ZRAKOPLOVNA TEHNIČKA ŠKOLA RUDOLFA PEREŠINA

AVIATION ENGLISH 1

INTERNA SKRIPTA IZ ENGLESKOG JEZIKA U ZRAKOPLOVSTVU

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1. History of Aviation

From Myths to the Powered Flight

Flying has been the dream of man throughout the ages. Who was the first man to fly? According to the Greek legend, it was Daedalus, the Athenian inventor, who shaped wings of wax into which he stuck bird feathers. As the story goes, Deadalus and his son Icarus had been imprisoned on the island of Crete by King Minos. They yearned to return to their native land, but their only hope of escape was to fly across the sea. When the wings were completed, they flew home and the father cautioned young Icarus to fly only the middle air. The impetuous Icarus flew too high and the sun melted the wax. He was drowned into the sea which is still called the Icarian Sea in honor of the first man to lose his life in flying.

Since that first legendary flight of Icarus, man has tried and tested thousands of ways with which to conquer gravity - and failed. Centuries ago, Leonardo da Vinci's studies of birds became the basis for a scientific investigation of flight. He reasoned that birds flew because they flapped their wings and that it was possible for man to do the same. Da Vinci designed the ornithopter, a flapping wing-flying machine.

In the 18th century, the Montgolfier brothers of France, the ornithoptists, introduced the world of flight in their hot air balloon. A step in the 'Wright' direction, yes, but What about powered flight. The answer to that question came a century later, in 1903 to be exact, when two bicycle mechanics proved to the world that powered flight was no longer a dream but reality. Thanks to Wilbur and Orville Wright's first flight, which lasted only 12 seconds, the way was clear for man to take to the air. Thanks must also go to other pioneers, such as Edward Rusjan, for the great contributions made to aviation history. If it had not been for these great men, would we be able to enjoy travelling faster than the speed of sound today or even able to walk on the moon? At last the age old dream of man has come true: no need to envy the birds their wings any longer for man can fly faster than any living bird.

1. Read the short historical survey of aviation. Arrange the following sentences in the correct sequence. The first one has been done for you.

a. Who was the first man to fly? __1__

b. The Wright brother's first flight. _____

c. He designed a flapping wing machine. _____

d. The sun melted the wax. _____

e. Leonardo Da Vinci studied birds. _____

f. He shaped wings out of wax_____

g. Flight in a hot air balloon. _____

2. Answer the questions.

1. Why is Daedalus called the Athenian inventor?
2. Where does the name for the Icarian Sea come from?
3. What was Leonardo Da Vinci's theory of flight based on?
4. Who introduced the first man-made object flight?
5. How long did the first powered flight last?

2. Aviation Pioneers

Edvard Rusjan was born in Trieste in 1886. He attended school in Gorica where he was apprenticed to a boilermaker and was a successful bicycle racer.

His aviation career began in 1908 when he started designing and building model aircraft. With his elder brother Josip's help, he designed a glider that later became a model for future aircraft.

A year later they began work on a powered aircraft. It was a biplane with a 3-cylinder, 25-horse-power, Anzani-model engine. In this aircraft Edvard Rusjan made the first successful powered flight in Slovene aviation history.

The flight lasted about 10 seconds and he travelled approximately 60 metres al a height of 2 metres. Four days later, he increased his distance to 500 metres at a maximum altitude of 12 metres. Observers estimated that the aircraft reached speeds of between 50 and 60 kilometres per hour.

The brothers decided to continue developing their aircraft. In one of them, Edvard made his first public flight for the citizens of Gorica. The brothers gained aeronautical knowledge rapidly and learned that the Anzani engine was not powerful enough for a biplane, so they decided that in the future, they would make only monoplanes. A new important phase of Rusjan's work began when he met Mihailo Mercep, an aviation enthusiast from Zagreb. They constructed a new aircraft and had it equipped with the best Gnome rotary engine.

In this aircraft Edvard made several successful flights that thrilled the Zagrebians. After this successful demonstration Edvard and Mercep organized a tour of European cities. The first stop was Belgrade in January 1911. Despite strong gusty winds, 24-year-old Edvard went ahead with a demonstration flight. His take-off and flight over the town were uneventful. However, while the aircraft was returning for a landing, at an approximate height of 20 metres, a strong gust ripped off a wing and the aircraft crashed against a tower wall killing the pilot outright.

However, Rusjan's death was not in vain as aviation development in Slovenia continued, spurred on by the great achievement of a true aviation hero.

1. After reading the text give short answers to the following questions.

Where was Edvard Rusjan born?

Where did he attend school?

When did his aviation career begin?

Which of his model aircraft later became a model for future aircraft?

In which aircraft did he make his first successful powered flight?

What speeds did he reach on his first flight?

Why did Edvard and his brother later decide to make only monoplanes?

When did a new important phase of Rusjan's work begin?

What engine was the newly constructed aircraft equipped with?

Where did Edvard and Mercep make the first stop on their European tour?

What was the weather like when Edvard set off on his demonstration flight?

Why did the aircraft crash against a tower wall?

2. Now write questions to which these phrases might be possible answers.

"In Trieste." - is the answer to the question "Where was Edvard Rusjan born?"

With elder brother Josip's help.____

A glider.____

The first powered flight.____

About ten seconds.____

At a height of 12 metres.____

For the citizens of Gorica.____

The Anzani engine.____

Only monoplanes.____

The Gnome rotary engine.____

In January 1911.____

Uneventful. ____

Because a strong gust ripped of a wing. ____

3. Match the words in the middle box with the descriptions from A to H

a. immediately b. a light aircraft that flies without an engine c. the science and art of operating aircraft d. a sudden strong increase in speed of wind	**1. aeronautics** **2. gust** **3. glider** **4. rip** **5. estimate** **6. spur** **7. racer** **8. outright**	e. to tear violently or suddenly f. calculate roughly g. encourage to try harder h. a person who competes in racing

4. Put the following adjectives in the appropriate sentences. Use each adjective only once.

vertical, suitable, simple, successful, visual, public, aeronautical, gusty, historical, human

1. An __________ almanac which is published yearly is a book dealing with events in aviation.

2. Thundershowers often produce __________ conditions.

3. Edvard Rusjan made his first __________ flight for the citizens of Gorica.

4. Hovering is an element of __________ flight

5. George Cayley built a __________device that somewhat resembled a helicopter.

6. The Wright brothers were in search of a __________engine to launch their latest design on its __________ first powered flight.

7. The idea of __________flight has engaged men from the time when they developed __________ imagination.

8. Henri Giffard, a French engineer, built the first __________ dirigible.

3. The Wright Brothers

childhood

On April 16, 1867, Milton and Susan Wright welcomed their third child into their household near Millville, Indiana. Little did Susan Wright know that she had given birth to the first half of one of the world's most famous ________________ partnerships. The other half of the duo, Orville, was born four years later, on August 19, 1871, in the family's newly-built home at 7 Hawthorn Street in Dayton, Ohio.

As youngsters, Wilbur and Orville looked to their mother for ________________ expertise and their father for intellectual challenge. Milton brought the boys various souvenirs and trinkets he found during his travels for the church. One such trinket, a toy helicopter-like top, sparked the boys' interest in flying. In school, Wilbur excelled, and would have graduated from high school if his family had not moved during his senior year. A skating accident and his mother's illness and subsequent death kept him from attending college. Orville was an average student, known for his mischievous behavior. He quit school before his senior year to start a printing business.

the wright cycle shop

The first time Wilbur and Orville referred to themselves as "The Wright Brothers" was when they started their own printing firm at the ages of 22 and 18. Using a damaged tombstone and buggy parts, they built a press and printed odd jobs as well as their own newspaper.
In 1892, the brothers bought bicycles. They began repairing bicycles for friends, then started their own repair business. They opened up a bicycle shop in 1893, and three years later, made their own bicycles called Van Cleves and St. Clairs. While nursing Orville, who was sick with typhoid in 1896, Wilbur read about the death of a famous German ________________ pilot. The news led him to take an interest in flying. On May 30, 1899, he wrote to the Smithsonian Institution for information on ________________ research.

Within a few months after writing to the Smithsonian, Wilbur had read all that was written about flying. He then defined the ________________ of a flying machine: wings to provide lift, a power source for propulsion, and a system of control. Of all the early ________________, Wilbur alone recognized the need to control a flying machine in its three axes of ________________: pitch, roll, and yaw. His solution to the problem of control was 'wing warping.' He came up with the revolutionary system by twisting an empty bicycle tube box with the ends removed. Twisting the surface of each 'wing' changed its position in relation to oncoming wind. Such changes in position would result in changes in the direction of flight. Wilbur tested his theory using a small _________________, and it worked.

the world's first airplane

In August of 1900, Wilbur built his first glider. He then contacted the U.S. Weather Bureau for information on windy regions of the country. Reviewing the list, he chose a remote sandy area off the coast of North Carolina named Kitty Hawk, where winds averaged 13 m.p.h. He and Orville then journeyed to Kitty Hawk where they tested the 1900 glider. The following year, they tested a new and improved glider with a 22-foot _________________. A disappointing performance by the 1901 glider prompted the Wright brothers to construct a wind tunnel to test the effectiveness of a variety of wing shapes. Using the results of the wind tunnel experiments, they constructed their 1902 glider. Testing it at Kitty Hawk in October, they met with success, gliding a record 620 feet. Once again they returned to Dayton and began work on developing a propeller and an engine for their next effort, a flying machine.

Having designed a propeller with the same principles thy used to design their wings, Wilbur and Orville then built their own 4-cylinder, 12-horsepower engine. They built the 1903 Flyer in sections in the back room of their cycle shop in Dayton. When completed, it was shipped down to Kitty Hawk and assembled. On December 14, 1903, Wilbur won a coin toss and made the first attempt to fly the machine. He stalled it on _________________, causing some minor damage. The plane was repaired, and Orville made the next attempt on December 17. At 10:35 a.m., he made the first heavier-than-air, machine powered flight in the world. In a flight lasting only 12 seconds and covering just 120 feet, Orville did what men and women had only dreamed of doing for centuries – he flew.

TASKS:

1) *While reading the text, put in the missing words:*

   aeronautical , aviators, elements, glider , inventive, kite, mechanical, motion, take-off, wingspan

2) <u>*Homework*</u>

   Choose ten unknown words from the text, write them down and find explanation and translation.

chronology

1867 Wilbur is born on April 16 in Millville, Indiana 1870 The family moves to Dayton,

1867 Wilbur is born on April 16 in Millville, Indiana

1871 Orville is born on August 19 in Dayton

1878 Milton brings the boys a toy helicopter.

1886 Wilbur is injured in a skating accident, keeping him away from college plans

1889 The boys start a printing business. Their mother, Susan, dies on July 4. Orville decides to quit school.

1892 The Wright Cycle Company is formed

1896 Orville survives six weeks with typhoid. Wilbur reads about the death of a famous glider pilot and becomes interested in flying

1899 Wilbur writes to the Smithsonian for information about aeronautics on May 30

1900 The brothers test their first glider at Kitty Hawk, North Carolina, in September and October

1901 They test the 1901 glider in July and August. The brothers build a wind tunnel to test the drag and lift of various wing shapes

1902 They test their third glider in September and October

1903 Orville makes the historic first flight on December 17 at Kitty Hawk, North Carolina

1905 They perfect their airplane and begin looking for buyers of their invention

1908 Wilbur does demonstration flights in Europe. Orville flies for the U.S. Army in Fort Myer, Virginia, and is severely injured in a crash.

1909 Wilbur and Orville are welcomed home to Dayton in a two-day gala celebration at which they receive a Congressional gold medal

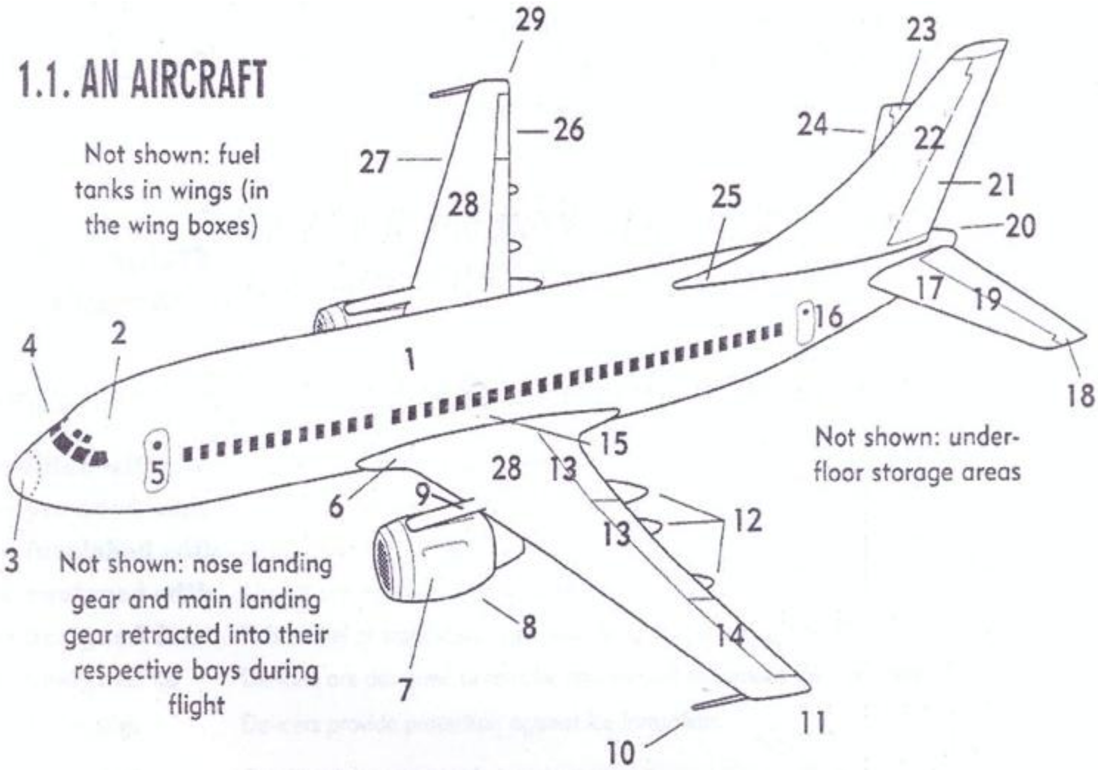
1912 Wilbur dies of typhoid May 30, aged 45

1932 A national monument to the Wright Brothers is dedicated at Kitty Hawk on March 3

1948 Orville dies on January 30, aged 77

4. Basic Aircraft Structure

1.1. AN AIRCRAFT



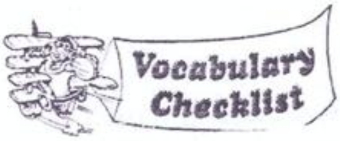
1.1.1. Identify the following parts. Write in the corresponding numbers.

a. fuselage	....	o. port navigation light (red)	......
b. cockpit	....	p. flaps	......
c. radome	....	q. aileron	......
d. wing	....	r. flap track fairings	......
e. leading edge (wing)	....	s. rear evacuation exit	......
f. trailing edge (wing)	....	t. vertical stabilizer	......
g. wing root fairing	....	u. horizontal stabilizer	......
h. engine	....	v. port trimming tailplane	......
i. engine pod/nacelle	....	w. starboard trimming tailplane	......
j. pylon	....	x. fin root fairing (fillet)	......
k. passenger door	....	y. rudder	......
l. emergency evacuation exit	....	z. tailcone	......
m. windscreen[1] (windshield) and wipers	....	aa. port elevator	......
n. static dischargers	....	bb. starboard navigation light	......
		cc. starboard elevator	......

[1]*windscreen* is the British word for *windshield* used in the US.

1.1.2. MATCH EACH PART BELOW WITH WHAT IT DOES OR PROVIDES

1. RADOME	a. provides protection to tracks
2. ENGINE	b. houses instruments
3. ENGINE POD/NACELLE	c. provides thrust
4. PYLON	d. fastens the engine to the wing
5. WING	e. fastens stabilizer to fuselage
6. NAVIGATION LIGHTS	f. houses the passenger cabins, cockpit and underfloor areas
7. FLAP TRACK FAIRINGS	g. provides lift
8. VERTICAL STABILIZER	h. identify the aircraft, make aircraft visible at night
9. HORIZONTAL STABILIZER	i. with elevators, provides stability and balance in flight
10. FUSELAGE	j. with fin and rudder, also contributes to stability and balance
11. FIN ROOT FAIRING	k. provides directional guidance in flight
12. RUDDER	l. surrounds and protects the engine



CHECK THAT YOU KNOW THESE WORDS

Configuration and design

THESE EXPRESSIONS WILL BE USED THROUGHOUT THIS BOOK. BE SURE THAT YOU ARE FAMILIAR WITH THEM.

❍ **to be fitted with/on**	Aircraft are fitted with equipment. Wings are fitted with static dischargers.
❍ **to be provided with**	Wings are provided with static dischargers.
❍ **to be furnished with**	All equipment is furnished with specifications.
❍ **to be equipped with**	Aircraft are equipped with de-icers.
❍ **to be designed for**	This model of static discharger was designed for use on the B777.
❍ **to be designed to**	De-icers are designed to remove and prevent hazardous ice formation.
❍ **to provide stg.**	De-icers provide protection against ice formation.
❍ **to be provided**	Specifications are provided upon request.
❍ **to furnish stg.**	De-icers furnish protection against ice formation. Details will be furnished upon request.
❍ **to supply stg.**	The APU (auxiliary power unit) supplies power while the aircraft is grounded. The airline agreed to supply all airlines with updated service bulletins.

1.1.3. GET INTO TRAINING.

PRACTICE USING THE WORDS ABOVE.

1. Wings .... flaps. Each wing is also .... navigation lights.
2. Very sophisticated computer systems .... the pilot .... information during the entire flight.
3. The horizontal and vertical stabilizers are .... stability in flight.
4. Each windshield (UK: windscreen) .... to remove rain.
5. The engines .... thrust for horizontal displacement of the aircraft.
6. Fuel tanks ....
7. All aircraft ....nose and main landing gear.

Vocabulary Checklist

FOCUS ON ENABLING AND ALLOWING
Vocabulary and Grammatical Patterns

- **to allow somebody to do something**
  The computer systems allow the pilot to monitor all flight parameters.
- **to enable somebody to do something**
  The newly designed display screens allow the pilot to see at a glance the engine pressure ratio.
- **to make it possible for somebody to do something**
  Today's widebodies make it possible for passengers to travel in maximum comfort.
- **to allow something (to be done)**
  Computer systems allow constant temperature control, allows the temperature to be controlled.
- **to enable something (to be done)**
  The computer systems enable pressurization and other parameters to be monitored at all times.
- **to make it possible for something to be done**
  Sophisticated warning systems make it possible for passengers to be transported in maximum safety conditions.

Notice these models

1. **Modern aircraft are equipped with sophisticated computer systems.**
2. **These systems are designed to allow the pilot to monitor all flight aspects.**

And combined into one sentence:

3. **Modern aircraft are equipped with sophisticated computer systems designed to allow the pilot to monitor all flight aspects.**

Training Exercises!

1.1.4. GET INTO TRAINING.
MAKE COMPLETE STATEMENTS USING THE PROMPTS.

EXAMPLE:

Radar system/design/pilot/identification of obstacles or weather fronts

Aircraft are equipped with radar systems designed to allow pilots to identify obstacles and weather fronts.

