Московский государственный технический университет
имени Н.Э. Баумана

Методические указания

Л.И. Иванова

ОБУЧЕНИЕ ЧТЕНИЮ И УСТНОЙ РЕЧИ НА АНГЛИЙСКОМ ЯЗЫКЕ ПО СПЕЦИАЛЬНОСТИ «КОСМИЧЕСКИЕ ТРАНСПОРТНЫЕ СИСТЕМЫ»

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И20 Обучение чтению и устной речи на английском языке по специальности «Космические транспортные системы» : метод. указания / Л.И. Иванова. — М.: Изд-во МГТУ им. Н.Э. Баумана, 2012. — 40, [4] с. : ил.

В методических указаниях содержатся учебные материалы: тексты на английском языке, словарные терминологические блоки, предтекстовые и послетекстовые лексико-грамматические упражнения, способствующие пониманию и осмыслению прочитанного, а также упражнения, направленные на развитие навыков перевода. Особое внимание уделено упражнениям на развитие навыков устной речи по профессиональной тематике.

Для студентов старших курсов технических университетов, обучающимся по машиностроительным специальностям; методические указания могут быть использованы как для самостоятельной, так и для аудиторной работы под руководством преподавателя.

Рекомендовано Учебно-методической комиссий НУК ФН МГТУ им. Н.Э. Баумана.

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ПРЕДИСЛОВИЕ

Целью методических указаний является развитие и совершенствование навыков и умений устной речи на основе чтения текстов, заимствованных из профессионально-ориентированных английских сетевых ресурсов, в пределах тем, предусмотренных учебной программой. Учебные материалы состоят из трех тематических блоков, включающих терминологическую лексику, задания на проверку понимания прочитанного и рекомендации по созданию устных сообщений в режиме «презентация». В приложении содержатся дополнительные тексты и словарь.

Для студентов старших курсов технических университетов, обучающихся по машиностроительным специальностям. Методические указания могут быть использованы для изучения как под руководством преподавателя в аудитории, так и для самостоятельного обучения в удобное для студента время. Настоящие методические указания представлены в мультимедийном формате и размещены на портале МГТУ им. Н.Э. Баумана: http://linguist.bmstu.ru

SPACE TRANSPORTATION SYSTEM (PART 1)

INTRODUCTION

Try to give answers to the following questions.

1. What was the orbital spacecraft designed for?
2. How many astronauts could it carry?
3. What missions could the shuttle perform?
4. What assemblies was the shuttle composed of?
5. What was the shuttle carrying capacity?
6. What site was it launched from?
7. How long did the program exist?
8. What landing did it perform?
9. What is the “launch window”?
10. What program will come after this program is closed?

I. LANGUAGE WORK

New words and word combinations

1. recover *v*	возвращать
2. lifespan *n*	срок эксплуатации
3. capacity *n*	мощность, грузоподъемность
4. expendable *adj*	одноразовый
5. booster *n*	ускоритель
6. umbilical *n* [ʌm'bɪlɪkeəl]	кабель для связи космонавта с кораблем
7. sweep *v*	образовывать угол, отклоняться
8. edge *n*	кромка (крыла), край
9. trailing *adj*	находящийся сзади
10. rudder *n*	руль направления
11. hatch *n*	люк
12. payload bay *n*	грузовой отсек
13. retrieve *v*	перемещать, удерживать груз
14. flight deck	кабина экипажа (многоместная)
15. extravehicular activity	работа в открытом космосе, выход в открытый космос
16. deploy *v*	размещать

Glossary

1. Canadarm	The Shuttle Remote Manipulator System (a mechanical arm used to maneuver a payload)
2. umbilical	a cable which supplies the required consumables to astronauts
3. the Orbiter Boom Sensor System	a boom containing instruments to inspect the exterior of the shuttle for damage to the thermal protection system
4. extravehicular activity (EVA)	a work done by an astronaut away from the Earth, and outside of a spacecraft
5. double-delta wings	Greek delta (Δ). The inner part of the wing has a very high sweepback. The outer part has less sweepback to create the high-lift vortex to reduce the drag
6. body flap	The body flap thermally shields the three SSMEs during entry and provides the orbiter with pitch control trim during its atmospheric flight after entry

Nouns

1. edge	кромка
2. lifespan	срок эксплуатации
3. capacity	грузоподъемность
4. booster	ускоритель
5. bay	отсек
6. rudder	руль
7. hatch	люк
8. ascent	подъем
9. umbilical [ʌm'bɪlɪk(ə)l]	кабель, трос
10. thrust [θrʌst]	тяга

Adjectives

1. partial	частичный
2. expendable	одноразовый
3. manned	пилотируемый
4. external	внешний, подвесной
5. extravehicular	внебортовой, в открытом космосе
6. trailing	задний
7. unpowered	с выключенным двигателем
8. thermal	тепловой
9. remote	дистанционный
10. double swept	двойной стреловидности

Verbs

1. recover	возвращать
2. glide	планировать
3. refurbish	ремонтировать
4. retrieve	*зд.* удерживать, перемещать
5. strip off	отделяться
6. deploy	размещать
7. depressurize	сбрасывать давление
8. steer	управлять
9. maintain	обслуживать, ремонтировать
10. resemble	быть похожим

***Exercise 1*. Guess the meaning from the context.**

1. The tank and boosters are ***jettisoned*** ____________ during ascent, only the orbiter goes into orbit.

2. The External Tank is ***discarded*** ____________ 8.5 minutes after the launch at the altitude ____________ of 60 nautical miles (111 km) and then burns up on reentry.

3. The Solid Rocket Booster ***cases*** ____________ are made of steel about ½ inch (1.27 cm) thick.

4. The Shuttle was originally ***conceived*** ____________ to operate like an airliner.

5. The Space Shuttle program is the most important earth-orbit space program ever ***undertaken*** ____________ by the United States.

6. The typical STS mission profile ***involves*** ____________ duration of seven days.

7. Boeing and NASA have developed a concept for a system that was very much like the ***ultimate*** ____________ STS.

8. An electrical discharge (arc) is created in a flow of propellant (typically hydrazine or ammonia). This ***imparts*** ____________ the additional energy to the propellant.

II. READING

***Read and translate text 1A and answer the questions* (*see exersise 4*).**

1A. Space Shuttle program

1. NASA's Space Shuttle, officially called Space Transportation System (STS), was the United States government's manned launch vehicle. The winged shuttle orbiter was launched vertically, usually carrying five to seven astronauts (although eight have been carried) and up to 22,700 kg of payload into the low earth orbit. When its mission was complete, it re-entered the earth's atmosphere and made an unpowered horizontal landing.

2. The Shuttle was the first orbital spacecraft designed for partial reusability. It was also so far the only winged manned spacecraft to achieve orbit and land. It carried large payloads to various orbits, provided crew rotation for the International Space Station

(ISS), and performed servicing missions. The orbiter could recover satellites and other payloads from orbit. However, it has been used to return large payloads from the ISS to earth, as the Russian Soyuz spacecraft has limited capacity to return payloads. Each Shuttle was designed for a projected lifespan of 100 launches or 10 years' operational life.

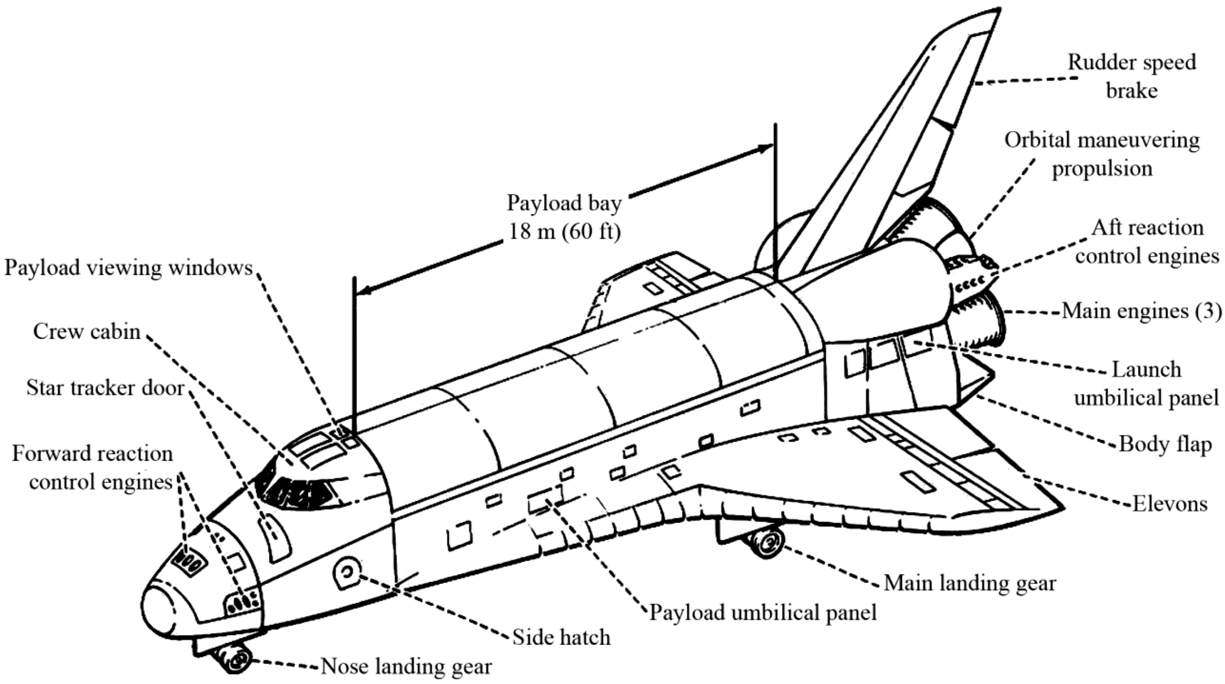


Fig. 1a. Description

3. The Shuttle is a partially reusable launch system composed of three main assemblies: the reusable Orbiter Vehicle (OV), the expendable External Tank (ET), and the two reusable Solid Rocket Boosters (SRBs). The tank and boosters are jettisoned during ascent; only the orbiter goes into orbit. The vehicle is launched vertically like a conventional rocket, and the orbiter glides to a horizontal landing, after which it is refurbished for reuse.

