment; opening up the case, or removing barrier guards, of any equipment that utilizes electricity; using any tools or a meter to measure for the presence of electricity; reseting a tripped circuit breaker, or replace a blown fuse. Ask a qualified person to perform these tasks.

Text 18. Electrical Drive Mechanisms for Agricultural Vehicles

Source: https://www.stw-mobile-machines.com/en/case-studies/detail/ropa/

Many self-propelled harvesting machines have extremely high-performance requirements, not just for the drive, but also during the processing of harvested goods. Although the tried and tested drive system representing the status quo is a hydraulic system, alternative drives are being investigated due to the frequently poor efficiency factors shown. The general trend to electrification would appear to open up a major savings potential, in particular in case of high performances. The proof for the correctness of this theory has now been provided by the companies Sensor-Technik Wiedemann (STW) and ROPA together with the TU Dresden within the scope of a project supported by the Bavarian State.

The starting point was the tried and tested hydraulic and hydrostatic drive systems, which, due to decades of development, feature a comprehensive modular system. Over these decades of development, the technology was adapted to the vehicles, and the concepts were harmonized from diesel via pumps right up to the drives. In spite of these efforts, the drives as a whole achieve only moderate efficiency factors. Electric drives, on the other hand, score points through their high efficiency factors in almost all operating conditions and are extremely easy to control. They offer decisive advantages for this reason alone. The aim of the State support was to provide both theoretical and practical verification of an increase in efficiency through the use of electric drives and to make the experiences and methods obtained also available for the evaluation of other machines. A further objective was to develop a system environment, which permits reliable operation of the drives in the frequently adverse ambient conditions and allows development of the full potential of control, build-up, power transfer, storage etc. for the machine manufacturer.

The STW started with the development of such drives in 2001 and has been able to gather a lot of experience in extreme ambient conditions, such as for example the use of their products in the Pistenbully by Kässbohrer. This created the optimum prerequisites for

the definition, together with the research conducted by the TU Dresden, of a system environment which permitted mobile machines in all branches such as construction machines, passenger and load transporters and special applications such as garbage trucks, aircraft towing vehicles and much more to operate using this technology.

Each of the development steps was checked with ROPA regarding the requirements placed on beet harvesters. In order to retrofit the hydrostatic vehicle drive to a diesel-electric version with comparable performance data, the actual condition is first recorded, and this not only in normal harvesting operation, but also under peak loads. The measurement data from a real field operation was assessed, and load collectives formulated via class frequency and average length of stay distributions.

Parallel to the retrofitting of the vehicle with an electric drive system, the simulation of the conventional hydraulic and the alternative electric drive took place. In the models, the complete drive line from the diesel engine via the generators and the electric motors (electrical drive line) or via the pump and hydro motors (hydraulic drive line) were depicted via the mechanical central drive right up to the wheel-ground contact. The simulation can supply comparative statements on the performance capability, the efficiency factor and the expected fuel consumption between the hydraulic and the electric drive.

The increase in the efficiency factor of the drive lies within a range from 20 to 30 percent points in accordance with the simulation results. The fuel consumption could be lowered in the simulation by up to 30 %. The initial field tests under realistic conditions confirmed the results. Under normal harvest conditions, with both versions of the beet harvester in a direct comparison, the electrically-powered Euro Tiger displayed surprisingly agile characteristics and did not display any weaknesses even under full load.

This highly promising approach now had to be confirmed using suitable measurement methods. For this purpose, the TU Dresden developed procedures in order to obtain reliable results under comparable conditions. The necessity of remaining independent of non-measurable loads occurs in almost all comparison journeys, as in the hydraulic version the exact amount of power emitted cannot be measured or can only be measured with a great deal of effort. In this specific case, the digging unit is pushed through the earth in order to dig out the beets. Even minor fluctuations in submersion depth can cause the performance requirements of the drives to fluctuate by 10-20%. The measuring procedure did not utilize the digging unit, and simulated the harvesting operation through a braking vehicle, which accurately determined the load through traction force measurements. The results impressively confirm the simulations. At an uprooting speed of 6 km/h, the efficiency increases in the simulation totaled 24.8%, and 24.1% in reality. The measurements continued to show that the electric drive is superior in all operating conditions and that the distance continues to increase at high speeds. As the hydrostatic drive reaches its limits substantially earlier, the design of the engine and transmission can also be revised. Subject to a transmission adaptation, the electric drive can be reduced by approximately one quarter in order to reveal comparable traction forces.

The measurements of the diesel savings lay at approximately only 15%. This result was under no circumstances a surprise, although the expectations lay at 20%. The cause of the low diesel savings was the increased consumption required for the additional cooling of the electrical system and the differences reasoned in the efficiency of the two diesel engines. This includes the fact that the measurement of the consumption revealed many errors, as only short measurement cycles with very low consumptions were possible. The losses of the cooling system can be compensated for through a consistent transfer to electric drives through the loss of the hydraulic system. Due to the higher efficiency factor of the electrical systems, less cooling power is required overall, which then leads to further savings.

In the current stage of development, many compromises have had to be made in the mechanical structure. In a series machine, further improvements would be added which would then make diesel savings of up to 30% possible as a result.

To sum up, it should be mentioned that the complex investigations of the TU Dresden with their scientific precision clearly proved that the use of electric drives in harvesting machines is expedient in spite of the limited number of operation days per year. Although the full savings potential has not yet been exhausted and the electric drives have certainly not yet reached their final possible price in this stage of development, a positive cost/benefit balance can already be achieved within only a few years. Within the scope of the State support, it was also possible to show that electric power transmission can open up further potentials due to its outstanding control characteristics, if an adaptation of the machines and devices is conducted based on this technology.

Text 19. Electrical Systems for Agricultural Buildings

Source:https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1594&context=extensionhist

Agricultural buildings – especially those used to house livestock, require special care in selecting wiring materials, wiring methods and electrical equipment because of corrosive dust, gases and moisture. These special requirements apply to adjoining areas such as feed and utility spaces as well. A power supplier's customer service representative can help assure proper planning of all components of the electrical system.

Each building should have only one electrical service. The service entrance panel must have a main service disconnect and should be surface mounted on a fire-resistant surface in a clean, dry room. If the panel must be located in an adverse environment, use a dusttight, watertight, corrosion-resistant enclosure. If the panel is mounted on the outside of the building, all openings between the enclosure and building (including conduit) must be sealed with electrician's putty. Do not use silicone caulk or foam-in-place insulation products.

Panels mounted in a building must have at least a 1/4-inch air space between the mounting surface and enclosure. Never recess panels into exterior walls as condensation causes accelerated corrosion. Locate all panels with at least 3 feet of clear open space in front and so the door can be opened a full 90°. The space in front of an electrical panel should not be used for storage. Easy access is required for servicing and in case of an emergency.

All service entrances must be provided with a grounding electrode (ground rod, minimum 8 feet) and a properly sized grounding electrode conductor properly clamped to the electrode. This conductor and grounding electrode must be installed and protected to minimize the risk of physical damage. The resistance from the grounding electrode to the surrounding soil must be 25 ohms or less. Where multiple ground rods are used to reduce resistance to ground, separate the rods at least twice the length of the ground rods and interconnect with a copper conductor and clamps approved for burial.

As to wiring location, all wiring (cables and conduit) must be surface mounted to facilitate maintenance and inspection, minimize rodent damage and reduce moisture migration. Under no circumstances wiring should be concealed within the walls or extended into the attic or ceiling spaces. Holes through the inside finish material and vapor barrier destroy the effectiveness of the vapor barrier.

Attach surface wiring in machinery storage facilities, free-stall barns, and similar structures underor to the sides of trusses and to the sides of poles and columns. Provide protection (conduit, wood overlay, etc.) for all wiring within 8 feet of the ground or floor surface. In horse and goat barns, provide protection to a height of at least 10 feet. A gen-

eral rule of thumb is to provide protection for all equipment within two times animal height above the floor.

A type UF or an underground feeder cable is required in all damp, corrosive areas of agricultural buildings. Weatherproof connectors and fittings are a required part of the system. Attach cable with nonmetallic cable straps and corrosion-resistant nails. A type NM or a nonmetallic cable may not be used in agricultural buildings.

Use nonmetallic conduit where multiple circuit conductors are needed or where wiring is subject to physical damage. Use appropriate conduits for general wiring and where mechanical protection is needed. Surface mount all conduit.

Where conduit passes between areas with different temperatures, the conduit must be sealed with electricians' putty, or equivalent. Do not use silicone caulk. Metallic conduit is not appropriate in most agricultural buildings. Gases and moisture in agricultural buildings lead to rapid deterioration of all types of metallic conduit. Electrical Nonmetallic Tubing (ENT) is not permitted in agricultural buildings.

To prevent breakage of conduit or equipment due to thermal expansion-contraction of nonmetallic conduit, use one 6-inch expansion joint per 50 feet of conduit. Additional expansion joints are required on installations subject to extreme temperature variations. An expansion joint is required between all rigidly mounted equipment, such as light fixtures. Conductors used in conduit must be approved for use in wet areas.

Text 20. Electrical Equipment for Agricultural Buildings

Source:https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1594&context=extensionhist

All equipment and all metallic components of the electrical system and building within 8 feet of the floor or soil surface must be bonded to the grounding electrode system. A grounding electrode (rod) at the site of a piece of metallic equipment is not permissible, except as a complement to a grounding conductor (bare copper or green insulation) from the service distribution panel. The soil is not permitted to be used as the only path for grounding circuits. All high-pressure power washers must also be equipped with ground fault circuit interrupters (GFCIs) for added protection.

Equipment grounding conductors must be kept electrically separate from other grounded conductors in the electrical system except at the service entrance. The equipment grounding conductor is intended to carry current only in the event of an electrical fault.

Corrosion of metallic conduit, boxes and fixtures frequently leads to electrical system failure. Boxes and fixtures made of a nonmetallic material or corrosion-resistant stainless steel, i.e., non-magnetic, are recommended for all agricultural buildings and are required in any building housing livestock or containing corrosive dust. Select equipment designed for use with dust-tight and watertight conduit and cable fittings. Plastic boxes designed for use in residential or other clean, dry environments are not permitted in agricultural buildings.

Equip all devices with dust-tight and watertight corrosion-resistant, gasketed covers. When mounted on a vertical surface, hinge the cover at the top. Single pole switches installed with spring-loaded covers must be installed so they are 'off' when in the down position. A preferred alternative is to use switches with external levers or weatherproof pushbutton covers. Surface-mounted fixtures made of thermosetting plastic are not permitted in agricultural buildings. Install combination fuse and switch devices in nonmetallic boxes with covers. Thermostats must be made of corrosion-resistant material and must be in watertight and dust-tight enclosures.

Use dust and moisture tight nonmetallic fixtures with shatterproof, vapor tight globes for incandescent light bulbs. Observe wattage limitations of fixtures when planning the lighting system. Special high temperature wire is required in some incandescent fixtures.

Whenever possible, cable or conduit should enter boxes and panels from the side or bottom. This will minimize the dripping of condensation onto electrical contact surfaces and reduce corrosion. Boxes for single outlets and switches may have to be wired from top and bottom. Alternatively, such boxes can be mounted sideways and wired from each side.

All electrical devices in agricultural buildings must be surface mounted. A minimum clearance of 1/4-inch is required between all boxes and the mounting surface to reduce entrapment of moisture, dust, and other corrosive materials. Never recess boxes or other electrical equipment enclosures into exterior walls. The inability to adequately insulate between the backside of electrical panels and boxes and outside walls allows condensation to form in the devices and accelerates corrosion of electrical equipment.

Switches, receptacles, and other devices must be located 4-6 feet above floor level to minimize potential damage from animals and equipment. Additional protective devices and methods are required where electrical equipment is accessible by animals such as cows, horses and goats. Avoid excessively high mounting heights which limit access for servicing or access and operation during an emergency.

Text 21. Electrical Appliances for Agricultural Buildings

Source:https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1594&context=extensionhist

As to suspended appliances, support suspended lighting fixtures, heating appliances and other electrical devices by chain or other mechanical method. Do not support any equipment by the power cord, conduit or electrical cable. The support should extend from a solid mounting at the ceiling and be attached to the appliance. Use porcelain sockets for all lamps designed to produce heat. Fixtures made of rubber and plastic are not acceptable.

Totally enclosed motors designed for farm service are essential for long life in the severe environment of agricultural buildings, especially feed processing areas and facilities used to house animals. Permanent wiring of all fixed motors is recommended. Do not connect permanently installed equipment with plug and cord. The continually open receptacles destroy the integrity of the electrical system. Wire movable equipment and equipment which vibrates during operation with flexible cord or liquid-tight flexible nonmetallic conduit. Use conductors with stranded wires. Wire outdoor equipment such as floating pumps or aerators with an appropriate type of flexible cord. Do not use submersible pump cable because sunlight (ultraviolet radiation) quickly destroys the insulation of such cables.

All electrically heated stock waterers must have a grounding conductor from the service entrance to the waterer to assure a low impedance (resistance) path and sufficient current flow to trip a circuit breaker or blow a fuse in the event of an electrical fault. A grounding electrode may be installed at the waterer for added protection. However, a grounding electrode is not, by itself, sufficient. A switch with a properly sized fuse adjacent to the waterer offers convenience and additional safety. Install a ground-fault circuit-interrupter (GFCI) device near the waterer for added safety and protection. Electric heat tape is commonly used to prevent freezing of exposed water lines. To reduce the risk of electrocution, use only three-wire (third wire grounding) heat tapes.

All metallic building components within 8 feet of the floor or soil surface must be grounded. This includes all materials such as siding, structural frames, rain gutters, feeders, grates, gates, farrowing crates, free-stall dividers, milking parlor equipment, etc. Although these components may have individual ground rods, they must also be bonded to

the electrical grounding electrode system servicing the building. Metallic parts that are not likely to become energized do not need to be grounded.

Where building openings are used for the transfer of materials between the inside and outside of the building, the point of attachment of conductors must be out of reach. The point of attachment of overhead wires should not be closer than 10 feet to either side of the opening and 3 feet above it. Under no circumstances should electrical conductors be attached below such openings. Attach overhead wires in a way that ensures portable elevating equipment can be maneuvered into openings without making contact with overhead wires.

Most livestock operations require standby electrical power. A double-throw transfer switch must be installed so the generating equipment is isolated from incoming power lines at all times. This protects servicemen from any on-farm generated power feeding back over the supply lines and eliminates potential damage to the generating equipment when normal power is restored. The transfer switch also provides a convenient means to disconnect power to the entire farmstead for servicing and in case of an emergency.

Surge or lightning arresters are necessary to safely lead transient overvoltages to ground and to protect equipment. Such protection becomes increasingly important as the use of computers and other electronic equipment and controls increases. Install surge and lightning arresters on the outside of boxes and panels.

Equip buildings, silos, feeding systems, etc., with a lightning protection system. A complete system includes air terminals ("lightning rods"), connecting cables and clamps, and grounding electrodes. Lightning protection system grounding electrodes may not be used as the required grounding of the electrical system. However, the lightning protection system grounding electrodes and cables must be bonded to any metallic equipment (e.g., building siding) within 6 feet of lightning protection system components. Do not allow aluminum grounding cables to come in contact with painted, galvanized, or bare steel roofing, elevator leg supports, etc.

In addition to good wiring practices, to reduce the possibility of extraneous voltage problems, in some instances a four-wire service for 230-volt single phase installation may be desirable. If a four-wire service is used, grounded neutral conductors and equipment grounding conductors must be kept electrically separated except at the main farm service disconnect. The grounding conductor must be copper if placed underground. A four-wire service is not recommended except where it has been shown to be appropriate through proper testing. However, service entrance panels at all individual buildings still require connection to a grounding electrode and the bonding of all branch circuit equipment grounding conductors to the grounding electrode. Equipping milking centers with an equipotential plane and voltage ramp will reduce the risk of extraneous voltage problems affecting cows during milking.

As to fences and cow trainers, locate electric fence chargers at least 10 feet away from buildings to reduce the risk of damage by lightning. Do not connect the output ground terminal of any charging device to the electrical system.

3.2. Auto electronics

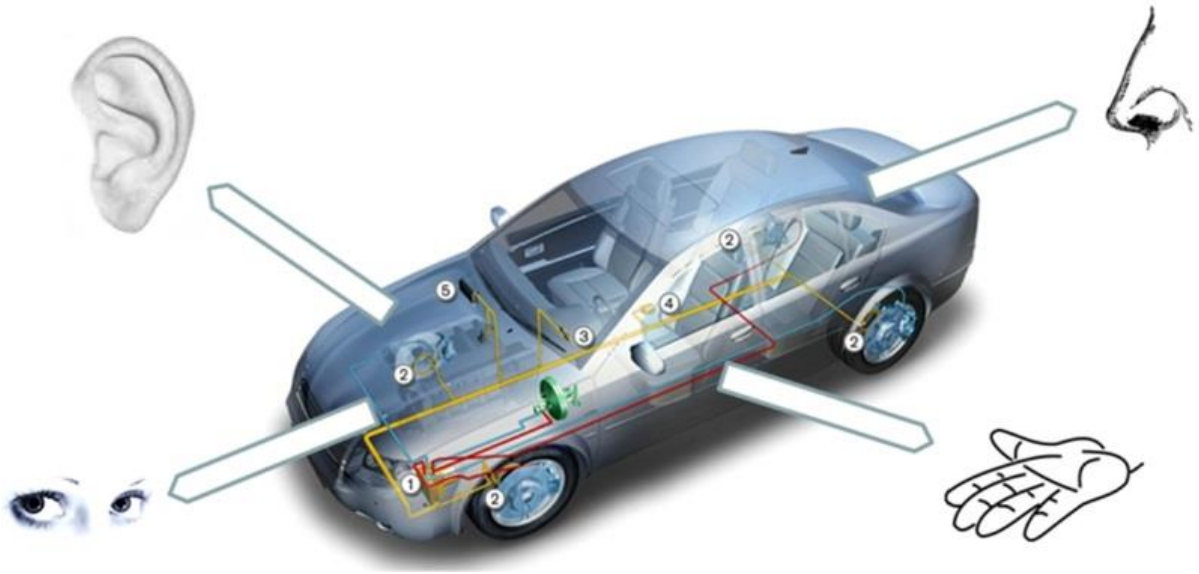
Text 1. Auto Electronics: Sensors

Sources: https://autoedu.info/en/autoelectronic/,
https://autoedu.info/en/autoelectronic/sensors/

Vehicles have many electronic systems to control the operation of mechanical and electrical systems. They monitor and control engine operation, braking, steering, safety, protection, multimedia, and others.

Electronic work control is performed through a network of electronic components. The electronic control unit (ECU) controls and manages a process, monitors the correctness of all parts and functions, communicates with other control units, and informs the driver about the system state on the dashboard and information panel. Through the diagnostic connection, the service technician exchanges data with the electronic control units, which makes it easier to check the correctness and detect faults in the vehicle. The specificity of the operation of electronic systems requires a different approach to diagnostics, detection of malfunctions, repairs or replacing parts of electronic systems.

Greater safety, security, comfort, and reduction of exhaust gas emissions on vehicles with easier and faster service enables the use of electronically controlled systems. One of the indispensable elements of electronic control is sensors. They are a kind of ‘sense’ that constantly tracks, monitors, and measures the parameters of various systems on vehicles.

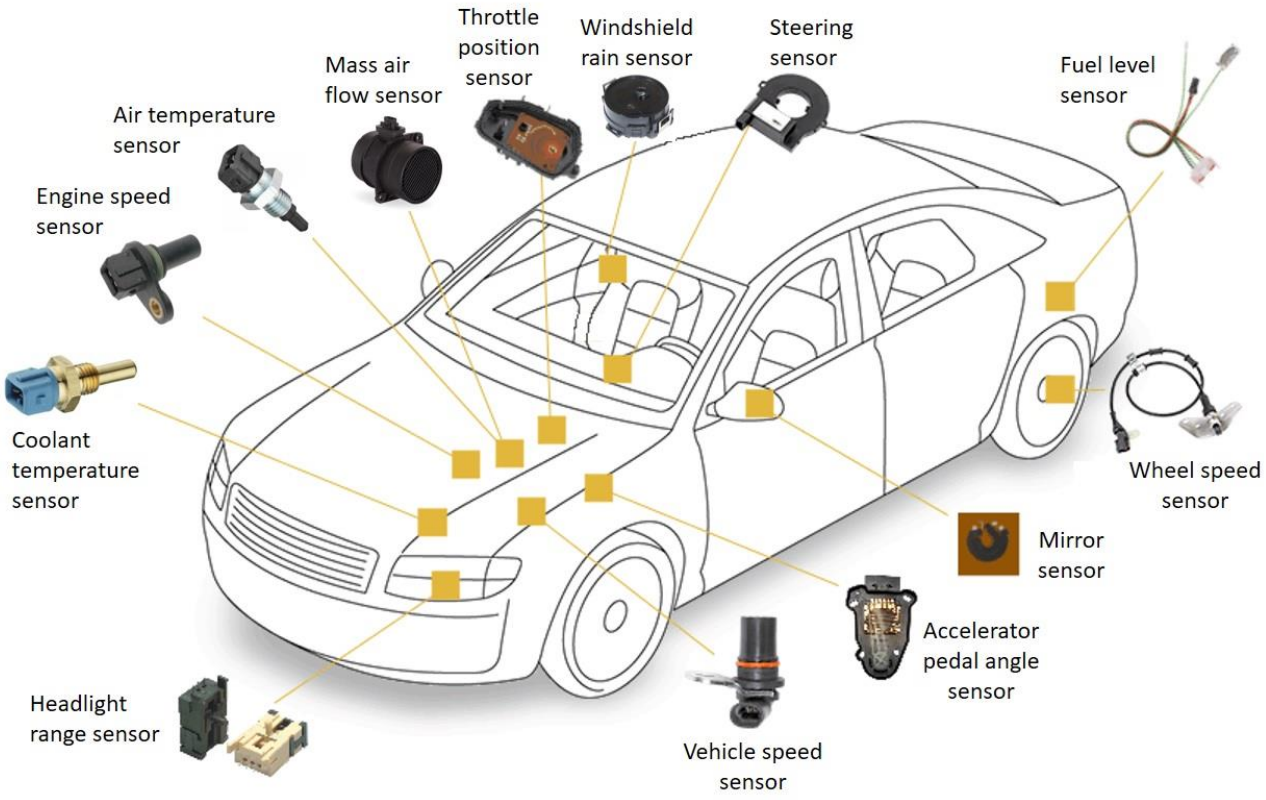


Modern vehicles have a large number of electronically controlled systems whose function is based on sensors. Sensors can be divided based on the measurement quantity that is monitored, measured, and converted into a suitable electrical signal.

There are sensors on the vehicles:

– mode;
– temperature;
– movements;
– position;
– distances;
– direction of movement;
– positions, speeds, and accelerations (angular, linear);
– elapsed time and frequency;
– noise and vibration;
– liquid level;
– pressure (absolute, differential, atmospheric);
– flow;
– number of rotations (rpm);
– forces and moments;
– mechanical stress;
– orientation;
– fluid viscosity;
– electrical voltage and amperage;
– humidity and rain;

– light intensity;
– gas concentrations.



Correct and reliable vehicle operation depends on correct and accurate sensors. The ECU constantly checks the correctness of the sensors during system operation. Also, service technicians check the correctness of the sensors through the vehicle maintenance and repair process. That is why service technicians must have a good knowledge of the role, mode of operation, and procedure of sensor testing.

Text 2. Mode Sensors

Source: https://autoedu.info/en/autoelectronic/sensors/mode-sensors/

Mode sensors inform the electronic control unit (ECU) about the current state (on or off) of a device, function, or system on the vehicle. Based on the data from the mode sensor, the ECU monitors whether the monitored system is on or off. Also, when the ECU gives the order to turn on/off a device, it receives feedback from the mode sensor as to whether its order is executed.

There are various examples of the use of mode sensors on vehicles:
– lighting on the vehicle;
– turning on stop lights when pressing the brake pedal (ECU ABS or lighting);
– starting of air conditioners (ECU engine, air conditioning);
– detection of the door, trunk, and hood opening (ECU central electronics);
– detection of fastening of seat belts (ECU airbag);
– parking brake release detection (ECU ABS, engine);
– determining the position of the gear lever (ECU engine, gearbox);
– detection of pressing the clutch pedal (ECU engine, gearbox);
– determining the position of the throttle valve at idle speed, etc. (ECU engine).

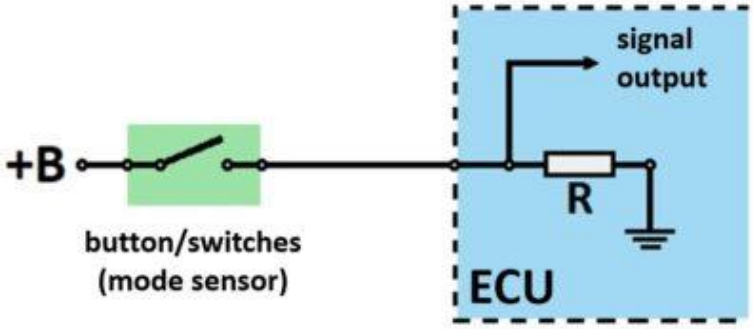
Condition sensors exist as buttons and switches.

We distinguish mode sensors with positive and negative power supplies. A mode sensor with a positive supply on one port has a permanent plus, while the other port is via

a conductor connected to the ECU.

Brake pedal button

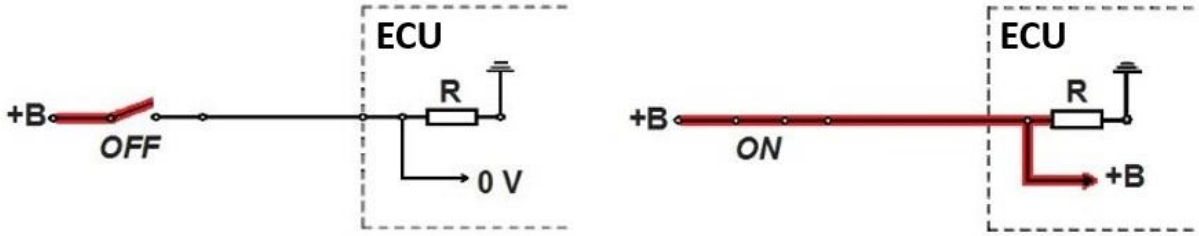
Vehicle lighting switch



Connecting mode sensor with positive power supply and ECU

When the switch/button is open (OFF), the ECU input disconnect from the plus power supply (+B). Then the output (control) point ECU is at the mass potential. Since the output voltage is equal to 0 V, the electronic control unit recognizes the state of the sensor – OFF.

