ZRAKOPLOVNA TEHNIČKA ŠKOLA RUDOLFA PEREŠINA

AVIATION ENGLISH 2

INTERNA SKRIPTA IZ ENGLESKOG JEZIKA U ZRAKOPLOVSTVU

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1. Warning

Vocabulary and speaking

1 Look at the posters and notices around the building where you are. What are their functions?

2 Match words on the left to related words on the right.

prevent	mandatory	remove	caution	protection	danger
warning	precaution	assess	take off	stop	evaluate
hazard	provide	prohibit	forbid	required	give

3 Discuss the differences in meaning with a partner.

Reading

1 Each of the posters *a–d* opposite has a different purpose. Look at them and complete these sentences.

a Poster ___ gives information about the correct way to do something.

b Poster ___ explains the responsibilities of the company and the workers.

c Poster ___ gives simple instructions in case of an accident.

d Poster ___ describes different types of safety warnings.

2 Look at the posters more carefully and decide whether these statements are true (T) or false (F).

a
i ___ Employers must train people in how to use safety equipment.
ii ___ PPE needs to be specialised for some tasks.
iii ___ Employers are responsible for putting away safety equipment.

b
i ___ An ambulance should be called in every case of a burn or scald.
ii ___ You should not try to take off any of the injured person's clothes.
iii ___ You should take off the person's watch.

c
i ___ A sign that tells you where fire equipment is kept is blue.
ii ___ A yellow sign means some kind of danger.
iii ___ First aid equipment will be found near a green sign.

d
i ___ There are five stages to lifting correctly.
ii ___ If you can, you should use a machine to lift things.
iii ___ You should look for dangers in your way before you lift.

3 Find an example of each of the following verbs in the posters. Which nouns do they occur with?

provide consult report maintain prohibit assess

a

WHAT YOU SHOULD KNOW

PERSONAL PROTECTIVE EQUIPMENT

In situations where risks cannot be controlled by other means such as systems of work or engineering controls, employers are required to protect their employees from risks to health and safety by providing suitable personal protective equipment (PPE).

THE EMPLOYER MUST:
- Provide suitable PPE free of charge.
- Maintain PPE in working order and good condition.
- Provide relevant training in the use of PPE.
- Consult employees on suitability of PPE.

PPE PROVIDED MUST:
- Be relevant for the work undertaken.
- Protect effectively against particular risks involved.
- Fit properly and comfortably (adjusting in size where necessary).
- Not hinder the performance of any task.
- Not add to the risks involved.

THE EMPLOYEE MUST:
- Use the PPE provided.
- Report any loss, defects or damage to PPE.
- Take care to correctly store PPE when not in use.

b

WHAT YOU SHOULD KNOW

BURNS AND SCALDS

✓

1. Place the burnt area under cold running water immediately for at least 10 minutes. If it is a serious burn ensure an ambulance is called.
2. If possible remove any items that may prevent swelling to burnt areas i.e. Belt, Boots, Watches or Rings.
3. Place a clean, sterile dressing over the burnt area.
4. Check that if required an ambulance has been called and check that the accident has been reported to the correct individuals.

1. DO NOT apply any lotion, ointments or creams.
2. DO NOT attempt to remove any items of clothing that may be sticking to the burnt area.
3. DO NOT touch or place anything other than a sterile dressing on a burn.
4. DO NOT burst any blisters that may form on or around the wound.

YOUR PROMPT ACTION CAN PREVENT SERIOUS INJURY OR EVEN DEATH!

EMERGENCY INFORMATION

HOSPITAL TEL: _____

DOCTOR TEL: _____

NEAREST FIRST AID: _____

YOUR FIRST AIDER IS: _____

c

WHAT YOU SHOULD KNOW

SAFETY SIGNS & THEIR MEANINGS

Recent regulation changes place a responsibility on employers to provide and maintain sufficient safety signs to warn of circumstances where risks to health & safety exist and to advise of precautions that need to be taken.

PROHIBITION SIGNS (DO NOT DO)
- A sign prohibiting behaviour likely to increase or cause danger eg. No Smoking. – Colour red.

MANDATORY SIGNS (MUST DO)
- A sign prescribing specific behaviour eg. Hard hats must be worn. – Colour blue.

SAFE CONDITION SIGNS (THE SAFE WAY)
- A sign indicating emergency exits or first aid/rescue equipment. – Colour green.

WARNING SIGNS (CAUTION, BEWARE)
- A sign giving warning of a hazard or danger. – Colour yellow.

FIRE SIGN (FIRE EQUIPMENT)
- A sign indicating the location of fire fighting equipment. – Colour red.

INFORMATION SIGN (GENERAL INFORMATION)
- A sign providing general information not covered by the above catagories.

d

WHAT YOU SHOULD KNOW

MANUAL HANDLING REGULATIONS

On 1st January 1993 regulations made under the Health and Safety at Work Act 1974 placed on employers additional responsibilities with regard to manual handling and lifting.

ASSESS THE SITUATION
- Can manual handling be avoided? If so use mechanical aid to lift or move the load.
- If not plan your lift.

CHECK FOR THE FOLLOWING
- Potential hazards ie. packing hooks, sharp edges, etc.
- Check stability of parcel, ease of grip, weight of parcel.
- Know your destination BEFORE lifting.
- Can you stop and rest if needed?
- Are you wearing protective equipment ie, gloves, safety boots, hard hat?

YOUR GUIDE TO SAFE LIFTING

1. Plan all aspects of your lift before taking weight.

2. Spread the feet, place them close to the load, bend the knees keeping back straight.

3. Grip the load firmly, keep arms close to the body, use the legs to lift upper body and load.

4. Hold load close to body, do not twist the trunk, move feet.

2. Safety at work

Speaking

Work with a partner. Discuss the following.

1 In Lesson 1 you saw what the colours of signs indicate. Do you remember them?

2 Look at the ten signs below. Which signs indicate:

a that something is mandatory (must be done)?

b that something is prohibited (must not be done)?

c safety measures and first aid?

d a warning?

3 Discuss what the signs mean and where you might see them.

Listening

1 Listen to six short conversations and number the six signs which are mentioned.

2 Now listen to some sentences from the recording. Try to write exactly what was said in that phrase or sentence.

a make that mistake _____

b another accident _____

c I was underneath _____

d sources of ignition _____

e no protection _____

f more windows _____

Pronunciation and speaking

1 Look at the Skills Box. Conversation 1 begins like this. The stressed words are marked.

a Do you know where Jack is? I've been waiting for him for twenty minutes.

b Last time I saw him, he was going off to wash his hands. He's been doing some painting.

Work with a partner and practise these two lines until the difference between the stressed and unstressed words is clear in your speech.

Skills Box

In spoken English, the important words for the message of a sentence are stressed. For example, in

We'll be ready to start in ten minutes

the words *ready*, *start* and *ten minutes* are stressed. If you remove the rest of the sentence, the basic message is still clear: *Ready – start – ten minutes.*

This is how you must listen to English, and speak it: focus on the 'message' words. They are louder, higher and longer than the rest of the sentence.

If you do not speak English in this way, it will be very difficult for others to understand you.

2 Look at the tapescript for this lesson. Choose one of the other conversations and mark the stressed words. Then practise the conversation as before, concentrating on the difference between stressed and unstressed words.

Writing

1 Look at the four signs that were not discussed in Listening Exercise 2 above. Write a short dialogue between two or three people in the workplace which is connected with one of them. Start the first dialogue like this:

A: What are you doing?

B: I'm going to ...

A: Be careful ...

2 Practise your dialogue, focusing on which words in the sentences should be stressed.

3 Read your dialogue to some colleagues. They will tell you which sign goes with the situation.

Unit 7, Lesson 2, Track 27

1.

A: Do you know where Jack is? I've been waiting for him for twenty minutes.

B: Last time I saw him, he was going off to wash his hands. He's been doing some painting ... Oh, here he is now. All right Jack? Why the bandage?

J: I've scalded myself with that water. I should have put some cold in first. It serves me right for ignoring the notice! Lucky it's only one hand.

A: You won't make that mistake again in a hurry.

2.

Foreman: How's that pump running now, Barry?

Barry: Fine, I've replaced the front main bearing so I'm just going to give it a bit more lubrication, clean it up and then it's ready to re-fit.

Foreman: Ok ... but make sure it's switched off when you do it! We don't want another accident like last week.

3.

A: Phyeeugh ... look at it, this overall's ruined and I've got some down my neck, I ... can feel it. Ugh, its all sticky.

B: And some on your face and hair, too ... look at the state of you ... what happened?

A: The sump plug fell out while I was underneath ... It's not ... funny!

C: It is from where I'm standing!

B: Well, you're completely covered in the stuff ... off you go to the washroom and clean yourself up thoroughly ... and make sure you change that overall!

4.

A: Ah ... Yes, I think this is the right stuff for cleaning all that paint away.

B: Better check first, though. What does it say on the label?

A: Hmmm ... harmful, do not swallow. Only use in a well ventilated area. Wash hands immediately after use. No smoking when using this product. Do not breathe fumes. Keep in a cool place well away from sources of ignition ... Here we are ... To use as a paint solvent, apply to a cotton cloth.

5.

A: Have you finished the block yet?

B: Yes, I'm just going to finish it off on the grinder ... get it nice and shiny and smooth.

A: Ok, but make sure you don't try to use the grinder over there. There's no protection on it at all. It got broken yesterday afternoon and hasn't been replaced yet. In fact, I'll go over and remove the wheel so it can't be used.

B: Might be an idea to disconnect it from the power supply as well.

A: Yep ... I'll do that.

6.

A: So this is where the new milling machines are going to go.

B: Yes, they're being installed next week ... once this place has dried out.

A: Hmmm ... yeah it's a pretty strong smell. They could do with a few more windows open. So what's going to go in these cupboards, do you know? Look out, mind that door.

B: Oh no! This is a new jacket. There should be a sign here.

3. Fuel + heat + O2 = fire

Speaking

1 **With a partner, discuss what is shown in this diagram.**

2 **What happens if each of the three main elements in turn is removed? How can this be done in real situations?**

Reading and writing

1 **Read the description below of the firefighting gas halon. Which other gas or gases is halon compared with?**

Halon differs from all other **extinguishing** agents in the way it puts out fire. Its essential extinguishing ability lies in its **capacity** to chemically react with the oxygen and put out the fire immediately, without leaving the kind of mess and damage that can be caused to avionics and electrical equipment by water, foam or dry powder. Halon fire extinguishers, which are effective on the three most common classes of fire, A, B and C, are thus ideally suited to aircraft use. Although they are more expensive than other types, the results are well worth the difference in price.

Like carbon dioxide (CO_2), halon is **unsuitable** for use in open areas. If you spray it into the open air, it disperses almost as soon as it is sprayed, but it is highly effective in closed areas. However, halon is superior to CO_2 for three good reasons. CO_2 must be stored at high pressure, whereas halon is stored at low pressure. This means that halon fire extinguishers can be less than half the size and weight of equivalent CO_2 extinguishers, which makes them particularly suitable for use aboard aircraft, where space and weight savings are a priority. CO_2 works by physically displacing all of the oxygen in the compartment, which suffocates the fire. Unfortunately, because it is heavier than air, it can also suffocate people. Halon, on the other hand, works by chemically **interrupting** the burning process, which means that it requires a fraction of the amount to do the job compared with CO_2 and there is therefore a lower risk of **suffocation.** In areas where there are people present, the systems are engineered to provide sufficient halon to kill the fire but not enough to cause anyone harm.

Unfortunately, like CO_2, halon is not good for the environment because it damages the ozone layer of the upper **atmosphere,** which protects the Earth from **dangerous radiation.** Its use is forbidden on the ground in most countries and, although it is still used in many **military** and civilian aircraft, it is gradually being replaced by new gases which are more environmentally friendly.

2 Look at the list of characteristics below. Refer back to the comparisons in the text and mark each characteristic *H*, *CO_2*, *both* or *neither* as appropriate.

a	can be used in open areas	neither
b	stored at high pressure	
c	small extinguisher	
d	heavy extinguisher	
e	no residue which can damage machinery	
f	prevents oxygen coming into contact with fuel	
g	changes chemistry of oxygen	
h	small amount required to put out fire	
i	higher risk of harm to humans	
j	not environmentally friendly	

3 Complete the table with your own notes for the two types of fire extinguishers.

	CO_2	halon
class of fire	B, C	
how it works		
open areas	unsuitable	
closed areas		
storage pressure		
weight of extinguisher		< ½ CO_2
size of extinguisher		
danger to humans		
amount of gas required		much less than CO_2
environment		
cost	?	more expensive than others

Pronunciation

Look at the words in bold in the text. Put them in the correct column of the table according to their stress.

Ooo	oOoo	ooOo

4. Put out the fire

Speaking and reading

1 Discuss with a partner.

a How can fires start? Think of as many causes of fire as you can.

b What can you do to extinguish a fire?

c What substances (apart from water) can be used to extinguish it?

2 What different types of fire are there? Match the classes of fire *A–D* with the example materials *i-iv*.

Class A: fuelled by non-metallic solid materials

Class B: involve flammable liquids and gases

Class C: involve energised electrical wiring or equipment

Class D: involve the combustion of unusual metals

i magnesium, sodium, titanium

ii paper, wood, cloth, rubber, certain plastics

iii gasoline, paint thinner, kitchen grease, propane, acetylene

iv motors, computers, panel boxes, wiring, cabling

3 Work in groups of three.

a Look at the table below. Check that you understand the column headings.

extinguisher		type of fire					
colour	type	solids (wood, paper, cloth, etc.)	flammable liquids	flammable gases	electrical equipment	cooking oils & fats	notes
	water	✓	✗	✗	✗	✗	*cools burning material reduces O_2*

b Each member of your group should read one of the paragraphs opposite: Foam, Dry powder or CO_2. When you are ready, explain your text to each other.

c Listen to your colleagues' explanations and put a tick (✓) for *yes* and a cross (✗) for *no* in the table. Complete any extra notes or points of interest in the last column. The information for the water extinguisher has been done as an example.

Common types of fire extinguisher

Water Only suitable for Class A fires. Colour-coded red; work by cooling burning material as well as reducing oxygen.

Foam More versatile than water extinguishers. Can be used for Classes A & B fires but not recommended for other classes of fire. Colour-coded cream. Work by forming a blanket or film on the surface. Because foam spreads over a wide area very quickly and is difficult to clean up, these are not recommended for use in the home.

Dry powder Multi-purpose fire extinguishers which can be used on Classes A, B & C fires (up to 1,000 volts maximum). Colour-coded blue. Work by "knocking down" flames and depositing a layer of powder on the material.

CO_2 Ideal for Class C fires because CO_2 does not conduct electricity and does not support combustion. Can also be used on Class B fires, but unsuitable for Class A fires because they do not have a cooling effect. Colour-coded black. Work by preventing oxygen coming into contact with the material. Where there is a risk of a particular type of Class D fire, a specific type of extinguisher should be available.

4 Work with a partner.

Student A: Describe a type of fire, e.g., engine oil on the floor.

Student B: Say what fire extinguisher is required to put it out (*foam, powder or* CO_2).

Vocabulary

1 Read the texts above about common types of fire extinguisher again.

a Underline the words *for* and *by* each time they are used.

b Circle the words which are used with *for* and *by* to form a fixed expression.

For example:

Only suitable for Class A fires.

2 Complete these sentences with *for* or *by*.

a A foam extinguisher works _____ covering the surface of the material.

b Water is unsuitable _____ Class C fires because it conducts electricity.

c CO_2 is recommended _____ Class C fires.

d The most suitable extinguisher _____ a fire which involves paper is water, but it cannot be used _____ Class B fires.

5. Fire extinguishers: Review

Speaking

In Unit 7, you looked at fires and fire extinguishers. Work with a partner.

1 Try to do the following from memory.

a Match the extinguishers with the classes of fire.




dry powder
CO_2
halon
water

b List the types of materials that are involved in each case.

c Sketch the three-part 'triangular' process that keeps a fire burning.

2 Check your answers in Unit 7.

3 Write some advantages and disadvantages of each type of extinguisher in the table below. Think about flexibility of use, the environmental effects of using them, materials they contain, cost, weight and any other factors.

advantages	disadvantages

Vocabulary

You are going to listen to the results of a fire test. You will need to understand and recognise the following words.

dust ignite glue smother backing foam mess upholstery fabric

1 Complete the definitions with a word from the list.

a _____ (*n*) material, usually cloth or leather, used to cover chairs and seats

b _____ (*v*) 1. catch fire, begin to burn 2. set fire to

c _____ (*v*) join with adhesive; stick (together). ~ (*n*) an adhesive

d _____ (*v*) cover completely, e.g., a fire, person, so that air cannot reach it

e _____ (*n*) collection of extremely small dry particles forming a layer on horizontal surfaces

f _____ (*n*) insulation made of plastic filled with many small bubbles of air to make it lighter

g _____ (*n*) disorder, untidiness. a ~: a situation in which there is no order or organisation

2 Practise the pronunciation of the words with your teacher.

Listening

1 Listen to this description of a test of the three types of extinguisher. Are any of your ideas from Speaking Exercise 3 mentioned?

2 Listen again and correct the information in the table.

Fire test

fuel: *upholstery, foam, kerosene*

	halon	CO_2	dry chemical
extinguished Y/N	Y	N	Y
no. of squirts required	22	4	7
time	minimum: ~2-3 secs	8-12 secs	4 secs
reignition Y/N	Y	N	N
approx. amount used (%)	40%	100%	33%
immediate environmental effects of use	none	airborne particles unpleasant	extensive layer of chemical powder on all surfaces in the area

Just to see how effective these agents are, we compared Halon with CO_2 and a dry chemical bottle. Um, now this was purely backyard pyromania - we claim no scientific basis for our tests - but the results were impressive. For a test bed, we glued upholstery fabric to foam backing somewhat similar to the material used for aircraft interior panels. We dabbed on a small glass full of gasoline and ignited the panel.

Our Halon extinguisher put out this blazing mess in minimum time – with just a couple of squirts. There was no re-ignition uhmm after only about half of the two-and-a-half pound bottle was used. And we were happy that the extinguisher had enough for another go if needed.

Then using a fresh, identical panel, we next tried the CO_2. It took about twice as long as Halon to put out the blaze – about three or four squirts. But much worse than that, once the fire appeared to be out, it flamed right back again and needed to be smothered again with the CO_2, so that's maybe 8 or 10 seconds overall, which can be a long time in an emergency of course. By the end of the second try, the bottle was nearly empty - and this fire was not particularly large.

The several types of dry chemicals we tried were nearly as effective as Halon in extinguishing the fire – they all did the job after a couple of squirts, using maybe two thirds of the content. But the mess. the resulting mess was a sight to behold, there was powder swirling in the breeze and coating everything in sight. The air was full of a biting, sour-tasting, white dust. We could only imagine trying to fly in a closed cabin with this stuff in the air: parachutes would be preferable.

6. Fire risk

Section one – Fire risk

1 Work in pairs. Discuss the questions.

1 What do you think is the most common cause of fires on board planes?
2 What incidents caused by fire have you heard about?
3 What training have you received for dealing with fires?

2 You are going to read dangerous goods incident reports from the Australian Civil Aviation Authority. Read the stories, and match each incident with a story. Write A–H.

In which incident:

1 was fire started by metal touching metal? ___
2 did someone try to illegally ship explosive powder? ___
3 did the movement of the aircraft cause a fire? ___
4 did leakage cause a dangerous chemical reaction? ___
5 was a fire discovered after landing? ___
6 did heat from a chemical reaction start a fire? ___
7 did an explosion in the hold cause a plane to crash? ___
8 did a passenger accidentally bring a dangerous item on board? ___

DANGEROUS GOODS INCIDENTS REPORT

A On arriving at the destination, one passenger's bag had smoke coming out of it. A check by the airline revealed that a cigarette lighter had ignited and burned some of the clothing.

B An aircraft crashed due to a flammable liquid – possibly perfume – leaking in a passenger's stowed baggage. An ignition source set light to the liquid, causing an explosion.

C A courier driver arrived at a freight-forwarder's premises and asked to pick up a large crate which contained an explosive material in the form of a black powder. The owner knew it was prohibited, and was already in trouble with the police for collecting a briefcase full of fireworks from the airport two days earlier.

D Federal police were called to a baggage carousel at an international airport to check an unclaimed bag. An inspection of the contents revealed a fire extinguisher and a packet of sandwiches. It was finally discovered that a passenger had accidentally taken a taxi driver's bag from the car and didn't notice that he checked in an additional bag.

E A shipper consigned a wet-cell battery, undeclared as dangerous goods. Before consignment he emptied the acid out of the battery. But he also placed a brake cable in the same package. On arrival of the aircraft, smoke from the package set off a smoke detector because the brake cable had caused a short circuit of the terminals.

F In a cargo hangar, a container ignited. One item of cargo in the container was an oxygen generator, undeclared as dangerous goods. These devices produce oxygen by chemical reaction, which creates significant heat.

G Undeclared dangerous goods described as 'laundry products' contained a mixture of a chemical solution and corrosive solids. It was loaded on its side in the cargo compartment and the liquid leaked onto the solids, causing a very hot fire.

H While unloading baggage, ground staff noticed smoke rising from a suitcase. Investigation revealed that a quantity of matches had ignited due to vibration in the hold.

3 Decide if the sentences are true or false. Write *T* or *F*. Then read the text again to check.

1 In incident A, the cigarette lighter caught fire first. ___
2 In incident B, a spark may have set the perfume alight. ___
3 In incident C, the courier driver had fireworks in his truck. ___
4 In incident D, the passenger was a taxi driver. ___
5 In incident E, the shipper hadn't taken any precautions. ___
6 In incident F, heat from the aircraft ignited oxygen. ___
7 In incident G, the goods were incorrectly loaded in the hold. ___
8 In incident H, ground staff immediately knew the cause of the fire. ___

Vocabulary – collocations related to fire

Match a word on the left with a word on the right to make collocations from the incident reports.