1. Wings/design/thrust
2. Navigation lights/aircraft/identified from a distance
3. Tailplane/flight stability
4. Cockpit windows/pilots/adequate angles of visibility
5. landing gear/taxi on the ground/ land
6. underfloor storage areas/passenger baggage/cargo/transport
7. fuel tanks in wings/engines/fuel
8. The APU (auxiliary power unit)/aircraft/electricity during on-ground operations.

1.2. SIMPLE DESCRIPTIONS

THE VERTICAL STABILIZER

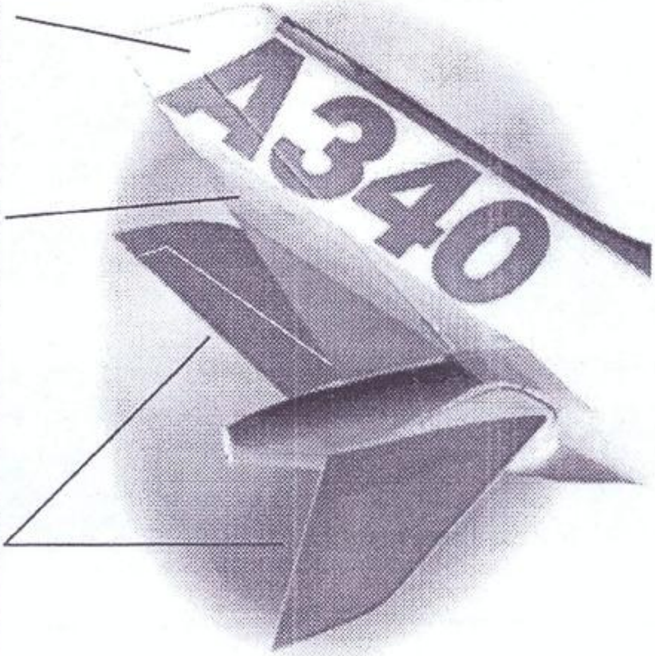
The vertical stabilizer or tailplane is designed to provide stability when the aircraft pitches.

THE RUDDER

The rudder is the rearmost (or aftmost) part of the vertical stabilizer and provides directional guidance while the aircraft is on the runway or corrects imbalance during flight (controlling the aircraft in the yaw axis).

THE HORIZONTAL STABILIZER

The purpose of the horizontal stabilizer is to provide the movement required for trimming to ensure balanced flight.



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Going further

More detailed descriptions. Note the following description of the horizontal stabilizer.

The horizontal stabilizer is one of the flight controls and is used to trim the aircraft in the pitch axis. It is actuated by two motors which are coupled differentially and which are driven by two different hydraulic systems. An elevator is located on each side of the horizontal stabilizer also driven by hydraulic actuators.

For more information on pitch (and yaw) see the following pages.

1.2.1. PRACTICE

CAN YOU PROVIDE APPROPRIATE DESCRIPTIONS FOR THE OTHER AIRCRAFT STRUCTURES SHOWN IN THE DRAWING ON PAGE 2? FOR INSTANCE:

a. Emergency evacuation exits ....

b. Starboard and port navigation lights: ....

c. Cabin door: ....

d. Flaps: ....

e. Flap tracks: ....

f. Windshield (UK: windscreens) : ....

g. Windshield wipers: ....

h. Wings: ....

Structures such as wings, flaps, and slaps are treated in later sections.

5. Types of Aircraft

aerodyne	**hang. glider**	**rocket**
aerostat	**spacecraft**	**parachute**
missile	**glider**	**balloon**
aeroplane	**airship**	**Rules of the Air**
aircraft	**rotorcraft**	**air traffic participant**

2. Read the text, then answer the following questions:

1. What terms are used in the text to denote the aerodyne and aerostat?

2. What aircraft does the first group include?

3. What kind of aircraft are airships and balloons?

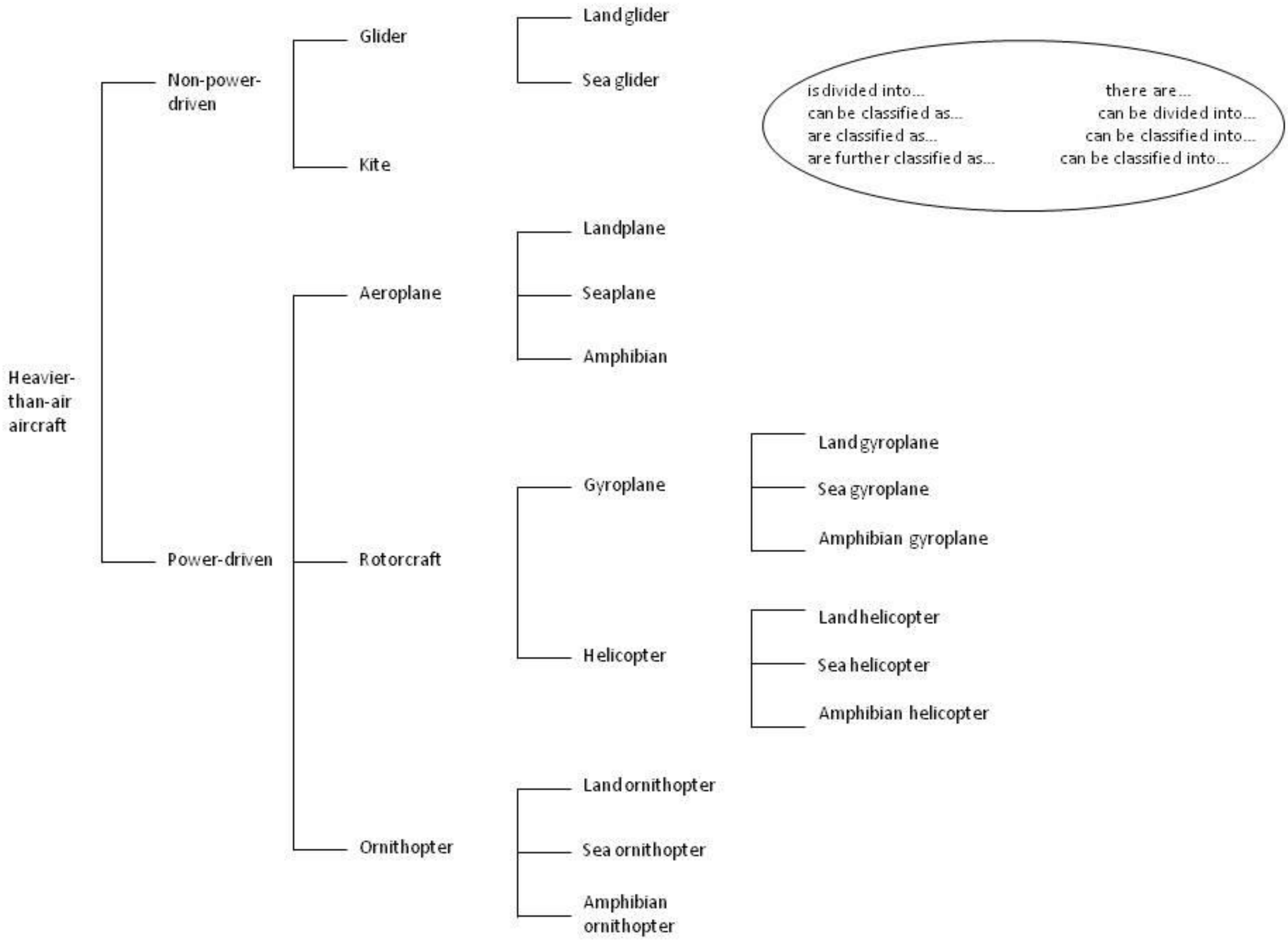
4. How do aerodynes and aerostats derive support in the atmosphere?

Aircraft may be divided into two groups: heavier-than-air and lighter-than-air aircraft. The first croup includes aircraft deriving their lift chiefly from aero dynamical forces This category includes aeroplanes, rotorcraft, gliders, hang gliders, rockets, spacecraft and missiles. The second group includes airships and balloons, i.e. aircraft being supported chiefly by their own buoyancy in the air. These terms form a part of the Rules of the Air and refer to the possibilities of airspace exploitation on the port of air traffic participants. Apart from the aircraft included in the Rules of the Air, there are also aircraft which follow the classification according to their physical and aerodynamic properties.

3. Classification - Read the following classification of lighter-than air aircraft

Lighter-than-air aircraft are classified into power driven and non-power driven balloons. Non-power driven balloons can be further sub classified into free balloons and captive balloons. Airships are power driven balloons which can be subdivided into rigid, semi-rigid and non-rigid airships. Free balloons are further subdivided into spherical free balloons whereas captive balloons are further subdivided into spherical and non-spherical captive balloons.

4. After reading the text, look at the following classification tree of heavier-than-air aircraft and make a classification in the same way:



5. Explain the difference:

aerodyne - aerostat

aeroplane - airplane

hang glider - glider

spacecraft - rocket

rocket - missile

parachute - balloon

6. Translate the words in exercise **5** and match them with their paraphrases.

A power driven heavier-than-air aircraft deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under the given conditions of flight - **aeroplane**

Any machine that can derive support in the atmosphere from the reactions of the air -

A vehicle for travelling in outer space -

A heavier-than-air aircraft -

An object or weapon suitable for throwing or projecting or directing at a target -

A lighter-than-air aircraft -

A device used to slow down free fall from an aircraft, consisting of a light piece of fabrics attached by cords to a harness and stored folded until used in descent -

A class of ultra light glider type, the simplest have no control system -

A missile whose motion is due to reaction propulsion and whose flight path cannot be controlled during flight -

A power driven lighter than air aircraft -

A heavier than air aircraft which derives lift from a rotor or rotors -

A non power driven heavier than air aircraft, deriving its lift chiefly from aerodynamical reactions of surfaces which remain fixed under given conditions of flight -

A non power driven lighter-than-air aircraft -

7. Paraphrase the words from the classification tree.

Ornitopher- a heavier-than- air aircraft supported in flight chiefly by the reaction of the air on the wings, to which a flapping motion is imparted.

Gyroplane- a heavier- than- air aircraft supported in flight chiefly by the reaction of the air on one or more rotors which rotate freely on substantially vertical axes

Amphibian- an aircraft capable of taking of and alighting on either land or water

6. Flying with the birds

Gliding birds, hawks, eagles, gulls and vultures are doing the same thing glider pilots do - looking for lift. The main difference is that they are far better at that than the pilots. So if you see a group of long-winged birds circling in one spot, just fly in that direction. You will find a good thermal there almost every time and can join in their frolic. The birds usually watch you, as you watch them. When they decide you are not a threat, they usually go about demonstrating their innate flying superiority, by tapping the strongest lift right in the core of the thermal, climbing rapidly above us.

What is a typical glider flight like? In most cases, the glider is hooked up to a powered airplane which tows it up to an altitude of 2,000 - 3,000 feet. When desired, the glider pilot releases the rope, although the powered airplanes can also release if safety demands it. After release, the tow airplane departs, taking its noisy engine with it. The pilot then searches for lift. Very strong wind might create dust devils or clouds of debris. If there are cumulus clouds about, these are very good indicators of thermal activity, either current or past. Another glider circling in one spot is often a good indicator of an active thermal. Sometimes the pilot will simply forge ahead and blunder into a thermal by chance - if thermal heights are substantial, then this is actually a viable way of soaring.

1. Put these in the correct sequence. The first one has been done for you.

1 Releasing the rope ______

2 The tow airplane departs ______

3 The birds looking for lift ______

4 The birds watching us ______

5 Searching for lift __1__

6 A glider circling in one spot ______

7 Very strong lift creating dust devils or clouds of debris ______

8 Blundering into a thermal by chance ______

2. Read again and answer these questions.

1 Which soaring birds did the speaker mention?

2 Why do glider pilots fly in the direction of circling birds?

3 Are birds afraid of gliders?

3. Match the terms in column A with their synonyms in column B.

A	B
1. Gliding	a. Undercarriage
2. Kite	b. Automatic direction finder
3. Flight deck	c. Throttle back
4. Tail rotor	d. Soaring
5. Radio compass	e. Lighter-than-air aircraft
6. Vertical stabilizer	f. Cockpit
7. Landing gear	g. Antitorque rotor
8. Aerostat	h. Fin
9. Rate-of-climb indicator	i. Variometer
10. Close the throttle	j. Hang glider

7. Gliding

Sailplanes or gliders are aircraft designed to use only aerodynamical forces to stay aloft. They are without engines, like hang gliders or ultra lights which often create an image of flimsy aluminium wires and frames; unlike them, gliders are advanced aircraft with fixed flexible wings and an enclosed cockpit. Today's high performance gliders may cover hundreds of miles at speeds more than 100 knots. They can also be equipped with engines as well as hang gliders and ultra lights.

The mechanics of flying gliders may be considered the same as the mechanics of flying powered aircraft; however, glider flights require constant alertness to changing altitudes, wind drift and atmospheric conditions to make the glider back to the gliderport or to a safe field on a cross-country flight.

Not only a high level of flying proficiency but also good knowledge of weather is required for gliding. The most common lift sources are thermals, which pilots flying powered aircraft often consider as annoying turbulence. The conditions under which thermal gliding is possible vary; thermals may be large or small, strong or weak, smooth or rough, and circular or otherwise in cross section. These varying conditions demand different techniques.

1. Decide if the following statements are TRUE (T) or FALSE (F):

• Gliders are supported only by aerodynamical forces to stay in the air.

• Hang gliders and ultra lights have cockpits.

• Hang gliders have fixed wings.

• Gliders make use of atmospheric conditions.

• Thermals are considered as unpleasant turbulence by glider pilots.

• Flying techniques depend on atmospheric conditions.

2. Answer the following questions.

1 Define the term "glider".

2 In what way do they differ from hang gliders and ultra lights?

3 At what speed do today's aircraft travel?

4 What is a major requirement for gliding?

5 Which are the most common lift sources?

6 Why is good knowledge of meteorology essential for gliding?

3. Find words in the text similar in meaning to the ones in bold type. Rewrite the sentences using the new words.

1 Gliders are **sophisticated** aircraft with fixed flexible wings.

____

2 Aerodynamical forces keep the glider **in the air**.

____

3 Like gliders, **dragons** and ultra lights have no engine.

____

4 **Different** conditions require different techniques.

____

5 The conditions under which thermal soaring is possible **change**.

____

6 Gliders are **manufactured** to use only aerodynamical forces to stay aloft.

____

7 The conditions under which thermal gliding is possible **call for** different techniques.

____

8 Ultra lights often create an image of **thin and easily thorn** aluminium wires and frames.

____

8. White elephants?

Vocabulary

1 How many different reasons can you think of why an aircraft design project could fail?

2 Work with a partner. Look at the list below of reasons why projects are sometimes abandoned.

a Check that you understand and can pronounce all of the phrases.

b Make a table in your notebook with the headings: *Politics*, *Design*, *Economics*.

c Group the reasons under the headings in the table.

d Can you add any more to the lists?

- negative public opinion
- need for investment in new infrastructure, e.g., runways, hangars, machinery
- withdrawal of funding
- accidents during trials
- delays in production
- innovative production techniques are expensive
- high manufacturing costs
- lack of interest from potential buyers
- changing commercial or military needs
- competition from other companies

Politics	Design	Economics

Reading

1 You are going to read about an aircraft project which failed. Look at the text opposite, but do not read it yet.

a From the picture and your own knowledge, what do you think the text will say?

b Read the text quickly to see how many of your ideas are there.

2 Read the text again more slowly and correct the information in these sentences.

a The American government put US$7 million into the project.

b The total cost of the project was US$18 million.

c The plane spent 33 years in a museum.

d The plane flew several times.

e Hughes designed the plane in 1924.

Skills Box 1

Predicting content

You can make it easier to read a text by thinking: *What can I guess about this topic? What do I already know?*

Look at the titles, pictures and layout to help you.

Skills Box 2

Reading for specific information

As well as predicting, you need to be able to understand the main details of the text. You do not need to worry about understanding every word, but you should be able to pick out key information in a longer text.

The Spruce Goose

The journey from the initial idea and design specifications to a finished aircraft is often long and complex. Sometimes it is so long and so complex that projects fail. They may fail at any stage, in some cases not even getting off the drawing board. Sometimes there are serious technical problems with the prototype which cannot be easily solved. Sometimes the cost of production proves to be much too high and the project is scrapped for financial reasons, even after millions of dollars have been spent. Sometimes, by the time a prototype has been produced, there is no longer any need for the aircraft.

One example of such a *white elephant* is the HK1 military transport, which became known as the 'Spruce Goose'. In 1942, during the Second World War, the millionaire businessman and engineer Howard Hughes took on responsibility for designing and building the largest plane in the world. The design brief for this enormous plane was very demanding. The plane had to transport men and materials in very large quantities across the Atlantic without stopping to refuel. It had to be able to land on water as well as land. Because it was wartime, aluminium and steel were in short supply, so most of the aircraft was built of alternative materials.

Because this was such an innovative project, many years were spent on research and development. This cost a lot of money. By the end of the war, the American government had invested $18 million in the project and decided that the aircraft was too expensive and that they no longer needed it. However, Hughes was determined to finish the project and put in $7 million of his own money. He completed a prototype and flew the 'Goose' for its first and only flight. Although the flight was a success, the American government didn't change its mind and the plane spent the next 33 years 'ready for flight' in a storage hangar at a cost of $1 million dollars a year. Finally, after Hughes died, the plane was sent to a museum.

Language

1 **Look at this sentence: 'Sometimes there are technical problems which cannot *be easily solved*.'**

Why is the passive form used here instead of the other option: 'Sometimes there are technical problems which the team cannot solve'?

2 **Find further examples of the use of passive forms in the text about the Spruce Goose: three in paragraph 1; one in paragraph 2 and two in paragraph 3.**

Language Box

Passives

When the person who does an action is unimportant or unknown, and the action is the more important element, English uses the passive form '*be* + past participle'. For example, instead of:

i *Workers assemble the parts.*
ii *A group approved the plans.*

it would be more usual to use:

i *The parts are assembled.*
ii *The plans were approved.*

9. Aerodrome

1 An aerodrome is a defined area on land or water (including any buildings, installations and equipment) intended to be used wholly or in part for the arrival, departure and surface movement of aircraft. According to the type of aerodrome we can distinguish land aerodromes and water aerodromes. Both of them can be further divided into civil and military aerodromes. The location of an aerodrome which is very important with respect to noise abatement, meteorological conditions and obstructions is called the aerodrome site. Pilots are provided with all essential details about the aerodrome, including aerodrome elevation and aerodrome reference points in special aerodrome charts.

2 Aircraft and other vehicles, called aerodrome traffic, operate on the manoeuvring and movement area of an aerodrome. The area comprising of runways and taxiways and the apron(s) is the movement area. Air traffic comprising also all aircraft in flight operates on the manoeuvring areas. The manoeuvring area is that part of aerodrome to be used for the take-off and landing of aircraft and for the surface movement of aircraft associated with take-off and landing, excluding aprons. It may be all grass or it may contain paved or unpaved runways, taxiways and holding positions or bays. Nearly all important aerodromes have runways and taxiways and nowadays most of them are paved concrete or asphalt or both.

3 At most major aerodromes movement of aircraft is confined to runways and taxiways. A runway is a defined area, on a land aerodrome, prepared for the landing and take-off of aircraft. It may be a non-instrument runway, i.e. a runway used by aircraft using visual approach procedures, or it may be an instrument runway i.e. a runway used by aircraft using non-visual aids. Instrument approach runways may be classified into non-precision approach runways, served by non-visual aids providing at least directional guidance for a straight-in-approach e.g. ADF, VOR, SRA, and precision approach runway, served by ILS and visual aids.