4. The Orbiter resembles an airplane with double-delta wings, swept 81° at the inner leading edge and 45° at the outer leading edge. The four elevons, mounted at the trailing edge of the wings, and the rudder/speed brake, attached at the trailing edge of the stabilizer, with the body flap control the Orbiter during descent and landing.

5. The Orbiter's crew cabin consists of three levels: the flight deck, the mid-deck, and the utility area. The upper-most is the flight deck which seats the commander and pilot, with two mission specialists behind them. The mid-deck, which is below the flight deck, has three more seats for the rest of the crew members. There is also the galley, toilet, sleep locations, storage lockers, and the side hatch for entering/exiting the vehicle. The airlock has another hatch into the payload bay. It allows two astronauts, wearing their Extravehicular Mobility Unit (EMU) space suits, to depressurize before a space walk.

6. The Orbiter has a large 60 by 15 ft (18 m by 4.6 m) payload bay, filling most of the fuselage. The payload bay doors have heat radiators mounted on their inner surfaces,

and so are kept open for thermal control while the Shuttle is in orbit. Thermal control is also maintained by adjusting the orientation of the Shuttle relative to the Earth and the Sun. Inside the payload bay is the Remote Manipulator System, also known as the Canadarm, a robot arm used to retrieve and deploy payloads. Since the arm was a crucial part of the Thermal protection inspection procedures were required for Shuttle flights.

(*2619 characters*)

Word combinations

1. government's manned launch vehicle	пилотируемый летательный аппарат, выполненный за счет средств бюджета
2. the winged shuttle orbiter	крылатый орбитальный летательный аппарат
3. to carry payload into the low earth orbit	доставлять полезную нагрузку на низкую околоземную орбиту
4. unpowered horizontal landing	горизонтальное свободное планирование
5. a projected lifespan	проектный срок эксплуатации
6. a partially reusable launch system	ракета-носитель с блоками многократного применения
7. the expendable external tank	одноразовый внешний (подвесной) бак
8. the reusable solid rocket boosters	твердотопливные ускорители многократного применения
9. double-delta wings	треугольное крыло с изломом передней кромки
10. the inner (outer) leading edge	внутренняя (внешняя) передняя кромка
11. the trailing edge of the wing	задняя кромка крыла
12. the extravehicular mobility unit	передвижной блок для работы в космосе
13. the remote manipulator system	система манипулятора с дистанционным управлением
14. the thermal protection inspection procedures	порядок проверки тепловой защиты
15. the payload bay doors	двери грузового отсека

III. LANGUAGE PRACTICE

Exercise 2. **Translate the word combinations.**

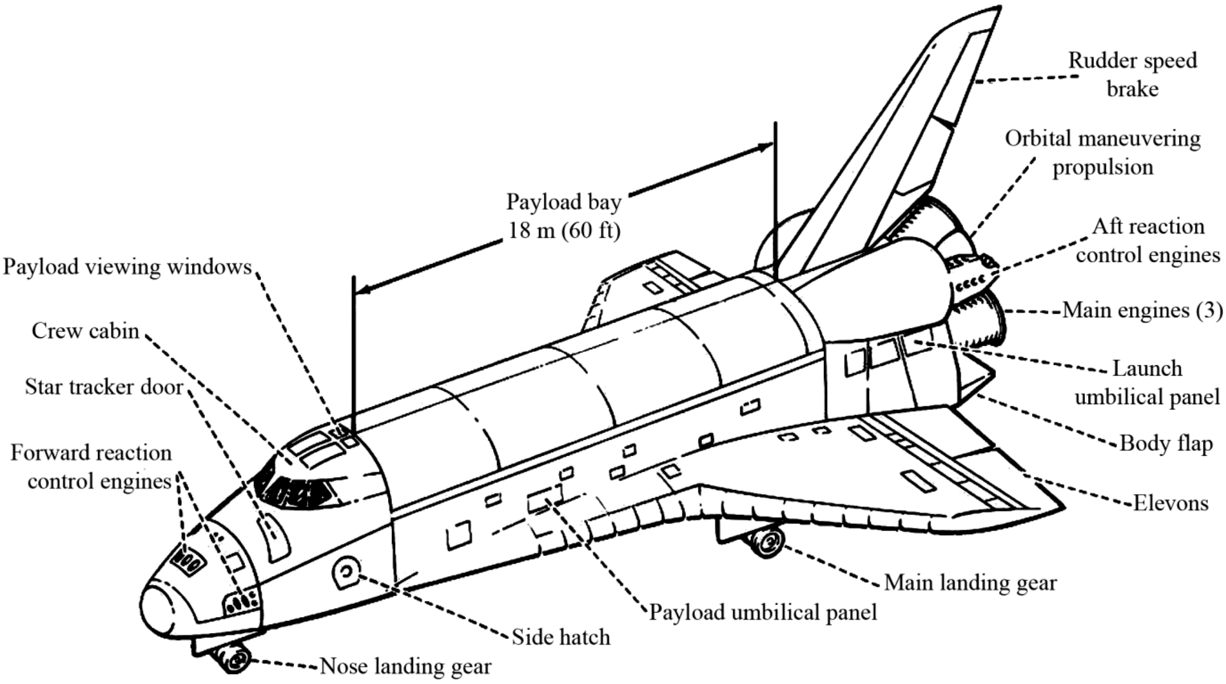


Fig. 2. Terms

Word combinations	Translation
1. Forward reaction control engines	
2. Star tracker door	
3. Crew cabin	
4. Payload viewing window	
5. Payload bay	
6. Rudder/speed brake	
7. Orbital maneuvering propulsion	
8. Aft reaction control engines	
9. Main engines	
10. Launch umbilical panel	
11. Body flap	
12. Elevon	
13. Main landing gear	
14. Payload umbilical panel	
15. Side hatch	
16. Nose landing gear	

Exercise 3. **Complete the sentences.**

1. When its mission was complete	a. satellites and payloads from orbit
2. The shuttle orbiter provided	b. for a lifespan of hundred launches
3. The shuttle consists of three main assemblies	c. to retrieve and deploy payloads
4. The Orbiter could recover	d. it made an unpowered horizontal landing
5. Each Shuttle was designed	e. crew rotation, satellites recovery and servicing missions
6. The Orbiter resembled	f. were kept open for thermal control
7. The payload bay doors	g. the reusable orbiter, the external tank and the solid rocket boosters
8. The remote manipulator system was used	h. an airplane with double-delta wings
9. The reusable solid rocket boosters	i. to adjust the Shuttle relative to the Earth and the Sun
10. The Orbiter Boom Sensor System	j. were separated when the required altitude was reached
	k. inspects the exterior of the shuttle for damage to the thermal protection system

1	2	3	4	5	6	7	8	9	10

Exercise 4. **Answer the questions. Choose the key words for your answers.**

1. What landing does it make when its mission is complete?	a. hundred launches or operational life of ten years
2. What was the orbital spacecraft designed for?	b. the four elevons and the rudder
3. What was a projected lifespan of each shuttle?	c. three main assemblies: OV, ET and two SRB
4. What assemblies is the shuttle composed of?	d. to retrieve and deploy payloads
5. What happens to the boosters and the tank during the ascent?	e. three levels: the flight deck, the mid-deck and the utility area
6. What was the shuttle carrying capacity?	f. they are jettisoned and only the orbiter goes into orbit
7. What controlled the orbiter during descent and landing?	g. adjusting the shuttle orientation relative to the Earth and the Sun
8. What levels does the orbiter crew cabin consist of?	h. seven astronauts and 22,700 kg of payload
9. What were the means of maintaining thermal control while the Shuttle was in orbit?	i. to recover satellites and payloads, to provide crew rotation
10. What was the Remote Manipulator System (rotate arm) inside the payload bay used for?	j. operational reliability
	k. an unpowered horizontal landing

1	2	3	4	5	6	7	8	9	10

Exercise 5. **Nouns. Match the right and left items.**

1. edge	a. отсек
2. lifespan	b. грузоподъемность
3. capacity	c. кабель
4. booster	d. подъем
5. bay	e. кромка
6. rudder	f. люк
7. hatch	g. ускоритель
8. ascent	h. тяга
9. umbilical	i. руль
10. thrust	j. срок эксплуатации

1	2	3	4	5	6	7	8	9	10

Exercise 6. **Verbs. Match the right and left items.**

1. recover	a. возвращать
2. glide	b. размещать
3. refurbish	c. удерживать, перемещать
4. retrieve	d. сбрасывать давление
5. strip off	e. ремонтировать
6. deploy	f. обслуживать, ремонтировать
7. depressurize	g. отделяться
8. steer	h. планировать
9. maintain	i. быть похожим
10. resemble	j. управлять

