



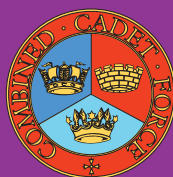
# **air** **cadets**

*the next generation*

## *air cadet publication*

*ACP 34*

*aircraft operation*  
*volume 2 - airmanship II*



Amendment List		Amended by	Date Incorporated
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# ACP 34

## AIRCRAFT OPERATION

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### Volume 2

## Airmanship II

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Instructors' Guide

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# CHAPTER 1

## AIR TRAFFIC CONTROL

### Introduction

#### **ATC, ATCC & ATCRU**

1. At Royal Air Force airfields all movements of aircraft, both on the ground and in the air, are monitored and controlled by a vital service known as Air Traffic Control (ATC). The ATC controllers and supporting staff operate from the “control tower”, and they communicate with the aircrew by radio telephony (RT). In the tower will be aerodrome controllers for aircraft on the ground and in the circuit, and approach controllers for aircraft that are outside the circuit, but within the airfield’s area of responsibility. Other controllers, responsible for the safety of aircraft flying between airfields, may be located in Air Traffic Control Centres (ATCCs) or Air Traffic Control Radar Units (ATCRUs) neither of which need be situated on airfields.

### The Control Tower

#### **Recognise a Control Tower**

2. The control tower on an airfield is always in a prominent position in the aircraft manoeuvring area. It has offices and rooms for electronic equipment, and it may house a Bird Control Unit (BCU) and a Ground Radio Flight. The size and design of ATC towers vary considerably.

**Fig 1-1** Just one of the many types of ATC tower



### The Aerodrome Controller

#### **Aerodrome or Airfield Controller**

3. The aerodrome controller works in a glass walled control room on the top of the control tower. From here there is an uninterrupted view of the manoeuvring area, of aircraft which are on the ground, taking off, or landing and in the airfield circuit. This controller supervises the movements of all traffic on the ground in the manoeuvring area (aircraft, vehicles and pedestrians), and all aircraft flying in the local circuit. The aerodrome controller may also be known as the airfield controller or the local controller.

**Fig 1-2** An aerodrome controller and assistants at work



### The Approach Controller

#### **Approach Controller**

4. The approach controller controls aircraft departing the airfield circuit and those making instrument approaches. In addition, the approach controller may provide a radar service to aircraft in transit through the area of responsibility of the airfield. Since most of these aircraft are out of sight of the airfield, the approach controller does not need a window to the world outside. Instead, obtains information from RT, landline communications, and radar displays.

**Fig 1-3** Approach controllers use displays and radios



## The Runway Controller

### **Runway Controller**

5. For more effective control at airfields that have a high rate of take-offs and landings, a runway controller may be used. This controller is in direct contact with the airfield controller and works from a caravan, painted in red and white squares, positioned to the left of the touch-down end of the runway in use. The runway controller can refuse aircraft permission to move onto the runway, or to take off, or to land, depending on circumstances. The controller also controls ground vehicles in the runway area. For example the controller might:

- a. Prevent an aircraft from landing with its undercarriage retracted by firing a red flare.
- b. Stop an aircraft from taking-off which had for example a panel unlocked or a fuel leak, by showing a steady red on the signalling lamp.
- c. Warn vehicles or aircraft on the ground to move clear of the landing area, by showing red flashes on the signalling lamp.
- d. Give permission to take-off, with a steady green on the signalling lamp.

**Fig 1-4** Runway controllers work from a caravan painted in red and white squares



## Communications

### **Communication Systems**

6. The control of air traffic depends hugely on good communications, both ground-to-ground and ground-to-air. Swift and accurate contact between ground organisations is achieved through the use of special telephones and tele-talk systems. Ground-to-air communications are by radio telephony (RT). Communication systems must be reliable, clear and precise so that the danger of instructions and information being misunderstood is reduced to a minimum.

## Telephone

### **DFTS**

7. The tower will most likely have its own switchboard so that it can make calls through three separate telephone systems: these are the normal BT system; the Defence Fixed Telecoms System (DFTS) which links all units and stations together; and a special air traffic control system which links the tower by direct cables (called landlines) to important centres such as ATCCs, ATCRUs, other airfields in the emergency organisation and controlling authorities. When direct landlines are installed there is no need to dial a number- the person being called can be contacted at once by lifting the receiver of the telephone.

## Tele-talk

### **Tele-talk**

8. Although the tower could use its telephone system to contact any section on the unit, it will most likely have a tele-talk system for direct contact with vital offices and sections on the airfield. Tele-talk is used, for instance, between the tower and the Station Commander, the Medical Officer, the met office and the fire section.

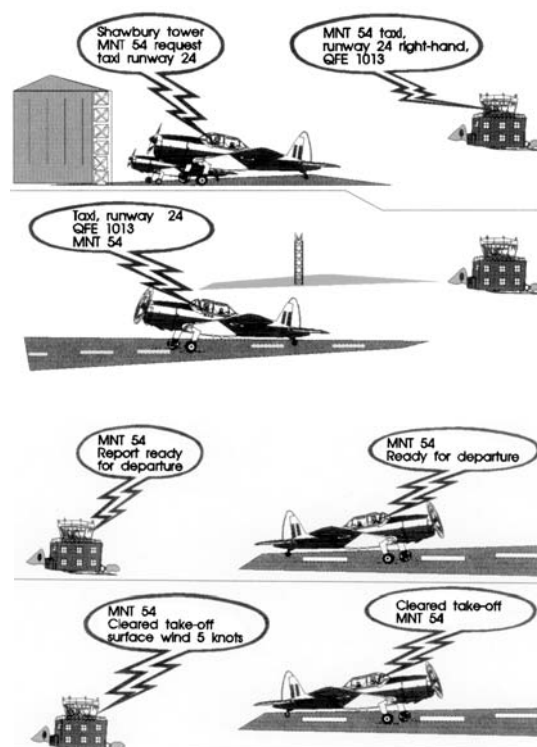
## Radio

### **VHF & UHF**

9. The main method of talking to aircraft and vehicles is, of course, by RT on very high frequency (VHF) or ultra high frequency (UHF) bands. The importance of these bands is that they give clear reception, free from interference. Each airfield has its own frequencies, allocated specifically for airfields control and approach control. Crash and vehicles using manoeuvring area will have yet another frequency. The tower may also have further frequencies for radar controllers and visiting aircraft. All RAF airfields also have the military distress frequency.



**Fig 1-5** Pilots and controllers communicate using RT



### Visual Communications

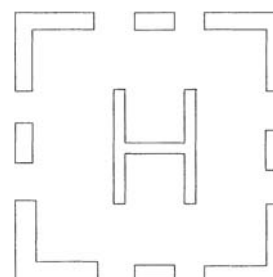
**Visual Communications** 10. Information and instructions can also be communicated visually, either by active means such as a signal lamp (as described earlier), or passively through the use of ground markings and signs. For example, a runway threshold is marked in white large enough to be seen from the air

### Helicopter Operating Areas

#### **Helicopter Operating Areas**

11. Helicopter operating areas are identified with a white letter "H", 4 metres high with a 2 metre crosspiece. These areas are normally well clear of fixed wing operations and may be further highlighted by the use of edging round the landing area.

**Fig 1-6** Helicopter operating area marker



## Airfield Hazard Markings and Obstruction markers

### **Stationary Hazards**

12. Stationary object hazards are identified by a three sided solid, mounted on a pole set in a round base.

**Fig 1-7** Stationary objects marker

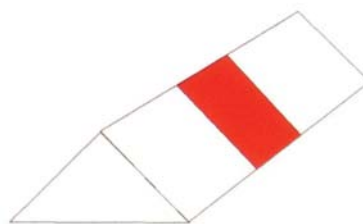


## Bad Ground

### **Bad Ground Markers**

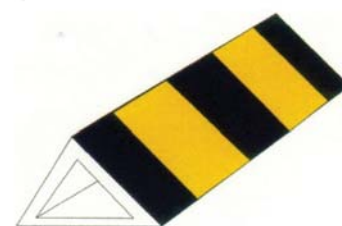
13. At airfields where taxiing on the grass is permitted, you may see markers to indicate bad or obstructed ground which must be avoided. Here are some examples:

a) A white canvas “V” marker (0.45m high and 2.1m wide) with a red band.



**Fig 1-8** Canvas marker

b) A 1m-long striped solid, alternating yellow and black every 0.2m and 0.45m high.



**Fig 1-9** Solid marker

c) Yellow flags or squares on light stakes (sides of squares are approximately 0.61 m).



**Fig 1-10** Flag marker

### Communication Aids

#### ***Location of Communication Aids***

14. Pilots cannot “see” the way ahead in bad weather, hence radio and radar systems are used. These systems enable pilots to take off and land almost regardless of the prevailing weather conditions. There are also many forms of radio and radar navigation aids to help them fly safely between airfields and on operational tasks. These aids may not necessarily be sited on an airfield and may not therefore be seen by you on visits.

#### ***Location of Approach Aids***

15. On your visits to airfields you may see airfield approach and runway approach aids. An airfield approach aid is designed to guide an aircraft down to a point in the vicinity of the airfield, from where, if the airfield can be seen clearly, the pilot will land visually. If the pilot is still in cloud and cannot see the airfield from that point, a runway approach aid guides the aircraft right down to a position on the correct approach, near to touch-down point on the runway in use.

### RADAR

#### ***Radio Detection And Ranging, Displays***

16. RADAR (Radio Detection And Ranging). A radar system consists of a transmitter and a receiver. A short pulse of electromagnetic energy is transmitted from an aerial and the receiver “listens” for an echo. Lots of objects will reflect the electromagnetic pulse back to the receiver, including aircraft flying within range. The receiver detects which reflections are from aircraft, and it can determine their position, direction of travel and speed. This information is then displayed through a cathode ray tube onto a screen. In this way radar has become the “eyes” of air traffic control.

### Radio Aids.

17. The two main radio aids likely to be seen at Royal Air Force airfields are;

#### ***DRDF***

a) Digital resolution direction finding (DRDF)

#### ***ILS***

b) Instrument landing system (ILS)

DRDF

**RT Transmission CDTC** 18. DRDF is a common airfield approach aid and is likely to be seen on most ATC towers. It receives an RT transmission from an aircraft and displays it on a cathode ray tube as a green line called a "trace". The line cuts the compass rose on the edge of the screen and this tells the approach controller the aircraft's bearing from the airfield. It will also allow the approach controller to tell the pilot what course to fly to reach the airfield. Using this equipment the approach controller can direct the aircraft to a point above the airfield and from there control its descent through cloud (CDTC) to a height and position on the approach from which the pilot can either land visually or employ a runway approach aid.

ILS

**Radio Beam** 19. ILS is a runway approach aid in which fixed transmitters on the ground send out a special pattern of radio signals which define a radio beam which is like a pathway in the sky, down which an aircraft can be guided to the touch-down point on the runway in use. Receivers in the aircraft pick up the signals and display the information on special instruments that enable the pilot to fly the aircraft down the beam to touch-down. In this system the pilot interprets the signals and does not need any outside assistance.

Radar Aids.

20. The two main radar aids likely to be seen at Royal Air Force airfields are:

- Surveillance Radar** a) Surveillance radar
- PAR** b) Precision approach radar (PAR)

Surveillance Radar

21. Surveillance radar is used both to monitor air traffic passing through an area and as an airfield approach aid. In the latter role it enables the controller to locate the aircraft and direct it to a position and height near the airfield from which the pilot can join the circuit visually and land, or, in poor visibility employ a runway approach aid such as ILS or PAR.

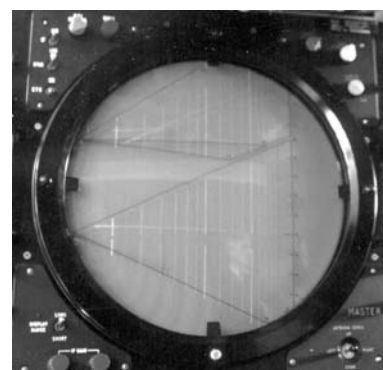
### Precision Approach Radar

**PAR CR62. Elevation & Azimuth. GCA**

22. The CR62 and PAR 2000 are the Royal Air Force's main PAR. The radar cabin is located on the airfield near to the runway, with a remote display screen for the system located in the tower. The controller has two screens, one for the aircraft's elevation (height) and one for azimuth (left and right), relating to the approach path.



**Fig 1-11** A CR62 PAR cabin



**Fig 1-12** A CR62 PAR display

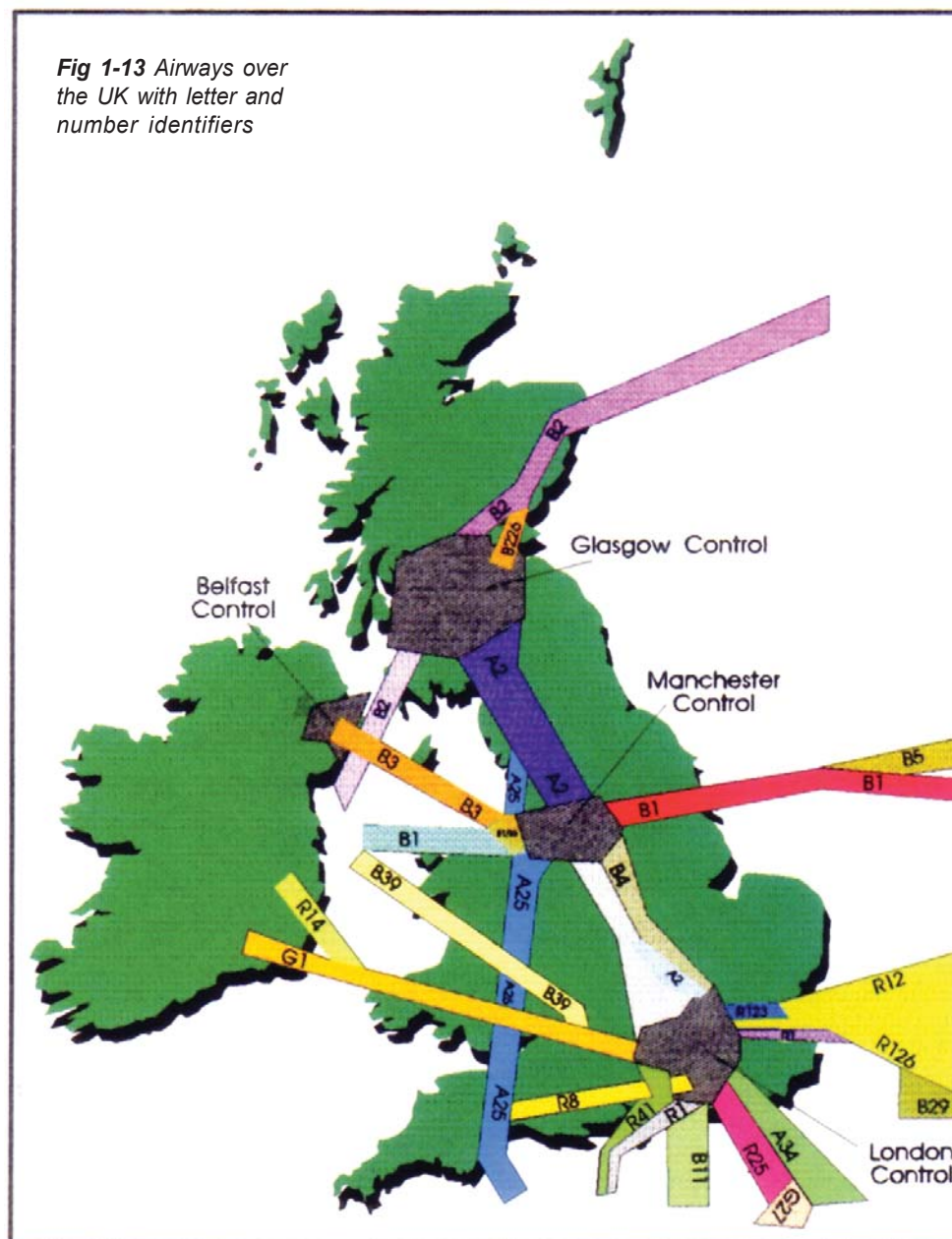
The controller uses this information to pass instructions by RT to the pilot, and thus guide the aircraft down the correct glide slope towards the touch-down point, until the pilot is close enough to land visually. Obviously, the controller must be very skilled and the pilot must fly very accurately. The procedure is called a ground-controlled approach (GCA). These two radars will be replaced by the new "Replacement PAR".

### Airways System - Controlled Air Space

**Airways**

23. As an aid to the control and safe management of air traffic, airspace is divided into classes or functional areas. Some of these have strict rules on the conduct of flying within them: they are termed "controlled airspace". One important class is a network of imaginary "tunnels" in the air called airways. They are vital in facilitating safe transit for large numbers of aircraft in congested airspace. Any aircraft, whether military or civilian can use them providing:

- a. The pilot has a valid instrument rating.
- b. The aircraft is fitted with appropriate radio and navigational equipment.
- c. The flight is made in accordance with the rules.



#### Width of Airways

24. Airways are between 10 and 20 nautical miles (18.5 to 37km) wide and have upper and lower height limits, although as they approach airfields they do slope down to the ground to form airfield zones.

#### Centre Beacons

25. The centre of an airway is marked by a series of radio navigation beacons. Aircraft fly from beacon to beacon reporting to ATCC their position, time and height.

In this manner ATCC are able to keep aircraft, which are flying at the same height, separated by time intervals.

***Clearance***

26. Clearance is always required for flights along airways. The route must be thoroughly planned beforehand and the flight plan submitted to ATCC before take-off. Once airborne, contact with ATCC must be established before an aircraft can enter the airway. The aircraft is then identified and tracked on radar, although it remains the pilot's responsibility to maintain planned tracks and timings.

**Crossing Airways*****Crossing Airways***

27. If an aircraft flying outside controlled air space wishes to cross an airway en route to a specific destination, there are 2 ways in which to do it:

- a. Providing the base of the airway is above the ground, the aircraft can be flown underneath and no permission is needed.
- b. The aircraft can be flown through the airway, provided clearance and radar control is obtained from the appropriate ATCRU.

## Self Assessment Questions

### ATC

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

1. Where is the Aerodrome Controller located?
  - a. In a small darkened room at the base of the control tower
  - b. In a Ground Traffic Control Tower
  - c. In a glass walled control room at the top of the control tower with an uninterrupted view of the manoeuvring area
  - d. In a green and white caravan close to the runway
2. What do yellow flags 0.61m square indicate?
  - a. Bad ground which should be avoided
  - b. Oil on the runway, aircraft should slow down
  - c. A stationary object hazard
  - d. Do not take off your undercarriage is still down
3. What is the RAFs own telephone system called?
  - a. General Purpose Telephone Network (GPTN)
  - b. Airbase Telephone System (ATS)
  - c. Defence Fixed Telecoms System (DFTS)
  - d. RAF telephone Network (RAFTN)
4. What does the abbreviation DRDF stand for?
  - a. Direct Radiation Direction Finding
  - b. Digital Reactive Detection and Finding
  - c. Digital Resolution Direction Finding
  - d. Direct Response Direction Finding
5. How are the centres of airways marked?
  - a. By a 4 figure map reference
  - b. By large white arrows cut into the ground
  - c. By a series of ATCRUs on the centre line
  - d. By a series of radio navigation beacons



## CHAPTER 2

### Rules Of The Air

#### Introduction

##### ***Avoiding Collisions***

1. Without the Highway Code the many thousands of cars travelling daily on our busy roads would find it impossible to move about safely. So it is with aircraft in the air. There must be rules to govern the way aircraft move about the sky so that accidents can be avoided. They are called “Right of Way” rules.

##### ***Rights of Way Rules***

#### Rights of Way for Differing Types of Aircraft

##### ***Differing Aircraft types - Rights of Way***

2. There are four main types of aircraft - balloons, gliders, airships and conventional powered aircraft. Balloons cannot be steered; they are completely at the mercy of the wind and cannot easily manoeuvre to avoid collision. For this reason, all other types of aircraft must give way to them.

3. Gliders are fairly manoeuvrable and so can try to avoid collision, but their air speed is generally low and they do not have engines to get them out of difficult situations. Gliders, therefore, have the right of way over both powered aircraft and airships.

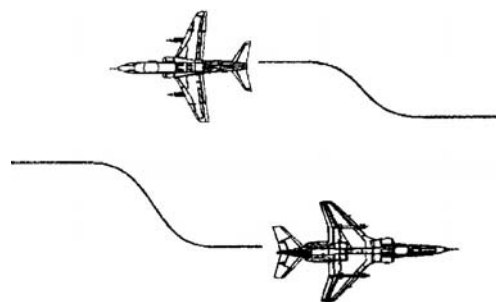
4. Airships, although not very common, do have engines to control their movement and so can avoid collision more easily than gliders or balloons. For this reason airships must give way to both gliders and balloons.

5. Powered conventional aircraft, by far the most manoeuvrable of the four types must give way to balloons, gliders and airships.

#### Rights of Way for the Same Type of Aircraft

##### ***Approaching head - on***

***Fig 2-1 Head-on - both  
move to their right***

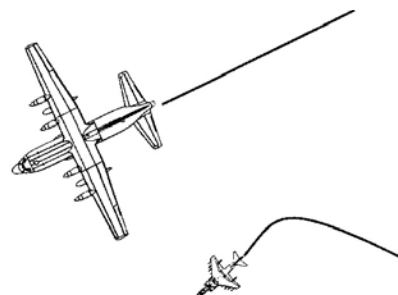


6. When two aircraft are approaching head on, or nearly so, each must alter course to the right.

**Converging Courses**

7. If two aircraft are flying at about the same height and are on converging courses, the aircraft which has the other on its right must give way.

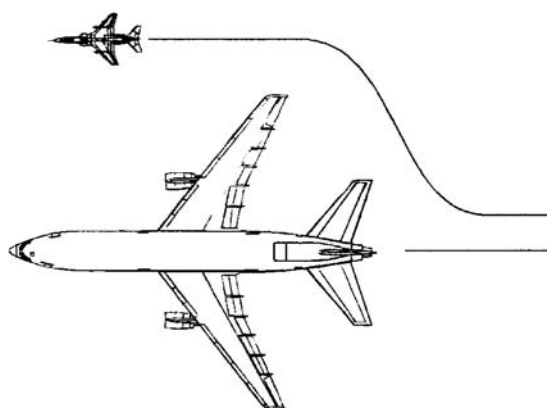
**Fig 2-2** Converging course - the left hand aircraft gives way.



**Overtaking**

8. An aircraft being overtaken has the right of way. The one overtaking must avoid the other by turning right. However, if both are gliders, the overtaker may turn right or left.

**Fig 2-3** Overtaking-the faster aircraft moves to starboard.



9. There are two special right of way rules that apply when aircraft are about to land:

**Approaching to Land**

- a. An aircraft landing or on final approach to land has right of way over aircraft in flight or on the ground.

**Emergency Priority**

- b. When two or more aircraft are approaching to land at the same time, the lower one has right of way, unless the captain of the lower aircraft becomes aware that one of the others has an emergency.

## On The Ground

### **Vehicles and Aircraft**

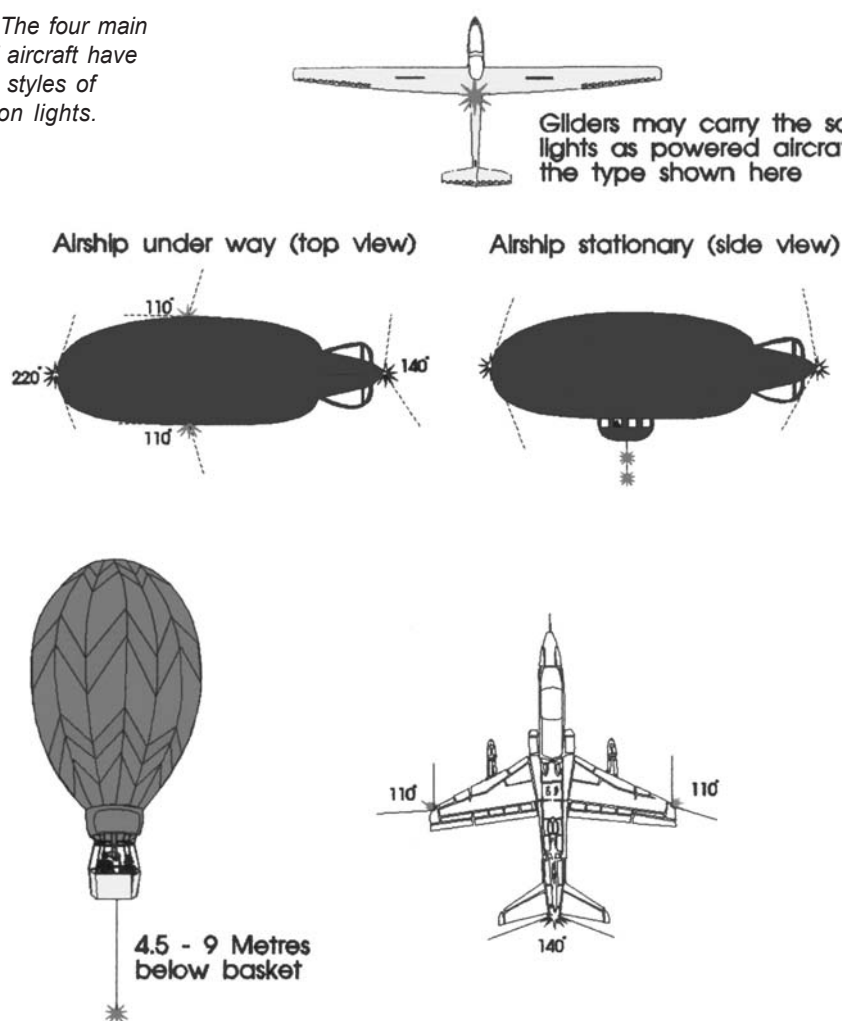
On the ground, aircraft and vehicles being taxied give way to aircraft being towed. Vehicles not towing aircraft give way to aircraft being taxied.

## Rules At Night

### **Navigation Lights**

10. At night it can be difficult for a pilot to see another aircraft - and when it is seen, its heading may still be unknown. It is however, vital to know, so that the right of way rules can be applied. Therefore, most modern aircraft carry one or more flashing "anti-collision" lights so that they can be seen easily, and "navigation" lights - different coloured lights on the wing tips and the rear - to help a pilot judge which way the other aircraft is travelling.

**Fig 2-4** The four main types of aircraft have different styles of navigation lights.



### Converging at Night

#### **Converging at Night**

11. In this converging example, if the Harrier (A) pilot looks out to starboard and sees a red light moving alongside (B), he knows that the other aircraft has right of way and he must take action to avoid a collision.

**Fig 2-5** At night navigation lights indicate heading of aircraft.

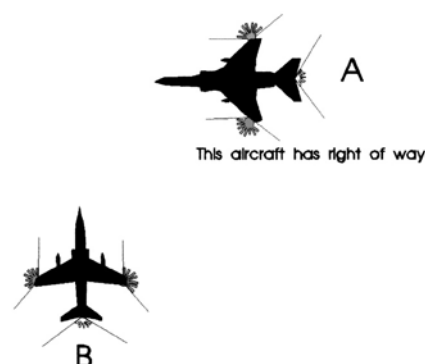


### Crossing Flight Paths at Night

#### **Crossing Flight Paths at Night**

12. In this example, the Jaguar pilot (A) sees a green light crossing from port to starboard, and therefore knows that the Hawk (B) should give way. The Jaguar pilot must, however, be aware that the Hawk pilot might not have seen him and should therefore be ready to take avoiding action if necessary.