4 Taxiways are used for taxiing and to provide a link between one part of the aerodrome and another. Rapid taxiways are connected to a runway at an acute angle and designed to allow landing aeroplanes to turn off at higher speeds thus minimizing runway occupancy and taxiing time.

1. Skim the text to find which paragraph contains information on these aspects.

a. Reducing the taxiing time ______

b .The function of the manoeuvring area ______

c .The classification of aerodromes ______

d. Essential details about the aerodromes ______

e. The connection between one part or the aerodrome and another ______

f. Types of runways and taxiways ______

g. The significance of the aerodrome layout ______

2. Find the difference in meaning between these aviation terms:

1 air traffic - aerodrome traffic

2 manoeuvring area - movement area

3 instrument runway - non-instrument runway

4 precision approach runway - non-precision approach runway

3. What do you know about aerodromes?

1 What kinds of aerodromes do we know?

2 Why is the location of an aerodrome important?

3 What essential details for flight preparation should pilots be provided with?

Where can they find them? What do they mean?

4 Are all manoeuvring areas paved today?

4. Using the text, define the following terms:

aerodrome

____

____

aerodrome site

____

____

taxiway

____

____

rapid taxiway

____

____

runway

____

____

aerodrome chart

____

____

manoeuvring area

____

____

air traffic

____

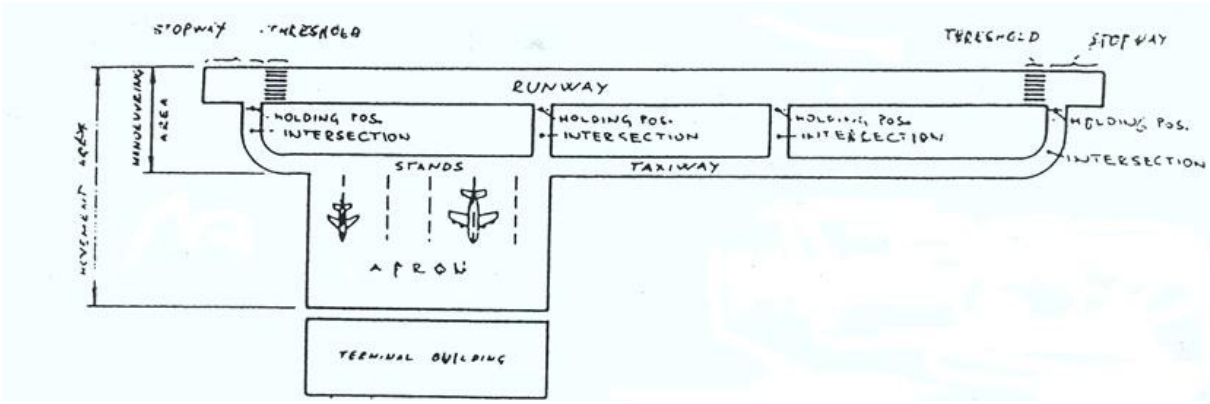
____

aerodrome traffic

____

____

5. Define the parts o fan aerodrome.



THRESHOLD, MANOEUVRING AREA, HOLDING POSITION, APRON or RAMP, TARMAC, TAXIWAY, RUNWAY, MOVEMENT AREA, STOPWAY, STANDS

1 The part of an aerodrome used for take-off, landing and taxiing of aircraft.____________________

2 The part of aerodrome consisting of the manoeuvring area and apron(s).______________________

3 A defined rectangular area on land aerodrome prepared for the landing and take-off of aircraft.

____

4 The beginning of the runway usable for landing at the approach end._________________________

5 The area at the upwind end of the runway where an aircraft can be stopped in the event of an interrupted take-off.____

6 A defined path on a land aerodrome established for the taxiing of the aircraft._________________

7 A defined area to accommodate aircraft during the loading and unloading of passengers (terminal apron)or cargo (cargo apron), parking (parking apron) or maintenance (service apron).____________

8 The point on the taxiway where departing aircraft wait for permission to go onto the runway.

____

9 The fixed places on the apron where aircraft wait during the disembarkation and embarkation of passengers.____

10 A colloquial expression for aircraft parking area, usually in front of a hangar. _________________

10. Airport design

Airports should be designed to ensure orderly service and development to the maximum capacity without having to pull down what is already there. The various parts should be grouped in such a way that each can be expanded logically to keep pace with the overall expansion.

Siting of airports

The general location of airports is influenced by geographical features, distribution of population and availability of ground transport. The number and type of aircraft required to carry the traffic determines the size of an airport, and its capacity is related to the surrounding airspace by the orientation of its runways creating certain traffic patterns.

Orientation and layout of runways

Runways are oriented in relation to prevailing winds taking into account their direction and velocity, so they wouldn't be strong enough to prevent aircraft taking off and landing. Atmospheric pressure, temperature and humidity do not directly affect the orientation of runway but they do affect their length. Lower density requires higher speed for a given total lift and take-off distances are longer. The height above the sea level determines the atmospheric pressure and air density. The humidity affects the work of piston aircraft which lose power and require longer take-off distances. A single runway may be inadequate because crosswinds make it unusable or it cannot accommodate all the traffic. The best layout for two runways is when they are sited parallel to each other; the intersecting layout should be avoided.

Terminal buildings

Terminal buildings are usually sited close to the aircraft stands on the terminal apron and close to each other so that passengers do not have to walk far. At the same time they should be close to the main surface connections to the city. The buildings are usually designed to separate arriving and departing passengers. Sometimes there are even different road levels for arrivals and departures. The organization of ground transport bringing passengers and freight to and from the terminal buildings is a major problem. Private cars must be allowed to load and unload, and public transport vehicles should have close access to the terminal buildings. There must be both short- and long-term parking facilities provided.

A terminal building should have space for receiving outgoing and incoming passengers and their luggage; space for completing state formalities concerned with international travel, and space for the passengers waiting to board aircraft or surface transport. The requirements for outgoing passengers are a waiting hall or lounge; ticket, enquiry and check-in counters; baggage reception, weighing and labelling equipment; food and drink arrangements; amenities such as toilets, money exchange, etc. The reception area for incoming passengers is less elaborate as it does not need the same provision for check-in. The state control on travellers usually calls for space for emigration and immigration offices, including interrogation rooms, offices and security rooms. Health control calls for interrogation rooms, offices and a quarantine area. Customs control requires a main customs hall, offices and a search room.

The assembly areas for passengers waiting to board the aircraft require a waiting lounge, catering areas and amenities such as telephones, toilets, etc. For incoming passengers this assembly area also requires equipment for the collection of baggage.

1. Which paragraphs deal with:

airport design _____

location _____

the size and capacity of an airport _____

the orientation of runway _____

the length of runway _____

the layout of runway _____

2. Answer the questions:

What should the airport design ensure?

What affects the airport location?

What affects the orientation and length of the runways?

Why are two runways better than a single runway?

Why is the parallel layout better than intersecting?

3. Fill in the gaps:

Terminal buildings are situated close to aircraft __________on terminal apron, close to each other so that the passengers don't have to __________far and close to surface__________.

Terminal building should provide space and __________for incoming and __________passengers and their__________.

The requirements for outgoing passengers are:

-waiting hall or__________

-ticket, enquiry and check-in__________

-baggage __________;weighing and __________ equipment

- food and drink arrangements, toilets, money__________

The incoming passengers do not need __________counters, but the assembly area requires equipment for the __________of baggage (conveyor belts).

The __________control on travellers includes emigration and immigration offices,__________ room, security rooms. Health control includes interrogation room and __________area. Custom control __________a main custom hall, offices and a __________ room.

4. Compare and paraphrase the following words:

single / parallel/ intersecting runway

aerodrome/airport

requirements for incoming/ outgoing passengers

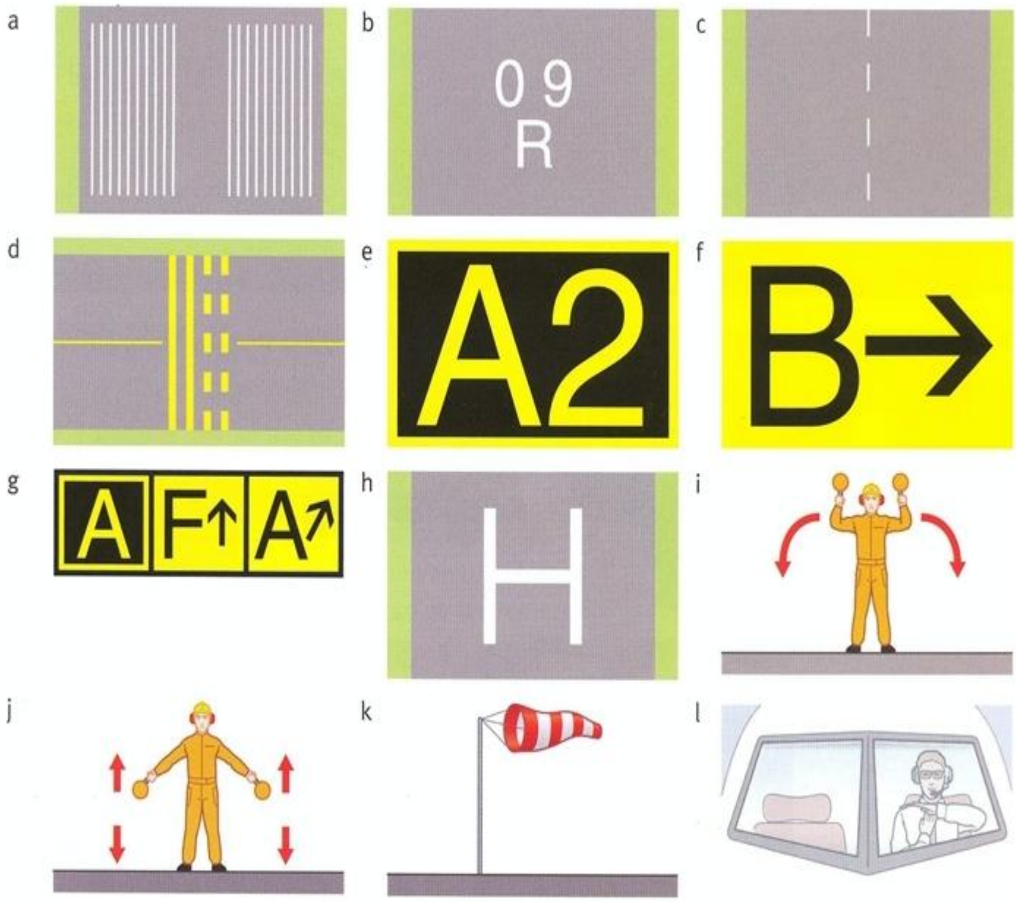
state control/ health control customs control

5. Write an essay about Zagreb airport (location, runway, terminal building...)

11. Ground movements

STARTER

Look at the signals and signs. Where do you find them? Can you say what they mean?



Match the signs and signals above with the names below.

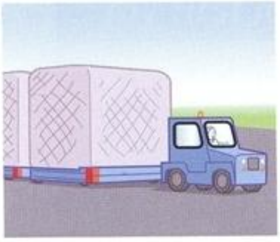
1 centre line marking
2 runway taxi holding position
3 runway designator
4 taxiway location sign
5 direction sign
6 connect ground power
7 reserved for helicopter
8 move ahead
9 taxiway A changing direction
10 slow down
11 threshold markings
12 wind direction and speed

Now mark items 1–12 above with G (ground/surface marking), SN (sign) or SG (signal). Do you have any experience of signs or signals that were confusing or difficult to see? What was the problem?

VOCABULARY

1 Match each picture to a name and an action.

a



b

Vehicle	Action
1 aircraft de-icer	transporting passengers
2 bus	spraying icy wings
3 fire engine	transporting construction materials
4 flat-bed truck	reversing planes
5 fuel tanker	repairing flat tyres
6 heavy plant	putting out fires
7 maintenance truck	getting rid of compacted ice
8 push-back tug	delivering kerosene
9 snowplough	clearing debris
10 sweeper	carrying cargo

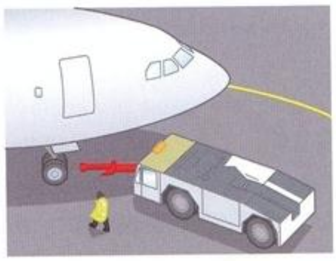
c

d

e

f

g



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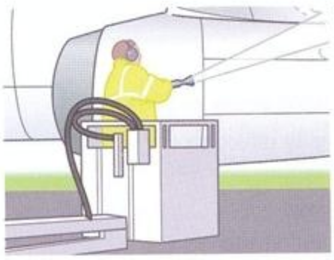

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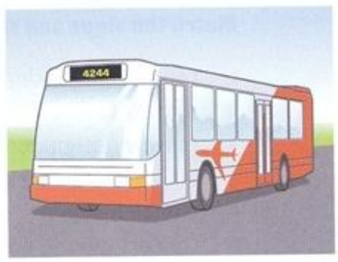


What is each vehicle used for? Use *is used for*.

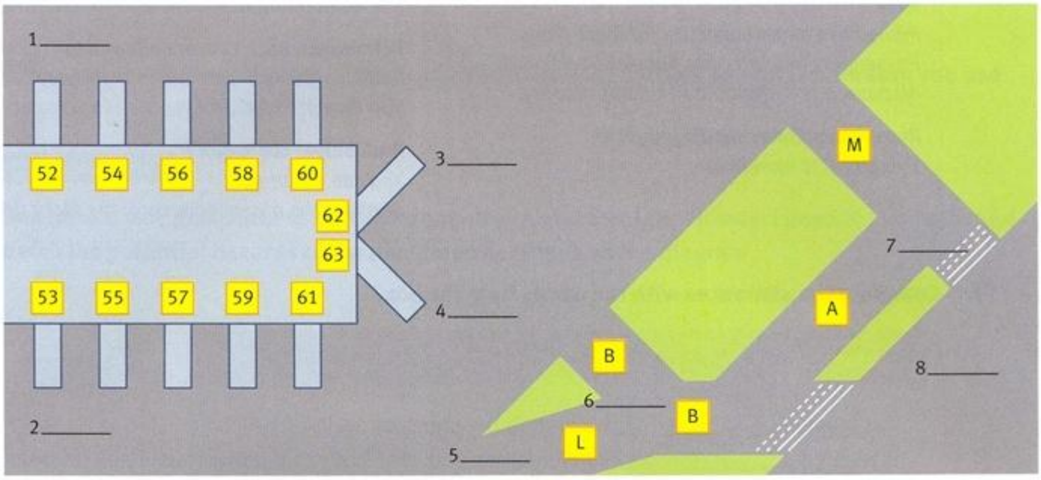
A de-icer is used for spraying icy wings.

British English	American English
snowplough	snowplow
kerosene	jet fuel

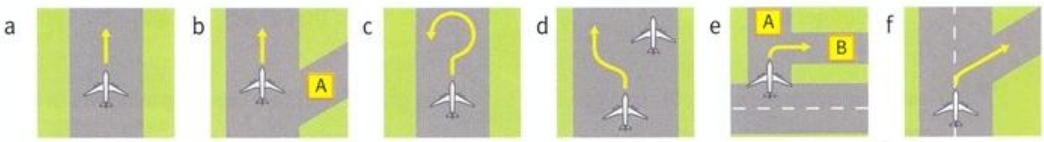
AUDIO 15

2 Listen. Where are the airside vehicles? Mark their locations.

RYR 372 • fire tender • BA Bus 5 • sweeper • de-icer • RYR 355 • UAL 439 • maintenance truck



3 Match the words and phrases for movement with the pictures.



1 keep well to the left of
2 backtrack
3 turn on to taxiway B
4 taxi off the runway
5 go straight ahead
6 go beyond taxiway A

COMPREHENSION

4 Match the sentence halves.

1	I have to be near	a	due to works.
2	I have a flat tyre	b	on the nose gear.
3	Do you need	c	a radio problem.
4	I've got	d	a push-back tug?
5	A maintenance truck	e	our maintenance area.
6	Taxi with caution	f	is on its way for your flat.

AUDIO 16

Now listen and check your answers.

FLUENCY

5 Listen again. Answer the questions or discuss them with a group.

1 How many planes is ground control dealing with?
2 Describe the tug driver's difficulty.
3 What plane does KLM 219 give way to?
4 Why is the KLM pilot impatient?
5 What's the difference between *Taxi slowly* and *Taxi with caution*?

15

UAL 439 United 439 holding on taxiway L.

Ground United 439, hold position. There's an aircraft de-icer at stand 62 blocking your stand. BA Bus Number 5, where are you?

Bus 5 Stand 52, waiting to depart. Number 5 Bus.

Ground Roger, BA bus. Hang on. I've got a fire tender outbound at taxiway B, repeat B.

Bus 5 Roger that. Holding.

RYR 372 Ryanair 372 request push back stand 53.

Ground Push back approved, 372.

UAL 439 United 439 holding on taxiway L. Is there a problem at stand 63?

Ground Hold position, 439. There's a maintenance truck leaving your stand.
Ryanair 355 proceed to intersection MA, hold short of the runway. Expect delay. A sweeper is still clearing runway 05.

UAL 439 United 439 holding on L.

Ground Stand by, 439.

RYR 355 Ryanair 355 holding short of runway 05.

Ground 355, line up and wait. The sweeper is leaving the runway.
Cleared for take-off.

RYR 355 Cleared for take-off, Ryanair 355.

UNIT 3, EXERCISE 4

16

Ground Tug 3, report when ready to vacate stand 6. Lufthansa 158 approaching.

KLM 219 Ground, KLM 219 runway 24 clear. Holding. Listen, can I change stand? I have to be near our maintenance area. I have a flat tyre on the nose gear.

Ground KLM, 219, do you need a push-back tug?

Tug 3 Hang on a minute. Hello. Hello. I can't hear. I've got a radio problem. Tug 3.

Ground Lufthansa 158, slow down, taxi slowly to intersection D4. KLM 219, stand by.
Tug 3, vacate stand 6. Report.

DLH 158 Taxiing slowly. Stand 6 in sight and still blocked. Request stand change. Lufthansa 158.

KLM 219 KLM 219, still holding. Did you get my message? Confirm stand, please.

Tug 3 Ground, read you now. Stand 6 vacated. Tug 3.

Ground Roger Tug 3. Lufthansa 158, stand 6 is cleared. Proceed straight ahead. Break break KLM 219, hold position. Give way to 757 on taxiway Z.

KLM 219 Holding postion, KLM 219.

DLH 158 Stand 6 confirmed. Lufthansa 158.

Ground KLM 219, stand 19 is clear. A maintenance truck is on its way for your flat. Taxi with caution due to works. Keep well to the left.

KLM 219 Stand 19. Hey, I can see lots of works. Request closest available stand. KLM 219.

12. Air Traffic Control

Jack Donnell is an air traffic controller who works in the radar room a short distance form the airport.

Dialogue:

Q: This room is dark, Jack, and there aren't any windows. How do you know what's happening outside?

J: We watch our radar screens and we listen to the radio.

Q: I always thought you worked in tall towers with big -glass windows.

J: There is a tower, but since we've had radar the tower is used only for airfield control.

Q: I see. Here you control the aircraft when they are in the air.

J: That's right. The men in the tower control the aircraft just as they are coming in to land and when they are taking off.

Q: How do you control the aircraft when they are in the air?