1 cigarette	a circuit
2 fire	b reaction
3 corrosive	c liquid
4 ignition	d extinguisher
5 chemical	e solids
6 smoke	f lighter
7 flammable	g source
8 dangerous	h material
9 explosive	i goods
10 short	j detector

Functional English – Obligation, prohibition and permission

1 01 Listen to a spokeswoman from the Australian CAA commenting on the dangerous goods reports. Underline the correct information.

1 *Many / Not many* passengers fly with dangerous goods by mistake.
2 Correctly-declared goods cause *hardly any / most* fires.
3 Airport staff should possibly be better trained in dealing with *fires / dangerous goods*.

2 01 Listen again and complete the sentences.

1 Most passengers know what they _____ and _____ bring into an airport.
2 It's obvious that you _____ bring anything explosive on board.
3 Although some people still try, even when they know it's _____.
4 The owner of the black powder knew he wasn't _____ transport it without declaring it as dangerous goods.
5 You _____ declare dangerous goods or you are _____.
6 It's difficult to understand, for example, how someone _____ chemical solutions and corrosive solids on board.

Speaking

Work in pairs. You are going to roleplay a customs official explaining rules about prohibited goods to a passenger. Student A look at p 105. Student B look at p 109.

01

Most passengers know what they can and can't bring into an airport. It's obvious that you mustn't bring anything explosive on board. Although some people still try, even when they know it's illegal. The owner of the black powder knew he wasn't allowed to transport it without declaring it as dangerous goods. You have to declare dangerous goods or you are breaking the law. Less than one percent of cargo incidents reported involve dangerous goods which have been correctly declared. It's difficult to understand for example how someone let chemical solutions and corrosive solids on board without question just because they were labelled as 'laundry products'. Maybe better dangerous goods training is required.

7. On-board fire

Section three – On-board fire

1 Compete the sentences with the verbs below.

come loose	set off	reset	overheated	trips	short-circuit	overloaded

1 The fan has _____ – there's smoke coming from it.
2 If anyone smokes in the toilet, it will _____ the smoke detector.
3 This outlet is _____ , so we need to unplug a couple of things.
4 Some wiring has _____ and needs securing in place.
5 Water has got into the wires and caused the system to _____ .
6 If the circuit-breaker _____ , you need to _____ it.

2 Work in small groups. When a fire is discovered during a flight, is it more important to fight the fire or land the plane? Why?

3 04,05,06 Listen to intra-cockpit and radio-telephony communications from a B747 in the cruise phase of flight. Tick (✔) the things that the crew do.

- put on their oxygen masks ☐
- inform air traffic control about the problem ☐
- investigate the cause of the fire ☐
- try to extinguish the fire ☐
- make an announcement to passengers ☐
- initiate an emergency descent ☐

4 04,05,06 Listen again and answer the questions.

1 How do the crew first realize there is a problem?
2 What does the pilot think the cause could be?
3 Where is the smell coming from?
4 How do they deal with the passengers who feel uncomfortable?
5 What two possible causes does the cabin crew manager mention?
6 What equipment does the cabin crew manager put on before investigating again?

Pronunciation – /l/ and /r/

1 07 Listen to six words. Write A or B, according to the word you hear.

	A	B	
1	right	light	___
2	fright	flight	___
3	frame	flame	___
4	wrong	long	___
5	road	load	___
6	arrive	alive	___

2 07 Listen again and repeat the words.

3 Work in pairs. Take turns to read one word from each line. The person listening must say if they hear A or B.

4 Now practise these sentences.

1 The right light is broken.
2 We had a fright when the flight landed heavily.
3 The flame came from the air frame.
4 The pilot flying took a wrong turn.
5 They'll transport the load by road.
6 All systems must be upgraded or replaced.
7 I was glad to arrive alive.
8 File the report on the fire.

Functional English – Identifying and responding to problems

Complete the extracts from the dialogue with the words below. Then listen and check.

1 05

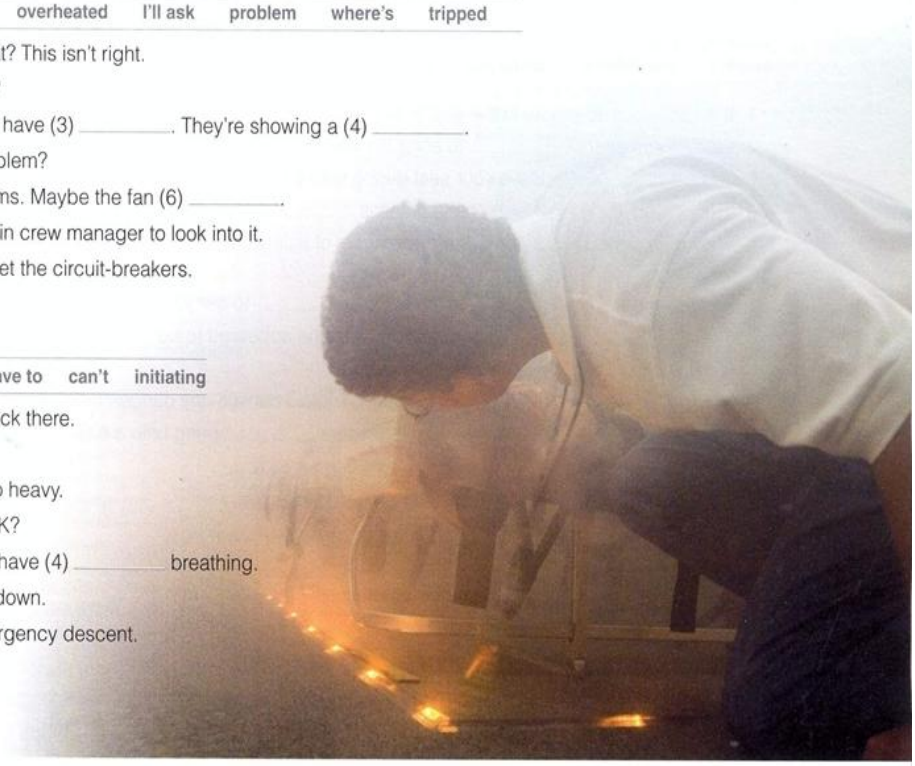
happened	I'll try	what	overheated	I'll ask	problem	where's	tripped

PF (1) _____ was that? This isn't right.
PNF What's (2) _____?
PF Three circuit-breakers have (3) _____. They're showing a (4) _____.
PNF (5) _____ the problem?
PF In one of the washrooms. Maybe the fan (6) _____.
PNF (7) _____ the cabin crew manager to look into it.
PF (8) _____ and reset the circuit-breakers.

2 06

trouble	why	smoke's	have to	can't	initiating

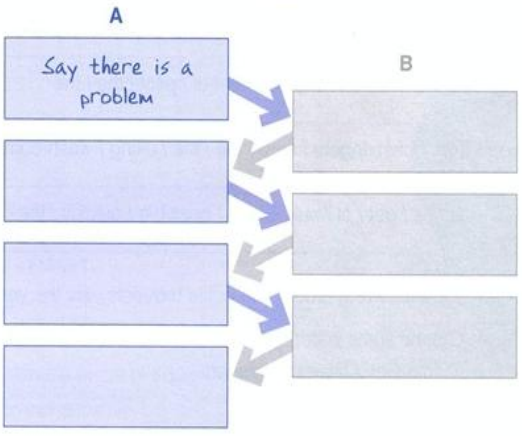
C I (1) _____ get back there.
PNF (2) _____ not?
C The (3) _____ too heavy.
PNF Are the passengers OK?
C People are starting to have (4) _____ breathing.
PNF We (5) _____ go down.
PF (6) _____ an emergency descent.



Speaking

1 The flow chart shows the pattern of communication in the two dialogues in the Functional English section. Complete the boxes with the appropriate statement. The first one has been done for you.

Say what the problem is
Announce action (x2)
Request clarification
~~Say there is a problem~~
Request further clarification
Give more information



2 Work in pairs. Use the prompts to make dialogues based on the flow chart pattern. Invent your own details.

1 There is a smell of burning plastic in the galley
2 The floor in business class feels hot.
3 There are sparks under the instrument panel.
4 There is smoke coming from a bag in an overhead locker.

04

C = controller, PF = pilot flying, PNF = pilot non-flying, CCM = cabin crew manager

C Siberian 3A, Kunming Centre, maintain FL 380 mach .85.
PNF Maintain FL 380 mach .85. Siberian 3A.

05

PF What was that? This isn't right.
PNF What's happened?
PF Three circuit-breakers have tripped. They're showing a problem.
PNF Where's the problem?
PF In one of the washrooms. Maybe the fan overheated.
PNF I'll ask the cabin crew manager to look into it.
PF I'll try and reset the circuit-breakers.
PNF OK?
CCM Yes, hi, I'm getting reports of an unpleasant smell back here, coming from the rear washrooms, like an electrical burning smell. Some of the passengers are getting a little uncomfortable with it.
PNF Could you move the passengers away?
CCM Sure, will do.
PNF Go have a look
CCM I'll check it out now.
PF Why didn't it set off the smoke detector? I'm not happy with this at all. Something's wrong.
CCM There was smouldering in the washroom. I don't know if any wiring has come loose. I sprayed it with the extinguisher – I think it's gone out.
PNF What do you think caused it?
CCM I don't know. Maybe the vacuum outlet overloaded. I couldn't see where it was coming from. I'll go back now and double check.
PF Yeah, go. We need to know the source of the fire.
CCM I'll take my goggles, just in case.
PF Yeah, We'll put our masks on. Go back, but don't get yourself incapacitated.

06

CCM I can't get back there.
PNF Why not?
CCM The smoke's too heavy.
PNF Are the passengers OK?
CCM People are starting to have trouble breathing.
PNF We have to go down.
PF Initiating an emergency descent.

07

1 right
2 flight
3 frame
4 long
5 load
6 arrive

8. Lifejackets

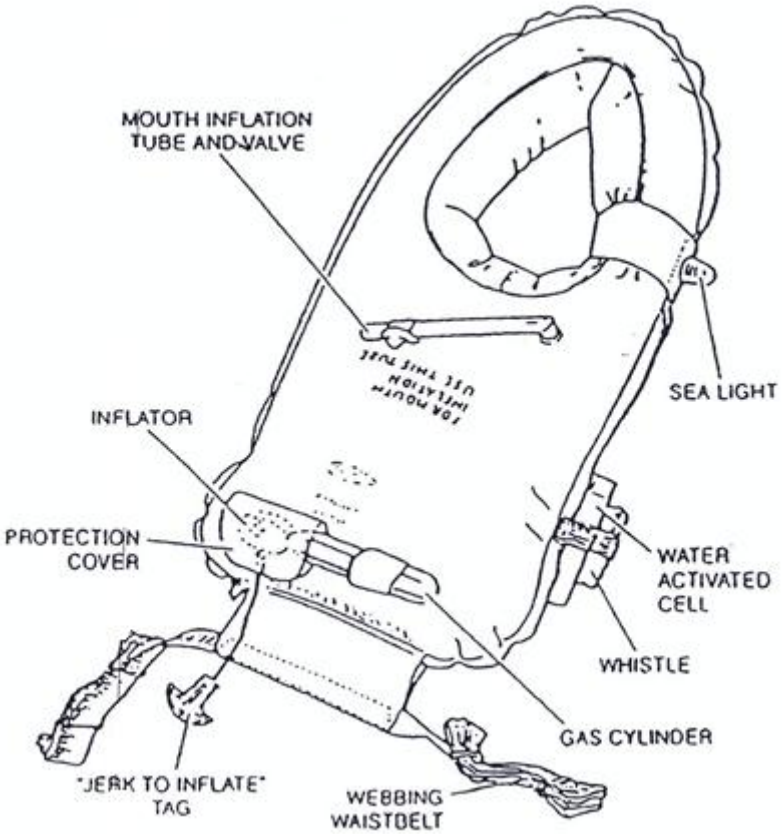
Lifejackets are designed as lightweight items of equipment and as such should be treated with care. They are normally packed in specially made fabric valises or containers for ease of handling and their protection. They also help to keep the lifejackets correctly folded, to facilitate donning .However, care should be taken not to drop a packed lifejacket or to place loads on it. Manufacturers often recommend that a lifejacket which has been subjected to such abuse or has been immersed in sea water should be rejected for further operational use.

The necessary instructions for fitting lifejackets are displayed in the aircraft and, in many instances, these instructions are repeated in safety pamphlets for distribution to individual passengers.

Normally, lifejackets are stowed under passengers' seats and in easily accessible position for crew members. Stowages should be kept clean and dry and the stowage retaining device should be checked periodically for security and ease of release.

Lifejackets which have been used for demonstration by crew members should be returned for inspection as if they were time expired. To ensure that this is always done, the demonstration lifejackets should be kept out of the normal stowage and a suitable warning label should be attached.

There are several types of lifejackets in use and all are basically similar. Buoyancy is obtained by inflating the jacket with carbon dioxide gas, which is stored under pressure in a small cylinder and released by means of a manually operated mechanism. Care should be taken to avoid unintentional operation of the inflation mechanism. The mechanism cannot be used to stop the gas flow, which will inflate the life jacket in a few seconds. To assist rescue operations, lifejackets are equipped with identification light, battery and a whistle. Some may carry even fluorescent sea marker dye, shark repellent products and special signaling devices.



1. Are the following statements true or false?

When a lifejacket is suitably packed, you can drop it, put load on it or immerse it in sea water.

Lifejackets are stowed under passengers' seats.

Demonstration lifejackets should be treated as if they were time expired.

Lifejackets are inflated with oxygen.

2. Fill in the gaps using the following words:

valises, repellent, donned, retain, dyed

If you go to South America take a mosquito_____with you.

If you eat salty food your body will_____water.

She kept her shoes in fabric_____to protect them from dust.

He_____his raincoat and ran out.

She started going to heavy metal concerts and_____her hair black.

3. Complete the summary and add new sentences:

Lifejackets are packed...

Packed lifejackets...

Stowages should not...

Demonstration lifejackets should...

Lifejackets are inflated...

They are equipped with...

9. Fasten seat belts

Reading

1 Look quickly at the text opposite. Which of these three titles is the best?

Types and functions of seat belts

Maintenance of restraints

Common restraint damage

2 Match the types of damage on the left with the correct definition on the right.

a	cut	___	**i**	general loss of shine, damage to surface
b	tear	___	**ii**	becoming longer
c	chafing	___	**iii**	marks caused by other substances
d	fraying	___	**iv**	the threads at the edge of the material are loose
e	stains	___	**v**	bending, twisting, change of shape
f	fading	___	**vi**	rust or oxidation
g	distortion	___	**vii**	damage with a sharp tool, e.g., a knife
h	elongation	___	**viii**	loss of colour over time
i	cracking	___	**ix**	general damage caused by use over a long time
j	corrosion	___	**x**	damage caused by rubbing against other objects
k	wear	___	**xi**	long, narrow breaks or splits
l	deterioration of finish	___	**xii**	damage caused by pulling, e.g., paper, in two directions

Speaking and writing

1 Look at the pictures opposite. With a partner, discuss what kind of damage is shown.

2 Look at the damage report below. Which belt does it describe?

item	notes
belt label	OK
damage to belt straps: specify place and type	signs of fraying around securing bolts
damage to fixings/fastenings: specify place and type	none
belt adjustment	difficult to tighten and loosen
damaged item: Repair/Discard	discard

3 Write similar reports for the other belts.

Seat belts are designed to withstand extremely high loads, e.g., a 100-kg man travelling at several hundred kilometres an hour. But if there is any damage to a belt, its load-bearing ability will be significantly reduced. Therefore, as part of regular maintenance, all of the restraints on an aircraft must be checked in accordance with a set procedure, such as the following:

1 Check that the seat belt label is intact and legible.

2 Without removing the safety harnesses from the aircraft, thoroughly scrutinise each individual strap of the safety harnesses in both front and rear cockpits for any evidence of:

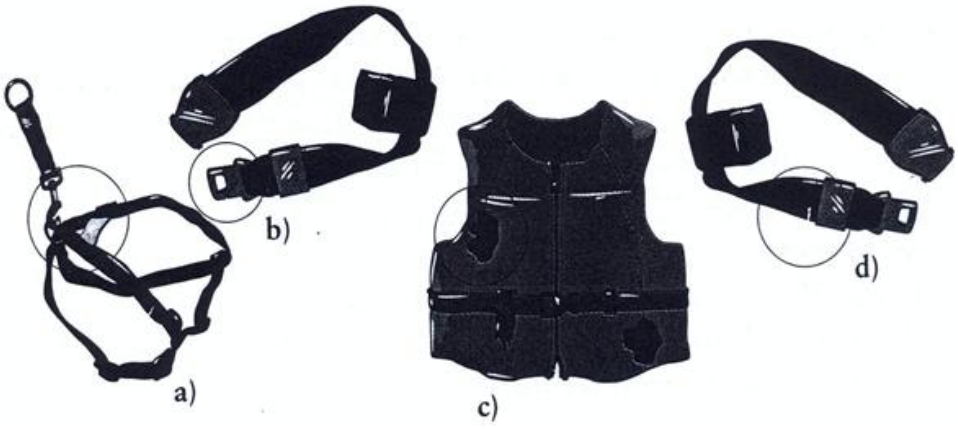
   a breaks in stitching
   b cuts and tears
   c chafing
   d fraying
   e stains due to acid, oil, grease and water
   f colour fading due to exposure to sunlight
   g distortion of end fittings
   h signs of excessive wear or elongation of the attachment holes

3 Examine each attachment bracket, its securing bolts, saddle washers and the fuselage frame in the vicinity for evidence of cracking, corrosion, wear or deterioration of the surface finish.

4 Finally, test all restraint mechanisms to ensure that the restraint can be:

   a fastened
   b released
   c tightened
   d loosened

5 In the event of the restraint failing any of the above checks, it must be replaced and either discarded or sent to an authorised repairer.



10. Safety procedures

Speaking

All commercial aircraft are required to carry out certain procedures to ensure the safety of the passengers and crew. They often use specific equipment to do this.

1 **Make a list of procedures and the equipment they involve. For example:**

dealing with a sick passenger: a first aid box

2 **Compare your list with your partner's. What are the details of the procedures you have listed? How is each piece of equipment used?**

Listening

Now listen to a safety inspector talking about his job on a radio programme.

1 **Listen once and mark all the equipment and procedures on your lists which are mentioned. Which others are mentioned?**

2 **Complete the notes on the inspection procedure for each of the pieces of equipment.**

signs	**1** make sure they are there **2**
fire extinguishers	**1** **2** in right places **3**
oxygen masks/bottles	**1** **2** in case of smoke in cabin
torches	**1** **2** batteries must be fully charged
sick bags	**1** in case of turbulence **2**
life jackets	**1** **2** in good condition
megaphone	**1** **2** crew to give instructions in an evacuation
seats	adjust up and down
seat belts	**1** **2** not twisted or frayed

remove the wheel so it can't be used.

B: Might be an idea to disconnect it from the power supply as well.

A: Yep ... I'll do that.

6.

A: So this is where the new milling machines are going to go.

B: Yes, they're being installed next week ... once this place has dried out.

A: Hmmm ... yeah it's a pretty strong smell. They could do with a few more windows open. So what's going to go in these cupboards, do you know? Look out, mind that door.

B: Oh no! This is a new jacket. There should be a sign here.

Unit 7, Lesson 4, Track 28

A: Hello and welcome to *I could do that*, the programme in which we give young people a chance to ask questions about interesting and unusual jobs and today in the studio my guests are Martin Robbins. You're how old Martin?

M: 12.

A: ... and Terry Gardner from the Civil Aviation Authority. I won't ask you how old you are Terry.

T: Thank you.

A: Now you are, I think I've got the title right, a civil aviation operations cabin inspector.

T: That's correct.

A: And can you give us an idea of what you do, in a few words?

T: Well as the job title suggests, I inspect aircraft cabins and make sure that the correct procedures are followed by the crew before, during and after a flight.

A: Right. Now I think it's over to you Martin. Let's have your questions.

M: Can you tell me - what exactly do you actually inspect?

T: Most of the things that you would expect to find inside an aircraft really -

M: Like the engines and the cockpit and stuff?

T: No, no, I'm not an aircraft engineer. Those sorts of thing are checked by the technical maintenance people. No my main priority, the most important thing I mean, is the safety of the aircraft passengers - making sure that everything in the passenger cabin is OK and that the cabin attendants do all the right things throughout the flight. For example one of the first things I check when I go on board is that there are legible signs in all the correct places. You know the sort of thing - No Smoking, Exit signs, emergency equipment. To make sure the signs are there and that everyone can read them easily, especially in case of an emergency.

M: What sort of emergency equipment do you look for?

T: Well, every model of plane is different of course, there's a different specification for each one. But I need to make sure that there are the right number of fire extinguishers, that they are in the right place, and that they have an up-to-date service tag.

M: What's that?

T: The service tag. That's a little label which tells you when the equipment was last checked. And of course there's a lot of other safety equipment. Aircraft – or airlines - are not allowed to fly if they don't have all the right safety equipment. Things such as oxygen bottles, and oxygen masks - protective breathing equipment in case there is smoke in the cabin. It's important to check that they that drop correctly down from the ceiling. Then there's First Aid kits ... and the passenger information cards, of course ... the flashlights - the torches – I need to make sure there are enough of them – in case the lights go out and, of course, I check that the batteries are charged.