1	2	3	4	5	6	7	8	9	10

Exercise 7. **Adjectives. Match the right and left items.**

1. partial	a. внешний, подвесной
2. expendable	b. задний
3. manned	c. частичный
4. external	d. одноразовый
5. extravehicular	e. с выключенным двигателем
6. trailing	f. внебортовой, в открытом космосе
7. unpowered	g. пилотируемый
8. thermal	h. двойной стреловидности
9. remote	i. тепловой
10. double swept	j. дистанционный

1	2	3	4	5	6	7	8	9	10

Exercise 8. **Give the English equivalents to the following terms (see fig. 1б).**

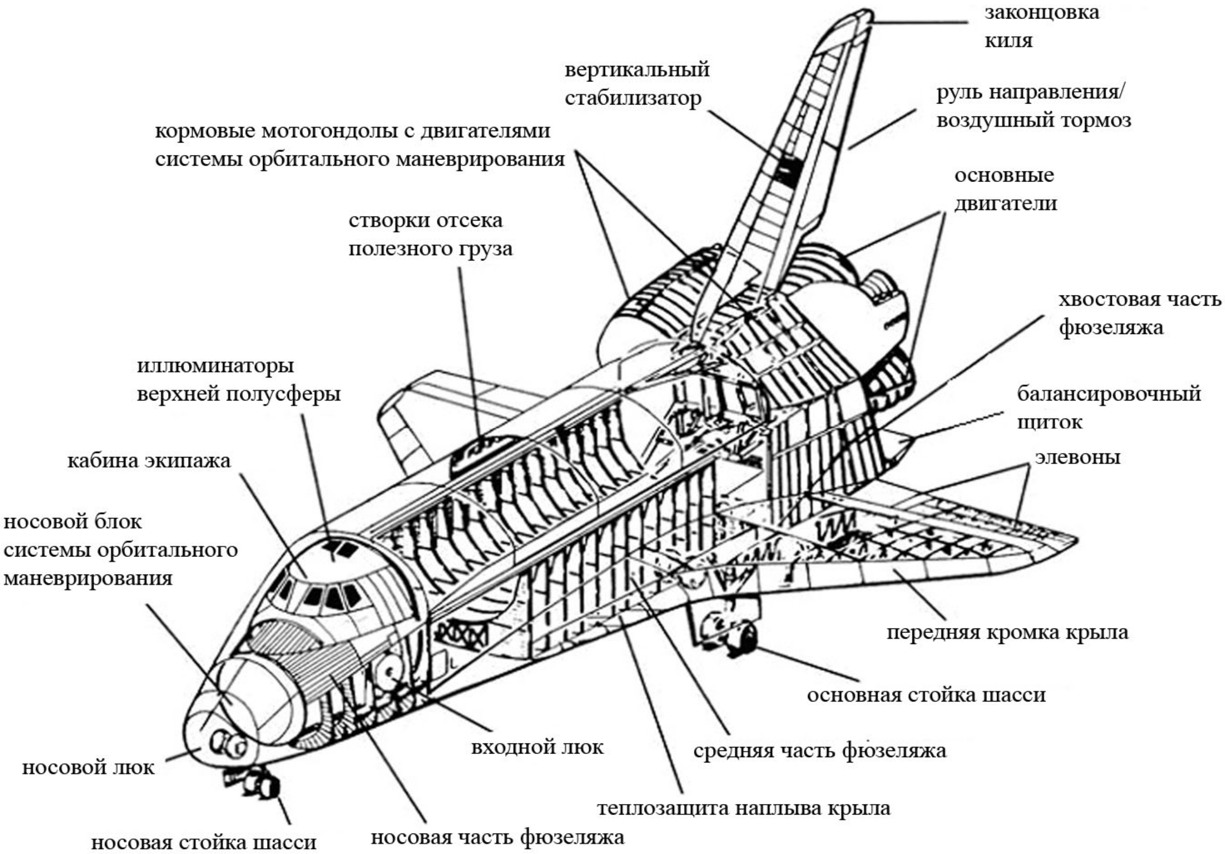
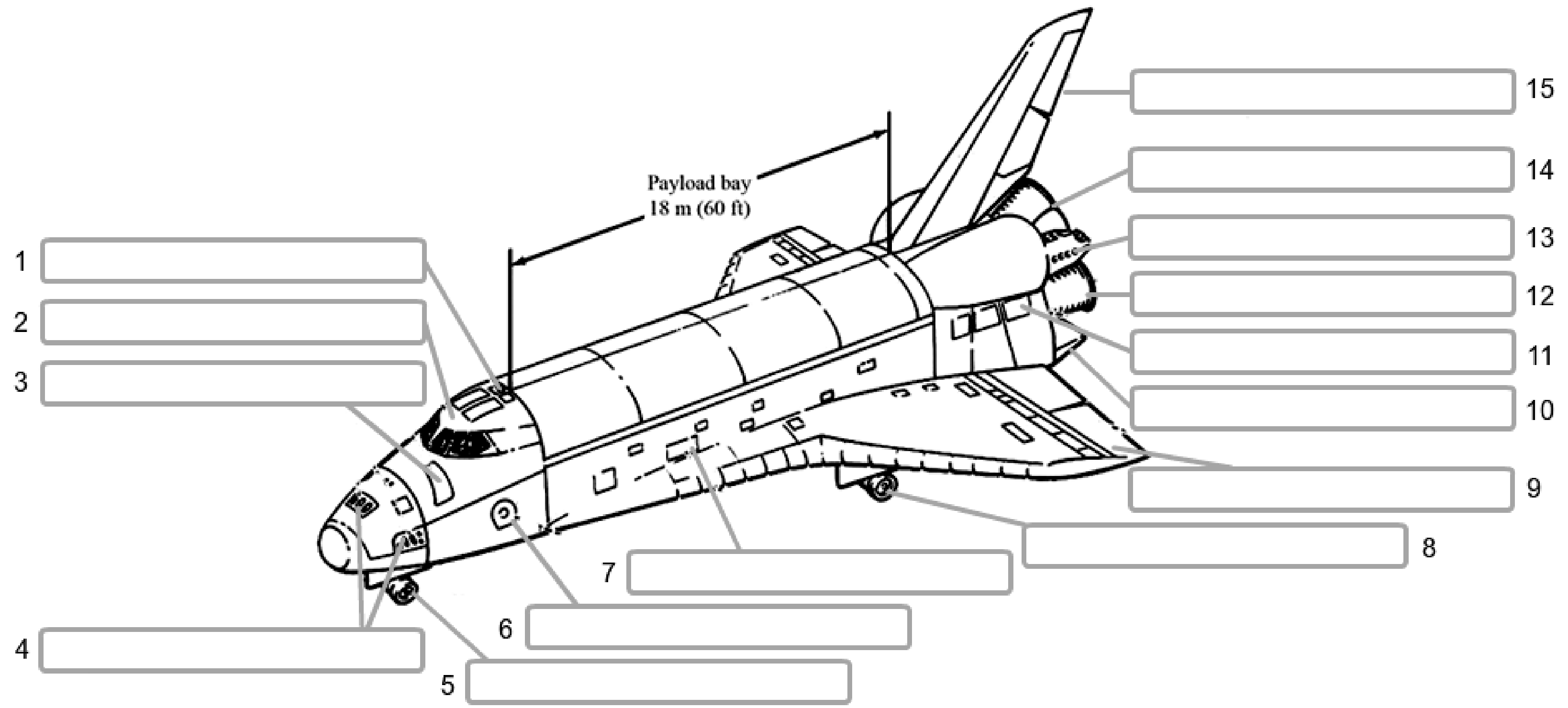


Fig. 1б. Основные элементы конструкции орбитального корабля

Word combinations	Translation
1. носовой люк	
2. носовая стойка шасси	
3. носовая часть фюзеляжа	
4. входной люк	
5. теплозащита наплыва крыла	
6. основная стойка шасси	
7. передняя кромка крыла	
8. балансировочный щиток	
9. руль направления/воздушный тормоз	
10. законцовка киля	
11. кормовые мотогондолы с двигателями системы орбитального маневрирования	
12. створки отсека полезного груза	
13. иллюминаторы верхней полусферы	

Exercise 9. **Fill the boxes (see fig. 2).**

Rudder speed brake	Launch umbilical panel	Aft reaction control engines
Main engines (3)	Main landing gear	Side hatch
Body flap	Elevons	Forward reaction control engines
Payload umbilical panel	Crew cabin	Payload viewing windows
Star tracker door	Orbital maneuvering propulsion	Nose landing gear



IV. SPEAKING ACTIVITIES

Exercise 10. **Listen to the report on Shuttle Launching, fill in the missing parameters of the flight, please. Convert into metric units (see p. 37):**

a. the altitude … miles.
b. the external tank and boosters weight … pounds.
c. the propellant burnt every second is … .

Movie: http://linguist.bmstu.ru/

Exercise 11. **Make reports supported by slides on the following topics.**

1. Space Shuttle Program (Historical Background).
2. Shuttle failures and delays.
3. Shuttle Launching.
4. Shuttle engines.
5. Shuttle boosters.
6. Shuttle vs Buran.
7. Rendezvous and docking.
8. New program (Ares).