**Fig 2-6** Flight paths cross - uses converging flight rules



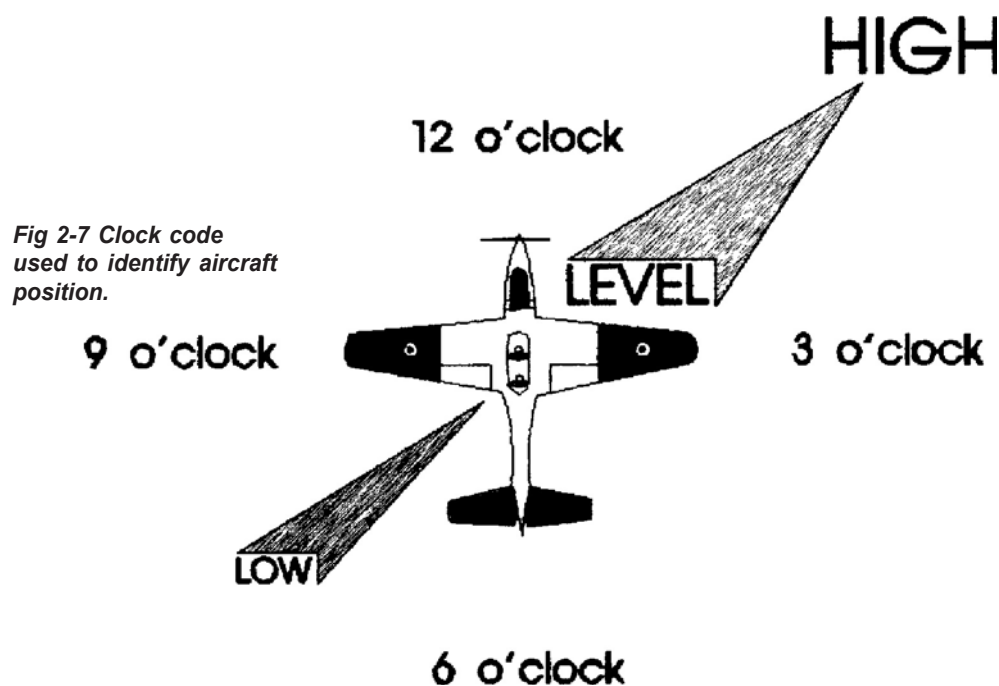
### Avoiding Other Aircraft

#### **Clock Code**

13. While in the air the best way to avoid a collision is to see the other aircraft as early as possible. If you are a member of a crew on a normal sortie and you see an aircraft that may pose a threat, you must inform the captain of the presence of the aircraft and its position. To pin-point the location of this aircraft you would use the "Clock Code" system. With this system you imagine that your aircraft is lying on the face of a clock. Directly ahead of your aircraft is 12 'o clock, directly astern

is 6 'o clock. Any aircraft sighted can now be positioned to the nearest clock numeral. This tells the captain which way the aircraft is, but for extra clarity you can add HIGH/LEVEL/LOW relative to your aircraft. Using this system will give the captain a rapid location of the aircraft and allow time for avoiding action to be taken.

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## Self Assessment Questions

### Rules Of The Air

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

1. What are the 4 main types of aircraft?
  - a. Gliders, space rockets, conventional powered aircraft and airships
  - b. Parachutes, gliders, balloons and hanggliders
  - c. Balloons, gliders, airships and conventional powered aircraft
  - d. Kites, parachutes, airships and conventional powered aircraft
2. When two conventional powered aircraft are approaching head- on they should:
  - a. Both turn to the left
  - b. Both alter course to the right
  - c. Not alter courses as they are very unlikely to hit each other
  - d. The aircraft going north should climb and the other should dive
3. When in the air the best way to avoid a collision is to?
  - a. File a flight plan
  - b. Rely on radar services
  - c. Hope that you don't hit any other aircraft
  - d. See other aircraft as early as possible and takeavoiding action if necessary

## CHAPTER 3

### AIRCRAFT KNOWLEDGE

1. All the aircraft selected to appear in this chapter are in service with the Royal Air Force today. They fall into three groups, namely operational, training and historical. These aircraft can be seen flying regularly either at RAF stations or at the many public displays given throughout the year. If you ever get the chance to see them, it should provide you with the opportunity to practice your aircraft recognition skills. In addition, you can further your aircraft knowledge by closer studies of aircraft during visits to RAF stations. This publication is not intended to be the sole source of information on aircraft in the RAF. Other publications such as the Observers Book of Aircraft and Jane's World Aircraft Recognition Handbook can also be consulted, together with the many high quality aircraft magazines that are available today.

2. The information in this chapter was up-to-date when it went to press but aircraft are generally under constant development. Engines are up-rated or changed, airframes are modified and various equipments are improved. This means that performance figures such as maximum speeds, all-up weights, payloads and armament may change. You should, therefore, study the current aviation press to keep abreast of aircraft developments. However, note that the examinations will be set from this booklet and your answers should be drawn from it.

3. The suffixes to the names of RAF aircraft indicate the primary role and the particular mark of aircraft. For example:

#### **"Hawk T Mk 1A"**

The "T" indicates that the role of the Hawk is training. "Mk 1A" indicates that this is the first version of the Hawk (Mk 1) with a subsequent revision (A), which in this case is the modification of the aircraft to carry out an air defence role.

4. The differences between various marks of aircraft may be quite extensive - different engines or a "stretched" fuselage for example - or very minor and hardly noticeable as in the case of some internal equipment modifications.

5. RAF aircraft are generally designated by a type name (also known as the “Reporting Name”) with role letters and mark numbers to follow. Some of the more common role letters are as follows:

<b>AEW</b>	Airborne Early Warning
<b>B</b>	Bomber
<b>C</b>	Transport
<b>E</b>	Electronic/Flight Checking
<b>F</b>	Fighter
<b>FG</b>	Fighter Ground Attack
<b>GR</b>	Ground Attack Reconnaissance
<b>HAR</b>	Helicopter, Air Rescue
<b>HAS</b>	Helicopter, Anti-submarine
<b>HC</b>	Helicopter, Cargo
<b>HCC</b>	Helicopter, Transport and Communications
<b>HT</b>	Helicopter, Training
<b>HU</b>	Helicopter, Utility
<b>K</b>	Tanker
<b>MR</b>	Maritime Reconnaissance
<b>R</b>	Reconnaissance



**PR**      Photographic Reconnaissance

**S**        Strike

**T**        Trainer

6.        Thus a Sea King HAR 3 is an RAF Sea King helicopter fitted for the air rescue role.

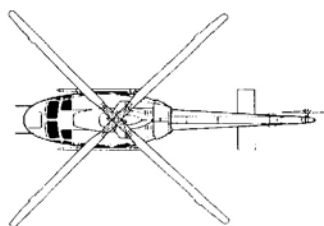
*Reporting Name***GRIFFIN***Role Letters and Marks***HT1***Role***TRAINING HELICOPTER**

1. The Griffin HT1, and advanced training helicopter, is operated within the Defence Helicopter Flying School (run by FBS Ltd), a combined operation by FR Aviation, Bristow Helicopters and SERCO, to train helicopter pilots for all three services. First entered service in 1997, civilian contractor owned and operated.
2. Manufactured by Bell Helicopter Textron, Fort Worth, Texas, the essentially similar Bell 212s are operated by Brunei.

*Technical Data*

<b>ROTOR DIAMETER</b>	<b>14.02M</b>
<b>LENGTH</b>	<b>12.92M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM CRUISING SPEED</b>	<b>258km/h (161 mph)</b>
<b>ENGINE</b>	<b>One Pratt &amp; Whitney Turbo</b>

**GRIFFIN HT1**  
*Training Helicopter*



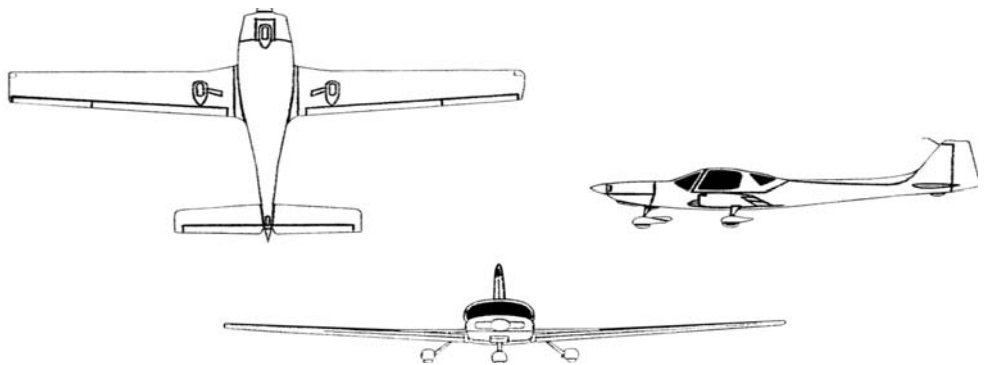
*Reporting Name***GROB 115 (TUTOR)***Role Letters and Marks*T1*Role***PRIMARY TRAINER**

1. The Grob 115 (Tutor) aircraft entered Royal Air Force service in 1999, replacing the Bulldog at UAS and AEFs. The RAF Tutor has dual controls and the 2 seats are in side-by-side format.

*Technical Data*

<b>WING SPAN</b>	<b>10M</b>
<b>LENGTH</b>	<b>7.4M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>150kts at Sea Level</b>
<b>ENGINE</b>	<b>One Lycoming 4-cylinder piston engine</b>

**GROB 115 (TUTOR) T1**  
*Primary Trainer*



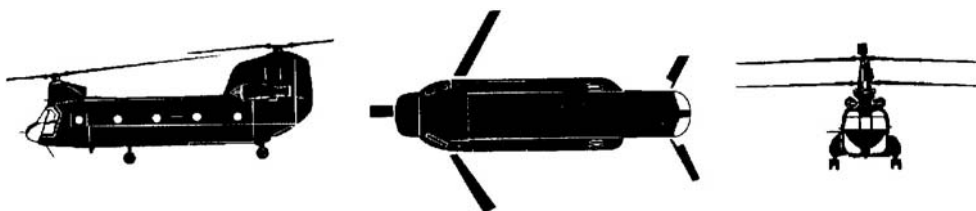
*Reporting Name***CHINOOK***Role Letters and Marks***HC2***Role***MEDIUM TRANSPORT & MEDIUM LIFT HELICOPTER**

1. The Chinook is a tandem-rotored, twin engined medium-lift helicopter with a crew of four. It can carry up to 45 fully equipped troops or up to 10 tonnes of equipment either internally or underslung. The Chinook fleet has recently undergone a mid-life update.

*Technical Data*

<b>ROTOR DIAMETER</b>	<b>18.29M</b>
<b>LENGTH</b>	<b>15.54M</b>
<b>CREW</b>	<b>4</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>157kts (291km/h) at maximum weight</b>
<b>ENGINES</b>	<b>Two Avco Lycoming T55-L-712 turboshafts</b>

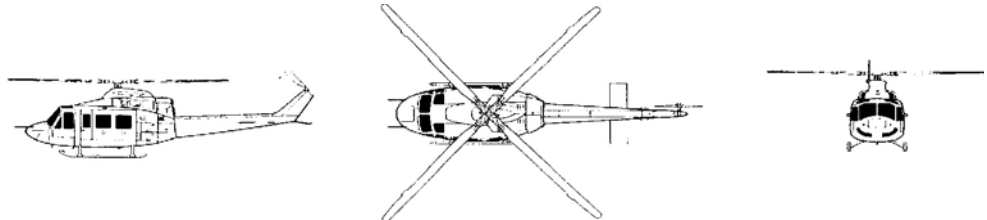
**CHINOOK HC2**  
*Medium Transport &  
 Medium Lift Helicopter*



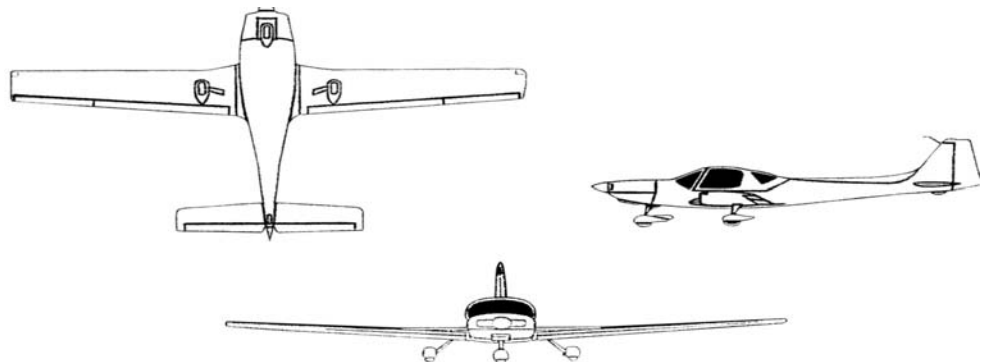
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

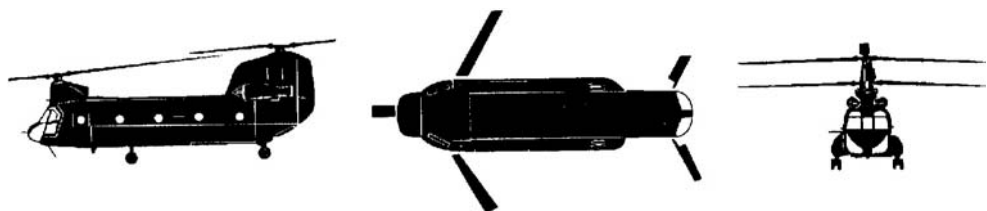
1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. What is the role of the Tutor?

- a. Primary Trainer
- b. Flight checking
- c. Reconnaissance
- d. Communications



5. How many crew are there in this helicopter?



6. What replaced the Bulldog for AEF?



- a. Viking
- b. Tutor
- c. Chipmunk
- d. Firefly

*Reporting Name***CANBERRA***Role Letters and Marks***PR9***Role***PHOTO RECONNAISSANCE**

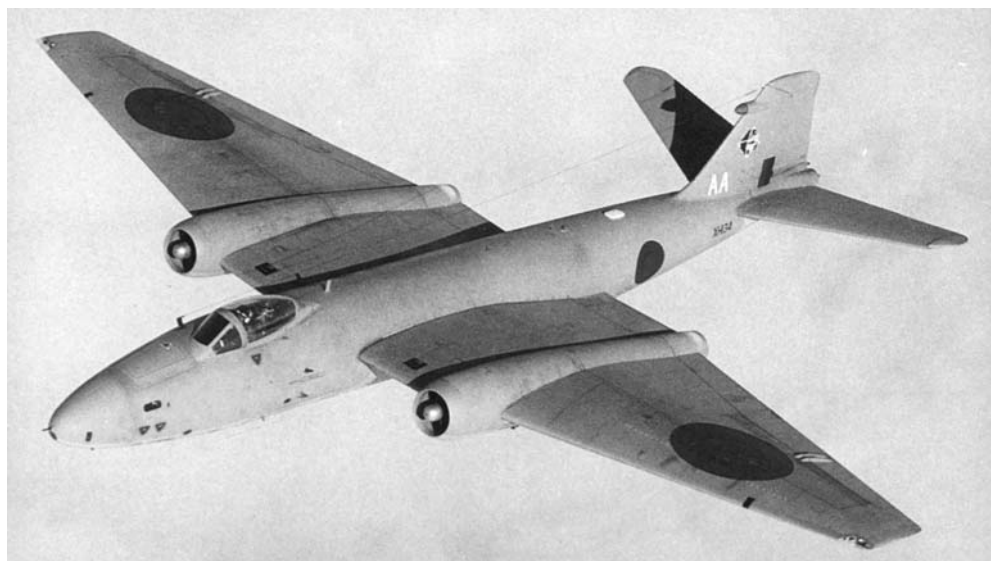
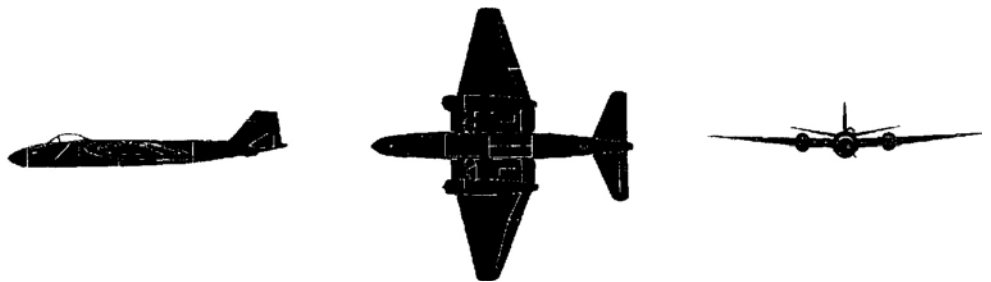
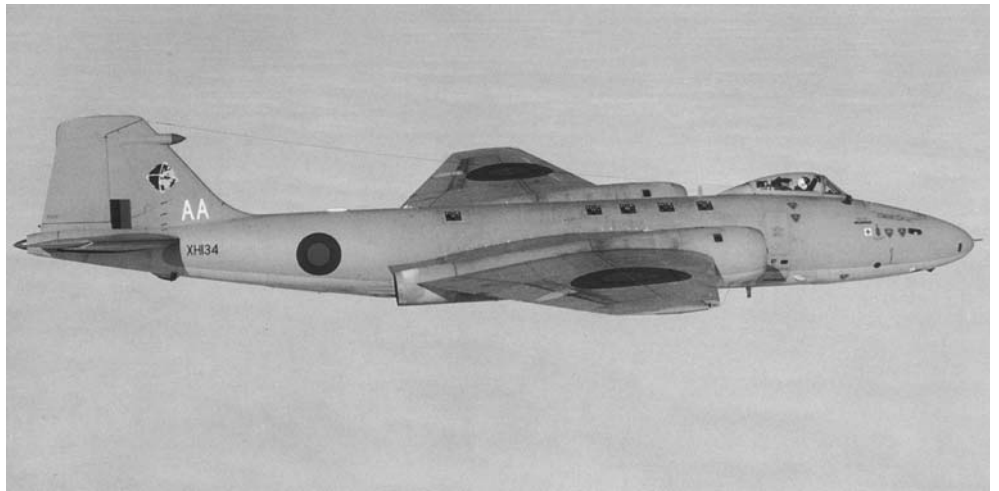
1. The Canberra was the first jet bomber to enter service in the RAF and has had a long and varied career. The prototype of the Canberra was the English Electric A1 which first flew on the 13 May 1949. Roles over the years have included tactical bomber, electronic countermeasures, target towing and photo reconnaissance.

2. Production of this aircraft has been carried out in the USA, Australia and the UK with over 1,400 aircraft being built. The Canberra has been operated by many air forces around the world as well as the RAF, including the air forces of Argentina, Chile, Ecuador, Ethiopia, India, Peru, South Africa, USA and Venezuela.

*Technical Data*

<b>WING SPAN</b>	<b>19.5M</b>
<b>LENGTH</b>	<b>19.96M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>450kts (834km/h) at sea level</b>
<b>ENGINES</b>	<b>Two Rolls-Royce Avon turbojets</b>

**CANBERRA PR9**  
*Photo Reconnaissance*



*Reporting Name***SQUIRREL***Role Letters and Marks***HT1 & HT2***Role***HELICOPTER TRAINER**

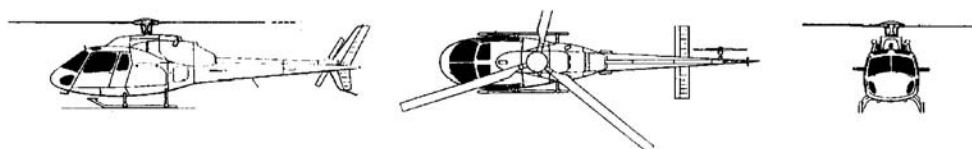
1. The Squirrel HT1 is used for advanced helicopter training at RAF Shawbury. Manufactured by Aerospatiale (now Eurocopter) in France, it first entered service in 1996. The single engine is used for training with the 2 Allison 250-C20F turboshafts engine version on 32 ( The Royal ) Squn at RAF Northolt.

*Technical Data*

<b>ROTOR DIAMETER</b>	<b>10.69M</b>
<b>LENGTH</b>	<b>12.94M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>144mph (238km/h) at sea level</b>
<b>ENGINE</b>	<b>One Turbomeca Arriel turboshaft</b>



**SQUIRREL HT1**  
*Helicopter Trainer*



**SQUIRREL HT2**  
*Helicopter Trainer*

*Reporting Name***FIREFLY MK2***Role Letters and Marks***T67M***Role***PRIMARY TRAINER**

1. Elementary flying training is undertaken by two components of the Air Training Group Defence Agency; the University Air Squadrons (UAS), using the Grob 115 (Tutor), which replaced the Bulldog T1, and the Joint Elementary Flying Training School (JEFTS), operating the Firefly M260.

*Technical Data*

<b>WING SPAN</b>	<b>10.6M</b>
<b>LENGTH</b>	<b>7.6M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM SPEED</b>	<b>157mph (252km/h) at sea level</b>
<b>ENGINE</b>	<b>One Lycoming piston engine</b>

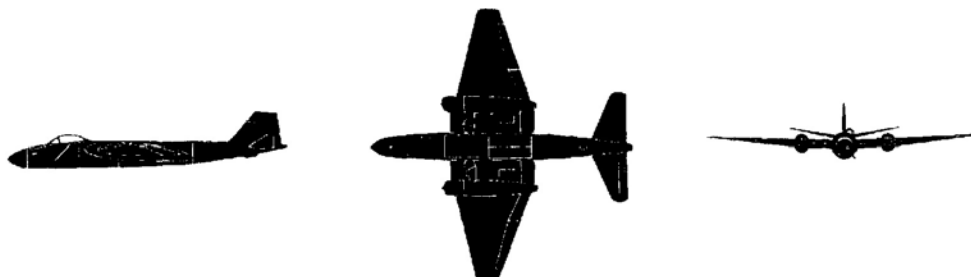
**FIREFLY MK2 T67M**  
*Primary Trainer*



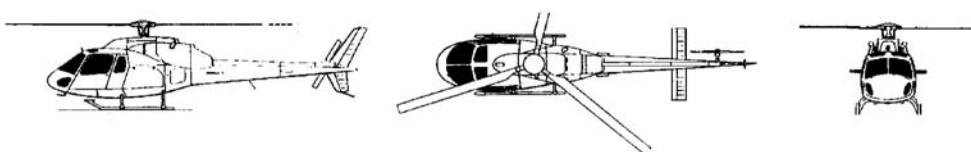
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. Which of these aircraft is the largest: in terms of wing span or rotor diameter?

- a. Firefly
- b. Canberra
- c. Tutor
- d. Squirrel



5. What is the name and make of the engine fitted to this aircraft?



6. Which one of these RAF aircraft is used in the photo reconnaissance role?

- a. Squirrel
- b. Tutor
- c. Chinook
- d. Canberra

7. How many crew are there in this aircraft?



- a. 2
- b. 3
- c. 5
- d. 18

8. Which one of the following is a primary training aircraft?

- a. Firefly
- b. Squirrel
- c. Canberra
- d. Chinook

**Reporting Name****DOMINIE & HS125****Role Letters and Marks**T1 & CC1, CC2, CC3**Role**NAVIGATION TRAINER & COMMUNICATIONS

1. The Dominie was developed originally as a civilian twin jet executive aircraft (HS 125) which first flew in 1962. It was modified and adopted for RAF use in 1965.
2. The Dominie T1 is used as an advanced navigation trainer, providing students with experience of navigation in high speed, at all height levels, such as they will experience on operational aircraft. For this role it is equipped with a full array of navigational aids
3. The RAF's HS 125 CC are used mostly for VIP and communications duties. The RAF has three types, the series 400 (CC1), 600 (CC2) and 700 (CC3). the series 400 has five cabin windows on each side as opposed to six on the later series. All HS 125's are powered by twin Garret turbofans, the T1's have two Rolls-Royce Vipers.

**Technical Data**

<b>WING SPAN</b>	<b>14.33M</b>
<b>LENGTH</b>	<b>15.4M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>445kts (825km/h) at 30,00ft</b>
<b>ENGINES</b>	<b>Two Garrett TFE 731 Turbfans ( or two Rolls-Royce Vipers - T1)</b>

**DOMINIE T1**  
*Navigation Trainer &  
Communications*



**BAe 125 T1**  
*Navigation Trainer &  
Communications*



**Reporting Name****HERCULES****Role Letters and Marks**C1, C3 & C130J**Role**HEAVY TRANSPORT

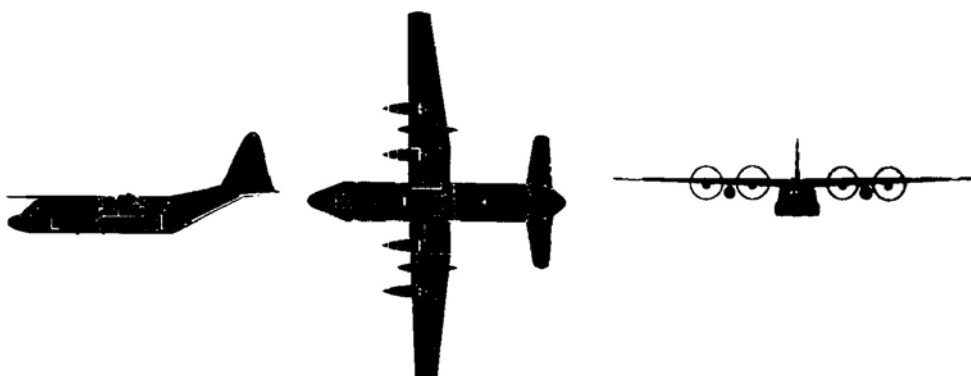
1. This versatile work horse is intended primarily for tactical operations and can operate from short unprepared airstrips. With in-flight refuelling it also has the capacity for long-range strategic lifts, including supply dropping, freight carrying, trooping and air ambulance duties. It originated from USA, where its known as the Lockheed C130. It has been in production since 1955.

2. The RAF versions are designated Hercules C1 and C3. They are fitted with British avionics, a roller conveyor system for heavy air-drops and more powerful engines than the C130. The C130J is the latest version the RAF operate. Externally it is no different from other Hercules, it does however have uprated engines with composite 5 bladed propellers and the cockpit is fitted with a “glass cockpit” and a head up display.

**Technical Data**

<b>WING SPAN</b>	<b>40.41M</b>
<b>LENGTH</b>	<b>C1=29.78M C3=34.37M</b>
<b>CREW</b>	<b>5</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>335kts (621km/h) at 20,00ft</b>
<b>ENGINES</b>	<b>Four Allison T56 turboprops ( or Four Allison AE2100D Turboprops - C130J)</b>

**HERCULES C1**  
*Heavy Transport*



*Reporting Name***PUMA***Role Letters and Marks***HC1***Role***ASSAULT TRANSPORT HELICOPTER**

1. The Puma is a French-designed twin engine helicopter built by Westland Aircraft Ltd in conjunction with Aerospatiale France. It entered service in the RAF in 1971. It has auto pilot, a heated, ventilated and sound-proofed cabin, retractable undercarriage, and modern navigation and search systems.

2. The Puma has many roles but in the RAF it is used as a tactical transport and support helicopter with a casualty evacuation capability. It can carry 16 fully equipped troops, or 6 stretchers and 6 sitting patients. A 3,200 kgs underslung cargo can be carried.

3. The tailboom, rotor blades and wheels can be removed to allow transportation in a Hercules to any theatre of operation.

*Technical Data*

<b>ROTOR DIAMETER</b>	<b>15.1M</b>
<b>LENGTH</b>	<b>14.1M</b>
<b>CREW</b>	<b>3</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>142kts at max weight, 158kts (293km/h) when lighter</b>
<b>ENGINES</b>	<b>Two Turbomeca Turmo turboshafts</b>

**PUMA HC1**  
*Assault Transport  
Helicopter*



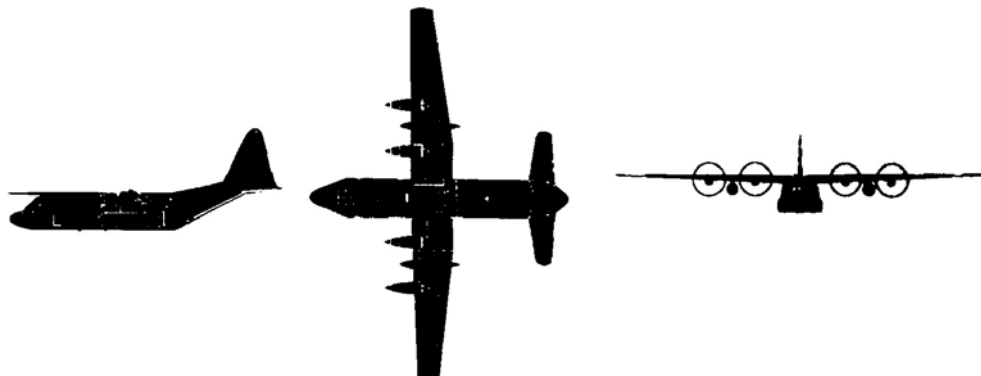
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. Which engines are fitted to the Puma?