M: Are the information cards the ones in the back of the seat with the pictures on, with the magazine and the sick bags?

T: Yes, that's it, and those are important, those sick bags, especially if there's a lot of turbulence - you know, if it gets bumpy - for everyone's comfort, not only the person who feels sick, and to keep

the cabin clean.

M: Yuck. Is that the lot?

T: No! There are dozens of other things ... Can you think of anything I might have missed?

M: What about lifejackets?

T: Well done. I have to check that there's one under each seat. And again I check the condition ... Oh, yes, of course there has to be at least one megaphone.

M: In case the intercom on the plane doesn't work.

T: Yes, for that, but mainly for use if the plane has to be evacuated and the crew need to give instructions to the passengers.

M: So after you've checked everything is there, the plane takes off?

T: Not quite. I inspect the cabin before the passengers come on board. And before they do, there's another very important thing I have to check. I can't really do it with the passengers on board - any ideas?

M: Uhh ... mmmmmm ... oh, I know - the seats.

T: Exactly. I check that they're working, that they can be adjusted up and down, and that the seat belts work properly and that they're not twisted or frayed. I also check the cabin crew seats and their safety harnesses as well. There really is a lot to look at. Then, when I'm satisfied that everything's ship-shape, the passengers are allowed to board.

M: Do you sometimes go on a flight without the crew knowing that you are there?

T: Well ... actually, I'm afraid that's confidential. It's the one thing I'm not allowed to tell you.

A: Ha ha. I think we can take that as a yes. OK, now perhaps you could tell us a bit more about the next stages in the inspection.

T: Well, as the passengers come on board, I make sure that the cabin crew show them to ...

Grammar

have to/need to

1 Look at the Language Box. How many examples of *have to*, *need to* and *be allowed to* can you find in the tapescript? Circle them.

2 Complete the following sentences with the correct form of *have to*, *need to* or *be + allowed to*.

a There are dozens of pieces of equipment that the inspector _____ check.

b Passengers _____ smoke on board.

c In case of emergency, crew members _____ give instructions to passengers.

d If an aircraft does not pass a safety inspection, it will _____ fly.

e The inspector _____ tell people all the details of his work.

f If there is smoke in the cabin, passengers will _____ use breathing equipment.

g The crew also _____ have safe seats and seat belts.

h All civil aircraft _____ carry a suitable first aid box.

Language Box

have to/need to/be allowed to

When people talk about regulations and responsibilities in English, they [illegible] the expressions *need to*, *have to* and *be allowed to*.

Examples:

Passengers [illegible] the aircraft [illegible].

The inspector [illegible] checks.

Most of the safety inspection [illegible] done while the cabin is empty.

Speaking

With a partner, describe as much as you can remember of the inspector's duties, using *have to/need to* and the verbs *check* and *make sure that*.

Example:

He has to check the seat belts.
He needs to make sure that the breathing equipment works properly.

11. Roles on the assembly line

Speaking and reading

1 Look at the jobs below quickly and find out what duties and skills each one requires.

VACANCIES

a

Position: **Aircraft Technician**
–2-year renewable contract
Location: Oman
Salary: from £21,500
Important: Must have structural/sheet metal background
Job specification:
We are looking for an aircraft technician to work on predominantly Hawk aircraft in Masirah. Oman.The successful candidate will need to have experience of all aspects of aircraft structures. You will be required to complete modifications on the aircraft and fabricate parts, etc., working from drawings and manuals. You must have riveting experience. Previous experience on Hawk is not essential. Candidates with commercial experience will be considered for this position.

£17,033 basic + £4,000 overseas allowance + £500 location bonus ALL TAX FREE. Medical and dental cover, free accommodation in the Sergeants' mess.

b

Position: **Mechanical Design Draughtsman**
Location: Lancashire, UK
Rate: £23.75/hour
Duration: 6 months
Job specification:
To produce manufacturing and design data to enable manufacture and assembly of clients' products.
Experience:
Some or all of the following:
Sheet metal weatherproof and non-weatherproof enclosures, including the use of inserts. Structural steel detail design; awareness of prevention of galvanic corrosion.
Complex CNC-machined components. A thorough understanding of the need to record modifications to drawings and documents.
Desirable:
HNC in mechanical engineering, competent EUCLID & AUTOCAD user.

c

Wanted: **Stress Engineers**
– permanent
Location: Kuwait
Salary: £20,000 to £40,000
Job specification:
Important: Degree with a minimum of 1 year's industry experience of stress engineering.
Some excellent opportunities exist for stress engineers, requirements vary from novice engineers to experienced stress engineers to work with a prestigious company based in Kuwait. These opportunities offer an exciting and dynamic work environment. The main tasks will be to perform stress analysis in the form of finite element (FE) or fatigue and damage tolerance and ideally you will have previous experience of working on airframe platforms. You will be required to work closely with the customer and so must be a good team player & able to work in a pressurised environment with minimal assistance. You will be required to deliver to time, cost and quality. You must be PC-literate and be able to use Mathcad and Microsoft Office (Word, Excel).

d

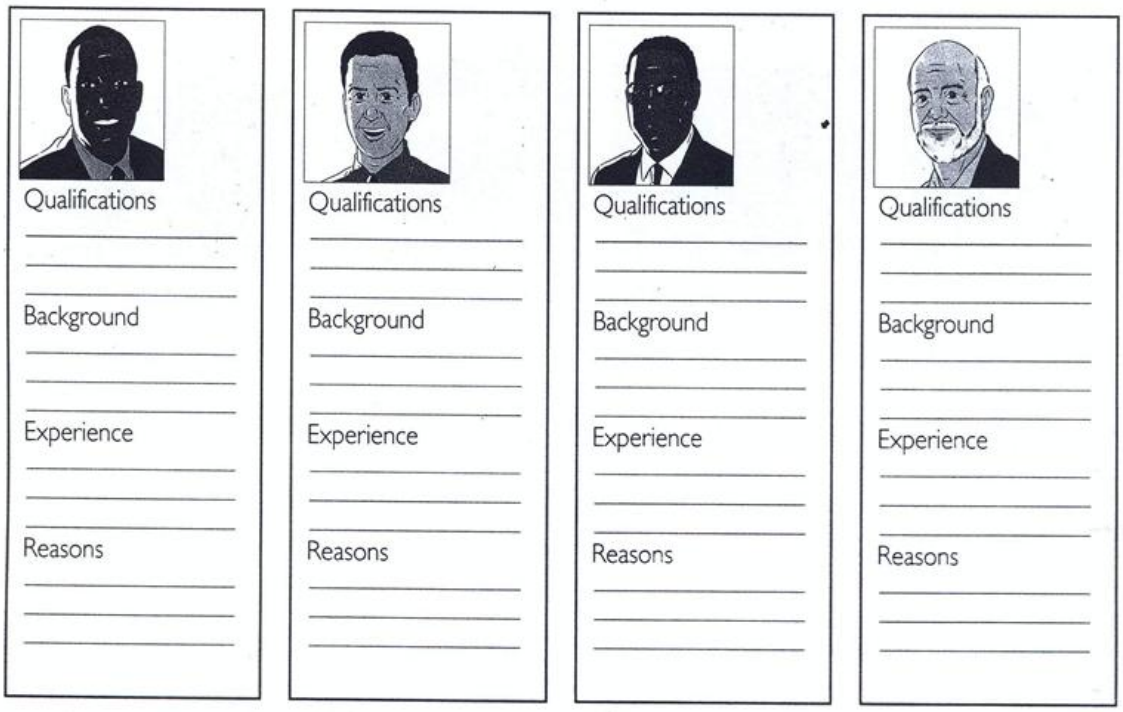
Position: **Systems Engineer, Navigation**
– permanent
Salary: £35,000 to £42,000
Important: Algorithm and mathematical bias
Location: South Wales
Job specification:
You will be working on a jet trainer project. Aircraft is single-engine, smaller than a Hawk. The candidate will be the single point of contact for any system queries on this project. Project is at test stage, although candidates will need to have some requirements experience as the product will be handed over to customer for review and changes are likely. Candidates will be reviewing flight tests, steering tests, systems test and mission systems. Candidates must be able to liaise with other departments and the customer. A mathematical, navigation, steering and weapons-aiming background would be useful. Candidates will have plenty of opportunity to progress.

2 Read the advertisements more closely. Which job would you prefer? What would be the disadvantages of that job for you?

3 Discuss your choice in pairs.

Listening

These four people are looking for a job in the aircraft industry.



a b c d

1 Listen and choose a suitable job for each person.

2 Listen again and take notes for each candidate in the space under his picture.

3 Compare notes with a partner.

Speaking

Work with a new partner. You are going to interview him for one of the jobs, *a* to *d*.

a Find out which job he would like to apply for.

b Prepare ten questions to ask him.

c Interview your partner.

Skills Box

Listening to a talk

Notes

When you are taking notes from a talk, remember: don't try to write down everything; use abbreviations and numbers.

Accents

In your work, you will often listen to people from all over the world speaking English. It is important that you get used to this and make sure your own accent is easy to understand.

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.

Unit 3, Lesson 9, Track 12

A: I left university eighteen months ago with a degree in maths and physics and an MSc in metallurgy. Since then, I've been working for a testing laboratory in London. It's quite a small firm so we all have to deal directly with customers face to face, especially if we have an urgent job on ... which is quite often! We've recently had quite a few jobs for one of the big aerospace companies, mainly on stress fractures as well as routine structural loading tests. That's how I became interested specifically in the aircraft industry. I know I'll have to start at the bottom and work my way up. That's no problem. And I'm not married yet, so I don't really mind where I work.

B: I've lived in the UK all my life. All my family's here. I'd never want to move away. I originally wanted to go to art school. I was always drawing and painting as a kid. I still do in my spare time. Thing is, there's no money in it ... so anyway, I took my Dad's advice and got an engineering degree. Luckily, I was good at maths and science, too! My job combines both, art and engineering. Mind you, I'm having to use computer aided design more and more these days. I don't stay long with any one company. I prefer short term contracts ... I think the longest I've done is eight months. I work away, sometimes. You know ... find a comfy bed and breakfast for Monday to Friday and then head back home at the weekends.

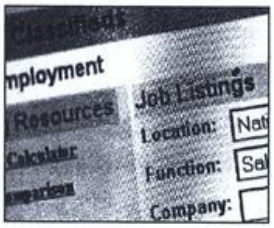
C: I was in the ajrforce for 20 years after I finished my apprenticeship ... had a wonderful time and went all over the place ... Germany ... Cyprus ... Malta. I worked on helicopters and Hercules transports mainly, skin fabrication mainly. That's my speciality, I suppose you could say. Since I came out of the air force, I've been working locally as a machinist, but to tell the truth, I'm getting a bit bored. It's the same thing day in, day out and really I'm a sheet metal basher at heart. I'd like to go somewhere sunny for a few years, preferably the Middle East, and try something new. I'd be able to save a bit more towards my pension too!

D: Mathematics is my chosen field. I've always loved it. I did a degree in maths and physics and then an MSc in avionics and control systems. I've been working on a Doctorate and teaching at the University at the same time, I've also done quite a few short contract jobs for the air force. I'm looking for something long term, a proper career in the systems and navigation field. I'd really like to work on a project from the early stages right through to completion. My family is from Italy originally. They came to South Wales to work in the coal mines during the last century. But I love it here – such a beautiful place – I would never move away.

12. Speaking clearly

Working in aircraft production or maintenance invariably involves working with people of different nationalities, roles, skills, experience and standards of education. Consequently, it is extremely important to try to communicate properly. A company with effective systems of communication is a safer, more efficient and happier place to work.





Vocabulary

1 Look at the words below and decide what parts of speech they are: noun (*n*), verb (*v*) or both (*b*).

a log ___ **c** intercom ___ **e** leaflet ___ **g** instructions ___

b terminology ___ **d** repeat ___ **f** order ___ **h** shout ___

2 Now write the words in the correct place in the table.

connected with written communication	connected with spoken communication	connected with written and spoken communication

Reading and speaking

1 Divide into five groups, *a* to *e*, and read the corresponding paragraph carefully.

2 Prepare a short talk about your aspect of communication, including the information in the text and any other information you want to add.

3 Form groups of five with one student from each group, *a* to *e*. Give your talk. Your colleagues will listen, take notes and ask questions at the end. These notes will be important later.

a In work situations, you should always try to use the correct terminology. Unless you use the special words that are related to the job, you may well cause confusion. If someone uses terminology that you don't understand, you should always ask them to explain what they mean. It is very important that you should never be afraid to tell someone you don't understand. A few minutes which you spend getting something clear in your mind can save many hours of work in the long run.

b Sometimes, you may have to give orders or instructions. These should be as short and simple as possible. Sometimes, it is a good idea to check that you have been understood by asking for your orders to be repeated. If you are given an order, it is often a good idea to repeat it so that the person who gave it can spot any mistakes. It is also vitally important not to pretend to understand what you are supposed to do just to save face. If you are not sure, ask for clarification. When unusual or emergency situations arise, clear communication is especially important: all relevant information must be reported to the supervisor and other employees so that they can act quickly and correctly.

c You should be especially careful when using the telephone, intercom or radio. It is usually a good idea to repeat information, whether you are giving it or receiving it, and to make a written note of it. Many people shout on the phone because they think others will hear them better. Try not to do this: shouting causes distortion. Care must be taken with mobile technology, however, that it does not interfere with machinery.

d The log is an important link in the chain of communication. It is a way of passing information from one shift to the next to ensure safety and smooth operations. If you have to complete a log, you should make clear and accurate entries and be sure to write down anything unusual that has happened. When changing shifts, it is a good idea to have a short talk with your relief. He should be able to read the log and ask questions before you go, to help him to understand any problems that may arise.

e One way that manufacturers are improving communication in the workplace is by dividing the workforce into maintenance or production cells. At one factory where the Eurofighter Typhoon is produced, this concept of *cellular manufacturing* has been introduced in order to give quality the highest priority. Each cell is almost completely self-managed and is responsible and accountable for its own performance. Initial communication about technical and personnel problems takes place within the team, which usually means that difficulties can be overcome more quickly. The aim is to create a feeling of responsibility and pride in the cell's product.

Writing

Prepare a 'Good Communications' information leaflet or notice for the manufacturing workplace, using your notes but without using the text for help.

13. Know-how


Speaking

Avionics (aviation electronics) systems are now an important and integral part of the design, repair and maintenance of aircraft navigation, communications, radar, instruments and computers that control flight manoeuvres, engine performance and environmental systems.

What specific areas do you think a modern avionics technician needs to know about? For example, specialist tools, using the manual correctly.

Reading I

1 Look quickly. Are your ideas from Speaking above mentioned in *a*–*e*?

a Practical applications of engineering science and technology, including materials, principles, techniques, procedures and equipment for the design and production of avionics equipment and systems.

b Schematic, layout, electromechanical drawings of avionics components and systems.

c The application of arithmetic, algebra, geometry, calculus and statistics to electronic and electrical equipment.

d Circuit boards and electronic equipment.

e Hardware and software, including applications and programming, processors and chips.

2 Match each of the five sentences with one of these three headings.

i Computers and Electronics **ii** Mathematics **iii** Engineering and Technology

Vocabulary

1 Look at the verb and noun combinations in column 1. Choose another noun from column 2 that can also go with each verb.

a	interpret drawings	a schedule	_____
b	coordinate work	faults	_____

c	install wiring	equipment	_____
d	set up support systems	malfunctions	_____
e	fine-tune an engine	assemblies	_____
f	carry out an inspection	data	_____
g	adjust equipment	problems	_____
h	diagnose faults	tests	_____

2 Add one more noun in column 3 which could go with each verb.

Reading II

1 Find and underline the verb-noun combinations from Vocabulary Exercise 1 in the following list of activities of the avionics technician.

The avionics technician needs to be able to:

- set up and operate ground support and test equipment to carry out functional flight tests of electrical and electronic systems.
- calibrate, regulate and fine-tune avionics equipment for optimum performance.
- interpret flight test data in order to diagnose malfunctions and systemic performance problems.
- test and troubleshoot instruments, components and assemblies, using circuit testers, oscilloscopes and voltmeters.
- interpret and refer to technical drawings.
- adjust, repair or replace malfunctioning components or assemblies.
- keep clear records of maintenance and repair work.
- coordinate work with that of engineers, technicians and other aircraft maintenance personnel.
- install electrical and electronic components, assemblies and systems in aircraft.
- connect components to assemblies such as radio systems, instruments, magnetos, inverters and in-flight refuelling systems.
- assemble components such as circuit boards, switches, electrical controls and junction boxes.
- fabricate parts and test aids as required.

2 Talk about activities which the avionics technician has to do. Which activities do you think are the most a) challenging and b) interesting? Use the verbs and nouns from the Vocabulary exercise.

14. Applying for a job – a CV and a covering letter

1 What is a CV? What is the aim of one? Have you ever written one? What information did/would you include?

2 What is the purpose of a covering letter?

3 Write the headings from **A** in the correct spaces in the CV in **B**.

A

Profile	Additional information
Education	Name
References	Work experience
Personal details	Interests

4 Answer the questions.

1 Where did Kate go to school?
2 What did she study at university?
3 Who is Prof Jane Curtis?
4 Does she have a lot of work experience?

5 How is a CV different in your country?

B

Name Kate Henderson

DOB 17/04/83

Address 31 Rendlesham Way
Watford
Herts
WD3 5GT

Phone 01923 984663

Mobile 07764 733689

Email katehenderson@hotshot.com

A highly-motivated, well-travelled, and enthusiastic graduate, with practical experience of working with children of all ages.

Watford Grammar School
8 GCSEs
3 A-levels

Bristol University
BA (Hons) Psychology and Education

June 2000
Life guard and supervisor at KLC Leisure Centre

July 2001
Athletics coach at training centre

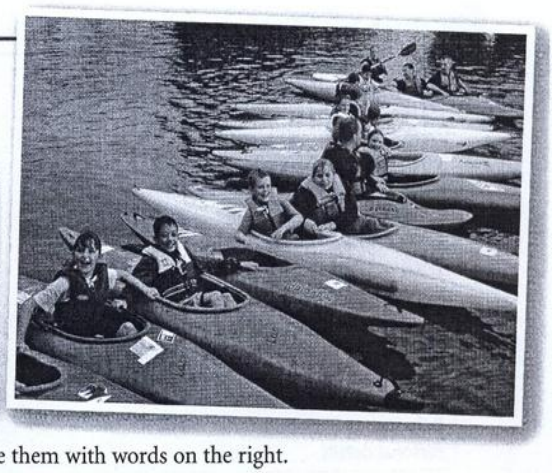
June 2003
Teaching assistant at secondary school

Dance, athletics, volleyball, travel, cinema

One of my main interests is dance, which I have done since I was three, passing many exams, and performing in annual dance festivals. I have organized sports events and training sessions for dance, athletics, and trampoline. I have travelled widely throughout the world, in Europe, the Far East, and the USA.

Prof Jane Curtis
Dept of Education
Bristol University
BS5 7LA

Mike Benson
Head Teacher
Bailey School
Watford, Herts
WD3 8JG



6 This is the job that Kate is applying for. Is she well qualified for it?

ACTIVITY HOLIDAY ORGANIZER IN THE CANARY ISLANDS

Are you …
- aged between 18–30?
- energetic?
- good at organizing people?

Do you …
- like kids?
- like sport?

Then come and join us as a leader for an Easter holiday of fun, looking after groups of kids at sports camp!

Send your CV to Mark Sullivan at 106 Piccadilly, Bristol BS8 7TQ

7 Read Kate's covering letter. Which parts sound too informal? Replace them with words on the right.

31 Rendlesham Way
Watford
Herts
WD3 5GT

01923 984663

Mark Sullivan
106 Piccadilly
Bristol
BS8 7TQ

17 March 2004

Dear Mark

I am applying for the post of camp leader, which I saw advertised somewhere recently. Here's my CV.

I reckon I have just about everything needed for this job. I have worked loads with kids, doing all kinds of stuff. They generally do what I tell them, and we manage to have a great time together. Having studied psychology and education at university, I know quite a bit about the behaviour of kids.

I am really into sport, and have lots of experience of organizing training events. I am a very practical person, easy-going, and it's no problem for me to make friends. I've been all over the place, and enjoy meeting new people.

I can't wait to hear from you.

Best wishes

Kate Henderson

Kate Henderson

extensively with young adults
respect my leadership abilities
I find it easy
very interested in
have a certain understanding of
Please find enclosed
look forward to hearing
considerable
many of the relevant
qualifications
have travelled widely
Mr Sullivan
Yours sincerely
in the March edition of the magazine *Holiday Jobs for Graduates*
feel
organizing a variety of activities
establish a good working relationship

Is this how a formal letter is laid out in your country? What are the differences?

8 Write your CV and a covering letter for a job that you would really like to do and are well qualified for.

15. Airframe design features

An aircraft is a very complex machine and every component has a specific purpose. Whatever the purpose of the aircraft (commercial or military), it must be strong enough and stiff enough and able to sustain a long life in service. It must also be constructed so that if any part fails, as some are bound to do, the failure does not cause the loss of the aircraft, and possibly many lives.