J: We can see the movements of the aircraft on our radar screens, and we talk to the pilots on the radio.

Q: Why do you have two screens here?

J: The screen on the left shows the position of, the aircraft from 50 to 240 kilometres - that's about 30 to 150 miles - from the airport. The screen on the right shows their position within 50 kilometres, or 30 miles, of the airport.

Q: Are the "blips" on the screen the aircraft?

J: Yes. The white lines are an outline map of the area. The pattern of lines which shows distance is called a grid.

Q: Do you use only radar to show you the position of the aircraft?

J: No. We also use coloured cards or strips. We write down the number of the aircraft and its position on the cards. There are white cards for departing aircraft and blue ones for arriving aircraft.

Q: Do you change the information on the cards?

J: Yes, as the aircraft moves we update its position.

Q: Why do you need cards as well as radar?

J: There are two reasons. First, as a fall-back system, in case the computer that stores the data goes wrong. Second, we like to have a double-check on its position.

Q: You said that every aircraft has a number. What kind of a number?

J: Every airline has its own code word. Each aircraft has its own number. When we speak to an aircraft we use both its code and number. Together they form the aircraft's call sign.

Q: What information do you give the pilots on the radio?

J: That depends where they are. If a pilot is in radar range, we tell him what to do: how high to fly, what course to take, how fast to fly, etc.

Q: You control his movements completely, do you?

J: Only when he is in the air space we can see on our radar screens. If he is out of radar range, we can only advise him about other aircraft in the area.

Q: But, if he is out of radar range, how do you know about other aircraft in that area?

J: Pilots report their movements to us by radio. Also, every pilot must hand in a flight plan before he takes off.

Q: Must a pilot keep to his flight plan?

J: Normally he wants to - but there are occasions when he wants to change. He may wish to fly higher or take a different route to avoid bad weather. If we can fit him in with other aircraft, we'll agree to the change of his plan.

Q: You really do control the air traffic, don't you? How many aircraft does an ATC look after?

J: That depends on the size of the airport. At a small airport there are six ATCs on duty at the same time. At a big airport, like London Heathrow, there would be over 30. At London there may be 100 aircraft in controlled air space at the same time.

Q: Do so many aircraft cause you any problems?

J: Most of our work is routine. Our aim is to avoid collisions in the air by keeping height and distance between each aircraft. But bad weather is a major problem because it slows everything up. If there are a lot of aircraft waiting to land, we stack them up, one above the other, and bring them down one at a time.

Q: And there can be delays in take off, too, I suppose?

J: That's right. There can be 10, even 20 aircraft waiting to take off. They must each wait their turn.

Q: You spoke about tower being responsible for runway control. What do they do?

J: Before we had radar, all air traffic control came from the tower. Now we use it only for the final approach. When an aircraft is within 8 kilometres - say 5 miles - of the airport, we hand it over to the tower. The ATCs in the tower then bring it down and tell the pilot which runway to use and where to park.

Q: And when to take off?

J: Yes, the control of an aircraft is passed from one ATC to another.

Q: How do you control a pilot who doesn't speak English?

J: All airline pilots must speak English. English is the language of aviation.

1. Answer the questions and complete the sentences:

1 ATC controllers use: **a)** radars **b)** radios **c)** head up displays.

2 They have 2 radar screens showing: **a)** the position of an aircraft from 50-240 km of the airport

b)

3 On a radar screen they can see **a)** aircraft **b)** UFOs **c)** grid.

4 Coloured cards or stripes are used to show: **a)** the number **b)** colour **c)** position of the aircraft.

5 They are used to **a)** double-check the position of the aircraft **b)**

6 Code number of each aircraft consists of **a)** airline ________ **b)** aircraft number

7 ATC gives pilots information on how__________and__________to fly, what__________to take.

8 Pilot changes his flight plan **a)** never **b)** only when he needs to.

9 There are more than 6 ATC towers at Heathrow.

10 The aim of ATC is to avoid__________in the air by keeping__________and__________between each aircraft.

11 In the case of bad weather, aircraft are put in a stack and then brought__________one__________time.

12 ATC towers are usually responsible for

a) the whole flight

b) final approach

c) for aircraft which are 5 miles within the range of the airport

d) to suggest pilots which runway and apron to choose.

13. ATC

Skim this text and identify the paragraphs which contain the information on these topics.

1 The function of Ground Movement Control - paragraph 4

2 Equipment of Aerodrome Control Tower -

3 Transfer of arriving aircraft -

4 Controlling aircraft taking off and landing -

5 ATC sectors -

1 The series of air traffic control (ATC) services operating throughout most of the world is provided to enable the safe, orderly and expeditious flow of air and aerodrome traffic. Each air traffic services unit (ATSU) performs its own function in reference to a particular type and phase of flying.

2 The function of Aerodrome Control Tower (TWR) is to issue information and instructions to aircraft to achieve a safe and rapid flow of traffic and to assist pilots in preventing collision between aircraft in flight in the vicinity of the aerodrome traffic zone, aircraft taking off and landing, aircraft moving on the manoeuvring areas, aircraft and vehicles operating on the manoeuvring area, and aircraft on the manoeuvring area and obstructions on that area.

3 The Control Tower is equipped with many transmitters and receivers, intercommunication systems with other agencies, telephones, airport lighting switches and wind instruments. Many Visual Control Rooms (VCRs) are equipped with an Air Traffic Monitor (ATM). This is a daylight-viewing, colour radar showing the local area out to a radius of about 10 miles.

4 The aircraft moving on the apron and aircraft and vehicles on the manoeuvring area is the responsibility of Ground Movement Control (GMC) which is a function of the Control Tower, but uses a separate frequency. It also delivers ATC clearances to pilots planning IFR flights; ATC clearances can also be delivered by a further subdivision of GMC called Clearance Delivery.

5 Another function of the Tower is Approach Control, which is concerned with the traffic landing at an airport within its defined area of control. An arriving aircraft is transferred from Area to Approach Control at a specified release point. At larger airports automated and semi-automated radar approach facilities are used to smooth the running of the flow of traffic.

6 Air route traffic control centres handle en route aircraft operating under instrument flight rules (IFR) between airport terminal areas. To facilitate traffic handling, an area under the jurisdiction of the Control centre (ACC) is broken into sectors, each with its own radio frequency.

1 Check your understanding - Are these statements true or false? Correct the false ones.

1 Air traffic services are used to control air and aerodrome traffic.

2 Each air traffic service unit has a definite function.

3 The Tower controls the traffic on the manoeuvring areas.

4 All Control Towers are equipped with transmitters and Air Traffic Monitor.

5 Ground Control uses the same frequency as the Control Tower.

6 Clearance Delivery delivers different clearances.

7 Arriving traffic is controlled by Approach Control at a specific release point.

8 Control Centre consists of several sectors.

2 Match the terms listed below with the definitions:

Air Traffic Control Unit	Clearance Delivery
Area Control Centre	Ground Control
Aerodrome Control Tower	release point
Approach Control	radar

Programmes whereby pilots of departing IFR aircraft may choose to receive their IFR clearance before they start taxiing for take-off.

1____

A unit established to provide an approach control service for arriving or departing controlled flights.

2____

A unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.

3____

Radio Detection and Ranging, a device which, by measuring the time interval between transmissions and receptions of radio pulses provides information on range, azimuth and/or elevation of objects in the path of transmitted pulses.

4____

A generic term meaning variously, area control centre, approach control office or aerodrome control tower.

5____

A ground facility which detects the movement of aircraft on the airport surface, working closely with other tower positions.

6____

The position, time or level at which an arriving aircraft comes under jurisdiction of approach control.

7____

Unit established to provide air traffic control service to aerodrome traffic.

8____

3 The following words and phrases are used in radio communication procedures.

Translate them into Croatian.

AFFIRM

CLEARED

COMPLY

CONFIRM

DISREGARD

EXPEDITE

HOW DO YOU READ?

I SAY AGAIN

NEGATIVE

READ

READ BACK

STANDBY

4 Which of the paraphrases mean: HOLD SHORT (OF), MAINTAIN, ROGER, ACKNOWLEDGE, WILCO

-let me know that you have received and understood the message

-continue in accordance with the condition(s) specified

-keep at a distance

-I have received all of your last transmission

-I understood your message and will comply with it .

5 What information is repeated using the same words?

Read back requirements

Example:

G: 9ADDD.CLEARED TO LAND.

RUNWAY 28. WIND 280/6 KNOTS. REPORT RUNWAY VACATED.

A: CLEARED TO LAND, RUNWAY 28.

WILCO. 9ADDD.

G: 9ADDD CORRECT.

6 Translate the messages:

A

P: Canadair 221. Overhead Brad at 300 feet. Commencing mission.

T: Canadair 221. Roger. Report mission completed.

P: Canadair 221. Wilco.

B

A: 9ADDA PASSING 4000 feet, CLIMBING TO 8000 feet

G: 9ADDA (ROGER)

C

A: REQUEST TOW (company name), (aircraft type) FROM (position) TO (position)

G: TOW APPROVED VIA (route)

G: HOLD POSITION

G: STAND BY

14. ICAO

2. Tablica izgovora ICAO-ove abecede i predaja brojki u radiotelefoniji

2. ICAO Spelling Table and Transmission of Numbers

2.1 Tablica izgovora ICAO-ove abecede

2.1 ICAO Spelling Table

Slovo Letter	Riječ Code Word	Izgovor Pronunciation	Hrvatski Croatian
A	Alpha	['ʌlfʌ]	AL FA
B	Bravo	['bravou]	BRA VO
C	Charlie	['tʃa:li]	ČAR LI
D	Delta	['deltə]	DEL TA
E	Echo	['ekou]	EK O
F	Foxtrot	['fɔkstrɔt]	FOKS TROT
G	Golf.	['gɔlf]	GOLF
H	Hotel	[hou'tel]	HO TEL
I	India	['indiə]	IN DIJA
J	Juliett	['dʒu:liət]	DŽU LI JET
K	Kilo	['kilou]	KI LO
L	Lima	['limə]	LI MA
M	Mike	['maik]	MAJK
N	November	[nou'vembə]	NO VEM BE
O	Oscar	['ɔskə]	OS KA
P	Papa	[pʌpa:]	PA PA
Q	Quebec	[kwi'bek]	KVI BEK
R	Romeo	['roumiou]	RO MIO
S	Sierra	['si:erə]	SIJE RA
T	Tango	['tængou]	TEN GO
U	Uniform	['ju:nifɔ:m]	JUNI FOM
V	Victor	['viktə]	VIK TOR
W	Whiskey	['wiski]	VIS KI
X	X-ray	['eksrei]	EKS REJ
Y	Yankee	['jænki]	JEN KI
Z	Zulu	['zulu]	ZULU

2.2. Predaja brojki u radiotelefoniji

2.2 Transmission of numbers

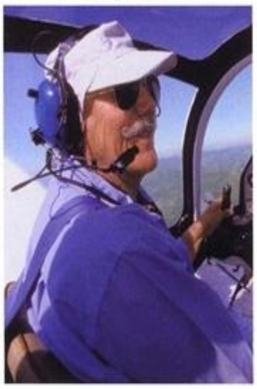
Hrvatski Croatian	Brojke i oznake Numbers and Marks	Engleski English
NU LA	0	ZE RO
JE DAN	1	WUN
DVA	2	TOO
TRI	3	TREE
ČE TIRI	4	FOW-er
PET	5	FIFE
ŠEST	6	SIX
SE DAM	7	SEV-en
O SAM	8	AIT
DE VET	9	NIN-er
DE SET - DEVEDESET DEVET	10 - 99	WUN-ZE-RO - NIN-er NIN-er
STO	100	HUN-DRED
TI SU ĆA/E	1000	TOU-SAND
ZA REZ	,	DAY-SEE-MAL
TOČKA	.	POINT

15. Introduction to air communications

STARTER

Use arrows (⟷) to link the people who talk to each other.

PILOT G-SC27



PILOT FLIGHT 71

CABIN CREW FLIGHT 71

TOWER CONTROLLER

CO-PILOT FLIGHT 71

PASSENGERS FLIGHT 71

COMPREHENSION

1 Air communications are vital for the safety of air travel. Listen to the two exchanges and answer the questions.

1 a Which stand is 363 on?
  b Where does the controller think 363 is?
  c Which numbers and letters are incorrectly pronounced?
2 a Which flight level is X7420 climbing to?
  b What is the altitude of X7420?
  c What two words does the controller confuse?

Look at the six language areas on page 2. Listen again to the two exchanges and look at the transcripts on page 84. Find an example of a difficulty with each language area.

Discuss these questions with a partner.

1 Have you had any similar experiences?
2 What communication problems have you had when talking to foreign pilots or controllers?

PRONUNCIATION

AUDIO 3

2 Listen and repeat.

ICAO ALPHABET AND NUMBERS

A	Alpha	K	Kilo	U	Uniform
B	Bravo	L	Lima	V	Victor
C	Charlie	M	Mike	W	Whiskey
D	Delta	N	November	X	X-ray
E	Echo	O	Oscar	Y	Yankee
F	Foxtrot	P	Papa	Z	Zulu
G	Golf	Q	Quebec		
H	Hotel	R	Romeo		
I	India	S	Sierra		
J	Juliett	T	Tango		
0	zero	4	fower	8	ait
1	wun	5	fife	9	niner
2	too	6	six		
3	tree	7	seven		

00 (hundred) hundred
000 (thousand) tousand
. (decimal) dayseemal

British CAA	**ICAO/Global**
FL 100 = flight level one hundred	FL 100 = flight level one zero zero

AUDIO 4

3 Listen to the sample message and repeat.

London Control, Express 164. Flight Level 100. Heading 345. ETA Belfast 0839.

INTERACTIONS

Work with a partner to pass and record messages. If you are not sure about the message, ask for clarification. Repeat *Say again* until you have understood.

ASKING FOR REPETITION

Repeat entire message	**Repeat specific item**
Say again.	Say again flight level.
	Say again all before heading.
	Say again all after flight level.
	Say again flight level to ETA.

PARTNER FILES
Partner A File 1, p. 70
Partner B File 8, p. 72

AUDIO 5

Listen and check. Then compare what you wrote with the information your partner read.

STRUCTURE

QUESTIONS AND SHORT ANSWERS

Are you on stand C63 or C61?	I'm/We're on stand C61.
Is the radio on the correct frequency?	Yes, it is./No, it isn't.
Have you set the QNH?	Yes./Yes, I have./No, I haven't.
Has the weather improved?	Yes, it has./No, it hasn't.
Do you have the flight plan?	Yes, I've got it here./No, I don't.
Do you know where John is?	Yes, I do./No, I don't.
Did the bird strike cause any damage?	Yes, it did./No, it didn't.

4 Put the words in the right order to make questions. Then answer them.

1 you a a controller pilot Are or ?
2 speak other languages you Do any ?
3 abroad ever you been Have ?
4 plane travel last When by you did ?
5 your provide training company courses English Does ?
6 English in minutes the ten your last improved Has ?

American English	British English
airplane	aeroplane

FLUENCY

5 Match the two parts of the sentences to make six reasons why international communications may be difficult.

1 ATCOs and pilots may speak
2 There may be very poor reception
3 Extra and unnecessary
4 ATCOs or pilots may sometimes
5 Non-routine situations have little
6 ATCOs or pilots may not understand

a English words are used.
b in their own language.
c or no standard phraseology.
d on the radio.
e use plain English.
f standard English phraseology.

AUDIO 6

6 Listen to five exchanges. Write the number of the exchange next to the description below. Then tick how often you expect to hear each of these in your work. Then discuss your answers with a partner.

	always	often	usually	sometimes	occasionally	rarely	never
a ____ standard phraseology	❑	❑	❑	❑	❑	❑	❑
b ____ non-standard phraseology	❑	❑	❑	❑	❑	❑	❑
c _1_ unnecessary English words	❑	❑	❑	❑	❑	❑	❑
d ____ plain English	❑	❑	❑	❑	❑	❑	❑
e ____ local language	❑	❑	❑	❑	❑	❑	❑

AUDIO 7

7 Listen to the exchange as a long haul flight approaches its destination. Answer the questions.

1 What is the main communication problem?
2 How did the pilot try to help the controller understand?
3 How did the controller deal with the situation?

VOCABULARY

8 Listen again. From each pair of words, tick the word you hear.

1	violent	vibration
2	rude	unruly
3	hit	hate
4	drink	drunk
5	aggressive	angry
6	ground	around
7	services	service
8	remain	remove

9 What is the problem on board the aircraft? Use words you have selected in exercise 8 to make sentences.

1 The passenger was ______________ , ______________, and ______________ .
2 The passenger ______________ a crew member.
3 The pilot wanted to get on the ______________ as soon as possible.

Have you ever had a difficult communication? What did you do?

Yes, I have. I had a medical emergency. The pilot asked for ...
The controller asked me to ...
No, I haven't.

10 Use words from exercise 6 to complete the article.

SAFETY SENSE

Dealing with non-routine events

Occasionally [1] a pilot may be able to use ______________ [2] phraseology for a non-routine event, but he will ______________ [3] have to use ______________ [4] English. In this event he had to use ______________ [5] phraseology but tried to assist the controller by not using any ______________ [6] English words and by using several different words with a similar meaning.

The radio transmission was good, but the controller could not understand the problem as he ______________ [7] dealt with domestic flights and ______________ [8] spoke to a foreign pilot. This can ______________ [9] be a problem for controllers as they get little practice with spoken English and ______________ [10] speak to local pilots in the ______________ [11] language. A non-English speaker will ______________ [12] be alone in this situation and help will ______________ [13] be available.

Answer the questions.

1 How often do you use English for your job?
2 How often do you speak English to:
   a non-native speakers?
   b native English speakers?
3 How often do you listen to the radio or watch TV in English?
4 What is your best English skill: listening, speaking, reading, or writing? Which would you most like to improve?
5 Have you ever had difficulty trying to speak English? What was the outcome?

UNIT 1 EXERCISE 1

Exchange 1

2 *Ground* Er ... 363, start up and push at 05.
Pilot 363 Tower, er 363, just started pushing back now. You do know there's another plane pushing back from the next stand?
Ground Say again 363.
Pilot 363 There's another pushing back on the next stand. We've had to stop.
Ground Er, 363, stand number give me.
Pilot 363 Er, say again.
Ground Number give me. Your number, please?
Pilot 363 Er – we're 363.
Ground No, I ask you stand number.
Pilot 363 Oh, you want our stand number. Yeah – we're on Charlie 61. 363.
Ground 363, you not C63?
Pilot 363 Negative. We're definitely on Charlie 61. 363.
Ground Ah! Sorry, sir. Stand Charlie 61.

Exchange 2

ATC X7420, confirm heading 040.
Pilot X7420 Roger, heading 040.
ATC X7420, turn right, heading 340.
Pilot X7420 Did you hear that? He did say right, didn't he? Er – can you confirm that, please? X7420.
ATC X7 – er – X – er 420. Right turn heading 3 – er – 40. Climb – er – flight level 1 – er – 00.
Pilot X7420 That's what I thought. Does this guy know right from left? I'm sure that should be left – I'm going to check again.
Er – Control – please confirm right onto heading 340. X7420.
ATC X7420, turn – er – right – er – heading 340.
Pilot X7420 Roger, OK. We're at 3800. If that's what he wants, that's what we'll do.
ATC X7420, turn left, left. I say again – turn left!