When the switch/button is closed (ON) the plus power supply is supplied to the ECU input via the switch/button. The resistor I separates the mass from the input voltage, so the output signal is equal to the supply +B, which corresponds to the state of the sensor of the controlled device – ON.



Switch	ECU
Open (OFF)	0 V
Closed (ON)	+B

Open/closed (OFF/ON) mode of the sensor with the positive supply

Possible malfunctions in the operation of the mode sensor are:

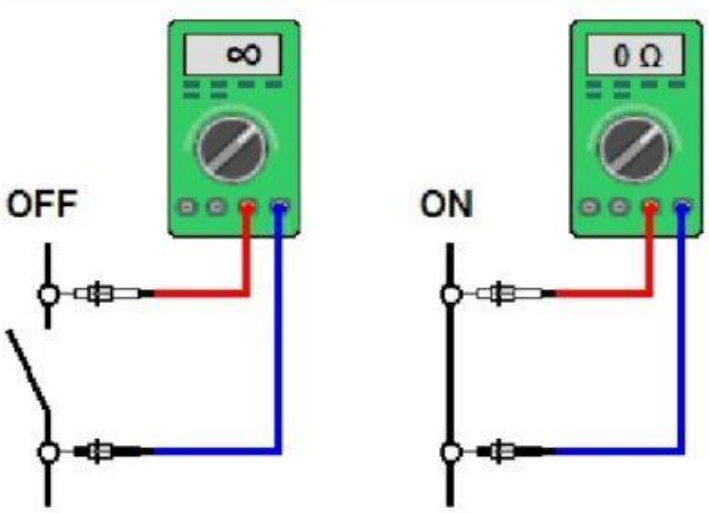
– defective switch/button;

– sensor power open circuit (in this case +B);

– open circuit between the sensor and ECU;

– interruption of the power supply from the ECU (in this case minus is ground).

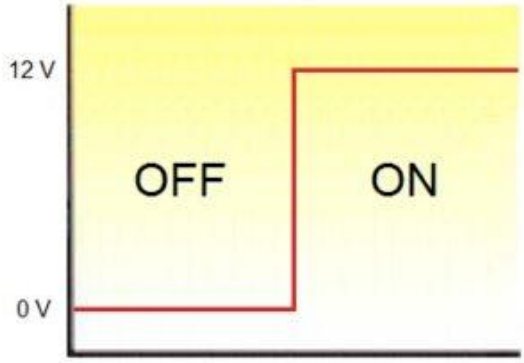
Testing the correctness of the mode sensor is performed with an ohmmeter when the system is without power or when the sensor is disconnected. The resistance at the terminals is measured when the button/switch is open and closed. When the button/switch is open (OFF), the measured resistance should be infinite, and when it is closed (ON) 0 Ω.



Mode sensor test

After checking the sensors, test the power supply. In the case of mode sensors with a positive power supply, the sensor comes from the mains plus supply (+B) and the ECU minus.

Finally, the output signal sent to the ECU is measured. The measurement is performed with a voltmeter or oscilloscope. When the sensor (button/switch) is open the output signal is 0 V. When it is closed, the ECU value of the voltage signal is equal to the supply voltage +B.



Mode sensor output signal with the positive supply

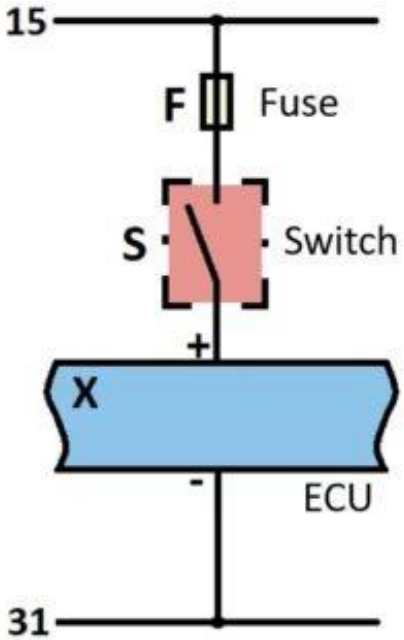
Text 3. Mode Sensor Test

Source: https://autoedu.info/en/autoelectronic/sensors/mode-sensor-test/

All mode sensors on vehicles have the same purpose and the same principle of operation. They convert the current mode through buttons or switches into an electrical signal and send it to the electronic control unit (ECU) for further processing. Button/switch activation can be done mechanically, pneumatically, hydraulically, thermally, or electrically.

Possible malfunctions and the test method are the same for all mode sensors. Malfunctions that can occur on the mode sensor are: faulty button/switch, interruption of the sensor's power supply (plus or minus depending on the type of power supply), interruption of the power supply from the ECU (plus or minus), or open-circuit between the sensor and the ECU or the power supply.

When the mode sensor is suspected to be defective, we first determine the vehicle's malfunction through system diagnostics. Then we get information about the mode sensor from the information system (installation position, wiring diagram, actual values, recommended test procedure, etc.).



Mode sensor circuit

The test procedure begins with disconnection by removing the socket from the mode sensor. With the given contact on the starting switch of the vehicle, we measure the power supply at the removed socket. In the event of a power failure in the outlet, detailed testing continues to determine the cause of the malfunction. It is checked whether there has been an interruption of the power supply from the network or the ECU. Then it is checked that the connection line is not the cause of the power interruption.

If there is power on the socket, we proceed to check the correctness of the buttons/switches.

When the malfunction is detected and eliminated, a final check of the correctness of the mode sensor on the vehicle is performed through diagnostics. The described test procedure can be applied to all mode sensors on vehicles. To test the mode sensor, follow these steps:

1. Preparation for sensor check: Check the correct operation of the mode sensor on the vehicle. View the wiring diagram, sensor location, and other test instructions. Get to know about the possible malfunctions of the mode sensor.

2. Sensor diagnostics: Read diagnostics and sensor operation via ECU. Remove the socket from the button/switch and test the power supply. Check the functionality of the buttons/switches. Determine the cause of the malfunction.

3. Check after repair/replacement: Repair/replace the faulty component. Place the removed components and connect the socket to the mode sensor. Test the correctness of the mode sensors on the vehicle and through diagnostics.

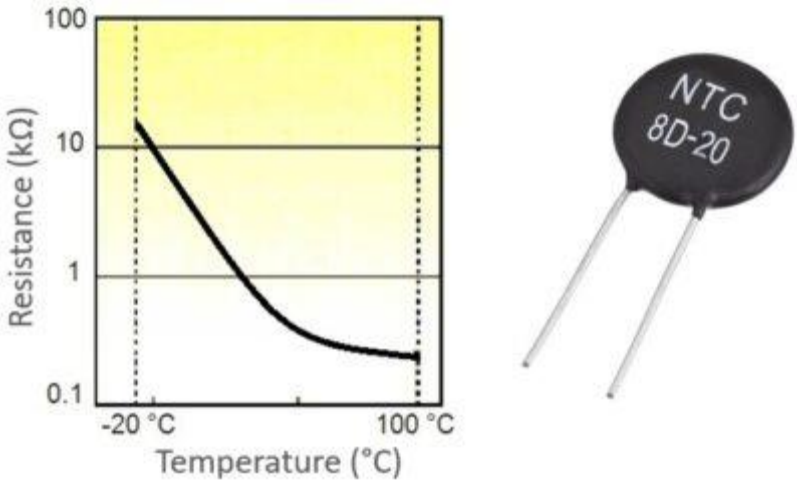
Text 4. Temperature Sensors

Source: https://autoedu.info/en/autoelectronic/sensors/temperature-sensors/

Temperature sensors use temperature-variable resistors (thermistors). There are two types of temperature variable resistors: negative temperature coefficient (NTC) and positive temperature coefficient (PTC). With NTC, the resistance decreases with increasing temperature and vice versa. With PTC, it increases with increasing temperature and vice versa. On vehicles, NTC resistors are most often used as temperature sensors.

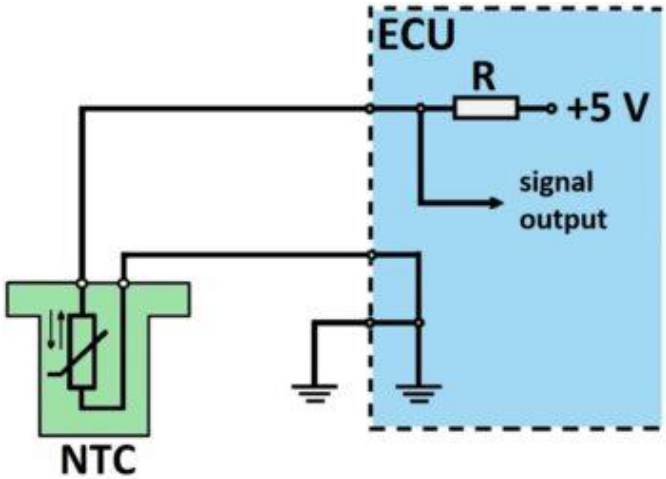
There are various examples of the use of temperature variable resistors as temperature sensors on vehicles. They are most often used to measure temperature:

– engine coolants;
– intake air;
– ambient air;
– air in the cabin;
– fuel;
– exhaust gas;
– engine oil;
– gearbox oil;
– air conditioner evaporator, etc.



NTC resistor

Temperature sensors measure the current temperature and convert it into a corresponding resistance, i.e., into a voltage. They are connected to control units to which they send data on the current temperature of the monitored area in the form of an electrical signal. The temperature sensors are supplied from the ECU with a constant DC voltage of 5 V through a series-connected resistor of constant resistance R. Together they form a voltage divider through which the ECU receives a voltage signal equivalent to the measured temperature.



Circuit of temperature sensor and ECU

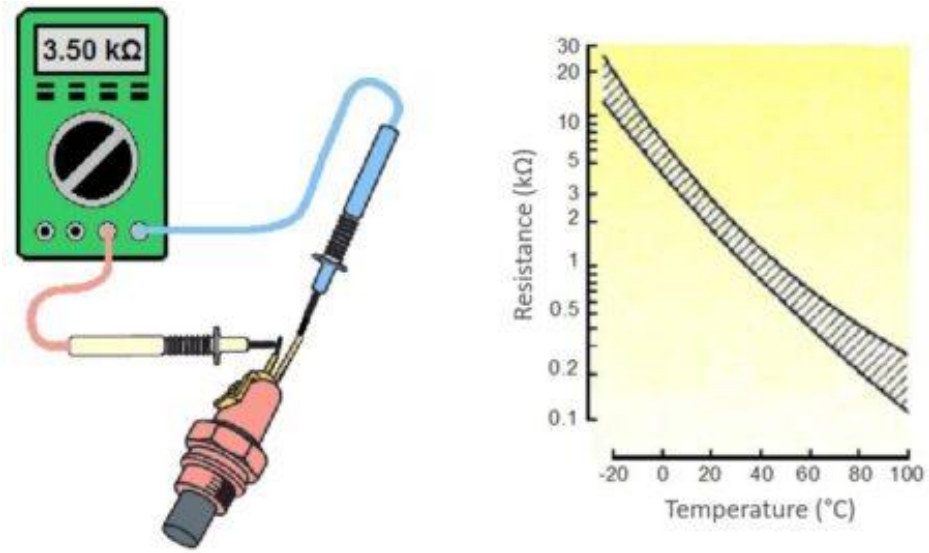
Possible malfunctions in the operation of the state sensor are:
– defective temperature sensor;
– open circuit between the sensor and ECU;
– interruption of the power supply from the ECU.
Testing of the NTC temperature sensor is carried out:
– ECU diagnostics;

– by checking the power supply of the sensor;

– by checking the resistance or output voltage of the sensor at different temperatures;

– by checking for open (A) and short in the circuit;

– by recording the oscillogram during the operation.



Testing the temperature sensor by checking the resistance

The ECU constantly checks the correctness of the temperature sensor and can recognize certain irregularities, such as an open and a short circuit. The ECU stores errors as fault codes. However, when the temperature sensor's output characteristic is disturbed, it begins to 'lie' and display the wrong temperature. The ECU cannot recognize the change in sensor output characteristics and incorrect measurement. By testing the sensor, we can establish the deviation from the actual value. That is why it is necessary to read the actual values from the information system to check the correctness of the temperature sensor.

The procedure for testing the temperature sensor is as follows:

1. We use the diagnostic device to read fault codes and actual values from the temperature sensor.

2. From the information system, we check the place of installation, the actual values for testing, and the circuit diagram.

3. We remove the socket from the temperature sensor. When the starting switch is on, we measure the supply voltage from the ECU on the socket connections. When there is no power, we check the condition of the cable for breaks and short circuits. If the cable is correct, we measure the supply voltage at the ECU connectors themselves, which tests the correctness of the control unit itself.

4. We check the correctness of the temperature sensor by measuring the resistance or the output voltage at different temperatures. We compare the obtained measurement results with the actual values from the information system. Likewise, we can establish the correctness of the sensor by recording the oscillogram of the output signal during operation.

The control unit monitors the temperature sensor only in the electrical correctness part. The ECU can recognize open circuit plus line, open circuit minus line, and short-circuit. When the temperature sensor is working, the output signal is between 0.5 and 4.5 V. When there is an open circuit in the plus or minus line, the output voltage is 5 V, and when there is a short circuit, the output signal is 0 V. In this way, the ECU recognizes the failure and stores the fault.

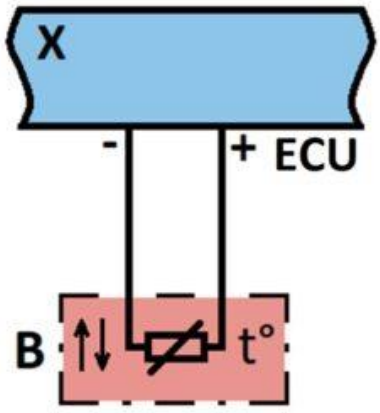
Text 5. Testing Temperature Sensor

Source: https://autoedu.info/en/autoelectronic/sensors/testing-temperature-sensor/

Diagnostics and measurements are used to test the temperature sensor. Temperature sensors are thermistors that change their resistance as the temperature changes. The use of NTC resistors on vehicles is frequent. There are examples (exhaust gas temperature sensors) where PTC resistors are also used. Regardless of whether the temperature sensors measure the temperature of the engine, intake air, outside air, cabin air, oil, etc., they all have the same correctness check procedure.

When the malfunction of the temperature sensor is suspected, the system diagnostics is performed first by reading the fault codes and the current actual value. Control units (ECU) receive data on the current temperature of the monitored area from the sensor. In addition, they check the electrical integrity of the sensor itself to ensure that there is no open circuit in the plus or minus line or a short circuit. When the ECU detects an electrical malfunction of the temperature sensor, it stores the fault code and lights the malfunction indicator lamp on the dashboard. In most cases, after a detected malfunction (open or short circuit) in addition to the fault code, the ECU takes the memorized substitute value for the temperature and continues with the system management. The only thing EUJ cannot recognize is when the temperature sensor starts to 'lie' and sends the wrong data for the temperature of the measuring area. Therefore, in addition to diagnostics, it is necessary to perform additional measurements on the sensor.

The next step in determining the malfunction is to get to know the electrical connection diagram, the position of the sensor on the vehicle, the procedure and the necessary measurement values for testing. The first test refers to checking the ECU's power supply to the sensor. At the same time, we test the correctness of the connection cables between the ECU and the temperature sensor. We remove the socket from the sensor, activate the power supply by making a contact and measure the supply voltage at the socket connections. Most often, the supply voltage of the sensor from the ECU is 5 V. If we find that there is no power or the voltage is of a different value, we approach the check from the socket to the ECU. The cause of the lower voltage value can be a bad contact on the sensor socket or the ECU. The absence of voltage can cause a break in the plus or minus lines, a short circuit, or a break in the power supply from the ECU.



Temperature sensor circuit

Engine coolant temperature sensor

If there is power at the socket connections, we proceed to check the temperature sensor. For each sensor from the information system, we receive resistance and/or output voltage data depending on the temperature in the form of a table or graphic dependence. For different temperatures, we measure the output resistance and/or voltage on the sensor and compare the obtained values with those required from the information system. If the values differ, it means the sensor is 'lying', and we replace it with the correct one.

Finally, through the diagnostic device, we check the change in the output signal with the temperature change. Also, we can check the accuracy of replacement data in ECU by simulating open and short circuits. We read the data for the replacement values from the information system for the given temperature sensor.

To test the temperature sensor, follow these steps:

1. Diagnostics ECU: Perform system diagnostics by reading fault codes and the actual value from the temperature sensor.

2. Sensor power supply check: Get to know the system from the information system by reading the electrical diagram, sensor installation position, actual values, etc. Remove the socket from the temperature sensor. Activate the power supply and measure the power supply at the socket connections. Compare the obtained value with the required one.

3. Temperature sensor check: Measure the resistance of the temperature sensor. If it is necessary to remove the sensor, heat it and read the resistance of the sensor by measuring the temperature. Compare the resistance values with those required from the information system.

4. Output signal check: Start the engine and monitor the temperature change via the diagnostic device. Check the replacement values by simulating a line open and a short circuit. Compare the obtained results with the required ones.

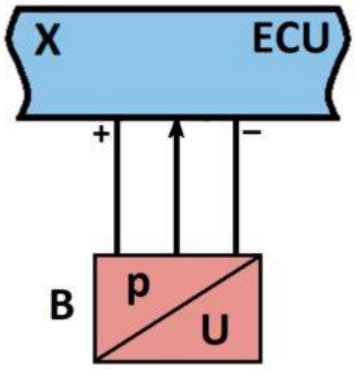
Text 6. MAP Sensor Test

Source: https://autoedu.info/en/autoelectronic/sensors/map-sensor-test/

The control units of the injection system to determine the amount of injected fuel and the formation of the combustion mixture require a constant flow of data on the mass of the intake air. One way to determine the air mass is to measure the absolute pressure of the intake manifold during engine operation. A MAP (Manifold Absolute Pressure) sensor measures air pressure in the intake manifold. In combination with the MAF (mass flow sensor), the MAP sensor controls the operation of the EGR valve.

Regardless of MAP sensor type (capacitive, resistive tensometric, or piezoelectric) procedure for correctness testing is the same. For its operation, the MAP Sensor requires a constant power source of 5 V, which it receives from the ECU via two conductors (plus and minus). The third conductor is for the output signal of the measured pressure value from the MAP sensor to the ECU.

MAP sensor



Map sensor circuit

The electronic control unit powers the sensor and constantly monitors its operation. If the ECU registers a malfunction, it stores the fault code and lights the malfunction indicator lamp on the dashboard. The ECU can detect a sensor malfunction, sensor circuit faults, damage, contamination, or poor sealing in the intake manifold. Electrical faults are registered, power failure, short circuits, and interruption of the output signal supply from

the MAP sensor in the intake manifold.

First, system diagnostics and fault code reading are performed. If there is a fault for the MAP sensor stored in the fault memory, this is the starting point from which to start the sensor test. Next, as part of the diagnostics, the actual values from the MAP sensor are read and compared with the required ones from the information system. In the end, recording and analysis of the oscillogram of the MAP sensor's operation as seen by the ECU is performed. This recording is done during idling, gentle acceleration and accelerator pedal release, and sudden acceleration. Oscillogram analysis checks the response of the MAP sensor to changes in the operating mode and the accuracy of the air pressure readings in the intake manifold.

After diagnostics, the power supply is checked. In the information system, we get acquainted with the electrical connection diagram, the arrangement of pins on the sensor socket, the required range of supply voltage, and possibly the recommended test procedure. The measurement of the sensor's power supply is performed with the given contact on the switch near the steering wheel. If there is no voltage, the power supply has been interrupted, and the causes can be: the opening of the plus and/or minus line, a short circuit, or an interruption of the power supply in the ECU. If the measured voltage is lower than the required value, check all connections from the ECU to the sensor for voltage drop due to poor contact, dirt, or corrosion.

The next check is related to measuring the output voltage on the MAP sensor itself. It is estimated when the engine is not running, idling and possibly (if data is available) at 2000 rpm. The output voltage values obtained are compared with the actual ones from the information system for that vehicle and the MAP sensor. If the measured values do not correspond to the set values, removing the MAP sensor and performing additional tests on the workbench are necessary. After this check, we can determine precisely whether the MAP sensor or the engine is faulty.

This measurement checks the reaction of the MAP sensor to changes in the engine operating mode. Over time, after long-term use, impurities (dirt, oil, fuel, etc.) accumulate on the measuring part inside the sensor, preventing direct contact between the intake air and the meter. Therefore, the MAP sensor cannot keep up with the constant changes in the operating mode, and a delayed measurement occurs. When we have such a case, it is necessary to eliminate malfunctions that lead to the appearance of impurities in the intake pipe and replace the old MAP sensor with a new one.

To test the MAP sensor, follow these steps:

1. Diagnostics ECU: Perform system diagnostics by reading error codes and the actual value from the MAP sensor at various engine operating modes. Record the oscillogram of the pressure change at idle, light, and sudden acceleration. Analyze the readings and recorded the oscillogram.

2. Sensor power supply check: Get to know the system from the information system by reading the electrical diagram, sensor installation position, actual values, etc. Remove the socket from the MAP sensor. Activate the vehicle's power supply and measure the power supply at the socket connections. Compare the obtained value with the required one. If there is no voltage or it is less than necessary, proceed with further tests on the socket pins, connecting cable, and ECU pins.

3. Output voltage measurement: Connect a voltmeter to the output of the MAP sensor in parallel with the socket. Read the output voltage with the engine off, idling, and possibly at 2000 rpm. Compare the measured values with the required ones from the information system. If the values do not agree, remove the MAP sensor and perform a workbench test.

4. Output signal check: Connect the oscilloscope in parallel to the output of the MAP sensor. Record the oscillogram of the change in the output voltage in different en-

gine operating modes (idle, slow acceleration and deceleration, and sudden acceleration and deceleration). Analyze the obtained oscillogram for the speed and accuracy of the MAP sensor measurement with a change in the engine operating mode. If the sensor is found to be sluggish, replace it with a new one.

Text 7. Testing an Oxygen/Lambda Sensor

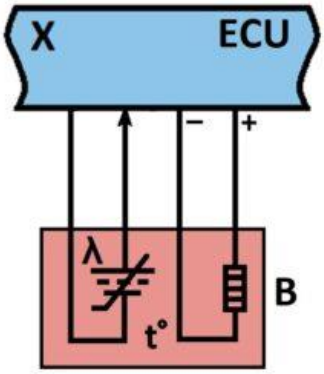
Source: https://autoedu.info/en/autoelectronic/sensors/testing-an-oxygen-lambda-sensor/

An oxygen sensor is a sensor that monitors the composition of the fuel-air mixture by measuring the oxygen level in the exhaust gas. For stable engine operation and more efficient operation of the catalytic converter, the engine ECU corrects the composition of the mixture based on data from the oxygen sensor. In tandem with the main oxygen sensor, another one is installed to control the correctness of the catalytic converter.

An oxygen sensor is of the galvanic type because it does not require power for its operation. However, for the sensor to measure, it must reach operating temperature. The operating temperature of the oxygen sensor is 350…850 °C. It uses hot exhaust gases for heating and contains a heater inside.

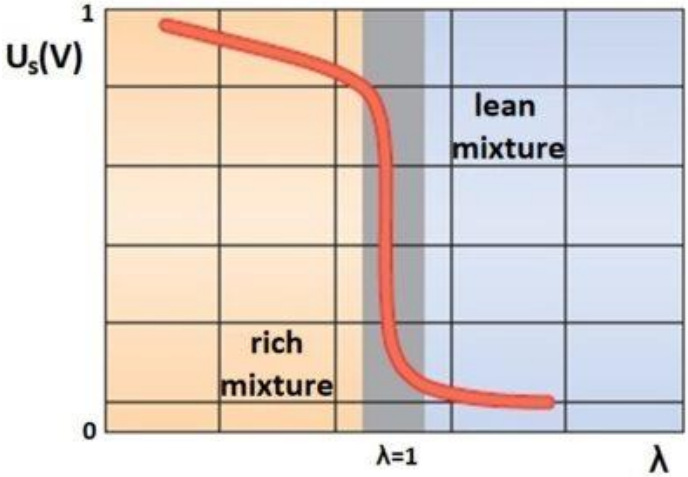
There are several types of oxygen sensors: two-step, planar wide-band and resistive. Most often, a jump-type oxygen sensor is used on vehicles, which, by a sudden change in voltage around the ideal value of the fuel-air mixture (λ=1), determines two states of a rich and a lean mixture.

Oxygen sensor



Oxygen sensor circuit

A voltage characteristic of the oxygen sensor jumps depending on the composition of the air-fuel mixture.



A two-step oxygen sensor consists of a sensor and a heater and is connected to the ECU via four wires. Two conductors are for powering the heater (plus and minus) and are

usually white. The sensor part has a minus line (most often grey) and an output signal line (most often black).

Service life and chemical pollution lead to the ageing of the oxygen sensor, which results in slow regulation and correction of the mixture by the injection system. There is no way to check the general condition of the oxygen sensor, that is, to determine that there has been a shift of the operating characteristic to the region of the rich mixture. A faulty oxygen sensor leads to an impairment of the efficiency of the catalytic converter and the exhaust gas quality with increased fuel consumption. The manufacturer recommends that the oxygen sensor be checked every 30,000 km and replaced after 100,000 km.

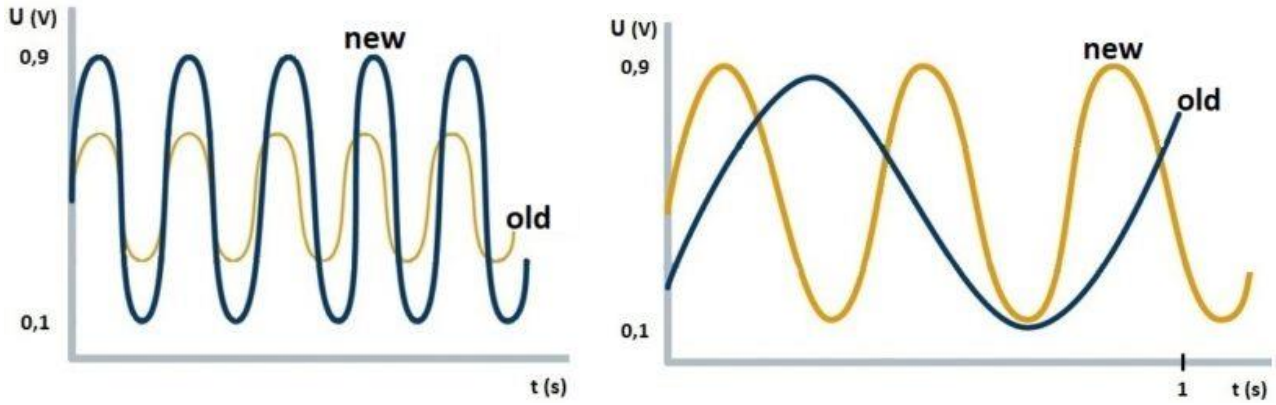
Possible malfunctions of the oxygen sensor are:

– defective sensor;
– sluggish (old) sensor;
– interruption of the lines from the probe to the ECU;
– heater out of order;
– interruption of the heater's power supply (open or short circuit of the lines);
– interruption of the heater's power supply from the ECU.