Airframe components in most aircraft are:
* the mainplane or wing
* the fuselage or body
* the tail unit
* mountings for all other systems

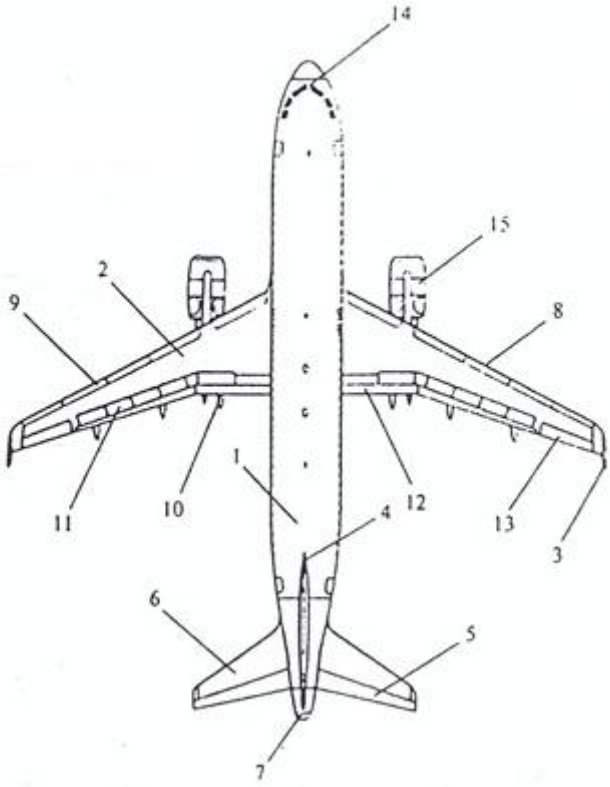
The WING must generate lift from the airflow over it to support the aircraft in flight. It must be stiff and strong to resist high lift forces, and the drag forces associated with them. Also, in most large aircraft, the wing carries all or most of the fuel, and supports the main undercarriage. In military aircraft it often carries a substantial part of weapon loads.

The FUSELAGE forms the body of the aircraft, housing the crew, passengers or cargo, and many of the aircraft systems. It is the main structural link between the wing and tail or foreplanes, often blended into the wing to reduce drag. Since it must endure considerable loads, pressures and forces, it must be strong and stiff to maintain its integrity throughout the required life of the aircraft.

The TAIL UNIT usually consists of a vertical fin with a movable rudder and a horizontal tailpalne with movable elevators. In some military aircraft, and even some sport and executive aircraft the horizontal tail surface is replaced by moving control surfaces at the nose of the aircraft, called foreplanes. This layout is known as the canard layout. These surfaces provide stability and control in pitch and yaw. Motion of an aircraft is defined about three axes, passing through the centre of gravity. Turning about each axis is controlled by a separate set of controls - elevators for pitch control, ailerons for roll and rudder for yaw. When air flows over aerodynamic surfaces its pressure will change with speed and produce large forces of lift and drag. LIFT is defined as a force at right angles to the direction of flight; and DRAG is acting along the direction of flight. To get the best possible performance and best fuel economy an aircraft must be shaped to minimise drag. Most of the loads that generate the stresses on the airframe structure result from the effects of aerodynamic pressures on the airframe external surfaces. The most successful aircraft are those whose design enables the best compromises to achieve maximum potentials. The aircraft must also be able to resist considerable inertia forces resulting from manoeuvres, which increase its static weight several times.

Finally, an aircraft has to cope with the thrust generated by its engine(s) which loads are transmitted through the engine mounts into the surrounding structure. The designers must have a thorough understanding of the loads on an aircraft structure and balance the diverse requirements of the operators, the airworthiness authorities and manufacturers - so that the aircraft is safe, economical and effective to operate and maintain.

1. Label each aircraft part and translate into Croatian:



___ vertical stabilizer / fin
___ speed brakes / spoilers
___ wing tip
___ rudder
___ elevator
___ trailing edge
___ fuselage
___ aileron
___ leading edge
___ wing
___ flaps
___ horizontal stabilizer
___ slats
___ cockpit
___ engine

2. Paraphrase the following words and fill in the gaps:
bound to do something - _____
substantial - _____
blend - _____
thorough - _____
diverse - _____

Aircraft design must fulfil _____ requirements.
Some parts _____ to fail, although they are carefully constructed.
Wings can carry a _____ amount of weapon.
The mechanics completed a _____ examination of the aircraft.

3. TECNICAL VOCABULARY - Match the words with their meanings:

MAINPLANE	plovidbenost
FUSELAGE	krilo
UNDERCARRIAGE	postolje, uporište, nosač
LOAD	os / osi
AXIS / AXES	sila
MOUNTING	trup
AIRWORTHINESS	stajni trap

16. The single-engine aircraft

Typically, an airplane is made up of five major parts. Its central component is the _____ to which the power plant, _____, _____ and landing _____ are attached.

The _____ serves several functions. Besides being a common attachment point for the other major components, it houses the cabin, or cockpit, which contains seats for the occupants and the controls for the airplane. The fuselage usually has a small baggage compartment and may include additional seats for, passengers.

The _____ are attached at the top, middle or lower portion of the fuselage. These designs are referred to as high-, mid-, and low-wing, respectively. The number of wings can also vary. Airplanes with a single set of wings are referred to as monoplanes, while those with two sets are called biplanes.

The wings have two types of control surfaces attached to the rear, or trailing edges. They are referred to as _____ and _____. Ailerons extend from about the midpoint of each wing outward to the tip. Flaps extend from the fuselage outward to the midpoint of each wing.

The _____ consists of the _____ _____ or fin, and the _____. These two surfaces are stationary and they are used to steady the airplane and help the pilot to maintain a straight path through the air. Besides the two fixed components, the empennage has two movable surfaces called the _____ and the _____.

The ruder is attached to the back of the vertical stabilizer while the elevator is attached to the back of the horizontal stabilizer.

Most airplanes have a small, hinged section at the back of the elevator called trim tab. Its purpose is to relieve the pressure the pilot must hold on the control wheel to keep the nose in the desired position.

The landing gear absorbs landing loads and supports the airplane on the ground. It typically consists of three wheels on shock struts. The two main wheels are located in either side of the fuselage. The third may be positioned either at the nose (tricycle landing gear) or at the tail (conventional landing gear). Airplanes with a tricycle landing gear have steerable nosewheel.

The landing gear can be fixed or retractable. The brakes are usually located on the main wheels and are applied by separate pedals. This capability is referred to as differential braking.

In small airplanes, the power plant includes both the engine and the propeller. The primary function of the engine is to provide the power to turn the propeller. It also generates electrical power, provides a vacuum source for some flight instruments, and, in most single-engine airplanes, provides a source of heat for the pilot and passengers. A firewall is located between the engine compartment and the cockpit to protect the occupants. The engine compartment is enclosed by a cowling, which is also called a nacelle.

1. TECHNICAL VOCABULARY

a) **canard layout** – a horizontal aerofoil is mounted on nose or forward fuselage to improve take-off and landing

b) **fin / vertical stabilizer** – a fixed surface which provides directional stability

c) **rudder** – a control surface designed to produce yawing movement

d) **elevator** – a control surface for controlling aircraft in pitch

e) **aileron** - movable portion of trailing edge of aerofoil, especially wing

f) **tailplane / horizontal stabilizer** - a small horizontal wing at the tail of an aircraft to provide longitudinal stability

2. What does an aircraft do in:
ROLL – raises one wing tip and drops the other
PITCH – _____
YAW – _____

3. Which four forces act upon an aircraft in flight?
How are they produced?

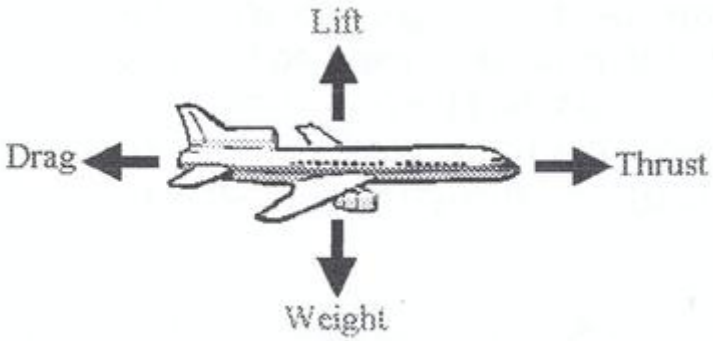
4. Complete the sentences:
a) Airframe components are: _____
b) The wing generates lift from the airflow over it, carries fuel or weapons, _____
_____
c) The fuselage houses the crew, passengers, _____
d) The tail usually consists of a vertical fin with a movable rudder and a horizontal _____
_____
e) The four forces which act upon an aircraft in flight are _____
f) LIFT _____. THRUST is generated by _____.
DRAG acts in the opposite direction to _____. Gravity is a force which pulls all objects to the _____.

5. Fill in the gaps:
In some aircraft the horizontal tail surface is replaced by surfaces at the nose of the aircraft, called _____. This layout, called _____ layout, stabilizes the plane in _____ and yaw. An aircraft moves about _____. Turning about each axis is controlled by a separate set of _____: elevator for _____ control, _____ for roll and rudder for _____.

6. Write the synonyms for
wing – _____
empennage – _____
undercarriage – _____
vertical stabilizer – _____
horizontal stabilizer – _____
speed brakes – _____

7. Put the following words in two columns: AILERONS, RUDDER, ELEVATORS, FLAPS, SLATS, UNDERCARRIAGE

DEFLECTED	**EXTENDED / RETRACTED**



A force may be thought of as a push or pull in a specific direction. A force is a vector quantity so a force has both a magnitude and a direction. When describing forces, we have to specify both the magnitude and the direction. This picture shows the forces that act on an airplane in flight.

Weight (gravity)

Weight is a force that is always directed toward the centre of the earth. The magnitude of the weight depends on the mass of all the airplane parts, plus the amount of fuel, plus any payload on board (people, baggage, freight, etc.). The weight is distributed throughout the airplane. But we can often think of it as collected and acting through a single point called the centre of gravity. In flight, the airplane rotates about the centre of gravity.

Flying encompasses two major problems; overcoming the weight of an object by some opposing force, and controlling the object in flight. Both of these problems are related to the object's weight and the location of the centre of gravity. During a flight, an airplane's weight constantly changes as the aircraft consumes fuel. The distribution of the weight and the centre of gravity also changes. So the pilot must constantly adjust the controls to keep the airplane balanced, or trimmed.

Lift

To overcome the weight force, airplanes generate an opposing force called lift. Lift is generated by the motion of the airplane through the air and is an aerodynamic force. "Aero" stands for the air, and "dynamic" denotes motion. Lift is directed perpendicular to the flight direction. The magnitude of the lift depends on several factors including the shape, size, and velocity of the aircraft. As with weight, each part of the aircraft contributes to the aircraft lift force. Most of the lift is generated by the wings. Aircraft lift acts through a single point called the centre of pressure. The centre of pressure is defined just like the centre of gravity, but using the pressure distribution around the body instead of the weight distribution.

The distribution of lift around the aircraft is important for solving the control problem. Aerodynamic surfaces are used to control the aircraft in roll, pitch, and yaw.

Drag

As the airplane moves through the air, there is another aerodynamic force present. The air resists the motion of the aircraft and the resistance force is called drag. Drag is directed along and opposed to the flight direction. Like lift, there are many factors that affect the magnitude of the drag force including the shape of the aircraft, the "stickiness" of the air, and the velocity of the aircraft. Like lift, we collect all of the individual components' drags and combine them into a single aircraft drag magnitude. And like lift, drag acts through the aircraft centre of pressure.

Thrust

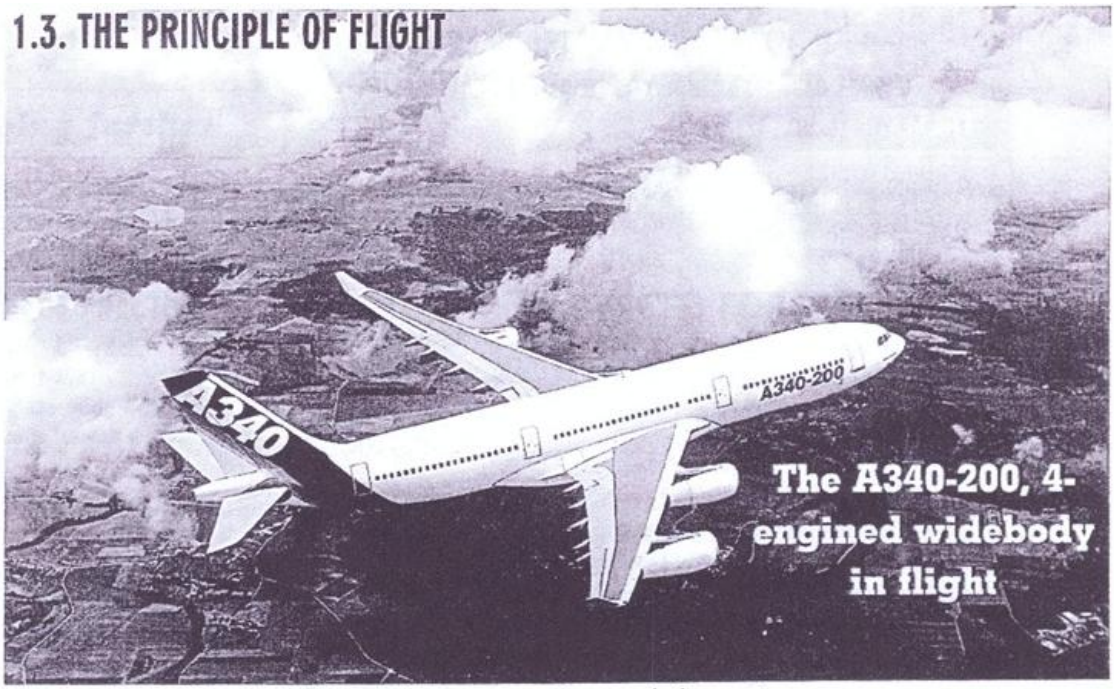
To overcome drag, airplanes use a propulsion system to generate a force called thrust. The direction of the thrust force depends on how the engines are attached to the aircraft. In the figure shown above, two turbine engines are located under the wings, parallel to the body, with thrust acting along the body centreline. On some aircraft, such as the Harrier, the thrust direction can be varied to help the airplane take off in a very short distance. The magnitude of the thrust depends on many factors associated with the propulsion system including the type of engine, the number of engines, and the throttle setting.

For jet engines, it is often confusing to remember that aircraft thrust is a reaction to the hot gas rushing out of the nozzle. The hot gas goes out the back, but the thrust pushes towards the front. Action <--> reaction is explained by Newton's Third Law of Motion.

The motion of the airplane through the air depends on the relative strength and direction of the forces shown above. If the forces are balanced, the aircraft cruises at constant velocity. If the forces are unbalanced, the aircraft accelerates in the direction of the largest force.

17. The principle of flight

1.3. THE PRINCIPLE OF FLIGHT



The A-340-200 in flight. ©Airbus Industrie. Reproduced by permission.

What makes flight possible? The physics involves what is known as lift, thrust, drag and weight. The aircraft's wings provide the necessary lift. Air passes over and under the wings. Passing over the top surface of the wing, air must travel a greater distance and speeds up. The increase in speed creates an area of low pressure over the wings and over the aircraft in general, while a zone of higher pressure is created under the wings. It is the low pressure area which pulls the aircraft upward.

Drag is caused by friction as air passes over and around the aircraft structure.

Thrust is provided by the engines and propels the aircraft forward.

1.3.1. Practice

Fill in the following information about flight using the language contained in the above passage. See the grammatical pattern on the right.

1. What ..... possible?
2. Flight ..... by four factors called
   - A. .....
   - B. .....
   - C. .....
   - D. .....
3. It is ..... which causes lift.
4. It is ..... which causes drag.
5. Thrust .....by the aircraft's engines and is the force which ....

WHAT MAKES IT HAPPEN?

What is responsible for ... ?
What causes ... ?
What makes .... possible?

1.3.2.

READ AND RESTATE

THE PRINCIPLES OF FLIGHT: BALANCED FORCES

Going further

The description on the right provides a simplified description of the forces involved in flight. Practice rephrasing the ideas using the language shown on the left.

LANGUAGE PRACTICE

is equated with
Stated differently this means...
Pressure is lowest where...

flow over the upper wing surface
push up over
pass under the wing
air flowing beneath the wing
flowing under the wing

EXPLAIN:

1) how a low-pressure area is created above the wing
2) how pressure is higher below the wing

COMPLETE:

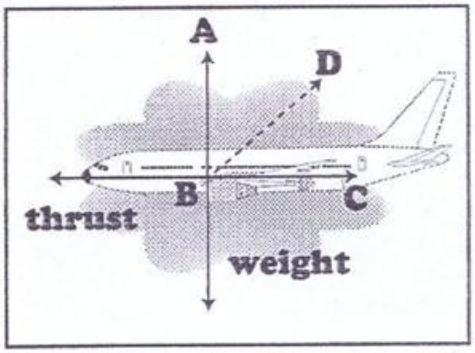
Opposing the forward thrust...
The thrust is offset by...
The forward thrust provided by the engines must...

See also: Cause and Effect: page 26.

BALANCED FORCES

High velocity means low pressure. This is equivalent to saying that pressure is least where velocity is highest, and that pressure will be greater where velocity is lower. This is the Bernoulli law.

When an aircraft is in flight at constant velocity, air streaming over the top of the wing must travel farther and faster than the air flowing along the underside of the wing. The air velocity above the wing surface is greater than that below it, resulting in an area of lower pressure.



In the figure above, the difference between the above-wing pressure and the below-wing pressure results in the force BD.

AB is the lift, equal to the weight of the aircraft and thus supports it. Vector BC is the component called ***induced drag*** which opposes the forward motion of the aircraft. ***Profile drag*** is related to surface characteristics (see page 12).

Engines must provide forward thrust equal to the drag for horizontal displacement to occur at constant speed. The aircraft moves even though all forces acting upon it are balanced, but at constant velocity.

Frictional drag results from resistance offered to airflow by the fuselage and other structures. One of the overriding concerns for aerodynamic engineers is how to reduce drag.

Training Exercises!

1.3.3. GET INTO TRAINING.

PRACTICE USING THE GRAMMATICAL PATTERN

DRAG IS LEAST/GREATEST

Pressure is (the) lowest where velocity is (the) highest.

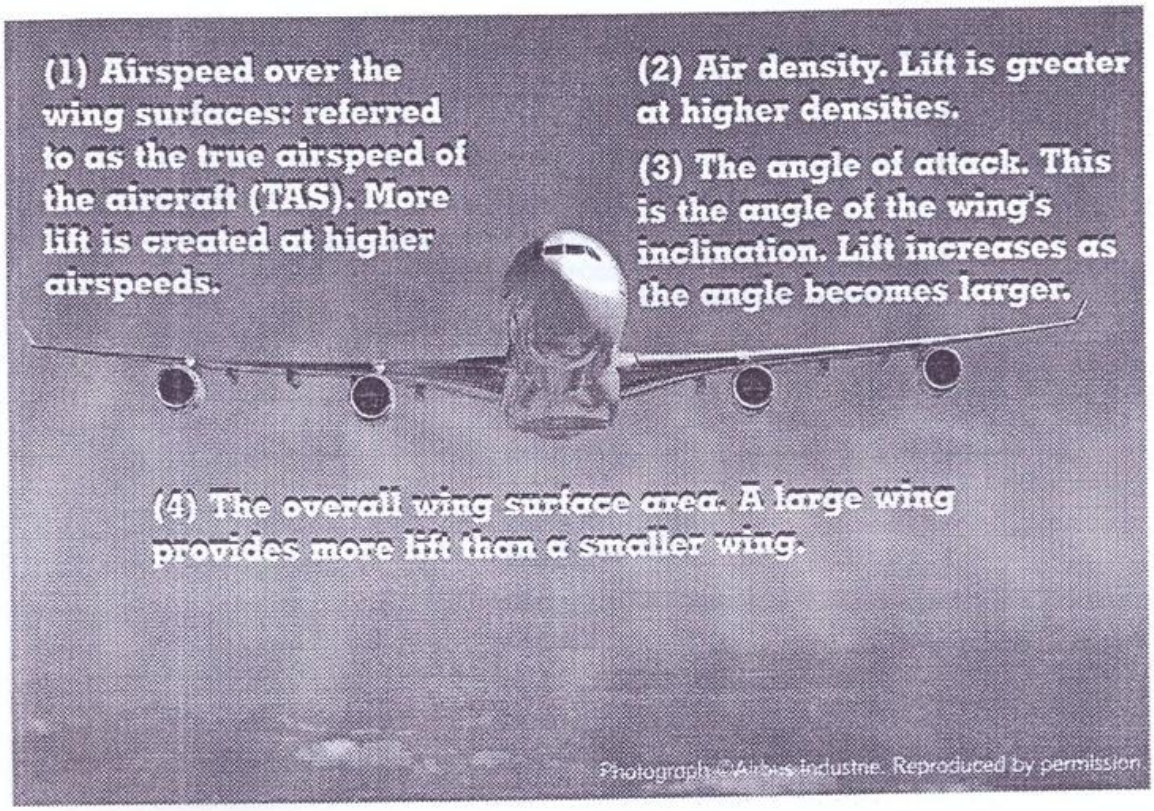
REPHRASE THE FOLLOWING IDEAS USING THE PATTERNS ON THE LEFT.

1. Pressure increases steadily with decreasing velocity.
2. Maximum thrust results in maximum drag.
3. Drag decreases as altitude increases.

1.3.4. FACTORS GOVERNING LIFT

Going further

FURTHER CONSIDERATIONS



Training Exercises!

1.3.5. STATED DIFFERENTLY

PRACTICE THE PATTERN SHOWN IN THE MODEL IN MAKING STATEMENTS ABOUT THE 5 IDEAS WHICH FOLLOW.

Note this model:

The greater the airspeed the greater the lift.

1. air density / lift
2. angle of attack / lift
3. wing surface area / lift
4. drag at higher densities
5. drag and higher engine thrust

1.3.6. READ, UNDERSTAND AND ANSWER

The angle of attack depends on the pitch of the aircraft, whether the nose is raised (nose up) or lowered (nose down). This is also referred to as the aircraft's attitude.