Consult "Presenting a paper", p. 34, 35. Make about from ten to fifteen slides.

Use the following Internet resources.

Links

1. http://en.wikipedia.org/wiki/Space_Shuttle_program
2. http://www.nasa.gov/
3. http://www.nasa.gov/pdf/304681main_sts119_press_kit.pdf
4. http://www.buran-energia.com/
5. http://www.infovisual.info/

and others.

SPACE TRANSPORTATION SYSTEM (PART 2)

INTRODUCTION

Try to give answers to the following questions.

1. What pattern are the main engines arranged?
2. What was its thermal protection system made of?
3. Why was the external tank of orange-brown color?
4. How many shuttle computers provided reliability?
5. What propellant was used for the shuttle main engines?
6. What were the solid rocket boosters used for?
7. What maneuvers did the shuttle perform?
8. What maneuvers were provided by the Reaction Control System?
9. What types of engines was the shuttle powered by?

I. LANGUAGE WORK

New words and word combinations

1. aft *n*	хвостовая часть
2. triangular *adj*	треугольный
3. swivel *v*	поворачиваться
5. insertion *n*	выведение
6. rendezvous *n*	сближение
7. abort once around	аварийное завершение полета после первого витка
8. altitude *n*	высота
9. pitch *n*	угол тангажа; тангаж
10. yaw *n*	рыскание
11. roll *n*	крен
12. reentry *n*	вход в плотные слои атмосферы
13. foam insulation	пенная изоляция
14. attitude *n*	ориентация в пространстве
15. fly-by-wire system *n*	электрическая система управления полетом
16. redundant *adj*	дублирующий
17. embeded *adj*	встроенный
18. survivable *adj*	способный к выживанию
19. pod	подвеска двигателя

Abbreviations

1. OMS	orbital maneuvering system — система орбитального маневрирования
2. RCS	reaction control system — реактивная система управления
3. SRBs	solid rocket boosters — твердотопливные ускорители
4. ET	external tank — внешний бак
5. TPS	thermal protection system — система теплозащиты
6. DPS	data processing system — система обработки данных
7. SSME	space shuttle main engine — основной двигатель (маршевый)

Glossary

1. abort once around (AOA)	This mode is available when the shuttle cannot reach a stable orbit but has sufficient velocity to circle the Earth once and land about 90 minutes after lift-off.
2. abort to orbit (ATO)	Allows the shuttle to fly at a lower orbit. The mission control can evaluate the problems and allow the shuttle to go into a higher orbit (and continue the mission).
3. long-time attitude hold	The maintained fixed position in space of the orbiter during docking or an astronaut during EVA.
4. specific impulse	It is a way to describe the efficiency of rocket and jet engines. It represents the impulse (change in momentum) per unit amount of propellant used.
5. dogleg	A horizontal swerve (отклонение) in a rocket launch trajectory.
6. vernier thruster	It is used on a spacecraft for fine adjustments to the attitude or velocity of a spacecraft.
7. Hall effect thruster (a plasma thruster)	A small rocket engine that uses a powerful magnetic field to accelerate a low density plasma to produce thrust. This is a form of electrostatic propulsion.
8. arcjet	Is a form of electric propulsion for spacecraft. An electrical discharge (arc) is created in a flow of propellant (typically hydrazine or ammonia). This imparts the additional energy to the propellant.

Nouns

1. altitude	высота
2. pitch	тангаж
3. yaw	рыскание
4. roll	крен
5. insulation	изоляция
6. attitude	ориентация в пространстве
7. insertion	выведение (на орбиту)
8. rendezvous ['rɔndɪvu:]	сближение до соединения
9. propellant [prə'pelənt]	топливо
10. thruster	рулевой двигатель

Verbs

1. swivel	поворачиваться
2. recover	восстанавливать
3. steer	управлять
4. jettison	сбрасываться
5. run software	запускать программу
6. translate	перемещаться
7. house	вмещать
8. perform	выполнять
9. pressurize	повышать давление
10. distribute	распределять

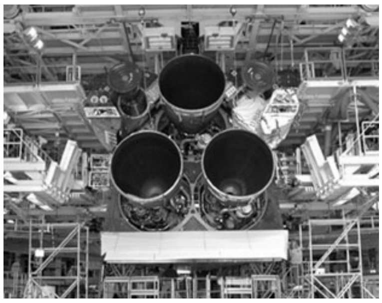
Adjectives

1. triangular	треугольный
2. redundant	дублирующий
3. embedded	встроенный
4. backup	резервный
5. subsequent	последующий
6. identical	идентичный
7. survivable	способный к выживанию
8. nautical	морской
9. predetermined	заданный
10. specific	удельный

II. READING

1B. Space Shuttle Main Systems

A



1. Three Space Shuttle Main Engines (SSMEs) are mounted on the Orbiter's aft fuselage in a triangular pattern. The three engines can swivel 10.5 degrees up and down and 8.5 degrees from side to side during ascent to change the direction of their thrust and steer the Shuttle as well as push. (See also Exercise 22 p. 24 Text 1. Space Shuttle Main Engines).

2. The Orbital Maneuvering System (OMS) provides the thrust for orbit insertion, orbit circularization, orbit transfer, rendezvous, deorbit, abort to orbit and abort once around. OMS is housed in two independent pods located on each side of the orbiter's aft fuselage. Each pod contains one OMS engine (AJ10-190) and the hardware needed to pressurize, store and distribute the propellants to perform the velocity maneuvers. The two pods provide redundancy for the OMS. The fuel used is monomethylhydrazine (MMH), which is oxidized with nitrogen tetroxide (N2O4). The vehicle velocity required for orbital adjustments is approximately 2 feet per second for each nautical mile of altitude change. After the main engine cutoff, the RCS thrusters in the forward and aft RCS pods are used to provide attitude hold until external tank separation.

3. During the first OMS thrusting period, both OMS engines are used to raise the orbiter to a predetermined elliptical orbit. During the thrusting period, vehicle attitude is maintained by gimbaling (swiveling) the OMS engines. If, during an OMS thrusting period the OMS gimbal limits are exceeded, RCS attitude control is required. If only one OMS engine is used during an OMS thrusting period, RCS roll control is required.

4. The Reaction Control System (RCS) provides attitude control and translation along the pitch, roll, and yaw axes during the flight phases of orbit insertion, orbit, and reentry. Its purpose is attitude control and steering. An RCS system is capable of providing small amounts of thrust in any desired direction or combination of directions. An RCS is also capable of providing torque to allow control of rotation (pitch, yaw, and roll). But a spacecraft's main engine is only capable of providing thrust in one direction.

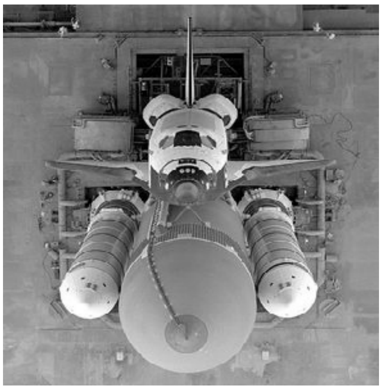
5. RCS systems often use combinations of large and smaller (vernier) thrusters, to allow different levels of response from the combination. Reaction control systems are used: for attitude control during re-entry, for station keeping in orbit, for close maneuvering during docking procedures. Because a spacecraft contains only a finite amount of fuel some alternative reaction control systems have been developed so that fuel can be conserved. For station keeping, some spacecraft (particularly those in geosynchronous orbit) use high-specific impulse engines such as arcjets, ion thrusters, or Hall effect thrusters.

(*2319 characters*)

B

1. The Thermal Protection System (TPS) covers the outside of the Orbiter, protecting it from the cold soak of -121 °C (-250 °F) in space to the 1649 °C (3000 °F) heat of reentry. The orbiter structure is made primarily from aluminum alloy, although the engine thrust structure is made from titanium.

2. The External Tank (ET) provides 2.025 million liters (535,000 gallons) of liquid hydrogen and liquid oxygen propellant to the SSMEs . It is discarded 8.5 minutes after launch at an altitude of 60 nautical miles (111 km), which then burns up on reentry. The ET is constructed mostly of 1/8 inch thick aluminum-lithium alloy. The external tanks of the first two missions were painted white, which added an extra 600 pounds (273 kg) of weight to each ET. Subsequent missions had unpainted tanks showing the natural orange-brown color of the spray-on foam insulation. The lighter unpainted tanks have increased the payload capacity by almost the entire weight savings of 600 pounds.



3. Two Solid Rocket Boosters (SRBs) provide about 83% of the vehicle's thrust at liftoff and during the first stage ascent. They are jettisoned two minutes after launch at a height of about 150,000 feet (45.7 km), then deploy parachutes and land in the ocean to be recovered. The SRB cases are made of steel about half an inch (1.27 cm) thick.