- a. Allison Turboprops
- b. Garrett TFE731 Turbofans
- c. Turbomeca Astazous
- d. Turbomeca Turmos



5. Which of the following aircraft is used in the heavy transport role?

- a. Hercules
- b. Dominie
- c. HS 125
- d. Puma

6. What is the reporting name of the aircraft on this flight line?



7. What is the wing span of this aircraft?

- a. 10.60m
- b. 15.40m
- c. 19.50m
- d. 40.41m



8. What is the length of this helicopter?

- a. 14.10m
- b. 15.10m
- c. 34.30m
- d. 15.40km



*Reporting Name***BAe 146***Role Letters and Marks***CC2***Role***VIP COMMUNICATIONS**

1. The BAe 146 aircraft of 32 (The Royal) Sqn of the Royal Air Force are converted civilian short-haul feederliners. They have a special VIP interior which seats 19 people, compared with the civilian BAe 146 Series which seats 71. They also have an enhanced communication and navigation package.

2. Externally they are identical to the early series of commercial aircraft. Distinctive features include a T-tail and, unusually for such a small aircraft, four podded engines under high mounted wings. Internally the CC2 has modifications that include greater fuel capacity. The BAe 146 has the distinction of being one of the quietest airliners in production to date, with good short field performance.

*Technical Data*

<b>WING SPAN</b>	<b>26.3M</b>
<b>LENGTH</b>	<b>26.1M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM OPERATING SPEED</b>	<b>339mph (555km/h) at 30,000ft</b>
<b>ENGINES</b>	<b>Four Avco Lycoming ALF502 turbofans</b>

**BAE 146 CC2**  
***VIP Communications***



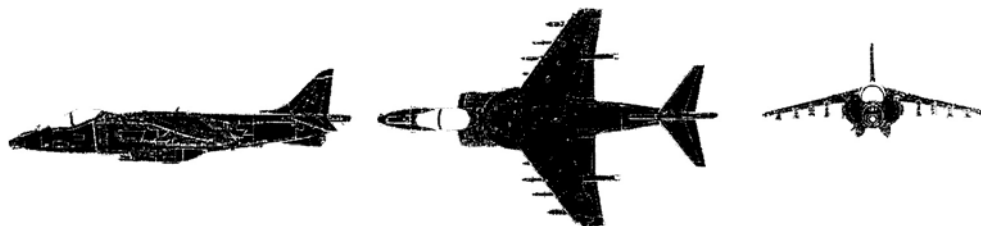
*Reporting Name***HARRIER***Role Letters and Marks***GR7***Role***GROUND ATTACK AND RECONNAISSANCE**

1. The Harrier was the World's first operational fixed wing vertical/short take-off and landing (V/STOL) strike fighter. Harriers operate in an offensive support role for ground based troops in both night and daylight. The GR7 carries forward looking infrared (FLIR) equipment which, when used with a pilot's night vision goggles (NVGs) gives the aircraft a low-level night and poor weather capability. The GR7 offers many advantages over the earlier GR3 Harrier. It can carry nearly twice the weapon load over the same radius of action, or the same weapon load over a much increased range. Other features reduce the pilot's work load, including multifunction cathode ray tubes(CRT), hands-on-throttle and stick (HOTAS) systems and angle rate bombing system (ARBS) for primary weapon aiming. Leading edge root extensions and digital engine control systems continue the Harriers high reputation.

*Technical Data*

<b>WING SPAN</b>	<b>9.24M</b>
<b>LENGTH</b>	<b>14.46M</b>
<b>CREW</b>	<b>1</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>640kts (1186km/h) at sea level</b>
<b>ENGINE</b>	<b>One Rolls-Royce Pegasus 105 vectored-thrust turbofan</b>

**HARRIER GR7**  
*Ground Attack and  
Reconnaissance*



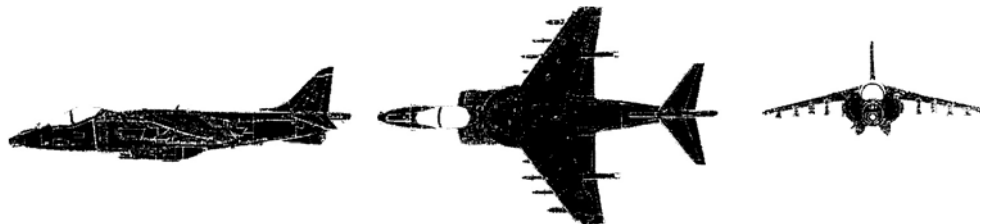
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. How many crew are there in a Harrier GR7?

- a. 4
- b. 3
- c. 2
- d. 1

4. What engines power this aircraft?



5. What engine is fitted to this aircraft and what is special about it?





**Reporting Name****VC 10****Role Letters and Marks**C1, C1K, K2, K3 & K4**Role**TRANSPORT & TANKER

1. VC10 has been in RAF service since 1967 and has been developed to fulfil many roles over the years. As a transporter the C1 can carry up to 150 troops or 24,516 kg of freight on pallets using a roller conveyor system. The original fleet of VC10 C1 aircraft have been modified and supplemented by ex-civilian VC10s and super VC10s (4m longer).

2. The tanker versions (K) are fitted with two Mk 32 in-flight refuelling pods, one under each wing, and in-flight refuelling probe on the nose. In addition they are fitted with close circuit television (CCTV) under the fuselage to allow the crew to see the refuelling receivers during mid-air refuelling.

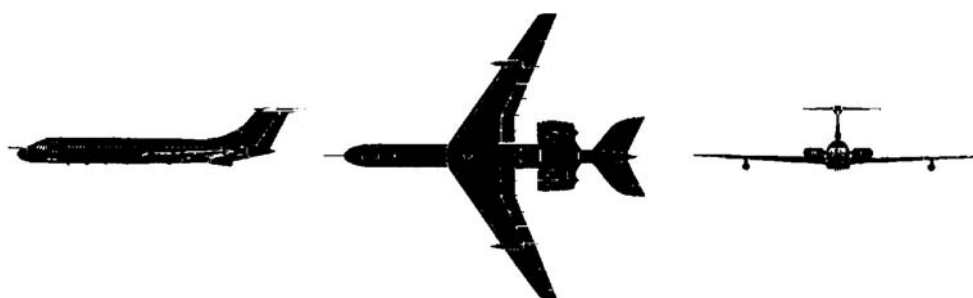
3. The K 2, 3 & 4s are also fitted with a centre-line refuelling hose drum unit (HDU) making them 3-point tankers.

**Technical Data**

<b>WING SPAN</b>	<b>44.5M</b>
<b>LENGTH</b>	<b>K2=50.59M K3=54.55M</b>
<b>CREW</b>	<b>4</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>500kts (922km/h) at 30,000ft</b>
<b>ENGINES</b>	<b>Four Rolls-Royce Conway 301 turbojets</b>



**VC10 - C1**  
*Transport & Tanker*



**VC10K**  
*Refueling a VC10 - C1*



*Reporting Name***JETSTREAM***Role Letters and Marks***T1***Role***CREW TRAINER**

1. This aircraft was originally designed and built by Handley Page for the civil market. A military version was delivered to the RAF in 1974; this was designated the Jetstream T1.
2. The Jetstream is used to train pilots (who have just completed basic training) on multi-engined aircraft, prior to their conversion to operational multi-engined aircraft.

*Technical Data*

<b>WING SPAN</b>	<b>15.8M</b>
<b>LENGTH</b>	<b>14.4M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>248kts (457km/h) at 12,000ft</b>
<b>ENGINE</b>	<b>Two Turbomeca Astazou turboprops</b>

**JETSTREAM T1**  
*Crew Trainer*



**Reporting Name****VIKING****Role Letters and Marks****T1****Role****CADET TRAINING**

1. The Viking T Mk1 is a development of the Grob 103 and is the mainstay of the Air Cadet Organisation's glider fleet. It is constructed from glass reinforced plastic (GRP) which provides strength and durability. This training aircraft has two seats in tandem, with dual controls allowing the aircraft to be flown from either seat. It is normally winch launched, but can be aero-towed.

2. As many gliders look similar with high aspect ratio wings of large span and "T" tails, the main distinguishing features to look for are:

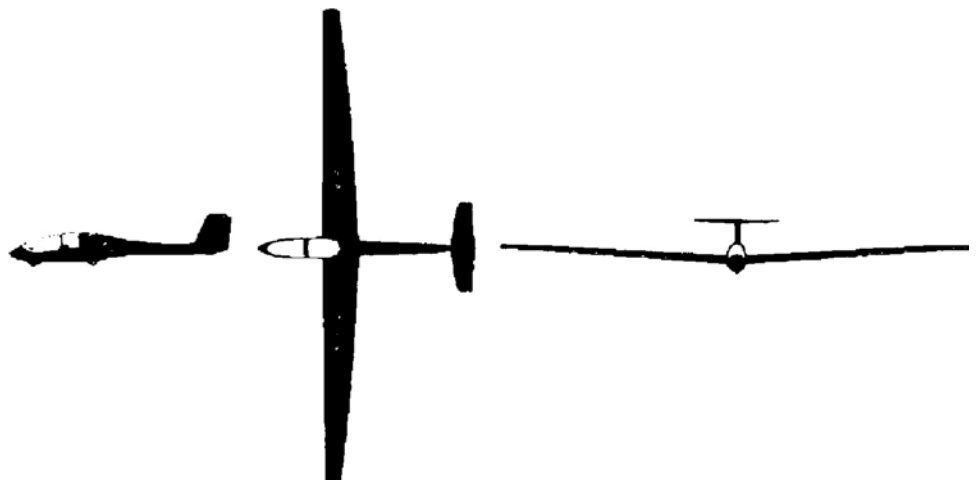
Twin wheel landing gear with the forward wheel just rear of the nose and the larger main wheel on the fuselage underneath the wing.

The dividing frame between front and rear cockpits is thick and regular in shape.

**Technical Data**

<b>WING SPAN</b>	<b>17.5M</b>
<b>LENGTH</b>	<b>8.18M</b>
<b>CREW</b>	<b>2</b>
<b>OPERATING OR RANGE SPEED</b>	<b>50-55kts (93-102km/h) or 57kts (105km/h)</b>
<b>ENGINES</b>	<b>NONE</b>

**VIKING T1**  
*Cadet Training*



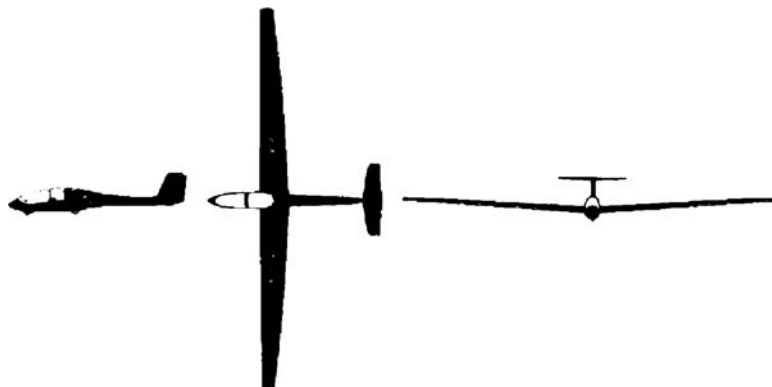
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

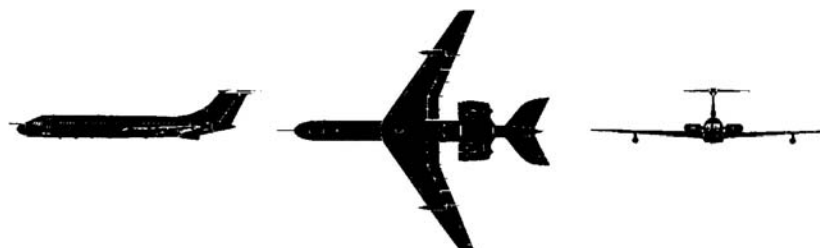
1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. Which one of these aircraft has the fastest cruise speed?

- a. Jetstream
- b. VC 10
- c. Puma
- d. Viking

5. What is the role of this aircraft?



- a. Transport
- b. Cadet Training
- c. Crew Training
- d. Ground Attack

6. What is the wing span of this aircraft?



- a. 15.80m
- b. 14.40m
- c. 17.20m
- d. 18.50m

7. What engines power this tanker aircraft?



- a. None
- b. 4 Rolls-Royce Gnomes
- c. 2 Turbomeca Astazous
- d. 4 Rolls-Royce Conway 301 Turbojets

*Reporting Name***JAGUAR***Role Letters and Marks*GR1 & T2*Role*TACTICAL SUPPORT AIRCRAFT

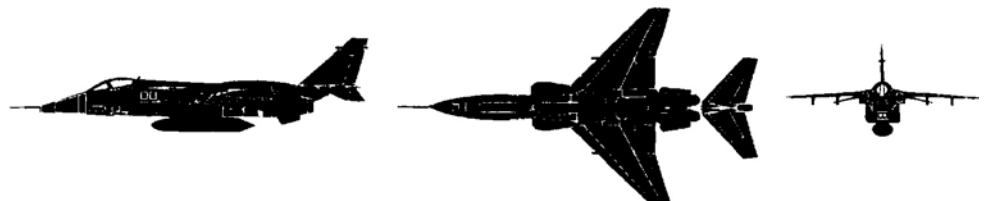
1. Built jointly by Breguet in France and BAe in the UK, Jaguar is designed for common requirements in both Air Forces.
2. The RAF's GR1 is a single-seat tactical support version with an advanced inertial navigation and weapon-aiming system, computer controlled. Jaguar can carry air-to-air guided missiles, 8 x 454kg bombs of various free fall and retarded types, reconnaissance packs and fuel drop tanks. Maximum external load is 4763 kg on 5 external stations. When air-to-air missiles are required, they are carried on distinctive over wing pylons.
3. The T2 is the two-seat (tandem) operational training version with full dual controls. It retains the GR1's electronics and weapons capability but only has one 30mm Aden gun.

*Technical Data*

<b>WING SPAN</b>	<b>8.49M</b>
<b>LENGTH</b>	<b>15.52M (GR) 16.42M (T2)</b>
<b>CREW</b>	<b>1 (GR1) 2 (T2)</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>729kts (1352km/h) Mach 1.1 at sea level</b>
<b>ENGINES</b>	<b>Two Rolls-Royce Turbomeca Adour turbofans</b>



**JAGUAR GR1 & T2**  
*Tactical Support Aircraft*



*Reporting Name***NIMROD***Role Letters and Marks***MR2***Role***LONG-RANGE MARITIME PATROL**

1. The Nimrod was developed from the Comet 4C and has the advantage of high altitude fast transit with good low speed manoeuvring and loiter capability - for which two engines may be shut down. The Nimrod MR2 fleet will be replaced by Nimrod MR4 - ISD 2006.
2. The MR2 has sophisticated communications equipment, an advanced tactical sensor, electronic countermeasures (ECM) and navigation systems.
3. Nimrods can carry Sidewinder air-to-air missiles for self defence, bombs, depth charges, mines, sonobuoys, Stingray torpedoes and Harpoon air-to-surface missiles.
4. In-flight refuelling probes were fitted to some aircraft during the Falklands conflict and are now a standard fit on all MR2s.

*Technical Data*

<b>WING SPAN</b>	<b>35M</b>
<b>LENGTH</b>	<b>38.63M</b>
<b>CREW</b>	<b>12</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>500kts (922km/h) at 30,000ft</b>
<b>ENGINES</b>	<b>Four Rolls-Royce Spey turbofans</b>

**NIMROD MR2**  
*Long-Range Maritime  
Patrol*



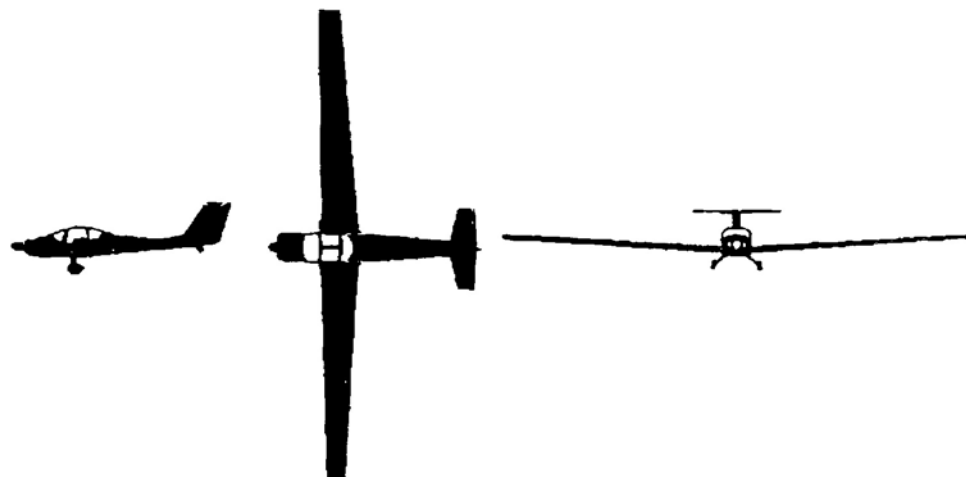
**Reporting Name****VIGILANT****Role Letters and Marks****T1****Role****CADET TRAINING**

1. The Vigilant has been in service with the ATC since early 1990 and equips many of the Volunteer Gliding Schools (VGS) around the country.
2. It is a self-launching, piston-engined motorised glider which requires no winch or cable to get airborne. The cockpit has seating for 2, side by side, with full dual controls and a modern instrument and radio panel. The aircraft is constructed from glass-reinforced-plastic (GRP) for strength and durability.
3. This T-tailed glider can be distinguished from other ATC gliders because it has a propeller and a two wheeled main undercarriage mounted on spring steel legs. The generous canopy has gull wing doors, which hinge up from the centre, allowing easy access.

**Technical Data**

<b>WING SPAN</b>	<b>17.4M</b>
<b>LENGTH</b>	<b>7.9M</b>
<b>CREW</b>	<b>2</b>
<b>OPERATING OR RANGE SPEED</b>	<b>60kts (111km/h) or 62kts (115km/h)</b>
<b>ENGINE</b>	<b>One Grob G2500 piston engine</b>

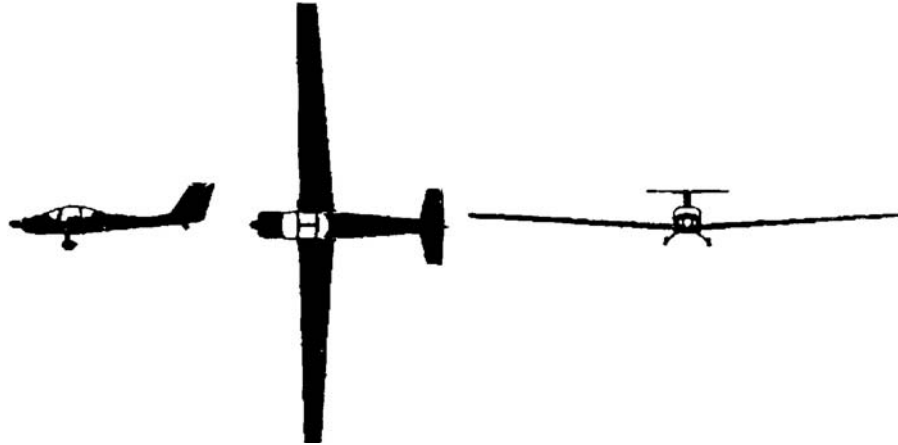
**VIGILANT T1**  
*Cadet Training*



## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

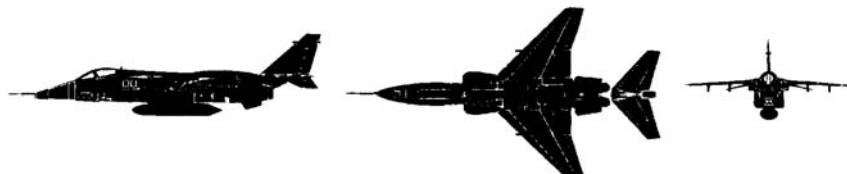
1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. Which one of these aircraft has a piston engine?

- a. Nimrod
- b. Jaguar
- c. Vigilant
- d. Chinook

5. Which one of the following aircraft is used in the tactical support role?

- a. Vigilant
- b. Nimrod
- c. HS 125
- d. Jaguar

6. Which of these aircraft has the longest wing span?

- a. Nimrod
- b. Canberra
- c. Jaguar
- d. Vigilant

7. What is the name of the engines fitted to this aircraft?



- a. Rolls-Royce Turbomeca Adour turbofans
- b. Rolls-Royce Spey turbojets
- c. Grob G2500 piston engine
- d. Gipsy Major

8. What is the role of the Vigilant aircraft?

- a. Transport
- b. Cadet Training
- c. Crew Training
- d. Ground Attack

**Reporting Name****TORNADO****Role Letters and Marks**GR1, 1A & 1B, GR4**Role****MULTI-ROLE STRIKE/RECONNAISSANCE**

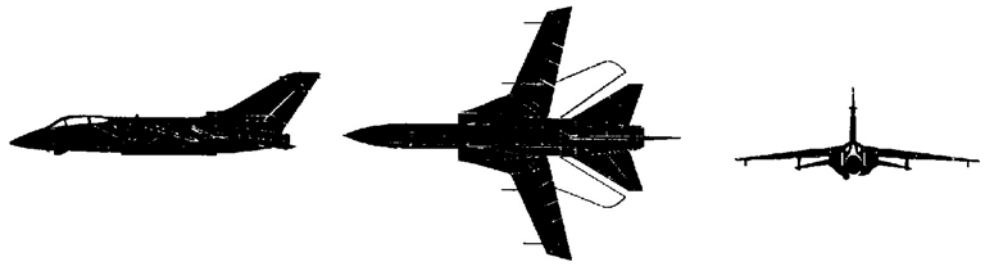
1. Designed and built as a joint collaborative project by companies in the UK, Germany and Italy - collectively called Panavia.
2. Tornado GR1 has a highly accurate navigation/attack system, using an automatic terrain-following capability. It can operate in all weather conditions, day or night at low level, delivering a variety of weapons, including laser guided bombs and nuclear weapons with great accuracy. A variable-geometry wing allows Tornado to perform over a wide range of speeds and heights. External stores and variable-geometry can change the appearance of the aircraft, but it has a distinctive large swept fin.
3. The GR1A is a reconnaissance version and the GR1B an anti-shipping maritime version using Sea Eagle missiles. Tornado - MLU aircraft are GR4 version.

**Technical Data**

<b>WING SPAN</b>	<b>13.9M fully forward 8.6m fully swept</b>
<b>LENGTH</b>	<b>16.7M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>800kts (1480km/h) (Mach 1.2) at sea level</b>
<b>ENGINES</b>	<b>Two turbo union RB199 turbofans</b>



**TORNADO** TGR1, 1A & 1B  
*Multi-Role Strike/  
Reconnaissance*



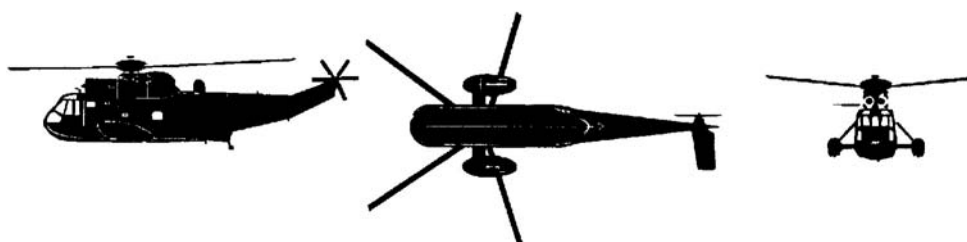
*Reporting Name***SEA KING***Role Letters and Marks***HAR3***Role***SEARCH AND RESCUE HELICOPTER**

1. The Sea King is a UK development of the American Sikorsky S-61 helicopter and is manufactured by Westland Helicopters. It is equipped with British avionics and has Rolls-Royce engines.
2. Sea King has advanced search and navigational equipment, an auto-pilot with on-board computer to assist positioning when hovering. A winch can be used to raise and lower personnel and small amounts of equipment. The cabin accommodates up to 18 passengers in addition to the crew.
3. This amphibious helicopter's lower fuselage is shaped like the hull of a boat and has flotation devices in the undercarriage sponsons. The undercarriage sponsons, the boat shaped hull and radar dome aft of the main rotor are good recognition features.

*Technical Data*

<b>ROTOR DIAMETER</b>	<b>18.9M</b>
<b>LENGTH</b>	<b>16.45M</b>
<b>CREW</b>	<b>4</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>124kts (230km/h) at sea level</b>
<b>ENGINES</b>	<b>Two Rolls-Royce Gnome turboshafts</b>

**SEA KING HAR3**  
*Search and Rescue*  
*Helicopter*



*Reporting Name***MERLIN***Role Letters and Marks***MK3***Role***SUPPORT HELICOPTER**

1. The EH 101 Merlin HC Mk3 support helicopters officially entered service in April 2000 with 28 Sqn at RAF Benson. A direct replacement for the Westland Wessex and the Puma, it will operate alongside the Chinook in the medium lift role.

2. The RAF's support helicopters will be grouped with the Royal Navy's commando helicopters and the Apache and light utility helicopters of the Army Air Corps to form a new Joint Helicopter Command. One of its primary missions will be to support 16 Air Assault Brigade, the seccessor to the army's 24 Airmobile Brigade.

*Technical Data*

<b>ROTOR DIAMETER</b>	<b>18.59M</b>
<b>LENGTH</b>	<b>22.81M</b>
<b>CREW</b>	<b>2 Pilots 1 Crew</b>
<b>OPERATING OR RANGE SPEED</b>	<b>167kts (309 km/h)</b>
<b>ENGINES</b>	<b>3 2240 shp Rolls-Royce turbomeca RTM 322</b>

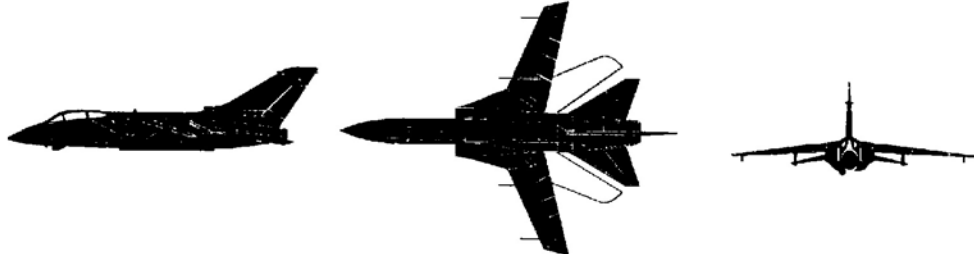
**MERLIN MK3**  
*Support Helicopter*



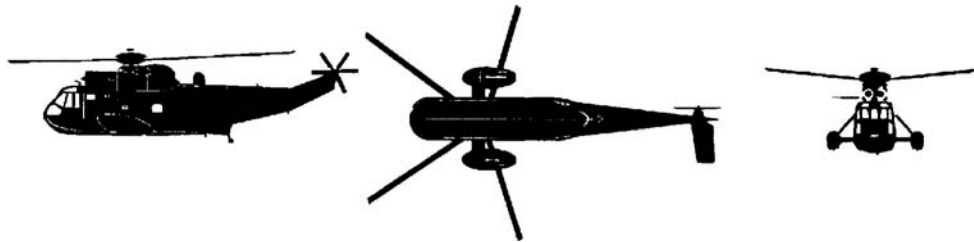
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. Which of the following aircraft has variable-geometry wings?

- a. Firefly
- b. Tornado
- c. Nimrod
- d. Tutor



5. What is the role of the Merlin Mk3?

- a. Transport
- b. Cadet Training
- c. Support Helicopter
- d. Ground Attack

6. How many crew does this aircraft have?

- a. 1
- b. 2
- c. 3
- d. 4



7. What engine powers this aircraft?



- a. 2 Turbo Union RB 199 Turbofans
- b. 4 Rolls-Royce Gnomes
- c. 2 Turbomeca Astazous
- d. 2 Rolls-Royce Conway 301 Turbojets

*Reporting Name***TORNADO***Role Letters and Marks***F3***Role***AIR DEFENCE**

1. This is a development of the Tornado GR1, which is described earlier. It is the RAF's standard all-weather fighter designed to meet the RAF's commitment for air defence in the UK. It is able to operate independently some 650 km from base whilst carrying out combat air patrols including loitering and multiple intercepts.

2. It has 80% parts commonality with the GR1 and externally is similar. The nose is longer and more pointed to house the Foxhunter radar, and the fuselage is longer to accommodate an extra internal fuel tank. The cockpit is further forward when compared with the engine intakes on the GR1. In addition the highest part of the fin leading edge does not have a box shaped radar warning aerial extending forward. It carries Sky Flash missiles giving the appearance of small fins extending below the aircraft.