1. How can the angle of attack be changed to increase lift?
2. How can the aircraft's attitude be changed?

1.3.7. STATED DIFFERENTLY

READ AND RESTATE THE IDEAS.

Streamlining: a way to reduce drag

Long thin objects slip through the air (and a liquid) more easily than wide ones.

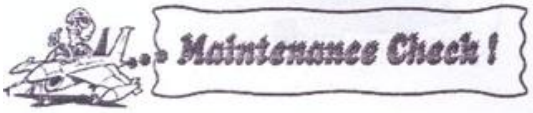
An object so shaped that it slips through air or liquid easily is said to be streamlined. Maximum drag reduction occurs when an object is rounded in front, tapering in the rear (like the shape of a fish). For more information, see AERODYNAMICS on pages 12 and 13.

■ USE THESE VERBS:

- ❍ MOVE THROUGH
- ❍ PASS THROUGH
- ❍ FLOW AROUND
- ❍ GLIDE THROUGH
- ❍ SLIP THROUGH
- ❍ OFFER RESISTANCE TO

■ IN TALKING ABOUT AIR FLOW AROUND THESE:

rounded objects
thick blunt objects
thin elongated objects
flat objects
rough-edged objects
smooth-surfaced objects
spherical objects

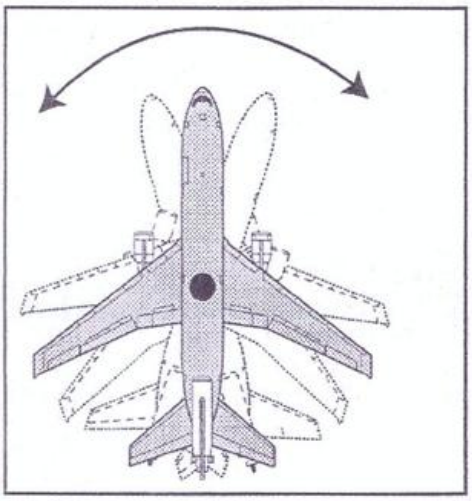


1.3.8. CHECK YOUR MEMORY!

CAN YOU USE ALL THESE WORDS IN A SIMPLE SENTENCE?

❍ nose landing gear	❍ main landing gear	❍ fuselage	❍ radome	❍ wing
❍ leading edge	❍ trailing edge	❍ wing root	❍ fairing	❍ pylon
❍ engine pod/nacelle	❍ evacuation exit	❍ windshield	❍ static discharger	❍ port
❍ starboard	❍ flap	❍ aileron	❍ flap track	❍ vertical
❍ stabilizer	❍ horizontal stabilizer	❍ tailplane	❍ trimming	❍ fin
❍ fin root	❍ rudder	❍ tailcone	❍ elevator	❍ de-icer
❍ fuel tank	❍ APU	❍ lift	❍ thrust	❍ drag
❍ weight	❍ airflow	❍ pressure	❍ velocity	❍ speed
❍ underside	❍ component	❍ TAS	❍ angle of attack	❍ pitch
❍ attitude	❍ streamlining	❍ shape		

1.4. STABILITY

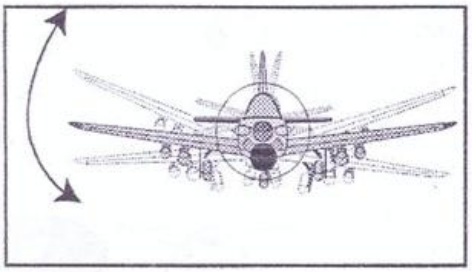


An aircraft is trimmed to ensure stability. During take-off and landing, trimming is a constant process, while in cruise it is usually performed automatically by computers. The horizontal stabilizer may be computer-controlled, with the appropriate setting determined by the computer in light of flight parameters.

Three important principles are involved in natural flight stability, all involving motion with respect to the aircraft's center of pressure (shown by a black dot in the drawings). These are:

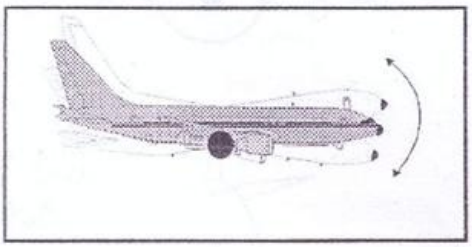
YAWING

The tail fin is positioned to cause the aircraft to move about its vertical axis to correct the effects of wind which can yaw the aircraft to the left or right.



ROLLING

Wind may roll the aircraft, causing it to slip to the side. When the aircraft sideslips, airflow hits the under surface of the lower wing, exerting an upward force. Due to the dihedral principle (the wing is mounted at an angle, for instance, 7°, to the horizontal), the wing on the opposite side of the aircraft body, tilted upward, is spared this sideways airflow, bringing the aircraft back to level position.



PITCHING

Wind may pitch the nose of the aircraft up, thereby causing a simultaneous increase in the angle of attack of both wings and tailplane (horizontal stabilizer). Because it is far from the center of pressure, the accompanying increase in lift raises the tail, returning the aircraft to stable horizontal position.

CHECK THAT YOU KNOW THESE VERBS

All but two (SET/EXERT) describe movements

set	The computers are set to control stability in light of flight parameters.
trim	The pilot needs to trim the aircraft continuously during take-off.
sideslip	A gust of wind can cause the aircraft to sideslip (slip to the side).
roll	The aircraft rolls when one wing moves up and the opposite wing down.
yaw	The aircraft yaws to the left or right around its vertical axis.
pitch	The pilot can pitch the nose up or down. Wind can pitch the nose up or down.
exert	We exert pressure on an object. We exert control over something.
bring back (return) to a position	The pilot performs the proper actions to bring the aircraft back / to return the aircraft to stable conditions.
move	The aircraft moves laterally.
raise	The pilot raises the horizontal elevator to force the tail down.
lower	The pilot lowers the horizontal elevators to force the tail up.

Ailerons are the flight control surfaces used in rolling (and turning) the aircraft. Shown here is the set of inboard and outboard ailerons in up position. Raising these ailerons causes reduced lift over the wing, pushing it down. The aircraft rolls or turns to the right. When the proper bank is reached, the ailerons are returned to their central position, and the aircraft continues to turn. By reversing aileron settings the pilot can return the aircraft to its previous straight horizontal position.

1.4.1. PRACTICE DESCRIPTIONS.

Describing effects

DESCRIBE THE EFFECT PRODUCED WHEN AILERONS ARE POSITIONED AS SHOWN IN EACH DRAWING.

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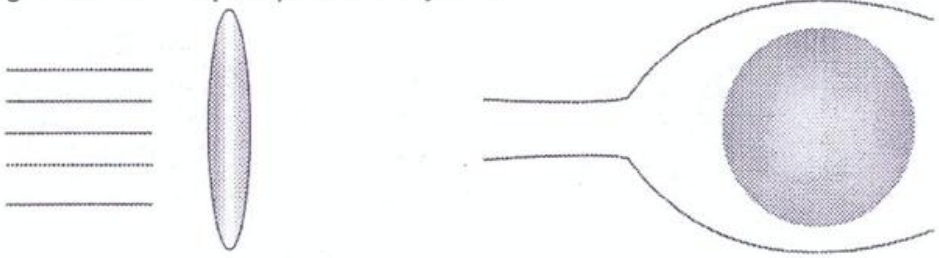
1.5. Aerodynamics

Talking about the basic principles of aerodynamics



Air behavior

The way air behaves as it flows over and around an object does not depend so much on the object's dimensions as it does on its shape. Air offers resistance to a moving object because this object must *occupy* the space that was previously *occupied* by air, thus *displacing* the air. The air is compressed in front of the moving object and flows along the contour of the object to occupy the free space left as the moving object *continues* on its *way*.

The greater the speed, the more compressed the air will be, and the greater the resistance will be. Resistance *thus* depends on velocity. This rule will *apply* whenever air meets a moving body.

1.5.1. Practice: stated differently

Rephrase the ideas, replacing the words in italics in the passage on the left with the expressions below.

force out of the way / hold / move along path / proceed / take up / therefore

1.5.2. Fluency practice

There are usually several ways to say the same thing. Restate the following idea using the expressions which follow and making any necessary changes:

The greater the speed, the more compressed will be the air, and the greater the resistance will be.

a. When the speed increases, ...
b. Compression becomes greater as ....
c. As airflow speeds up, ...
d. Compression increases when ....
e. Resistance ....

Resistance and airspeed

Resistance *thus* depends on airspeed and is proportional to the square of the speed. If speed increases by a factor of two, then resistance increases fourfold. Or stated differently: if an aircraft doubles its speed it will *meet* quadrupled resistance (profile drag). *As opposed to* induced drag which is caused by airflows resulting from lift, profile drag is directly *linked to* the shape and surface characteristics of the object.

This law *is valid* only for speeds lower than that of sound in air (330 meters per second). At supersonic speeds resistance increases more rapidly than the square of the velocity.

1.5.3 Stated differently

Rephrase the ideas replacing the words in italics in the passage on the left with the expressions below.

force out of the way / hold / path / proceed / take up / therefore / encounter / unlike

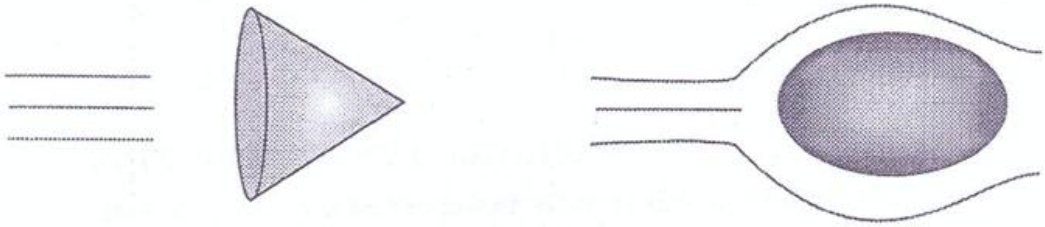
1.5.4. Fluency practice

Now practice restating this idea using the sentence openers which follow:

As opposed to induced drag which is caused by airflows resulting from lift, profile drag is directly linked to the shape and surface characteristics of the object.

a. Profile drag differs from... in that ....
b. The shape and surface characteristics ....
c. Changing an object's shape can result in ....
d. Induced drag is directly linked to .... unlike .... which ....

Aerodynamics



Shape

Resistance encountered by a sphere is half that experienced by the disc. Resistance encountered by the cone is 2/5 that of the disk. And resistance encountered by the egg-shaped object is only 1/20. The latter favors air-flow toward the rear.

Surface

A polished surface favors smooth air flow (laminar flow), whereas a rough surface leads to disrupted flow (turbulent flow).

NOTE THESE DEFINITIONS

LAMINAR FLOW

Laminar flow is non turbulent motion of a fluid (or air) in which parallel layers have different relative velocities.

TURBULENT FLOW

Turbulent flow is motion in a liquid (or air) whose speed at any point varies rapidly in an irregular manner.

1.5.5. DEFINE AND DESCRIBE : CAN YOU DEFINE AND DESCRIBE THE FOLLOWING TERMS?

1. turbulence
2. smooth airflow
3. smooth surface
4. friction (or resistance)

1.5.6. FLUENCY PRACTICE

Rephrase the following idea using the expressions or structural patterns which follow:

A polished surface favors smooth air flow (laminar flow) whereas a rough surface leads to disrupted flow (turbulent flow).

1. Unlike polished surfaces which ...
2. Polished surfaces ... as opposed to ...

Aerodynamics and lift

Aircraft wings are asymmetric in contour, which forces the airstream to follow a longer path along the topside than along the underside. Air must flow faster over the top to encounter air flowing along the underside at the rear edge of the wing. This fact accounts for lift which pulls the aircraft upward.

1.5.7. INTERPRET: COMPLETE EACH STATEMENT

1. Thanks to asymmetry in wing contour ....
2. Without this asymmetry ....
3. The faster airflow over the top surface of the wing results in .... (See preceding sections which deal with lift).

18. Controls

An aircraft in flight rotates about three axes - pitch, roll and yaw. The pitch axis is an imaginary transversal line from wingtip to wingtip. The roll axis is an imaginary longitudinal line extending from the very tip of the nose to the tip of the tail. The yaw axis is another imaginary vertical line through the fuselage. All three axes have the same intersection point - the centre of gravity (c.g.) or the airplane's balance point.

The aircraft is moved about these three axes by ailerons, elevators and rudder, known as the flight control surfaces. Every aircraft has two or more ailerons. They are located on the trailing edge of each wing, generally close to the wingtip. They are used to rotate the aircraft about the roll axis and make it bank left or right. Some aircraft have also inboard aileron which control banking manoeuvres at high speed. The ailerons are interconnected by cables and operate simultaneously in opposite direction. A movement of the control column to the left causes the left aileron to move upward and the right aileron to move downward. Air striking the right aileron causes high pressure on the bottom, which lifts the wing up, while the air striking the left aileron causes high pressure on the top, pushing the wing down. As a result, the aircraft rotates into a left-hand bank.

To avoid undesirable drag in the high pressure area bellow the wing, they are often designed with differential aileron travel - more aileron up than aileron down travel.

For nose-up or nose-down control, aircraft have elevators attached to the trailing portion of the horizontal tailplane. They swing up and down as the control column in the cockpit is pulled back or pushed forward making the aircraft climb or descend. As the airflow passes over the stabilizer, it strikes the elevator surface. When the elevators are in the down position, the pressure is high on the bottom and low on the top. This creates lift on the tail which pitches the aircraft's nose down.

The rudder is the control surface which turns the aircraft right or left. When the pilot wishes to turn left, he banks the aircraft to the left using the ailerons and applies a slight amount of pressure to the left rudder pedal.

Most jet aircraft have yaw dampers which move the rudder back and forth in small increments when the air is turbulent, to smooth out the flight.

The aircraft's control surfaces are trimmed out to balance all of the high or low- pressure areas leaving the aircraft in a state of equilibrium.

1. Translate into Croatian:

a) **rudder** (a control surface designed to produce yawing movement) – _____

b) **elevator** (a control surface for controlling aircraft in pitch) – _____

c) **aileron** (movable portion of trailing edge of aerofoil) – _____

2. What does an aircraft do in?

ROLL – _____

PITCH – _____

YAW – _____

3. Match the words like in the example:
Lateral, longitudinal, vertical, yaw, roll, pitch, ailerons, elevator, rudder
OKOMITA: vertical – yaw – rudder
UZDUŽNA:
BOČNA:

4. Complete the information chart:

AILERON
Position: _____
Function: _____
Differential aileron: _____

ELEVATOR
Position: _____
Function: _____

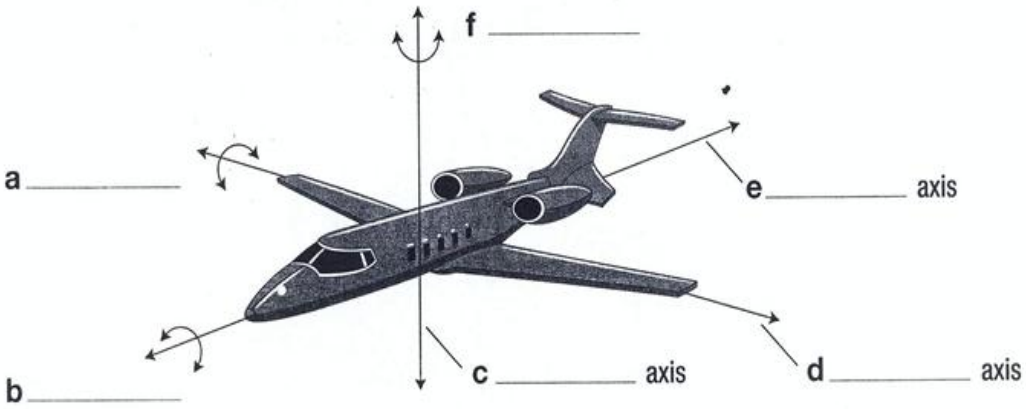
RUDDER
Position: _____
Function: _____
Yaw damper: _____

5. What does a pilot have to do when he wants to:
- bank the aircraft to the left?
- pitch the aircraft's nose down?
-turn the aircraft left?

19. First flight basics

Vocabulary and speaking

1 Label the vertical axis, the lateral axis and the longitudinal axis on the diagram.



2 Read these definitions of aeroplane movements and finish labelling the diagram.

pitch: changes in pitch raise and lower the nose of the plane
roll: rotation along the longitudinal axis of the fuselage
yaw: horizontal rotation around the vertical axis of the plane

Listening and writing

Martin is 17 and has just had his first flying lesson, which was a surprise birthday present from his father. You are going to hear an instructor describing how the aircraft controls work.

1 Listen and write a list of the controls that are mentioned. Check you understand what they are.

2 Look at Skills Box 1. With a partner, try to complete the notes in the table on the next page.

Then listen again to check your answers.

Skills Box 1

Form-filling

In aviation engineering, there are a lot of forms which must be completed in note form. Remember that:

- you should not use full sentences; *a(n)*, *I* and *the* can be left out;
- you should use capital letters for clarity.

	where on aircraft?	determine(s) which movement?	controlled how by pilot?
elevators			joystick pulled/ pushed
ailerons		rolling movement of plane (banking)	
rudder			

Speaking

1 Look at Skills Box 2. Practise saying the following phrases, which contain consonant clusters.

against the law
the instructor was there
flight control
called the joystick
in the longitudinal axis
to increase or decrease your flying height
The flaps are near the fuselage
I want the plane to roll or bank
not exactly
pre-flight checks

Skills Box 2

Consonant clusters

English words can have two or three consonant sounds at the beginning, and even four at the end.

For example:
price, glass, spring, split
next, arranged, months

These consonant clusters are important for understanding and speaking. They must be pronounced with no extra vowel sounds between them.

2 Find the phrases in the tapescript and practise the whole sentences. Don't forget to use the right sentence stress.

Vocabulary and speaking

1 In the tapescript, underline five or six key p' ases for explaining how the control surfaces work. Then list them on a separate piece of paper.

2 Practise two conversations. You must use all the phrases on your list.

a Between Martin's father and friend: Martin's father is telling the friend about Martin's first lesson and the things that he learned.

b Between the instructor, Dennis Saunders, and a colleague who asks him how the first lesson went and what Martin learned.

Unit 4, Lesson 8, Track 17

M: Hi, I'm back!

F: How did it go?

M: Fantastic! I actually got to fly the plane by myself!

W: You mean they let you go up alone?

M: No, of course not. That's against the law. Dennis - the instructor - was there all the time. But, I did actually steer the plane and made it go up and down. It's got dual controls.

B: What's that?

M: It means you have your own set of controls but the instructor can take over from you instantly if he needs to. Anyway I'm going to have another lesson as soon as I've saved enough money. It's just such a wonderful feeling up there!

F: Slow down, slow down. Why don't you tell us all about it from the beginning?

M: Sorry, yes, well I got to the airfield and Mr Saunders - Dennis - he began by showing me the main controls in the cockpit and explained what they do.

D: Now, before you get in, I'm just going to show you the main controls and how they relate to the flight control surfaces. Those are what we call the bits of the plane that move about. So if you stand just there while I get in ...

D: OK. First, here's the control column. That's the correct name for it, but it's sometimes called the joystick, or even just ... just the 'stick'. Now I can move it in the longitudinal axis, backwards and forwards ... and I can move it laterally, side to side. Now if I push it forward like this - look at the back of the plane. You can see the elevators moving up and down – so it also controls movement in the vertical axis.

M: Oh yes, I see.

D: Now, when I pull the stick back the elevators move up. And it's this control we use for what's known as the pitch of the plane - raising and lowering the front end, the nose.

M: Right. So you can use it to increase or decrease your flying height.

D: Yes that's it. Now, as I said, we can also move the stick from side to side. Look, watch what happens.

M: Ah yes, those flaps on the wings are moving up and down.

D: Well, actually they aren't flaps. The flaps are actually further in, near the fuselage, you see.

M: OK. What do they do?

D: Well, we mainly use those for take-off and landing. You won't be doing either of those things today, so don't worry about it for now. No, these control surfaces are called ailerons and they control the rolling movement of the plane, sometimes called banking. You see, if I want the plane to roll or bank to the left, I move the stick to the left. If I want to bank to the right, I have to move the stick laterally to the right.

M: OK, yes, I've got it.

D: And lastly, there are these two pedals down here. Now if I press them down with ...

M: Ah yes, it's like a ship's rudder.

D: Yep, that's it. It is the rudder. We use it to swing or turn the nose of the plane to the right or left. It's called yaw. Y-A-W: yaw.

M: So that's the control we have to use if we want to turn the plane round.

D: Well, in fact, not exactly - you mainly use the ailerons for that - but yes, you still need the rudder to help you control the turn.

M: How are the cockpit controls connected to the surfaces? Is it electrical or hydraulic?

D: In this little plane, neither! All the linkages are mechanical. It's all rods and cables, so you can really feel directly how the plane is behaving.

M: Right.

D: So. Now you know about the primary control system, I think that's enough theory for the moment. Now we're going to do all the pre-flight checks and then we're off.

M: Great! So what checks do you have to do?

20. In the cockpit

The cockpit of the A340, nearly identical to that of the A320.. Photograph ©Airbus Industrie. Reproduced by permission.

4.1. HISTORICAL PERSPECTIVES

Cockpit design in the A300 B2-B4/A310

The original design called for two pilots facing forward with a console between each. Furthermore, a CM3 seat (Crew-member 3) was initially to be provided behind on the right for the flight engineer with his panels on the right.

A fourth seat for an observer was also fitted. As such this configuration was called SFCC (side-facing crew cockpit).