UNIT 1, EXERCISE 3

Communication 1

5 Gatwick Approach, Speedbird 209. Flight level 110. Heading 100. ETA Isle of Man 1005.

Communication 2

Shanwick Control, BD744A requesting Oceanic clearance. Estimating 58 West, 10 North at 1310 UTC. Requesting flight level 350, Mach .80.

Communication 3

Speedbird 567A is cleared 16 000 on 1010 hectopascals. Expect to cross GOOSE – Golf Oscar Oscar Sierra Echo – level at 120, speed 250 knots.

Communication 4

London Control, United Air 955. Flight level 90. Heading 230. ETA Saint Abbs Head 1005.

Communication 5

Roger Prestwick, 317A is cleared 58 North, 10 West, 60 North, 20 West, 60 North, 30 West, 60 North, 40 West, 58 North, 50 West, PORGY– Papa Oscar Romeo Golf Yankee. Maintain 350 Mach .80.

Communication 6

UK Air 298A Heavy. Taxi to hold R for runway 31. QNH 1016. FALCON 4F departure. FALCON – Foxtrot Alpha Lima Charlie Oscar November. Squawk 7412.

UNIT 1, EXERCISE 6

Exchange 1

6 Er – yeah. Good morning there, Quality 405. A departing 747 reported wind shear at 800 feet. Airspeed loss 25 knots, strong right shift. Let me know if you have a problem, please. And – have a nice flight! Bye.

Exchange 2

BAW 456 Speedbird 456 request descent.
Approach Speedbird 456 maintain flight level 260 expect descent after HERON.
BAW 456 Maintaining flight level 260. Speedbird 456.

Exchange 3

038-NT Bellevue Tour, 038-NT, nous avons les installations en vue. Pourrait-on envisager une approche à vue main droite pour la 31 droite?
Tower 038-NT, vous me confirmez le terrain en vue?
N97962 Er – Bellevue Tower. Stinson N97962. Request vectors to base-leg 31 right.
Tower Stinson N97962. Yeah – go ahead ...
038-NT Affirm NT, nous avons les installations en vue.
Tower Alors autorisé approche à vue main droite 31 droite, NT.
N97962 Er – Bellevue Tower Stinson N97962, I say again. Request vectors to base-leg 31 right.

Exchange 4

A48BX BX ready for take-off. Request left turn out heading 300 degrees.

Departure BX, left turn cleared. After departure climb not above altitude 2000 feet until reaching zone boundary.

A48BX Left turn approved. Climbing to 2000 feet until reaching zone boundary. BX.

Exchange 5

Er – hi, there N526. You've got a south westerly blowing in there. Around about 10 knots. You're OK to land. Runway 28.

UNIT 1, EXERCISE 7

7 *Blaze 606* Tukubu Tower, Blaze 606. We have a problem and we'd like a priority landing. We have a violent passenger on board.

Tower 1 Say again 606. I don't understand.

Blaze 606 We have an unruly passenger on board. We have a violent passenger. He has hit a member of the cabin crew. Request priority landing.

Tower 1 606, I'm sorry, sir. I do not understand your problem, sir.

Blaze 606 This passenger is endangering the safety of the flight. He is drunk.

Tower 1 The safety of the flight is in danger?

Blaze 606 Affirm. We have an aggressive passenger. We need to get on the ground as soon as possible.

Tower 2 606, understand you have a problem with a passenger, sir? Do you need medical assistance?

Blaze 606 Negative. We have a medical doctor on board and do not need medical assistance. We need services to remove this unruly passenger from the plane.

Tower 2 606, the police and the airport authorities will meet you, sir.

16. Engineering materials

1. Scan the table which follows to find a material which is:

1. soft
2. ductile
3. malleable
4. tough
5. scratch-resistant
6. conductive and malleable
7. durable and hard
8. stiff and brittle
9. ductile and corrosion-resistant
10. heat-resistant and chemical-resistant

MATERIALS	PROPERTIES	USES
METALS		
Aluminium	Light, soft, ductile, highly conductive, corrosion resistant	Aircraft, engine components, foil, cooking utensils
Copper	Very malleable, tough and ductile, highly conductive, corrosion-resistant	Electric wiring, PCBs, tubing
Brass (65% copper, 35% zinc)	Very corrosion-resistant, casts well, easily machined. Can be work hardened. Good conductor	Valves, taps castings, ship fittings, electrical contacts
Mild steel (iron with 0.15% to 0.3% carbon)	High strength, ductile, tough, fairly malleable. Cannot be hardened and tempered. Low cost. Poor corrosion resistance.	General purpose
High carbon steel (iron with 0.7% to 1.4% carbon)	Hardest of the carbon steels but less ductile and malleable. Can be hardened and tempered.	Cutting tools such as drills, files, saws
THERMOPLASTICS		
ABS	High impact strength and toughness, scratch-resistant, light and durable.	Safety helmets, car components, telephones, and kitchenware.
Acrylic	Stiff, hard, very durable, clear. Can be polished easily. Can be formed easily.	Aircraft canopies, baths, double glazing.
Nylon	Hard, tough, wear-resistant, self-lubricating	Bearings, gears, castings for power tools
THERMOSETTING PLASTICS		
Epoxy resin	High strength when reinforced, good chemical and wear resistance.	Adhesives, encapsulation of electronic components.
Polyester resin	Stiff, hard, brittle. Good chemical and heat resistance.	Moulding, boat and car bodies.
Urea formaldehyde	Stiff, hard, strong, brittle, heat-resistant and a good electrical insulator	Electrical fittings, adhesives

2. Scan the table to find:

1. A metal used to make aircraft.
2. Plastics used for adhesives.
3. Steel which can be hardened.
4. An alloy suitable for castings.
5. A plastic with very low friction.
6. A material suitable for safety helmets.
7. A metal suitable for a salt-water environment.
8. A metal for general construction use but which should be protected from corrosion.
9. A plastic for car bodies.
10. The metal used for the conductors in printed circuit boards.

3. Use the table on the previous page to make definitions of the materials in column **A**. Choose the correct information in columns **B** and **C** to describe the materials in column **A**.

A	B	C
1. An alloy 2. A thermoplastic 3. Mild steel 4. A conductor 5. An insulator 6. High carbon steel 7. Brass 8. A thermosetting plastic	a metal a material an alloy	allows heat or current to flow easily. remains rigid at high temperatures. does not allow heat or current to flow easily. contains iron and0.7% to 1.4% carbon. becomes plastic when heated. contains iron and 0.15% to 0.3% carbon. formed by mixing other metals and elements. consists of copper and zinc.

4. Add this extra information to the following text about plastics.

1. Plastics can be moulded into plates, car components, and medical aids.
2. Thermoplastics soften when heated again and again.
3. Thermosetting plastics set hard and do not alter if heated again.
4. ABS is used for safety helmets
5. Nylon is self-lubricating.
6. Nylon is used for motorized drives in cameras.
7. Acrylic is a clear thermoplastic.
8. Acrylic is used for aircraft canopies and double glazing.
9. Polyester resin is used for boat and car bodies.
10. Polyester resin is hard and has good chemical and heat resistance.

Plastics are synthetic materials. They can be softened and moulded into useful articles. They have many applications in engineering. There are two types of plastics: thermoplastics and thermosetting plastics.

ABS is a thermoplastic which is tough and durable. Because it has high impact strength, it has applications where sudden loads may occur.

Nylon is a hard, tough thermoplastic. It is used where silent, low-friction operation is required.

Acrylic can be formed in several ways. It is hard, durable, and has many uses.

Polyester resin is a thermosetting plastic used for castings. It has a number of useful properties.

17. Materials and properties

Vocabulary and speaking

In this lesson, you are going to think and talk about the materials that aircraft and other products are made of.

Language Box

Appearance and properties

be/looks + adjective:
It is long.
It is dark blue.
It looks very smooth.
It looks hard.

Size

long/high/wide:
It's about 35 cm long.

1 Look around the classroom and try to identify all the different materials you can see.

a If you don't know the English name for all the materials, try to describe them with words you do know. This is called *paraphrasing* and is a very useful skill. For example: *It comes from a tree. It's used for making car tyres*. Look at the Language Box for some useful phrases.

b Are any items made of the following: moulded plastic, copper, glass, metal alloy, paper, wood?

2 Match the following questions and answers. What object is being described?

Question	Answer
a What's it made of?	**i** It's about 10 cm by 10 cm.
b Can it be used for storing things?	**ii** Yes, it is.
c Is it hard?	**iii** Plated metal alloy.
d What is it for?	**iv** You turn it with your hand.
e How does it work?	**v** No, it can't.
f How big is it?	**vi** It's for opening a door.

3 With a partner, discuss the questions below.

a Think of a car. How many different materials are used in its manufacture? Why is each material used?

b What about an aeroplane? Look at these three pictures of aeroplanes and discuss the different materials you think you would find in them and why.



Reading

1 Take two minutes to quickly read the following text. Decide which of the sentences below is the best summary of the whole text.

a The modern jet fighter is made using the most advanced materials.

b The properties of materials are a central part of design.

c Modern materials have completely replaced traditional ones.

Materials and design

As well as designing the structure, shape and size of a product, the designer must also specify the materials that it will be made of. In the past, the range of materials was very limited. Natural materials often had to be used because synthetic materials were not available. Wood, steel, leather, cotton and glass were used to manufacture early cars, trains and aircraft as well as household products such as vacuum cleaners, radios and even TV sets! Of course, these traditional and natural materials are still used today, but the designer now has a wide range of synthetic materials to choose from as well.

A good example of the way in which new synthetic materials are used is the jet fighter in the picture. The wings of this state-of-the-art fighter aircraft are made of carbon fibre composite and the nose cone is made of glass-reinforced plastic, which is also a composite material. This means that over 70 per cent of the aircraft body is non-metallic.

The choice of suitable materials depends on three main factors. These are suitability, availability and cost. In order to decide if a material is suitable, a designer has to know about the physical and mechanical properties of a material. These are:

Physical properties	Mechanical properties
coefficient of linear expansion (how much you can stretch it)	toughness
specific heat capacity	elasticity
melting point	strength
conductivity	brittleness
electrical resistivity	malleability
density	ductility
hardness	lustre

The designer will also need to know about the chemical stability of the material under specific operating conditions. For example, will the material corrode if it is exposed to rain?

2 Match the following questions with some of the mechanical properties listed in the reading passage. Then work in groups to think of more questions.

a Can it be used to make electrical wire? ______________________

b Will it break into pieces easily when you hit it suddenly? brittleness

c Can it be pulled into a long, thin shape? ______________________

d Does heat pass through it quickly? ______________________

18. Bright ideas

Listening

1 Match the words in the two columns below, then label each picture with one of the phrases.

air	jet
flat screen	engine
bagless	cushion
MP3	(vacuum) cleaner
vertical take off	television
high-performance	player

a ______________ b ______________ c ______________

d ______________ e ______________ f ______________

2 You are going to hear some short conversations about the technologies in Exercise 1. Listen and number the pictures according to the order in which they are discussed.

3 Listen again and circle the words below which you hear in the conversations.

picture	glass	memory	coffee	boat
water	music	shopping	base	driver
wings	machine	motor	motorway	

4 Listen again. Fill in the table with detailed information.

	product	measure	unit	how much?
a		weight		
b				1
c	MP3			
d			km/h	
e		capacity		
f				230

5 Look at the completed table. Do you remember all the information about each product?

Speaking

1 With a partner, discuss the following questions. Use the phrases in the box below.

a Why do you think the products in the pictures are different from what came before?

b Which technologies do you find interesting?

It's really + (adj) *It's got* + (noun)
It can + (verb) *You can* + (verb)

2 Can you think of innovative technologies in the following areas? Discuss them in groups of three or four.

- fuel sources
- health and medicine
- IT and communications
- materials and textiles
- ways of identifying people

Skills Box

Listening in different ways

To develop your listening skills, you need to be aware that we do not always listen in the same way.

In Listening Exercise 2, you listened to get the overall idea of the conversation. This involves using your knowledge of the topic and words that are connected with it. This is called *listening for gist.*

In Listening Exercise 3, you listened for single words, and in Listening Exercise 4 you identified more key information, e.g., numbers, dates. This is called *listening for specific information.*

Think about how you would listen to the following things in English:

- an airport announcement
- a lecture

3 Each of you should choose a technological idea or invention that is innovative or important for the future.

a Imagine you have been asked to give reasons why your chosen technology would be the best one to spend a large Research & Development grant on. Make some notes.

b When you are ready, talk with your group members. Try to persuade them that your ideas are the best.

c When you have all spoken, decide who should win the grant.

Unit 1

Unit 1, Lesson 1, Track 1

1.

A: So this is your new telly then?

B: Yep – what do you think?

A: Brilliant picture ... and it's so thin.

B: And it's really light ... only about 18 kilos ... I can lift it easily!

2.

A: Have you ever been on a hovercraft?

B: Yes. We went across to France on one last year.

A: What was it like?

B: Amazing! I didn't know if I was on a boat or a plane. We were doing nearly a hundred and twenty kliks and we were only about a metre above the water. Fantastic!

3.

A: Look, this is the one I'd recommend Bob. It's got a massive memory.

B: Really?

A: Yeah, 60 gigabytes. You'll be able to play your horrible music for hours!

B: Ha ha.

4.

A: Whoa, what was that?

B: Oh, it's one of the Harriers from the air base along the coast. It's probably doing a thousand kilometres an hour.

5.

A: Can I help you, sir?

B: Yes. I'm interested in this machine here. Can you tell me something about it?

A: Sure ... Well, of course, there's no bag to worry about and it's got a big strong motor, 1,400 watts in fact ... And a 2 litre bin ... So you don't have to empty it too often.

6.

A: That's the new Mazda RX 8, isn't it?

B: Yeah. It's a lovely motor. 230 brake horse power. That's far more than you usually get from smallish cars like that. I bet it goes like a rocket on the motorway!

Unit 1, Lesson 4, Track 2

Host: Good evening and welcome to amazing animals. This evening, we are going to hear about one of nature's strongest materials, made by some of nature's smallest creatures, the spiders. To tell us more about these remarkable little insects is Dr Donald Parsons, the director of Hopewell Zoo ... Good evening, Doctor Parsons.

Dr P: Good evening, Robin and ... er ... before we go any further can I er just correct one small mistake ...

Host: Oh ... yes, of course.

Dr P: Yes ... well, you see the thing is, spiders are not actually insects.

Host: Oh really?

Dr P: No, they actually belong to a group of creatures called arachnids, which have eight legs, not six, like insects and they are more related to crabs and scorpions than they are to flies and beetles.

Host: Oh, well, thank you for putting me straight about that ... Now, I believe that you have got some interesting information for us about the silk that spiders use to make their webs with.

Dr P: Yes, that's right. And not just to make webs either. They use the silk to wrap up the small creatures they catch in their webs, to make shelters where they can hide from their enemies and even as lifelines to help them escape when they are being chased.

Host: So this spider silk must be a pretty amazing material. I know I get spider webs on my car wing mirrors in the morning and they don't blow off even when I'm driving fast.

Dr P: That's right. The silk often contains a strong adhesive, it's very, very sticky. Like chewing gum ... but also extremely, extremely strong. Did you know that someone once calculated that a length of spider silk only the thickness of a pencil could stop a Boeing 747 airliner, without breaking.

Host: Incredible!

Dr P: Yes, weight for weight, it's much stronger than steel ... up to 5 times as strong under the right conditions. If I can give you a few technical details ...

Host: Well I don't ...

Dr P: Yes there's something called Young's modulus of elasticity, which is a measurement of the tensile strength, how much you can stretch something before it breaks really ... and this is measured in units called Pascals. The radial thread of a spider's web ...

Host: Radial thread?

Dr P: Yes ... the line that goes from the centre of the web to the edge.

Host: Uh huh ...

Dr P: Yes, well that radial thread has a tensile strength of well over a thousand Pascals, whereas mild steel, by contrast comes out at about 400 Pascals.

Host: Hmm. That's a big difference. Does it have any other interesting properties?

Dr P: It certainly does. It is very, very light stuff, 25% lighter than synthetic plastics made from oil. And it keeps its strength at very low temperatures – down to minus 40 in fact. At that temperature, a lot of materials become very brittle and really quite useless. It is also fairly resistant to moisture, more so than the silk that is used to make clothes ...

Host: But if it's so marvellous, why don't we see it being used more often? It sounds like an almost perfect material.

Dr P: Well, the problem is, it's almost impossible to collect it in any useful quantities. The silk is very, very fine – finer than a human hair and you need an awful lot of it to make a useable amount. And you can't farm spiders like silkworms. They don't do as they are told. But seriously, spider silk has occasionally been used in the past, to make the cross hairs in instruments and gun sights, for example. However, there may be a chance of producing more of it in the future.

Host: Really?

Dr P: Yes, apparently, some biologists and chemists in Canada are trying to produce a type of spider silk from goat's milk.

Host: Goat's milk?

Dr P: Yes, it's really most interesting. Their idea is to mix the genes of the ...

Unit 2

Unit 2, Lesson 2, Track 3

PM: Welcome to another edition of collector's corner. I'm Phillip Martin. In today's programme, we'll meet someone who claims to have the world's largest collection of bicycles, someone with a wonderful collection of Arab coffee pots and lastly a chap who collects ... wait for this ... you're not going to believe it ... the labels from tea bags - yes, tea bag labels are now collectable! You heard it here first.

But to start today's programme we're going to talk to Richard Bolton about that traditional weapon of the Japanese warrior, the Katana sword.

Hello, Richard and welcome to the programme. Now you've been collecting Japanese swords for quite a number of years I believe?

RB: Yes, that's right. It all started when I went to Japan on a business trip about 15 years ago. I was lucky enough to be taken to see a Japanese swordsmith at work while I was there. I found it so fascinating that I became completely hooked ... and ... well I've just been collecting Japanese armour and weapons ever since.

PM: How many swords have you got altogether?

RB: Seven.

19. An amazing material

Listening and note-taking

You are going to listen to an extract about spider silk from a popular science programme.

1 Tick the topics from the following list which the speakers mention.

- **a** ☐ how spiders make silk
- **b** ☐ the tensile strength of steel
- **c** ☐ airliner design
- **d** ☐ properties of spider silk
- **e** ☐ elasticity
- **f** ☐ difficulties for commercial use
- **g** ☐ synthetic spider silk
- **h** ☐ how spiders use their silk
- **i** ☐ the clothes industry

2 Now listen for key information.

a First, look at the Skills Box.

b Copy the topics from Exercise 1 that the speakers mentioned into the space below. Leave space after each topic for writing notes.

c 🎧 Listen to the programme again and make notes beside each topic.

3 Compare your notes with a partner. How much of the key information can you remember between you?

> **Skills Box**
>
> **Taking notes**
>
> You will need to take notes quickly at lectures and meetings. These notes must be clear enough for you to understand later.
>
> - Don't write full sentences. Use bullet points.
> - Don't write everything the speaker says. Write key facts, concepts and numbers.
> - Use abbreviations.
> - Read your notes as soon as possible after writing them and make sure you can remember the necessary information.
> - Write up your notes for future reference if necessary.

Spider Silk

Speaking

1 Choose a material, traditional or new, which you know something about. Under the headings *Characteristics/properties* and *Applications/uses*, make notes in your notebook for a short presentation.

2 Practise your presentation with a partner. Check any pronunciation in a dictionary or with your teacher.

3 Present your material to the group. The group must listen and refer to the mechanical properties you have studied in Lessons 3 and 4, and ask questions about any of them which are not included in the talk.