*Technical Data*

<b>WING SPAN</b>	<b>13.9M fully forward 8.6M fully swept</b>
<b>LENGTH</b>	<b>16.45M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>800kts (1480km/h) (Mach 1.2) at sea level</b>
<b>ENGINES</b>	<b>Two Turbo Union RB199 turbofans</b>



**TORNADO F3**  
*Air Defence*



*Reporting Name***SENTRY***Role Letters and Marks***AEW1***Role***AIRBORNE EARLY WARNING**

1. The Sentry is a development of the American E-3 AEW aircraft which itself was a heavily modified version of the Boeing 707 civil airliner. The aircraft has a very distinctive circular radome above the rear fuselage, housing the surveillance radar. The four podded engines fitted to the Sentry are bigger in size to the 707 aircraft.
2. The RAF's Sentry has an in-flight refuelling probe fitted above and to the right of the cockpit, as well as an American style in-flight refuelling receptacle directly above the cockpit. There is a flight-deck crew of 4 and a mission crew of 9.
3. The wing tips are fitted with electronics pods and aerials. The information obtained by the many sensors is processed by the mission crew. According to the type of mission, additional members (to work shifts) may be carried. Also, airborne technicians to carry out in-flight rectification of faults may be added.

*Technical Data*

<b>WING SPAN</b>	<b>44.4M</b>
<b>LENGTH</b>	<b>43.9M</b>
<b>CREW</b>	<b>13 to 20</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>460kts (853km/h) at 35,000ft</b>
<b>ENGINES</b>	<b>Four CFM 56 turbofans</b>

**SENTRY AEW1**  
*Airborne Early Warning*



*Reporting Name***EUROFIGHTER EF-2000 (TYPHOON)***Role Letters and Marks***F***Role***MULTI-ROLE FIGHTER**

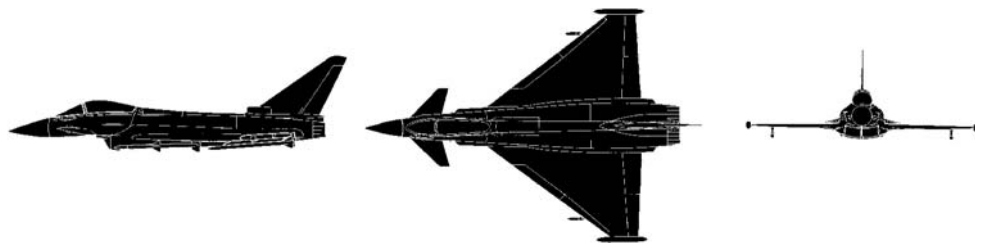
1. The agreement to develop what has until recently been called the European Fighter Aircraft was signed between Italy, the UK and West Germany in May 1988, with Spain joining the organization in November 1988.
2. This important tactical combat aircraft was planned as an extremely agile STOL fighter with a primary air-to-air tasking and secondary air-to-surface role, and in concept is a close-coupled canard design using a high proportion of composites and advanced fly-by-wire control system to obtain maximum agility out of the airframe.
3. The first prototype flew in 1994, and the first of a possible 800 production aircraft should fly late in the decade for service early in the forthcoming century. Service introduction of the Eurofighter will give the RAF its first single-seat fighter since the English Electric Lightning.

*Technical Data*

<b>WING SPAN</b>	<b>10.50M</b>
<b>LENGTH</b>	<b>15.96M</b>
<b>CREW</b>	<b>1</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>1,147kts (2125km/h) (Mach 2.0) at 36,090ft</b>
<b>ENGINES</b>	<b>Two Eurojet EJ200 Turbfans</b>



**EUROFIGHTER EF-2000  
(TYPHON)**  
*Multi-Role Fighter*



## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

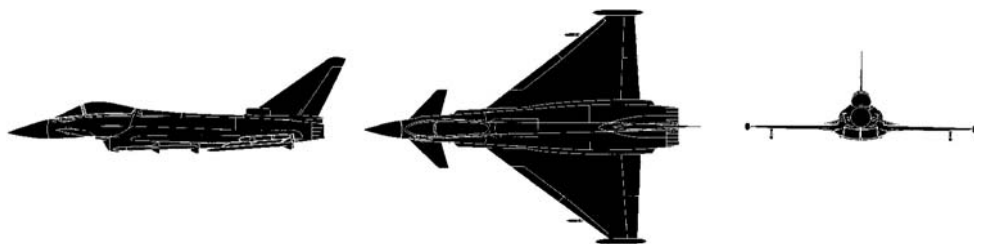
1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. How many crew are there in a Nimrod?

- a. 2
- b. 4
- c. 8
- d. 12

5. What is the role of this aircraft?



- a. Advanced cadet training.
- b. Airborne Early Warning.
- c. Search and Rescue.
- d. Air Defence.

6. What engines power this aircraft?



- a. 2 Turbo Union RB 199 turbofans.
- b. 2 Rolls-Royce Gnome turboshafts.
- c. None.
- d. 2 CFM 56-2A-3 turbofans.

7. What is the wing span and length of the Sentry AEW1?

- a. Span 44.4m Length 43.9m.
- b. Span 20m Length 8.62m
- c. Span 43.9km Length 44.4m.
- d. Span 13.9m Length 18.6m.

**Reporting Name****TRISTAR****Role Letters and Marks**K1, KC1 & KC2**Role**TRANSPORT/TANKER

1. These conversions of a successful Lockheed civil airliner, have given the RAF a greatly increased strategic transport and refuelling capability. The basic aircraft are former Pan-Am and British Airways aircraft, suitably modified. The alterations include the fitting of an in-flight refuelling probe and centre-line hose drum unit (HDU).

2. The tanker role has a close circuit television (CCTV) system fitted to allow the crew to monitor the refuelling operation. On some aircraft the already large fuel load has been increased by fitting extra tanks in the underfloor baggage holds.

3. The interior of the aircraft has been reworked to military specifications and can take a wide variety and combinations of loads, including up to 20 pallets of equipment or 250 passengers.

**Technical Data**

<b>WING SPAN</b>	<b>50M</b>
<b>LENGTH</b>	<b>50M</b>
<b>CREW</b>	<b>3</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>527kts (978km/h) at 30,000ft</b>
<b>ENGINES</b>	<b>Three Rolls-Royce RB211 turbofans</b>



**TRISTAR K1, KC1 &  
KC2**  
*Transport / Tanker*



*Reporting Name***TUCANO***Role Letters and Marks***T1***Role***BASIC TRAINER**

1. Shorts of Belfast produce the Tucano T1. It is a development of the Brazilian EMB-312 Tucano (Toucan).
2. The RAF version has a 50% more powerful engine and a 50% increase in fatigue life as a result of strengthened wings and undercarriage. The canopy perspex is in two sections and is bird strike-resistant for pilot protection. The underside of the fuselage has a ventral air brake. The turboprop engine exhausts protrude out of the lower fuselage just forward of the wings.
3. The cockpit layout has been designed to mimic that of the Hawk advanced trainer as much as possible, to aid continuity in training. The instructor's rear seat is raised to allow a clear view over the student's head; this gives the aircraft a hump-backed appearance - a good recognition feature.

*Technical Data*

<b>WING SPAN</b>	<b>11.3M</b>
<b>LENGTH</b>	<b>9.8M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>273kts (507km/h) at sea level</b>
<b>ENGINES</b>	<b>1 Garrett TPE 331 turboprop</b>

**TUCANO T1**  
*Basic Trainer*



*Reporting Name***HAWK***Role Letters and Marks***T1 & T1A***Role***ADVANCED JET TRAINER**

1. The Hawk entered the Royal Air Force in late 1976 and is now the standard aircraft for advanced fast-jet pilot training and weapon training. It is also the choice of the Red Arrows Aerobatic Team. Some training Hawks (the T1A) have an emergency war role in Air Defence Squadrons; they can be fitted with Sidewinder air-to-air missiles and Aden cannons, which are standard on the T1A.

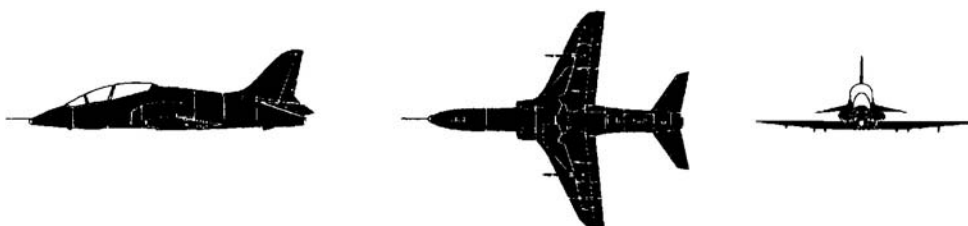
2. The single-engined Hawk is a low-wing monoplane with swept-back wings and tail unit for high-speed agile flight. It has a one-piece all-moving power-operated anhedral tail plane. The rear seat of the tandem arrangement is elevated. It has dual controls, and the cockpits are pressurised and air conditioned. It has a large ventral airbrake underneath the rear fuselage. There are two air intakes, one on each side of the fuselage forward of the leading edges.

*Technical Data*

<b>WING SPAN</b>	<b>9.4M</b>
<b>LENGTH</b>	<b>11.2M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>560kts (1038km/h) at sea level</b>
<b>ENGINES</b>	<b>1 Rolls-Royce Turbomeca ADOOR turbofan</b>



**HAWK T1 & T1A**  
*Advanced Jet Trainer*



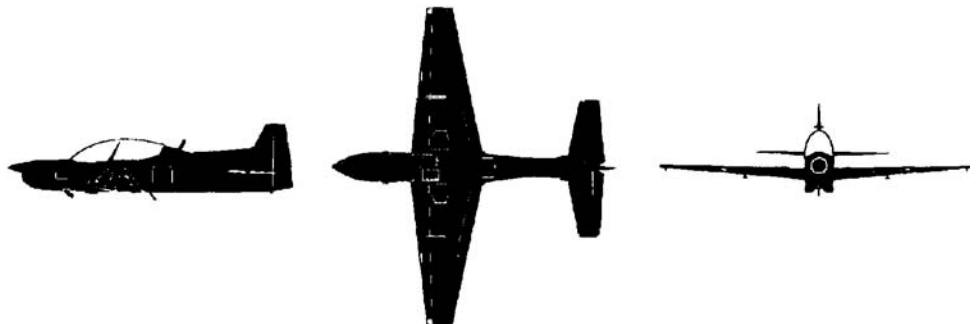
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

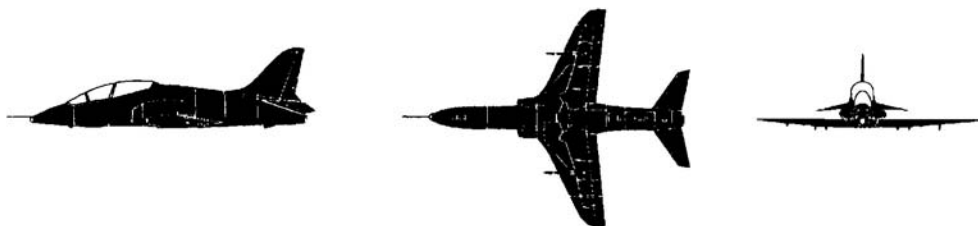
1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?



4. Which of the following aircraft is used as a crew trainer?

- a. Valiant
- b. Tornado
- c. Nimrod
- d. Jetstream

5. What engine is fitted to this aircraft?



- a. Rolls-Royce RB 211 turbofan.
- b. Garrett TPE 331 turboprop.
- c. Turbomeca Adour turbofan.
- d. Rolls-Royce Dart turboprop.

6. What is the role of the Tristar KC1?

- a. Transport /Tanker.
- b. Basic Trainer.
- c. Support Helicopter.
- d. Photo Reconnaissance.

7. What is the wingspan of this aircraft?



- a. 9.4m.
- b. 11.2m
- c. 8.4m.
- d. 11.3km.

8. How many crew are there in a Tornado GR1?

- a. 2.
- b. 3.
- c. 4.
- d. 1.

*Reporting Name***LANCASTER***Role Letters and Marks***B1***Role***BATTLE OF BRITAIN MEMORIAL FLIGHT**

1. The Avro Lancaster is possibly the most famous of the British wartime bombers. It was one in a series of evolving designs which incorporated such innovations as hydraulic powered turrets and retractable undercarriage. The first Lancaster flew in January 1941.

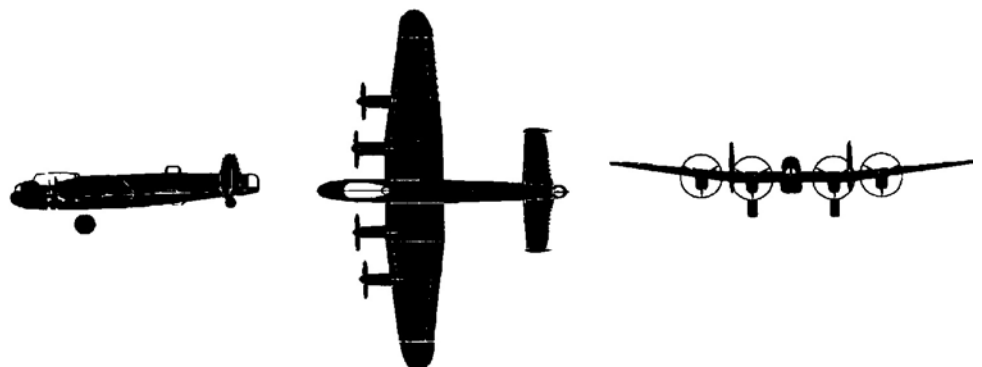
2. Altogether, 7,377 Lancasters were built, with a peak of 293 made in one month, August 1944. Famous operational changes to the Lancaster included structural alterations to accommodate the massive 9,979kg Grand Slam bomb, and the Barnes Wallis “bouncing” bomb as used by No 617 “Dambusters” Squadron.

*Technical Data*

<b>WING SPAN</b>	<b>31M</b>
<b>LENGTH</b>	<b>21M</b>
<b>CREW</b>	<b>7</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>238kts (442km/h) at sea level</b>
<b>ENGINES piston engines</b>	<b>Four Rolls-Royce Merlin</b>



**LANCASTER B1**  
*Battle of Britain*  
*Memorial Flight*



**Reporting Name****SPITFIRE****Role****BATTLE OF BRITAIN MEMORIAL FLIGHT**

1. The Supermarine Spitfire was a development of a famous Schneider trophy racing aircraft designed by R.J. Mitchell. The prototype Spitfire first flew in March 1936 from Eastleigh Airport, Southampton. It incorporated many developments in advanced aerodynamics and construction techniques used on its predecessor. Its speed and agility allowed the Spitfire to establish and maintain a reputation for air superiority which was so vital to the defence of the United Kingdom, and ultimately victory, in the Second World War. The RAF received its first service aircraft in August 1938.

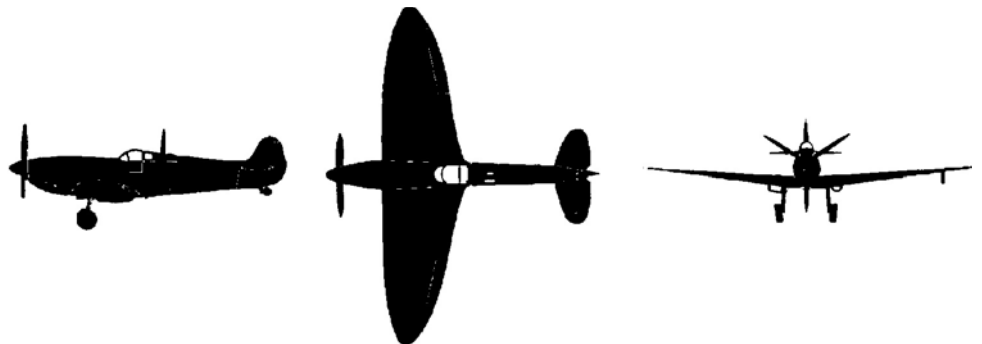
2. It is a tribute to R.J. Mitchell's design, that over 22,000 Spitfires were produced in 36 separate Marks. Many of the performance improvements came from the Rolls-Royce Merlin piston engine and its later derivative the Griffon, which had more than double the power of the prototype Spitfire.

3. Distinctive because of the elliptical shaped wing and the roar from the powerful piston engine, Spitfire is a stirring sight at open days and flying displays.

**Technical Data**

<b>WING SPAN</b>	<b>11.2M</b>
<b>LENGTH</b>	<b>9.1M</b>
<b>CREW</b>	<b>1</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>378kts (700km/h) at sea level</b>
<b>ENGINES</b>	<b>1 Rolls-Royce Merlin</b>

**SPITFIRE**  
*Battle of Britain*  
*Memorial Flight*



**Reporting Name****HURRICANE****Role****BATTLE OF BRITAIN MEMORIAL FLIGHT**

1. The Hawker Hurricane stands alongside the Spitfire in the halls of fame. In fact, the Hurricane predates the Spitfire by some two years, being designed in 1934, by Sydney Camm who later designed the Hunter and Harrier aircraft.

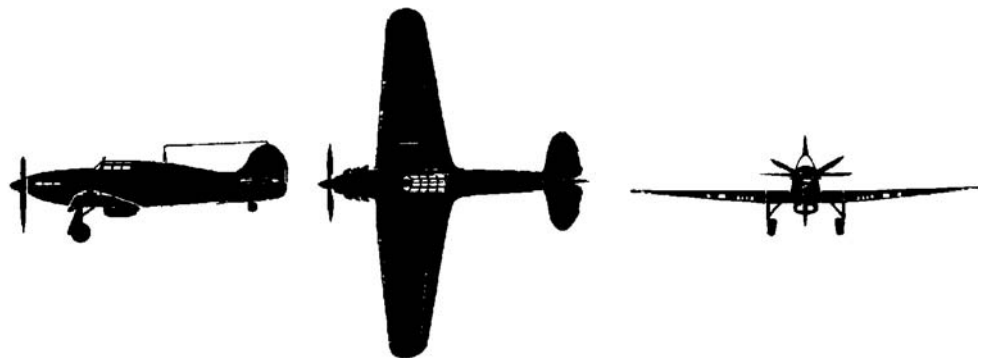
2. The Hurricane was the first monoplane fighter in RAF service and also the first to exceed 260 kts (482 km/h) in level flight. Although perhaps not quite as well known as the Spitfire, it contributed more to the Battle of Britain, by destroying a greater number of enemy aircraft. This was due partly to its better turning performance, and partly to its the more rugged and more damage-tolerant construction.

3. Although not developed to the same extent as its more famous contemporary, 14,533 Hurricanes had been built by the time production ended in 1944.

**Technical Data**

<b>WING SPAN</b>	<b>12.2M</b>
<b>LENGTH</b>	<b>9.75M</b>
<b>CREW</b>	<b>1</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>328kts (609km/h) at sea level</b>
<b>ENGINES</b>	<b>1 Rolls-Royce Merlin piston engine</b>

**HURRICANE**  
*Battle of Britain*  
*Memorial Flight*



*Reporting Name***DAKOTA***Role Letters and Mark*DC-3*Role*BATTLE OF BRITAIN MEMORIAL FLIGHT

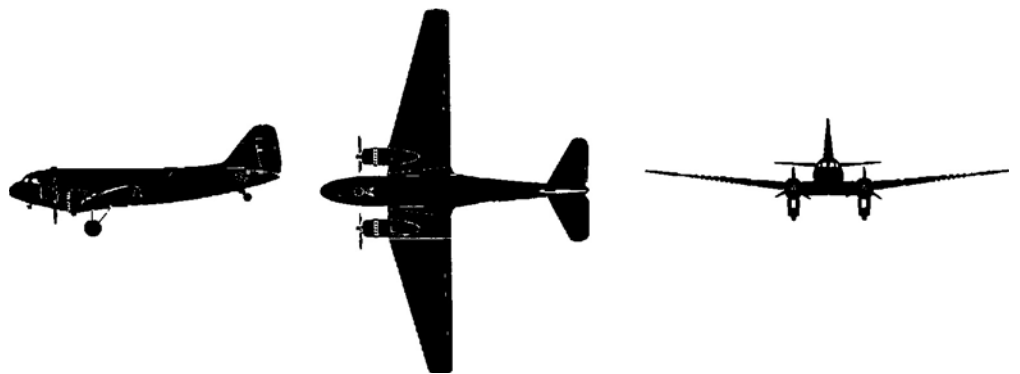
1. One of the most famous American-built transport aircraft ever produced. Nearly 13,000 were made by the Douglas Corporation since the first aircraft flew in 1935. Several hundreds are still flying and working today.
2. Renowned for its rugged construction, Dakotas have transported passengers and freight around the world. This low winged monoplane has distinctive radial piston engines and a sleek aerodynamic fuselage.
3. The fin and rudder appear large and the tail wheel juts out below the fin. On the ground the nose of this tail dragger sits high in the air, supported on the balloon tyres of the retractable main under- carriage. Another good feature is the rectangular window shape.

*Technical Data*

<b>WING SPAN</b>	<b>28.9M</b>
<b>LENGTH</b>	<b>19.5M</b>
<b>CREW</b>	<b>2</b>
<b>MAXIMUM LEVEL SPEED</b>	<b>240kts (448km/h) at sea level</b>
<b>ENGINES</b>	<b>Two Pratt &amp; Whitney R1830-90D piston engines</b>



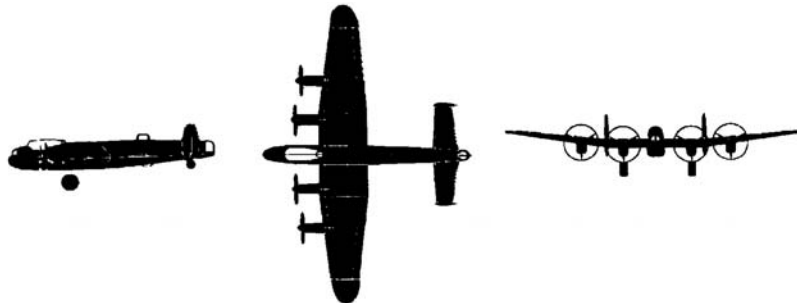
**DAKOTA DC3**  
*Battle of Britain*  
*Memorial Flight*



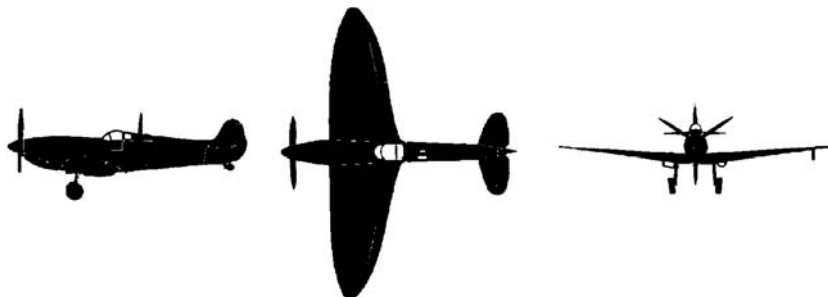
## Self Assessment Questions

*Do not mark the paper in any way - write your answers on a separate piece of paper.*

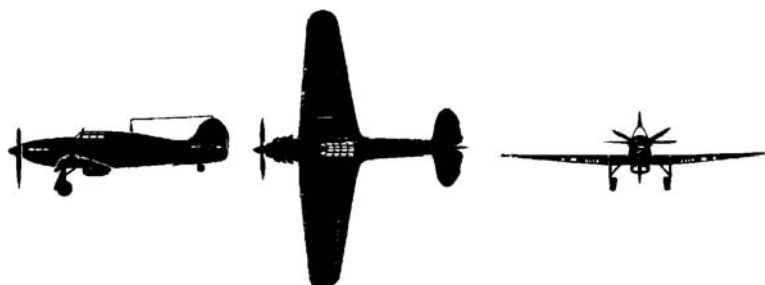
1. What is the reporting name of this aircraft?



2. What is the reporting name of this aircraft?



3. What is the reporting name of this aircraft?

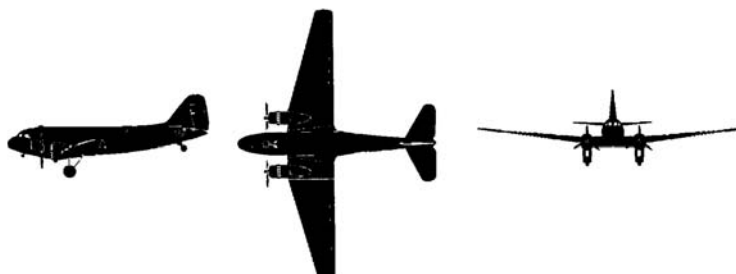


4. Which of these aircraft is not powered by Rolls-Royce Merlin engines?

- a. Hurricane.
- b. Spitfire.
- c. Lancaster.
- d. Dakota .



5. What is the reporting name of this aircraft?



6. What is the maximum level speed of the Spitfire?

- a. 409 km/h.
- b. 700 km/h.
- c. 422 km/h.
- d. 448 km/h.

7. How many crew are there in the Lancaster B1?

- a. 2.
- b. 4.
- c. 6.
- d. 7.

8. What is the wing span of the Hurricane?

- a. 11.2m.
- b. 9.75m.
- c. 31m.
- d. 12.2m.

9. How many and what type of engines power the Dakota DC-3?

- a. 2 Merlins.
- b. 2 Rolls-Royce Merlins?
- c. 4 Rolls-Royce Darts.
- d. 2 Pratt & Whitney R1830-90D piston engines.