In the A310, this was later modified to do away with the CM3 and the FFCC (Forward-facing cockpit crew) was born.

1. Explain the difference between SFCC and the FFCC.
2. If CM3 designated "Crew-member 3"), whom do CM1 and CM2 designate? (Hint: who is the "number 1" person in the cockpit?")

Airbus A320 Cockpit and displays

Digital avionics with FBW (Fly-By-Wire) flight controls integrated an all-new technology.

Each pilot enjoys an uninterrupted view of 2-color display panels largest then available: (184 sq. mm).

Radio management panels (RMPs) to side of the throttles on the control console. Purpose: to control a mass of communications and navigation avionics (HFs, VHFs[1] VORs[2]).
small SSC (sidestick controller): ahead of his outboard armrest.

1 Very high frequency (HF = high frequency)
2 Very high frequency omnidirectional range

3. Can you locate the components mentioned in the description of the A320 cockpit in the photograph of the A340 cockpit (remember that both are nearly the same).

Photograph ©Air France. Reproduced by permission.

4.2. THE BOEING 777 COCKPIT: A BRIEF DESCRIPTION

The 777 cockpit features electrically-powered seats and large windows with wide-angle view, and in the opinion of many pilots and test pilots, offers the most spacious cockpit cabin of any to date, with the most advanced FBW found on any Boeing aircraft. The square display screens measure 200 mm on a side, making them also among the largest of any display screens on commercial jets. LCDs (liquid crystal displays) brighten in bright or strong light

PDF (primary flight display) and ND (navigation display) are next to each other directly in front of the pilot.

EICAS (Engine-Indication and Crew Alerting Systems) and MFD (Multi-function display) are positioned vertically one above the other in the center. The EICAS screen is primarily reserved for main engine instrument readings. Also provided to the right and beneath the EICAS screen are blocks reserved for memos, warnings and data from supplementary systems.

The MFD selector panel is located to the right of the glare shield autopilot mode control panel (MCP).

3 flight-management control and display units are found in the central console between pilot seats, as well as integrated-navigation/communication-frequency selector panels. Directly behind the console is a printer and accompanying bin for storing paper.

The overhead-system panel is within easy reach of cockpit crew members.

MAKE SURE YOU KNOW:

PDF
NC
LCD
EICAS
MFD
MCP

1. The description mentions several items and display units. Can you locate them in the photograph?
   - PDF • ND • EICAS • MFD • MFD selector panel
   - overhead panel • glare shield • special-purpose blocks
   - MCP • flight-management control and display units
   - navigation/communication-frequency selector panels
   - central console • printer
2. What differences can you describe between the A340/A320 and B777 cockpits as presented on these two pages?

4.3. BOEING AIMS HIGH!

The Aircraft Information Management System (AIMS) found on the B777 features the very latest innovations in state-of-the-art technology. Comprising two separate cabinets housing all input and output hardware, AIMS deals with

- all aspects of flight management
- display control
- central maintenance
- aircraft conditions management
- flight deck data acquisition
- engine performance data
- data conversion

4.3.1. COMPLETE OR ANSWER:

1. AIMS represents ...
2. The basic AIMS system is composed of ...
3. What do the following acronyms (invented for this practice) stand for?

DC .....
FL .....
FDDA .....
ACM .....
EPD .....

AIMS is the "central nervous system" of the 777 fly-by-wire, with all other operations closely linked to it. To perfect such a system, Honeywell implemented two of the most recent innovations in avionics: robust partitioning, making it possible for the same computer to run and use different software applications, and ASIC, a new technology which integrates an increased number of system functions in one processor channel.

Thanks to robust partitioning, software dedicated to flight-critical functions is kept distinctly separate from non flight-critical functions within each computer module.

4.3.2. COMPLETE:

1. Robust partitioning enables the same computer ...
2. ASIC offers a distinct technological advance in that ...
3. Another noteworthy advantage of robust partitioning is that ...

Other systems interact with AIMS, such as EFIS and FMS
In one other way, Boeing took a giant step forward with the introduction of active-matrix liquid-crystal flat-panel display screens, a noteworthy improvement over traditional CRT or hybrid CRT displays.

4.3.3. FIND REFERENCES TO THESE:

- application-specific integrated circuits
- flight management system
- electronic flight instrument system
- cathode ray tube

4.3.4. FLUENCY PRACTICE: RESTATE THE SAME IDEA USING THE NEW GIVEN SENTENCE OPENERS:

Thanks to robust partitioning, software dedicated to flight-critical functions is kept distinctly separate from non flight-critical functions within each computer module.

a. Robust partitioning enables...
b. It is now possible to...

4.3.5. MAKE SURE YOU UNDERSTAND THE ACRONYMS: WRITE THEM OUT.

1. AIMS _____
2. EFIS _____
3. FMS _____
4. CRT _____

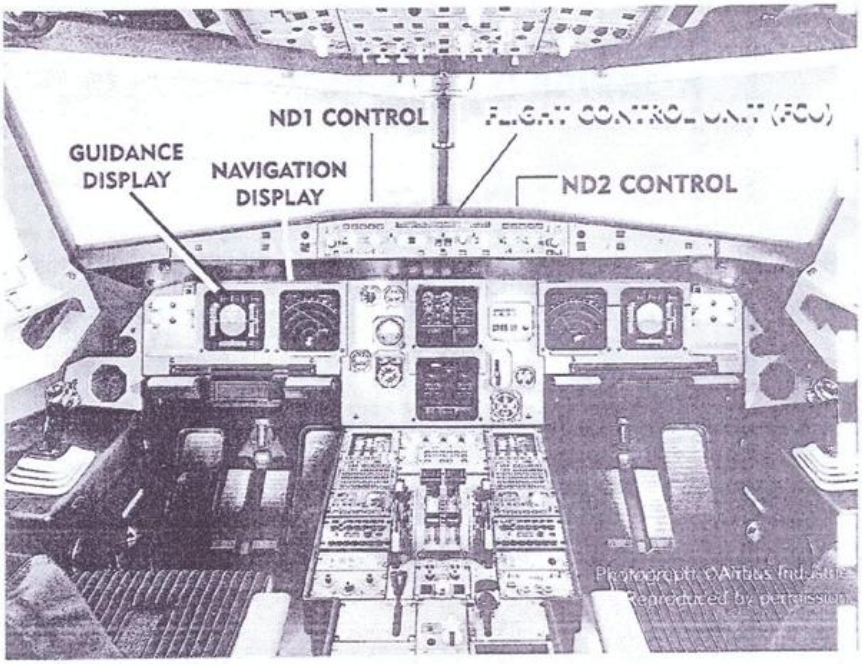
4.4.FLIGHT DECK CONFIGURATION: A320

NOTE: This section also focuses on compound nouns. You should find the equivalent of each acronym in the list in the bottom right-hand corner of this page, paying special attention to the formation of the compound nouns.

The FMGS is made up of:

- 2 FMGCs
- 2 FACs in avionics bay
- 2 MCDUs
- FCU center of glare shield
- 2 thrust levers

For more information and practice, see the exercises below.



LOCATE THESE ITEMS IN THE PHOTOGRAPH

2 MULTIFUNCTION CONTROL AND DISPLAY UNITS (MCDUs)
One is located in the top left-hand corner, the other in the top right-hand corner of the central console (or on the right and left sides of the forward pedestal).

THRUST LEVERS
In the central part of the console, one for the pilot, the second for the co-pilot, transmit output to the FMGCs and the FADECs

SCRATCH PAD WITH KEYBOARD
For the pilot, to the left of his thrust lever; for the co-pilot, directly to the right of his thrust lever.

SIDESTICK CONTROLLER
Situated ahead of the outboard armrests.

[1]What's in each of the 2 EFISs? A PFD and an ND.

PFD	ND
■ FMGS guidance target (FD commands, speeds, altitudes, headings)	■ flight plan displayed
■ SES	■ position and flight path
■ SRM	■ navigation features (airfields, waypoints)
■ navigation information (ILS)	■ computed current speed (TAS, ground speed, wind)

MORE ABOUT FMGC AND EFIS.

FMGC System sends roll and pitch commands to the EFCS which comprises two computers: the ELAC and the SEC. Furthermore, the FMGS sends thrust commands to the FADEC in association with the movement of the thrust levers. The system is also designed to transmit flight plan, map and position data to the EFIS[1] via the DMC so as to display to the pilot aircraft position with respect to the flight plan.

REFERENCES

system engagement status
system related messages
display management computer
flight management guidance system
flight augmentation computer
flight control unit
flight display
instrument landing system
full authority digital engine control
elevator aileron computer
spoiler elevator computer
electronic flight instrument system
electronic flight control system
flight management guidance computer
true air speed

4.5. AVIONICS

AVIONICS

A very brief look at recent technological advances

CNS/ATM SYSTEMS

Communications, navigation, surveillance and air-traffic management is undergoing considerable development. Here's just a partial list of some of the recent technology.

GPS: global positioning system, advocated heavily by the United States, is a satellite-based system. Rockwell-Collins launched in 1996-1997 a new GPS-based FMS system.

MMR (multi-mode receiver) is another system favored by Europe, and which integrates:

GPS
ILS (instrument landing system)
MLS (microwave landing system)

As of 1995, the United States government has been pushing FMS/GPS. American Airlines moved ahead for fleet-wide installation of FMS/GPS.

In Europe the consensus is that existing ILS units, having experienced several incidents, need to be replaced with systems protected from interference from high-powered FM radio stations. MMR would seem the best suited for these requirements.

Lockheed-Martin (1996-1997) came out with **ILS/GPS MMR** capable of being upgraded to integrate its Autonomous Prevision Approach and Landing System (APALS) which featured an airborne radar that scans the ground below the approach path and guides the aircraft as it touches down.

GPWS (ground proximity warning systems) was developed by AlliedSignal, and later enhanced — EGPWS (enhanced ground proximity warning systems) — to provide display of terrain around the airport

WHICH SYSTEM DOES WHAT?

Refer to the passage above and fill in the name of the system together with its acronym.

1. capable of detecting possible hazards when aircraft is landing

   _____

2. traditional system guiding aircraft landing onto runway

   _____

3. an integrated system featuring both satellite-based and microwave-based positioning-landing systems

   _____

4. protects against FM interference

   _____

5. scans and displays vicinity around airfield

   _____

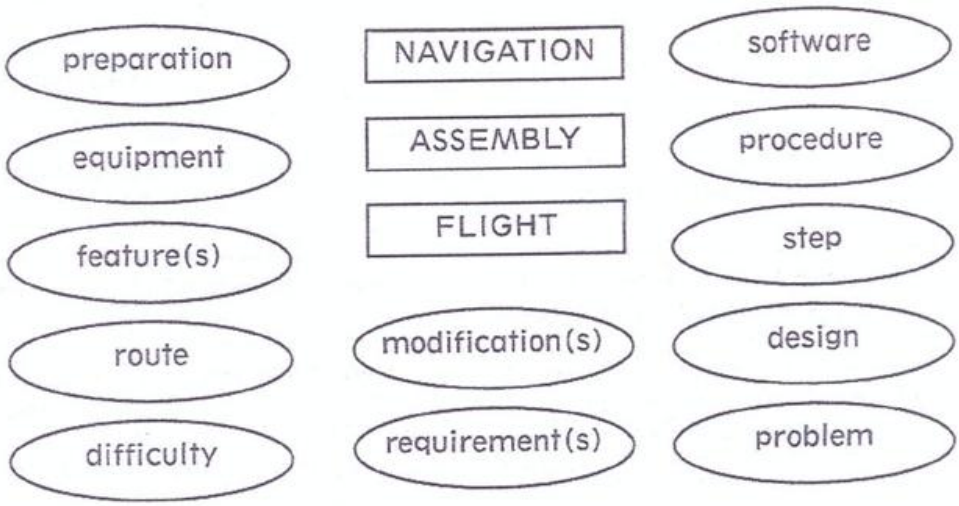
A. MATCH THE ACRONYM WITH ITS CORRESPONDING DESCRIPTION. IN SOME CASES THERE WILL BE MORE THAN ONE DESCRIPTION.

1. STDMA _____
2. ADS-B _____
3. NEAN _____
4. VHF _____
5. INS _____
6. DME _____
7. ATM _____
8. CNS _____
9. HUD _____
10. RVSM _____
11. CNSE _____
12. STDMD _____
13. CFD _____
14. CFDS _____
15. AIDS _____
16. ADIRS _____

a. air traffic management
b. self-organized time-division multiple datalink
c. very high frequency
d. distance-measuring equipment
e. velocity hazard frequency
f. data measuring equipment
g. size temperature and distance measure analysis
h. communication-navigation-surveillance
i. international navigation security
j. automatic dependent surveillance-broadcast
k. inertial navigation system
l. aircraft information data systems
m. communication-navigation-surveillance equipment
n. centralized fault display system
o. aircraft data and instrument recording system
p. North European automatic dependent surveillance-broadcast network
q. reduced vertical-separation minima
r. computer fault display
s. air data and inertial reference system
t. head-up display
u. instrument navigation system
v. aircraft temperature maintenance
w. air information and data services

B. PRACTICE MAKING MEANINGFUL COMPOUND NOUNS.

The words in boxes can be used with most of the words in ovals. And you can also meaningfully combine many of the words in ovals. Try to make as many meaningful combinations as you can. In each case you should be able to explain the term or idea.



21. Happy landing

Speaking

1 Cover the text on the right. Work with a partner and describe the stages in the animal's fall.

a 

b 

c 

d 

e 

i The head and front part of the body are twisted to face the ground, and the back legs are bent.

ii It lands on all four feet to spread the load, and with the backbone slightly curved to absorb the shock.

iii The front legs are brought up towards the face to protect the head from impact.

iv It twists the back part of the body to line up with the front and extends all its legs.

v The cat determines which way up it is before rotating its head so that it is the right way up.

2 Match the pictures with the five stages on the right.

3 Discuss this question with a partner: *Which aspects of the cat's solution to landing are applied to an aircraft?*

Vocabulary

1 Which words on the left have a similar meaning to those on the right?

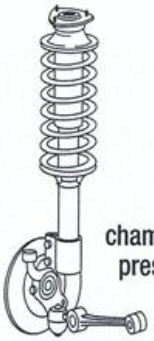
a descent	**i** distribute
b determine	**ii** shock
c flexibility	**iii** fall
d impact	**iv** exact
e manoeuvre	**v** decide/judge
f precise	**vi** turn
g spread	**vii** mobility

2 Check that you can pronounce all these words correctly.

Listening

You are going to listen to a lecturer comparing aircraft landing systems with those of a cat.

1 **Listen first for the main ideas. In which order are the three things in the pictures discussed?**



chamber filled with pressurised fluid

skeleton of a cat

inner ear of a cat

2 **With a partner, decide whether you think the statements are true (T) or false (F). If you're not sure, mark it with a question mark (?). Then listen to check answers.**

a ___ A pilot can determine his position relative to the ground quickly.
b ___ A falling cat slows down as it falls.
c ___ An artificial horizon is something in the inner ear.
d ___ Both a pilot and a cat use visual information to judge their landing.
e ___ Both always land on all points simultaneously.
f ___ Both have flexibility built into their internal structure.
g ___ Hydraulic systems do the same job in aircraft as muscles do in animals.
h ___ The wheels are filled with high-pressure liquid.
i ___ The landing gear acts as a piston.
j ___ The pilot can manoeuvre more easily at low speeds.
k ___ A cat's flexible skeleton helps it survive an emergency landing.

3 **Look at the Skills Box.**

a Look at the sketches on page 246 showing the process of an aircraft landing.
b Label sketches 3 to 7 in note form.
c Practise explaining your sketches to a partner. Remember, when you are speaking you must use full grammatical sentences, with the most important words stressed.

⇨ **Workbook pages 54/55**

Skills Box

Short forms for notes

When you are writing in note form, it is very common to leave out certain parts of the sentence: *a/an*, *the*, the verb *be* and the pronoun *I*.

For example:
The report is not finished yet.
Report not finished yet.

I will send it this afternoon.
Will send this afternoon.

This is also usual in passive sentences:
The legs are brought up to protect the face.
Legs brought up to protect face.

Note: When you are speaking, or writing longer texts, it is not normal to do this.

Unit 4, Lesson 5, Track 15

... the use of hydraulics in matters of life or death. If I can take an example that everybody's familiar with, which is the domestic cat. Cats are good climbers and will often jump from a tree at a bird, or sometimes just slip, and fall. But, a fall that would kill or badly injure a human or another animal, may have little effect on a cat, because they have two characteristics which are essential for a safe landing, and which the aviation industry, among others, makes use of.

Firstly, cats have a small but extremely sensitive fluid-filled organ in their inner ear. When they move, so does the fluid, and so they know precisely their position relative to the ground at all times, and in a landing situation, of course, that's vital information. The equivalent in an aircraft is an instrument called the artificial horizon, which tells the pilot his orientation. As soon as a fall – or a descent, in the case of an aircraft – starts, this detector enables the animal, or pilot, to determine their orientation quickly so that they can prepare for the landing impact.

That's one important feature. Then, secondly, to help prepare the body itself for landing, the physical design needs to enable the falling body to easily get into the best position. Cats benefit from an extremely flexible skeleton. They don't have collar bones, and the bones in their backs have an especially high mobility. This enables them to twist and turn their bodies quickly and easily in an emergency landing, so that by the time they hit the ground they are oriented in the best position to absorb the shock. Aircraft don't have anything like that structural mobility, although there is some flexibility built into the airframe.

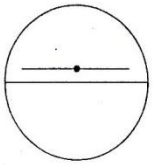
But what a pilot can do is to use the aircraft's control surfaces – the surfaces that move- like the rudder, flaps, etc. He can use them to slow the aircraft's descent – something that a cat can't do. This will minimise the shock of landing and give him time to manoeuvre. The control surfaces also allow him to ... to manoeuvre into the best position very accurately.

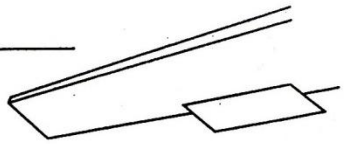
The cat looks at the ground to help here; so, of course, does the pilot. This is where hydraulics comes in. To distribute the load, cats always land on all four feet simultaneously; aircraft, however, land just on their two main wheels or wheel groups. Cats curve their backs, which aircraft can't do of course, but where animals use muscles to minimise the shock of the impact, aircraft have to make use of hydraulics: as we saw with the air brake, a hydraulic chamber is filled with pressurised fluid.

When the aircraft hits the ground, the landing gear assembly basically acts as the piston inside the chamber, pushing against the fluid, which absorbs the force of the landing.

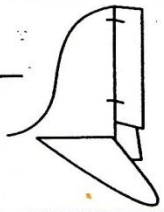
All being well, both the animal and the aircraft will land safely – although, hopefully, the aircraft will have many more than just nine lives ...

Process of an aircraft landing

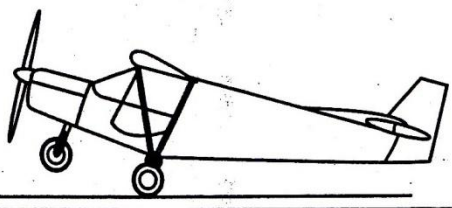
1 _____ 

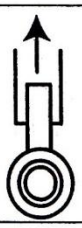
2 _____ 

3 _____ 

4 _____ 

5 _____ 

6 _____ 

7 _____ 

22. Doing the paperwork

Vocabulary

Complete the definitions with an item from the box.

relationship mandatory appropriate certify overhaul Authority factor regulate

a _____ (*n*) element affecting a situation or a result. *Overall weight is an important ~ in engine design.*

b _____ (*adj*) in accordance with a rule. *All new operators must complete the ~ training course successfully.*

c _____ (*n*) official organisation responsible for a certain area of industry. *These are the new rules from the Workplace Health & Safety ~ .*

d _____ (*v*) to control in accordance with rules. *We need to ~ the use of dangerous equipment.*

e _____ (*v*) to mark or register something to show it has been checked and fulfils requirements for use. *An inspector must ~ rebuilt engines before they can be reinstalled.*

f _____ (*adj*) suitable and correct for a particular case. *Anyone reporting an accident has to fill in the ~ forms.*

g _____ (*n*) the way in which people or systems are connected and work together. *The ~ between speed, distance and time can be expressed as S=D/T.*

h _____ (*v, n*) 1 (*v*) to disassemble, check and repair completely. 2 (*n*) the process of disassembling, checking and repairing something. *The report says that the system needs a complete ~ .*

Reading

1 Look at the diagram opposite. Work with a partner. Discuss what each of the three icons might represent.

2 Read the text quickly and see if you were right. Label the three icons in the diagram.

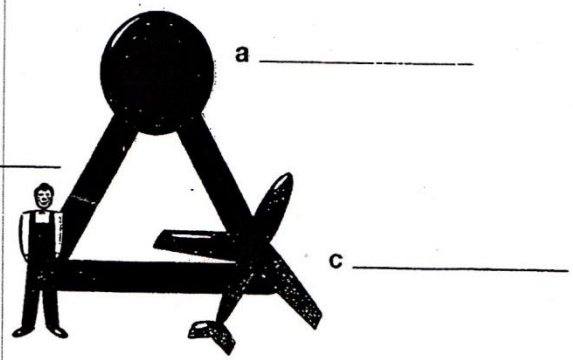
3 Read the text again and answer the questions below.

a What can be done to improve the safety of each element in aircraft?

b What is the job of the ICAO, FAA and EASA?

c Who is responsible for filling in forms?