(*1100 characters*)

Word combinations

1. the orbiter's aft fuselage	хвостовая часть фюзеляжа
2. to swivel up and down during ascent	поворачиваться вверх и вниз при подъеме
3. translation along the pitch, roll and yaw axes	перемещение вдоль осей тангажа, крена и рыскания
4. the engine thrust structure	рама крепления двигателя
5. subsequent missions	последующие полеты
6. the spray-on foam insulation	пенная изоляция, нанесенная распылением
7. the payload capacity	максимальная грузоподъемность
8. turnaround process	полет туда и обратно
9. survivable abort modes	режимы аварийного прекращения полета с сохранением живучести
10. the backup flight system	резервная (дублирующая) система

III. LANGUAGE PRACTICE

***Exercise 12*. Match the right and the left items.**

1. a partially reusable launch system	a. одноразовый наружный (подвесной) бак
2. the expendable external tank (ET)	b. пенная изоляция, нанесенная распылением
3. extravehicular mobility unit	c. рама крепления двигателя
4. double-delta wings	d. поворачиваться вверх и вниз при подъеме
5. engine thrust structure	e. перемещение вдоль осей тангажа
6. translation along the pitch, roll and yaw axes	f. режимы аварийного прекращения полета с сохранением живучести
7. the spray on foam insulation	g. ракета-носитель с блоками многократного управления
8. the back up flight system	h. треугольное крыло с изломом передней кромки
9. to swivel up and down during ascent	i. резервная (дублирующая) система
10. survivable abort modes	j. передвижной блок для работы в открытом космосе

1	2	3	4	5	6	7	8	9	10

***Exercise 13.* Answer the questions. Choose the key words for your answers.**

1. According to what pattern are the main engines arranged?	a. attitude control, translation along the pitch and yaw and roll axes
2. What maneuvers are provided by the Orbital Maneuvering System?	b. by swiveling the OMS engines
3. What does the Reaction Control System provide?	c. thrusters or Reaction Control System
4. What temperatures can the thermal protection system withstand?	d. for it does rendezvous in orbit
5. What is the external tank made from?	e. insertion, circularization, transfer, rendezvous, abort once around
6. What is the advantage of the unpainted external tank?	f. has increased the payload capacity by almost the entire weight savings of 600 pounds
7. What is the orbiter attitude during the first thrusting period maintained by?	g. 1/8 inch thick aluminum-lithium alloy
8. Why is the Shuttle design provided with so many engines?	h. in triangular pattern
9. What thrusters are used for station keeping?	i. cold soak and heat reentry
10. What alternative RCS are used to save the fuel?	j. high-specific impulse engines, arcjets and ion thrusters
	k. liquid hydrogen and liquid oxygen

1	2	3	4	5	6	7	8	9	10

Exercise 14. **What is provided by a shuttle system? Find the answers.**

1. OMS provides	a. attitude control and translation along the roll, pitch and yaw axes
2. RCS provides	b. protection from the cold soak and the heat of reentry
3. SRBs provide	c. the Shuttle steering and pushing
4. ET provides	d. fail safe reliability
5. TPS protects	e. liquid hydrogen and liquid oxygen propellant
6. DPS provides	f. insertion, rendezvous, abort once around and other orbital maneuvers
7. SSMEs provide	g. about 83 % of the vehicle thrust at lift off

1	2	3	4	5	6	7

Exercise 15. **Fill in the necessary prepositions (they may be used more than once):**

a. at **b.** to **c.** along **d. for** **e.** with **f.** before

1. The orbiter is launched vertically carrying five ____________ seven astronauts.
2. The shuttle is designed ____________ partial reusability.
3. The orbiter resembles an airplane ____________ double-delta wings.
4. The mid-deck has three more seats ____________ the rest of the crew members.
5. The Reaction Control System provides attitude control ____________ the pitch and roll axes.
6. Advances in technology ____________ the last decade have made probes smaller and lighter.
7. The primary concern ____________ shuttle computer system is reliability.

1	2	3	4	5	6	7

Exercise 16. **Nouns. Match the right and left items.**

1. altitude	a. изоляция
2. pitch	b. топливо
3. yaw	c. выведение (на орбиту)
4. insulation	d. высота
5. attitude	e. подвеска двигателя
6. insertion	f. ориентация в пространстве
7. rendezvous	g. рулевой двигатель
8. propellant	h. рыскание
9. thruster	i. сближение до стыковки
10. pod	j. тангаж

1	2	3	4	5	6	7	8	9	10

Exercise 17. **Verbs. Match the right and left items.**

1. swivel	a. восстанавливать
2. recover	b. поворачиваться
3. steer	c. сбрасываться
4. jettison	d. вмещать
5. run software	e. перемещаться
6. translate	f. распределять
7. house	g. запускать программу
8. perform	h. управлять
9. pressurize	i. выполнять
10. distribute	j. повышать давление

1	2	3	4	5	6	7	8	9	10

Exercise 18. **Adjectives. Match the right and left items.**

1. triangular	a. задний
2. redundant	b. резервный
3. embedded	c. треугольный
4. backup	d. способный к выживанию
5. subsequent	e. дублирующий
6. aft	f. заданный
7. survivable	g. последующий
8. nautical	h. удельный
9. predetermined	i. встроенный
10. specific	j. морской

1	2	3	4	5	6	7	8	9	10

Exercise 19. **Fill in the words where necessary:**

to accommodate, thrust, are jettisoned, the external tank, thrusters, the hatches, reentry, specific impulse.

1. There are fewer abort options during ____________ and descent.

2. East Coast Abort Landings (ECAL) are designed to permit the Orbiter to reach an emergency runway along the east coast of North America but the emergency sites are not well equipped ____________ an Orbiter landing.

3. The space shuttle flight control system directed the ____________ of the three shuttle main engines and the two SRB nozzles to control shuttle attitude and trajectory during lift- off and ascent.

4. The propellant mixture in each SRB motor develops a ____________ of 242 seconds at sea level or 268 seconds in a vacuum.

5. The SRBs ____________ from the space shuttle at high altitude (146,000 feet).

6. The SRBs separate from ____________ within 30 milliseconds of the ordnance firing command.

7. The solar arrays on the ISS are adjusted so they face the Shuttle — this prevents damage or contamination from exhaust created by the Shuttle's ____________ .

8. Astronauts can float through ____________ to visit, study, work, deliver supplies, and take away items no longer needed.

9. If the shuttle was initially designed with a cabin escape system, a significant ____________ penalty might have been added.

***Exercise 20*. Translate the sentences paying attention to the Participle and its functions.**

1. The abort modes cover a wide range of problems, but the most commonly expected problem is the Space Shuttle main engines failure, creating inability to either cross the Atlantic or achieve orbit, depending on timing and number of failed engines.

2. Since the destruction of Space Shuttle Columbia during STS-107, NASA has outfitted the Canadarm — a mechanical arm used on the Space Shuttle to maneuver a payload with the Orbiter Boom Sensor System, a boom containing instruments to inspect the exterior of the shuttle for damage to the thermal protection system.

***Exercise 21*. Read the text. Underline the key words and word combinations (10–15), covering the context of the text. Write the title.**

1. The Challenger accident originated with a design flaw and system failure of one of its SRBs. The cause of the accident was found to be a faulty design of the SRB joints. The commission found that the large rubber “O-rings” in SRB joints were not effective at cold temperatures like those of the January 1986 morning of the accident (36 deg F). A cold weather-compromised joint in the right SRB failed at launch and eventually allowed hot gases from within that rocket to sear a hole into the adjacent external tank and also weaken the lower strut holding the SRB to the external tank. The leak in the SRB joint caused a catastrophic failure of the lower strut and breach of the external tank: a massive explosion fueled by hydrogen and oxygen was the result.

2. During the subsequent downtime, detailed structural analyses were performed on critical structural elements of the SRB. Analyses were primarily focused in areas where anomalies had been noted during postflight inspection of recovered hardware. One of the areas was the attachment ring where the SRBs are connected to the external tank. Areas of distress were noted in some of the fasteners where the ring attaches to the SRB motor case. This situation was attributed to the high loads encountered during water impact. To correct the situation and ensure higher strength margins during ascent, the attach ring was redesigned to encircle the motor case completely (360 degrees). Previously, the attachment ring formed a ‘C’ shape and encircled the motor case just 270 degrees.

3. Additionally, special structural tests were performed on the aft skirt. During this test program, an anomaly occurred in a critical weld between the hold-down post and skin of the skirt. A redesign was implemented to add reinforcement brackets and fittings

in the aft ring of the skirt. These two modifications added approximately 450 lb (200 kg) to the weight of each SRB. The result is called a “Redesigned Solid Rocket Motor” (RSRM).

(*1724 characters*)

Exercise 22. **Translate consulting a dictionary.**

Text 1. Space Shuttle Main Engines

1. The three Space Shuttle Main Engines, in conjunction with the Solid Rocket Boosters, provide the thrust to lift the Orbiter off the ground for the initial ascent. The main engines continue to operate for 8.5 minutes after launch, the duration of the Shuttle’s powered flight. Each Space Shuttle Main Engine operates at a liquid oxygen/liquid hydrogen mixture ratio of 6 to 1 to produce a sea level thrust of 179,097 kilograms (375,000 pounds) and a vacuum thrust of 213,188 (470,000 pounds). As the Shuttle accelerates, the main engines burn a half-million gallons of liquid propellant provided by the large, orange external fuel tank.

2. After the solid rockets are jettisoned, the main engines provide thrust which accelerates the Shuttle from 4,828 kilometers per hour (3,000 mph) to over 27,358 kilometers per hour (17,000 mph) in just six minutes to reach orbit. They create a combined maximum thrust of more than 1.2 million pounds.

3. The engines’ exhaust is primarily water vapor as the hydrogen and oxygen combine. As they push the Shuttle toward orbit, the engines consume liquid fuel at a rate that would drain an average family swimming pool in under 25 seconds generating over 37 million horsepower. Their turbines spin almost 13 times as fast as an automobile engine spins when it is running at highway speed.