When light the malfunctioning indicator lamp is on the dashboard or when a malfunction of the oxygen sensor is suspected, ECU engine diagnostics are performed by reading stored fault codes and actual values. Through the ECU engine, we can check the current condition of the heater and the operation of the oxygen sensor. First, the output voltage oxygen sensor is measured when the engine is not running. Then the ECU takes a substitute value of 450 mV because the oxygen sensor is not functional. Start the engine. The oxygen sensor heated for 2…3 min at 2000 rpm. After heating, the oscillogram of the voltage signal from the oxygen sensor is recorded and analyzed. A correct oxygen sensor has an oscillation amplitude of 0.1 to 0.9 V and an oscillation frequency of at least one oscillation per second.

After diagnostics, the heater power supply is measured. Remove the socket from the oxygen sensor and measure the power supply coming from the ECU engine with the given contact. If there is no or insufficient power supply, continue by checking the condition of the lines from the socket to the ECU.

The next check relates to the condition of the oxygen sensor heater. The resistance of the heater is measured with an ohmmeter, and the measured value is compared with the one required from the information system for that oxygen sensor. If the heater is interrupted or the measured value is outside the specified range, it is necessary to replace the oxygen sensor.



Oscillogram analysis of the oxygen sensor output signal

Finally, the oscillogram of the output voltage signal of the oxygen sensor is recorded, which checks the state of the oxygen sensor. An oscilloscope is connected in parallel

with the output connections on the oxygen sensor. First, the oxygen sensor is heated, and then the oscillogram of the output signal is recorded at 2000 rpm and idle. The amplitude signal should range from 0.1 to 0.9 V, and the frequency should have at least one full oscillation in one second.

When it is determined that the output signal of the oxygen sensor is outside the set value, the ECU of the engine adjusts the mixture incorrectly, we have a worse engine performance, increased fuel consumption and the quality of the exhaust gas is impaired because the efficiency of the catalytic converter is reduced. That is why it is necessary to replace the old oxygen sensor with a new one.

To test the oxygen sensor, follow these steps:

1. Diagnostics ECU: Perform system diagnostics by reading fault codes and actual values from the oxygen sensor at different engine operating modes. Record they scillogramm ”f“ he output signal of the ox”ge“ sen”or“at idle speed and 2000 rpm. Analyze the read values and the recorded oscillogram.

2. Heater power supply check: Get to know the system from the information system by reading the electrical circuit, the installation position of the oxygen sensor, actual values, etc. Remove the plug from the oxygen sensor. Turn on the power supply and measure the power supply at the socket connections. Compare the obtained value with the actual value. If there is no voltage or it is less than necessary, proceed with further tests on the socket pins, connecting cable and ECU pins.

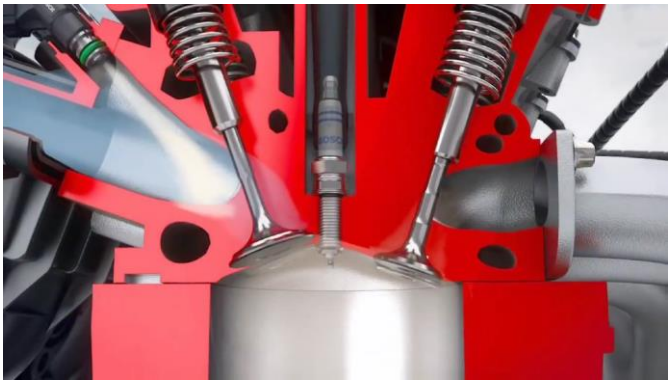
3. Heater check: From the information system, read the position of the pins on the sensor socket for the heater and the range of the required heater resistance. Measure the resistance of the heater with an ohmmeter and compare it with the required values. If the heater is open circuit or the measured resistance is out of range, replace the oxygen sensor.

4. Output signal check: Connect the oscilloscope in parallel to the output connections of the oxygen sensor. First, warm up the oxygen sensor during 2 to 3 minutes of engine operation at 2000 rpm. Record the oscillogram of the output signal at idle and at 2000 rpm. Analyze the received oscillogram according to the signal amplitude and frequency. If the oxygen sensor is slow, replace it with a new one.

Text 8. Gasoline Injection Systems: Air Intake

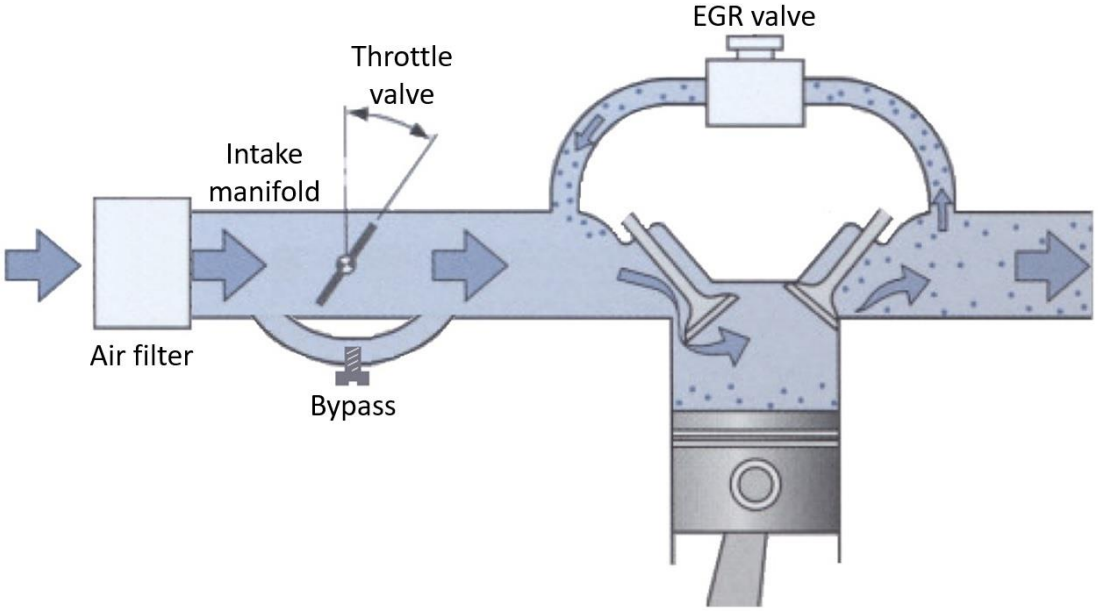
Sources: https://autoedu.info/en/autoelectronic/gasoline-injection-systems/, https://autoedu.info/en/autoelectronic/gasoline-injection-systems/air-intake/

A gasoline injection system is an electronic control system for mixture formation and engine operation. Solving problems in the injection system requires systematicity with knowledge of operating principles and test procedures. It is better to group interconnected elements, sensors and devices of the injection system that have similar fields of action into subsystems. In this way, service technicians can more easily locate the fault when there are irregularities in the injection system.



Air intake includes all elements of the injection system of gasoline engines that participate in the implementation, measurement and regulation of air supply to the engine. Air is introduced in the engine from the environment to form a mixture and burn fuel.

The primary components of the automotive intake system are the air filter, the intake manifold, the throttle valve, the bypass line and the EGR valve for returning part of the exhaust gas to the intake line.

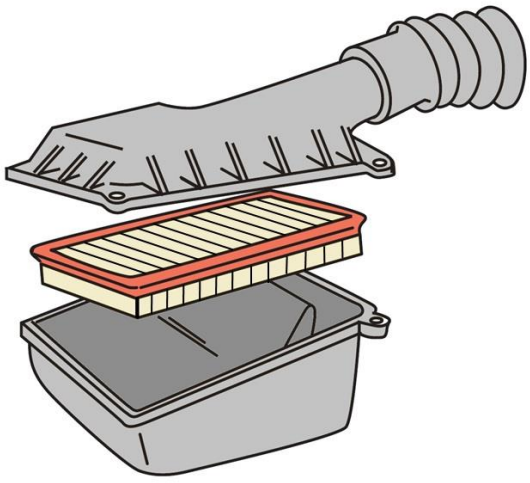


To make sure all the components of the automotive intake system work properly a service technician should know the procedures for checking, testing and repairing the elements responsible for air intake.

Text 9. Engine Air Filter Check

Source: https://autoedu.info/en/autoelectronic/gasoline-injection-systems/air-intake/engine-air-filter-check/

The air filter is the first element of the intake and prevents impurities from entering the engine cylinders. Dust and sand can seriously damage and significantly shorten the engine life. That's why all the intake air passes through the filter before entering the intake manifold and the engine.



During exploitation, the filter retains impurities and reduces the airflow. Restricted flow through the filter can affect the operation of the injection system, causing increased fuel consumption, poor engine performance and high exhaust emissions.

The vehicle manufacturer prescribes the air filter replacement interval. However, this applies to normal driving conditions. Where there are dusty roads, the filter gets dirty sooner. That is why a periodic check of the filter condition is performed before the replacement interval expires. The inspection determines whether there is dirt or clogging on the filter.

The best way to do this is to remove the filter from the housing and point it at a bright light source. When little or no light passes through the filter, replace the air filter. Dirt from the filter is not removed by shaking or blowing because, after installation, loose dirt gets into the engine.

Text 10. Intake Manifold Testing

Source: https://autoedu.info/en/autoelectronic/gasoline-injection-systems/air-intake/intake-manifold-testing/

In injection engines, the mass intake air is measured so that the control unit determines the amount of fuel to inject and form the mixture. If there are cracks in the intake pipe or connecting hoses and elements, the engine draws in more air, especially at idle. It is false air that is not measured, the control unit will not inject enough fuel while the engine will run on a lean mixture. In turbocharged engines, air leaks from the intake manifold, dropping the charge pressure.

There are several ways to test the suction line for leaks.

1. Checking with the additional fuel method: When false air is suspected, a check can be performed using acetylene or propane as additional fuel. While the engine is idling, the technician carefully directs a small amount of fuel toward any suspected leaking components. If this fuel passes through the crack, the vacuum will draw gas into the intake manifold, enriching the mixture and increasing engine speed. The problem is if the engine has an idle speed control system that regulates every change and does not allow the engine speed to increase. Before testing, it is necessary to disable the regulation or keep the gas open only enough that it does not control the idle speed. You may also be able to use a scan tool to watch the oxygen sensor, injector pulse width, and short-term fuel trim reading while applying and removing the acetylene or propane. Be careful with this method. The gas is highly flammable and can cause a fire on a hot engine.

2. Checking with soapy water: When we suspect that the generated overpressure from the turbocharge is leaked through the intake manifold, check the leak site by applying soapy water. The soapy water is sprayed to the intake line and any components suspected of leaking. Soap bubbles will appear when the engine runs at higher rpm where there is a crack and air leak.

3. Checking with smoke: The best method for finding a crack in the intake manifold is to use a smoke machine. When the engine is off, the smoke machine pushes low-pressure smoke into the intake manifold. Thus, the entire intake line is filled with smoke. If there is a crack, the smoke will escape from that place. Therefore, everywhere where the smoke comes out (except at the entrance) is a place of leakage or the appearance of false air. Using a bright light, look around the engine compartment for traces of smoke.

Text 11. Throttle Valve Check

Source: https://autoedu.info/en/autoelectronic/gasoline-injection-systems/air-intake/throttle-valve-check/

Checking the condition of the throttle valve is performed very rarely. Sometimes the cause of engine idling problems can be the throttle valve itself.

In gasoline engines, the throttle regulates the engine speed. It is located on the intake pipe and controls the airflow as a valve. In idle mode, the throttle is closed and lets in

the minimum amount of air sufficient to keep the engine running at the lowest set rpm. However, when the engine is cold and in the warm-up phase, a slightly higher mixture is needed, which requires more air to be passed through the bypass line or by moving the throttle valve. When the engine is warmed up, the mixture is adjusted at idle to maintain the set rpm.

When there is an oil leak and its combustion, the purity of the exhaust gas and intake manifold is disturbed. The soot in the exhaust gas is introduced into the intake manifold via the EGR valve. Also, engine oil can enter the intake manifold through damaged intake valve guides or the turbocharger (if equipped). Over time, these impurities accumulate on the walls of the intake manifold in the throttle body, preventing the passage of air when the throttle valve is closed. An engine with less air flow at idle has an unstable operation, chokes and dies.

Checking the throttle valve can be done by removing the intake hoses or the throttle module. Inspection of the inside of the throttle valve body determines the condition. If deposits are visible on the walls of the intake manifold in the part of the throttle valve, it is necessary to clean it. While the throttle valve is in the zero position, the module is redirected towards a bright light. By observation, we can see the light around the entire circumference of the valve towards the walls. The space between the valve and the module wall should have a paper thickness, which is enough to allow air to pass through in idle mode. Dirty walls prevent the passage of light and this is a sign that the module is dirty.

Before cleaning the throttle body, remove all non-metallic parts such as sensors, regulators and gaskets. Cleaning is done by applying a grease remover and wiping with soft cloths. Remove the dirt without scraping so as not to damage the surface of the walls of the suction line. Compressed air blows out all passages on the throttle body and dries the inside.

To check the throttle valve, follow these steps:

1. Disassembly of the throttle body: Disconnect the intake line from the housing. Remove all connections from the throttle module. Disconnect the module from the engine.

2. Throttle body check: Visually check the internal part of the throttle module. Point the module towards the light source and observe the space between the closed valve and the intake tube of the module. If the presence of dirt is found, clean it.

3. Throttle body cleaning: Remove all non-metallic parts (sensors, regulators and seals). Apply means for degreasing and removing impurities. Remove dirt with a soft cloth without damaging the intake walls of the throttle module. Blow out all passages with compressed air and dry the inside of the housing.

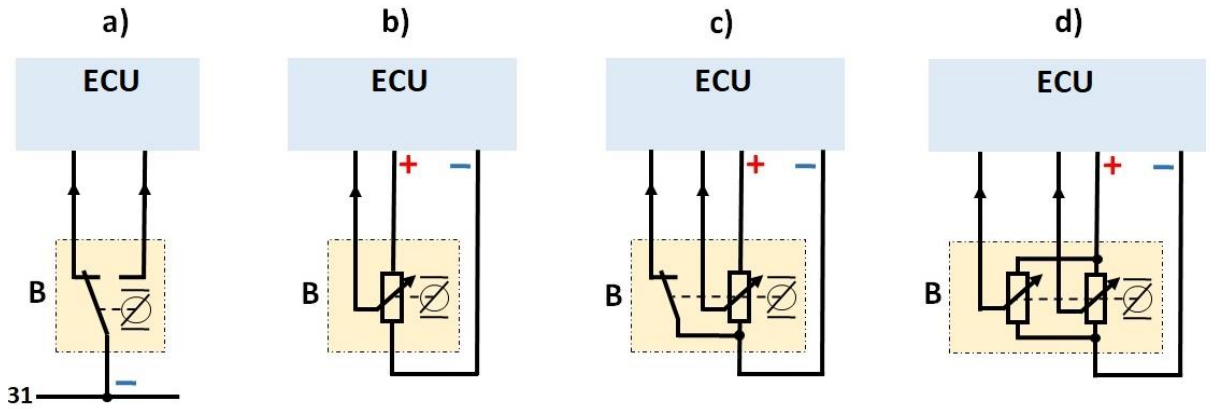
Text 12. Throttle Valve Sensor Test

Source: https://autoedu.info/en/autoelectronic/gasoline-injection-systems/air-intake/throttle-valve-sensor-test/

The throttle valve sensor measures the angular position of the throttle valve and forwards the data as a voltage value to the control unit for further processing. The most common symptoms of a bad or misaligned sensor are engine stalling, incorrect idle speed, and hesitation and stalling during acceleration. The fuel/air mixture is out of tune because the ECU is not receiving the correct data from the throttle position sensor. If these problems occur in engine operation, it is necessary to perform test correctness of the throttle valve sensor.

Before testing, we get acquainted with the type, electrical connection diagram, connection arrangement and actual values for a correct throttle valve sensor.

There are several types of throttle valve sensors.



Different types of throttle valve position sensors

The oldest type is the throttle position switch (a). It contains two buttons and a cam on the throttle shaft. At idle, the throttle is closed, and the cam presses one button. When the throttle valve is fully open it is full load mode, and the cam presses another button. In partial load mode, the throttle is partially open. In this mode, the cam does not touch either key and both are open. The control unit receives negative voltage through the sensor switch. Based on the combination of data obtained from the ECU button, it recognizes three engine operating modes (idle, partial and full load) and can adjust the injection and engine operation accordingly.

With the development of the injection system, the ECU requires the exact position of the throttle. Instead of a button, a potentiometer (b) is built into the sensor. The potentiometer slider is on the shaft and rotates together with the butterfly. The potentiometer is supplied with a constant voltage from the ECU. The potentiometer is a voltage divider and the output voltage from the slider depends on its position, i.e., the angular position of the throttle. Based on the received data from the sensor, the ECU can calculate the exact position of the throttle.

Some sensors have a button (c) next to the potentiometer, which is activated when idling, that is when the throttle is closed.

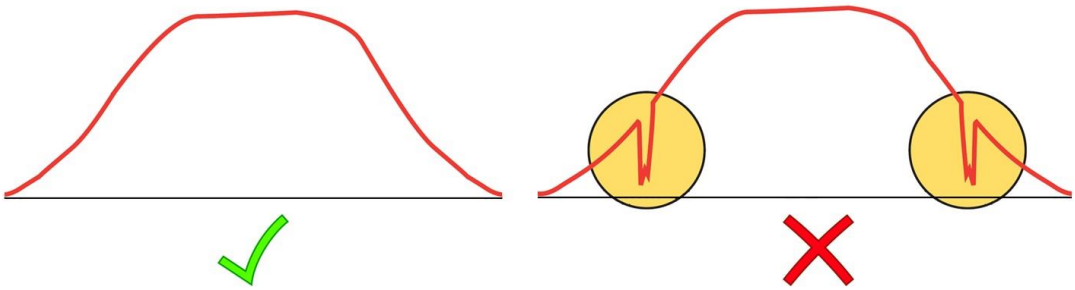
In newer injection systems, due to the requirement that there should be no stalling of the engine due to failure of the mixture control elements, a double potentiometer (d) is installed in the throttle position sensor. They work in parallel, but if there is a failure on one, the other works properly, the ECU recognizes the error, turns on the error light, and the engine continues to function smoothly.

Testing the sensor as a throttle valve position switch comes down to checking the correctness of the button when we rotate the cam, the negative power supply and the correctness of the lines to the ECU.

In the case of potentiometer sensors, the power supply from the ECU to the sensor (5 V), the resistance value at the ends of the potentiometer and the accuracy of the output resistance or voltage from the slider when the throttle is closed (idle) and fully open (full load) are checked.

The initial adjustment of the idle sensor is critical. With many sensors, we can adjust this output voltage by rotating the entire sensor relative to the throttle body when the loosened retaining screws are.

This is not enough to claim that the sensor is correct. It happens that during long-term use, the slider damages part of the resistance path of the potentiometer. Then there is an interruption of operation when the slider passes over that damage, and the ECU loses the signal from the sensor. Interruption occurs most often in the part of the lower partial load because it is the most common driving frequency. The test is performed by recording the signal from the slide when we slowly add gas to the end and back. The test lasts about 2 seconds and based on the recorded waveform we can determine the correctness of the sensor.



Recording of the sensor output signal

For sensors with a double potentiometer, the test procedure is the same, only it is performed separately for one and the other. These two potentiometers have a common power supply from the ECU.

To test the throttle valve sensor, follow these steps:

1. Data overview: For a given vehicle from the information system, we get acquainted with the type of sensor, installation position, electrical connection diagram, connection layout, actual values and recommended test procedure.

2. Power supply check: Remove the electrical socket from the sensor. Switch on the vehicle's power supply. Use a voltmeter to measure the power supply voltage at the socket. If there is no or a different value than required, measure the voltage at the ECU output connectors and check the cables.

3. Sensor check: With the socket removed, measure the resistance of the potentiometer at its ends and compare it with the required value. With the engine idling, between the minus and output connections on the sensor, measure the resistance or voltage value (when the socket is installed and the vehicle's power supply is switched on). Then measure the resistance or voltage at full throttle deflection. Compare the measured values with the required ones. If the measured values differ from those required, replace the sensor.

4. Recording the output signal: Connect an oscilloscope parallel to the socket between the minus and the output port. Measure output resistance (unpowered) or voltage (powered). Lightly the throttle valve or manually move the throttle valve shaft from idle to full throttle and back again. Pause and analyze the obtained waveform. If there are interruptions in the signal, replace the sensor.

Text 13. Idle Air Control Valve Test

Source: https://autoedu.info/en/autoelectronic/gasoline-injection-systems/air-intake/idle-air-control-valve-test/

When the engine has a high or low idle speed or shuts down, the cause may be the control valve and an idle air control valve test should be performed. In addition to the air control valve, the cause may be a dirty intale line in the throttle part or a leak in the intake manifold.

Testing the idle air control valve is done in a few steps. If the fault light is on, reading fault codes through diagnostics directs us to the cause of the malfunction.

The next step is to check the rpm engine with and without the idle air control valve. Start the engine and record the engine idle speed. Stop the engine, the removed plug from the idle air control valve, and the restarted engine. If the rpm is the same without the valve, the problem is most likely in the idle air control valve itself. However, if the rpm increases, the idle air control valve is correct.

When, after the test of disabling the operation of the idle air control valve, there is doubt about its correctness, a performed visual inspection of the valve. Remove the idle air control valve. The installation site and valve are visually inspected for soot, rust or dirt.

Also, check the valve shaft. Cleaning is done with a suitable means for removing impurities. They can damage the walls, ducts and valve and thereby change the function of the idle speed regulator.

The next step is to check the electrical functions. The resistance of the valve winding is measured with an ohmmeter and compared with the actual value. If the resistance is outside the set value, the regulator is faulty. The control signal from the ECU is checked using a test light. The valve is unplugged. Connect the negative lead of the test light to the chassis vehicle. The engine starts. The tip of the test light is connected to each terminal of the socket. The test light should flash when plugged in. If it does not flash, the problem is in the supply of the control signal.

To test the idle air control valve, follow these steps:

1. Fault diagnosis: Connect the diagnostic tool to the vehicle. Read and analyze fault codes. If the fault code refers to the idle air control valve or the regulation of the idle speed, proceed to check the valve and other elements that may be the cause of the failure.

2. Testing by switching off the valve: Start the engine and read the idle speed. Turn off the engine. Remove the electrical socket from the idle air control valve. Start the engine again and read the idle speed. If the read values are the same, continue testing the idle air control valve.

3. Visual inspection: Remove the idle air control valve from the intake manifold. Visually check the valve installation site for dirt. Inspect the valve and valve shaft. If there are impurities, apply a suitable agent and clean without scraping. If damage is detected, replace the idle air control valve.

4. Electrical testing: Measure the resistance of the valve coil with an ohmmeter. If they are outside the actual values, replace the idle air control valve. With the valve socket removed, start the engine. Connect the minus conductor of the test light to the chassis of the vehicle, and connect the plus to each connector of the socket in turn. The test light should be flashing, otherwise, the problem is in the supply of the control signal to the idle air control valve.

Text 14. Accelerator-pedal Module Test

Source: https://autoedu.info/en/autoelectronic/gasoline-injection-systems/air-intake/accelerator-pedal-module-test/

Testing the condition and operation of the position sensor is a procedure that determines the correctness of the Electronic throttle control (ETC) in the electronic engine power control system. The test procedure includes a review of the accelerator pedal and the electrical correctness of the position sensor.

Inspect the accelerator pedal for visible damage such as broken parts or cracks. Also, check mechanical functionality during startup. It is necessary to push it smoothly, whereby the pedal creates a certain resistance and returns to the starting position by itself.

Remove the socket from the accelerator pedal, and with the power on the measure power supply on the appropriate pins as specified in the information system for the given vehicle. The size of the supply voltage should be around 5 V. Care should be taken that there is a separate power supply for each position sensor. If there is no voltage, continue the search towards the control unit. A possible cause of the power interruption may be the power cable or the control unit.

Checking the pedal position sensor is done by measuring the resistance, that is, the output voltage or by reading the value through diagnostics.

With the socket disconnected, the total resistance at the ends of the potentiometers is first measured and compared with the set values. After that, an ohmmeter is connected be-

tween the minus terminal and the slider output. The resistance is measured when the pedal is released and fully depressed.

Also, the pedal position sensor checked can be by measuring the output voltage when the socket pedal is connected and the power is on. The output voltage is measured in zero and full positions.

All this can be checked via diagnostics by reading the actual values for both sensors.

It is desirable to record a graph of the output from the sensor from initial to full deflection and back. The waveform must not have interruptions.

You should know that outputs from sensors are different because a resistor is added to one of the potentiometers.

To accelerator-pedal module test, follow these steps:

1. Pedal overview: Visually inspect the pedal for damage. Press down and release the gas pedal. Estimate the strength of the thrust resistance. Make sure that the pedal is pressed smoothly and returns to the initial position independently.

2. Checking power supply: Remove the socket from the pedal. Determine the arrangement of pins on the socket. Turn on the power supply. Use a voltmeter to measure the power supply for both sensors. If the voltage value is different from the prescribed or there is no voltage, continue the search to determine the cause of the irregularity.

3. Pedal position sensor test: With the socket removed, measure and compare the total resistance of both sensors. At the output, measure the resistance when the pedal is released and pressed all the way. This can be done by measuring the output voltage with a voltmeter or via diagnostics when the socket is connected and the power supply is on. Record and analyze the output signal in the entire range with an oscilloscope or through diagnostics. If any value is outside the default, replace the accelerator-pedal module.

Text 15. Comfort Systems: Air Conditioning

Sources: https://autoedu.info/en/autoelectronic/comfort-systems/, https://autoedu.info/en/autoelectronic/comfort-systems/air-conditioning/

The design of modern vehicles is such that they provide passengers with comfort and safety. There is an increasing number of different electronically controlled systems that provide additional comfort to the vehicle. Comfort systems include heating, air conditioning, multimedia systems, navigation, cruise control, distance radar and others.

Comfort systems require maintenance and service in case of failure. This chapter provides procedures for system installation, maintenance and repair of certain electronic devices that provide additional comfort while driving.

Periodic maintenance and checking the correctness of the vehicle's air conditioning system prevent the air conditioner from working poorly or not at all.