4 Complete the text with the words from the Vocabulary section. You will need to change the form of some of the words.



The safety of an aircraft depends on a triangle of _____. Each one is important, and the _____ between them is also important. The external environment cannot be controlled, although extreme environmental conditions can be avoided. However, control of people and machines can be _____. People who work with aircraft, such as pilots and maintenance personnel, can only do so if they have the _____certificate from the correct _____. Similarly, machines – airframes, systems and all component parts – have to be checked and _____ in order for the plane to be considered airworthy. Some of the main authorities that control airworthiness are:

ICAO = International Civil Aviation Authority

FAA = Federal Aviation Administration

EASA = European Aviation Safety Agency

It is the job of the maintenance personnel to ensure that the _____ regular inspections, _____ , repairs and replacements are carried out correctly and that all the necessary forms are correctly filled in.

Speaking

Look at the forms on pages 251 and 252.

1 Which relate to:

a airworthiness?

b faults?

c overhaul?

d non-certified components?

2 Work in pairs or small groups. Choose one form each and find out:

a when it would be used.

b what kind of information would be required in each section.

3 Show your forms to your partner(s) and explain them.

Forms

Form 1

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION MALFUNCTION OR DEFECT REPORT		OPER Control No.		8. Comments (Describe the malfunction or defect and the circumstances under which it occurred. State probable cause and recommendations to prevent recurrence.)	DISTRICT OFFICE	OPERATOR DESIGNATION
		ATA Code				
		1. A/C Reg. No.	N.		OTHER	
Enter pertinent data	MANUFACTURER	MODEL/SERIES	SERIAL NUMBER			
2. AIRCRAFT					COMMUTER	
3. POWERPLANT						
4. PROPELLER					FAA	
5. SPECIFIC PART (of component) CAUSING TROUBLE						
Part Name	MFG. Model or Part No.	Serial No.	Part/Defect Location		MFG	
					AIR TAXI	
6. APPLIANCE/COMPONENT (Assembly that includes part)						
Comp/Appl Name	Manufacturer	Model or Part No.	Serial Number		MECH.	
				Optional Information:	OPER.	SUBMITTED BY:
Part 11	Part TSO	Part Condition	". Date Sub.	Check a box below, if this report is related to an aircraft: ☐ Accident: Date _____ ☐ Incident: Date _____	REP. STA.	TELEPHONE NUMBER ( )

Form 2

US Department of Transportation FEDERAL AVIATION ADMINISTRATION	SUSPECTED UNAPPROVED PARTS REPORT	
Refer to page 2 for instructions on how to complete the form.		
1. Date the Part was Discovered:		2. Part Name:
3. Part Number:		4. Part Serial Number:
5. Quantity:	6. Assembly Name: Assembly Number:	7. Aircraft Make & Model:
8. Name, Address, and Description of the Company or Person Who Supplied or Repaired the Part:		
Name:	Street Address:	
City:	State:	ZIP Code:
Country:	Phone Number:	

Forms

Form 3

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION MALFUNCTION OR DEFECT REPORT	Form No: AWSD Form 6A AMDT No: 0 Issue Date: 17/11/00 Page No Page 1 of 5	PRELIMINARY INSPECTION REPORT FOR ISSUE/RENEWAL OF CERTIFICATE OF AIRWORTHINESS Level 1

IRISH AVIATION AUTHORITY
Airworthiness Standards Department
Aviation House, Hawkins Street, Dublin 2

Preliminary Inspection Report For Issue/Renewal of Certificate of Airworthiness

Completed form including the Airworthiness Directives Listing and Equipment List to be forwarded to above address.

Note: *Where an item is not applicable, or appropriate, the letters 'NA' should be entered.*

1. Registration: _____ **2. Aircraft Type:** _____ **3. Serial No.:** _____

4.	Since Manufacture	Since last C of A	Last Calendar Year
Aircraft Hours			
Aircraft Cycles/Landing			

Form 4

US Department of Transportation FEDERAL AVIATION ADMINISTRATION	**MAJOR REPAIR AND ALTERATION** **(Airframe, Powerplant, Propeller, or Appliance)**	Form Approved OMB No. 2120-0020 11/30/2007 **For FAA Use Only** Office Identification

INSTRUCTIONS: Print or type all entries. See FAR 43.9, FAR 43 Appendix B, and AC 43.9-1 (or subsequent revision thereof) for instructions and disposition of this form. This report is required by law (49 U.S.C. 1421). Failure to report can result in civil penalty not to exceed $1,000 for each such violation (Section 901 Federal Aviation Act of 1958).

1. Aircraft	Make	Model
	Serial No.	Nationality and Registration Mark
2. Owner	Name (As shown on registration certificate)	Address (As shown on registration certificate)

3. For FAA Use Only

4. Unit Identification				**5. Type**	
Unit	Make	Model	Serial No.	Repair	Alteration
AIRFRAME	----------(As described in Item 1 above)----------				
POWERPLANT					
PROPELLER					

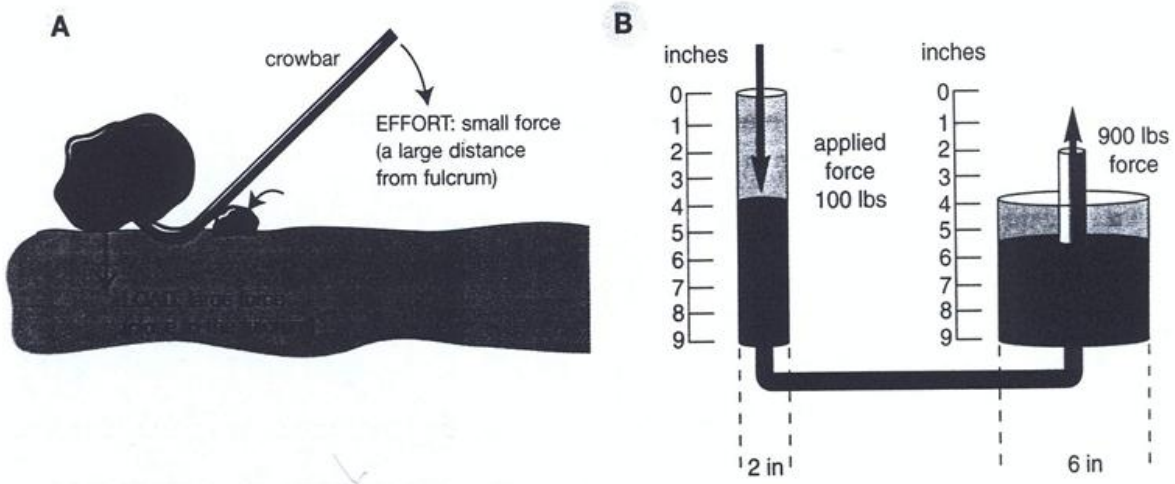
23. Modern hydraulics

There are two key facts that make hydraulic power important.

- Firstly, hydraulic devices can give a 'mechanical advantage'; that is, a large amount of work can be produced from a small amount of effort.
- Secondly, hydraulic systems can be used to transmit a force immediately from one place to another, without the force being reduced in strength.

Speaking

Look at the two diagrams. With a partner, discuss the mechanical advantage in each case.



Reading and vocabulary

1 Read the text opposite quickly and choose a suitable title for each paragraph.

a Hydraulics in the aircraft industry
b Future hydraulic systems
c The historical development of hydraulics
d Everyday applications of hydraulics
e Fluid properties

2 Complete the gaps in the text using the words in the box.

technological	increasing	atmospheric	properties	fluid
electrical	surfaces	loading	conditions	ram

The hydraulic ⓐ_____ pump is a very simple way of using the pressure of a liquid or fluid to do work, and there is hardly any aspect of modern ⓑ_____ life that doesn't involve hydraulics in one form or another. The effectiveness of a hydraulic system can be increased considerably by ⓒ_____ the pressure inside the system, using a pump driven by the power plant of the equipment. The power-assisted steering found in most modern cars is an example of this, whereas the brakes used to stop the car work effectively with fluid at ⓓ_____ pressure.

Because of its unsuitable chemical and physical ⓔ_____, water is not normally used in modern hydraulic systems. It has been replaced by a number of different kinds of hydraulic fluid, which are usually some kind of oil. The properties of the fluid will depend on the ambient operating ⓕ_____ of the system. A hydraulic system which operates in very low temperatures obviously requires a ⓖ_____ with a very low freezing point. Conversely, those operating in high temperatures must have a high boiling point.

Hydraulic systems are used throughout the aircraft industry. On the tarmac and in the hangar, much of the equipment used for towing, lifting and ⓗ_____ aircraft is hydraulic. Aboard aircraft, hydraulic systems are used to control the flight surfaces, landing gear and other ancillary equipment. Most aircraft have a combination of hydraulic, ⓘ_____ and mechanical controls, although some small light planes are only fitted with mechanical linkages. For example, they may be fitted with mechanical linkages for the primary control ⓙ_____, i.e., the ailerons, rudder and elevators, but the flaps, air brake and landing gear may be hydraulically operated.

Language

1 Look at the Language Box. Underline the adverb in each of these phrases from the text.

a there is hardly any aspect of modern life

b the effectiveness of the system can be increased considerably

c the brakes work effectively with fluid at atmospheric pressure

d water is not normally used

e which is usually some kind of oil

f the flaps, air brake and landing gear are hydraulically operated

g some planes are only fitted with mechanical linkages

Language Box

Adverbs

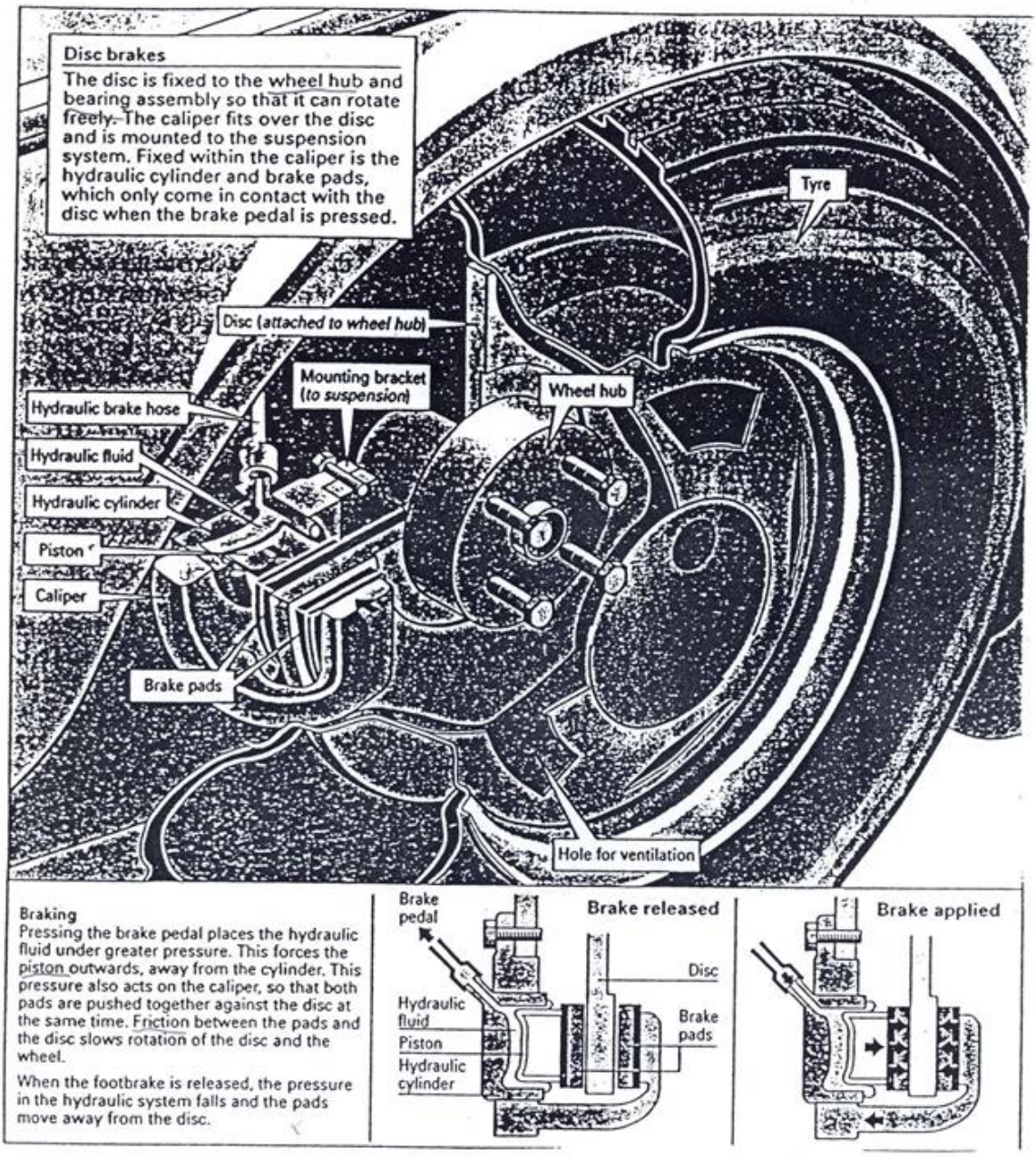
Information about a verb must be added using an adverb. Adverbs give information about how, when or where the action happens, e.g.:
*It needs to be done **accurately**.*
*This was **originally** built in 1952.*
*They are **often** wrong.*

Adverbs often end in *~ly*, but many do not, e.g.:
hard, now, well, sometimes, very

2 Circle the verb which each adverb refers to.

3 Go back to the text and underline all seven of the phrases. Can you find any additional adverbs in the text?

24. Disc brakes



1. Skim the text below to find which paragraphs contain information on these aspects of disc brakes.

Information	**Paragraphs**
a) The hydraulics of braking.	___
b) Principles on which disc brakes operate.	___
c) The operation of the calliper system.	___
d) Consequences of heat generated in braking.	___
e) Energy conversion in braking.	___

Disc brakes are used on cars and motorcycles. They work by using friction and hydraulic power. The friction is generated when the brakes' stationary pads mounted to the suspension system rub against metal discs turning with the wheels. **(1)**

The pads are covered with a high-friction material. The resistance of the pads against the rotating discs converts the energy of the moving vehicle (kinetic energy) into heat energy in the brakes. As kinetic energy is lost, the car slows down. **(2)**

This method of braking produces a great deal of heat, so brakes has to be made from a heat-resistant material, like asbestos. The intense heat also explains why car wheels need vent-holes around the centre: when the car is moving the slots ensure a flow of air over the brakes, helping, to cool them down. **(3)**

When the driver presses the brake pedal, it pushes down the piston in the master cylinder, so creating pressure in the fluid. The fluid is incompressible. The pressure is transmitted to the wheel cylinder which forces the brake pads against the revolving disc. The master cylinder has a smaller diameter than the wheel cylinder. **(4)**

Hence, a relatively small force applied on the pedal produces a large force on the brake pads. The brake pads are held in a clamping device called a caliper. The caliper system ensures that one brake pad is pushed against the inner surface of the disc while, simultaneously, the other pad is pulled against the outer surface. This gives twice the braking power. The action is like squeezing something between forefinger and thumb. **(5)**

2. Answer the questions.
a) What is the function of the callipers?
b) Why do car wheels have vent holes?
c) Where are the brakes mounted?
d) What type of material are brake pads made from?
e) What is the difference between the master and the wheel cylinder?
f) What kind of energy does a moving vehicle have?

3. Fill in the gaps.
The brakes are stationary _____ mounted to the _____ system. The resistance of the pads against the rotating discs converts _____ into heat energy in the brakes. As kinetic energy is _____, the car slows down. Since breaking produces heat, breaks have to be made from _____. Car wheels also need _____ to cool them down. _____ cylinder creates pressure in the fluid. _____ cylinder forces the brake pads against the discs. The _____ system ensures that one brake is pushed against the inner and the other against the _____ surface of the disc.

4. Replace the words in italics in the following sentences with a suitable verb from the list.

ensure	enlarge	harden	lengthen	lessen	lighten
loosen	roughen	sharpen	shorten	soften	strengthen
tighten	toughen	weaken	widen		

a) Steel rods are used to *make* concrete beams *stronger*.
b) A torque wrench is used to *make* cylinder bolts *tight*.
c) Thermoplastics can be *made soft* by heating them.

d) After thermosetting plastics *become hard* they cannot be softened again.
e) A reamer is tool used to *make* a hole *larger*.
f) Corrosion *makes* structures *week*.
g) Compressive forces will *make* a beam *shorter*; tensile forces will *make* it *longer*.
h) Carbon fibre frames *make* racing bicycles *lighter* and *stronger*.
i) Oil can be used to *make* tight bolts *looser*.
j) Carbon steels are *made tough* by heating and quenching.

25. Undercarriage

Undercarriage supports the aircraft on the ground, absorbs the shock of landings and provides smooth taxying. It is subject to severe stresses, so it must be strong and at the same time as small and light as possible. Most aircraft use the tricycle layout of undercarriage, the number of wheels and their arrangement depending on the weight of the aircraft and the way in which the undercarriage is to be retracted. By having the weight spread over a greater number of wheels, the contact pressure of the undercarriage is reduced. There is also greater safety if a tyre bursts on landing. The Boeing 747 has 18 wheels- four main units, each with four wheels, and a dual nose-wheel unit.

The problem of retraction influences the particular choice of undercarriage. The main units of low-wing aircraft are usually retracted into the wing. Twin turboprop aircraft have engine nacelles on the wing and it is quite common to retract the main legs into these nacelles - otherwise, they must be stowed in the fuselage. The position of the undercarriage units is very important. If they are too far forward, the aircraft may tip during loading and taxying. If they are too far aft, the aircraft will pitch forward violently during landing, which could cause the nose leg to collapse. If the main units are not sufficiently wide apart, the aircraft may tend to roll sideways, on the ground, especially in side winds and during taxying.

Shock absorbers

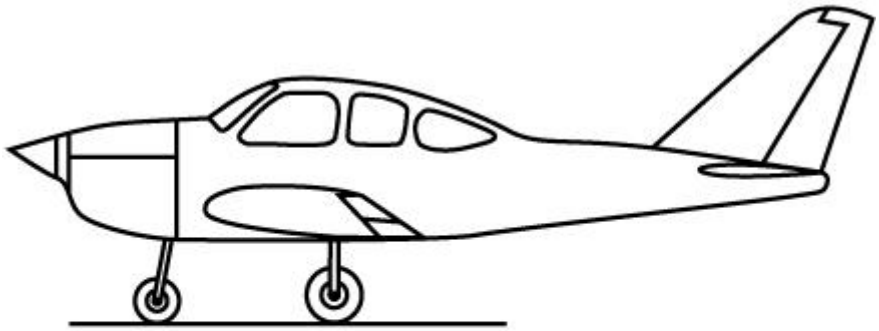
When an aircraft lands, a large force is generated on the undercarriage as it meets the ground. This may be up to three times the weight of the aircraft for transport aircraft, and up to eight times for an aircraft landing on a carrier deck. To prevent damage to the structure this shock must be absorbed and dissipated by the undercarriage so the aircraft wouldn't bounce back into the air.

Light aircraft may have simple spring steel and rubber shock absorbers. Most large aircraft, however, are supplied with oleo type shock absorbing struts. The most widely used oleo type strut is the pneumatic/ hydraulic or air/oil strut.This strut consists of two telescoping tubes that extend while in flight and are compressed upon landing. The two tubes are known as cylinder and piston and are actually two chambers for the movement of the fluid. The lower chamber or piston is filled with fluid, while the upper chamber or cylinder contains compressed air.

The moment the wheels touch the ground on landing, the mass of the aircraft starts compressing the strut, making the piston slide into the cylinder. The fluid from the piston is forced through an orifice into the cylinder where it further compresses the air. At the end of the compression stroke, the air is compressed to a point where the strut will travel no more. At that point, the energy stored in the compressed air acts as a spring to return the strut to normal. The flow of fluid into the upper chamber is controlled by the variable shape of a metering pin passing through the orifice. Some aircraft incorporate damping devices to prevent a too rapid extension of the strut which would cause the aircraft to oscillate and eventually damage both aircraft and undercarriage.

Tricycle Landing Gear (aircraft Landing Gear)

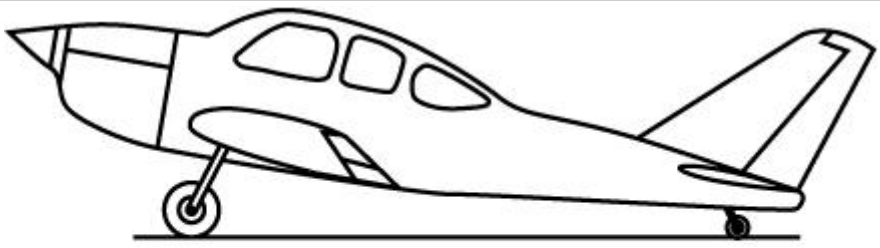
A type of aircraft landing gear that uses two main wheels located behind the centre of gravity and a nose wheel well ahead of the centre of gravity. The ease of ground handling of aircraft with tricycle landing gear has made this the most widely used landing gear configuration.



tricycle landing gear

Conventional Landing Gear (airplane Landing Gear)

The type of airplane landing gear with the main wheels ahead of the centre of gravity and a small wheel supporting the tail when the airplane is on the ground. A conventional landing gear requires a great deal of pilot skill to keep the airplane from ground looping (accidentally turning around) when it is moving at a fast speed on the ground. The other type of landing gear, which is now the most commonly used, is the tricycle landing gear. The two main wheels are behind the centre of gravity, and the auxiliary wheel supports the aircraft nose.



conventional landing gear

1. Translate and paraphrase the following words:

severe – _____
tricycle – _____
retracted – _____
dual – _____
nose – _____
wheel unit – _____
low-wing aircraft – _____
turboprop – _____
nacelle – _____
to tip – _____
aft – _____
nose leg – _____
dissipate – _____
spring – _____
orifice – _____
metering pin – _____
damping device – _____

2. Are the following statements TRUE or FALSE?

a) Undercarriage doesn't have to be light.
b) The most common layout is tricycle.
c) A great number of wheels is not desirable.
d) It cannot be retracted into the wing.
e) If it is positioned too far forward, an aircraft will roll sideways.
f) Shock absorbers have to absorb 2 times the weight of a transport aircraft.
g) Shock absorbers prevent aircraft from bouncing back in the air.