4. The main engines develop thrust by using high-energy propellants in a staged combustion cycle. The propellants are partially combusted in dual preburners to produce high-pressure hot gas to drive the turbopumps. Combustion is completed in the main combustion chamber. Temperatures in the main engine combustion chamber can reach as high as 6,000 degrees Fahrenheit (3,315.6 degrees Celsius).

5. The engines can be throttled over a thrust range of 65 percent to 109 percent, which provides for a high thrust level during liftoff and the initial ascent phase but allows thrust to be reduced to limit acceleration to 3 g's during the final ascent phase. The engines are gimbaled to provide pitch, yaw and roll control during the ascent.

(*1725 characters*)

I. SPACE TRANSPORTATION SYSTEM. BURAN VS SHUTTLE (PART 3)

I. LANGUAGE WORK

New words and word combinations

1. predecessor *n*	предшественник
2. cargo delivery	доставка груза
3. tile *n*	плитка
4. wind tunnel tests	испытания в аэродинамической трубе
5. to perform a sliding descent	выполнять скользящий спуск
6. reusable thermal protection system	теплозащитное многократного применения
7. outside surface curvature	кривизна внешней поверхности
8. cuts and notches	разрезы и вырезы
9. high lift-to-drag ratio	высокое аэродинамическое качество
10. the lay-out pattern	образец компоновки

***Exercise 23*. Guess the meaning of the marked words without a dictionary.**

1. Whereas the cargo flow on the Earth-orbit increased the development of reusable vehicles of large carrying capacity has become ***inevitable*** ____________.

2. During descending from a space orbit the orbiter ***experienced*** ____________ large hypersonic (M-25) up to landing (M = 0,2) speeds.

3. One of the most noticeable ***distinctions*** ____________ between NASA STS and Buran is that the Soviets placed the liquid fuel engines on the base of the fuel tank, rather than on the back of the shuttle.

***Exercise 24*. Match the pairs of synonyms.**

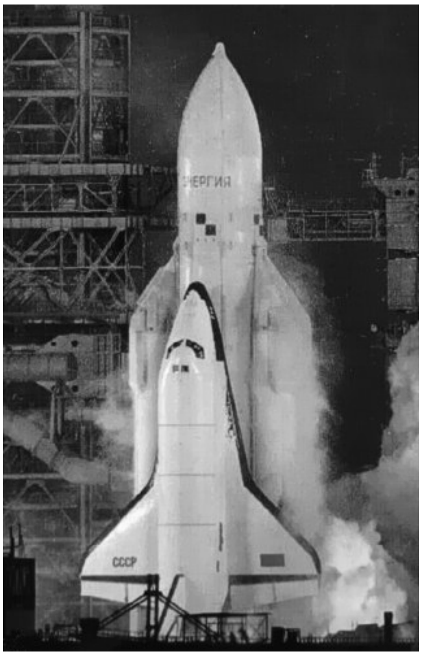
1. distinctions	a. main
2. size	b. payload
3. perform	c. dimensions
4. accommodate	d. pattern
5. scheme	e. house
6. core	f. make
7. propellant	g. differences
8. cargo	h. fuel

1	2	3	4	5	6	7	8

II. READING

1C. Russian Space Transportation System BURAN

A



1. The BURAN predecessors: VOSTOK and SOYUS vehicles were intended only for crew flights, PROGRESS — for cargo delivery onto the orbital station. Whereas the cargo flow on the Earth-orbit increased the development of reusable vehicles of large carrying capacity has become inevitable.

2. The BURAN orbiter is able to put up to 30 tons into Space and to return up to 20 tons of payload to the Earth. A cargo compartment of impressive sizes permits to transport orbital station modules up to 17 m long and 4,5 m in diameter, and 2–4 crew members and up to 6 passengers can be accommodated in a crew cabin.

3. During descending from a space orbit it experienced large hypersonic (M-25) up to landing (M = 0,2) speeds. In this connection the aerodynamic scheme without a horizontal tail with a double swept wing, with elevons, rudder-aerodynamic brake and balance flap as control surfaces has been chosen. This assembly has been worked out during wind tunnel tests and evaluated in the BOR-5 suborbital flying model flights.

4. Having made two unmanned turns around the Earth it performed an automatically controlled touch with the accuracy the experienced pilots could envy. It was the first automatic landing of a space plane. The Soviets added a pair of jet engines to the aft end of their orbiter so that the final stage of landing could be performed under power. By contrast, the US orbiter is unpowered and must glide to its landing. Expendable space vehicles perform a ballistic or sliding descent in the atmosphere and parachute landing.

(*1273 characters*)

B

1. In overall design Buran is nearly identical to the American STS. A critical difference between the two shuttle designs is in their rocket systems. Energia is a heavy lift rocket capable of sending up to 100 tones in standard mode, Buran shuttle being one of its cargoes. Energia is simply a launch platform for Buran. The Soviet STS can be launched without the orbiter. It has four boosters, rather than the two of the NASA design.

2. There are also significant differences in getting their cargoes into orbit. The U.S. Shuttle's central tank is not a rocket, but just a tank. Another important difference is that the Buran-Energia is designed as a fully reusable shuttle system. It includes four side Zenit boosters and the main Energia core super booster. The U.S. Shuttle system is only partially reusable. The other difference is that the Energia rocket system is powered by liquid propellant, both in the core booster and in the side booster rockets. Buran is

4600kg lighter than the STS and can carry 5000kg more payload, with a slightly bigger payload bay. It also requires less fuel to get into orbit. Although it carries only more propellant for orbital maneuvers, its orbital engines are significantly more powerful.

3. One of the most noticeable distinctions between NASA's STS and Buran is that the Soviets placed the liquid fuel engines on the base of the fuel tank, rather than on the back of the shuttle. There are also four of them, rather than the three of the American version. These rocket motors were designed for other rockets and converted for Buran. They are not reusable as they are destroyed along with the fuel tank during each launch. Designing and building reusable engines is not easy and rather expensive. The lack of reusable rocket engines meant there was no need to carry the main engines aboard the Buran orbiter itself. The three engines on the STS require enormous maintenance. Buran flight was unmanned but NASA's STS has never flown unmanned. Its first flight had the minimum crew of two, a commander and a pilot. Buran flight was a technical success. It made a fully automatic landing.

4. The gliding descent through the dense atmosphere has caused a new reusable thermal protection system. Each of forty thousand ceramic thermal protection tiles had its original geometry. They differ from plane form, side surfaces, surfaces curvature, availability of cuts and notches. Buran lost significantly fewer insulating tiles on re-entry, possibly due to the wing design. On the first flight of the NASA orbiter, more than 20 tiles were lost. Buran lost only five out of more than 38,000.

(*2200 characters*)

III. LANGUAGE PRACTICE

***Exercise 25*. Give the English equivalents to the following terms (see fig. 3).**

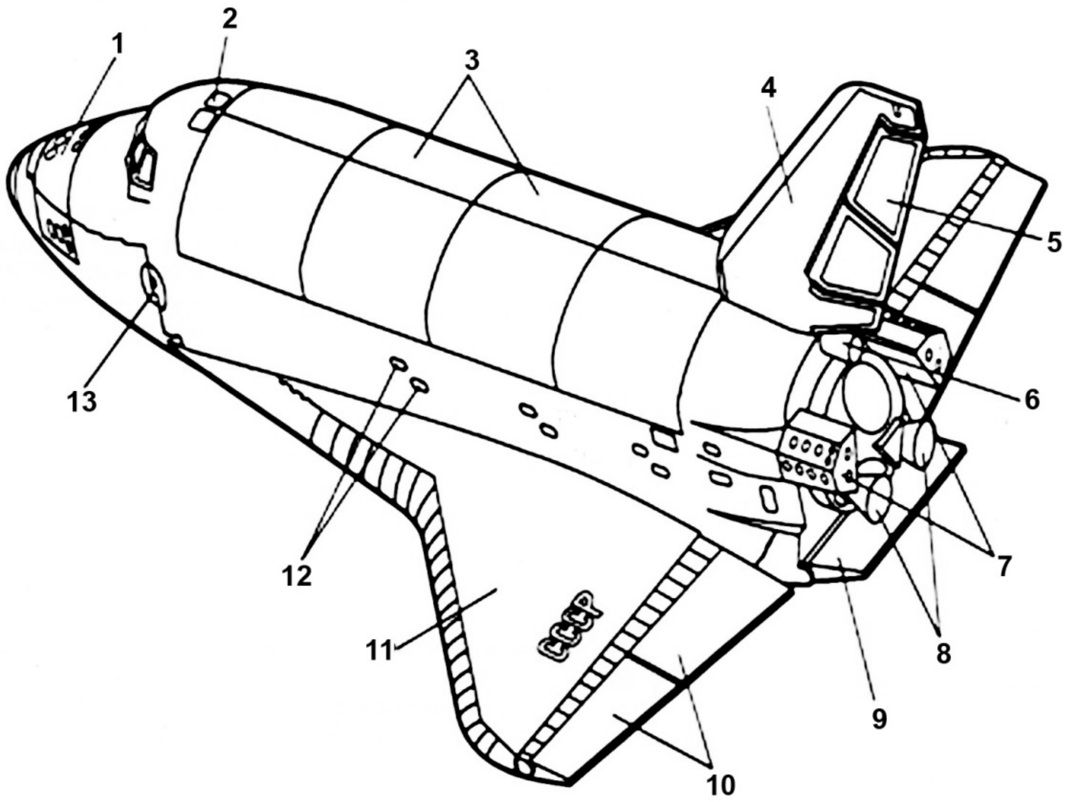
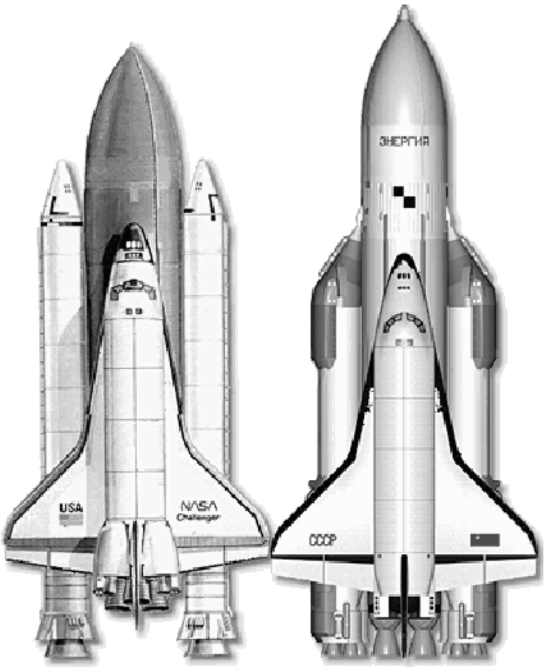