20. Aluminium

Reading

1 Read the text below quickly and decide which of these three titles you think is best.

a A comparison of industrial metals

b Useful properties of aluminium

c Industrial chemicals

Skills Box

Skimming

You need to be able to read a long text quickly to get the general idea of the content. This is called *skimming*.

Since the Wright brothers chose an aluminium engine for their historic first flight in 1903, this versatile metal has become increasingly important in the aircraft industry. Today, aluminium comprises 70 to 80 per cent of the weight of modern commercial aircraft. Why is it so important?

Probably the main reason is that it is a strong and very light metal with a density which is about a third that of steel. Pure aluminium weighs only 2.7 g per cubic centimetre, compared with 7.8 g for mild steel. This reduces the dead weight of an aircraft and the energy consumption, making it possible to carry heavy loads such as passengers or cargo.

Secondly, it is highly corrosion-resistant. When it is exposed to the atmosphere, a thin invisible skin of oxide forms but, unlike steel, this process of oxidisation does not eat any further into the metal. The layer of oxide protects the metal from further corrosion, and this enables the metal to last a long time.

Because it is a relatively soft metal, aluminium can be cut, drilled, machined and formed into different shapes much more easily than steel. This is extremely important for manufacturing planes quickly and cheaply. In its pure form, however, aluminium is too soft and too ductile to be suitable, so alloys containing metals such as copper, manganese, chromium and zinc are produced. Different alloys are used for the different parts of the plane, depending on the strength and other properties required.

Because they are not pure aluminium, these alloys are often susceptible to corrosion. To avoid this, alloy sheets for aircraft are sometimes electrochemically coated with pure aluminium. As long as this protective coating stays intact, the underlying alloy is unaffected by harmful substances and the durability of the metal is increased.

In addition to its mechanical properties and corrosion resistance, aluminium has high conductivity, both electrical and thermal. Although less effective as a conductor than copper, it is cheaper and as a result is the most commonly used material in main electrical power lines.

2 Now read the text more carefully. Which set of notes, A or B below, represents the information better? Why?

A

Since 1903 (Wrights), Al v. imp: 70-80% weight of modern plane. Why?

1 Strong+light. Al 2.7g/cm^3, mild steel 7.8g/cm^3, so less fuel used, more cargo capacity with Al

2 Resists corrosion, long-lasting: Al oxide forms in air; protects metal from corrosion

3 Soft + easier to work than steel, so plane production quick + cheap. Alloys with copper, manganese, chromium and zinc used for extra strength/ other properties. But alloys not pure Al, so corrosion a problem - sometimes coated with pure Al for durability

4 Good conductor of elec. (and heat), - used in power lines.

B

- Al important since 1903 – Wrights' engine made of aluminium. Used in modern planes. Why?
- Al is strong and light. Density is a third of steel. Al weighs 2.7g/cm^3, mild steel weighs 7.8g/cm^3. This is very important in designing aircraft. More passengers can be carried.
- Secondly, it is highly corrosion-resistant. Unlike in the case of steel, this process of oxidisation does not eat any further into the metal. The layer of oxide protects the metal. This enables the metal to last a long time.
- Aluminium can be cut, drilled, machined and formed into different shapes. This is extremely important for manufacturing planes quickly and cheaply. In its pure form, however, aluminium alloys containing copper, manganese, chromium and zinc are produced. Harder and stronger.
- Alloys are more susceptible to corrosion.
- In addition to its mechanical properties and corrosion resistance, aluminium has high conductivity and is used in electrical power lines.

3 Circle the following in the text in Reading. What do they refer to?

this (line 2) this (line 7) it (line 10) its (line 16) these (line 20) this (line 21) it (line 26)

Vocabulary and speaking

1 In the set of notes A above, what do the following abbreviations mean?

e.g. v. imp + Al elec. g/cm^3

2 Find the expressions from the box below in the text and look at how they are used. Use them to fill in the gaps in a to e.

However secondly Because so In addition to

a Because gold does not rust easily, it is often used in jewellery and dentistry.

b Asbestos is a good insulator. However, the dust is highly toxic.

c There are two reasons: firstly, water is cheaper than chemical options; Secondly, it is easier to store.

d In addition to the high cost of raw materials, other problems include the long development process.

e Common cutting tools need to be rust-free, so they are often made of stainless steel.

21. Working with Alclad

Vocabulary

Complete the table with the correct forms of the words. Check that you know the correct pronunciation of all the words.

adjectives	nouns
soft	
malleable	
ductile	
	lightness
	resistance
conductive	
	density
durable	
	flexibility
tough	

Language Box

Noun – adjective

In English, a noun is a word for a person or thing:
water; Tony; wing; time

An adjective describes a noun:
blue; expensive; commercial

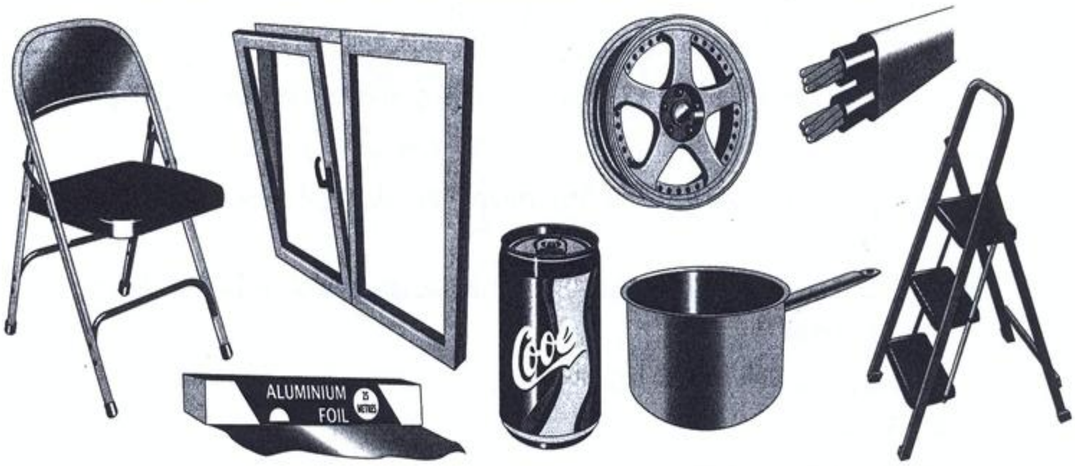
Adjectives come before nouns or after the verb *be*:
We have a new project.
adj n

It was difficult.
be adj

Speaking and writing

1 In pairs, talk about the properties of aluminium which make it suitable for these products.

2 Write a sentence for each of the objects in the pictures. For example:
Aluminium is good for making windows because it is tough and durable.



Listening

1 Before you listen, check that you know what these words mean.

bend shears scriber mark out edge smooth handle hole radius burr

2 Listen to an instructor in a workshop talking to some students about working with a material called Alclad. How many of the following does he tell them how to do: *cutting*, *drilling*, *marking out*, *bending*?

3 Listen again. Decide whether the statements below are true (T) or false (F).

a ___ The Alcladding process stops corrosion.

b ___ You have to handle all aluminium sheets very carefully.

c ___ There are five main operations you do on sheet metal.

d ___ You mustn't use a scriber on Alcladded metal sheets.

e ___ You must make sure the edges are completely smooth.

f ___ You mustn't bend the sheets too much.

4 Listen again to the instructor and follow in the tapescript. Choose five or six expressions from the text which you think would be useful to remember for asking about processes and giving instructions, for example:

- Why do you ...?
- What do you do ...?
- You have to ...
- It's really important to ...

Speaking

Write and rehearse a short conversation in which the instructor either:

a comments on John's and Martin's work on the Alclad sheet;

or

b instructs the two young men to make some additional bends or cuts in the sheet.

Include the language you identified in Listening Exercise 4.

Check that you know the correct pronunciation of all the words.

9. Always stop the machine before changing speeds or feeds.

Unit 2, Lesson 6, Track 6

The lead screw is a long, threaded rod that carries a tool along the axis of a rotating workpiece. It ensures that the workpiece moves at a constant, even speed so that threads can be cut into it. The relationship between the longitudinal speed of the tool and the rotational speed of the workpiece can be varied by means of a gearbox.

Unit 2, Lesson 8, Track 7

T: John, Martin can you come over here … ok ... good ... now have you done … what I asked?

J: Yes, we've cut two square sheets of this metal you gave us, hang on, here you are, is that all right?

T: Hmm, it looks ok but, uh … Martin, run your thumb along the edge there, yes, … that one.

M: Ouch, it's a bit sharp.

T: Yes, I thought so ... it's really important to smooth off the edge of any metal you cut. You know why?

J: Yes, cos somebody could get hurt.

T: That's right, safety is always important, but there's another reason to do with this particular metal.

M: What, you mean aluminium sheet?

T: Well this isn't ordinary aluminium, though, it's an alloy, which has been through a process called alcladding. It's had a skin of pure aluminium applied to it on both sides.

M: What's the point of that?

T: It's to stop corrosion … The aluminium forms a protective oxide skin. But this means that you have to handle it and work with it very carefully because …

J: … you might break the skin and then the metal underneath ... you could get corrosion in underneath the skin.

T: Exactly … and in an aeroplane, thousands of feet up in the sky, that's dangerous … very dangerous.

M: Does this stuff have a special name?

T: This particular sheet is called 2024-T3 ... It's used a lot in aircraft.

J: So how exactly do you have to be careful when you work with it?

T: Well, think for a moment … What are the four main operations you do on sheet metal?

J: … er … cutting, drilling, bending … er …

M: … and marking out …

T: … exactly, ... marking out ... Before you do anything else … and that's when you have to start being careful ... from the beginning.

M: …when you're scribing the lines.

T: Ah ... but that's the first thing to remember. You mustn't use a scriber to make the lines and points. Scribers can cut too much into the oxide surface, which allows corrosion in … Also, … where you cut into the metal, it makes it a little weaker along those lines … and if … there is vibration and stress in the metal ... it can fracture there. It's a bit like breaking the pieces off a bar of chocolate. The chocolate breaks along the lines marked in it. So you should always use a special marker pen like this ... It's called a sharpie … you can get them in different colours, but I prefer blue, it seems to show up better.

J: What about cutting the sheet? Are there any special things to remember?

T: Yes, three things: finishing, finishing and finishing. You must make sure that any cut edges are rounded off and completely smooth. Rough and jagged edges are like small cracks in the metal … And these can get bigger and bigger. The best test is to check that you can't see the marks of the saw teeth ... or the guillotine blade if you use the treadle shears. The same thing when you drill a hole … you must remove all the burrs and make sure the inside of the hole is completely smooth.

M: And what about making bends?

T: Now that's quite a complicated subject ... But the basic rule is that you mustn't put too much stress on the metal. You mustn't bend it over too far or with a bend radius that is too small for the metal you are working with.

M: How do you know if you've done that?

T: You make sure you don't by looking at the special tables ... no ... no, I think that's enough talking for today. We'll leave it until tomorrow. What I want you two to do now is mark out these two sheets, and drill the holes here and here, just like you can see on this drawing ... you see ... here and here ... and then bring them back to me. And remember you must remove all the burrs and smooth all the sharp edges. You should be able to finish it in about half an hour. But don't worry if you can't. You don't have to finish it today. The important thing is to do it correctly ...

J &M: Right ... Ok ...

T: You can use that bench over there.

22. Production lines

Speaking

In the past, aircraft were usually built *in situ*. However, although this still happens with small light aircraft, most commercial and military aircraft are now manufactured on a production line which is constantly in motion.

1 Look at the photograph on the opposite page. In pairs, discuss what processes you can see.

2 Discuss the following questions with a partner. Use some of the speculating words and phrases from the Skills Box.

a How many parts are there in a large airliner?

b How are the parts transported to and around the factory?

c How long does it take to build an airliner?

Skills Box

Speculating

When you are guessing or unsure, one option is to use *maybe*, for example:
Maybe they use robots.

There are many other common alternatives which you can use to express your ideas more exactly, for example:
They must have about 150.
It probably costs a lot.
I'd say it'll take about two weeks.
Yes, perhaps.
I doubt if they do it by hand.

Reading

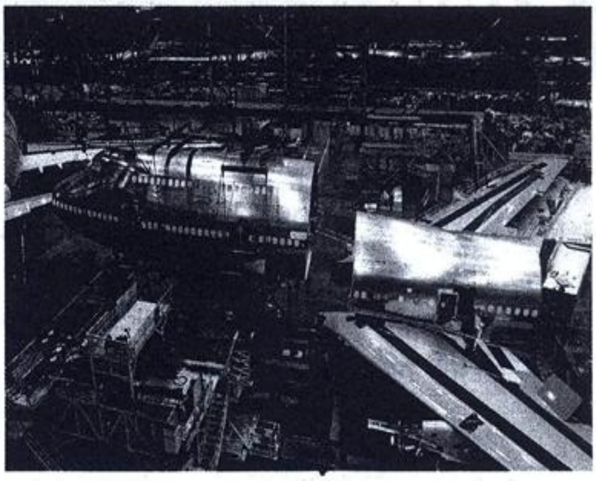
Look at the text opposite.

a In no more than 30 seconds, circle all the numbers in the text.

b Some of the numbers in the table are incorrect. Check and correct the information.

c Were your answers in Speaking Exercise 2 right?

a	number of homes that could fit inside the factory	200
b	hangar door width	900 m
c	parts in a 777 airliner	300,000
d	bridge cranes	25+
e	build time for a 747	±150 days
f	shifts	3
g	employees	2,000
h	maximum crane load	40 tons
i	height of hangar doors	90 ft



At the Boeing aircraft production site at Everett in the USA, every 747 airliner starts life as wing spars at one end of the production line and ends up at the other as a completed aircraft, on average four months later.

The main assembly building at Everett is the largest building in the world by volume. It is so big that about 2,000 family homes could fit inside. In addition to the 747, the 767 and 777 aircraft are produced here. At least 25,000 people are employed here working three shifts, and the site is so large and complex that it has its own fire department, fully equipped health clinic and electrical substations.

The 767 and 777 each consist of around three million parts, and the 747 has twice as many as this. Ordering, tracking and distributing the thousands of components and sub-assemblies are extremely complex management tasks. It is impractical and uneconomic to keep components in stock all the time, so a system of last-minute delivery is used. This method, called 'just-in-time', ensures that parts only arrive at the factory just before they are needed and can be delivered to the right point on the assembly line at exactly the right time.

Every day, parts and sub-assemblies are received from all over the world as well as other parts of the USA. Many of them arrive by ship, and there is a railway line that runs directly from the nearby port into the factory. Once inside the factory, the parts are distributed by fork-lift trucks and cranes. There are more than 25 overhead bridge cranes, some capable of lifting up to 40 tons. These move backwards and forwards some 90 feet above the floor, delivering heavy items from one assembly position to another.

As production proceeds, the aircraft move closer and closer to the hangar doors at the end of the line. Finally, these enormous doors, over 26 metres high and 90 metres wide, are opened so that the finished plane can be rolled out onto the tarmac, ready for flight testing.

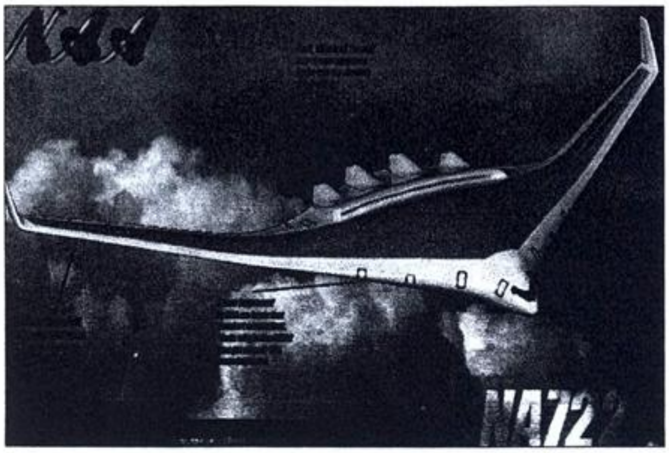
Speaking

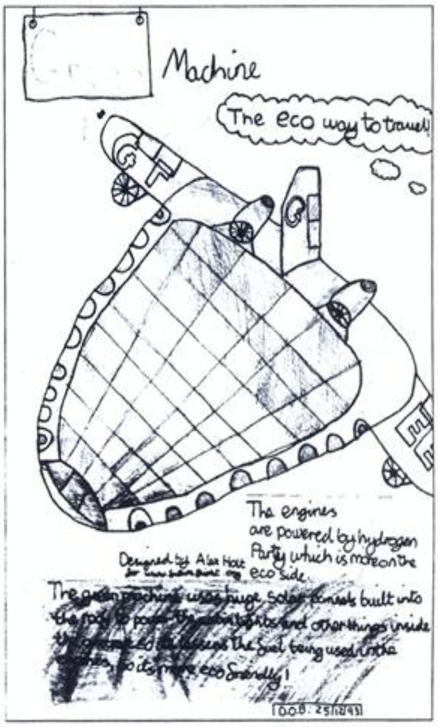
What is the most surprising/interesting thing about the Boeing plant? Discuss your ideas in small groups.

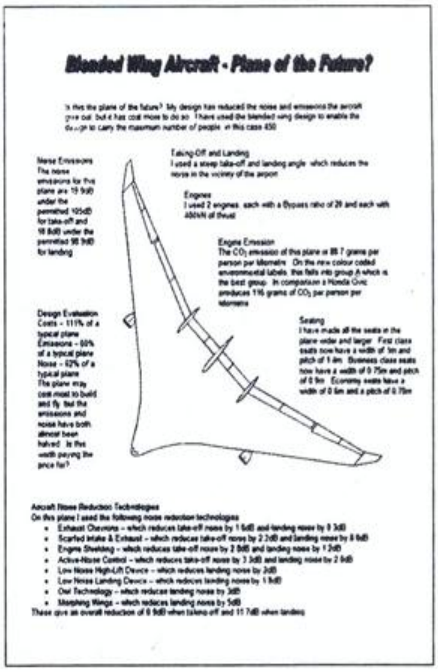
23. Design specifications

Speaking and vocabulary

In 2005, a competition was held by Southampton University in Britain for young people aged seven to 19 to design an aircraft for the year 2050. Below are three of the designs which won prizes.







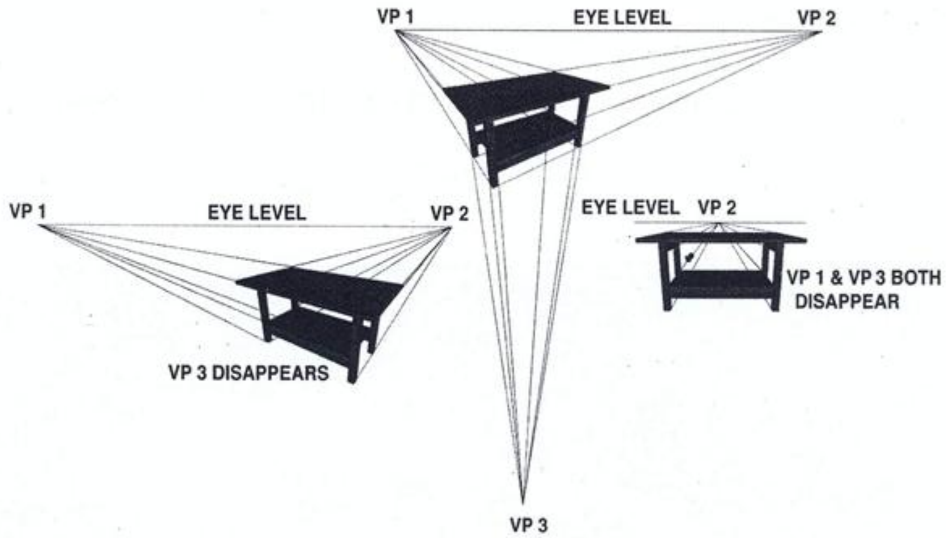
1 Look at the pictures and discuss how much information they give. Which picture gives the best general idea about the plane? Why?