3. Answer the questions.

a) What is the function of undercarriage?
b) Why does it have to be light but firm?
c) What does the number of wheels and their arrangement depend on?
d) What is the most common layout?
e) Why does the Boeing 747 have 18 wheels?
f) Where can undercarriage be retraced?
g) What happens if it is positioned too far forward / too far aft?
h) How large is the force generated when an a/c meets the ground?
i) What are shock absorbers used for and why?
j) What kind of shock absorbers are there?
k) How does the air / oil strut work?
l) Why do some aircraft contain damping devices?

4. Retell the text and explain the following terms:

a) UNDERCARRIAGE: function, layout, retraction, position
b) SHOCK ABSORBERS: function, types, air / oil strut

26. A tire has ten lives

Aviation technology today is highly advanced, but each year inventors come up with new ideas on how to perfect aircraft. The landing gear, in particular, seems to offer the most scope for innovation.

Several inventors have suggested using motors to propel the aircraft's wheels. They have noticed that at every landing, the tires smoke and leave black stripes of abraded rubber on the runway, causing unnecessary wear and tear.

If the wheels were turning at the moment of making contact with the ground rather than having to instantly accelerate from zero to 150 miles per hour, their life could be extended many times. 'Great idea!' say the aircraft designers, and they have been saying this for decades. But adding so many mechanical parts and so much weight to the landing gear would simply be impractical.

So things remain as they have always been: after about 150 landings, aircraft tires are worn down and have to be retreaded. Once it has been as ascertained that their basic structure is undamaged, a fresh tread is applied by means of rubber vulcanization. Unlike car tires, however, aircraft tires only have lengthwise grooves because once on the runway aircraft only travel in a straight direction. A tire can be retreaded as many as nine times, which means that a healthy aircraft tire can have ten lives.

Most car owners don't know much about their car wheels, except that they have a rim and a tire which has to be changed occasionally. At major airlines, changing tires is an everyday routine. The strict safety guidelines governing air traffic dictate that all wheels make regular trips to the workshop before a defect turns up and not afterward. If you consider that the largest aircraft, the jumbo jet, has only two wings but no fewer than 18 wheels, you get some idea of just how much work this involves.

Each year, Lufthansa's wheel workshop at Frankfurt Airport checks 13,000 aircraft wheels, which come in 20 types and sizes. Automatic testing units use various methods to detect even the finest cracks in an aluminium rim. The 'history" of each wheel is faithfully recorded: its origin and age, the number of breakdowns and repairs, tire changes, aircraft changes and everything else it has encountered during its lifetime of flying.

The cheapest part of a wheel is still the tire. A single jumbo tire sells for DM 2,200 and can be retreaded for one-fourth of the price. Rims and brakes are, in comparison, much more expensive. A carbon disc brake costs as much as complete automobile.

To reduce the fire hazard, the tubeless tires are filled with nitrogen rather than air. The pressure, which is checked daily, is between 12 and 14 bar, that is, six to eight times that of a car lire. If a tire has to be changed out on the apron, this high pressure comes in handy. Mechanics fill the aircraft jack with nitrogen from the tire, thus lifting the landing gear off the ground. However, as tires sometimes weigh in excess of 200 pounds, they don't remove them by hand.

Aircraft clock up considerable mileage even while taxiing on the ground. Between each landing and takeoff they travel about five miles on average. In the course of a year, this can amount to over 6,000 miles. Each tire supports a weight of 15 to 25 tonnes and a far heavier force at the impact of landing.

What happens if the take-off of a fully-loaded long-haul aircraft has to be aborted? It's the supreme test of any landing gear, with hot brakes and scraping, smoking, sometimes bursting tires. But as an aircraft has 18 tires, one of them can go flat without any risk whatsoever of skidding.

1. Paraphrase the following words and fill in the gaps:
retreaded, rim, lengthwise, cracks, skidding, propel, worn down, by means, impractical, faithfully, propel

Several inventors have suggested using motors to _____the aircraft's wheels. But adding so many mechanical parts to the landing gear would simply be _____. After about 150 landings, aircraft tires are _____ and have to be _____. A fresh tread is applied _____ of rubber vulcanization. Aircraft tires only have _____ grooves because aircraft travel only in a straight direction. Automatic testing units use various methods to detect even the finest _____ in an aluminum _____. The history of each wheel is _____ recorded. As an aircraft has 18 tires, one of them can go flat without any risk of _____.

2. Fill in the chart:

VERB	NOUN	ADJECTIVE
perfect	/	
abrade	/	_____
propel	_____	_____
/	instant	/
/	wear	_____
ascertain	/	_____
_____	government	_____
		/

3. Explain the numbers from the text:
18 wheels, 9 times, 10 lives, 13000 wheels, 12-14 bar, 200 pounds, 5 miles

4. Complete the sentences.

a) If tires had motors_____

b) Tires are retreaded_____

c) Tires are regularly checked_____

d) _____to prevent defects.

e) Tires are filled with nitrogen because_____

f) _____

_____ to avoid skidding during aborted flights.

g) The most expensive part of a wheel _____

27. Safety topics

An accident to an RAF Chinook happened a few years ago and was not caused by maintenance error made within the Service. It was, however, due to a simple but catastrophic mistake made at a civilian overhaul facility. Almost unbelievably, the next day another RAF Chinook was destroyed in a virtually identical accident, having precisely the same cause. Ironically, a similar but much less damaging incident had occurred less than a year before. With the wonderful gift of hindsight, if the incident had been handled differently, it could have prevented both accidents.

As Chinook ZA 678 hover taxied at the commencement of a post minor maintenance air test, ground crew seated in the rear cabin heard an unusual, but short-lived "whirring" noise from the area of the aft transmission. Shortly after this they noticed light wisps of white or grey smoke behind the aircraft. At about the same time, a brief transmission chip detector warning, indicating a build-up of metallic particles in the oil system, was observed by the co-pilot. This resulted in the captain terminating the air test and turning the aircraft towards the airfield.

As the aircraft approached the dispersal, there was another slight flicker of the chip detector warning, a distinctive whining noise and a loud bang. The aircraft dropped to the ground and looped almost 360° before coming to rest. The front rotor head transmission and pylon separated from the aircraft with debris being flung in all directions. Nobody was seriously injured, although at least one parked car received a rather drastic unsought structural modification.

When examined, the magnetic chip detector plugs in the rear transmission system had attracted an abnormally large amount of debris. The transmission was subjected to a strip examination at third-line maintenance. This revealed that the thrust bearing for the input pinion gear, which transmits the drive from the engines into the rear gearbox, had been fitted the wrong way round.

The transmission had accumulated 103 flying hours before being returned to the aircraft manufacturer for a repair under warranty, and the accident flight had been the first since its reinstallation. It was inconceivable that the gearbox had run for 103 hours with the thrust bearing incorrectly fitted and hence the only conclusion was that the error had been made during the warranty repair. Although the repaired gearbox had been bench-tested prior to re-issue, the test had not reproduced the loads to which the gearbox would have been subjected during flight. Consequently, when such loads were applied, the incorrectly fitted bearing had allowed the pinion gear to move axially on its shaft and become unmashed. The subsequent rotor de-synchronization had allowed the rotors to collide with spectacular results.

1. Match the words and their meanings.
aft, flicker, pylon, hover, post, whirring, commencement, chip, axially, debris, wisp, whining, pinion gear, transmission, thrust bearing, unmashed, unsought, warranty, bench-test

razumijevanje situacije tek nakon što se ona dogodila –_____gift of hindsight_____
lebdjeti –_____
čin, obrada, radnje – _____
poslije – _____
iza, stražnji – _____
prijenos – _____

brujanje, zujanje – _____
komadić, pramen – _____
krhotina – _____
treptaj – _____
zavijanje – _____
nosač gondole na motoru – _____
otpaci – _____
valjkast ležaj u klipnom motoru koji apsorbira opterećenja radilice – _____
mali zupčanik – _____
neželjeni – _____
garancija – _____
standardna provjera – _____
po osi – _____
nestabilan, klimav – _____

2. Are the following statements TRUE or FALSE?

a) The captain terminated the air test because he noticed smoke. ___
b) The aircraft looped about 180^0 before coming to rest on the ground. ___
c) Debris killed someone. ___
d) Thrust bearing for the input pinion gear had been fitted the wrong way round. ___
e) The transmission accumulated 50 flying hours before being repaired under warranty. ___
f) The error was committed during the bench test. ___
g) The rotors collided. ___

3. Answer the questions.

a) Where was the maintenance error made?
b) Why did the captain terminate the air test?
c) What else preceded the dispersal?
d) What happened on the round?
e) Why was the transmission subjected to examination?
f) What were the results of the investigation?
g) How many flying hours had the transmission accumulated?
h) When was the error committed?
i) Why did the gearbox pas the bench test?
k) What were the consequences of the bearing being incorrectly fitted?

4. Write a REPORT on the incident as if you were the pilot.

INTRODUCTION – place and date of incident
PROCEDURE / DESCRIPTION– description of how the incident happened
RESULTS – immediate causes of the incident, corrective actions taken
DISCUSSION – contributing causes
CONCLUSION – ongoing investigation

28. Writing a report

Example

introduction	On 4 September, 2001 at Munich aerodrome, we experienced the loss of left hand nose wheel.
description	After departure and while taxiing to the runway, a nose wheel vibration was felt and the left hand nose wheel was ripped off.
result	The aircraft stopped on the runway. The left hand outer bearing, the axle sleeve and the wheel locking bolts were found broken.
discussion	The wheel had accumulated 86 landings since the last installation.
conclusion	The airworthiness authority is investigating the incident.

1. Writing the Incident Report – Put the sentences in the correct order. Make any necessary changes. Do not forget the date and place of the incident.

1. At the same time the aircraft yawed momentarily to the right.
2. Instead of the usual sound of the retraction mechanism in transit, there was an immediate shudder and loud thump which shook the whole aircraft.
3. There was a gear problem.
4. The passengers and the cabin crew had heard and felt the severe shudder and loud thump.
5. As we moved the landing gear selector to the down position, something went wrong.

TOPICS

1. Tail impact during automatic landing

- auto land carried out
- normal approach and landing to main wheel touch down
- all annunciations normal
- thrust reverse selected – the nose of the aircraft suddenly and rapidly pitched up
- the autopilot immediately disconnected
- the nose wheel lowered onto the runway
- the autopilot otherwise normal with a smooth touchdown on the centreline of the runway
- medium auto brake used
- a visual inspection at the gate revealed that the tail had impacted the ground and was damaged

2. Fire in the toilet

- a flight attendant reported smoke in the toilet
- the smoke had an acrid, electrical smell
- the co-pilot picked up a CO2 fire extinguisher from its bracket, opened the toilet door
- activating the extinguisher, discharging it into the toilet compartment
- emergency declared
- fire completely extinguished after landing by airport alerting service fire-fighters

3. Loss of fuel flow to the engine

- the aircraft climbing out
- engine No.2 experienced loss of fuel flow and vibration
- engine was shut down
- emergency declared
- landing without further incident
- maintenance inspection found disclosed metal in the oil filters and evidence of internal and external overheating at the fan frame vents

4. Engine damage

- engine No.1 failed during take-off
- loud bang heard
- successfully aborted take-off
- No.1 engine fire light illuminated as the aircraft cleared the runway
- the pilot fired both fire bottles and secured engine No.2
- the aircraft towed to gate
- investigation revealed the failure of the fan
- damage of high speed compressor from ingestion of foreign object
- a brass hammer head and additional parts of knurled handle found on the runway

29. Looking for damage

It is very important that maintenance crews check tyres for correct pressure and for damage.

Speaking

Discuss with a partner.

a Why is it important for a tyre to be as soft as possible?

b Why is it important for it to be as hard as possible?

c Why is it important to check for damage to a tyre?

Vocabulary

1 Put the words in the box into the correct column in the table.

tread misalignment bead sidewalls burst
damage vibration cracking layers wear puncture

parts of a tyre	problems with tyres

2 Mark the stress on the multi-syllable words and practise saying them with a partner.

Listening

1 Read the job sheet opposite. Listen and complete the JOBS CARRIED OUT section.

2 Listen again and complete the REMARKS section with any relevant comments or information you hear.

JOB SHEET	TYRE INSPECTION	
REASON FOR INSPECTION	BAD LANDING SUSPECTED DAMAGE TO TREAD	
		WRITE YES OR NO
JOBS CARRIED OUT	TREAD DEPTH MEASURED	
	TYRE DEFLATED	
	FOREIGN BODY REMOVED	
	WHEEL REPLACED	
	WHEEL FLIPPED	
	BEADS CHECKED	
	SIDEWALLS INSPECTED	
REMARKS AND FURTHER WORK		

3 **From the conversation, do you remember what *it* is in each of these phrases? Write down your ideas, then listen again and check your answers.**

a put it in the grooves
b look at it
c demount it and turn it round
d remove it
e inspect it

Language

1 **Look at the Language Box. Complete these sentences from the conversation using *some/any*, *something/anything*.**

a We need to look for _____ stuck in the tyre.
b Can you see _____? _____ foreign matter?
c What happens if we find _____ stuck in the tyre? Do we try to remove it?
d That's a bad sign. It means that there's _____ damage.

2 **Read the tapescript to check your answers.**

Language Box

some/any

Any refers to the whole group of items which are available, e.g.:
*You can contact me **any** time.*
*If you have **any** problem at all, talk to the supervisor.*

Some refers to a certain part of the whole group, e.g.:
*Can I take **some** of this paper?*
Some people think it wasn't a good idea.

These words work in the same way:
something, somebody, somewhere;
anything, anybody, anywhere.

A: Right, let's have a look at this then.

B: So why did they request a tyre inspection? We don't normally do it every time the plane lands, do we? Usually one of the crew does a quick visual.

A: No, I know, but apparently she had a bad landing because of these sudden crosswinds. Came down with quite a bump. And skidded a bit more than usual. That can sometimes do a lot of damage when the plane comes down quite hard.

B: Ok, so what's the main thing to look for?

A: We'll do it by the book. Have you got the tread gauge there?

B: Here you are.

A: Thanks. Hmmm ... Right, let's see. Just put it in the grooves - there ... and there ... and there ... Yep, that's good. There's plenty of wear left on these tread. So let's just stand back and look at it from the front. Ah yes, small problem there, can you see?

B: Oh yes, the treads look a bit more worn on the right hand side than on the left. Does that mean replacing it?

A: Not necessarily. If there's no other problem, we can just flip it.

B: Flip it?

A: Demount it and turn it round so that the wear is evened out. But we'll need to report it, so that the nose wheel gear is checked.

B: So that might be the cause of the problem. Gear misalignment.

A: Yes, and it's probably causing a bit of nose wheel vibration as well. Right, now we need to look for anything stuck in the tyre. No ... Looks OK. Can you see anything? Any foreign matter?

B: No. Looks all clear. What happens if you find something stuck in the tyre? Do we try to remove it?

A: Not while the tyre is inflated, you don't. You could burst it and really hurt yourself. No, if there's anything noticeable, it has to come off and be repaired in the workshop. Now, let's have a look at the beads and the sidewalls.

B: What are we looking for?

A: The obvious things really - heat damage on the beads, they're the hottest parts of the tyre. Cracking or bulges.

B: Like this you mean?

A: Ah yes. Well spotted. It's only about the size of your thumbnail, but it's a definite bulge all right. Well that's it then, off it comes. The shop'll have to inspect it, no question.

B: But it doesn't look too bad.

A: Not yet, it doesn't, but it's a bad sign. It means that there's some damage or separation between the layers. Every time it's used, it'll get worse. Right I'll let the flight crew know what's happening and then we'll get started.

30. Going through the checks

Reading and speaking

1 What meaning do all of these verbs share?

ensure verify confirm ascertain make sure

2 Look at the following text. With a partner, discuss these questions.

a What are the people in the pictures doing?

b Why is it important that they do this?

c Can you suggest some reasons why they might miss things during this job?

d What items/systems might a pre-flight visual check involve?

3 Read the following text and tick any of your ideas that are mentioned.



Before a flight, it is mandatory for the captain or the copilot to make an inspection of the aircraft, whether any maintenance has been done or not. This pre-flight inspection includes:

1. visually inspecting for obvious structural damage;
2. ensuring that all access doors are secure;
3. verifying that landing gear locking pins have been removed;
4. checking that the control surface locks have been removed;
5. ascertaining that there are no fuel or oil leaks;
6. making sure that engine air ducts are clear of foreign objects;
7. verifying that tyres are correctly inflated and in acceptable condition;
8. confirming that fuel, oil and other liquid systems have been properly serviced;
9. going through pre-flight checks of instruments and indicators in the cockpit.

Listening

Unfortunately, flight crews don't always spot problems. You are going to listen to some reports from aircrew on the results of poor maintenance work.

1 Revise the three forms of the following verbs. Underline the eight verbs that do not end in *~ed* in the past and past participle forms. For example, tell (*told*).

take off	land	call	discover	fly	accept
try	check	say	be	do	notice
move	fail	seem	push	arrive	suspect
have to	miss	hand over	give	tell	indicate

2 Look at the Skills Box. Check that your pronunciation of the verbs is correct.

3 Listen to four reports from aircrew and decide which items on the list in the text from the Reading and speaking section are being referred to.

Skills Box

Speaking and listening

Remember that the *~ed* ending of regular past tense verbs is never pronounced /ed/ like *bed*. It is pronounced /t/, /d/ or /id/.

For example:
missed, removed, inflated

The three forms of verbs that don't end in *~ed* have to be memorised.

Writing and language

Study the Language Box.

1 Look at the sentences below. Decide if the result of the situation is in the past or the present.

a If there had been a warning flag on the pin, *someone would have noticed it.*

b *It would be easier to believe if* the captain himself hadn't missed it.

2 Write sentences expressing these past conditions and their results.

a I didn't ask for an authorised fuel delivery document, so I didn't know how much fuel there was in the tanks.

If I had asked _____., I would _____.

b I'm annoyed because maintenance didn't do a good job.

I wouldn't _____ if maintenance had _____.

c The heavy traffic meant that we landed at another airport.

We wouldn't _____ if the traffic hadn't _____.

d I didn't spot the damage with my flashlight, so now I'm in trouble.

If I _____, I wouldn't _____.

e The locking pin was in position, so we weren't able to bring up the landing gear.

_____

Language Box

Hypothetical past conditions and their results

The word *if* is used with *would have* + past participle to express the past result of a past hypothetical event, e.g.,
If I had worked harder I would have passed the test.

However, when the result is in the present, *would/could* or *might* is used with the verb infinitive, e.g.,
If we hadn't seen the problem so quickly, we could be in trouble now.

Report A:

We took off without any trouble, until we tried to bring up the landing gear. The left hand gear wouldn't come up - you know why? Maintenance had forgotten to remove the pin before they moved the plane from the hangar to the gate. Anyway, we had to divert to another airport nearby, because of heavy traffic. We landed again ok and the pin was removed. Now maintenance checked it and didn't see it – the pilot did a pre-flight and missed it, and even the push crew who moved them away from the gate failed to spot it. Now ... my guess is that there was no warning flag on the pin. I'm sure someone would have noticed if there had been. So that was two mistakes -or three if you count the inspection failures as well.

Report B:

We were flying from our maintenance base to the airport to take the plane back into service. As part of the cockpit check, I called for a fire warning system check and the Captain said "complete". Everything seemed fine. It was an uneventful flight and we handed over to a relief flight crew at our destination. But they discovered that the fire extinguisher indicator lights weren't illuminated - and in fact it turned out that the bottles weren't actually connected! They were still unplugged from when the plane was in maintenance. They'd forgotten to hook up the bottles again! I can't believe that the Captain missed it first time round ... but I suppose that's what must have happened.

Report C:

As we pushed back from the terminal at Dallas airport we got a report that we'd hit another aircraft with our tail. Maintenance was called and they gave us the all clear. Anyway, we flew on down to Mexico City, arriving there at just after midnight local time in the pouring rain. I did the pre-flight with a torch, just before we took off at 2 am – still raining hard – all looked ok. We arrived in Chicago five hours later and when the aircraft was being inspected in the hangar they found tail damage. Now I'm in trouble with management because they say I didn't do a proper inspection and I shouldn't have taken off from Mexico. It's crazy. Maintenance have all the equipment in the world and they didn't spot it first time round. I'm supposed to see it at 2 am in the pouring rain, in the dark, with a flashlight. It's ridiculous.

Report D:

I accepted the aircraft for a test flight after it had had a couple of weeks in maintenance for fuel tank leaks. The mechanic in charge told me that they'd put in 1,200 lbs of fuel per wing. The pre-flight was fine and take off normal and the short flight went OK, although I noticed the fuel transfer light came on just before landing and the fuel gauges indicated zero intermittently, but I suspected a faulty connection problem. I took it up again for a longer run and about 3 minutes into the flight, the right engine flamed out, followed 90 seconds later by the left. The engines wouldn't re-start and I was forced to make an off runway landing on a bit of empty highway. Luckily, it isn't used very much. Of course, it turned out that both main tanks were empty. I've learnt my lesson. In the future, I will watch the fuelling being done, look in the tanks myself, or insist that I have an authorised fuel delivery document.

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