Fig. 3

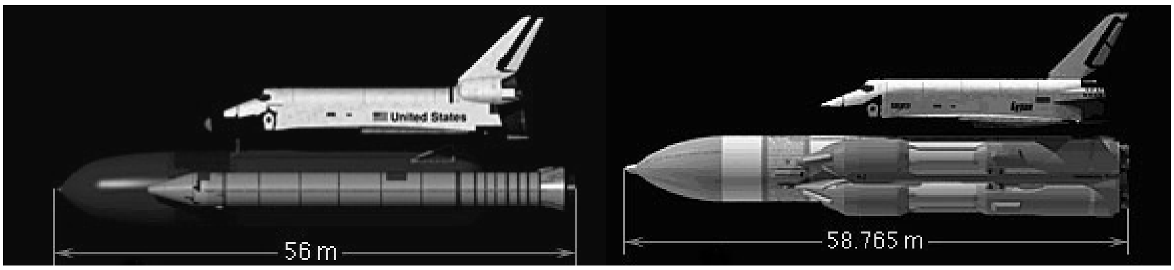
1. носовой блок двигателей управления (БДУ-Н)	
2. иллюминаторы	
3. створки отсека полезного груза	
4. киль	
5. руль поворота (воздушный тормоз)	
6. контейнер тормозной парашютной системы	
7. хвостовые блоки двигателей управления (БДУ-А и БДУ-П)	
8. двигатели орбитального маневрирования	
9. балансировочный щиток	
10. секции элеронов	
11. крыло	
13. люк	

Exercise 26. **Compare Shuttle and Buran. Make a list of similarities and differences:**

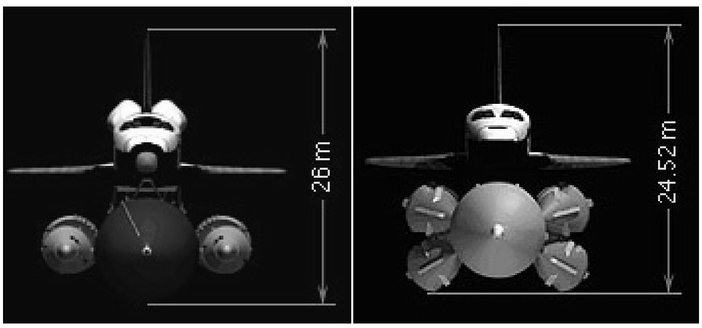


- the automatic landing of Buran from orbit onto the runway
- the absence of the main rocket engine. The main engine was placed onto a central block of a carrier-rocket ENERGIA which is able to launch 120 tons of payload against 30 tons for Space Shuttle
- Buran high lift-to-drag ratio is 6.5 against 5.5 for Space Shuttle
- Buran was able to return 20 tons of payload against 15 tons for Space Shuttle orbiter from orbit
- the lay-out pattern of thermoprotection tiles of Buran is optimal and longitudinal slits of tile belts are orthogonal to the flow line. There are no sharp angles on the tiles. The tile belts on Buran fuselage and fin are optimal.

Compare the general view:



Compare the front view:



Exercise 27. **Fill in the boxes using the information from the texts above and the Internet. Speak on the distinctions in the design systems (make a review).**

Useful language:

to carry, to deliver cargo, to transport, to launch, to accommodate, to perform, to be powered by, to require.

Parameters and systems	Energia — Buran	Space Shuttle
1. Assembly		
2. Boosters		
3. Engines		
4. Lifting capacity		
5. Aerodynamic scheme of OV		
6. Propellant		
7. Weight and dimensions		
8. Accommodation		
9. Landing		
10. TPS		

Exercise 28. **Complete the sentences.**

1. The booster system	a. perform a sliding descent in the atmosphere
2. The Energia super booster	b. was one of several payload options attached to the Energia core
3. The Buran orbiter	c. was designed as a fully reusable shuttle system
4. A cargo compartment of impressive sizes	d. was surrounded by four liquid rocket strap-on boosters
5. Expendable space vehicles	e. was designed only partially reusable
6. The Buran — Energia	f. accommodated orbital station modules
7. The U.S. Shuttle system	g. was composed of a large central core rocket Energia

1	2	3	4	5	6	7

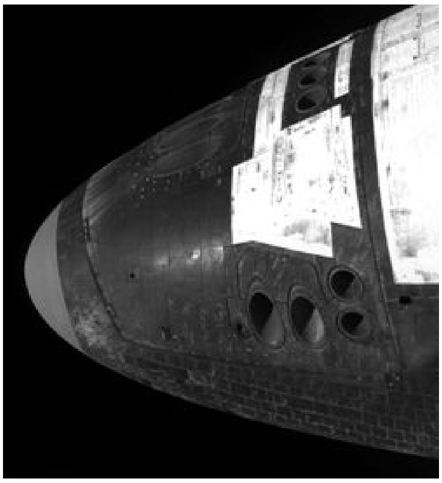
Exercise 29. **Answer the following questions. Give reasons and try to explain.**

1. What contributed to the Buran superior cargo capacity (30 tons)?	a. in their rocket systems and in getting their cargoes into orbit
2. Why were there no the main engines carried aboard the Buran itself?	b. removing the propulsion system from the orbiter
3. Why is the heavy Energia rocket not in current use?	c. a launch platform and the core super booster
4. What is the critical difference in the US Shuttle and Buran designs?	d. without a horizontal tail, with a double swept wing, with elevons and balance flap as control surfaces
5. What was the Energia rocket for Buran?	e. all the satellites launched are small and a small rocket like Proton is required
6. What caused the development of a new reusable TPS for Buran?	f. the lack of reusable rocket engines
7. What aerodynamic scheme was chosen for Buran to withstand high hypersonic speeds?	g. the engines burn up and are not reused like the American SRB's and three liquid engines are mounted on Shuttle
8. What kind of landing did Buran perform?	h. orbital station modules up to 17 m long and 4,5 m in diameter
9. What cargo was Buran able to accommodate?	i. a fully automatic landing
10. What made the Buran launching more expensive?	j. a sliding descent through dense atmosphere

1	2	3	4	5	6	7	8	9	10

SUPPLEMENT TEXTS

Text 1



RCS thrusters on the nose of the Space Shuttle

1. The Space Shuttle has many thrusters, for it does rendezvous in orbit. Shuttle thrusters are grouped in the nose of the vehicle and on each of the two aft Orbital Maneuvering System pods. No nozzles pierced the heat shield on the underside of the craft. Instead, the nose RCS nozzles which control positive pitch are mounted on the side of the vehicle, and are canted downward. The downward-facing negative pitch thrusters are located in the OMS pods mounted at the tail.

2. The forward RCS has 14 primary and two vernier engines. The aft RCS has 12 primary and two vernier engines in each pod. The primary RCS engines provide 870 pounds of vacuum thrust each, and the vernier RCS engines provide 24 pounds of vacuum thrust each. The vernier engines are operable in a steady-state thrusting mode of one to 125 seconds maximum as well as in a pulse mode with a minimum impulse time of 0.08 second. The vernier engines are used for finite maneuvers and station keeping (long-time attitude hold) and have an expansion ratio that ranges from 20-to-1 to 50-to-1. The vernier thrusters are not redundant.

(*909 characters*)

Text 2

1. Prior to the destruction of the Space Shuttle Columbia in 2003, NASA investigated the replacement of the current 4-segment SRBs with either a 5-segment SRB design or replacing them altogether with liquid "fly back" boosters using either Atlas V or Delta IV EELV technologies. The 5-segment SRB, which would have required little change to the current shuttle infrastructure, would have allowed the space shuttle to carry an additional 20,000 lb (9,100 kg) of payload in an International Space Station-inclination orbit, eliminate the dangerous "Return-to-Launch Site" (RTLS) and "Trans-Oceanic Abort" (TAL) modes, and, by using a so-called *dog-leg maneuver*, fly south-to-north polar orbiting flights from Kennedy Space Center. With the destruction of the Columbia, NASA has shelved the 5-segment SRB for the Shuttle Program, as the three surviving Orbiters, Discovery, Atlantis, and Endeavour will be retired in 2010 after the completion of the International Space Station. On September 10, 2009 a five-segment Space Shuttle SRB was static fired on the ground for the first time in ATK's desert testing area in Utah. This was the test of what will be the first stage for the Ares I rocket.