Air conditioning is a standard part of a modern vehicle. In summer, excessive heating of the air inside the vehicle occurs due to the high outside temperature. The air conditioner should provide the appropriate temperature and air humidity in the passenger compartment to make driving comfortable.

The air conditioner controls four air parameters inside the vehicle:

– cooling;
– circulation;
– purification;
– dehumidification.

It happens that, due to some disturbance, the air conditioner works poorly or not at all. That is why it is necessary to carry out periodic technical maintenance and check the correctness of the vehicle's air conditioning system.

Technical maintenance involves replacing the pollen filter and disinfecting the airflow system.

A malfunctioning air conditioner can cause a lack of refrigerant due to a leak or a malfunction of some component in the air conditioning system.

Maintenance and repair of the air conditioner should be performed by a professional person following the manufacturer's recommendations and using appropriate equipment.

Text 16. Charging the Air-Conditioning System

Source: https://autoedu.info/en/autoelectronic/comfort-systems/air-conditioning/charging-air-conditioning-system/

When the air conditioner does not work, the most common cause is an insufficient amount of refrigerant. The electronic system on the vehicle constantly controls the refrigerant pressure, and if it falls below the minimum value, it blocks the air conditioner from turning on.

Before checking the amount of gas, the service technician first gets acquainted with the air conditioning system in the technical documentation for that vehicle. The necessary data for air conditioning servicing are the number and location of refrigerant connections, the type and amount of refrigerant, and the type and amount of oil. Also, it gets acquainted with the recommended procedures for testing and charging.

Checking the correctness and charging of the air conditioner, the service technician should use protective equipment (gloves, glasses) and adhere to the prescribed safety measures.

The air-conditioning station is used to check the pressure and charge. The AC station must contain the same type of refrigerant as the vehicle's air conditioner. Different types of refrigerant must not be mixed. After locating refrigerant ports on the vehicle, the caps are removed and the connection to the AC station is made using hoses with special protective fittings. After connecting, the refrigerant from the air conditioner on the vehicle reaches the pressure gauge at the station.

The resting pressure of the refrigerant should be equal on both sides of the system (low and high pressure), and the correct value ranges from 5 to 6 bar. If the pressure is lower, means that the amount of refrigerant is insufficient, and therefore the operation of the air conditioner is blocked.

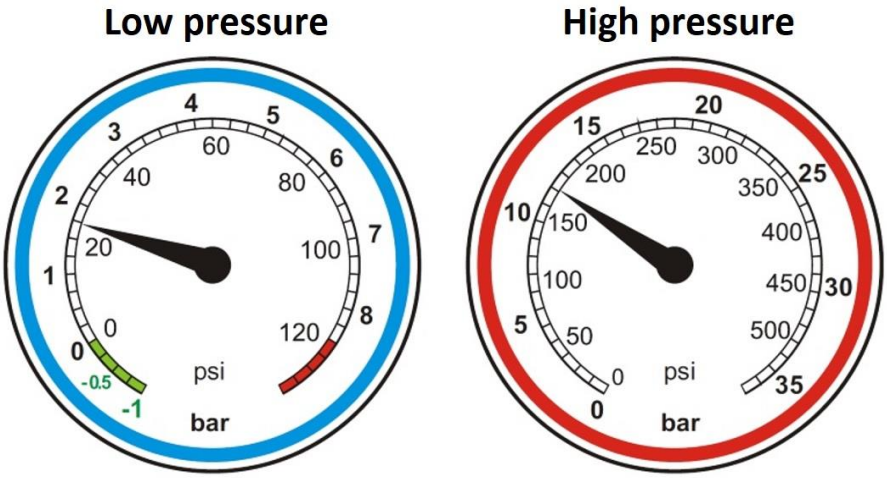
If a lower refrigerant pressure is determined, the refrigerant is evacuated from the air conditioning system. The valves open, and discharge is activated. The refrigerant from the air conditioner is transferred to a station where it is cleaned, dried and stored in a bottle where the refrigerant is under pressure.

After extracting the refrigerant, the system is vacuumed. The required vacuuming time is 20 minutes. After that, the station automatically checks the tightness of the system by monitoring the vacuum condition for 2 minutes. In this way, larger system leaks can be detected. If a weaker vacuum leak is still suspected, the check can be extended up to 30 min. When the system loses vacuum during the check, it means that the system is open (defective), the station reports an error and does not allow filling the system with refrigerant because it would quickly leak out after filling. In that case, the approach is to find the place of leakage and repair the system. After the repair, the vacuuming procedure is repeated.

When the station after vacuuming determines that the system holds a vacuum, the filling procedure follows. Before filling, the cover of the engine compartment (engine hood) is lowered for safety reasons. First, the oil is put in. The amount of refrigerant oil depends on whether the system has been repaired and what has been done. If only filling is done without system intervention, a small amount of refrigerant oil (5 to 10 cm3) is insert-

ed. Together with the refrigerant oil, a fluorescent dye is introduced into the system. When there is a refrigerant leak, that place is coloured and we can easily detect it using a UV lamp. After adding the refrigerant oil, the refrigerant is added. Based on the data from the technical documentation, the amount of refrigerant to be charged is programmed.

After charging the air conditioner, by closing the valve at the station, the gas systems of the station and the air conditioner are separated. It remains to check the correctness of the air conditioner during operation. The engine is started, the air conditioning is activated with maximum exhaust, and the rpm engine is raised to the value defined in the technical documentation. The refrigerant pressure is monitored on the station's manometers. The expected value on the low-pressure side is around 2 bar, and on the high-pressure side between 10 and 15 bar.



The picture shows the correct working refrigerant pressures of the low-pressure and high-pressure sides of the air conditioner on the vehicle.

If the outside air temperature is high, the upper-pressure value can exceed 15 bars. For exact values, consult the data from the technical documentation for that vehicle.

At the same time, the exhaust temperature inside the vehicle is checked. The cold air outlet opens only through the opening on the centre console. A thermometer is placed in the opening, and the temperature of the cold air discharge is monitored. In 60 seconds, the exhaust temperature should be between 6-8 °C.

If the refrigerant pressures and cooled air are within the set values, the air conditioner on the vehicle is working properly. The station's connections are disconnected from the air conditioning system, protective caps are installed and the station is returned to its initial state.

If one of the parameters does not have the required value, a further air conditioner check is carried out until the fault is detected and eliminated.

To check the correctness and charge the air conditioner on the vehicle, follow the following steps:

1. Overview of the manual: In the technical documentation for a given vehicle, get acquainted with the technical data of the air conditioner (type of air conditioner, number and position of refrigerant connections, type and amount of refrigerant, type and amount of refrigerant oil, etc.). Read the actual values to check the air conditioner of the vehicle.

2. Air conditioner check: Prepare the vehicle for the air conditioner check. Prepare a station for testing and charging the air conditioner. Connect the station to the air conditioner and read the refrigerant pressure at rest. Based on the results reading, determine the next steps for working on the air conditioner.

3. Refrigerant evacuation: Prepare the station and the air conditioner for the safe evacuation of gas. Before evacuation, program the station for the entire process of vacu-

uming and charging the air conditioner. During the refrigerant evacuation, monitor the parameters at the station.

4. Vacuuming: Start the 20-minute vacuuming of the system. After vacuuming, the station monitors the vacuum condition in the air conditioning system for 2 minutes. When the system holds a vacuum, continue with the charging process. If the system loses vacuum, stop the charging process and begin to find and repair the system leak.

5. Charging the air conditioning: After vacuuming, the system is ready for charging. First, refrigerant oil with a fluorescent dye is added in the amount according to the manufacturer's instructions and the type of air conditioning repair. Then the required amount of refrigerant is introduced. The station automatically shuts off charging when the specified amount of refrigerant is inserted.

6. Air conditioner check: After charging the air conditioner, close the valves at the station. Start the engine, turn on the air conditioner at the maximum exhaust and maintain the engine speed at the required value. Monitor the movement of the refrigerant pressure at the station and measure the temperature of the exhaust inside the vehicle. If the measured values are within the specified limits, the air conditioner is correct. Otherwise, take further necessary actions to detect the malfunction.

3.2. Auto electrics

Text 1. Battery

Sources: https://autoedu.info/en/auto-electric/, https://autoedu.info/en/auto-electric/battery/

Auto Electrics includes electrical systems, devices, and components on vehicles. They are used for starting the engine, supplying electricity, and electrically starting the device for the vehicle's safety, protection, and comfort. They are used for starting the engine, supplying electricity, and electrically starting the device for the vehicle's safety, protection, and comfortlarity.

A proper approach during maintenance, testing, and repair of electrical system elements will contribute to more efficient and faster vehicle servicing. When a problem in operation or a breakdown occurs, the technician is informed first about the electrical system, the position of the elements on the vehicle, the electrical diagram, and the test and repair procedure. Using the appropriate tool and equipment, the service technician can easily find the cause of the problem and eliminate the fault in the vehicle's electrical system.

Battery

A battery is the primary source of electricity on the vehicle when starting and for powering electrical devices while the engine is not running. The battery must be regularly inspected and maintained. A dead or lousy battery cannot start the engine.

During a regular inspection, irregularities can be noticed that are caused by poor conditions of exploitation on the vehicle or due to age. Testing determines the cause, which includes charging, troubleshooting, or replacing the battery.

Always wear safety glasses when working with batteries. When the battery is charged or discharged, it releases highly explosive hydrogen, while a certain amount of hydrogen is always present in the battery. An open flame or spark can ignite this gas, causing the battery to explode violently, spraying the acid over a wide area. Sulfuric acid can

cause severe skin burns. If the electrolyte contacts your skin or eyes, flush the area with water for several minutes. If eye contact occurs, open the eyelid and flush the eyes with an eyewash solution. Do not rub your eyes or skin, and call a doctor immediately.

Text 2. Battery Inspection

Source: https://autoedu.info/en/auto-electric/battery/battery-inspection/

A battery inspection is carried out because the battery is the primary source of electricity on the vehicle when it is stationary and when starting the engine. Regular maintenance is important for correct and reliable operation. The battery should be inspected during each oil change, and especially in the fall before the arrival of the colder period when it is additionally loaded. First, the age of the battery is checked by reading the date of manufacture and activation from the sticker. Then the condition of the housing is inspected. Damage to the case leads to leakage of electrolytes and such a battery should be replaced. Loose terminals and damaged poles on the battery create transient resistance and losses in the transmission of electricity. Make sure the outside of the case is dry and free of dirt. Dirt on the top of the case can cause the battery to self-discharge prematurely, as current 'leaks' through the dirt. This mixture becomes conductive and drains the battery over time. Perform a leak test. If the battery or any of its associated parts are dirty or corroded, they should be removed and cleaned.

Where possible, check the electrolyte level in the battery cells. If necessary, top up with distilled water. After topping up, it is necessary to charge the battery before further checking. Before conducting any test, make sure the battery is fully charged. After charging, first, remove the surface charge by switching on the headlights with the engine off. Keep the lights on for at least 3 minutes. Inaccurate tests can lead to problems and expensive and unnecessary repairs. Depending on the design of the battery, the charge level and capacity can be determined in several ways: specific gravity tests, visual inspection for batteries with a built-in hydrometer, open circuit voltage tests, and capacity tests.

To perform battery inspection, follow these steps:

1. Checking the battery's age and appearance: Check the age by reading the date on the label. Inspect the casing for cracks, damage, dirt, and grease. Check for missing covers, holders, and heat shields.

2. Checking the poles, terminals, and cables: Check if there are loose posts on the battery and if they have oxidized. Check that there are no loose, corroded, or damaged terminals. Inspect all cables for damage to cable insulation.

3. Checking the electrolyte level: If possible, check the electrolyte level in all cells and top up if necessary. If distilled water is added, charge the accumulator before any further testing.

Text 3. Battery Replacement

Source: https://autoedu.info/en/auto-electric/battery/battery-replacement/

Removing and installing the battery is done when it is necessary to clean, check its condition, or replace it with a new one. The service technician should follow the established procedure when replacing the battery.

Some vehicles are sensitive to battery discharge because certain electronic systems remain without power and can lose stored adaptive values. Check manufacturer and owner information to determine which electronic systems will be affected by the loss of power. You must identify each system that requires security or initialization codes to be reset and ensure that procedures and equipment are available to reinitialize the system or module.

When necessary, an external 12 V power source is used via the diagnostic socket using a separate cable or via the cigarette lighter socket if it is permanently on. Only after connecting the external power supply can you start disconnecting the battery.

When disconnecting the battery terminals, always remove the negative terminal first. After removing the negative terminal, if the key touches the chassis when it is on the positive terminal, there will be no spark because there is no connection to the negative terminal. After all, the chassis is no longer at ground potential. You still have to be careful not to bridge the key directly from the positive to the negative terminal, as this could cause a large spark.

The spring-loaded terminals are removed by lifting the lever which spreads the terminal and frees it for removal from the battery post. These are the so-called quick terminals for quick interruption of the power supply due to a major breakdown in the vehicle.

For terminals tightened with nuts and bolts, loosen the nut with an open-end wrench. Using regular pliers or an open-end wrench can cause problems. These tools can slip out under more pressure, breaking the cell cover or damaging the case. Always hold the cable while loosening the nut, as this reduces the pressure on the battery post, which could break. If the terminal does not lift easily from the post when released, use a puller. Lifting the terminal with a screwdriver or a bar loads the pole and the base. Doing so can break the cell cover or crack the pole.

Mounting the battery on the vehicle is done in reverse order. The battery is carefully placed in the holder, covered with heat shields, and secured with hold-downs. Terminals are additionally opened so that they can be easily placed over the posts. First, the plus terminal is installed and tightened. Then the minus terminal is installed and tightened. Terminals are coated with anti-corrosion paste or spray. If present, the external power source that stored the adaptive memories of the electronic devices on the vehicle is turned off.

Batteries can look lighter than they are. Always lift them carefully and get help if necessary. When reconnecting the battery, be sure to connect it correctly. If you reverse the polarity, the current flows in the electrical system in the opposite direction. Reverse polarity is likely to damage some or all of the electronic control units throughout the vehicle, so what started as a simple maintenance task becomes an expensive diagnostic and repair job to compensate for the damage.

To perform battery removal and installation, follow these steps:

1. Adaptive memory protection: Determine the need for electronic memory preservation for a given vehicle. Determine the method of connecting the external power supply. Connect the external power supply before removing the battery (if necessary).

2. Battery removal: Remove the negative terminal from the battery. Remove the positive terminal. Remove the brackets and release the battery. Carefully remove the battery from the carrier on the vehicle.

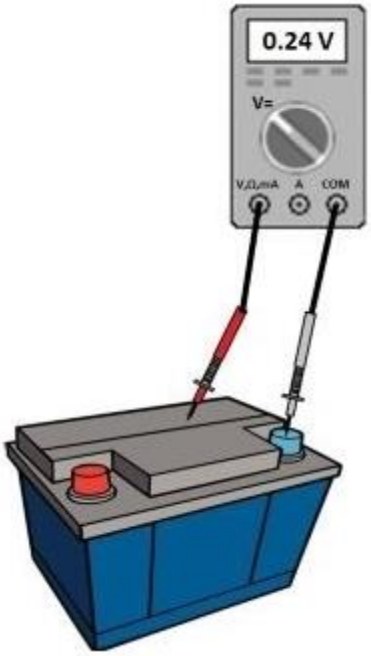
3. Installing the battery: Carefully install the battery on the support. Check the battery's polarity about the terminals. Install and tighten the positive terminal on the plus pole of the battery. Install and tighten the minus terminal. Apply an anti-corrosion agent over terminals and the poles. Disconnect the external power supply (if installed). Secure the battery with the holder. Install heat shields.

Text 4. Battery Leakage Test

Source: https://autoedu.info/en/auto-electric/battery/battery-leakage-test/

A leak test on the battery is performed when frequent discharge is observed while it is unloaded and all other tests show that the battery is good. Dirt, moisture, and grease on the case can become conductive and cause the battery to leak. Over time, such leakage drains the battery. Batteries last longer if properly maintained.

When the battery is discharged with no load, a leakage test should be performed. A DC voltage digital multimeter is used for testing. Before measuring, it is necessary to disconnect and remove the battery from the vehicle. The black (minus) pipette of the multimeter is placed on the minus pole of the battery, and the red pipette is passed over the battery housing. Any measured voltage greater than 0.2 V indicates a leak. Clean the battery housing with a mixture of baking soda and water. Make sure that this mixture does not get inside the battery, because it will permanently neutralize the electrolyte and thus damage the battery. Grease is removed with a detergent solution or solvent. After cleaning, rinse the battery poles and terminals with clean water. Dry the components with a clean cloth or low-pressure compressed air. If a leak is detected on the cleaned battery even after the repeated test, the case has permanently lost its insulating properties and it is necessary to replace the battery with a new one.



Battery leakage test

To perform a battery leakage test, follow these steps:

1. Removing the battery from the vehicle: Before removing the battery terminal, check whether it is necessary to connect additional power for saving data in the memories of electronic devices. First, remove the minus terminal from the battery. Then remove the positive terminal. Release and carefully remove the battery from the base of the vehicle.

2. Leakage test: Set the DC voltage measurement on the digital multimeter. Place the black (minus) pipette on the minus pole of the battery. Move the red pipette over the battery housing. If you measure a voltage higher than 0.2 V stop the test because there is a leak.

3. Cleaning the battery case: If there is a leak, thoroughly wash the battery housing. Wash with a solution of baking soda and water. During washing, make sure that the solution does not get inside the battery. Remove greased parts with grease removers. After washing and drying, repeat the leakage test. If the leak is confirmed again, the case has permanently lost its insulating properties, is necessary to replace the battery with a new one.

Text 5. Cleaning Battery Poles and Terminals

Source: https://autoedu.info/en/auto-electric/battery/cleaning-the-battery-poles-and-terminals/

Cleaning the poles and terminals of the battery should be done when they are dirty, corrosive, and greasy, as well as when deposits appear. Salt deposits and corrosion act as an insulator, reducing the flow of electricity to the vehicle's electrical devices. Dirt deposits on the poles and terminals of the battery can cause difficulty starting because the starter does not receive enough electricity to start the engine.

Salt deposits around the terminal occur when the sealing around the post loosens, as a result of forceful removal of the clamp when it sticks or gets stuck. Cleaning is done with a solution of baking soda and water. The solution is applied over the deposits and thoroughly washed with a brush. After cleaning, the place is washed with water, and the battery is removed, wiped, and dried. Sealed surfaces are repaired with resin or a special glue based on plastic.

Lead on the poles and terminals of the battery oxidizes over time. Lead oxide is an insulator and can be identified by its dark gray or black color. The only effective way to remove it is with a special scraper for battery terminals and terminals or a wire brush, which removes the oxides and restores the lead to a bright silver color. Once the terminal

is reinstalled and tightened, the terminals are coated with a battery oxidation inhibitor to slow down the oxidation process.

To clean the battery terminals and terminals, follow these steps:

1. Removal of salt deposits: Prepare a mixture of baking soda and lukewarm water. Lightly pour the mixture over the salt deposits. Thoroughly clean poles and terminals, and cover the battery with a brush. After cleaning, wash with water. Remove the battery from the vehicle, wipe and dry it. Renovate the sealing surfaces around the poles of the battery with resin or special glue.

2. Cleaning of corrosion from poles and terminals: Use a special brush with an external scraper to clean the corrosion on the terminals. Use a brush with an internal scraper to clean the poles of the battery. After installing the battery and connecting the terminals, apply a means to protect the lead parts from corrosion.

Text 6. Jump-starting the Vehicle

Source: https://autoedu.info/en/auto-electric/battery/jump-starting-the-vehicle/

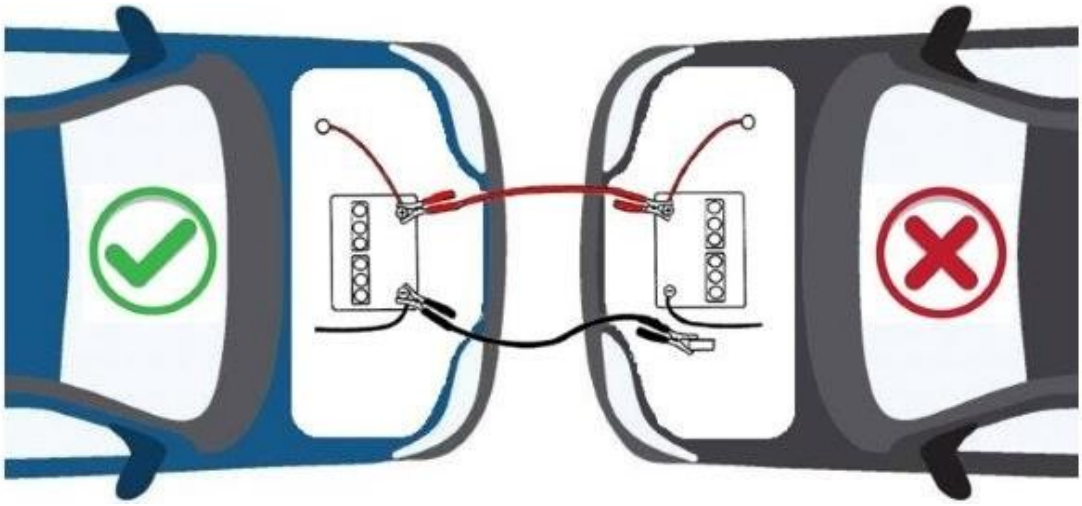
Jump-start is the process when a vehicle with a good battery is used to start the vehicle with a discharged or 'dead' battery. Since starting the engine requires a large amount of electricity, the started vehicle can put a load on both vehicles. When the engine is started, the discharged battery has a low voltage. This causes the alternator on the utility vehicle to be under heavy load and to send maximum charging current. But as soon as the start is complete, the voltage spikes and is potentially high enough to damage electronic components in both vehicles. The same voltage spike can occur when jumper cables are disconnected.

Another risk is overheating and damaging the alternator on a started vehicle. Due to the increasing number of electrical devices on vehicles, today's alternators are more powerful. However, a discharged battery can push the alternator into a dangerous operating zone. Due to the risk of damaging the electronics and alternator, many vehicle manufacturers do not allow jump-starting. They now recommend secondary charging the battery or replacing it with a charged one.

If you decide to jump-start the vehicle, always read the owner's manual for both vehicles and follow their starting instructions. Never attempt to jump-start a frozen battery. It is usually best to allow 5 to 10 minutes for the frozen battery from the other vehicle to charge after connecting before attempting to start the vehicle. Once the dead vehicle's engine starts, let both vehicles idle for a while. Do not switch off the vehicle with a discharged battery, as it takes a long time to recharge. Before removing the jumper cables, it is advisable to switch on additional consumers, for example, headlights, on both vehicles to protect the alternator. This allows any sudden increase in voltage due to a sudden decrease in alternator load to be absorbed. Another method to reduce the risk of damaging sensitive electronic devices is to use jumper cables with built-in surge protection.

Another less risky way does not to use another vehicle to start, but the starter. The starter does not involve the vehicle's charging system and reduces the risk of voltage spikes. This device contains a relatively large capacity battery, short connection cables, and spring clamps for direct connection to a weak battery. It provides a significant additional increase in electrical energy to start the engine.

When connecting jumper cables, there is almost always a spark on the last connection you make. That's why it's to make the final connection on the engine block away from the battery and other flammable items. The spark also occurs when you disconnect the first connection, so it should be at the engine block. Also, do not connect the negative cable to the body or chassis because the ground wire from the body to the negative battery terminal is usually of small gauge and weak to carry the current needed to start the engine.



Jump-Starting

Alternators are generally not designed to charge a fully discharged battery while powering a few additional devices. It is preferable to refresh the battery a little with a charger before starting the engine. That way, the alternator won't have to struggle as much. It takes only 15 minutes to burn up an alternator when charging a dead battery. And if you must drive the vehicle after starting it, turn off as many accessories as possible, which will lessen the load on the alternator.

To perform jump-start the vehicle, follow these steps:

1. Jump-Starting the battery: Place the starter or auxiliary vehicle battery as close as possible to the empty battery within reach of the jumper cables. Make sure that the vehicles do not touch each other. First, connect the short-circuit cable to the positive terminal of the discharged battery, and then the other end of the cable to the positive terminal of the auxiliary (starter or vehicle). Connect the second jumper cable to the minus terminal of the auxiliary battery (starter or vehicle), and the other end to the engine block as far as possible from the empty battery.

2. Engine start: Try starting the engine with an empty battery. If the full battery does not have enough power or the jumper cables are small, start the engine of the utility vehicle and let the discharged battery partially charge for a few minutes. Turn on the headlights on the support vehicle to reduce the voltage damaging the electronic equipment and try to restart the engine.

3. Disconnecting the auxiliary vehicle's battery: When the engine has started, let both vehicles idle for a while. Disconnect the cables in the reverse order of connection. If the starting vehicle's charging system is working properly and the battery is in good condition, the battery will recharge while the engine is running, otherwise, it may overheat and damage the alternator.

Text 7. Battery Charging

Source: https://autoedu.info/en/auto-electric/battery/battery-charging/

When the battery is determined to be empty, charging can be done on or off the vehicle. Workshop chargers are for charging batteries.

A battery is used only to start the engine and power the electrical equipment when the engine is not running. While the engine is running, the battery is charged by the alternator. The alternator ensures the battery is always charged and ready to restart the engine. However, batteries can become discharged and require charging, especially if the vehicle has been stationary for more than a few weeks or if the charging system is faulty. Also, before testing the battery, it is preferable to charge it. Before charging, it is necessary to de-

termine the speed (time) of charging the battery. But you should know that slow charging is less stressful for the battery than fast charging.

The battery is usually removed from the vehicle when charging is required. If we want to charge the battery on the vehicle, the negative terminal is removed to reduce the risk to the vehicle's electronics. When the battery terminals and poles are badly corroded, you may need to clean them before charging.

The charging mode (slow or fast) or by selecting the initial charging current is set on the rectifier. It is best to charge the battery more slowly, with a twenty-hour charging current. We divide the battery capacity by 20 and get the charging current (e.g., 60 Ah: 20 h = 3 A).

Professional automatic chargers are used in services. They are safe for fast, ten-hour battery charging. With such chargers, the battery capacity or the calculated 10-hour charging current is set (e.g., 60 Ah: 10 h = 6 A). These chargers automatically reduce the charging current with an increase in voltage, thus protecting the battery from overheating and the appearance of gases due to the boiling of the electrolyte.

It is recommended to clean the poles, cable clamps, and housing after charging the battery.