2 What are the most important constraints on aircraft design? Number the following in order of importance.

- **a** ☐ range
- **b** ☐ potential freight load
- **c** ☐ speed
- **d** ☐ manufacturing costs
- **e** ☐ passenger capacity
- **f** ☐ passenger comfort
- **g** ☐ safety
- **h** ☐ existing airport facilities

Reading and vocabulary

1 Check the meaning of the words in bold in the following text and record them in your vocabulary log.



When something new is designed, it is necessary to produce detailed technical drawings by **orthographic projection** so that it can be built correctly. The problem with these drawings is that they are **two-dimensional** but the world around us is **three-dimensional,** and it is sometimes difficult to **visualise** what the finished product will look like. Because of this, designers often produce **pictorial drawings** as well as orthographic ones. Sometimes a quick rough sketch is enough, but often this doesn't provide enough information. A better way of producing a pictorial view is to use **perspective.** The history of this drawing **technique** goes back a thousand years to the ideas and discoveries of the Arab mathematician and philosopher, Ibn al-Haitham (965–1040). It was his work in **geometry** and **optics** that enabled later artists and engineers to develop the skill of drawing things in a realistic way. There are a number of different ways of drawing perspective, but they all give the **impression** that you are actually looking at the object from a specific **point of view.** The most common type of perspective is called **two-point perspective** because it is based on two vanishing points which are situated on a horizontal line known as **eye-level.** There is a more complex kind of perspective called **three-point perspective** which gives an even more realistic impression.

2 Read the passage again and label the different types of pictures on this page.

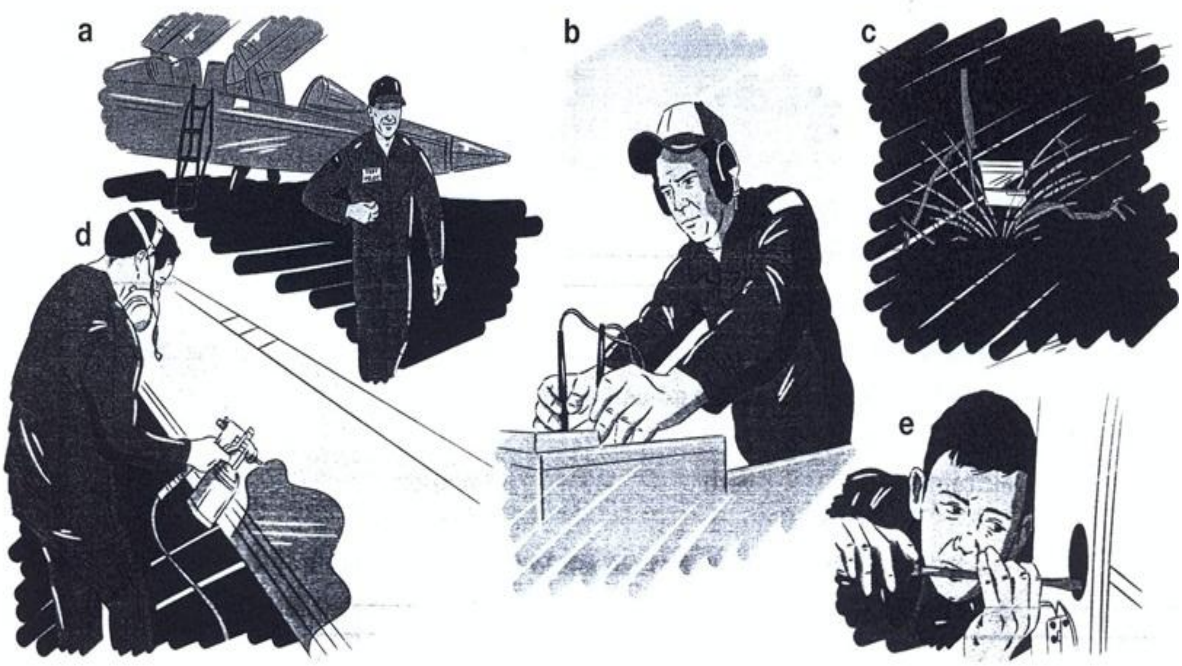
3 With a partner, discuss the advantages of perspective projection, orthographic projection and pictorial drawings.

24. Assembly

Speaking and listening

You are going to hear a talk about an aircraft production line.

1 Before you listen, look at the picture below of a production line. Work in small groups. Discuss the stages of production you would expect to find at a factory like this. In what order would these stages happen?



2 Listen to the description of the production of a jet fighter. While you listen, number the stages in the correct order.

- **a** engines
- **b** main assemblies
- **c** painting
- **d** flight control systems
- **e** hydraulics tests
- **f** pre-flight tests
- **g** wings
- **h** flight tests
- **i** electronics tests

Skills Box 1

Predicting

You can always help your understanding of spoken English by using visual clues and your knowledge of the world.

3 Talk to a partner. Was the order the same as you expected? What was similar/different?

Vocabulary

Look at Skills Box 2. Then listen again and correct the sequencing signposts which the speaker uses.

- **a** In the first stage ______
- **b** Nextly ______
- **c** At these points ______
- **d** At third stage ______
- **e** Following on satisfactory completion ______
- **f** Following to this ______
- **g** Once this has been carried out ______

> **Skills Box 2**
>
> **Signposts**
>
> Just as with reading skills, you can help your understanding of spoken English by listening for 'signposts' which will tell you what direction the talk is taking, and so help you to follow it. For example:
> *After this …*
> *We'll finish by …*
> *Let me give you an example.*
> *There are two reasons.*

Language

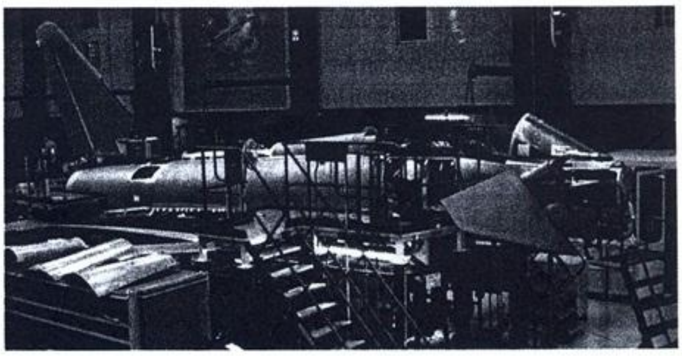
1 Use the passive form of the verbs below to complete these sentences.

test splice paint install attach carry out

- **a** The three main assemblies ______ together.
- **b** The aircraft ______ in air force colours.
- **c** Pre-flight tests ______ .
- **d** The wings ______ to the fuselage.
- **e** Navigation systems ______ .
- **f** Electrical cables ______ .

2 Listen to the talk again and check your answers.

3 Look at the picture of an aircraft during construction. Ask and answer questions about it using the passive voice. For example: *Has the cockpit been fitted?* Use the prompts.



cockpit fitted?
main assemblies spliced together?
flight control surfaces attached?
engines assembled?
weapons systems fitted?
wings painted?
pre-flight tests carried out?
moved to Station 4?

Unit 3, Lesson 6, Track 11

The final production assembly line for the German version of the Eurofighter is located in the South German town of Manching. It is here that, as well as equipping the main fuselage, the engineers and technicians put together more than 300 pieces of equipment, sub-assemblies and assemblies to produce

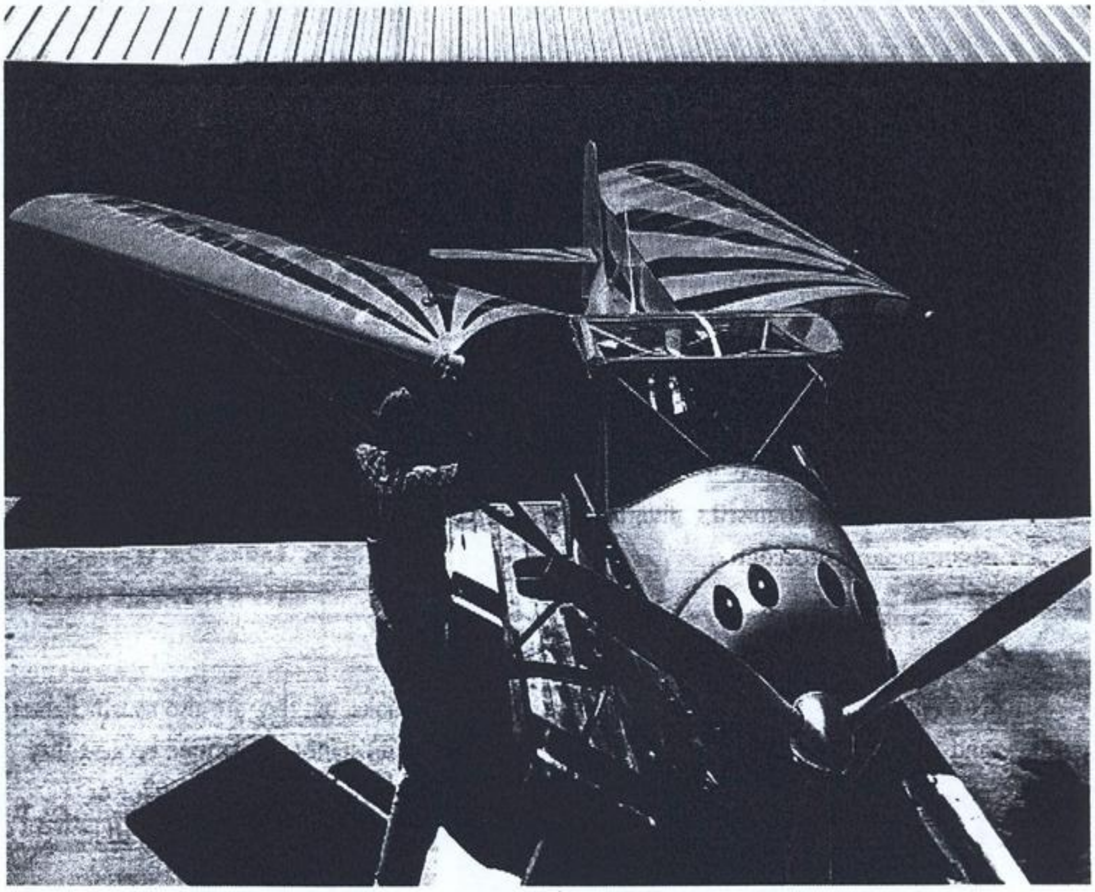
the finished aircraft.

At the first stage, the three main assemblies are fitted or spliced together. These are the centre fuselage, the rear fuselage and the cockpit. Next, the flight control surfaces such as the wings, flaps and fins are attached to the fuselage. At this point, the fighter starts to look like a real plane. At the third stage, all the electrical cables are thoroughly tested and then the aircraft is moved on to Station 4, where the mechanical, electrical and hydraulic systems are subjected to rigorous testing with detached computerized equipment. Following satisfactory completion of these system tests, the aircraft is ready to have its engines and weapons systems fitted.

Following this, the flight control and navigation systems are installed and the plane is now ready for its pre-flight tests. Once these have been carried out, the aircraft is tested in flight, before finally being moved to the paint shop to be painted in the colours of the German air force.

25. Review

Here is a picture of an aircraft being built from a kit.



Speaking and listening

1 Discuss these questions in pairs.

- **a** Why would someone want to build their own aeroplane?
- **b** Where would they build it?
- **c** How much do you think it would cost to buy the kit or the parts?
- **d** How many man-hours would it take?
- **e** What tools and facilities would they need?

Language Box

would

To describe imaginary situations, use the form *would* + infinitive:

It would take a long time.

I would like to build one.

You would need a runway.

2 Listen to the interview with a man who built his own plane and make notes on the questions in Exercise 1.

Vocabulary

1 **Look at the following list of words from Unit 2. Put them into groups according to the number of syllables they have. For example, *engine* has two: en-gine; *micrometer* has four: mi-cro-me-ter.**

technical experience interested rivet transmit
elements grip alloy special hammer drill lathe

1 syllable ●	2 syllables ● ●	3 syllables ● ● ●	4 syllables ● ● ● ●

2 **Look at the Skills Box. Now underline the stressed syllable in each word in columns 2, 3 and 4 above.**

Skills Box

Word stress

It is extremely important in English that you stress the correct syllable; that is, you make one vowel louder, longer and higher than the others:

- the first syllable is stressed in **en**-gine;
- the second syllable is stressed in com-**pu**-ter;
- the third syllable is stressed in man-u-**fac**-ture.

Language

Three of the sentences below have grammatical mistakes in them. Correct the ones that are wrong.

a Tin snips are usually used for cut sheet metal.
b It's better to use blind riveting when you can't reaching both sides of the job.
c Because it is light, aluminium is especially useful in aircraft manufacture.
d Some people say that hand tools last a longer time than powered tools.
e To build it yourself, you would need good plans.

T: You make sure you don't by looking at the special tables ... no ... no, I think that's enough talking for today. We'll leave it until tomorrow. What I want you two to do now is mark out these two sheets, and drill the holes here and here, just like you can see on this drawing ... you see ... here and here ... and then bring them back to me. And remember you must remove all the burrs and smooth all the sharp edges. You should be able to finish it in about half an hour. But don't worry if you can't. You don't have to finish it today. The important thing is to do it correctly ...

J &M: Right ... Ok ...

T: You can use that bench over there.

Unit 2, Lesson 10, Track 8

I: So, Robert, this is the plane you built yourself?

R: Yes, this is my baby, what do you think of her?

I: Well, to be honest, I'm amazed! It looks just like a new plane from a factory. It's so well finished. You must have done a lot of studying and technical training before you started building it!

R: No, not really. Of course I've always been interested in planes and I've had a pilot's license for over ten years now. But my normal job is in a bank ... and ... apart from a few household repairs, I don't have much hands-on technical experience – At least I didn't before I started building her.

I: And how long did it take you from start to finish?

R: Hmm ... let's see now ... this is August and the kit was delivered in April the year before last ... yes, so just over two years.

I: And how much of that time did you spend on the project?

R: Practically every weekend really, as well as a lot of evenings after work. I'm afraid my family didn't see very much of me. I suppose it was about 800 hours altogether.

I: You said it was a kit?

R: Oh yes, I couldn't have built it from scratch. A lot of the difficult stuff had already been done at the factory.

I: And where did you actually make it?

R: In my garage.

I: Your garage?

R: Yes. Of course, I had to move the car out and put a work bench in!

I: I bet you did! You must have a pretty big garage.

R: Hmm, biggish but not enormous. What is it ... Yes ... It's about 24 feet long, 9 feet wide and nine feet high. Of course, I had to fit the wings on outside. But I did most of the construction inside.

I: You must have needed a lot of special equipment.

R: No, not really, although I did buy myself a kit of good hand tools.

I: Such as?

R: Oh, you know, the usual thing, screwdrivers, pliers, saws, spanners and so on. Oh yes, and a pair of tin snips for cutting the sheet metal.

I: So just those hand tools then.

R: Not exactly. I did get myself a new electric drill ... the old one was on its last legs. And a hand rivet gun for the blind rivets.

I: 'Blind' rivets?

R: Yes, sorry, it just means a kind of rivet that one person can fit easily on their own into any part of the plane. You only need to work from one side.

I: Right ... and tell me ... how much did all this cost, apart from your time, of course?

R: Just under fourteen thousand pounds for the kit, plus about two hundred for the tools. Of course, I did have to take my family away for a special holiday to make up for all the time they didn't see me. That was a couple of thousand for all of us!

I: And one last question, if you don't mind.

R: Sure.

I: Why did you do it?

R: Ah. Well, partly the cost, it was a lot cheaper than buying one ready-made. But really, I suppose it was also because I enjoy a challenge. And I wanted to do something that was completely different to my work. You know, even if I never build anything else I'll always be proud of this ... it's given me a lot of satisfaction.

26. Lasers

The word LASER is an acronym of the words: light amplification by stimulated emission of radiation. The theory of the laser was first described in 1958, but the first working laser was not developed until 1960. Lasers are devices which amplify light and produce beams of light which are very intense, directional and pure in colour. The first laser was a single crystal of ruby. Ruby lasers are still used, but gas lasers, semiconductor lasers, and liquid lasers have also been developed.

For a laser to work, an energy source outside the laser must supply enough energy to the laser material to bring all the atoms to an excited state. This process is called „pumping". An electron in an excited state emits a photon of specific frequency upon returning to ground state. In a laser, atoms which have been excited are triggered into the ground state by light of resonant frequency. That way they simultaneously emit identical-frequency photons in a cascade known as the laser beam.

When lasers were invented, some people thought they could be used as "death rays". In the 1980s, the United States experimented with lasers as a defence against nuclear missiles. Nowadays, they are used to identify targets. But apart from military uses, they have many applications in engineering, communications, medicine and the arts.

Lasers have found their greatest use in industry. Since powerful laser beams can be focused on a very small area, they can heat, melt or vaporize material in a very precise way. They can be used for drilling diamonds, cutting complex shapes in materials from plastics to steel, for spot welding and for surfacing techniques, such as hardening aircraft engine turbine blades. Laser beams can also be used to measure and align structures.

Lasers are ideal for communications in space. Laser light can carry many more information channels than microwaves because of its high frequency. In addition, it can travel long distances without losing signal strength. Probably the most spectacular trial has been the transmitting of a laser signal 239000 miles through space to the Surveyor 7 spacecraft on the moon. One disadvantage of laser communications, however, is that clouds, rain or fog can prevent reception.

Lasers can also be used for information recording and reading.

In medicine, laser beams can treat damaged tissue in a fraction of a second without harming healthy tissue. They can be used in very precise eye operations.

In the arts, lasers can provide fantastic displays of light, which often accompany pop concerts today.

1. Answer these questions.

1. Where does the name Laser come from?
2. How does a laser work?
3. How does laser light differ from normal light?
4. How are the atoms and molecules of certain gases, liquids or crystals excited to higher energy levels?
5. What happens when these atoms and molecules begin to return to unexcited state?
6. What are the main characteristics of the laser beam?
7. In which fields have lasers recently been applied?
8. How are laser beams applied in communications?
9. What is the special application of lasers in medicine?

2. Paraphrase and translate:

amplify - ____
acronym - ____
beam - ____
photon - ____
ground state - ____
to trigger ____
vaporize - ____
spot welding - ____
surfacing techniques - ____
align - ____
tissue - ____
fraction - ____
trial - ____

3. Complete the table:

Military	**Engineering**	**Communications**	**Medicine**	**Arts**
___________	drilling diamonds cutting complex shapes ___________ ___________ ___________ ___________ ___________	___________ Information recording and reading	testing damaged tissue ___________	___________

4. Complete the following summary of the text with the correct verb form.

The word LASER ___________ (come) from the first letters of the phrase 'Light Amplification by Stimulation of Radiation' and this also ___________ (describes) how the laser ___________ (work). The light from the laser ___________ (differ) from normal light in that it ___________ (consist) of only one wavelength ___________(emit) in only one direction in the form of a narrow beam. The concentrated energy from such a beam ___________ (can) ___________ (make; pass.) very great. By means of modern technology lasers _______________ (make; pass.) ready for use in various fields such as medicine, metallurgy, photography, communications and many others.