10. How long is the Lancaster B1.

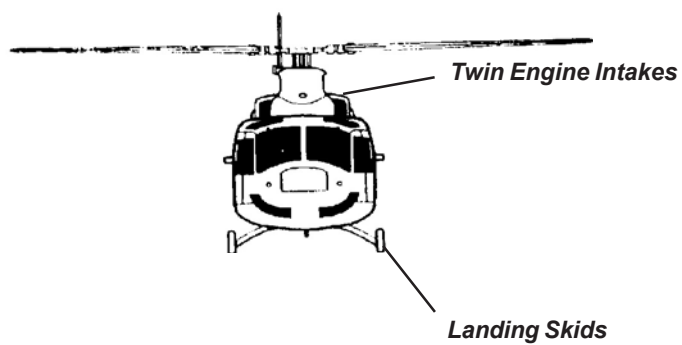
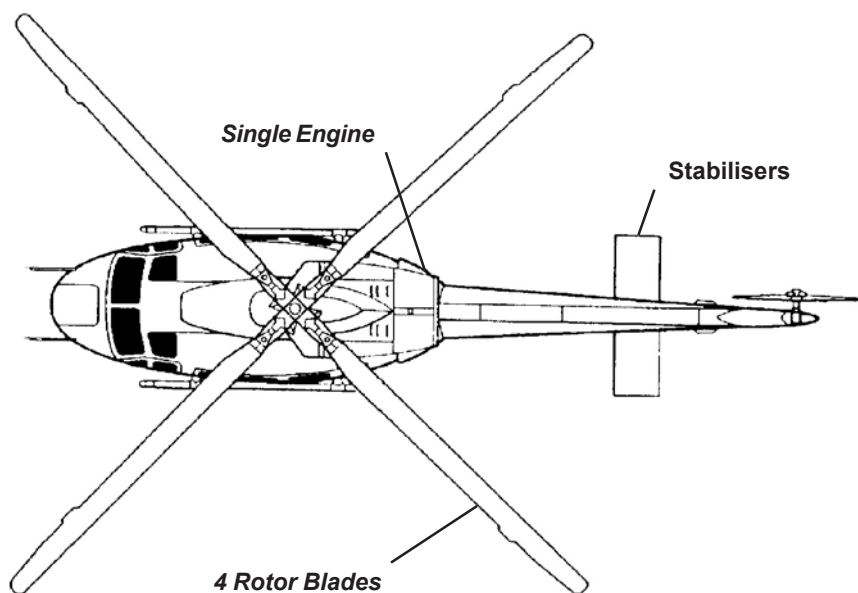
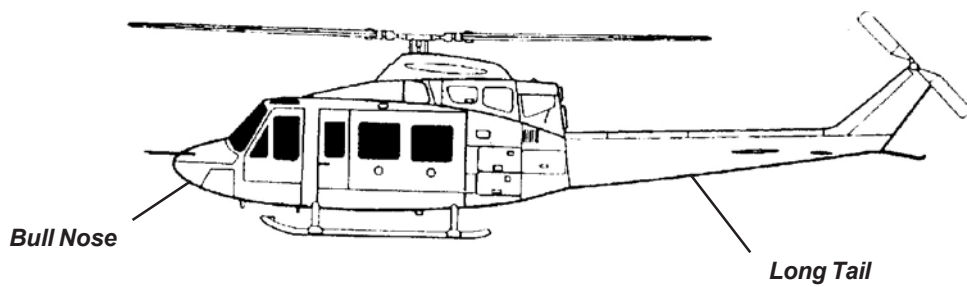
- a. 21m.
- b. 31m.
- c. 25m.
- d. 19.5m

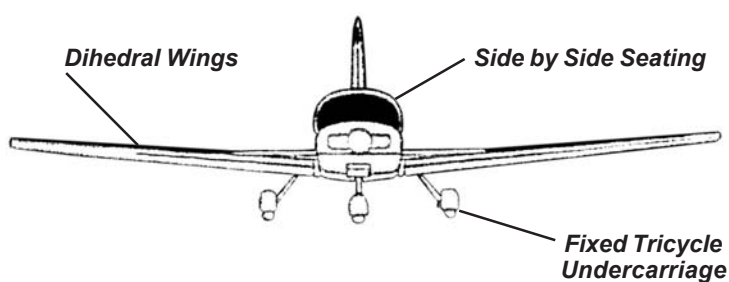
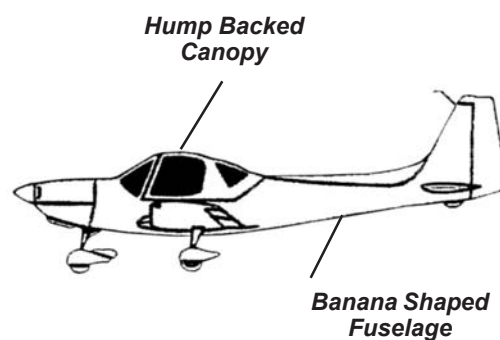
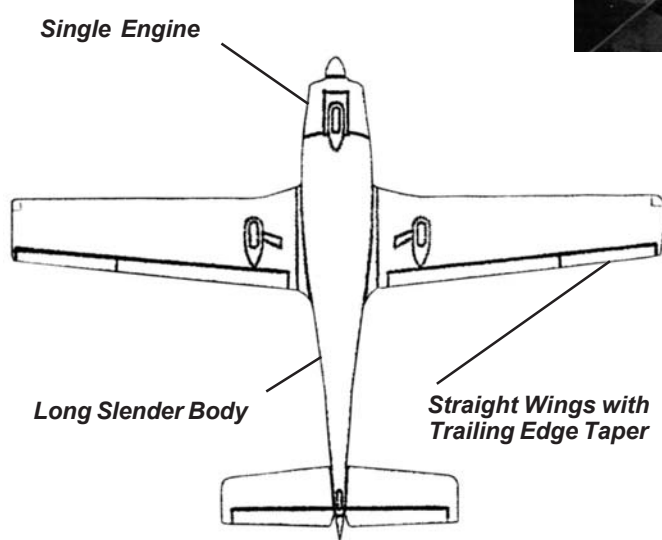
# INSTRUCTORS GUIDE

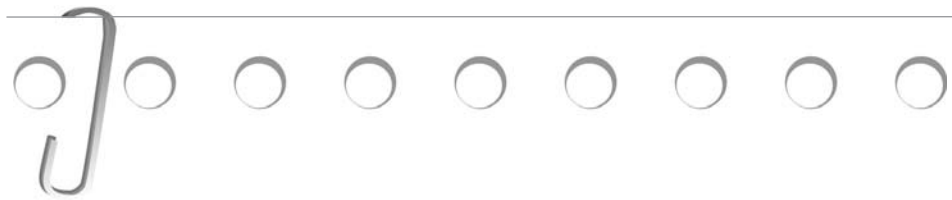
## Chapter 3

Page 34.2.3-5

### GRIFFIN HT1



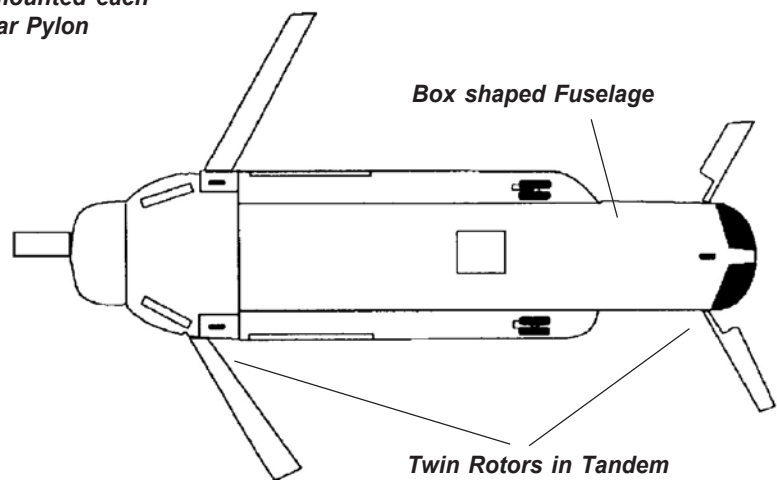
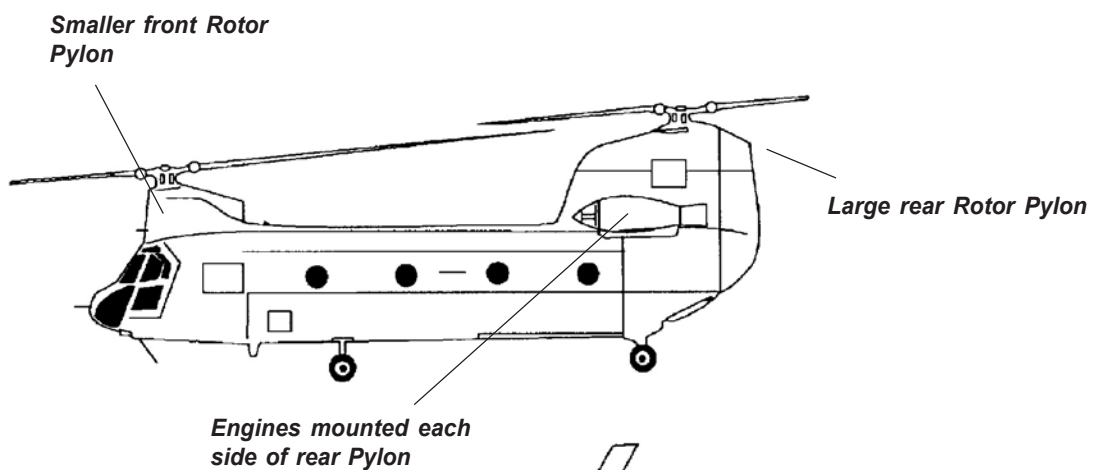
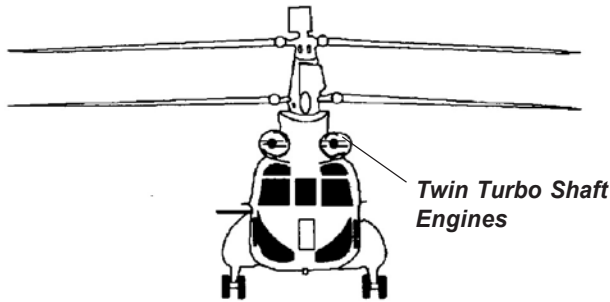
**Chapter 3****Page 34.2.3-7****GROB 115 (TUTOR)**



Chapter 3

Page 34.2.3-9

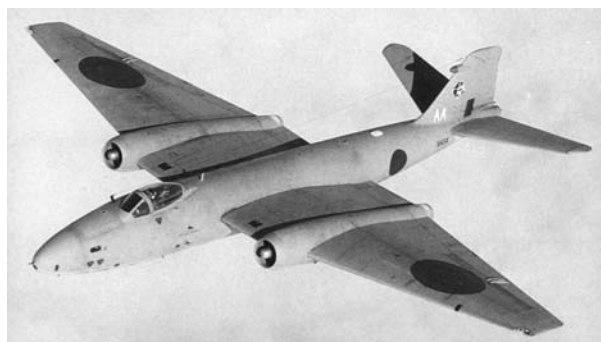
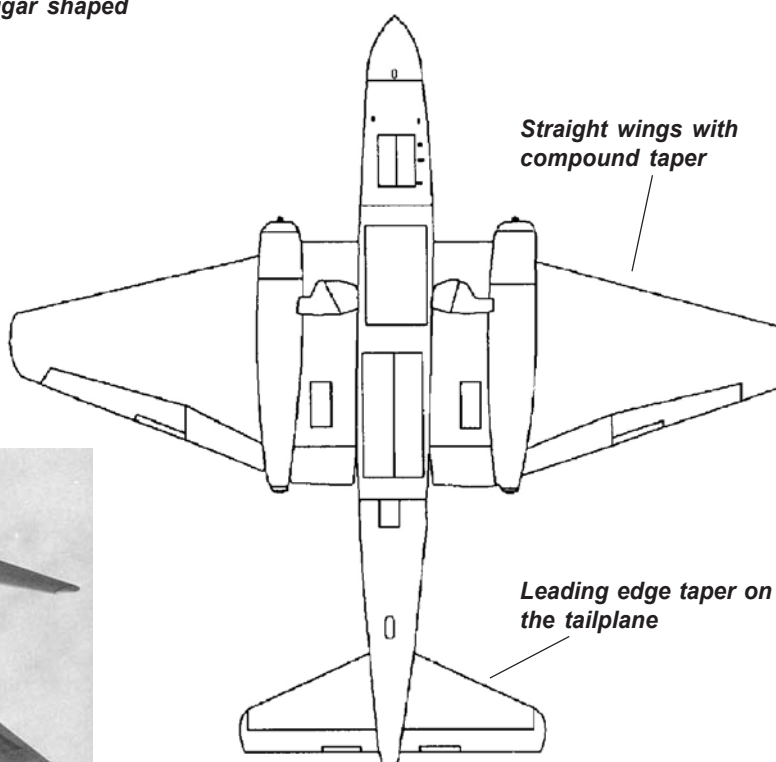
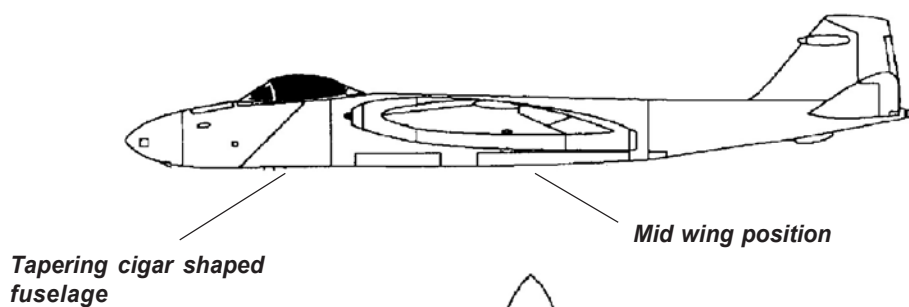
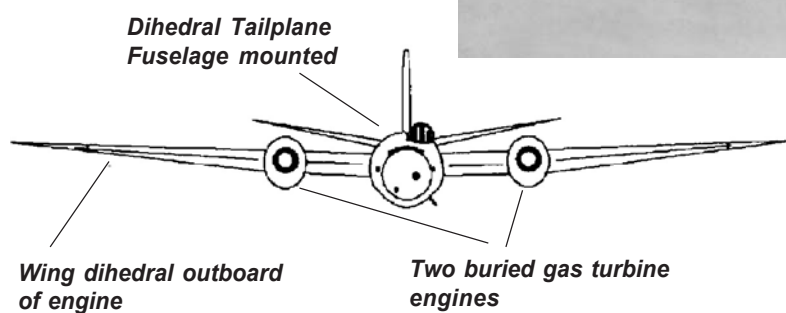
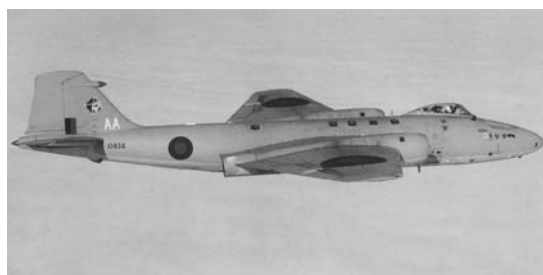
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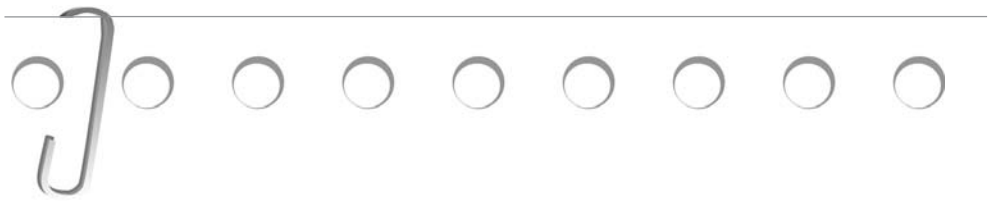


## Chapter 3

Page 34.2.3-13

## CANBERRA





Chapter 3

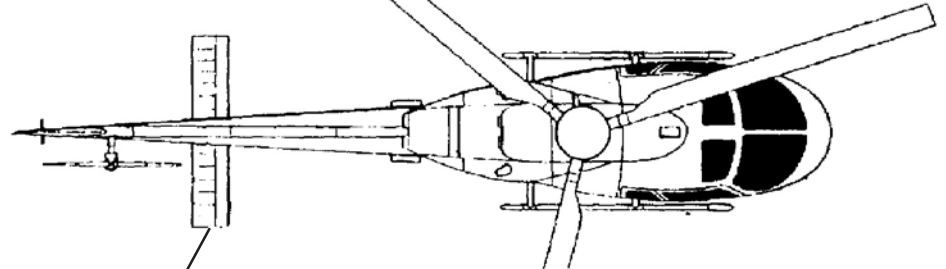
Page 34.2.3-15

## TWIN SQUIRREL

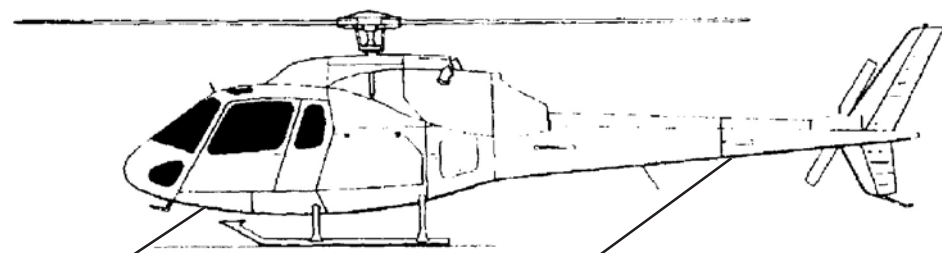
Three Rotor Blades



Twin Stabilisers



Tadpole Shaped Body



Long Tail



Single Engine

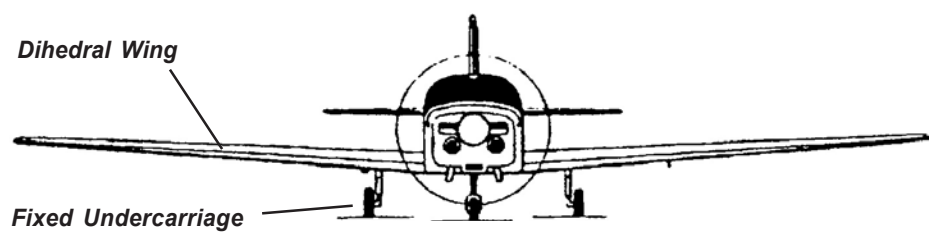
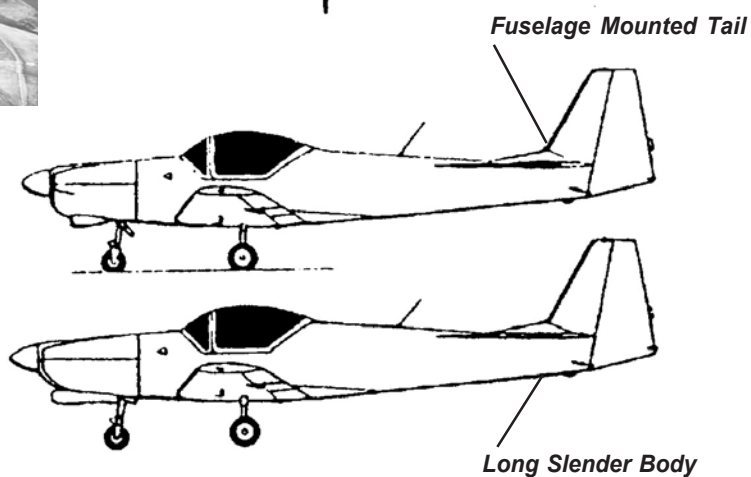
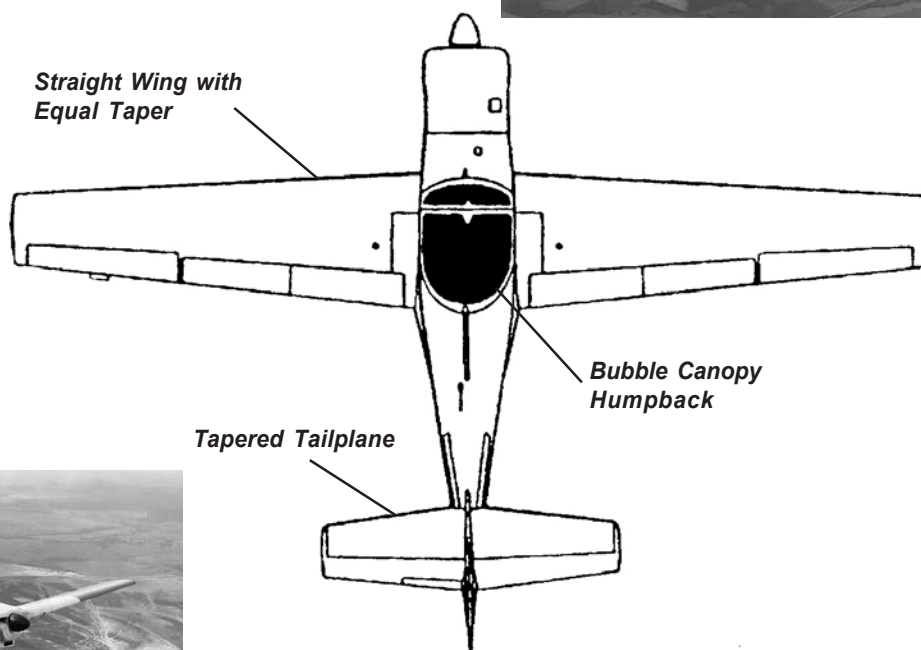




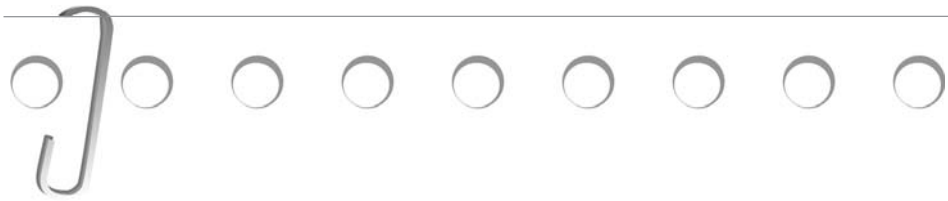
## Chapter 3

Page 34.2.3-17

## FIREFLY



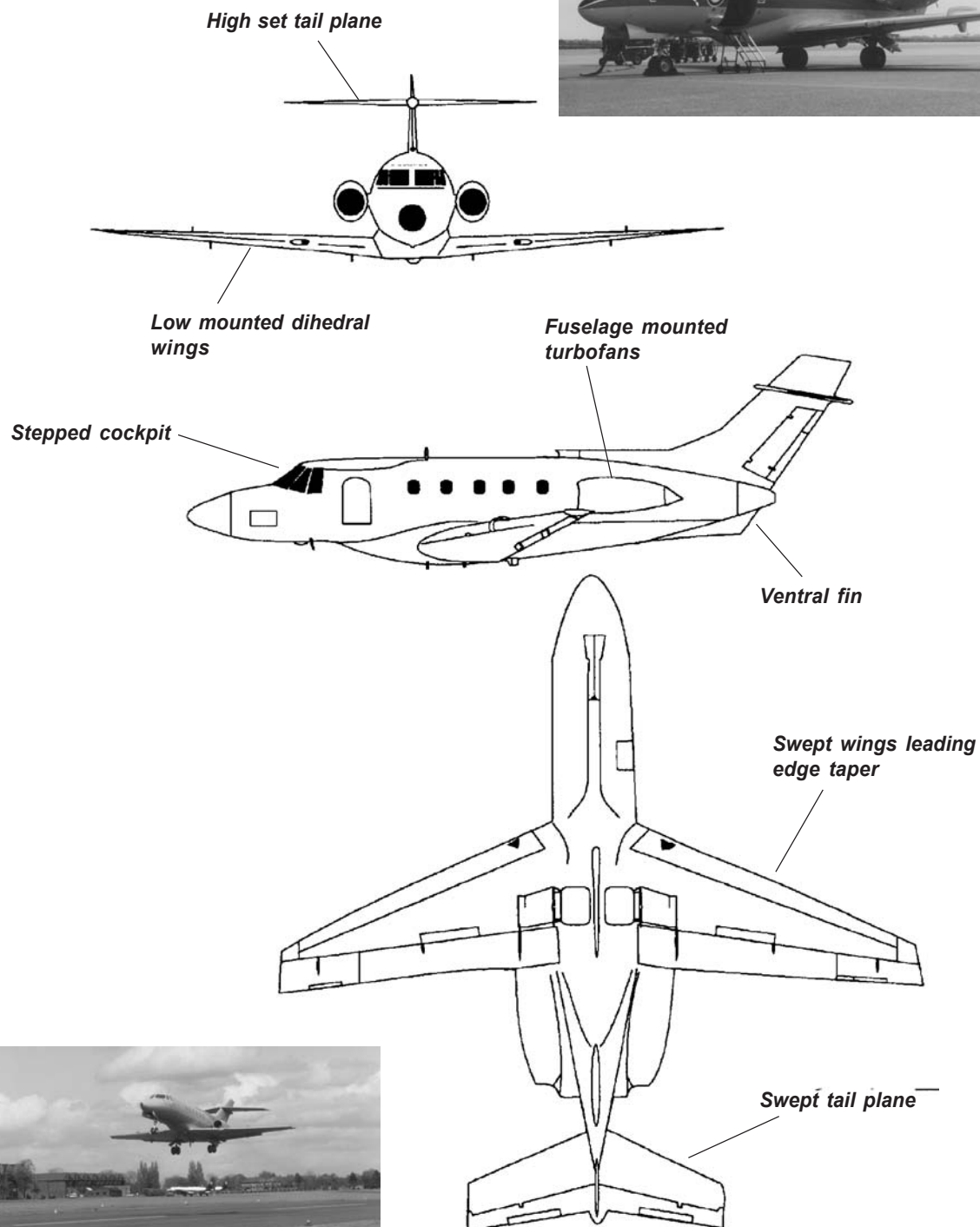




Chapter 3

Page 34.2.3-21

## DOMINIE & HS125



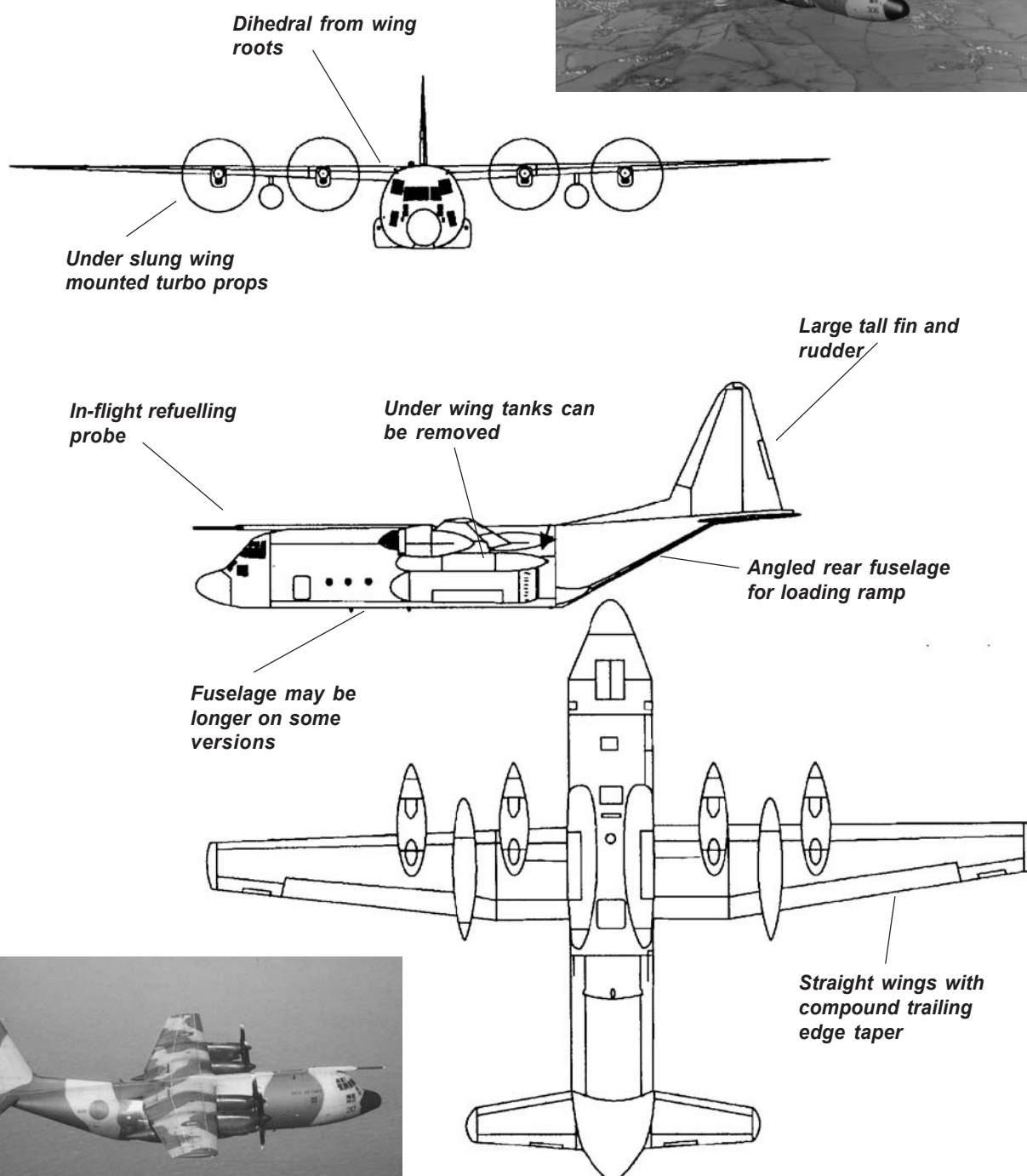


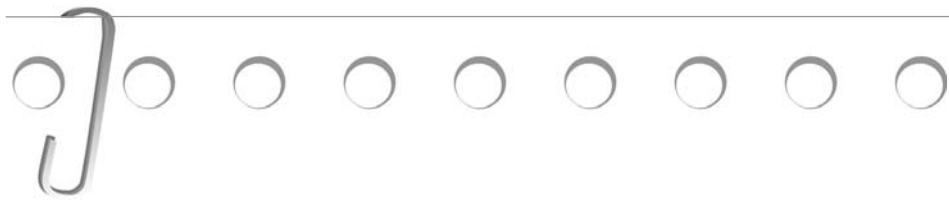


## Chapter 3

Page 34.2.3-23

## HERCULES

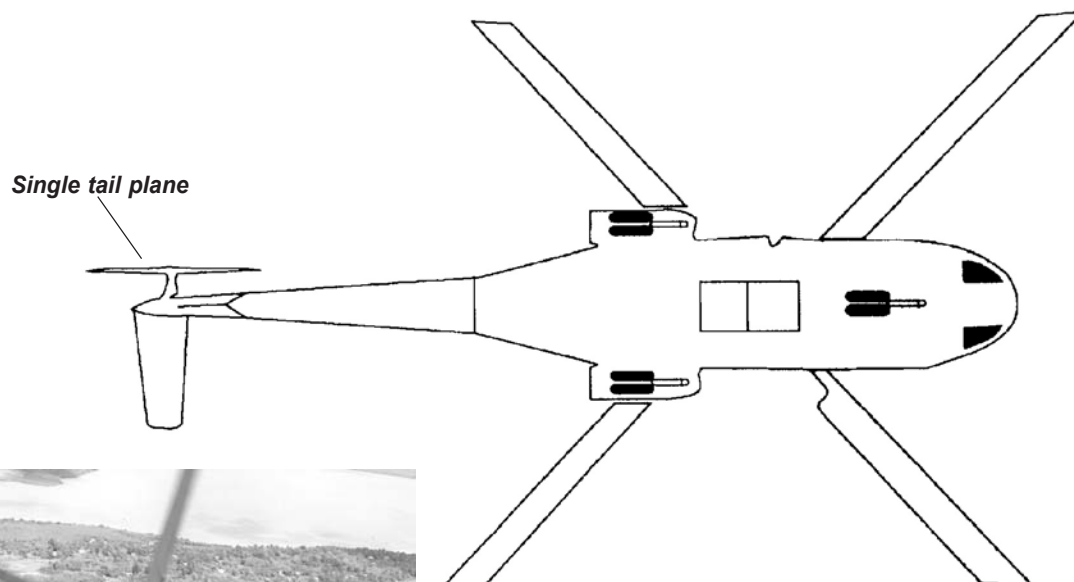
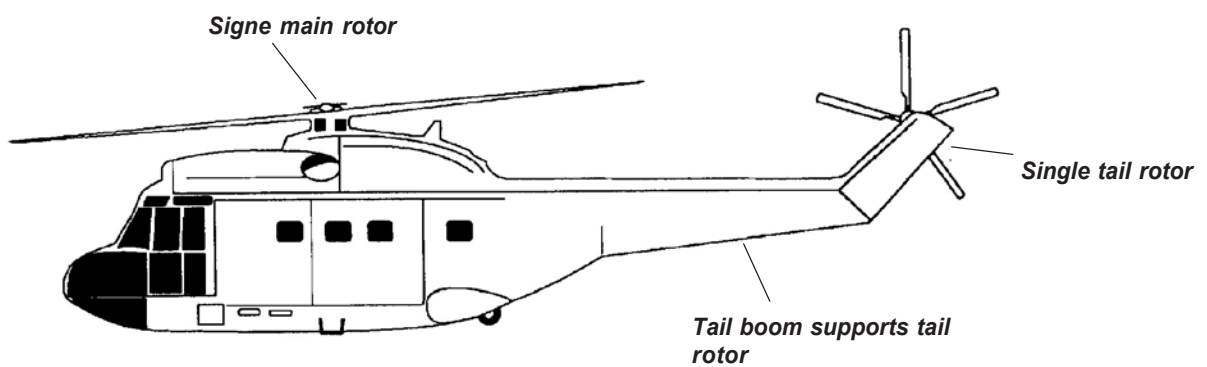
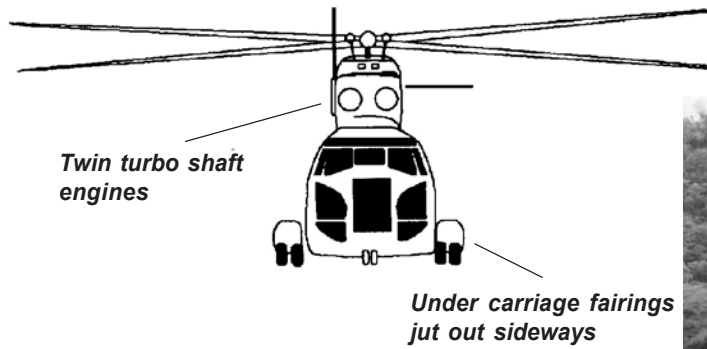