To charge the battery, follow these steps:

1. Preparation for charging: Make sure that the battery has not been frozen. If necessary, connect an external power supply to save the memory. To charge the vehicle, disconnect the negative terminal. To charge outside the vehicle, disconnect the battery. Check that the charger is switched off. Connect the red cable of the charger to the plus pole, and the black to the minus pole of the battery.

2. Battery charging: Calculate the ideal and maximum charging current. Set the charging current or battery capacity on the charger and start charging. During charging, monitor the charging voltage and battery condition.

3. Battery condition check: After the battery is charged, turn off the charger. Clean and connect the battery to the vehicle. Remove the surface charge by turning on the headlights for three to five minutes. Use a conductivity tester, load tester, multimeter, refractometer, or hydrometer to test the state of charge and battery capacity.

Text 8. Battery Voltage Test

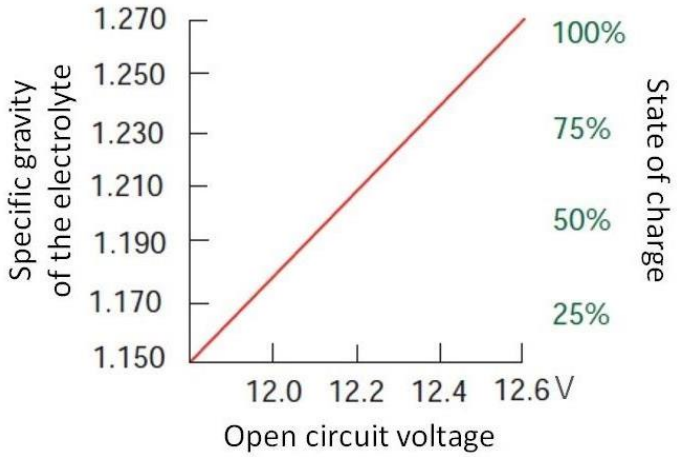
Source: https://autoedu.info/en/auto-electric/battery/battery-voltage-test/

A battery voltage test is a quick and relatively accurate indication of the state of charge in an open circuit. A digital multimeter is used for voltage measurement. The test is applied to sealed accumulators without maintenance and a built-in hydrometer, as a substitute for testing the electrolyte density.

Depending on the degree of charge, the battery voltage changes. The battery temperature should be between 15°C and 38°C. Before measuring, the battery should stabilize for at least 10 minutes, without load. On vehicles, with high discharges (control units, clocks, and accessories that always consume a small amount of current) it may be necessary to disconnect the minus terminal from the battery. If the battery has recently been charged, remove the surface charge by turning on the headlights for three to five minutes.

When the voltage stabilizes, measure the battery voltage with a digital voltmeter. A fully charged battery should have a voltage of 12.6 V or more. A measured voltage of 12.4 V indicates a charge of about 75%, and 12.0 V indicates that the battery is empty.

If the test shows that the charge is below 75%, charge the battery and perform a capacitance test to determine its condition.



The relationship between open circuit voltage and specific gravity/state of charge of a battery

To perform a battery voltage test, follow these steps:

1. Preparation for measurement: Check the battery temperature. If recently charged, remove the surface charge by turning on the headlights for three to five minutes. Remove the minus terminal and let the battery voltage stabilize for 10 minutes.

2. Voltage measurement: Use a digital multimeter to measure the battery voltage between its poles.

3. Measurement analysis: Based on the measured voltage, estimate the charge level of the battery from the graph. If the charge is below 75%, charge the battery, remove the surface charge and perform the charge test again.

Text 9. Hydrometer Testing

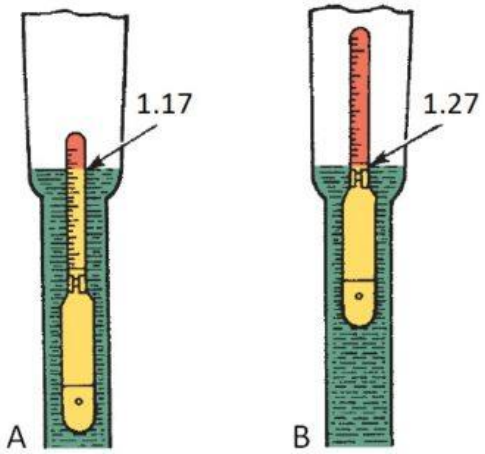
Source: https://autoedu.info/en/auto-electric/battery/hydrometer-testing/

Measuring the gravity of the electrolyte with a hydrometer is a method for determining the charge level and condition of the battery. The degree of battery charge depends on the specific gravity. The electrolyte of a fully charged battery consists of about 64% water and 36% sulfuric acid. It corresponds to a specific gravity of 1,270 kg/l. As the battery discharges, the specific gravity decreases. By measuring the specific gravity of the electrolyte, we can determine the degree of battery charge. We use a hydrometer to measure the specific gravity of the electrolyte in the battery.

A classic battery hydrometer uses a glass float (hydrometer) in a glass tube to measure the specific gravity of the electrolyte. Squeezing and releasing the rubber ball draws the electrolyte into the hydrometer tube. When filled with test electrolyte, the float floats in the electrolyte. The depth to which the float sinks in the electrolyte indicates its relative weight to water. The value on the float scale in the electrolyte level is gravity. If the hydrometer floats deeply in the electrolyte, the specific gravity is low (A). If the hydrometer floats high in the electrolyte, the specific gravity is high (B).

Measurements are only possible on batteries that are not sealed and have openings above each cell. These measurements give a good indication of the condition of the battery. Hydrometer readings should not vary by more than a 0.05 kg/l difference between cells. A larger deviation is an indication that the battery is defective.

Since temperature affects the specific gravity of the matter, the reading should be corrected by ±0.004 for every ±10°C above or below 27°C. Most hydrometers have a built-in thermometer to measure the temperature of the electrolyte. The hydrometer reading may be incorrect if not corrected.



Electrolyte gravity measurement

When the gravity of the electrolyte falls below 1,230 kg/l, it is necessary to charge the battery.

To perform gravity of the electrolyte measurement with a hydrometer, follow these steps:

1. Preparation for measurement: Clean the upper housing of the battery. Blow out and dry the area around the lid. Remove the battery cover and check the electrolyte level in the battery cells. If necessary, top up the cells with distilled water. If water is added, charge the battery before any testing.

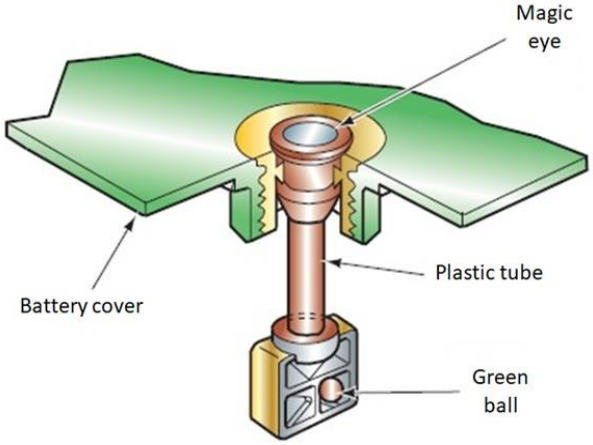
2. Gravity measurement with a hydrometer: Immerse the hose in the electrolyte of the first cell. Squeeze and release the rubber ball. Read the gravity of the electrolyte on the float of the hydrometer. Record the measurement result. Repeat the measurement procedure for all battery cells.

3. Measurement analysis: Compare the measured values of electrolyte gravity. When the difference between the cells is greater than 0.05 kg/l, then the battery is defective. If all the gravities are approximately equal, take the mean value and determine the state of charge of a battery. Determine further actions.

Text 10. Built-in Hydrometers

Source: https://autoedu.info/en/auto-electric/battery/built-in-hydrometers/

On some maintenance-free batteries, it is possible to measure the gravity of the electrolyte with a built-in hydrometer. There is a temperature compensated hydrometer on top of the battery housing. The built-in hydrometer visually shows the charge status of the battery. The battery should have a clean cover to see the correct indications on the built-in hydrometer. In low light, it is necessary to illuminate the hydrometer. Always look straight down when looking at the hydrometer.

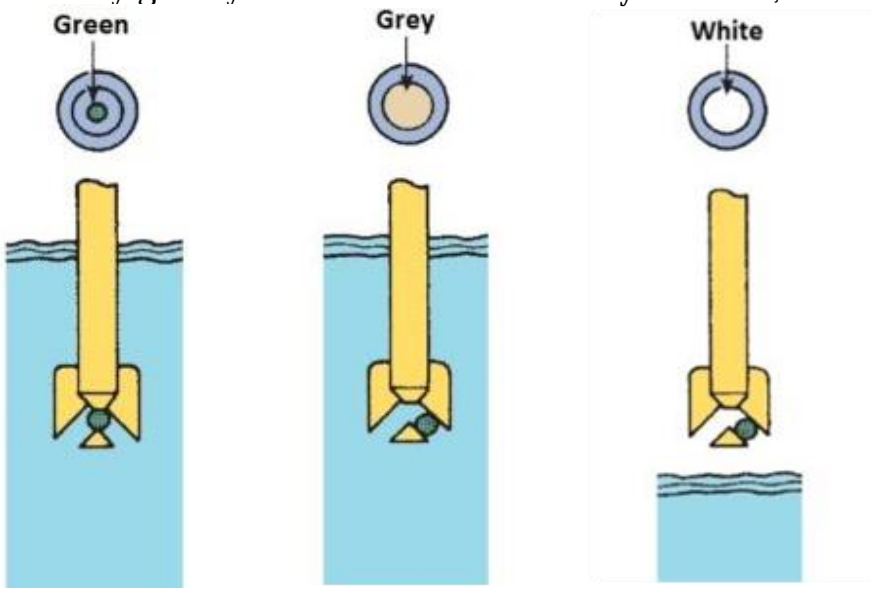


Built-in hydrometer on the battery cover – a magic eye

Built-in hydrometers use a color display to determine battery status. Green means ‘OK’, Grey/black means ‘Battery needs charging’, and White means ‘low electrolyte’.

The disadvantage of this reading is that the built-in hydrometer monitors the state of only one battery cell. If the condition worsens in another cell, we cannot see it through this hydrometer. There is a case where the battery is dead because one cell has died, and the hydrometer shows that the battery is good.

To perform a battery gravity check with the built-in hydrometer, follow these steps:



1. Green: The battery is sufficiently charged. The battery charge is from 65% to 100%.
2. Grey/black: The battery needs to be recharged. The battery charge is less than 65%.
3. White: Low electrolyte level. It is necessary to add water and charge the battery.

Text 11. Battery Load Test

Source: https://autoedu.info/en/auto-electric/battery/battery-load-test/

A battery load test determines how well the battery performs under load. The test determines the battery’s ability to deliver starting current and maintain sufficient voltage to operate other systems. In other words, if the battery can sustain a high discharge for some time and the voltage is still relatively high, then you know the battery has good capacity and is in good condition. If the voltage drops quite quickly, the battery capacity is low.

The battery load tester serves to carry out the load test. It contains an ammeter, a voltmeter, and a high-power variable resistor. Depending on the strength of the battery, the amount of load for testing is determined. The tester draws current from the battery through the resistor. An ammeter measures the amount of current drawn. The maximum draw current and battery voltage drop define the battery state.

Battery load tester

There are several prerequisites for the battery test. The battery electrolyte should be at room temperature, between 21°C and 27°C. A cold battery shows a significantly lower capacity. Never test a sealed battery if its temperature is below 15°C. A load test is performed only on a fully charged battery.

When testing the battery load, use the following test parameters:

– Test load = half of the starting current of the battery.

– Loading test time = 15 seconds.

– Results: Pass = 9.6V or greater; Error = less than 9.6V.

If the battery fails the load test, another test is required before a final judgment is made on the battery. Charge the battery with a 20-hour charging current and repeat the load test. If the test results are still weak, the battery is sulfated and must be replaced with a new battery. If it passes the retest, test the vehicle's charging system to see if it is properly charging the battery.

Some manufacturers emphasize that their batteries should not be load tested, but instead tested for conductivity. They claim that load testing can damage the battery. Therefore, always check the service information for a given battery before performing a load test.

To perform a battery load test, follow these steps:

1. Connecting testers: Use an infrared temperature gun to measure the temperature on the side of the battery and check that it is within the test parameters. Connect the red clip to the plus pole of the battery and the black to the minus pole.

2. Testing: If using an automatic load tester, enter the starting battery current. When using a handheld load tester, calculate the load, which is usually half the starting current (e.g., 700A/2 = 350A – test current), and set the load.

3. Results analysis: Test for 15 seconds. Read the test voltage on the voltmeter and immediately turn off the tester. If after 15 seconds the test voltage is 9.6V or higher, the battery is good. When the test voltage is less than 9.6V, charge the battery and repeat the load test. If the voltage is lower than 9.6V again, the battery is faulty. However, if the repeated test voltage is higher than 9.6V, check the power supply system.

Text 12. Battery Conductance Test

Source: https://autoedu.info/en/auto-electric/battery/battery-conductance-test/

A battery conductance test is a process of checking the capacity and accurately determining its current state. Conductivity testers measure battery capacity. Before testing, check whether the battery is suitable according to the specification for the given vehicle. Look for information in the manual about the required characteristics of the battery for the given vehicle. Using a battery with too low a capacity will overload the battery itself and the starting system. Using a battery with a larger capacity is heavier and puts more strain on the carrier. Also, it puts more stress on the charging system. Therefore, always check whether the correct battery is used for the given vehicle.

After verifying the battery, proceed to test. Electronic testers have replaced the need for a hydrometer and other invasive types of battery testing. Many manufacturers now require the use of a conductivity test instead of a load test to be considered for warranty coverage. Almost all conductivity testers have an integrated printer, and test printouts can follow the warranty. A conductance tester sends low-frequency signals into the battery to determine its ability to conduct current. A higher capacity battery has a higher current carrying capacity. As the battery deteriorates over time, its capacity also decreases. The tester can measure the battery's capacity by measuring its conductivity, which allows for an almost linear comparison of these two parameters. Dirty battery terminals can affect conductivity and measurement accuracy. It may therefore be necessary to clean the terminals and poles before testing.

Since the conductance test only takes a minute or two, it's an opportunity to show customers the health of their battery. During each regular vehicle inspection, the client can see how the condition of the battery deteriorates over time. Once the conductivity test

shows that the battery is bad, the customer will have confidence that the battery is at the end of its useful life and must be replaced.

To perform a battery conductance test, follow these steps:

1. Preparation for measurement: If necessary, clean the terminals and poles of the battery from corrosion. If feasible, check the electrolyte level in the cells. If necessary, before testing, top up the cells and connect the battery to the charger.

2. Conductance test: Connect the red clip to the plus and the black to the minus pole of the battery. Set the type and type of tested battery on the tester. Start testing. At the end of the test, print the measurement results.

3. Results analysis: Based on the test results, determine the condition, that is, the current capacity of the battery.

Text 13. Saving Memory After Battery Removal

Source: https://autoedu.info/en/auto-electric/battery/saving-memory-after-battery-removal/

With some electronic devices on vehicles, it is necessary to save memory after removing the battery. When they are without power, such electronic devices lose their stored data.

Electronic modules in vehicles, such as radio and driver settings, require a small amount of energy to store their memory (KAM). When removing the battery, the memory of certain electronic systems is lost. For some electronic systems, memory loss can be problematic. The electronic control unit can lose its adaptive learning data, meaning it will need to recollect this information throughout driving which can take several days. For other systems, such as the security system, memory loss can prevent the vehicle from restarting or using the radio.

Check manufacturer and owner information to determine which systems will be affected by the power loss. You must identify each system that requires restarting security or initialization codes and ensure that procedures and equipment are available to reinitialize the system or module. In case of loss of codes, they can be requested by contacting sellers or manufacturers to reactivate the vehicle's system.

External sources of 12-volt DC power can save the memory of electronic devices after removing the battery. The external source is connected via the diagnostic socket with the appropriate cable.

External power supply via diagnostic socket

External power supply via the cigarette lighter

If the cigarette lighter socket is always on, an external power supply can be connected via the cigarette lighter to save memory.

When the external memory storage power source is connected, still be careful when working on the vehicle to avoid shorting.

To connect the external power supply to save memory after removing the battery, follow these steps:

1. Identifying critical modules: In the appropriate service information or owner's manual, identify the electronic modules that require re-initialization or code entry when the battery is disconnected. Check if there are any recommendations on how to connect the external power supply.

2. Connecting the external power supply: Use a suitable external power supply and connection method to save the memory. Connect the external power supply using the appropriate connector to the diagnostic socket or the cigarette lighter. After connecting and turning on the external power supply, remove the battery from the vehicle.

3. Checking after battery installation: After installing and connecting the battery, turn off and disconnect the external power supply. Check all electronic systems on the vehicle (radio, error lights, etc.). In the event of a memory loss, use the correct codes to reactivate the modules as needed.

Text 14. Measuring Parasitic Draw

Source: https://autoedu.info/en/auto-electric/battery/measuring-parasitic-draw/

Finding hidden consumers is done when there is increased consumption from the battery when the vehicle is at rest. Modern vehicles, after shutdown, still draw a small amount of current for memory maintenance (KAM) or the operation of some safety systems. For example, a vehicle's anti-theft system draws relatively little current, as excessive draw can quickly drain the battery. Professionally, this rest consumption is also called a parasitic draw.

The additional current draw does not have to immediately drop to the lowest level when the engine is not running. Typically, when the key is off, the vehicle's engine stops, and the vehicle's systems begin to shut down and enter a 'sleep' mode. On-board systems turn off at different rates. For example, on some vehicles, it takes several hours before the rear system goes to sleep and the additional current draw reaches its minimum value. Look in the manufacturer's service data for the maximum allowed current draw and the time required for the module to sleep after turning off the ignition.

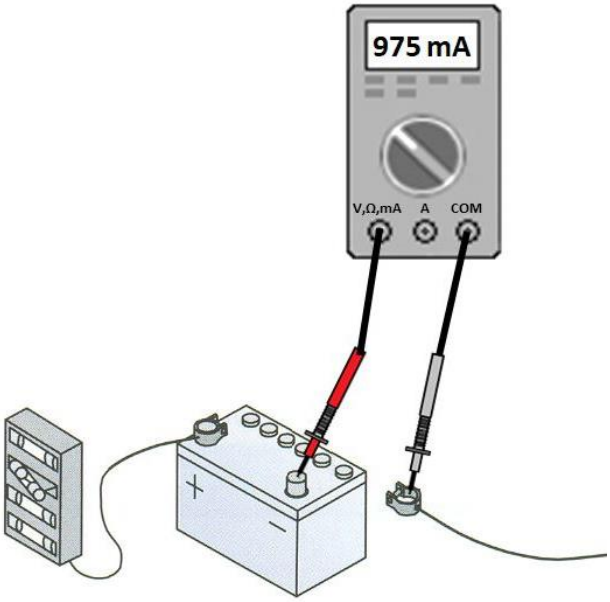
While the vehicle is stationary, the permitted current draw is minimal and cannot drain the battery. However, when the battery discharges while the vehicle is stationary, without sulfation or leakage on the battery, we have the appearance of a parasitic draw. A parasitic draw a lot of currents and can completely drain the battery while the vehicle is stationary. If we suspect that the cause of battery discharge is a parasitic draw, we proceed to check and reveal the location of the fault on the vehicle's electrical network.

Finding parasitic draws can be done in several ways, and one of the methods is to use an ammeter that can measure milliamps. Remove the minus terminal from the battery. The ammeter is connected in series between the minus pole of the battery and the minus terminal. The ammeter will show the value of the withdrawal current of the hidden consumer. By removing the fuse one by one, we disconnect individual electrical systems.

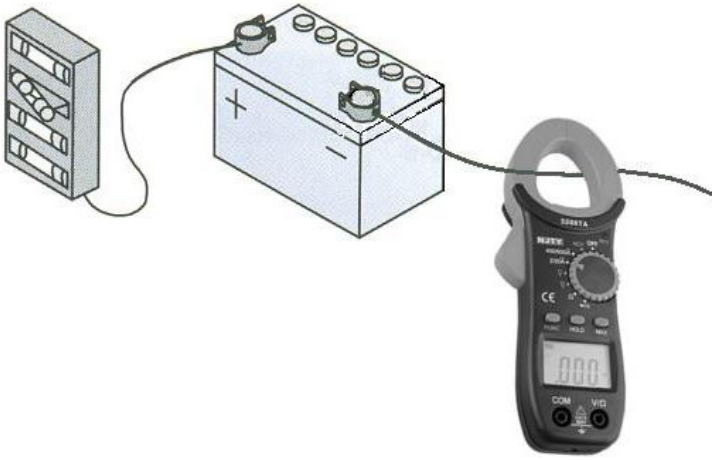
When, by removing one of those fuses, the current value on the ammeter drops, we have located the part of the electrical installation where the parasitic draw is located. Once again, we check by turning that fuse on and off to determine the accuracy of the search.

After we have localized part of the installation, we proceed to a detailed search of the entire network until we find the parasitic draw. The search includes all electrical devices, conductors, and connectors.

When the excessive current draw does not go away after removing all the fuses, suspect an unfused circuit such as the diodes and alternator regulator, the ignition system on some vehicles, or the control module power lines.



Measuring parasitic draw with an ammeter



Measuring parasitic draw with current clamps

An easier and faster way to find parasitic draws is to use current clamps to measure small currents. With current clamps, we grasp all the conductors from the minus terminal of the battery and measure the draw current without disconnecting the battery. The search procedure is the same as with the fuse removal.

An ohmmeter is set to measure small resistance values. First, zeroing the ohmmeter is done by short-circuiting the measuring pipettes. If a non-zero value is displayed on the screen, remember it as an error. Then the black pipette is placed on the negative pole of the battery, and the red one first on the unpainted surface of the alternator housing. Read the value on the ohmmeter and subtract the error (if any). Then, the red pipette is placed on the ground of the vehicle (chassis) and the resistance is read with the error subtracted.

Up to a value of 0.3 Ω with a multimeter with a 10 MΩ impedance or up to 0.6 Ω with a 20 MΩ impedance corresponds to a current draw of 35 mA. Any reading above these indicates the existence of a parasitic draw. If the resistance is too high, by removing the fuse one by one, we monitor the moment the resistance drops. If the resistance does not decrease after removing all the fuses, suspect an uncontrolled circuit, such as diodes and the alternator regulator or ignition circuit.

To find parasitic draw with current clamps, follow these steps:

1. Preparation for measurement: Remove the minus terminal from the battery. Set the multimeter to measure DC in mA. Connect the test leads to the corresponding terminals of the multimeter.

2. Measurement: Connect the plus pipet to the minus pole of the battery. Connect the minus pipette to the minus terminal. Read the current value. If the current draw is high, disconnect the fuses in turn.

3. Locating the parasitic draw: If the measuring current decreases by removing the fuse, examine all the electrical components and devices of that circuit until the parasitic draw is located. When the measuring current has not decreased even after removing all the fuses, examine the diodes and regulator of the alternator and other uninsured electric circuits.

Text 15. Alternator Removal

Source: https://autoedu.info/en/auto-electric/alternator/alternator-removal/

Removing the alternator from the vehicle is necessary when a mechanical or electrical malfunction is found that requires repair or replacement of the alternator. By electrical malfunctions, we mean that the alternator is not charging, insufficient or excessive charging voltage. Mechanical malfunctions include faulty bearings or other internal or external damage.

Be careful when removing the alternator because the battery voltage is always present at the alternator output terminals, and a strong spark may occur due to a short circuit to the ground. That's why the minus terminal from the battery is removed first before removing the alternator. Then disconnect all electrical connections from the alternator.

Loosen the main bearing bolt that secures the alternator to the engine and remove the drive belt tensioning bolts. Moving the alternator toward the engine loosens and separates the drive belt from the pulley. On an alternator without a tension bolt, a lever is used to release the tensioner to loosen and separate the belt from the pulley.

After separating the drive belt, while holding the alternator unscrew the supporting screws all the way and remove the alternator from the engine.

To perform the removal of the alternator from the vehicle, follow these steps:

1. Disconnecting the electrical connections: Disconnect the minus terminal from the battery. Disconnect all electrical connections from the alternator.

2. Removing the drive belt: In the alternator with tension screw, loosen the main support screw. Remove the tension screw. Move the alternator towards the engine and remove the belt from the pulley. If the alternator is without tensioning screw, use the lever to release the tensioner and remove the belt from the alternator pulley.

3. The alternator removal: Unscrew all the screws holding the alternator. Remove the alternator from the vehicle.

Text 16. Alternator Disassembly

Source: https://autoedu.info/en/auto-electric/alternator/alternator-disassembly/

After removal from the vehicle for repair, the alternator is disassembled. A faulty alternator can be the result of many different internal problems. Diodes, stator windings, and rotor windings may be open, shorted, or improperly grounded. Brushes or slip rings may wear out. The voltage regulator may be faulty. The rotor shaft can be bent, the bearings worn, and the pulley can be loose or warped.

For examination, repair, and replacement of alternator elements, it is necessary to disassemble them. Follow the operating instructions for the given alternator during disassembly, testing, and replacement parts.

Disassembled alternator

Depending on the type of alternator, the sequence of actions during disassembly may differ. Here the most common disassembly procedure is described. Before disassembly, mark the housing parts with a marker or chalk to ensure proper assembly of the alternator.

Remove the voltage regulator with brushes. By unscrewing the screws, remove the screws that connect the alternator covers. Separate the rear part of the alternator cover by gently hitting it with a rubber mallet. If extraction is more difficult due to the bearing, a 2 or 3 yaws puller is used. Carefully separate the front part of the cover with the pulley and the rotor from the stator. During separation, be careful not to damage the stator and rotor windings.

Grip the rotor with a bench vice and remove the pulley with a suitable tool. Then the cover is removed from the rotor shaft. Remove the rotor from the stator by tapping the rotor shaft with a rubber mallet. When you take it out of the cover, the rotor falls, so put a cloth under it in advance.

Depending on the construction of the alternator, the diode plate eventually separates.

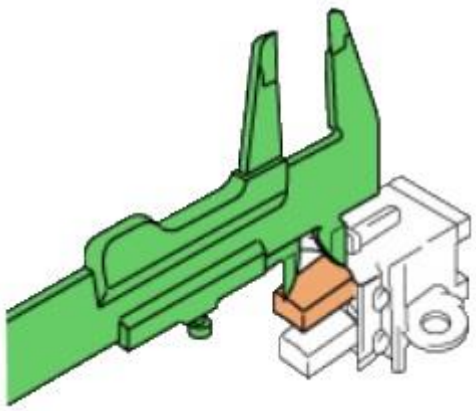
Text 17. Checking and Replacing Alternator Brushes

Source: https://autoedu.info/en/auto-electric/alternator/checking-and-replacing-alternator-brushes/

Checking and replacing the brushes is a regular process after dismantling the alternator or voltage regulator and when there are problems in the charging system. Brushes through the sliding rings and transmits power supply to the rotor windings. Power supply to the rotor windings and operation of the alternator depends on correct brushes. In the case of brushes, it is important that they have sufficient length, that the springs push them with a certain force, and that they slide easily in their holders.