27. CNC machine tools

Speaking

1 **What sort of machine tools are you familiar with? Make a list and compare it with a partner.**

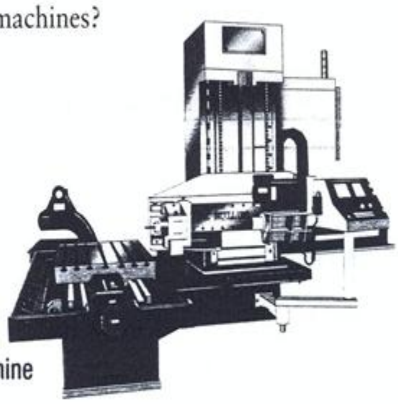
2 **The machines below are computer numerical control (CNC) machine tools. In pairs, discuss the following questions.**

a What do you think *computer numerical control* means?

b Have you ever seen or used CNC tools?

c What advantages do they have over hand-operated machines?

milling machine



drilling machine

Vocabulary

Look at the following words in the introduction to a description of CNC tools. The word *production* occurs as *mass-production* and *speed of production*, two very common combinations. In what combinations do the other three words occur?

production (lines 2 and 10) equipment (line 8). machines (line 6) main (lines 7 and 9)

CNC machine tools

Mass-production of large aircraft, both commercial and military, would be impossible without the use of computer numerical control (CNC) machine tools. Although hand-operated machines and tools are still used, most of the main parts of the airframe are now produced by computerised equipment. There are three main reasons for this: speed of production, accuracy and repeatability.

Vocabulary Box

Word combinations

Vocabulary always occurs as combinations of words, so memorise the whole phrase, not just a single word.

This system will help to improve your reading, writing, listening and speaking skills.

Reading and speaking

1 Circle these numbers or quantities in the text below: *5, 3, 70, 1,000*.

2 Look again. What do they refer to?

3 Read the text again more carefully and transfer the information it gives into the table.

	basic function	problem in the past	advantage of this system
ICY			
FAM			
drilling machine			

In the past, parts were often tailored specially to fit one particular aircraft and could not be fitted to another of the same design. This was because the tolerances and margins of error were too wide.

Nowadays, however, manufacturers try to make parts interchangeable by using ICY (an industry abbreviation for interchangeability). At the Eurofighter component factory in Samlesbury, some aircraft parts are machined to tolerances as fine as 70 microns. The tolerance is the difference between the maximum and minimum acceptable dimension: the upper and lower limits. Making components to this very fine tolerance means that if there is a hold-up with one plane, a part can be fitted to another one without modification. In this way, the production process is kept moving.

One of the key types of machine at this factory is the five-axis milling machine (FAM). Milling machines are used for forming surfaces and are extremely versatile. By the use of different configurations and different-shaped cutters, a wide variety of shapes and surfaces can be machined. Before this, standard milling machines were designed to work on only three axes, which limits the amount of cutting that can be done at any one time without changing the position of the workpiece. The FAM machine can operate along five separate axes and is able to produce highly complex curved shapes and surfaces in a short time.

Another type of CNC machine being used at the Samlesbury factory is a drilling machine. Traditionally, holes were drilled in aircraft skins by hand. However, there is now a computer-controlled drill that can automatically make a thousand holes in the front fuselage of the Eurofighter. This speeds up production and produces much more accurate load-bearing panels. Some modern CNC drills have multiple spindles, which enable several drilling operations to be carried out on a workpiece simultaneously.

4 Work in groups and give a short talk about one of the machine tools in the table.

Machine tool

A **machine tool** is a machine for shaping or machining metal or other rigid materials, usually by cutting, boring, grinding, shearing or other forms of deformation. Machine tools employ some sort of tool that does the cutting or shaping. All machine tools have some means of constraining the workpiece and provide a guided movement of the parts of the machine. Thus the relative movement between the workpiece and the cutting tool (which is called the **toolpath**) is controlled or constrained by the machine to at least some extent, rather than being entirely "offhand" or "freehand".

The precise definition of the term machine tool varies among users. It is safe to say that all machine tools are "machines that help people to make things"; although not all factory machines are machine tools. Today machine tools are typically powered other than by human muscle (e.g., electrically, hydraulically, or via line shaft), used to make manufactured parts (components) in various ways that include cutting or certain other kinds of deformation.

Numerical control

Numerical control (NC) refers to the automation of machine tools that are operated by abstractly programmed commands encoded on a storage medium, as opposed to controlled manually via handwheels or levers, or mechanically automated via cams alone. The first NC machines were built in the 1940s and 1950s, based on existing tools that were modified with motors that moved the controls to follow points fed into the system on punched tape. These early servomechanisms were rapidly augmented with analog and digital computers, creating the modern computer numerical control (CNC) machine tools that have revolutionized the machining processes.

In modern CNC systems, end-to-end component design is highly automated using computer-aided design (CAD) and computer-aided manufacturing (CAM) programs. The programs produce a computer file that is interpreted to extract the commands needed to operate a particular machine via a postprocessor, and then loaded into the CNC machines for production. Since any particular component might require the use of a number of different tools-drills, saws, etc., modern machines often combine multiple tools into a single "cell". In other cases, a number of different machines are used with an external controller and human or robotic operators that move the component from machine to machine. In either case, the complex series of steps needed to produce any part is highly automated and produces a part that closely matches the original CAD design.

28. Hand tools vs power tools

Although modern manufacturing is dependent on powered machinery, there are still some jobs that can only be done by hand. Even in the most modern and well-equipped factory or workshop, you will find a wide range of tools that require the skill, knowledge and muscles of the person using them.

Vocabulary

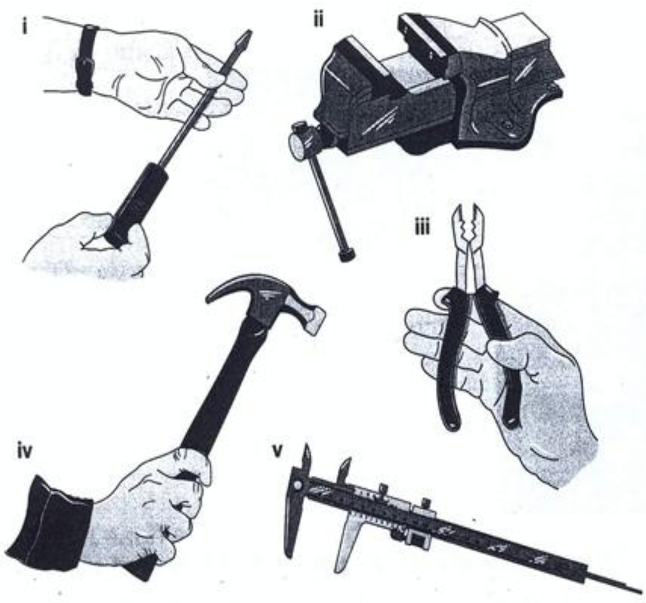
1 Look at the words in the box below.

clean jaws tighten calibrate teeth oil blade
head edge sharpen handle hit put cover

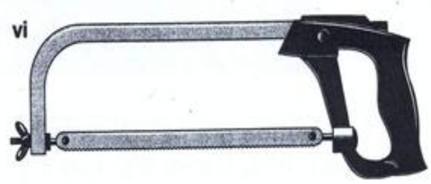
a Put these words into two groups, nouns and verbs (some words may go in both groups).

nouns	verbs

b Which words go with the tools in these pictures?



> **Language Box 1**
>
> **Imperatives**
>
> In English, sentences usually contain a subject followed by a verb, e.g.:
>
> *He sharpened the blade.*
>
> Imperative sentences giving instructions, orders or warnings have a verb but no subject:
>
> *Put those tools away.*
> *Don't cut that wire!*



c Look at Language Box 1. Make imperative sentences using the verbs and tools from this exercise.

2 Hand tools are used for a variety of purposes. Check the meaning of these verbs with a partner or in your dictionary. Can you think of others?

measuring gripping bending cutting pounding punching screwing threading

3 Match each of the verbs with at least one of the tools in Vocabulary Exercise 1.

4 Check that you know the pronunciation of all of the vocabulary in Exercises 1 to 3.

Speaking

There are three golden rules for using hand tools.

1 Use them for their correct purpose.
2 Make sure they are in good condition.
3 Keep them in their proper place.

> **Language Box 2**
>
> **Preposition + verb + *-ing***
>
> Prepositions such as *for, in, from* and *by* are followed by the *-ing* form of a verb or by a noun phrase:
> *It's designed for gripping.*
> *This stops it from rusting.*
> *It's used in metal polishing.*
> *You start by heating it.*

1 Look at Language Box 2. In pairs, discuss the three rules by answering these questions.

a What is the correct purpose of each tool in the pictures?
b How do you keep them in good condition?
c Where should they be kept?

2 Look at the description in the table below. Guess what type of tool is being described.

components	handle, frame and removable blade
size	small (junior variety) to large (similar to band saw)
uses	used for cutting a variety of metals
used by	engineers, plumbers, etc.
power	hand or mechanical tool
safety	sharp blade, may fracture

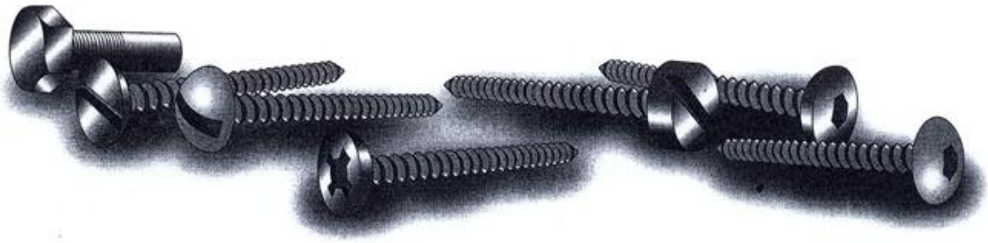
3 Work with a partner. Choose two more tools and complete the tables.

components	
size	
uses	
used by	
power	
safety	

components	
size	
uses	
used by	
power	
safety	

29. Modern lathes

Reading and speaking



1 Look at the screws and bolts in the pictures. With a partner, discuss whether the following statements are true (T) or false (F).

a ___ Screws are nearly always made from steel.

b ___ Screw heads come in many shapes and sizes.

c ___ All screws need to be turned clockwise when they are tightened.

d ___ The dimensions of most screws and bolts are standardised.

e ___ The same system of standardisation is used all over the world.

2 Read the passage and check your answers.

Screws and bolts are made in a wide range of materials, including brass, bronze, aluminium and titanium as well as steel. They consist of a shaft with a thread and a head that may come in a variety of shapes, including round, flat, oval, button or cap. The vast majority of screws have a right-hand thread, which means they are tightened by clockwise rotation. Occasionally, screws have a left-hand thread, such as the left-hand pedal on a bicycle.

Machine screws come in a range of sizes, and around 85% of all screws and bolts are designed to unified thread dimensions. They are categorised according to their diameter and pitch, or number of threads per inch. ISO metric screw thread is the most popular standard and has displaced previous systems, but there are other common systems, including the British Standard Whitworth, BA system (British Association) and the SAE Unified Thread Standard.

3 Discuss the following questions in groups.

a Why is it important to have standardised screws and bolts in the modern world?

b Which industries rely on mass-production of fasteners?

c When did screws and bolts start to become standardised?

d What machinery is needed to produce standardised screws and bolts?

Listening

You are going to listen to someone talking about the development of the modern lathe.

1 Listen and tick the questions from Reading and speaking Exercise 3 that the man answers.

2 Complete the text below with words from the box.

gearbox	workpiece	rotational	threads	lead screw	rotational

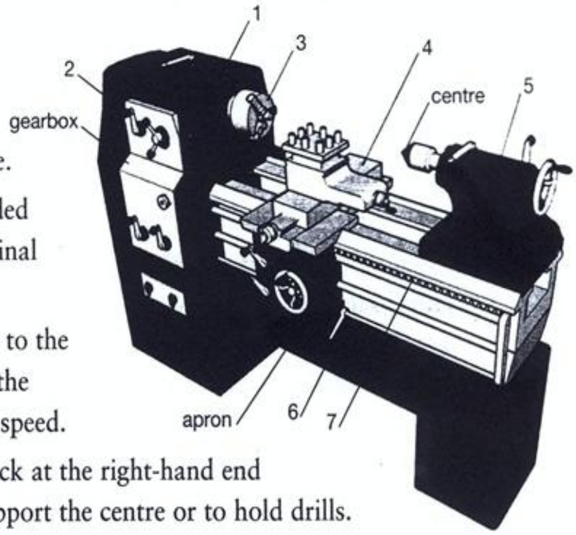
The **a**__________ is a long, threaded rod that carries a tool along the axis of a rotating workpiece. It ensures that the **b**__________ moves at a constant, even speed so that **c**__________ can be cut into it. The relationship between the **d**__________ speed of the tool and the **e**__________ speed of the workpiece can be varied by means of a **f**__________.

3 Listen and check your answers.

Vocabulary

The diagram shows a schematic view of a modern lathe with some of its main parts.

1 Read the descriptions of the parts and match them with the correct number.



a __ BED: the main body of the lathe.

b __ LEAD SCREW: the long, threaded rod which controls the longitudinal speed of the saddle.

c __ HEADSTOCK: the box, always to the left of the operator, containing the gears which control the spindle speed.

d __ TAILSTOCK: the moveable block at the right-hand end of the lathe which is used to support the centre or to hold drills.

e __ SPINDLE SPEED SELECTOR: the knob or lever used to control the rotational speed (rpm) of the spindle.

f __ SADDLE: the metal block which supports the tool and moves longitudinally between the headstock and the tailstock.

g __ SPINDLE: the rotating shaft to which the workpiece is attached.

2 With a partner, take it in turns to ask each other questions about the different parts of the lathe.

Unit 2, Lesson 6, Track 5

1. Before starting the machine, ensure that the feed engage lever and the thread cutting lever are disengaged.
2. Select either longitudinal or transverse feed axis by means of the push-pull knob on the apron.
3. Use the small selector handle at the bottom of the gearbox to determine the direction of feed.
4. Select the feed rate required by setting the selector dial and the three feed-selector handles at the top of the head-stock.
5. Use the two handles at the top of the gearbox to select the spindle speed.
6. Switch on the electrical supply at the mains isolator.
7. Start the spindle by raising it for forward rotation or lowering it for reverse.
8. Start and stop the feed motion as required, by means of the feed-engage lever.
9. Always stop the machine before changing speeds or feeds.

Unit 2, Lesson 6, Track 6

The lead screw is a long, threaded rod that carries a tool along the axis of a rotating workpiece. It ensures that the workpiece moves at a constant, even speed so that threads can be cut into it. The relationship between the longitudinal speed of the tool and the rotational speed of the workpiece can be varied by means of a gearbox.

30. Sales pitch

Vocabulary and pronunciation

1 **Work with a partner. One of you should check the meaning of the words in list A below; the other should check list B.**

2 **Take turns to explain the meaning of the words to each other. Use your own words as much as possible: do not memorise the dictionary definition.**

A	B
replenish (*v*)	circulation (*n*)
percentage (*n*)	replace (*v*)
dilute (*v*)	filter (*n*)
contaminant (*n*)	recirculate (*v*)
ventilate (*v*)	interval (*n*)

3 **Divide the words into three groups according to the number of syllables they contain (2, 3 or 4).**

4 **Practise saying the words with the correct stress and pronunciation.**

Reading

The text on the opposite page is from the website of an aircraft manufacturer. It gives information about an air conditioning system.

1 **Read the text quickly. Is the air conditioning system for a) airport buildings; b) aircraft; or c) hospitals?**

2 **Read the text again. Find at least five advantages of this system over other systems.**

3 **Compare your answers with a partner.**

Grammar and writing

1 **In the text, find and circle at least three comparative adjectives ending in -*er*. What is being compared?**

Products | Business Units/Services About Us | News | Investor Relations Merchandise | Multimec Global Search

Boeing Home / Commercial Airplanes / About Commercial Airplanes / Cabin Air Systems

Search Commercial

- Commercial Airplanes
- About Commercial Airplanes
- Overview
- Current Market Outlook
- Cabin Air Systems
- Cabin Air Environment
- How Environmental Control Systems Work
- Commercial Airliner Environmental Control System
- Myths and Facts
- Tips for Travelers
- Developing New Products
- Jetliner Safety
- Boeing Commercial Airplanes and the Environment
- Major Assembly Sites
- Orders and Deliveries
- Prices
- Site Tours
- StartupBoeing - Starting an Airline
- Products
- Services & Support
- Other Services
- Industry Information

Compared with other modes of transport, office buildings and other enclosed spaces occupied by large numbers of people, today's jetliners provide an environment that is superior in many respects. For example, in the heating and cooling seasons, most office buildings provide a far lower percentage of outside air – often as low as 20% or even less. In addition, buildings typically have a much lower air-change rate, and they're seldom equipped with high-efficiency filters like those found in Boeing airplanes.

A further advantage for airplane passengers is that the outside air entering jetliner cabins at cruising altitudes is generally much cleaner than what is available for ventilating buildings and surface modes of transportation. Air circulation is continuous. Air is always flowing into and out of the cabin. The cabin has a high air-change rate. All of the air in the cabin is replaced by the incoming mixture of outside air and filtered air during intervals of only two to three minutes, depending on airplane size. That's 20 to 30 air changes per hour. Outside-air mixing replenishes the cabin air constantly. The outside-air content keeps carbon dioxide and other contaminants well within standard limits and replaces oxygen far faster than the rate at which it is consumed. Replenishment also assures that the recirculated portion of the air does not endlessly recirculate but is rapidly diluted and replaced with outside air.

Studies have confirmed the overall safety and effectiveness of cabin air systems. One of the studies, conducted for the U.S. Government, was the most comprehensive of all. It involved an independent testing service taking air samples on 92 randomly selected airline flights. The levels of pollutants such as fungi and bacteria were found to be similar to or lower than those encountered in normal indoor environments. Also, levels of carbon dioxide were found to average less than one-third the limit recommended by the American Conference of Governmental Industrial Hygienists. Studies conducted by Boeing and by airlines have shown similar results.

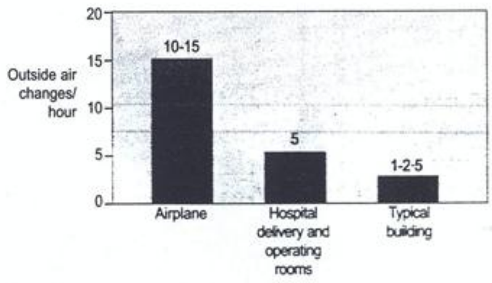


Figure 1

2 Complete the sentences using your own ideas.

- **a** A good night's sleep is equal to ____________________.
- **b** An air ticket to New York costs as much as or more than ____________________.
- **c** On average, girls ____________________ more than boys.
- **d** ____________________ are as strong as or even stronger than ____________________.
- **e** ____________________ cost even less than ____________________.

3 Compare your ideas with another student.

Speaking

Look at Figure 1 above and discuss what the graph shows. Are these statements true (T) or false (F)?

- **a** ___ Some buildings change air less than half as often as hospitals.
- **b** ___ Hospitals change air at least twice as often as aircraft.
- **c** ___ Some aircraft change air up to six times as often as some buildings.
- **d** ___ All aircraft change air more than three times as often as hospitals.

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