Chapter 3

# PUMA

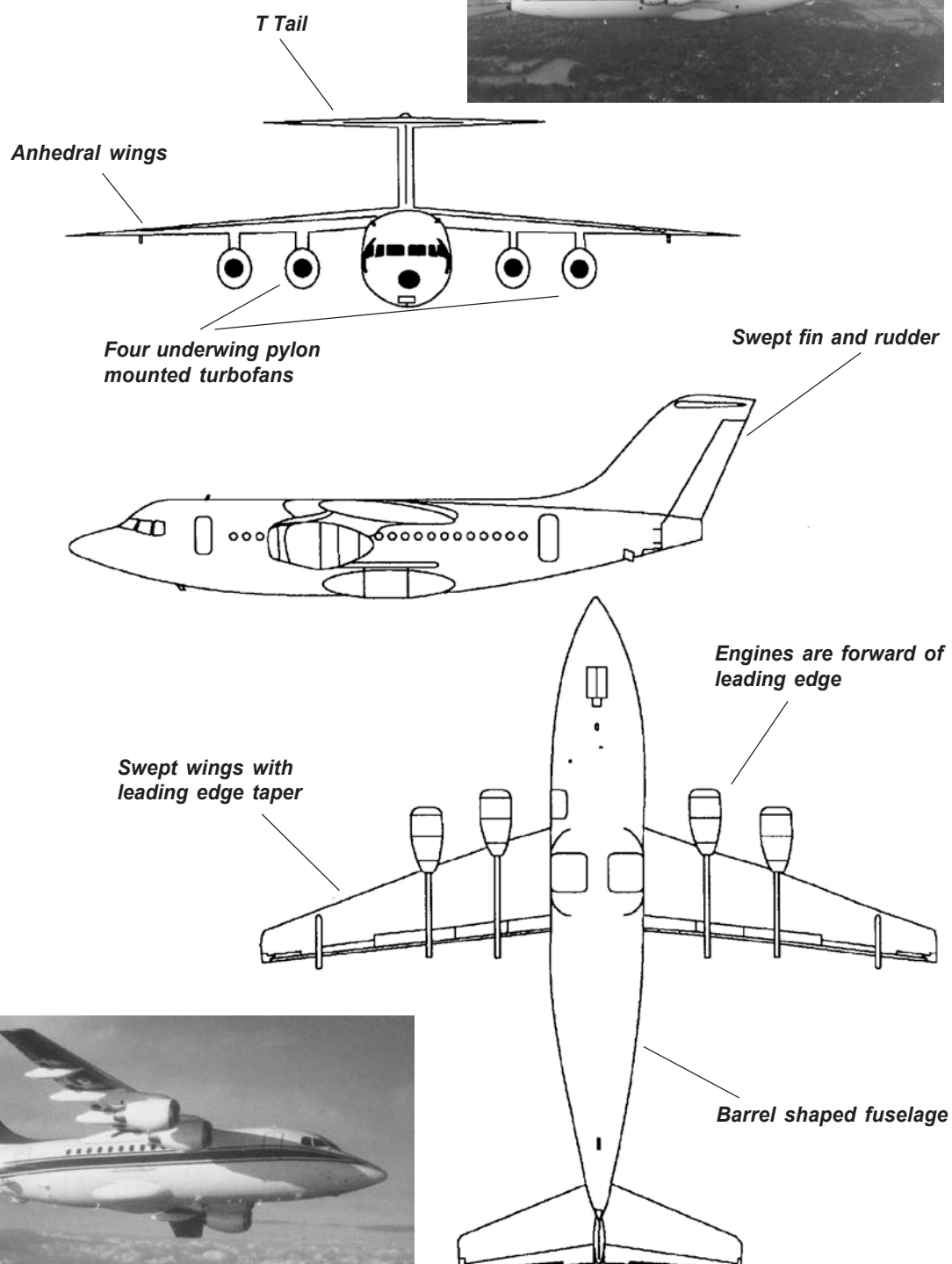
Page 34.2.3-25



## Chapter 3

Page 34.2.3-29

## BAe 146

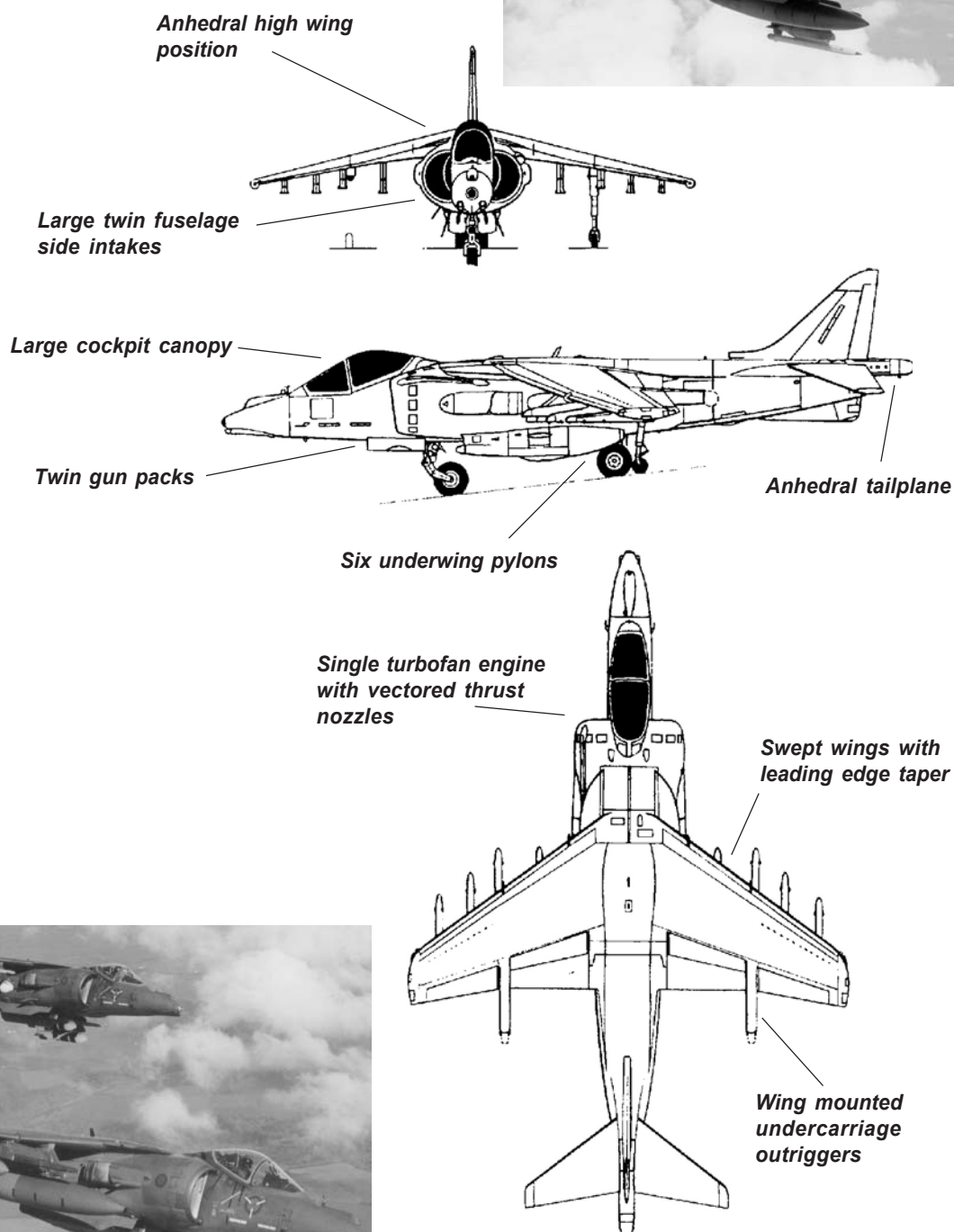




Chapter 3

Page 34.2.3-31

# HARRIER

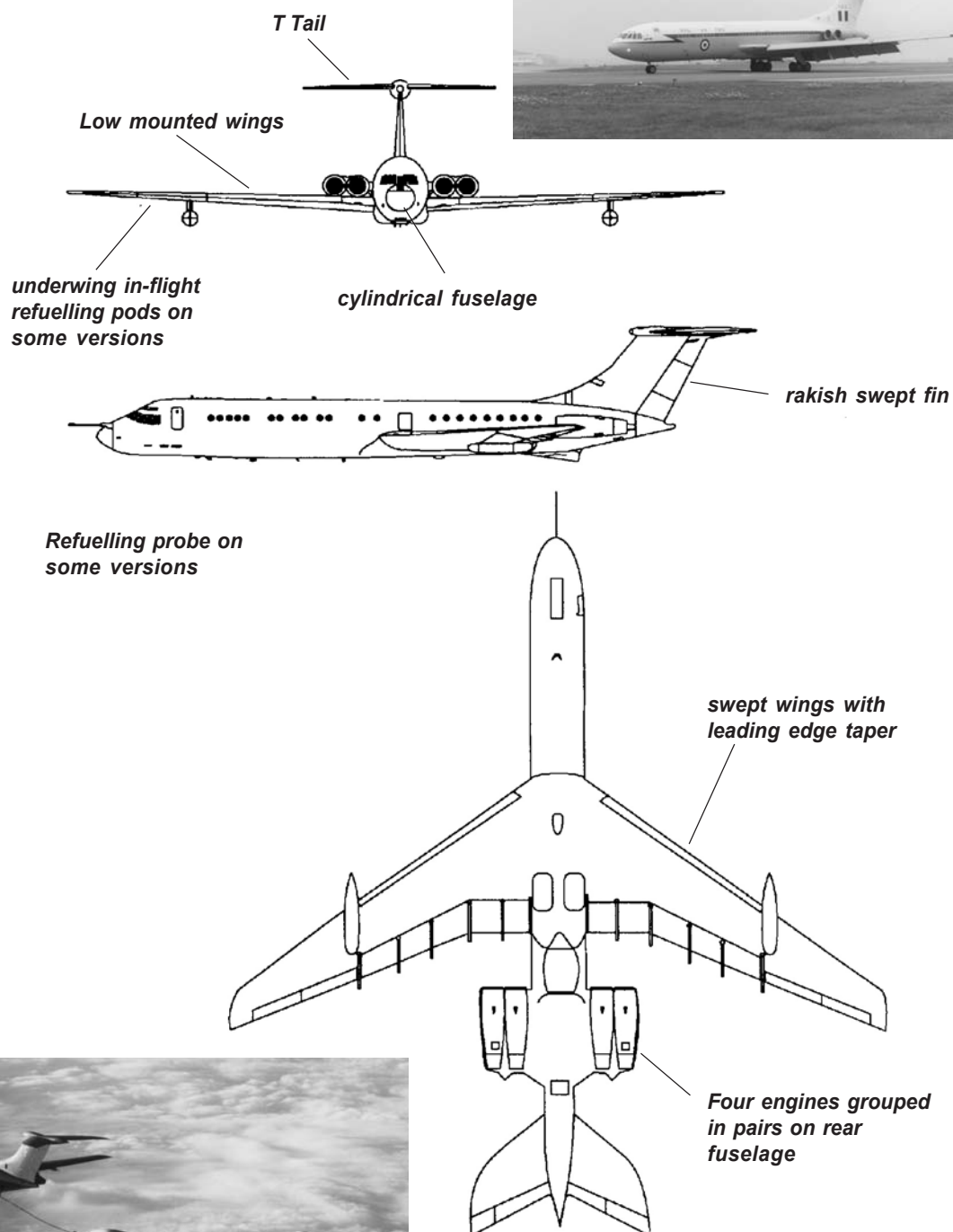




Chapter 3

Page 34.2.3-37

# VC 10

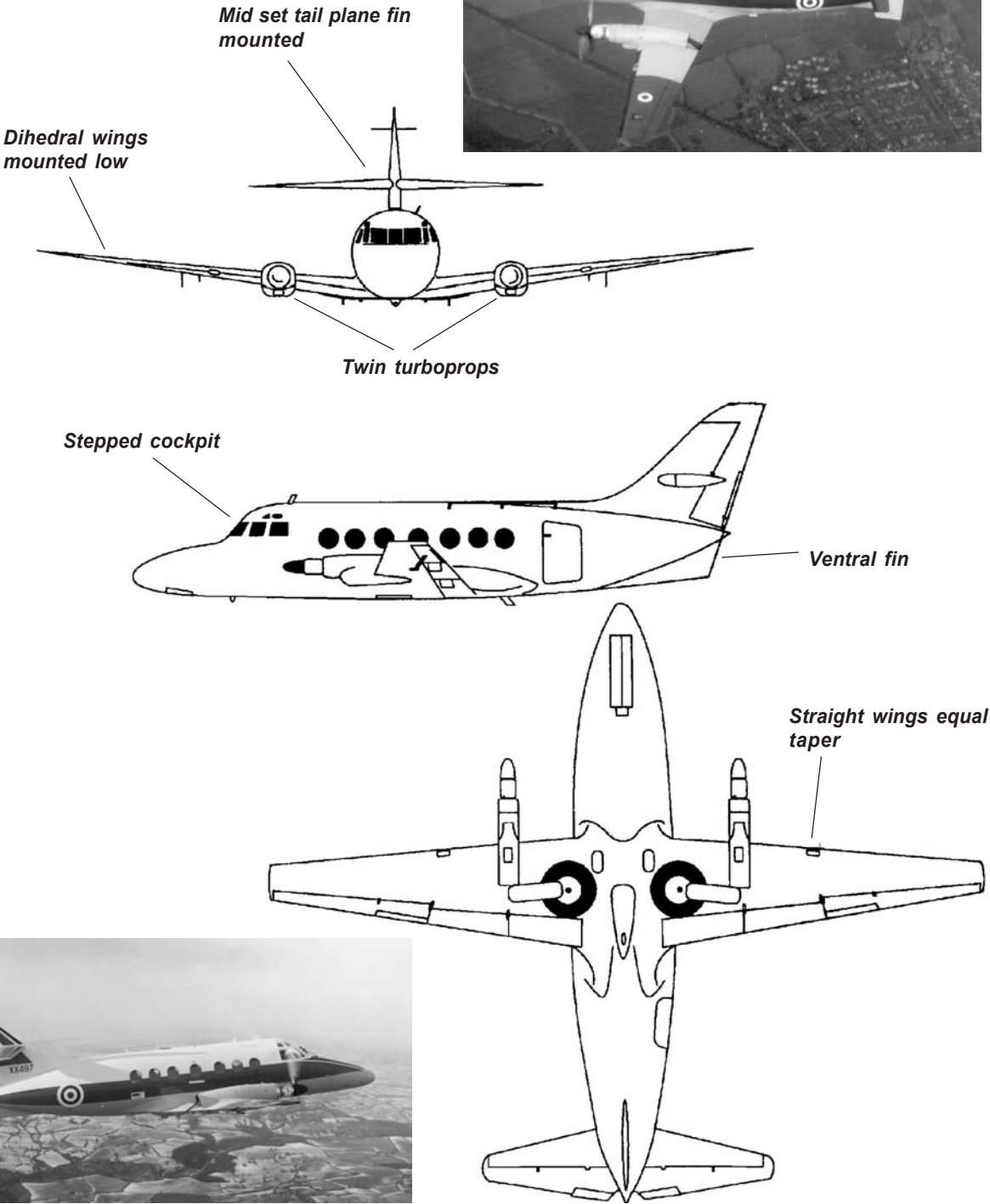




Chapter 3

Page 34.2.3-39

JETSTREAM



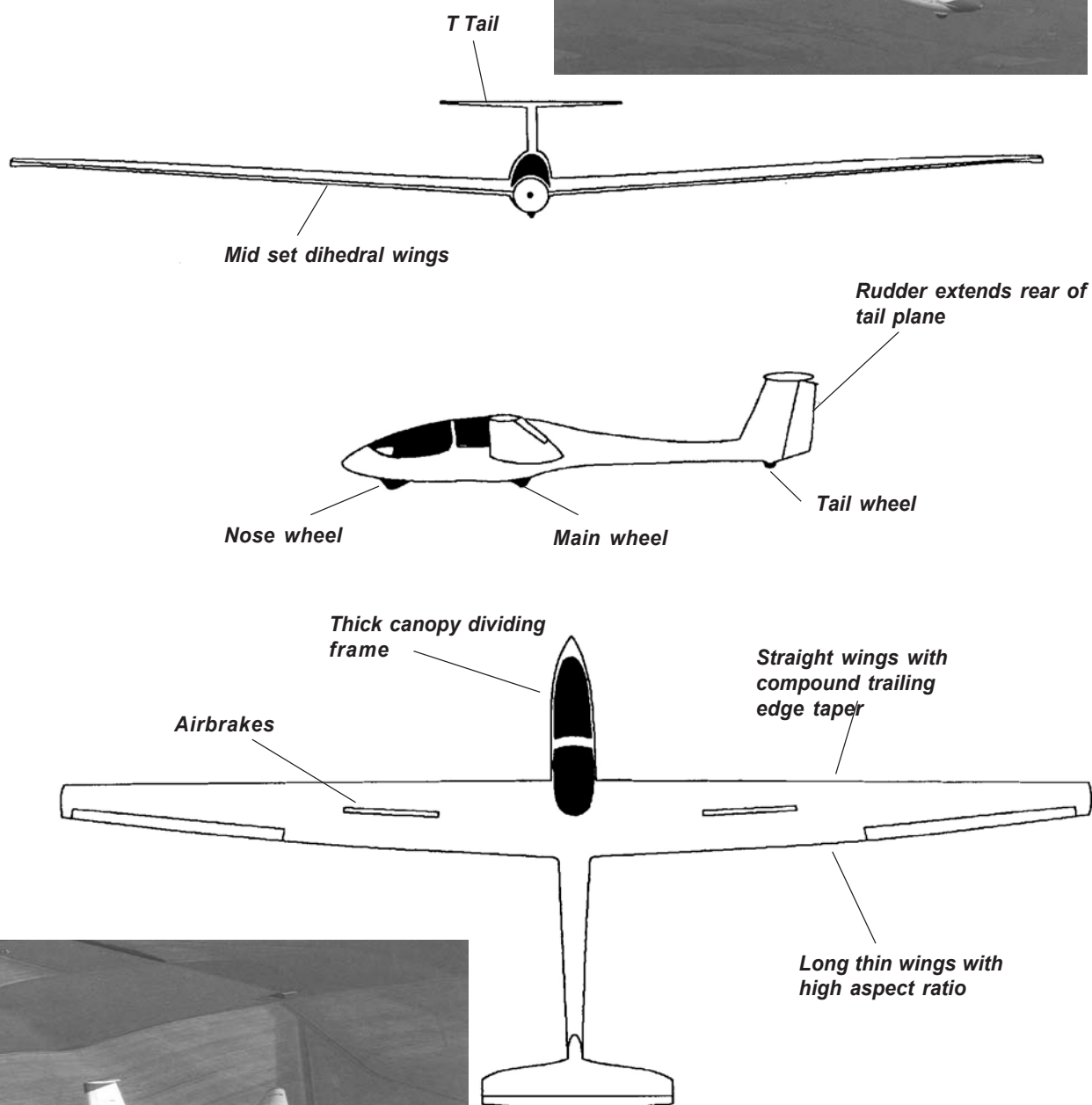


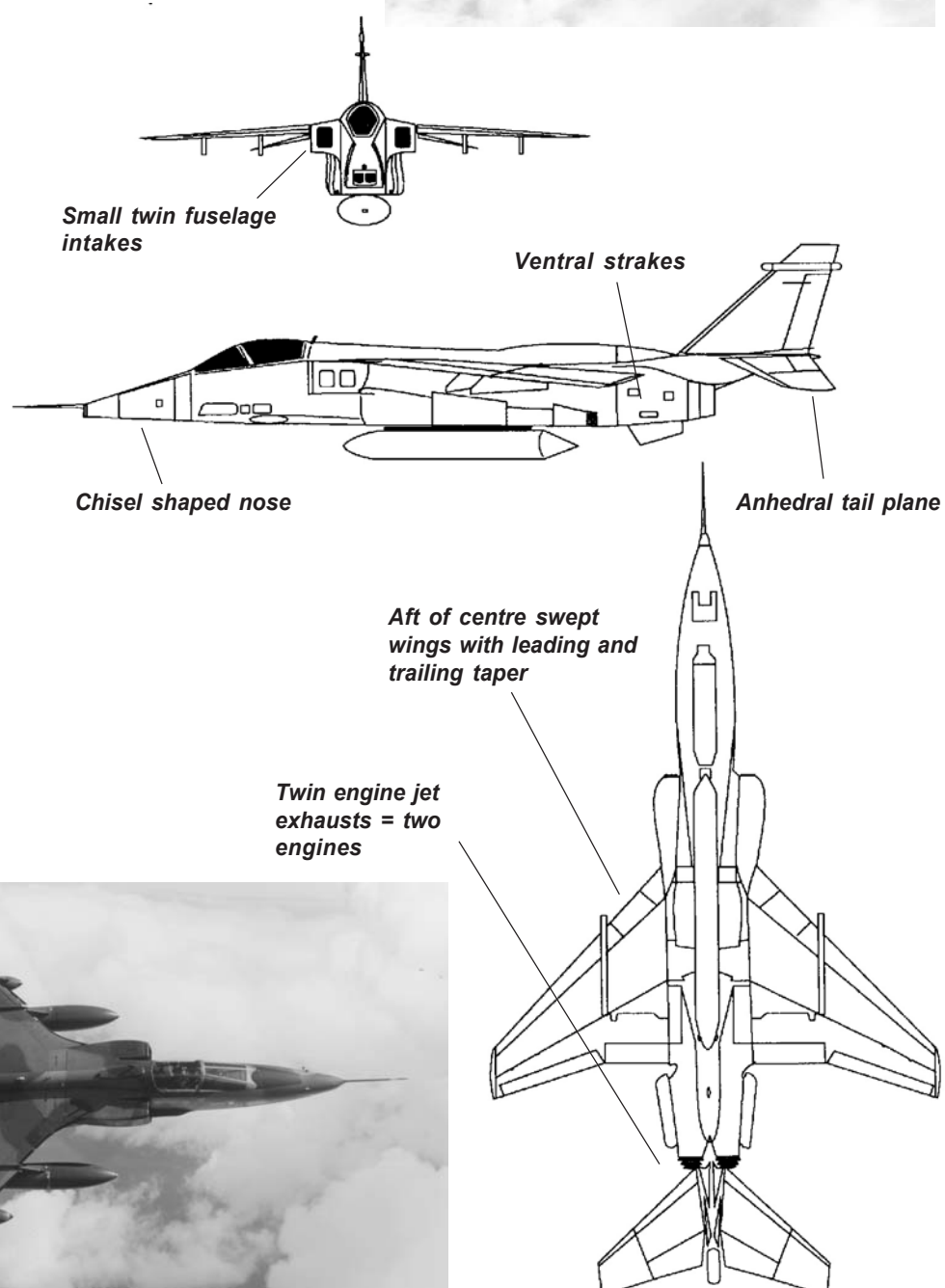


Chapter 3

Page 34.2.3-41

# VIKING



**Chapter 3****Page 34.2.3-45****JAGUAR**

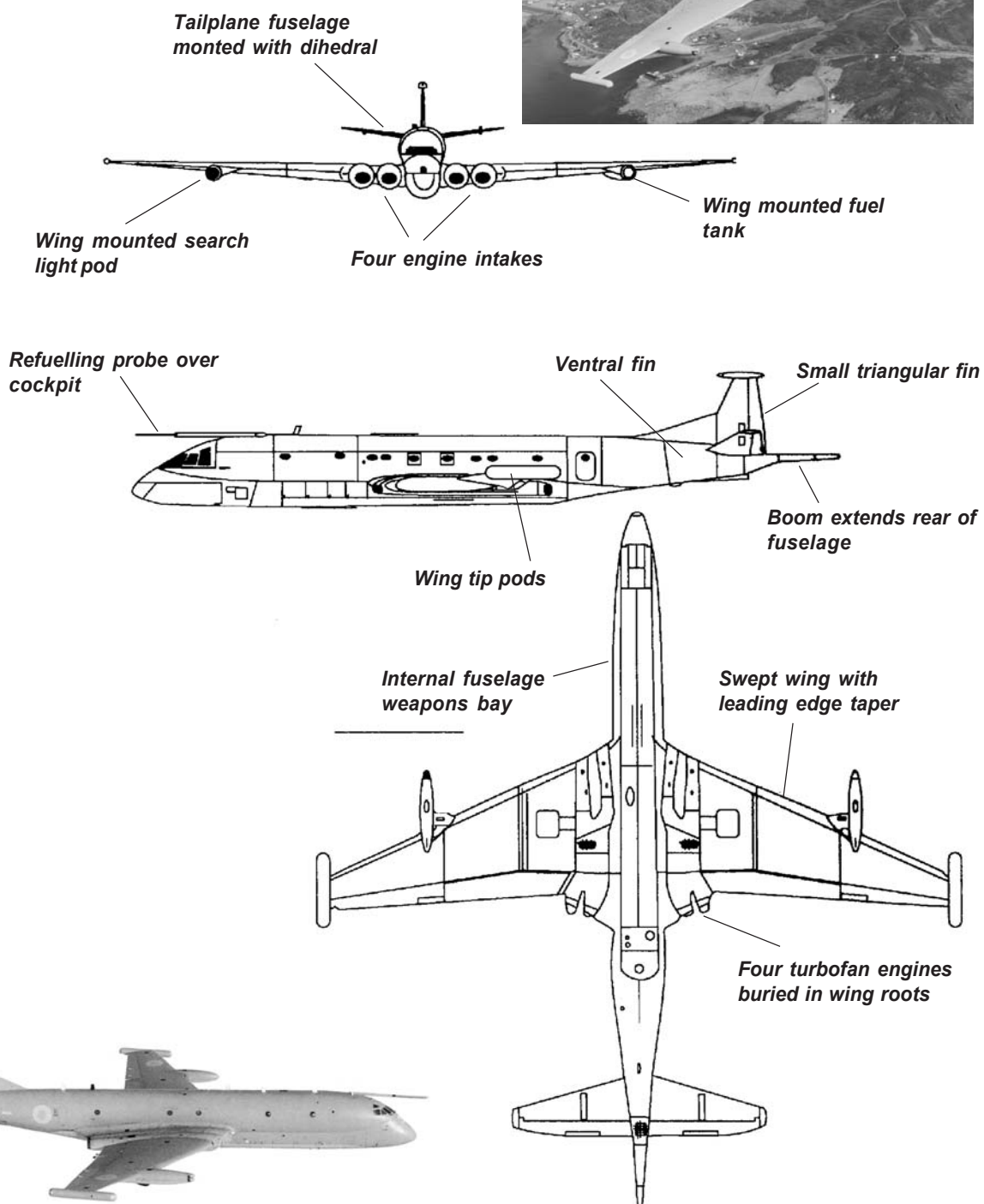




Chapter 3

Page 34.2.3-47

# NIMROD

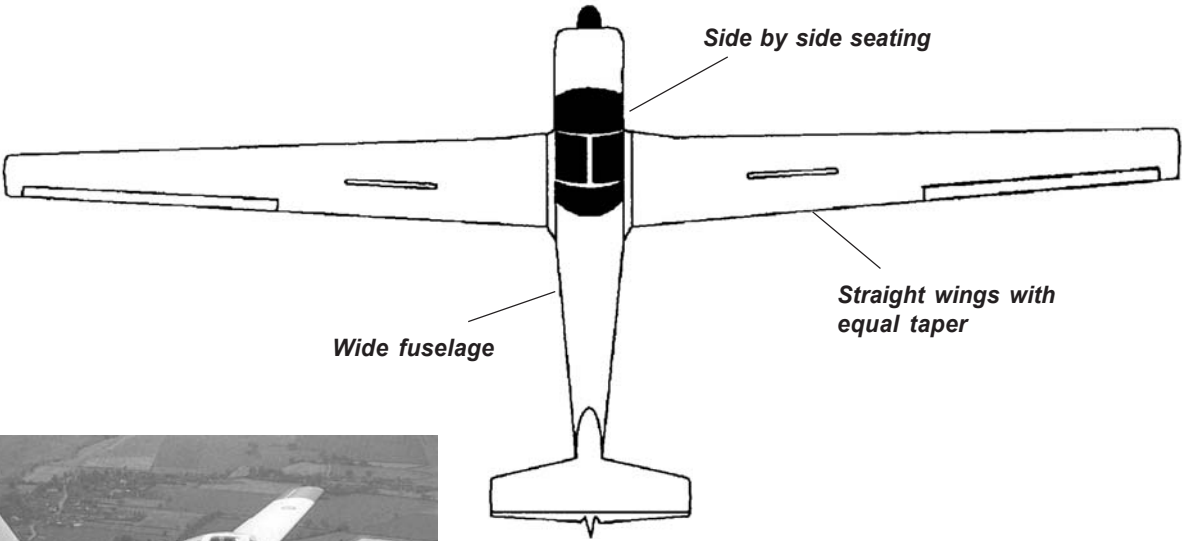
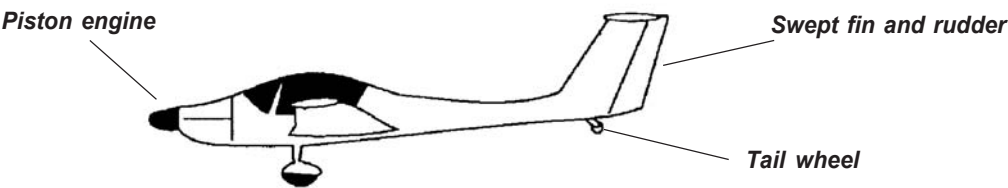
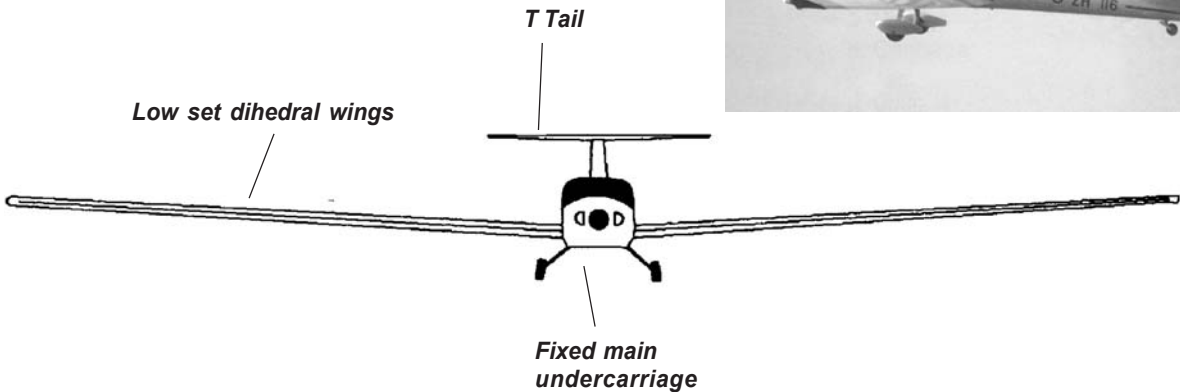




Chapter 3

Page 34.2.3-49

VIGILANT

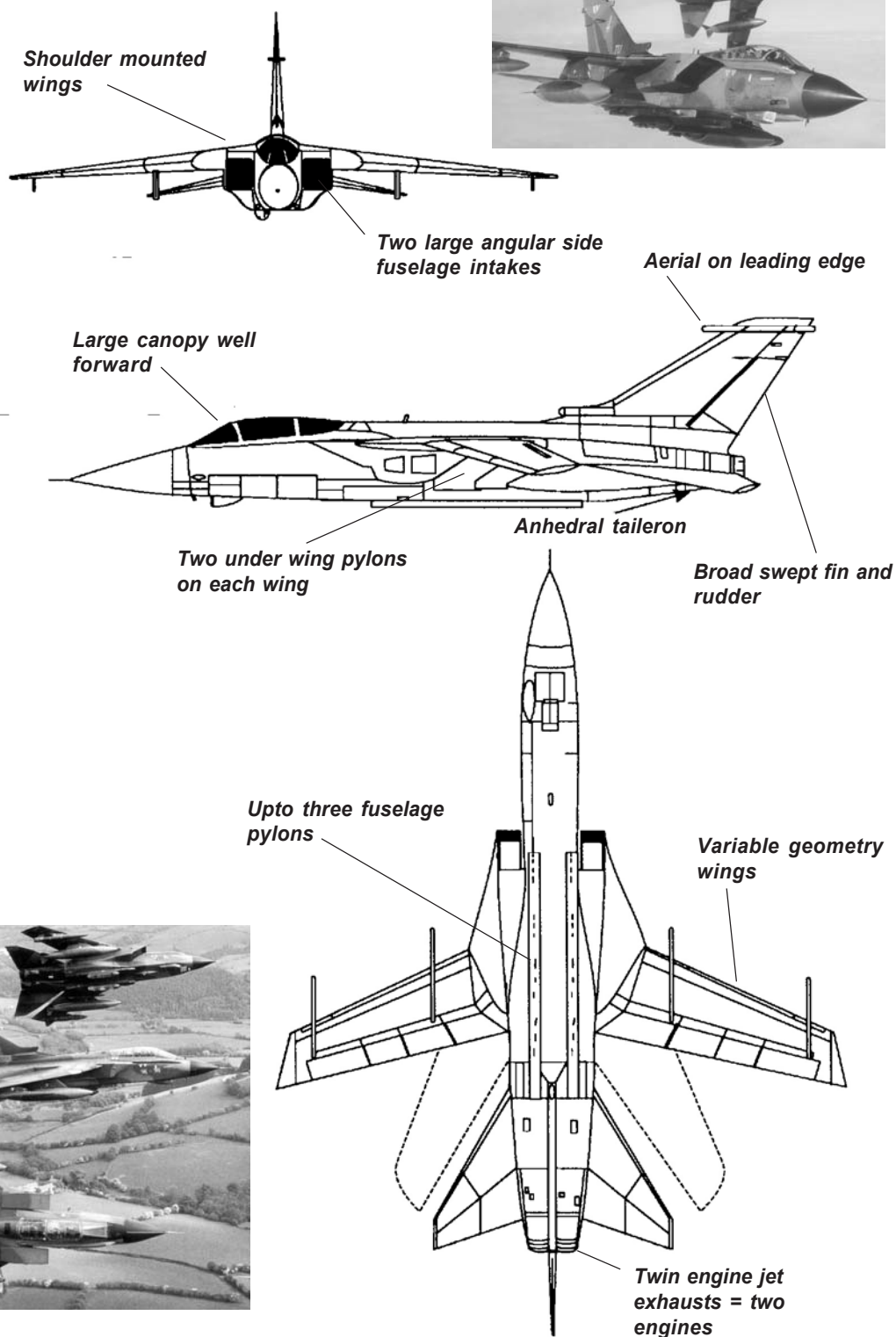


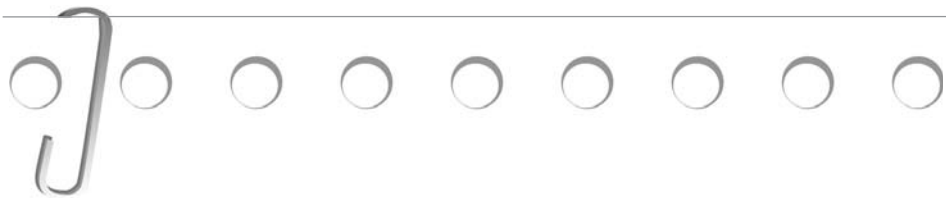


Chapter 3

Page 34.2.3-53

## TORNADO GR1

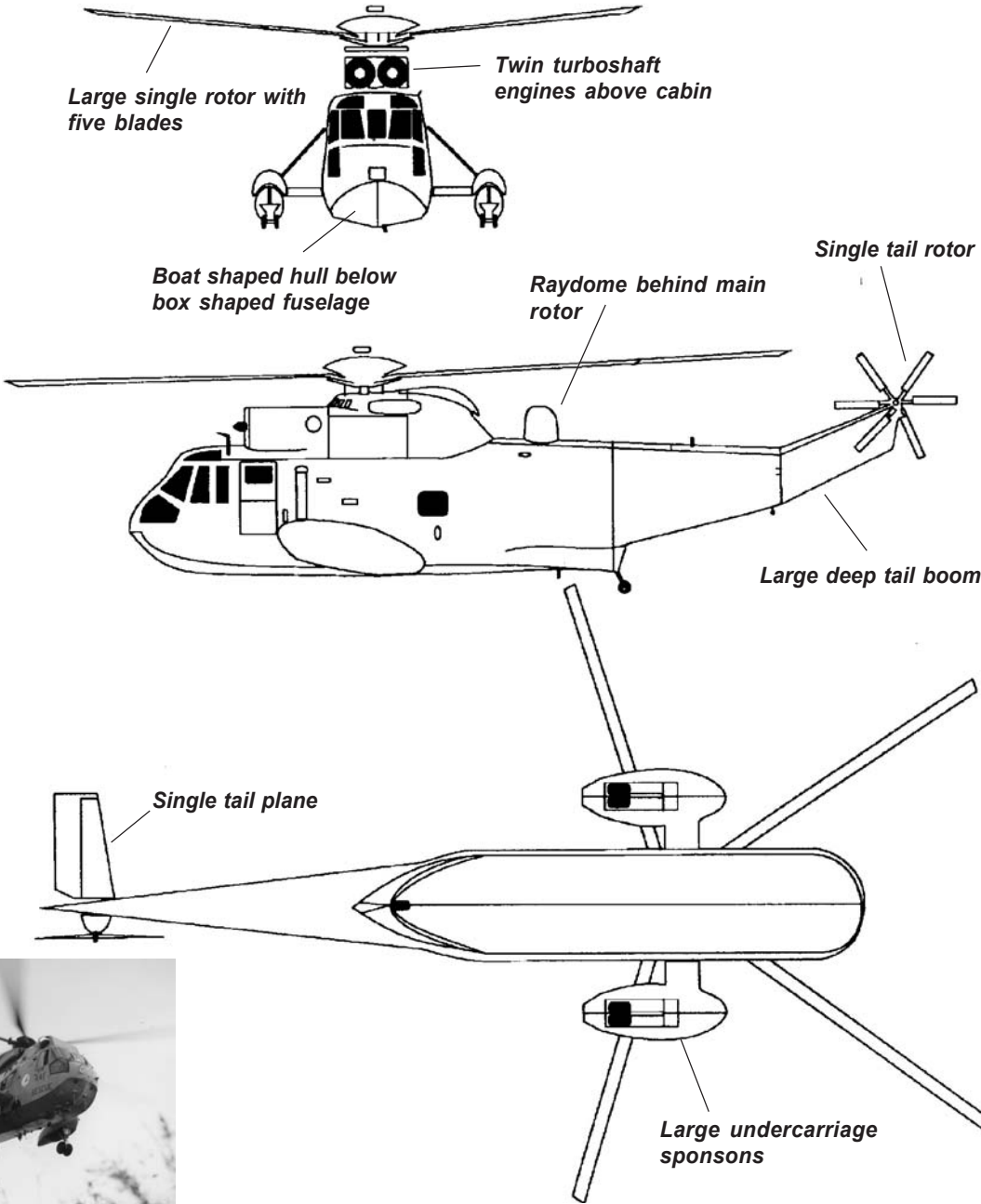


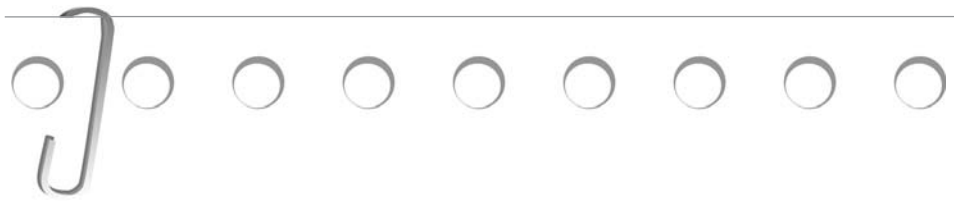


Chapter 3

Page 34.2.3-55

SEA KING

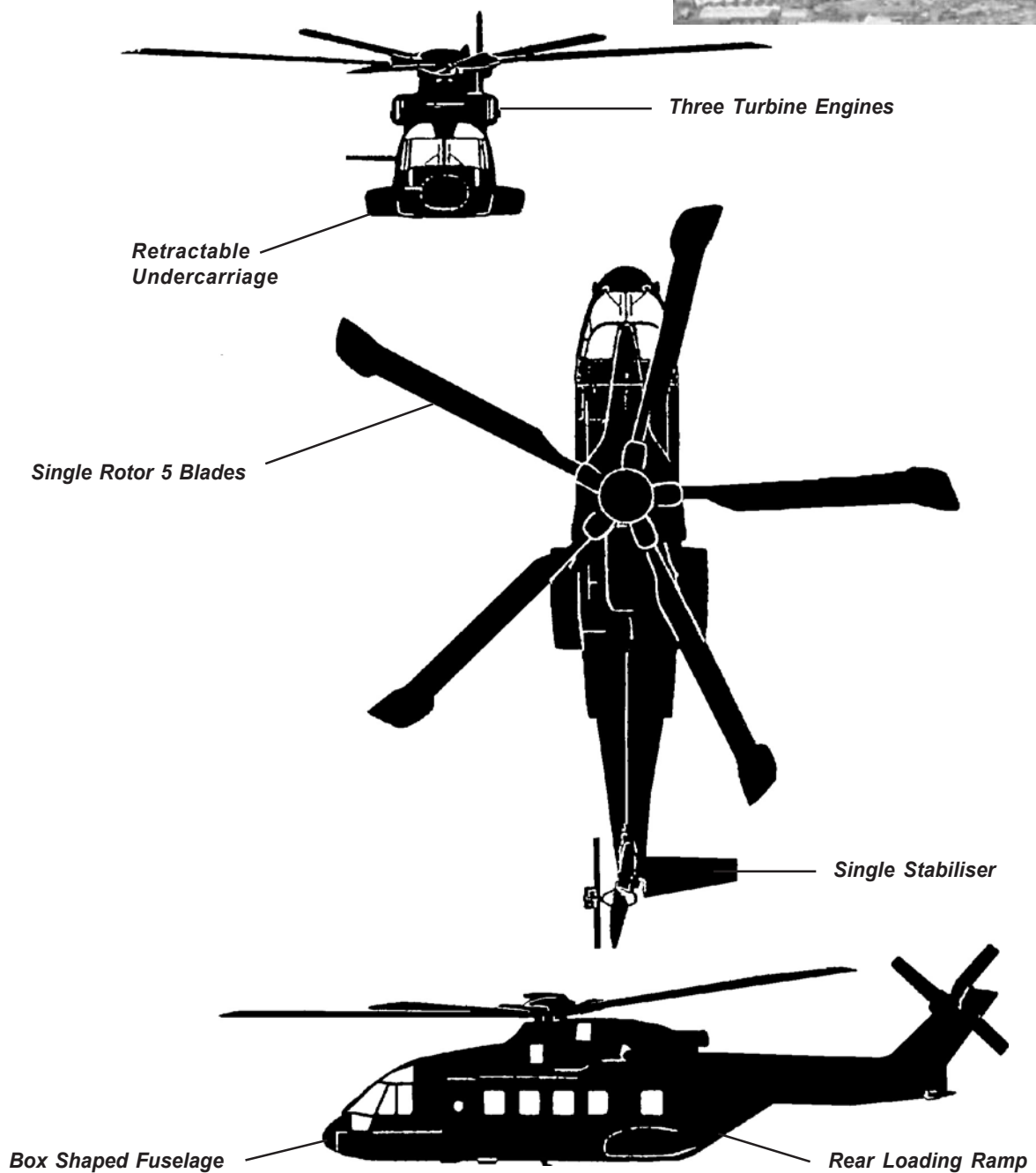


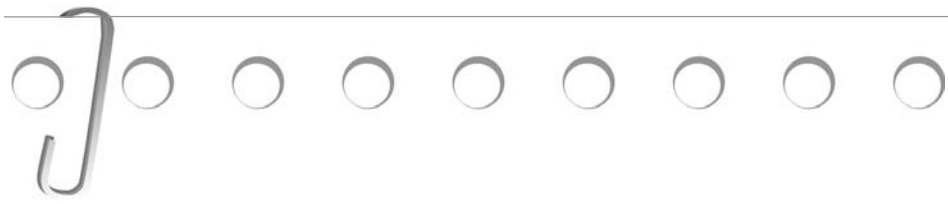


Chapter 3

Page 34.2.3-57

# MERLIN





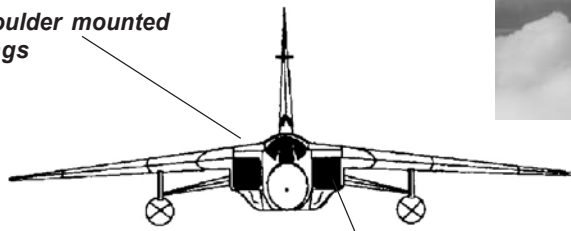