After removing the brush holder from the alternator, a visual inspection of the condition is performed. The brushes should be of equal length, the correct shape, and the holder should be undamaged and clean.

Bad brushes can damage the slip rings. Short brushes make weak contact with the sliding rings because the springs cannot press them with the necessary force. There is a high voltage drop and a weaker power supply to the rotor windings. The length of the brush is measured with a vernier caliper. The brush is correct as long as its length is 5 mm above the upper edge of the brush holder. If the brush is damaged or worn, they are replaced in pairs according to the specification for that alternator.



Measuring brush length

There are various types of spring brushes. They can be in the form of a spiral or push rod. Some are part of the holder, separate or delivered together with the brushes. Their condition and thrust are checked. Defective springs are replaced because they do not perform their function of pushing the brushes.

If the brush head, check the condition of the holder, that is, the guide. If necessary, the holder is cleaned or replaced. If the brush after replacing the head, it is necessary to check the diameter of the brush body and possible sanding of the sides. The brush holders must be well insulated from the ground and have a good electrical connection with the brushes. Their electrical condition is checked with a multimeter.

To check and replace the alternator brushes, follow these steps:

1. Checking and replacing brushes: Perform a visual inspection of the condition of the brushes. Replace damaged or too short brushes with new ones. Measure the length of

the brush with a vernier caliper. If the brush is below the required minimum length, replace both with new ones.

2. Removing the drive belt: Check the condition of the brush spring (length, color, etc.). Check the spring pressure. Replace defective springs with new ones.

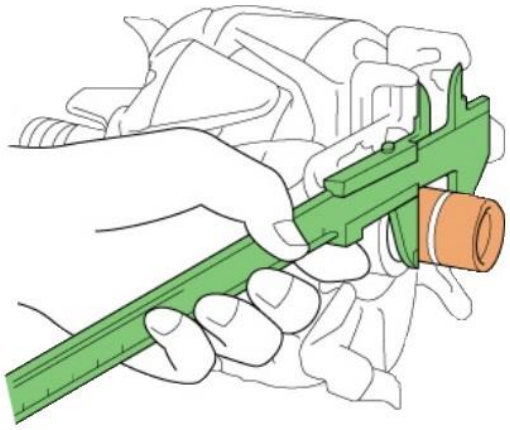
3. Brush holder control: Inspect the holder for cracks, damage, and dirt. Replace damaged supports with new ones. Clean the carrier. Use an ohmmeter to check the electrical connection between the power supply on the holder and the brush. If transient resistance is observed, locate the bad connection and eliminate the malfunction.

Text 18. Slip Ring Inspection

Source: https://autoedu.info/en/auto-electric/alternator/slip-ring-inspection/

Slip ring inspection is always performed when disassembling the alternator or when there is a malfunction in the power supply system. As the rotor rotates, the brushes touch the slip rings, ensuring the transmission of electrical energy to the rotor windings. Sparking and graphite dust lead to the burning of the ring. Dirt and burnt surfaces of the rings interfere with the flow of electricity and the operation of the alternator.

The surface of the sliding rings must be smooth, clean, and without burn marks. If rings are dirty and greasy, clean them up with a soft cloth and degreasing agent. When there are visible traces of burning on the surface due to sparking, the surface of the rings should be sanded with fine sandpaper that does not leave deep scratches. If the traces of damage on the surface of the rings are deeper so that repair is not possible, it is necessary to replace the rotor.



Measuring the diameter of slip rings

During the operation of the alternator, the slip rings wear out. When the rings are worn out too much, the brushes barely touch the surface of the rings, which leads to instability in the operation of the alternator. The degree of wear is determined by measuring the outer diameter of the rings. When the diameter of the ring is below the minimum allowed value, the rotor is changed. The vernier caliper is used to measure the diameter of the ring, and the minimum diameter is read from the service manual for the alternator.

To inspect the slip rings of the alternator rotor, follow these steps:

1. Surface control: Perform a visual inspection of the condition of the surface of the sliding rings for dirt, grease, burning, and damage. Clean the greased surface with a suitable agent. In case of noticeable damage and burning, wipe the surface with a fine cloth and sand with fine sandpaper. In case of damage, replace the rotor.

2. Diameter measurement: Measure the diameter of the sliding rings with a vernier caliper. If the diameter is below the minimum allowable value, replace the rotor.

Text 19. Alternator Rotor Testing

Source: https://autoedu.info/en/auto-electric/alternator/alternator-rotor-testing/

Testing the alternator rotor involves a visual inspection of the condition and an electrical check of the correctness of the rotor windings.

Alternator rotor

First, a visual inspection of the condition of the rotor is performed. The rotor windings are carefully inspected for discoloration, overheating, or burning. If these changes are noticed, the rotor is not good. If there are scratches on the outer surface of the rotor jaws, it means that the rotor is touching the inside of the stator during rotation. The cause may be worn bearings or a bent rotor shaft. The condition of the sliding rings is also carefully inspected. They should be smooth, clean, and undamaged.

When the rotor passes the visual inspection, the electrical testing of the windings continues. A multimeter or an ohmmeter is used to measure the coil resistance. Typical winding faults can be open-circuit, short-circuit, or short-to-ground.

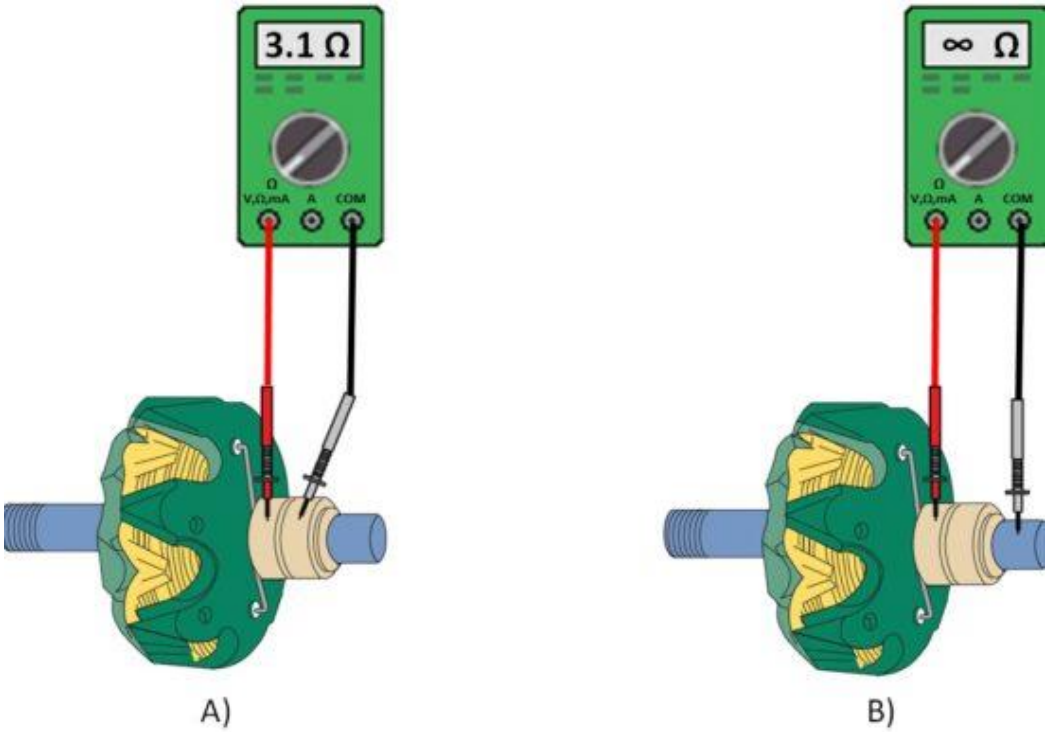
The rotor winding resistance is measured between the slip rings (A). The correct, expected rotor winding resistance value is read from the information system for a given alternator. If the data is not available, typical values of 2.4-3.5 Ω or 3-6 Ω depending on the type are used.

When the measured resistance is within the specified values, the rotor is correct.

If the measured resistance is infinite, the winding is faulty and the rotor needs to be replaced.

If the resistance is less than the minimum required value, there is a short circuit and the rotor is faulty. In this case, the rotor draws more current, creates a strong magnetic field, and the alternator overheats.

If a higher-than-expected resistance is measured, there is a transient resistance due to poor solder or corrosion. Cleaning or soldering the joint can often eliminate this irregularity. Otherwise, the rotor is defective and needs to be replaced.



Testing windings for open-circuit, short-circuit (A), and short-to-ground (B)

The windings must be well insulated from the ground, that is, the housing and rotor shaft. When the insulation of the winding is damaged, windings are short-to-ground. The test is performed when one measuring pipette of the ohmmeter is placed on the slip ring and the other on the rotor shaft (B). With a correct rotor, the value of mass resistance is infinite. Any other resistance reading means that there has been an insulation breakdown to the ground, and the rotor needs to be replaced.

To perform an alternator rotor winding test, follow these steps:

1. Visual inspection: Perform a visual inspection of the condition of the rotor windings, claws pole surface, slip rings, and shaft. If there is a noticeable color change, overheating, or burning of the coil, replace the rotor. In case of noticeable defects on the surface of the jaws or sliding rings, perform a further inspection according to the procedure. If the shaft is bent, replace the rotor.

2. Testing windings for open-circuit and short-circuit: Read the required resistance value of the rotor winding from the information system. Set the resistance measurement on the multimeter. Connect the measuring pipettes to the sliding rings. If the resistance reading is infinite or lower than the required value, replace the rotor. If the resistance is higher, locate the cause of the transient resistance, eliminate the defect or replace the rotor.

3. Testing windings for short to ground: Place one measuring pipette of the ohmmeter on the sliding ring, and the second on the rotor shaft. The measured resistance should be infinite. If a resistance value is measured, the winding insulation has broken and the rotor needs to be replaced.

Text 20. Alternator Stator Testing

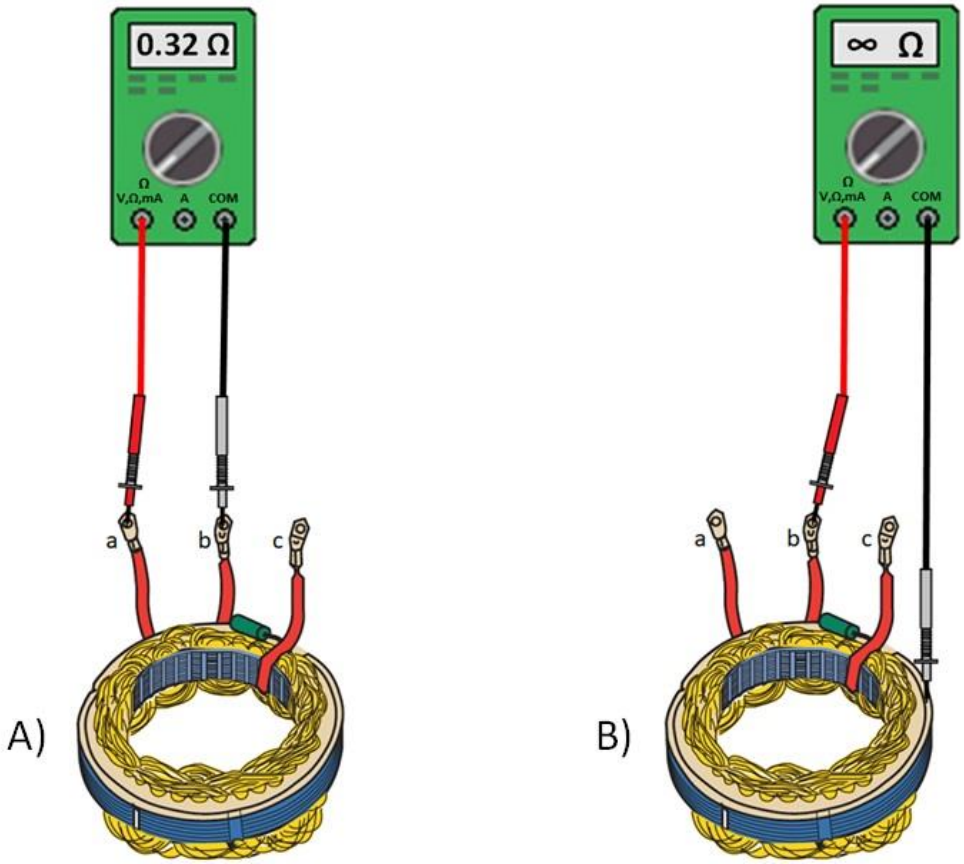
Source: https://autoedu.info/en/auto-electric/alternator/alternator-stator-testing/

Testing the correctness of the stator winding of the alternator is performed visually and by measuring the resistance. The visual inspection looks for changes in color or damage to the windings. Often due to excessive heat, parts of the winding insulation are deformed. A quick check of the condition of a suspicious part of the winding is to scrape the winding with a knife blade. If the varnish falls off, the winding insulation is damaged. In the same way, the connections on the stator are also checked. Any signs of damage indicate that the stator is faulty.

If the stator passes the visual inspection, it is approached testing of windings for open-circuit, and short to ground. The electrical check is done with an ohmmeter. As the stator has three windings connected in a star, there are three leads (a, b, and c). Resistance measurement is performed between two leads in each combination (a-b, a-c, and b-c). The measured coil resistance should be less than 0.5 Ω. If infinite resistance is measured between any two terminals, the winding is broken and the stator is replaced.

Alternator stator

An ohmmeter is connected between the stator housing and the winding terminal to test for a short-to-ground. With good winding insulation, the ohmmeter shows infinite resistance across all three windings. If at least one winding shows some resistance, the insulation of that winding has broken, it is short-to-ground and the stator is replaced.



Testing windings for open-circuit (A) and short-to-ground (B)

To perform an alternator stator winding test, follow these steps:

1. Visual inspection: Perform a visual inspection of the state of the stator winding and its insulation. In case of a noticeable color change, overheating, or burning of the winding, replace the stator. If in doubt about the condition of the insulation, scratch the insulation with a knife blade. If it falls off, the winding insulation is defective, and replace the stator.

2. Testing windings for open-circuit: Read the required stator winding resistance value from the information system. Set the resistance measurement on the multimeter. Connect the measuring pipettes between the two leads of the stator. Repeat the measurement two more times between each combination of leads. If at least one measurement shows infinite resistance, replace the stator.

3. Testing windings for short to ground: Place one measuring pipette of the ohmmeter on the stator housing, and the other on each output of the stator winding. The measured resistance should be infinite. If any resistance value is measured, the winding insulation has broken, and the stator needs to be replaced.

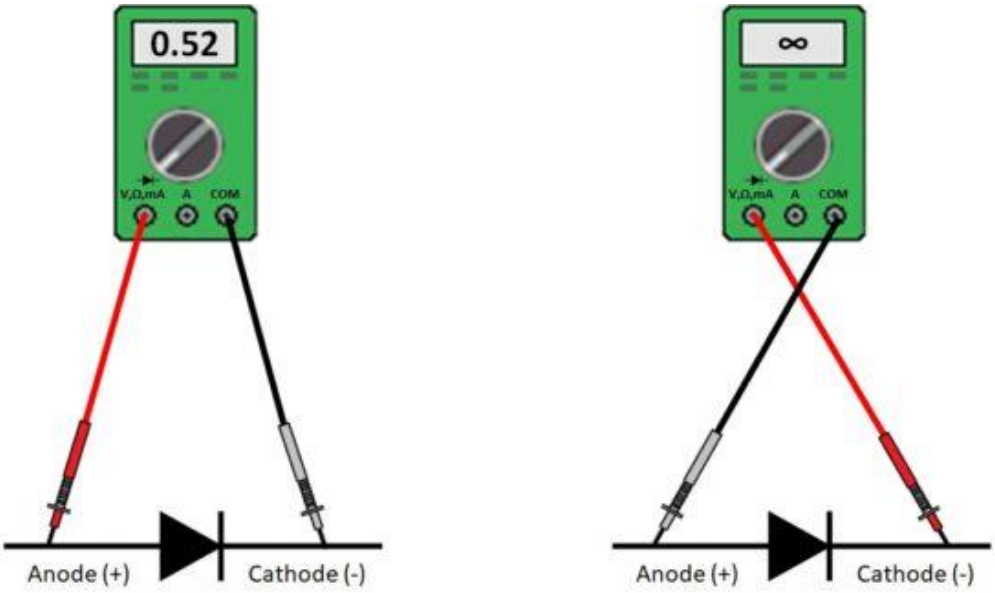
Text 21. Alternator Diode Testing

Source: https://autoedu.info/en/auto-electric/alternator/alternator-diode-testing/

An alternator diode testing is a procedure for checking the correctness of the elements on the diode board. The alternator is a generator of three-phase alternating voltage. As direct current is used on vehicles, diodes transform the generated alternating current into direct current. The proper operation of the vehicle's electrical power supply system depends on the correctness of the diodes.

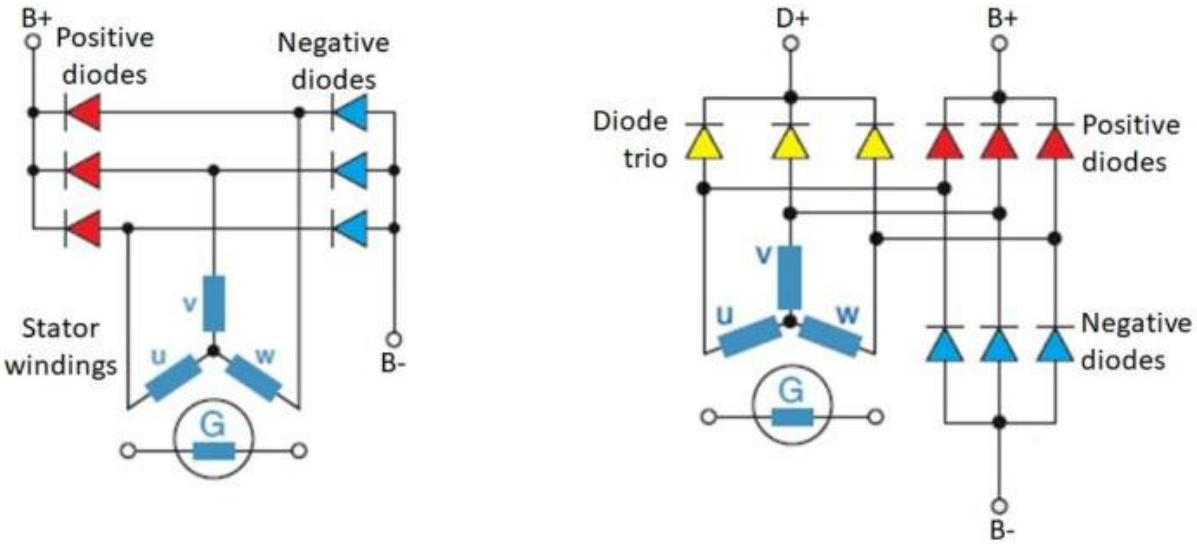
The test of diodes is reduced to checking their ability to pass current in only one direction. The measurement can be done with a multimeter.

Alternator diode plate



Diode test with a multimeter

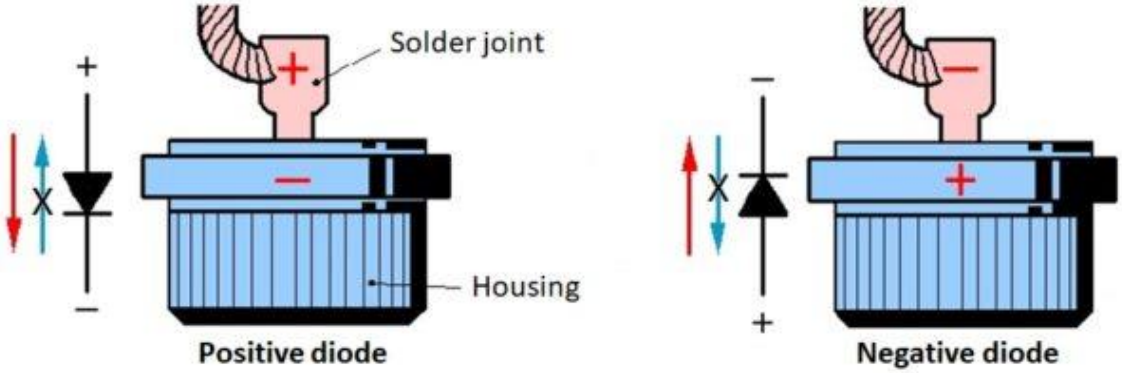
The diode check option is selected. If the multimeter doesn't have this option, then an ohmmeter is used. Measuring pipettes are connected to the diode ends. A correct diode conducts in one case, while in the other when the pipettes are replaced, it does not conduct. When the diode conducts in both directions, the diode is short-circuited, or when it does not conduct, it is open-circuit.



Alternator with 6 and 9 diodes

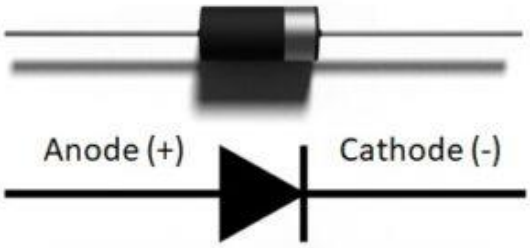
The diodes on the alternator are located on the diode board. Depending on the type, the alternator can have 6 (3 positive and 3 negative) or 9 (3 positive, 3 negative, and 3 exciting – diode trio) diodes.

The plus and minus diodes are the main ones, and the entire vehicle system is powered through them. Positive and negative diodes are specially designed for easier assembly and cooling. With a positive diode, the housing is the cathode, and with a negative diode, the housing is the anode. When testing, you have to pay attention to which diode is positive and which is negative.



Main diodes

A diode trio are excitation rectifier diodes, and on them, the ring indicates the cathode.



Excitation diode

The multimeter is set to measure a diode or resistance. The main diodes are checked first. One measuring pipette is placed on the positive plate (B+), and the other touches all three leads for the stator windings. All three readings should be the same, conducting or not depending on the polarity of the measuring pipette. Then the pipettes are reversed, and the measurements are repeated. All three results should be the same and opposite of the previous measurements. Now the procedure is repeated when the measuring pipette is placed on the negative plate (B-). If two identical values are measured when changing the place of measuring pipettes, then that diode is defective and should be replaced.

Finally, the excitation diodes, if any, are tested. We check each diode separately through two measurements by crossing the pipettes. If we measure two identical values, that diode is faulty and needs to be replaced.

To perform the alternator diode test, follow these steps:

1. Testing of main diodes: Set up a multimeter to measure diodes or resistance. Place one measuring pipette on the positive plate (B+), and connect the other one to each of the terminals for the stator windings. Then replace the pipettes and repeat the measurements. Do the same procedure between the negative plate (B-) and the lead for the stator windings. If you measure two of the same size after crossing the pipettes, that diode is faulty and needs to be replaced.

2. Testing of excitation diodes: Test each excitation diode separately twice by crossing the pipettes. If the same readings happen to be obtained, that diode is defective and needs to be replaced.

Text 22. Voltage Regulator Testing

Source: https://autoedu.info/en/auto-electric/alternator/voltage-regulator-testing/

When the alternator's output voltage is unstable or intermittent, it is necessary to test the voltage regulator. The regulator regulates the alternator's output voltage between 13.8 and 14.5 V and controls the power supply to the rotor windings. As long as the output voltage is below the maximum value, the regulator feeds the rotor windings that create the magnetic field through the brushes. The rotor's rotation under the magnetic field's influence in the stator windings generates voltage, which is sent to the vehicle's electrical network via the diode plate. When the output voltage exceeds the maximum allowed voltage, the regulator cuts off the power supply to the rotor. Without excitation voltage, there is no magnetic field in the rotor, and the generation of voltage in the secondary windings is interrupted. The output voltage drops, and when it falls below the minimum value, the regulator turns on the power supply to the rotor windings again.

The voltage regulator regulates the alternator output voltage by turning on and off the excitation voltage.

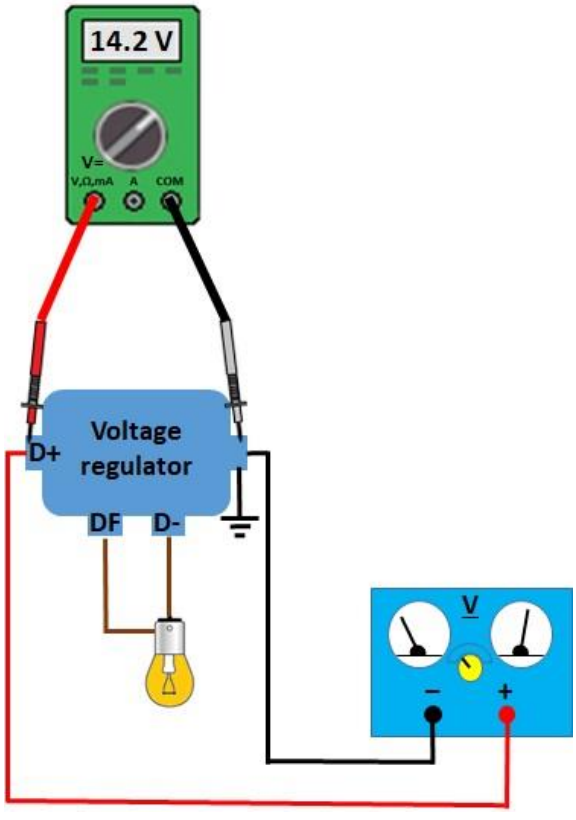
Various alternator voltage regulators

Irregularities in the operation of the voltage regulator can be power interruption, too high output voltage, and very rarely too low output voltage. Apart from the voltage regulator, other factors can influence the appearance of these irregularities.

To check the correctness of the regulator, we can use special testers or check its operation ourselves with the help of a few elements. We need a voltage regulator (0-20 V), a low-power bulb, and a multimeter for measuring DC voltage for a manual correctness test.

We connect the minus wire from the voltage regulator (0-20 V) to the ground of the alternator voltage regulator, and the plus wire from the voltage regulator (0-20 V) to the 12 V (D+) output port on the alternator voltage regulator. We connect the light bulb to the DF and D- alternator voltage regulator connections or the brushes. We connect the black measuring pipette of the multimeter to the ground and the red one to D+ of the alternator voltage regulator. Let's set the multimeter to measure DC voltage.