(*1004 characters*)

Text 3

1. Data Processing System. A primary concern with digital fly-by-wire systems is reliability. Much research went into the shuttle computer system. The shuttle uses five identical redundant IBM general purpose computers (GPCs), model AP-101.

2. Four computers run specialized software called the Primary Avionics Software System (PASS). A fifth backup computer runs separate software called the Backup Flight System (BFS). Collectively they are called the shuttle Data Processing System (DPS). After a single failure the shuttle can continue the mission. After two failures it can land safely. The four general-purpose computers operate essentially in lockstep, checking each other.

3. The software for the shuttle computers is specifically designed for a real time embedded system environment. The Shuttle was originally conceived to operate somewhat like an airliner. After landing, the orbiter would be checked out and be ready for launch in weeks. Instead, this turnaround process usually takes months. The primary focus of the Shuttle program is to return the crew to Earth safely, which can conflict with other goals, namely to launch payloads cheaply. Furthermore, because in many cases there are no survivable abort modes, many pieces of hardware simply must function perfectly and so must be carefully inspected before each flight.

(*1139 characters*)

PRESENTING A PAPER

Making a presentation (a report)

To make your presentation clear and easy to understand you must remember that:

1. A presentation is NOT a report, read aloud.
2. A presentation CAN NOT be delivered as a written report. You should speak slowly and clearly.
3. BEFORE introducing new information give the listener time to anticipate what kind of information is coming.
4. Make a list of the most important topics and things you have to say and arrange them logically.
5. Make a list of minor, but interesting points.
6. Arrange the information into a logical sequence.
7. Use links between the points (issues) and have a beginning and an end.

The following phrases can be used at different stages within your presentation.

In the introduction to the topic:
To begin with, let’s consider …
During this short talk I’m going to …
This morning I’m going to … (talk about …)
Today I’d like to … (describe …)
The aim of my report is to …. (explain …)
I’ve divided my report into … (three parts)
First, I’d like to … (give you a review of the project) … Then I’ll focus on …
After that we’ll deal with … (the technical aspects) …
Finally, we’ll consider … (what new skills will be needed)

In introducing each section:
So, let’s start with … (the objectives …)
Now let’s move on to … (the next part …)
It is worth mentioning the fact that …
Let us have a closer look at …
I can tell you without any exaggeration …
Finally … (let’s consider …)

In response to a question:
I wish I could agree with you but …
I think, you are entirely right …
I would object just a little …
I’d rather not answer that, if you don’t mind …

Referring to information:
I won’t go into details …
This diagram shows …
If you look at this graph you can see …
I’d like to draw your attention to …
I’d like to emphasize the fact that …
I have doubts about …
Contrary to …

Summarizing a section or the whole report:
In conclusion let me …
So, to summarise the main idea of my report …
In closing (conclusion), I’d like to mention very briefly …
That brings me to the end of my presentation …
I’d like to express my gratitude to …
Are there any questions?

Exercise 30. **Give the English equivalents of these phrases.**

1. Тема моего сообщения …
2. В докладе я затрону следующие вопросы …
3. Цель моего сообщения — сделать обзор …
4. Мне интересна эта тема, так как …
5. Сначала я хотел бы дать общее описание …
6. Я хочу подчеркнуть тот факт, что …
7. Я хочу обратить ваше внимание на чертеж …
8. Позвольте дать пояснения …
9. С одной стороны, … с другой стороны, …
10. Это, в частности, справедливо для …

Exercise 31. **With the list below distribute the speech patterns to the appropriate columns.**

In closing, I'd like to mention very briefly …
I can tell you without any exaggeration …
First of all, I would like to …
It should be pointed out that …
In conclusion, let me say …
I'd like to emphasize the fact that …
Finally, I'd like to say a few words about …
The subject of my report is …
I am pleased to have this opportunity to …
This diagram shows …
Let us have a closer look at …
It is worth mentioning the fact that …
Let me begin with …
The last part of my talk will be devoted to …
I end this report with a description of …

Introductory patterns	Patterns for the body of report	Closing speech patterns

UNITS OF MEASURMENT

Customary system

Linear measure	
12 inches	1 foot
3 feet	1 yard
5.5 yards	1 rod

Mariners' measure	
6 feet	1 fathom
3 nautical miles	1 league

Square measure	
144 square inches	1 square foot
9 square feet	1 square yard
30 1 / 4 square yards	1 square rod

Liquid measure	
4 gills	1 pint
2 pints	1 quart
4 quarts	1 gallon
31.5 gallons	1 barrel

Metric and customary equivalents

Linear measure

Customary unit	*Metric unit*
1 inch	25.4 millimeters
	2.54 centimeters
1 foot	30.48 centimeters
	3.048 decimeters
	0.3048 meter
1 yard	0.9144 meter
	1609.3 meters
1 mile	1.6093 kilometers
0.03937 inch	1 millimeter
0.3937 inch	1 centimeter
3.937 inches	1 decimeter

LIST OF WORDS

A	
abort once around	аварийное завершение полета после первого витка
adjacent *adj*	прилегающий
aft *n*	хвостовая часть
altitude *n*	высота
ascent *n*	подъем
assembly *n*	компоновка
attitude *n*	ориентация в пространстве
attribute to *v*	относить к
B	
backup *adj*	резервный
bay *n*	отсек
booster *n*	ускоритель
C	
capacity *n*	мощность, грузоподъемность
cargo delivery	доставка груза
case *n*	корпус
cause *n*	причина
consume *v*	потреблять
crew rotation	смена экипажа
cuts and notches	разрезы и вырезы
D	
damage *n*	повреждение
deploy *v*	размещать
depressurize *v*	сбрасывать давление
distinctions *n*	различия
distribute *v*	распределять
double swept	двойной стреловидности
drag *n*	лобовое сопротивление
E	
edge *n*	кромка (крыла), край
embedded *adj*	встроенный
emphasize *v*	подчеркнуть
exaggeration *n*	преувеличение
exist *v*	существовать
expendable *adj*	одноразовый

external *adj*	внешний, подвесной
extravehicular activity	работа в открытом космосе, выход в открытый космос

F

failure *n*	внештатная ситуация, поломка
fastener *n*	крепеж
flap *n*	закрылок
flight deck	кабина экипажа (многоместная)
fly-by-wire system	электрическая система управления полетом
foam insulation	пенная изоляция

G

gear *n*	стойка шасси
gimbal *v*	отклоняться
glide *v*	планировать

H

hatch *n*	люк
high lift-drag ratio	высокое аэродинамическое качество
house *v*	вмещать

I

identical *adj*	идентичный
implement *v*	осуществлять
insertion *n*	выведение (на орбиту)
insulation *n*	изоляция
is worth mentioning	стоит упомянуть

J

jettison *v*	отделять, сбрасывать
joint *n*	шов

L

lay-out pattern	образец компоновки
leak *n*	протечка
lifespan *n*	срок эксплуатации
longitudinal *adj*	продольный

M

maintain *v*	обслуживать, ремонтировать
maintenance *n*	техническое обслуживание
manned *adj*	пилотируемый

N

nautical *adj*	морской

O

outside surface curvature	кривизна внешней поверхности

P

partial *adj*	частичный
payload bay	грузовой отсек
perform *v*	выполнять
perform a sliding descent	выполнять скользящий спуск
pitch *n*	угол тангажа; тангаж
pod *n*	подвеска двигателя
predecessor *n*	предшественник
predetermined *adj*	заданный
pressurize *v*	повышать давление
propellant [prə'pelənt] *n*	топливо
propulsion *n*	движение

R

recover *v*	возвращать
redundant *adj*	дублирующий
reentry *n*	вход в плотные слои атмосферы
refurbish *v*	ремонтировать
remote *adj*	дистанционный
rendezvous ['rɔndɪvu:] *n*	сближение до стыковки
resemble *v*	быть похожим
retrieve *v*	перемещать, удерживать груз
roll *n*	крен
rubber *adj*	резиновый
rudder *n*	руль направления
run software	запускать программу

S

shield *v*	экранировать
site *n*	стартовая площадка
specific *adj*	удельный
spin *v*	вращаться
steer *v*	управлять
strip off *v*	отделяться
subsequent *adj*	последующий
survivable *adj*	способный к выживанию
sweep *v*	образовывать угол, отклоняться
sweepback *adj*	обратной стреловидности
swivel *v*	поворачиваться

T

thermal *adj*	тепловой
thermal protection system	теплозащита
thrust [θrʌst] *n*	тяга

thruster *n*	рулевой двигатель
tile *n*	плитка
trailing *adj*	задний, находящийся сзади
translate *v*	перемещаться
triangular *adj*	треугольный

U

umbilical [ʌm'bɪlɪk(ə)l] *n*	кабель, трос
unpowered *adj*	с выключенным двигателем

V

vortex *n*	завихрение

W

wind tunnel	аэродинамическая туба

Y

yaw *n*	рыскание

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