## Chapter 3

Page 34.2.3-61

## TORNADO F3

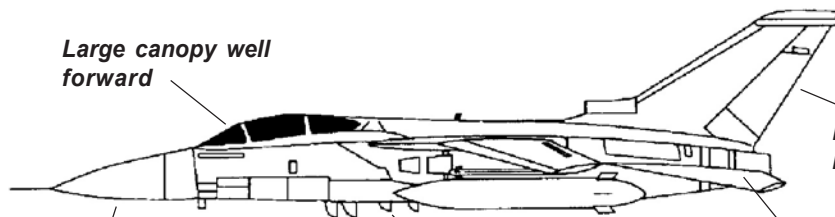


Shoulder mounted wings



Two large angular side fuselage intakes

Large canopy well forward



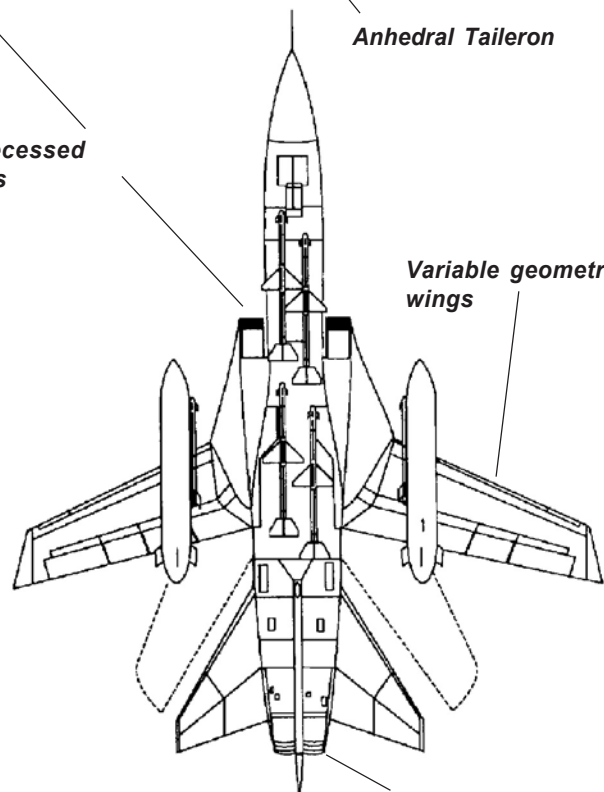
Broad swept fin and rudder

Longer fuselage and more pointed nose than the GR1

Semi-recessed missiles

Anhedral Taileron

Variable geometry wings

Twin engine jet exhausts  
= two engines

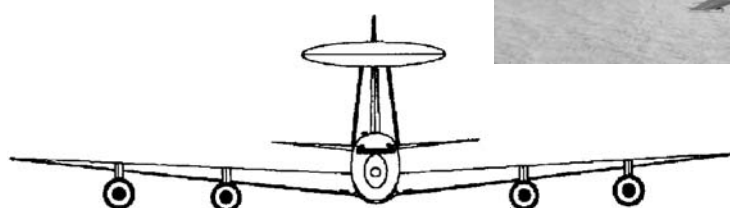




Chapter 3

Page 34.2.3-63

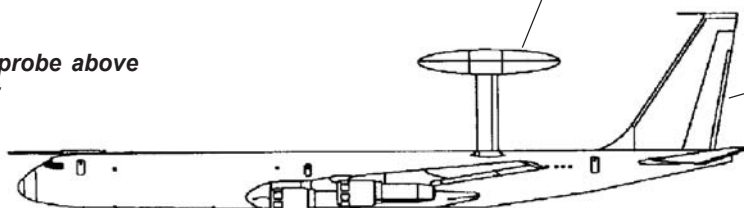
# SENTRY



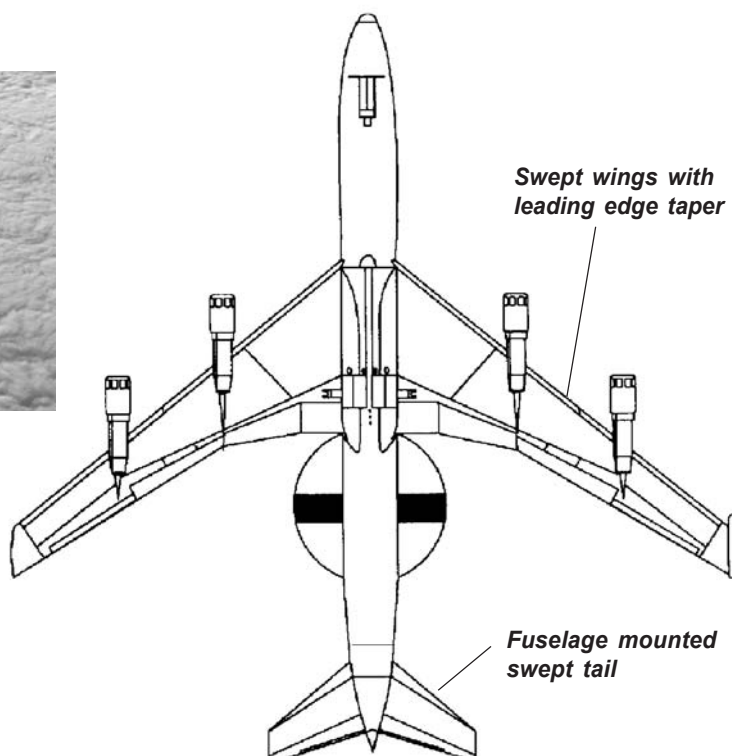
*Four under wing pylon mounted turbo fans*

*Prominent rotadome*

*Refuel probe above cockpit*



*Tall fin*



*Swept wings with leading edge taper*

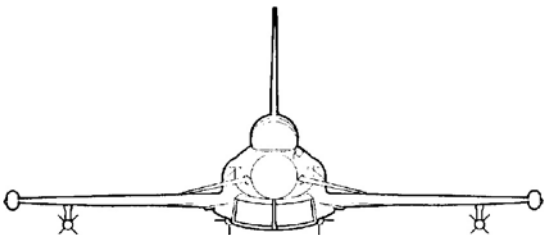
*Fuselage mounted swept tail*



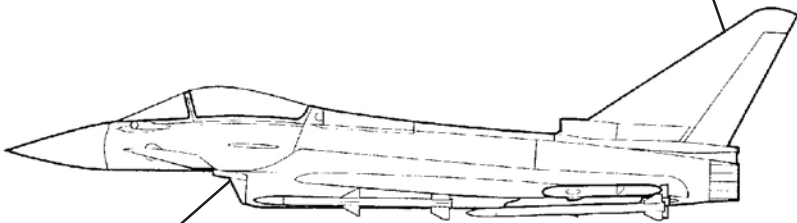
Chapter 3

Page 34.2.3-65

EUROFIGHTER, EF-2000



Single Large  
Fin & Rudder



Square Intake Under Cockpit

Cannards

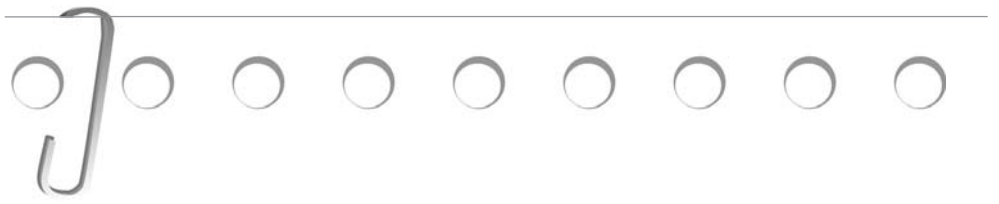
Delta Wing

ECM Pods on  
Wing Tips

Twin Engine  
Exhausts



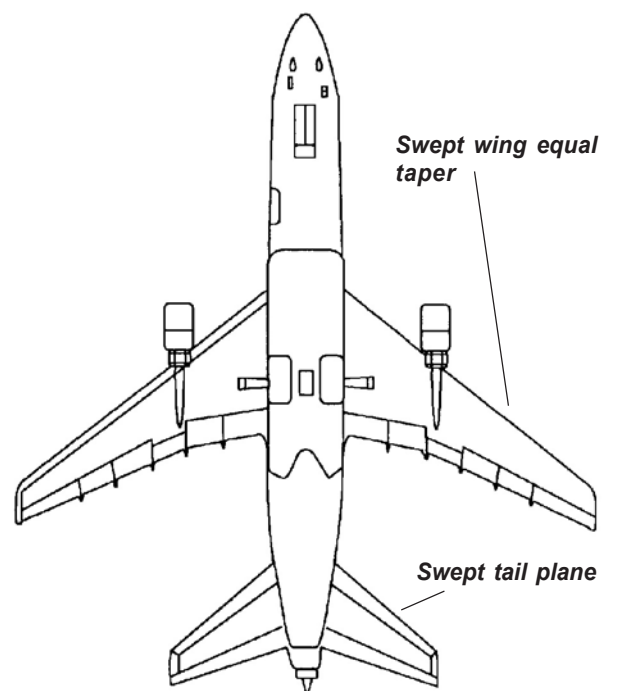
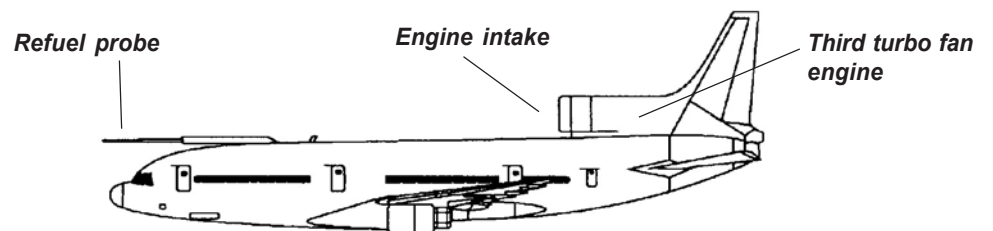
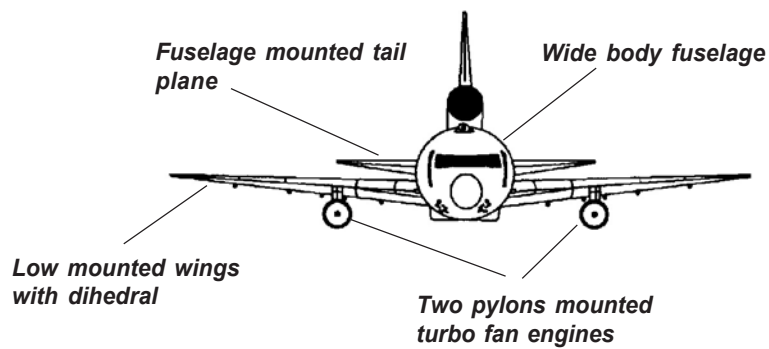