When all the necessary test elements are connected to the voltage regulator, we turn on the power source and increase the output voltage. The light



Voltage regulator testing

bulb is getting brighter. We monitor the voltage on the multimeter and the operation of the light bulb. With a correct regulator, when the voltage exceeds the value of 14.6 V, the bulb should turn off. With a further increase in voltage, the bulb does not work. Then we lower the voltage, and when we reach a value of about 13.8 V, the bulb lights up again. We increase and decrease the voltage on the regulator several times. The bulb should always turn off when 14.6 V is exceeded and turn on again when the voltage drops below 13.8 V. If it reacts differently than described, the regulator is faulty and needs to be replaced.

To perform an alternator voltage regulator test, follow these steps:

1. Connecting: Connect the minus wire from the voltage regulator (0-20 V) to the ground of the alternator regulator, and the plus wire to D+. Connect the bulb to the DF and D- alternator voltage regulators or the brushes. Connect the black measuring pipette of the multimeter to the ground, and the red pipette to D+ of the regulator. Set the multimeter to measure DC voltage.

2. Testing: From the information system, read the required values of the regulation voltage for the given regulator. Turn on the power supply regulator and increase the supply voltage from zero upwards. Monitor the operation of the bulb that is lit. As the voltage increases, monitor the value on the multimeter. When the bulb goes out, read the voltage value on the multimeter. Increase the voltage a little more and if the bulb is out, start reducing the supply voltage. When the bulb lights up, read the voltage of the bulb ignition. Repeat the procedure a few more times. Compare the voltage of turning on and off the bulb with the required voltage values of the regulator regulation. If they are outside the rear frame, replace the alternator voltage regulator.

Text 23. Alternator Bearing Replacement

Source: https://autoedu.info/en/auto-electric/alternator/alternator-bearing-replacement/

When noises are heard, screeching is often caused by bad bearings, and the alternator bearings need to be replaced. Replacing the bearings requires disassembling the alternator. Each alternator has two bearings, front, and rear. The method of removing and mounting the bearings differs and depends on the type of alternator.

The front bearing is on the front cover of the alternator. It is usually closed with the bearing retainer with the help of three screws. First, unscrew the screws and take off the bearing retainer. The bearing is removed with a suitable punch placed on the outside of the cover. By striking the punch or pressing the press, the bearing falls out of its housing. Installation is in reverse.

Alternator bearings

The rear bearing can be on the rear cover or the rotor shaft. When it is on the rotor, removing the bearing is done with a suitable tool and a puller. Mounting is done by pushing using a suitable tubular tool.

To replace the alternator bearing, follow these steps:

1. Front bearing replacement: Remove the three screws that hold the bearing retainer to the front housing. Remove the bearing retainer. Remove the front bearing from the housing.

2. Rear bearing replacement: The rear bearing can be on the rear cover or the rotor shaft. When it is on the rotor, removing the bearing is done with a suitable tool and a puller. Mounting is done by pushing using a suitable tubular tool.

Text 24. Oscilloscope Alternator Test

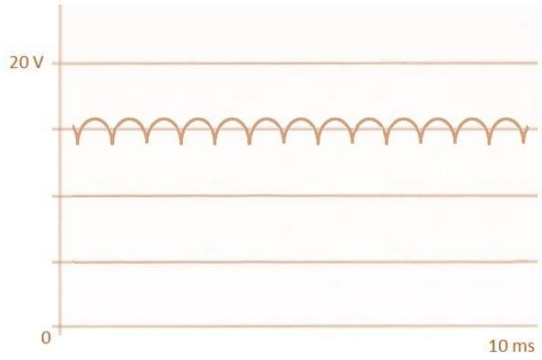
Source: https://autoedu.info/en/auto-electric/alternator/oscilloscope-alternator-test/

One of the faster ways to check an alternator is an oscilloscope test. The resulting oscillogram gives us an insight into the alternator's correctness and directs us towards further testing and finding the cause of the failure.

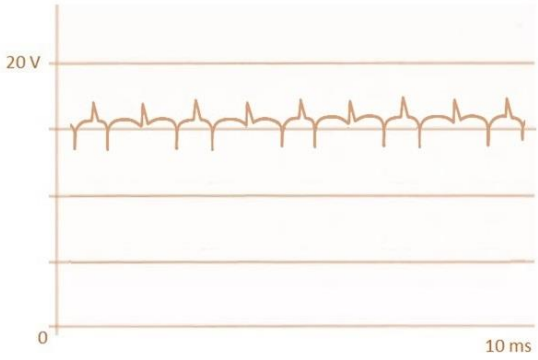
An oscilloscope recording of the alternator output voltage can determine the existence of an alternating component. All electrical components on the vehicle operate on DC voltage. Often, an alternating component in the power supply can block their operation. It happens that you replace a "faulty" electronic component, and then you find that the new one does not work either. That's a sign to record an oscillogram of the alternator output voltage.

The plus probe of the oscilloscope is connected to the plus output of the alternator (B+), and the minus probe to the ground. The oscilloscope is set to measure alternating voltage in the range of up to 20 V. The time axis is set to 10 or 20 ms. The output signal of the alternator is recorded under a load of 15 A and at 2000-2500 rpm. With some types of alternators in good condition without load, it has an unusually high voltage peak, but under load it is good. For the load, it is enough to turn on the headlights and some additional devices.

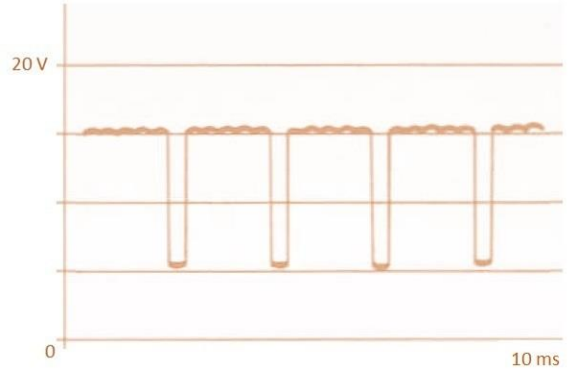
The following pictures show examples of recorded oscillograms with a description of the state of the alternator.



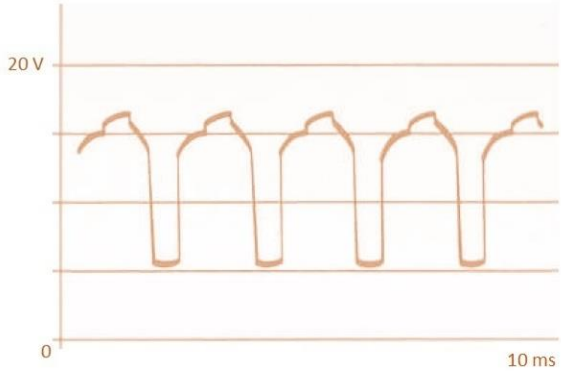
Correct alternator
(under load and at 2000 rpm)



Correct alternator - some types
(no load and idling)

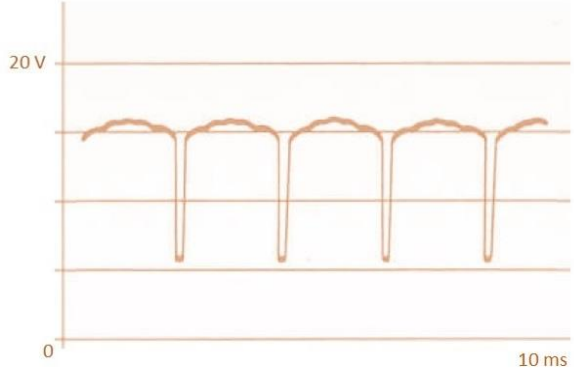


The excitation diode is open

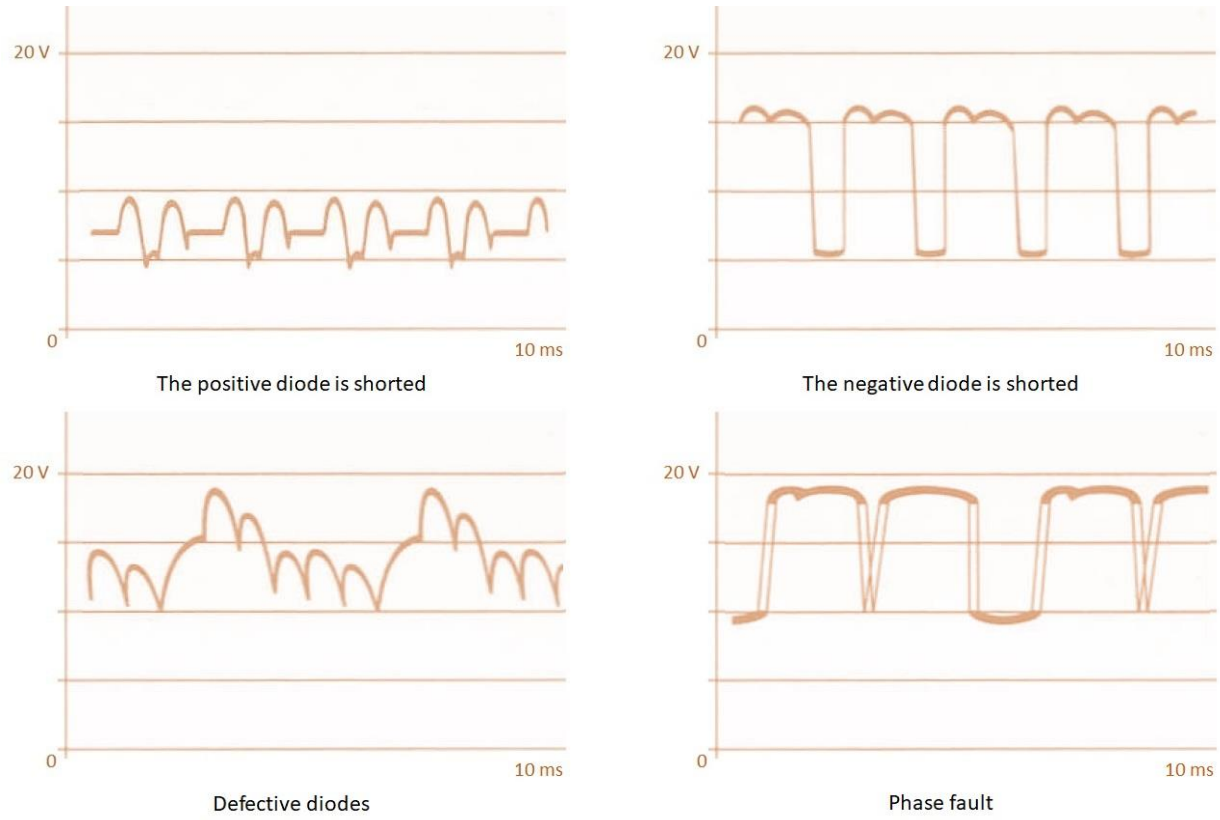


The excitation diode is shorted

The positive diode is open



The negative diode is open



To perform an oscilloscope test on the alternator, follow these steps:

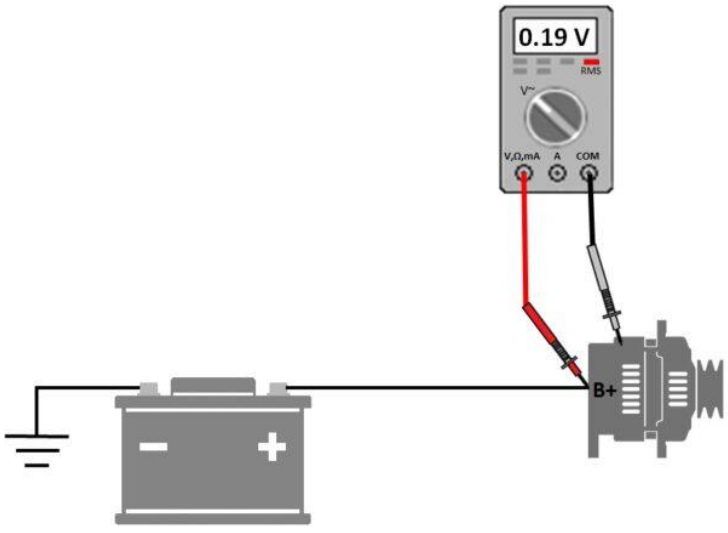
1. Oscilloscope connection: Connect the plus probe of the oscilloscope to the plus output of the alternator (B+) and the minus probe to the ground, alternator housing. Set the oscilloscope to measure AC voltage, the voltage axis to 20 V, and the time axis to 20 or 10 ms.

2. Oscillogram measurement and analysis: Start the engine. Turn on the headlights and some other consumers. Keep the engine speed at around 2000 rpm. Record and analyze the obtained oscillogram of the output voltage from the alternator. If any anomalies are found, conduct further tests to identify and eliminate the fault.

Text 25. AC Ripple Voltage Test

Source: https://autoedu.info/en/auto-electric/alternator/ac-ripple-voltage-test/

The test for the presence of alternating voltage at the output of the alternator is a procedure for determining the presence of an alternating component in the direct voltage.



AC ripple voltage measurement at the alternator output

Electronic components are sensitive if an AC component is coming through the power supply, and it may break down. Testing is done by oscilloscope recording of the output signal. If you don't have an oscilloscope or want an even faster test for the presence of an AC component in the power supply, you can measure with a multimeter.

Connect the plus measuring pipette of the multimeter to the plus output of the alternator (B+) and the minus pipette to the housing (ground). Set a small value AC voltage measurement, and it preferably turns on the RMS (root mean square) option. Measurement is performed under load and at 2000-2500 rpm. While the engine is running, the headlights and additional devices turn on to load the alternator. Any measured AC voltage greater than 0.25 V means that there is an AC component and that the alternator is faulty, that is, some diode is defective.

To measure the presence of alternating voltage at the output of the alternator with a multimeter, follow these steps:

1. Connecting a multimeter: Connect the plus measuring pipette to the plus output of the alternator (B+) and the minus pipette to the alternator housing (ground). Set the multimeter to measure the alternating voltage of a small value and, if possible, activate the RMS option.

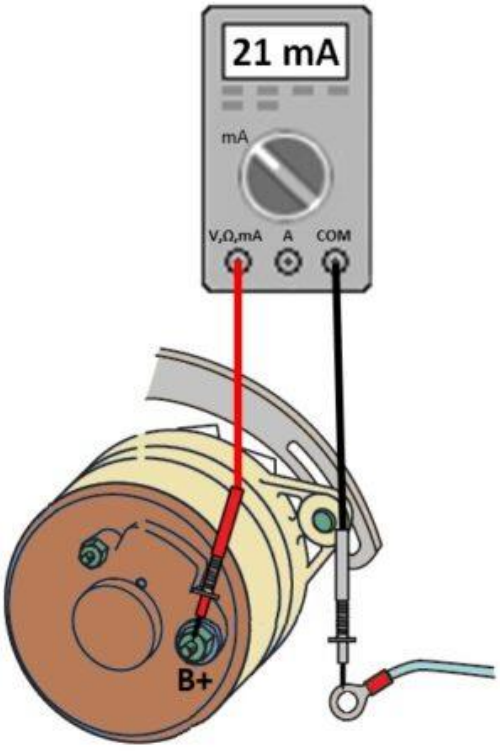
2. Measurement and analysis: Start the engine. Turn on the headlights and some other consumers. Keep the engine speed at around 2000 rpm. Measure the alternating voltage at the output of the alternator. If the measured voltage is greater than 0.25 V, carry out further tests to identify and eliminate the fault.

Text 26. Alternator Leakage Test

Source: https://autoedu.info/en/auto-electric/alternator/alternator-leakage-test/

The leakage test determines whether a shorted diode conducts power from the battery to the alternator windings while the engine is off. As a parasitic draw, it leads to battery consumption in rest mode.

When the battery is weak at start-up, and after charging you find that it has good capacity, the suspicion falls on parasitic draws. The procedure for detecting a parasitic draw requires connecting an ammeter to the battery. By removing the fuse in order, determine the line where the fault is located. However, when after removing all fuses the problem is not detected and there is still a leak, it is necessary to check the alternator leak.



Alternator leakage test with an ammeter

The alternator leakage test is performed with a multimeter while the engine is not running and with the ignition off. The multimeter is set to measure current in mA. Disconnect the supply plus wire from the plus terminal (B+) on the alternator. Connect the plus measuring pipette of the multimeter to the B+ of an alternator, and the black pipette to the removed terminal of the supply line. Depending on the type of vehicle, there is always a small amount of current flowing between the battery and the alternator when the vehicle is at rest. However, if a current of more than 60 mA is flowing, there is an alternator leak that acts as a hidden consumer draining the battery. When there is a leak, it is necessary to check the condition of the diodes on the alternator diode plate.

To perform an alternator leak test with a multimeter, follow these steps:

1. Connecting a multimeter: Disconnect the supply line from the plus (B+) connection of an alternator. Set the multimeter to measure the current in mA. Connect the plus measuring pipette to the plus output of the alternator (B+), and the minus pipette to the socket of the disconnected supply line.

2. Measurement: If the current is greater than 60 mA, there is an alternator leak, and take further steps to detect and eliminate the malfunction of the alternator.

Text 27. Electrical Installations. Relays Testing

Sources: https://autoedu.info/en/auto-electric/electrical-installations/, https://autoedu.info/en/auto-electric/electrical-installations/relays-testing/

Electrical installations on vehicles provide a safe and secure power supply to electrical and electronic devices and data transmission between control units and peripheral components of the control system.

To work on electrical installations, a service technician needs to understand the terminology, the behavior of electricity, and the theory of electrical components and networks. Also, the service technician should be able to read electrical diagrams, measure electrical quantities, calculate electrical values, and maintain and repair elements of electrical installations. Electrical installations include conductors, connections, fuses, switches, relays, and other components for distributing electricity to consumers. Communication networks (LAN, CAN, etc.) are for data transmission.

For maintenance, testing, and repair of elements of electrical installations, it is necessary to follow the manufacturer's instructions and procedures using appropriate tools and equipment.

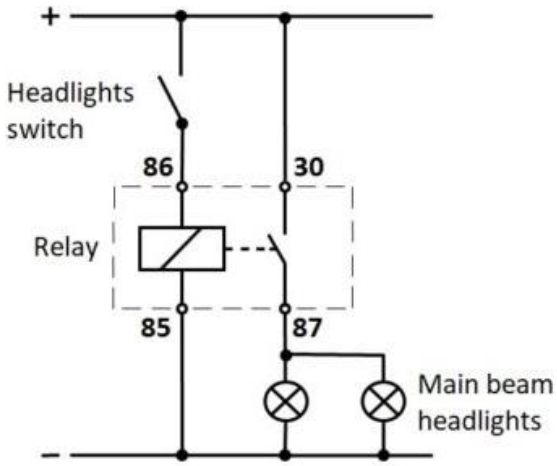
Relays are electromagnetic switches that use small currents in the coil to control significantly higher operating currents. Standard relays have four or five connectors. The markings are numerical and are 30 (permanent plus), 86 (plus on the coil), 85 minus (output from the coil), and 87 minus (output to the consumer). If there is a fifth connector, it is labeled 87a.

Relay and circuit

Due to the heavy use of relays on the vehicle, we will explain the standard test procedure. The relays are located on the relay plate with the other relays and fuses. Testing the relay is done in two stages: checking the correctness of the relay base on the plate and testing the relay on the workbench. Before testing, it is necessary to get to know the electrical connection diagram and the position of the components.

First, the correctness of the system is checked, in our case, the operation of the main beam on the vehicle. If turning on the main beam headlights switch does not turn on both lights, the electrical diagram shows that the relay is one of the possible malfunctions.

From the information system, we get to know the position of the lighting relay on the vehicle. We remove the relay from the plate and perform a visual inspection of the exterior of the housing and connectors. If the relay is visibly damaged, replace it with a new one.



Relay wiring diagram for lights

We determine the arrangement of connections (numbers) on the relay socket. First, we check the voltage between terminals 85 and 86. We connect the voltmeter and turn on the main beam switch. If the measured voltage is 0 V, there is a fault in the power supply of the relay coil. It is necessary to carry out additional tests and determine the location of the failure. If the measured nominal voltage is 12 V, the power supply to the relay coil is correct.

Then there is a check of the main beam power supply via the relay. Short-circuit terminals 30 and 87 are on the relay socket. We turn on the main beam through. If the main beam bulbs do not light up, there is a fault in the power supply of the bulbs. It is necessary to carry out additional tests and locate the fault. If the main beam bulbs light up, the relay socket is correct, and we move on to testing the relay itself.

Relay testing is done with an ohmmeter. First, measure the resistance of the relay coil between connectors 85 and 86. The expected resistance value is 70-120 Ω. For the exact value of the tested relay, use the information system. If the measured value is not within the specified limits, the relay winding is defective, and it is necessary to replace the relay with a new one. If the measured value is within the specified limits, the relay winding is correct. After winding, check the entire relay. A 12 V power supply is supplied to the coils of relays 85 and 86. We connect an ohmmeter to connectors 30 and 87. If the resistance is infinite after switching on the relay, the relay is faulty and needs to be replaced. If the resistance is 0 Ω, the relay is working.

In new vehicles, it is not allowed to use a test lamp with a light bulb due to the possible transfer of high current and damage to the ECU. Take care of the pinout when testing.

To perform a relay test, follow these steps:

1. System overview: Check the correctness of the system. Get to know the wiring diagram of the system. Determine the location of the relay on the vehicle. We remove the relay from the plate and perform a visual check of the state of the relay. If the relay is visibly damaged, replace it with a new one.

2. Testing of the relay socket: Determine the layout of the pins on the relay socket. Turn on the system. Measure the voltage between connectors 85 and 86. If the voltage is 0 V, perform additional tests and determine the fault. If the voltage is 12 V, short-circuit connectors 30 and 87. If the consumer does not turn it on, perform additional tests and determine the fault. If the consumer turns on, the relay socket is good and continues testing the relay.

3. Testing the relay on the workbench: Measure the resistance of the relay coil between connectors 85 and 86. If the resistance is 0 V, replace the relay with a new one. If the measured resistance is 70-120 Ω, check the relay switch. Connect a 12 V supply to connectors 85 and 86 and measure the resistance between 30 and 87. If the resistance is 0 Ω, the relay is working. If the resistance is infinite, the relay is faulty and replaced with a new one. After replacing the relay, check the correctness of the system.

РАЗДЕЛ 4. ИНСТРУКЦИЯ ДЛЯ ПОДГОТОВКИ УСТНОЙ ПРЕЗЕНТАЦИИ ТЕКСТОВОГО МАТЕРИАЛА НА АНГЛИЙСКОМ ЯЗЫКЕ

4.1. Поэтапная инструкция по подготовке презентации текстового материала Presentation Preparing Guide

STEPS

Step 1. Know the context of the presentation: Who are the audience, and what are their interests? How big will the audience be? How long is the presentation to be? What facilities are available for visual aids? What about time for questions?

Step 2. Decide on your topic. Think carefully about the main point or points that you want to communicate. You should be able to write these clearly in one or two sentences.

Step 3. Structure the content. Most people begin with an unordered collection of ideas and then put them into sequence. Then decide on the relative weight of each section of the talk.

Step 4. Think of ways of catching the listeners' interest: examples, anecdotes, impressive statistics, and interesting quotations.

Step 5. It is useful to 'rough-draft' visual aids at this stage because they can help you make the sequence of points clearer and more logical. Think about whether some information should be put into handouts.

Step 6. Check overall length, and the relative weight of sections. A little too short is better than even a little too long. As a rough guide, allow about 1 minute for every 100 words, plus time, if necessary, for changing transparencies. One A4 page, double-spaced, takes about 3 minutes of speaking time.

Step 7. Finish preparation of visual aids. If you are using PowerPoint data projection, having slides or transparencies is a useful back-up in case of last-minute technical problems.

Step 8. Prepare handouts, if you want them. Make copies.

Step 9. Plan the exact words you will use for the opening, the transition points, and the conclusion. Practice them again and again. If you are anxious, write on cards the introductory and concluding sentences. Make more notes if you need them.

Step 10. REHEARSE your presentation, as often as necessary. Do not omit this step! You can practice alone, or ask a friend or colleagues to listen to you. With practice, you will become more fluent and at ease. Make sure you speak simply, but in academic not conversational style. Project your voice across the room. You will find this slows your speech. Check the timing carefully and make adjustments if necessary. Mark a time reference at one or two points in the presentation.

Step 11. Think about the questions the audience may want to ask you. Plan how you will answer them.

Step 12. On the day of your presentation, be calm and organized. If you are unfamiliar with the location, go beforehand to plan where you will stand and where you will put your papers and to see how the projection works. Arrive in good time for your presentation. Remember to take all your visual aids, notes and papers.

If you feel nervous, do not worry. That's normal. Breathe slowly and deeply for a few minutes beforehand, and try to relax the muscles of your face, mouth and neck. This will make you look relaxed, and will improve the quality of your voice. Then remind yourself how well prepared you are, and enjoy it. Concentrate not on yourself or your notes, but on the audience and making clear to them what you have to say.

Visual aids

If you are using an **overhead projector,** follow steps 1–4 below.

1. Before your presentation, check that the equipment works. Decide on the best place to stand, so that you do not obscure the view of the audience; decide where to put transparencies before and after use; decide whether you will point at the transparency or at the screen (or not at all).

2. If you point at the transparency, use a pen as a pointer.

3. Detach the transparencies from their backing paper to make things easier during your presentation. Interleave them with plain paper.

4. Number the transparencies in case you drop them.

If you are using **Power Point** data projection, follow steps 1–6 below.

1. Check beforehand whether you should bring your presentation on diskette or CD or DVD. If you are bringing a computer, check on the type of connection required for the data projector.

2. If possible, set up your presentation before your talk. This can take several minutes, even if all goes well.

3. Have a blank slide at the start and end of your presentation. This makes your start and finish smooth.

4. Power Point has an excellent online tutorial and help system. Use it when you are preparing your presentation so that you can make full use of its faculties (such as time monitoring, handouts and notes).

5. Don't be tempted, because of Power Point's capabilities, to make your slides too 'busy'. That will distract the audience's attention.

6. Even if you are giving your presentation in a well-equipped room, technology can go wrong. Print out your PowerPoint slides on to transparencies, so that you have an alternative.

Handouts

Handouts are useful in **three ways**.

1. They show data that are too detailed for a visual aid, such as transcript data from interviews, or mathematical calculations. If there is a lot of detail, the points you want to refer to in your presentation should be clearly highlighted in the handout. The handout is given immediately before the presentation, and then referred to.

2. They provide a 'signposting' framework to guide the audience through your talk. In this case, the handout will be a note-frame, which is given out before the presentation. Don't put too much into it, or the audience will read the handout instead of listening to you.

3. They act as a record of your presentation, which the audience can take away. This could be either a note-frame or a fuller text. For this 'record' type of handout, it's common practice to add your address and email address, so that people working in the same field can contact you later. Some presenters like to give out this type of handout at the end of their talk, so that the audience listens with full attention. Others give it out at the start, as a support to listening.