Chapter 3

Page 34.2.3-69

# TRISTAR

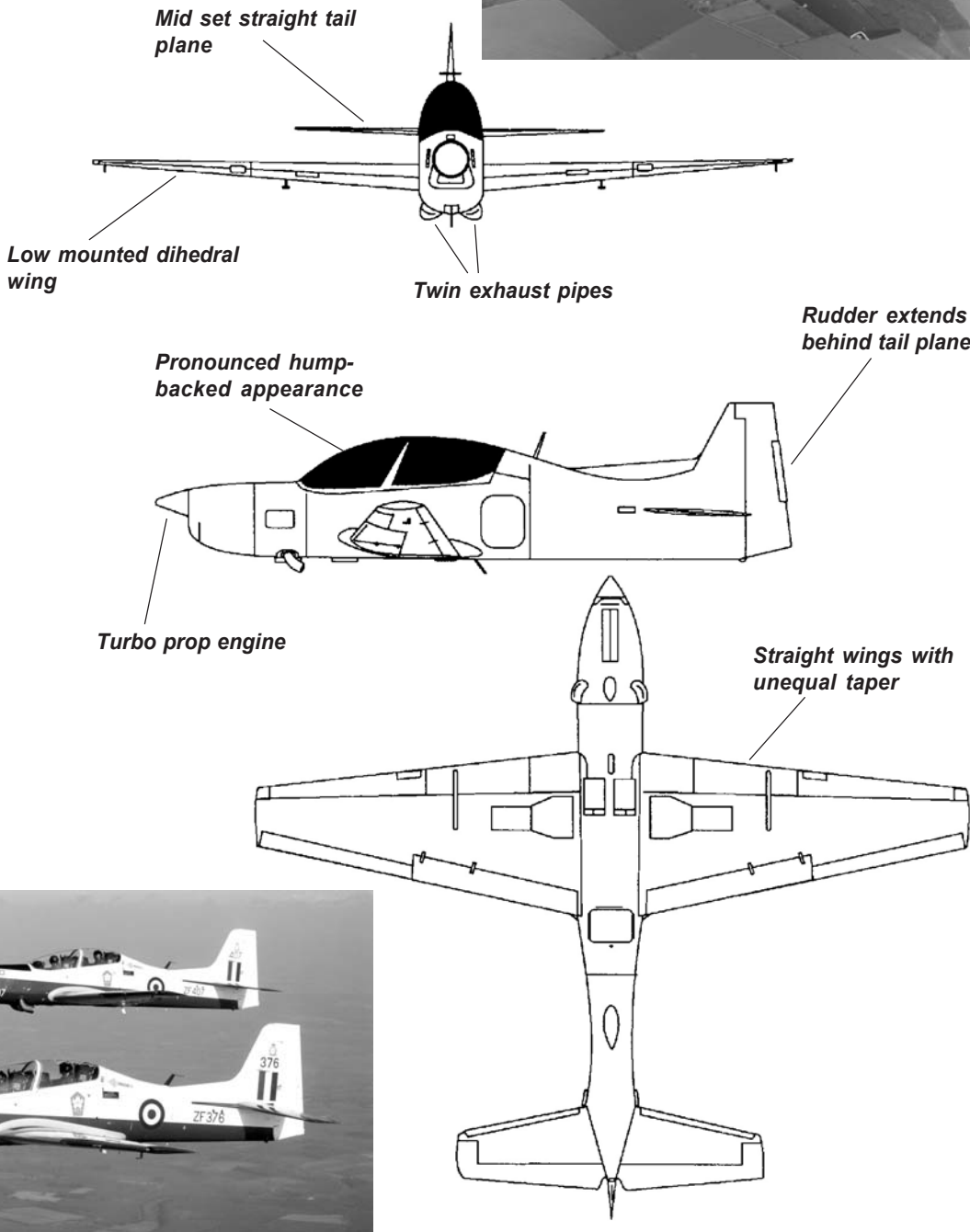




Chapter 3

Page 34.2.3-71

TUCANO

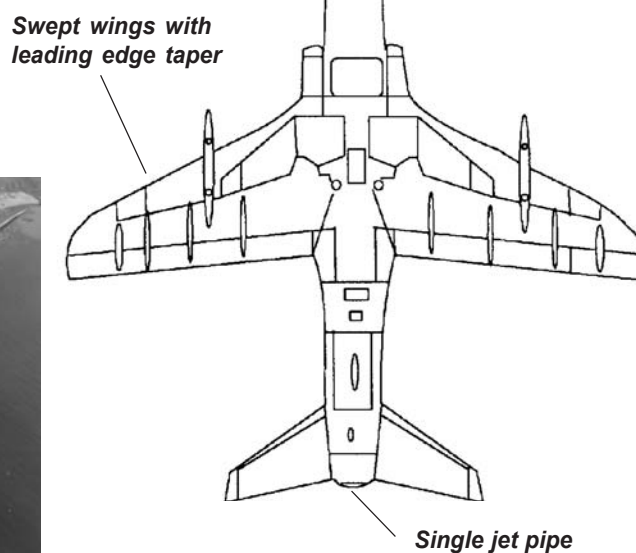
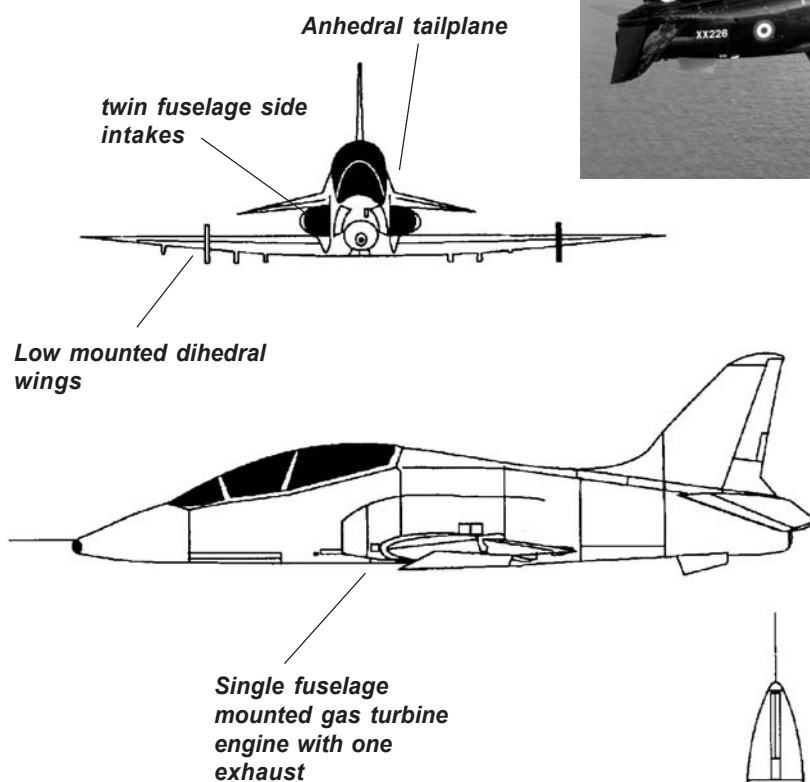




Chapter 3

Page 34.2.3-73

# HAWK

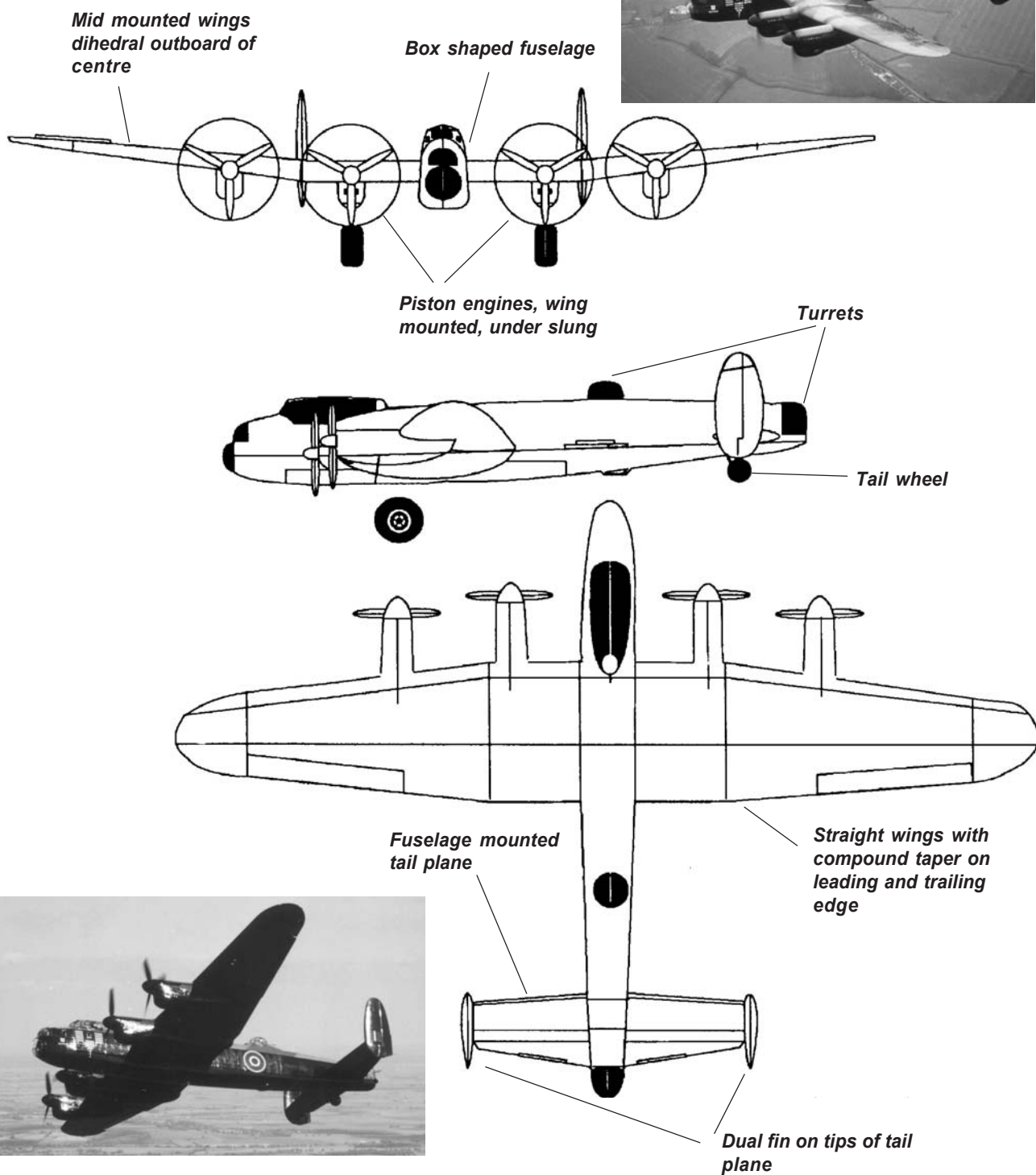




## Chapter 3

## LANCASTER

Page 34.2.3-77

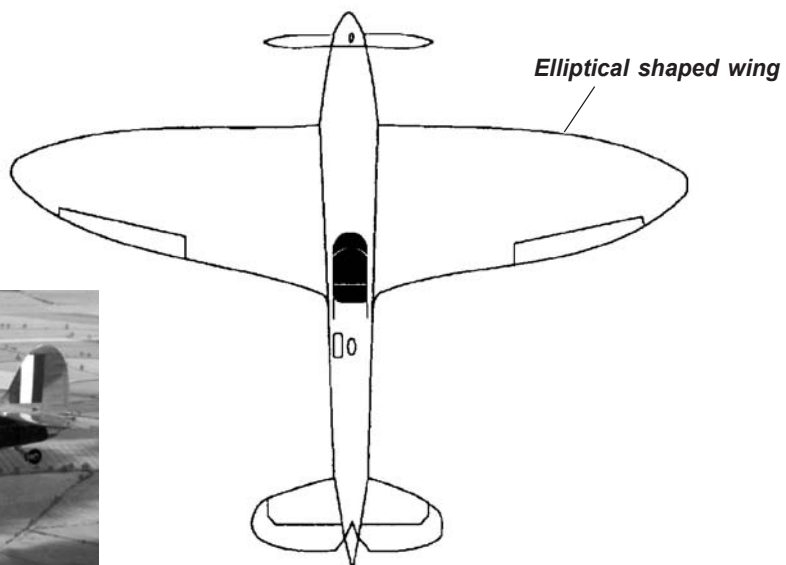
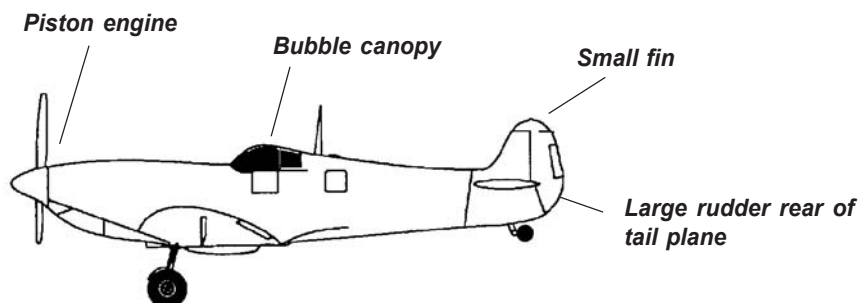
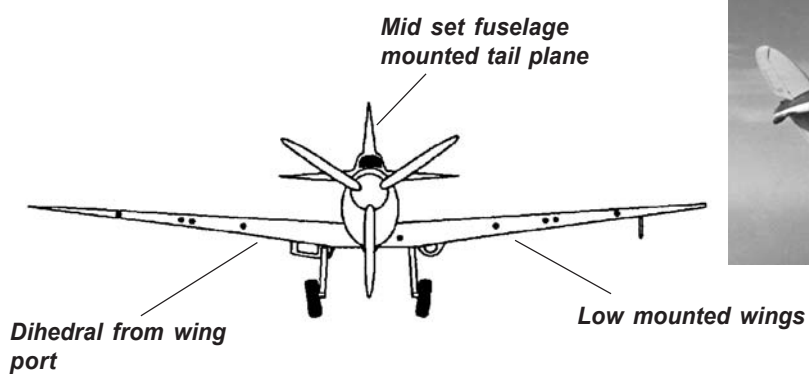


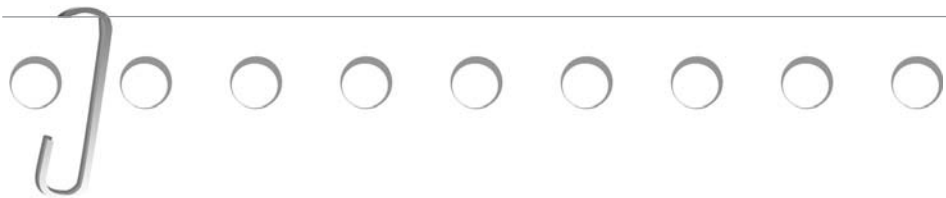


Chapter 3

Page 34.2.3-79

# SPITFIRE

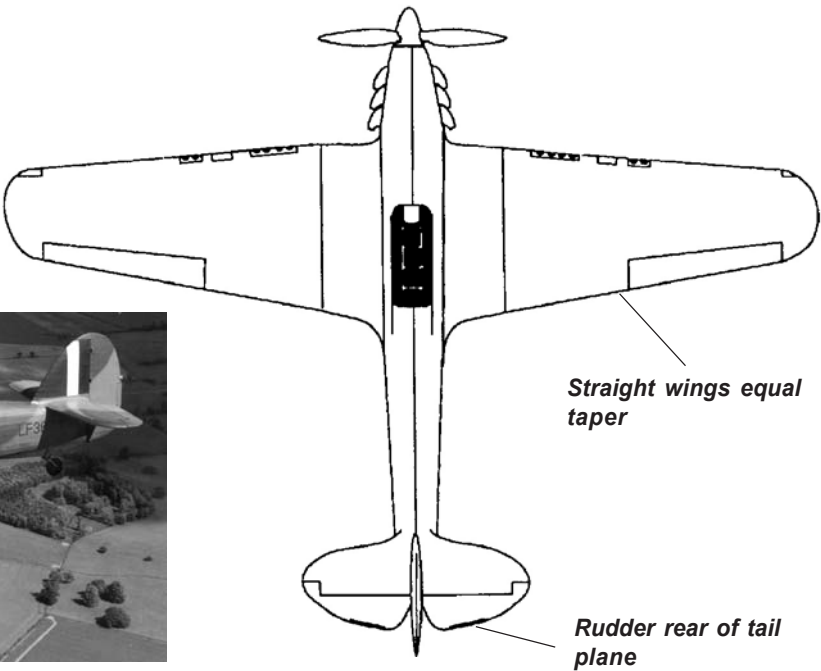
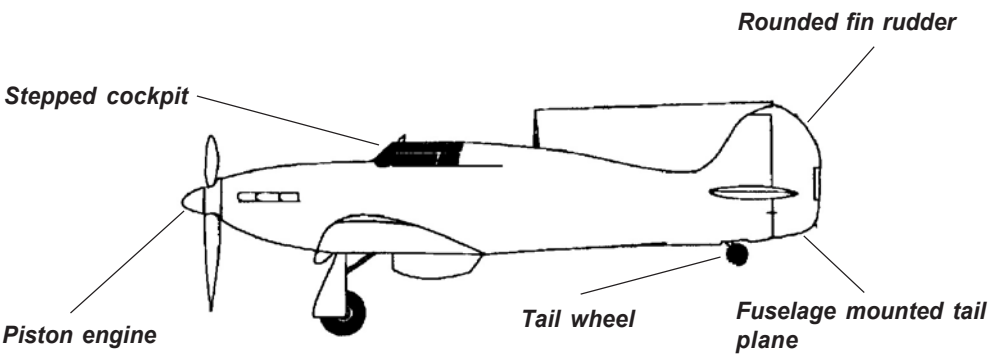
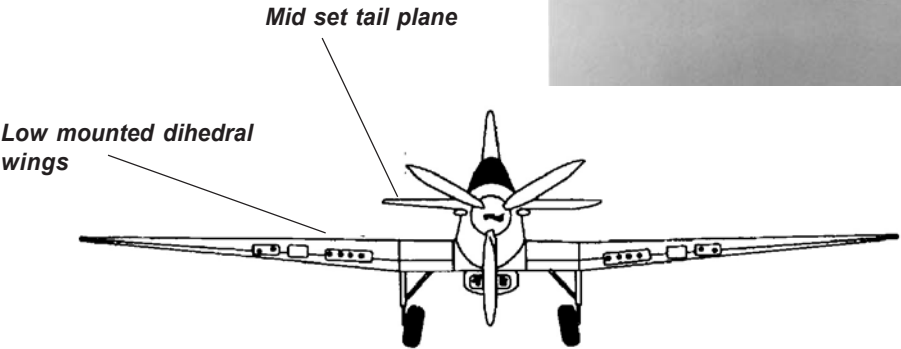




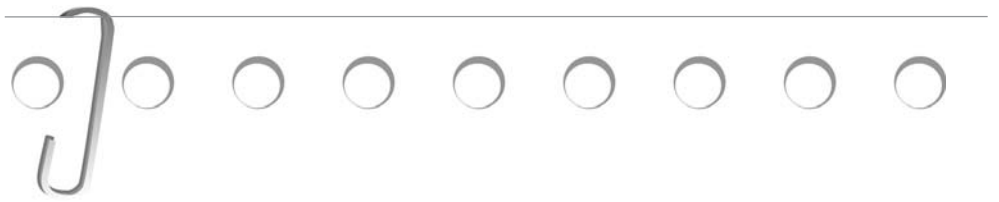
Chapter 3

Page 34.2.3-81

HURRICANE



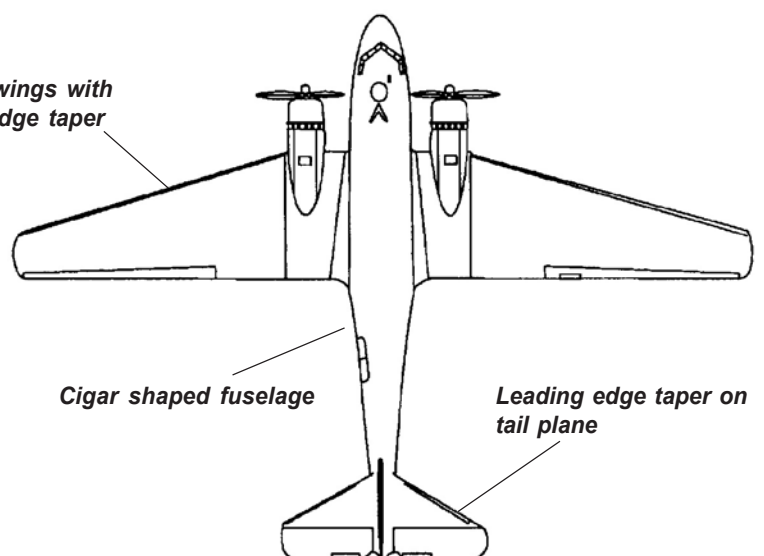
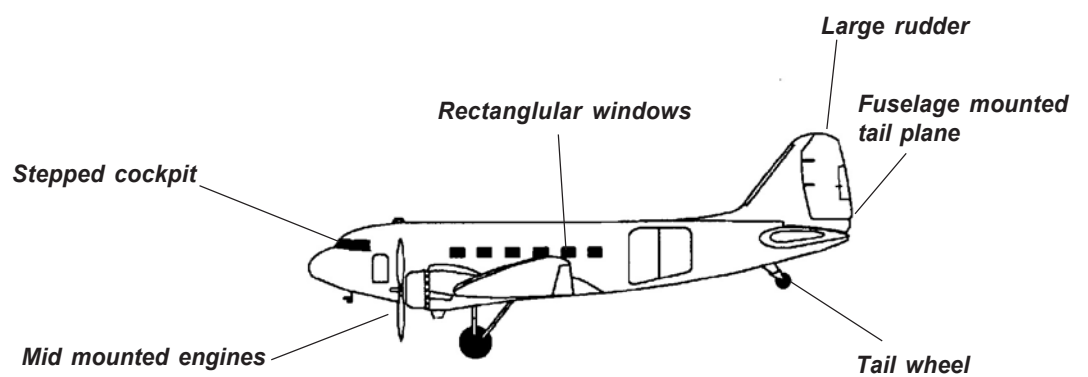
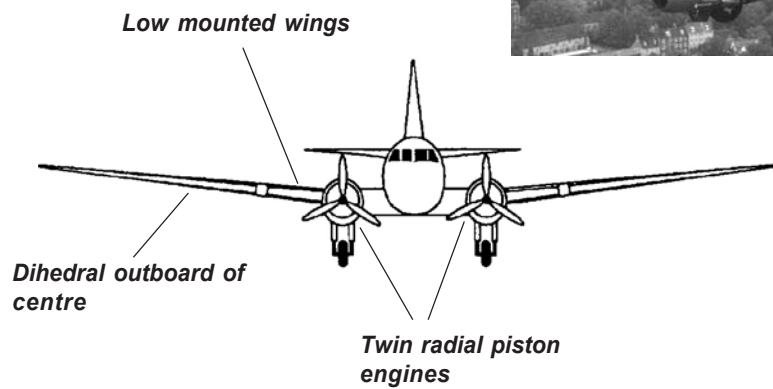




**Chapter 3**

**Page 34.2.3-83**

# DAKOTA



## Self Assessment Questions - Answer Sheet

### Chapter 1

Page 34.2.1-12

1. c In a glass wall control room at the top of the control tower with an uninterrupted view of the manoeuvring area
2. a Bad ground which should be avoided
3. c Defence Fixed Telecoms Systems (DFTS)
4. c Digital Resolution Direction Finding
5. d By a series of radio navigation beacons

### Chapter 2

Page 34.2.2-6

1. c Balloons, gliders, airships and conventional powered aircraft
2. b Both turn to the left
3. d See other aircraft as early as possible and take avoiding action if necessary

### Chapter 3

Page 34.2.3-10

1. Griffin
2. Tutor
3. Chinook
4. Primary trainer
5. Four crew in a Chinook
6. Tutor

Page 34.2.3-18

1. Canberra
2. Squirrel
3. Firefly
4. b Canberra
5. Turbomeca Arriel turboshaft, fitted to the Squirrel
6. Canberra
7. a 2(Aircraft is a Canberra PR9)
8. a Firefly

Page 34.2.3-26

1. Dominie or HS125
2. Hercules
3. Puma
4. Turbomeca Turmos
5. Hercules
6. Dominie or HS125
7. d 40.41 (Hercules)
8. a 14.10m (Puma)



### Self Assessment Questions - Answer Sheet cont....

#### Page 34.2.3-34

1. BAe 146
2. Harrier
3. d 1
4. Avco Lycoming ALF502 Turbofans
5. Rolls-Royce Pegasus 105 turbofan and it has the ability to vector or direct the thrust

#### Page 34.2.3-42

1. Jetstream
2. Viking
3. VC10
4. VC10
5. Cadet Training (Viking Glider)
6. a 15.80m (Jetstream)
7. d 4 Rolls-Royce Conway 301 turbojets

#### Page 34.2.3-50

1. Vigilant
2. Nimrod
3. Jaguar
4. c Vigilant
5. d Jaguar
6. a Nimrod
7. a Rolls-Royce Turbomeca Adour turbofans
8. b Cadet Training

#### Page 34.2.3-59

1. Tornado GR1
2. SeaKing
3. Merlin Mk3
4. b Tornado
5. c Support helicopter
6. a 1 (Jaguar)
7. a 2 Turbo Union RB199 turbofans

## Self Assessment Questions - Answer Sheet cont....

### Page 34.2.3-66

1. Tornado
2. Sentry
3. Eurofighter
4. d 12
5. d Air Defence (Tornado F3)
6. b 2 Rolls-Royce Gnome turboshafts (Seaking)
7. a Span 44.4m Length 43.9m

### Page 34.2.3-74

1. Tristar
2. Tucano
3. Hawk
4. d Jetstream
5. b Garret TPE 331 turboprop (Tucano)
6. a Transport/Tanker
7. a 9.4m (Hawk)
8. a 2

### Page 34.2.3-84

1. Lancaster
2. Spitfire
3. Hurricane
4. d Dakota (2 Pratt & Whitney R1830-90D)
5. Dakota
6. b 700km/h
7. d 7
8. d 12.2m
9. d 2 Pratt & Whitney R1830-90D piston engines
10. b 31m