Keep your handout short – one page if possible.

Notes

Visual aids often provide sufficient support for your presentation. If you feel you need notes as well, remember that they will be more to cope with during the presentation: you will have to deal with the visual aids, the notes, and the audience.

1. Cards or A5 paper are often recommended because they are neater in the hand than big pages. Make sure you number them clearly!

2. A good alternative is to use photocopies of your visual aids, with notes written on them. It is then easier to coordinate your progress through notes and visual aids.

3. Write very large and clear, with plenty of space.

4. Use colour, so that you can quickly locate key points or words.

4.2. Технология создания электронной презентации текстового материала

4.2.1. Облако слов

«Облако слов» представляет собой визуальное представление ключевых слов текста. Это — графическая визуализация текста.

1. Зарегистрироваться на сайте **http://tagul.com/**

2. Нажать клавишу My clouds, затем клавишу CREATE NEW CLOUD и зайти во вкладку Tags source (Теги: источник) → URL (вводим адрес веб-страницы) и текст загружается в буфер.

3. Нажать клавишу Visualize, таким образом, текст появится справа.

4. Придать облаку желаемый вид с помощью меню:

Appearance — внешний вид
Font — шрифт
Color — цвет, раскраска слов в облаке
Background color — цвет фона (на экране)
Animation speed — скорость анимации
Roll over text color — развернуть цвет текста
Roll over box color — развернуть цвет рамки
Roll over stroke color — развернуть цвет шрифта
Grab and share — сохранить и поделиться
Save to local computer — сохранить на своем компьютере
Save graphic image — сохранить графическое изображение
Place on a web-page — разместить на веб-странице
Send link to a friend — отправить ссылку другу

5. Сохранить созданное облако, нажав на клавишу Save graphic image. После нажатия появляется окошко «Сохранить как», и вы выбираете место сохранения.

6. Отправить ссылку своим коллегам.

ИЛИ

1. Используя сайт **http://www.tagxedo.com/**, создать **облако слов** из текста.

2. Придать облаку желаемый вид с помощью меню:

Color — цвет
Theme — тема
Font — шрифт
Orientation — ориентация
Layout — расположение слов в облаке
All — всевозможный вариант
Shape — очертание/форма
Hide History — история выполненных действий

3. Сохранить, нажав клавишу Save, и выбрать необходимые параметры сохранения: размер и расширение. После нажатия клавиши сохранить изображение в любом месте на вашем компьютере.

4.2.2. Диаграмма связей / ассоциативная карта

«Диаграмма связей», известная также как «Интеллект-карта», «Карта мыслей» (англ. Mind map), «Ассоциативная карта», — способ изображения процесса общего системного мышления с помощью схем. Также может рассматриваться как удобная техника альтернативной записи.

1. Зайти на сайт **http://freemind.sourceforge.net/**. В пункте **See Download** нажать на **Download** (загрузка). Вы автоматически попадаете на страницу **Download,** где спускаетесь в пункт **Installing Free Mind.**

2. Если компонент Java уже установлен, то нужно нажать на **You can find a Free Mind installer including java here**. После чего начинается автоматическая загрузка файла Free Mind-Windows на ваш компьютер.

3. Установить программу в обычном режиме на компьютер.

4. На рабочем столе появляется значок, который вы запускаете как программу.

5. В центре поля щелкнуть на **Free Mind** / Новая карта и написать центральное понятие, например: «статья о программе Free Mind».

6. Нажать клавишу **Insert /** Вставка для вставки пункта первого уровня (например, «Введение»).

7. Нажать клавишу **Enter** для вставки второго пункта первого уровня (например, «Установка приложения»).

8. Основное редактирование необходимо производить с помощью клавиш **Insert** / Вставка, **Enter** / Ввод, **Escape** / Выход и **Delete** / Удаление.

9. Для редактирования текста внутри выбранного узла можно воспользоваться клавишей **F2.**

10. Можно перемещать карту целиком в любое место рабочего пространства методом обычного **drag'n'drop** / перетаскивание — нужно зажать мышью рисунок и перетаскивать его, не отпуская, в нужное место.

11. Попробуйте изменить размеры узлов. Все возможные формы работы с узлом вы найдете, щелкнув по узлу правой кнопкой мыши, в пункте «Формат».

12. Нажатием сочетания клавиш **Alt+I** откройте каталог с предустановленными иконками («Выберите пиктограмму»). Вы можете выбрать любую из них для добавления к узлу на вашей карте. Добавление иконок делает ее более читаемой и интуитивно понятной.

4.2.3. Шаги по созданию и работе с узлами ассоциативной карты

1. Щелчок мышью по «**Новой карте**» дает возможность внести ключевое слово. Нажав клавишу **Enter**, вы закрепляете данное ключевое слово.

2. «**Вставка → Новый смежный узел после текущего**» дает возможность создать узел с правой стороны.

3. «**Вставка → Новый смежный узел перед текущим**» дает возможность создать узел с левой стороны.

4. Щелчок **левой** кнопкой мыши по «**Новому смежному узлу**» дает возможность внести название для созданного узла.

5. Выполнение щелчка **правой** кнопкой мыши обычно приводит к отображению **списка доступных действий** для **работы с узлом:**

Редактировать F2	Изменение названия узла
Изменить текст в редакторе	Форматирование шрифта: цвет, курсив, жирный шрифт, подчеркивание, выравнивание, вставка таблицы, создание списка, создание нумерации

Редактировать атрибуты	Создание таблицы с атрибутами под названием узла
Удалить узел	Удаление узла
Вырезать	Удаление узла из данного места и вставка в другом месте
Копировать	Копирование узла и вставка в другом месте
Копировать только этот узел	Копирование только этого узла и вставка в другом месте
Вставить	Вставка узла
Новый подчиненный узел	Создание нового узла, подчиненного заданному узлу
Новый смежный узел после текущего	Создание нового смежного узла **под** существующим узлом
Новый смежный узел перед текущим	Создание нового смежного узла **над** существующим узлом
Развернуть/свернуть	Развёртывание и свёртывание подчиненного узла
Пиктограммы ***здесь же:***	Вставка пиктограмм из предложенного списка
• **Удаление последней пиктограммы**	Удаление последней пиктограммы в данном узле
• **Удаление всех пиктограмм**	Удаление всех пиктограмм в данном узле
Экспортировать ветвь как новую карту Alt+Shift+A	Экспорт данной ветви в новую карту, т. е. перенос в новое окно, где с ней можно отдельно работать (в главной карте появляется ссылка на этот элемент ассоциограммы)
Формат	**Работа с узлом** Тип узла — овал, кривая Увеличить шрифт узла Уменьшить шрифт узла Курсив Жирный Цвет узла Высветлить узел Фоновый цвет узла Убрать фоновый цвет узла Цвет облака (облако создается в вставке) Цвет ребра (прямая, кривая, заостренная прямая, заостренная кривая) Толщина ребра (как у родительского узла, тонкое ребро, 1, 2, 4, 8)
Вставка	Облако Изображение из файла (Alt+K) Ссылка (выбор файла) – вставка файла через ссылку Ссылка (текстовое поле) Создать связь (выделив минимум два узла) / между узлами
Стиль	Изменение стиля текста в рамках узла

6. Если подвести курсор к узлу — появится значок на повороте узла, и **узел** можно **перенести** в другое место, потянув в нужном направлении.

7. Файл — экспортировать — как… (выбираем формат, в нашем случае PDF). Сохранить созданную ассоциативную карту связей.

4.2.4. Ментальная карта

1. Зайти на сайт http://www.spiderscribe.net/ (предварительно зарегистрировавшись).

2. Создать новую ментальную карту – **Create New Map.**

3. Задать имя папки – **Map name**.

4. Добавить описание данной папки – **Description**.

5. Кликнуть по иконке «**Текст**» и, удерживая кнопкой мыши, перетащить на поле. Ввести текст.

6. Отформатировать текст по желанию: справа на экране панель форматирования текста. Изменить фон окна, шрифт, кегль текста (размер шрифта).

7. Щелкнуть по знаку «+» и создать новую ветвь.

8. Кликнуть по иконке «**Изображение**» и, удерживая кнопкой мыши, перетащить на поле.

9. Щелкнуть на кнопку загрузки **Upload image** и загрузить изображение. Отформатировать изображение по желанию: справа на экране панель форматирования изображения.

10. Проделать похожие шаги с картой, календарем, документом Word.

11. Внести дополнительные изменения в работу с ментальной картой: в верхней части экрана находится **Панель инструментов**: отмена последнего действия, центрирование карты, изменение размера, печать, экспортирование карты, удаление карты.

12. После окончания работы с картой нажать на **Share** (поделиться) – в правом верхнем углу экрана.

Private – Частные (по умолчанию) – карта видна только владельцу и тем, с кем автор поделился (указать электронные адреса).

Public with the link – Общедоступная со ссылкой – карта видна всем, кто имеет ссылку. Вход в аккаунт SpiderScribe.net не требуется.

Public on Internet – Опубликованная в Интернете – карта видна и доступна всем.

При выборе режима **Private**в левом поле ввести список людей, которым разрешен доступ к карте. Выбрать формат доступа: **readers** – только чтение, **editors** – редактирование. Нажать кнопку **Save** (сохранить). Сохранить. Предоставить доступ одному из участников. **Или:** выбрать режим **Public on Internet,** скопировать адрес карты и сохранить в отдельном документе. Нажать кнопку **Save** (сохранить).

Нажать в верхней части экрана на **Export Map** (экспортировать карту) и выбрать формат JPG.

РАЗДЕЛ 5. МЕТОДИЧЕСКИЕ РЕКОМЕНДАЦИИ ПО ОРГАНИЗАЦИИ САМОСТОЯТЕЛЬНОЙ РАБОТЫ INDEPENDENT WORK GUIDE

5.1. Рекомендации по организации работы с текстами для чтения

Чтобы научиться понимать и переводить иноязычный текст, необходимо в первую очередь научить студента выделять и понимать содержание на уровне *текста, абзаца* и *предложения,* а также дифференцировать основную и второстепенную информацию.

Основные признаки текста: 1) *связность;* 2) *тематичность* (все предложения объединены какой-либо одной темой); 3) *цельность* (использование средств связи между предложениями).

Тема текста. Текст представляет собой сложное суждение, в котором есть текстовый субъект (о чем говорится в тексте?) и текстовый предикат (что говорится в тексте?).

Текстовым ***субъектом*** является тема текста, которая находит словесное выражение чаще всего в заголовке или в самом начале текста.

Текстовый ***предикат*** представляет собой группу суждений, раскрывающих тему текста, т. е. сам текст.

Главное содержание текста. Понять содержание текста – значит уяснить его тему и идею.

Тема текста – это предмет данного описания, т. е. предмет, явление, событие, о которых идет речь в тексте.

Идея текста – это главная мысль о данном предмете, авторское отношение к описываемому предмету. Идея текста – это вывод, к которому должен прийти читающий после ознакомления с содержанием текста.

Тема часто сообщается в заголовке или в первом предложении текста. Понять идею можно лишь после прочтения всего текста. Иногда она не имеет словесного выражения, тогда читающий должен сам сделать определенные выводы.

Основное содержание текста. Для этой цели выделяются элементы, в которых заключена основная смысловая информация текста. Они называются «ключевыми фрагментами» (слово, словосочетание, предложение, группа предложений). Каждый абзац имеет ключевое предложение – «абзацную фразу», если их объединить, то можно получить основное содержание текста.

Ключевое предложение может находиться: а) в верхней части абзаца (*дедуктивная* структура – изложение мысли от общего к частному); б) в нижней части абзаца (*индуктивная* структура – изложение мысли от частного к общему); в) в верхней и в нижней части (*рамочная* логическая структура).

Другие предложения текста представляют собой способ логического развития мысли в абзаце.

Формы передачи информации. Существуют следующие формы передачи информации: *сообщение, описание, повествование и рассуждение.* Так, ядро самого простого типа информации – сообщения – составляют ответы на следующие вопросы: кто, что, когда, где, как, почему.

В текстах психолого-педагогического профиля преобладает тип информации о ситуации или положении дел, а также комбинированный тип информации (сообщение, передача высказывания, информация о событии или факте, о ситуации или положении дел, рассуждение).

Основные виды текстов для чтения

1) учебный;

2) художественный (story – рассказ, play – пьеса, novel – роман);

3) научный и научно-популярный (research work – научный труд, theses – диссертация; monograph – монография; reference – статья из справочной литературы; article – журнальная статья; notes – сообщение).

5.2. Методические рекомендации для студентов

5.2.1. Чтение с полным пониманием прочитанного

Цель – полностью понять содержание текста, выделить главную информацию, передать содержание, оценить его, сравнить с уже известным ранее.

Алгоритм

1. Перед чтением спрогнозируйте по заголовку содержание текста.
2. Читайте текст с полным пониманием, т.е. старайтесь как можно точнее понять содержание и смысл читаемого.
3. Проверьте, насколько хорошо вы поняли содержание и смысл текста. Для этого необходимо:

– ответить на вопросы к тексту, позволяющие выделить детали;
– самостоятельно поставить вопросы к тексту;
– составить развернутый план прочитанного.

4. Для подготовки *пересказа* текста необходимо:

– найти в тексте и выписать основные ключевые слова и выражения;
– составить последовательность фактов и событий;
– изложить содержание текста с опорой на ключевые слова и выражения.

5. Для *характеристики* какого-либо объекта текста необходимо:

– определить объект характеристики;
– выписать слова и выражения, относящиеся к определяемому объекту;
– описать объект;
– высказать свое мнение о нем.

6. Для подготовки *высказывания* по проблеме текста следует:

– определить исходный тезис;
– определить основной материал для аргументирования;
– выписать ключевые слова и словосочетания;
– аргументировать тезис;
– привести примеры.

7. Для *обсуждения проблемы* текста следует:

– выделить предмет обсуждения;
– выделить информацию о предмете;
– выписать ключевые слова и словосочетания;
– выразить свое отношение к предмету;
– аргументировать свою точку зрения.

8. Для *реферирования* текста необходимо:

– зафиксировать основные опорные пункты;
– распределить информацию по степени важности.

9. Для *аннотирования* текста следует:

– зафиксировать тему и главную мысль;
– выразить свое отношение.

5.2.2. Чтение с пониманием основного содержания

Цель – получить общую информацию о содержании текста, выделить главную мысль, высказать свое отношение к прочитанному.

Алгоритм

1. Перед чтением спрогнозируйте по заголовку содержание текста.
2. Читайте текст с пониманием основного содержания, то есть сконцентрируйтесь на основных фактах текста, опуская второстепенную информацию;
3. Старайтесь охватить взглядом все предложение или его часть;
4. Старайтесь догадаться о значении незнакомых слов или обратитесь к словарю;
5. Во время чтения подчеркивайте или выписывайте словосочетания и предложения, несущие основную информацию.
6. Проверьте, поняли ли вы основные факты текста, определите его основную мысль. Для этого необходимо:

– выбрать заголовок из предлагаемых вариантов или сформулировать самому;
– разделить текст на смысловые отрезки;
– ответить на вопросы, выделяющие основную информацию.

7. Для подготовки высказывания следует:

– сформулировать главную мысль текста;
– сказать, что вы узнали нового;
– кратко изложить основные идеи текста;

5.3. Рекомендации для написания рефератов, аннотаций

Реферат, составленный по одному источнику, называется *монографическим*. Структура реферата строго установлена. Он состоит из двух частей: *заголовочной* и *собственно реферативной*. В заголовочной части отражается название первоисточника, фамилия автора и библиографические данные (место издания, издательство, год издания).

Текст собственно реферативной части строится на основе выделенных при чтении ключевых слов и ключевых фрагментов, большинство из которых могут быть терминами в данной специальной области.

Реферат, составленный по нескольким работам на одну тему, называется *обзорным*.

5.3.1. Рекомендуемые клише для оформления реферата на английском языке

The Paper is called = The title of the Paper is…– Название реферата…
The theme of the Paper is… – Тема реферата…
It is spoken about… –Говорится о…
It is said in brief that… – Кратко говорится о…
Reader's attention is drawn to…– Внимание читателей привлекает…
The text gives information about… – Текст дает информацию о…
The following facts are stressed in the article…– В статье подчеркиваются следующие факты…
The content of the text includes…– Содержание текста охватывает…
The text is devoted to the problem…– Текст посвящен проблеме…
The articles are taken from… – Статьи взяты из…
In the article it is analyzed… – В статье анализируется…
The author characterises… – Автор характеризует…

The author emphasizes … –Автор подчеркивает, что…
The author suggests… – Автор предлагает…
The author considers that… – Автор считает, что…
The main (sufficient) part of the research work contains… – Главная часть исследования содержит…
The text contains statistics about…– Текст содержит статистику о…
In the introductory part the author touches upon…– Во вступительной части автор касается…
At first it is depicted that… – Во-первых, изображается…
Secondly it is revealed that… – Во-вторых, обнаруживается, что…
First of all, it is stressed that… – Вначале ударение делается на…
The author underlines that… – Автор подчеркивает, что…
In concluding paragraphs, it is pointed out…– В заключительных параграфах указывается на…
Summing up the information… – Подводя итог…

5.3.2. Алгоритм составления реферата

1. Оформите заголовочную часть: запишите название первоисточника, фамилию и инициалы автора (авторов) и библиографические данные.
2. Пронумеруйте абзацы текста.
3. Просмотрите текст и определите его главную тему.
4. Внимательно читая текст по абзацам, определите тему и подтемы каждого абзаца и запишите их вместе с номером абзаца в виде ключевых слов и выражений.
5. Таким образом вы составите логический план текста.
6. Обдумайте последовательность расположения пунктов плана.
7. Выберите из каждого абзаца ключевые фрагменты (отдельные слова или словосочетания), которые характеризуют выделенные вами темы и подтемы, запишите их. Так выявляются смысловые ряды.
8. На материале смысловых рядов составьте текст реферата, используя связующие специфические выражения и языковые клише.
9. Прочитайте составленный текст реферата и отредактируйте его.
10. Укажите свою фамилию и инициалы, факультет, курс, номер группы и дату.

5.3.3. Клише для обсуждения реферата

To my mind the Paper is… – По моему мнению, реферат…
From my point of view… – С моей точки зрения…
It seems to me that… – Мне кажется, что…
I would like to express my own opinion on the problem… – Хотелось бы высказать свое мнение по проблеме…
I would like to clarify… – Я хотел бы кое-что прояснить…
I would like to tell something else… – Я хотел бы сказать следующее…
I would like to add… – Я хотел бы добавить…
An example of this would be… – Примером этого будет…
For example, … – Например…
The point is that… – Смысл в том, что…
Обсуждение
I disagree with the position of the author. – Я не согласен с позицией автора.

I do not share the author's point of view. – Я не разделяю точку зрения автора.

I have just the opposite idea. – У меня противоположное мнение.

I can't agree with the author's opinion. – Я не могу разделить мнение автора.

Согласие

I do share the author's opinion that… – Я разделяю мнение автора в том, что…

I agree with your point of view that… – Я согласен с вашей точкой зрения, что…

You are defenitely right that… – Несомненно, вы правы, что…

I find this Paper interesting / important. – Я нахожу данный реферат интересным / важным.

There is no doubt that… – Нет сомнений в том, что…

It goes without saying… – Без сомнений, …

Сомнение

I am not quite sure that… – Я не вполне уверен, в том что…

It eems to me doubtless because… – Это кажется мне сомнительным, потому что…

I agree to the point but…– Я согласен с этим, но…

I suppose you are right but… – Предполагаю, что вы правы, но…

I would like to mention that… – Хотелось бы упомянуть, что…

Требование, просьба

I would like to ask a question… – Я хотел бы задать вопрос…

Could you tell me more about… – Не могли бы вы рассказать о…

Do you know anything else about… – Знаете ли вы еще что-нибудь о…

Can you confirm the fact? – Вы можете подтвердить… ?

I would like to ask you to tell your opinion about… – Я хотел бы вас попросить высказать свое мнение о…

5.3.4. Аннотирование текста

Аннотация – короткая справка о печатном произведении, излагающая содержание в виде перечня его основных вопросов. Аннотация дает представление только о характере оригинала (книга, статья и т. д.), о его строении (перечень вопросов), о его назначении (на кого оригинал рассчитан), а также об объеме оригинала (количество страниц). Аннотации пишутся как на языке оригинала, так и на родном языке. При составлении аннотации используются языковые клише. Объем аннотации составляет 0,5 страницы.

Структура аннотации стабильна. Она состоит из заголовочной части (название оригинала, фамилия автора, издательство, место и дата издания и др.). Написание собственно аннотации начинается с чтения текста и нумерации абзацев, определяется ведущая тема текста, темы и подтемы каждого абзаца, составление логического плана текста в виде перечня тем и подтем текста.

Клише, используемые при составлении аннотации:

а) клише, начинающие аннотацию и вводящие в главную тему:

The article (text) is called…

The title of the article (text) is…

The article (text)is published in…

The article is printed in…

The article consists of…

The article is devoted to…

The text touches upon the probleme…

In the introductory part the author points out…

в) клише, оформляющие основную мысль произведения:

The author raises the problem of…

The main part of the text informs about…

The article contains statistics about…

с) клише, оформляющие выводы автора оригинала:

In the concluding paragraphs it is pointed out…

Summing up the information it is important to say that…

Generalizing the information, it is necessary to say that…

В конце аннотации указывают фамилию, инициалы составителя, факультет, курс, группу, дату составления.

Например:

Summary

The article is called 'English for Specific Purposes in Russia: a Historical Perspective'. The article is published in Journal 'ESP Russia' in January, 1996. Volume 1. It is written by Tamara Nazarova, Professor of Moscow State University. The article is devoted to historical development of an approach of language teaching which is directed by specific and apparent reasons for learning.

The author raises two problems for identification. The 1st is: What is the meaning of the word ESP? And the 2nd: How to use it?

In the concluding paragraphs it is pointed out that ESP methodology has been consistently applied to intellectual communication at large. Summing up the information it is important to say that as it is shown, terminologies of usage differ in various sciences, but the category of reproduction allows the learner to acquire proficiency in the use of neutral 'prefabricated units'.

5.4. Рекомендации для разработки проектов

Проектное обучение представляет собой технологию активной познавательной деятельности студентов, в основе которой лежит разработка в ходе самостоятельной (групповой или индивидуальной) исследовательской деятельности различных типов проектов – перспективных заданий, направленных на решение задач практики.

Участники проектной деятельности должны ответить на вопросы:

1. Что является целью проектной деятельности?
2. В чем актуальность (оригинальность, ценность) идеи проекта?
3. На решение каких задач практики он будет направлен?
4. Каков будет результат (продукт)?
5. Где он может быть применен?
6. Как он может изменить ситуацию?

Типы проектов в вузе:

– *исследовательские* проекты, подчиненные логике исследования и имеющие структуру, приближенную или полностью совпадающую с научным исследованием;

– *информационные* проекты (модуль исследовательского), направленные на поиск, знакомство и представление информации;

– *практикоориентированные* проекты, имеющие профессиональную направленность, результат которых ориентирован на социальные интересы самих студентов.

Процесс работы над проектом многоступенчатый. В таблице представлены этапы и содержание проектной деятельности.

Этапы работы над проектом	Содержание работы	Деятельность студентов
Подготовка	Определение реальной ситуации, ее осмысление, рождение задачи (проблемы) из описания ситуации, постановка вопросов	Анализируют ситуацию, выявляют проблему, рассматривают актуальность ее решения
Прогнозирование и целеполагание	Прогноз изменения ситуации, постановка личностных и коллективных целей, их осознание	Обсуждают. Прогнозируют. Определяют цели
Планирование	Определение источников, способов сбора и анализа информации, форм представления результатов. Установление критериев оценки процесса и результатов. Распределение задач между членами групп	Разрабатывают план действий. Определяют и распределяют задачи. Вырабатывают критерии оценки результатов
Реализация	Сбор информации. Работа над проектом. Решение промежуточных задач. Получение запланированных результатов	Выполняют свою часть проекта. Промежуточное обсуждение хода реализации проекта
Оформление и представление	Формы представления устного и письменного отчета. Оппонирование	Отчитываются, обсуждают, представляют результаты для внедрения в практику
Мониторинг и рефлексия	Интерпретация и анализ процесса и результата. Внешняя оценка. Рефлексия студентов по поводу авторства в проекте. Формулирование выводов. Новое целеполагание	Анализируют, интерпретируют, оценивают в ходе коллективного обсуждения и самооценок

Параметры внешней оценки проекта:

– значимость и актуальность проблемы;

– корректность используемых методов исследования и обработки полученных результатов;

– активность каждого члена проектной группы в соответствии с его индивидуальными возможностями;

– характер принимаемых решений, общения, взаимопомощи;

– глубина проникновения в проблему, привлечение знаний из других областей;

– эстетика оформления результатов проекта;

– умение аргументировать, доказывать, делать выводы и заключения, отвечать на вопросы.

5.5. Общие практические рекомендации для изучающих иностранный язык

Владение иностранным языком на современном этапе развития общества играет важную роль в формировании личности человека, свидетельствует о его высоком образовательном и культурном уровне. Изучение иностранного языка, с одной стороны, занятие довольно увлекательное, а с другой – очень непростое. Помимо интереса и желания оно требует больших усилий и терпения, значительных временных затрат, постоянной систематической работы.

Для организации успешной самостоятельной работы по овладению иностранным языком предлагаем вам несколько практических советов:

1. Регулярно занимайтесь языком. Не допускайте длительных перерывов, так как процесс забывания иноязычной информации происходит быстрее, чем в родном языке.

2. Составляйте собственный план работы над языком на день, неделю, месяц и старайтесь его выполнять.

3. Фиксируйте свои достижения в изучении иностранного языка. Помните, язык – беспредметен и безграничен, и каждое усвоенное слово или явление языка обогащает ваши знания.

4. Старайтесь сделать свои занятия разнообразными и интересными, используя различные виды деятельности: работу над произношением, выполнение грамматических упражнений, перевод, чтение вслух, прослушивание аудиокассет, просмотр телепрограмм, видеокассет или дисков с повторением и имитацией диктора, составление небольших ситуаций и рассказов, исполнение песен на иностранном языке и др.

5. Старайтесь больше учить наизусть стихов, песен, считалок, поговорок, диалогов, выражений речевого этикета, фрагментов текстов. Все это тренирует вашу память, расширяет ваши знания иностранного языка.

6. Будьте настойчивы и терпеливы в изучении языка. Здесь, как нигде, действует принцип перехода количественных изменений в качественные. Будьте активны, участвуйте во всех мероприятиях на иностранном языке, настраивайтесь на успех и добивайтесь его.

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