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CHAPTER 16

PO 360 – RECOGNIZE ASPECTS OF AERODROME OPERATIONS

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 1

EO C360.01 – IDENTIFY TYPES OF AERODROMES

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to review, clarify, emphasize and summarize the types of aerodromes.

INTRODUCTION

REVIEW

Review the following from EO M160.01 (Identify Major Aerodrome Components, A-CR-CCP-801/PF-001, Chapter 14, Section 1):

- an aerodrome is any area of land or water designed for the arrival, departure and movement of aircraft; and
- an airport is an aerodrome that possesses a certificate stating it has met all of the airport safety standards.

OBJECTIVES

By the end of this lesson the cadet shall have identified types of aerodromes.

IMPORTANCE

It is important for the cadets to be able to differentiate types of aerodromes. Aerodrome type is critical as it directly affects all aspects of operations at the aerodrome. The aerodrome type dictates operational requirements in terms of facilities, equipment and human resources.

Teaching Point 1 | **Review the Definitions of Aerodrome and Airport**

Time: 5 min | Method: Interactive Lecture

AERODROME

An aerodrome is defined by the Aeronautics Act (1985) as:

"Any area of land, water (including the frozen surface thereof) or other supporting surface used, designed, prepared, equipped or set apart for use either in whole or in part for the arrival, departure, movement or servicing of aircraft and includes any buildings, installations and equipment situated thereon or associated therewith."

Any area designated or set aside for aircraft to use can be considered an aerodrome.

AIRPORT

An airport is an aerodrome for which a certificate has been issued under Subsection 302 of the Canadian Aviation Regulations (CARs). This is done by ensuring the site is inspected periodically for compliance with Transport Canada standards. Certified aerodromes must also maintain an Airport Operations Manual and conduct operations in accordance with the manual.

An aerodrome that has been certified by Transport Canada is considered an airport.

There are three situations in which an aerodrome must be certified. They include:

- an aerodrome located within the built-up area of a city or town;
- a land aerodrome used for scheduled passenger service; or
- any aerodrome that the Minister of Transportation (the Minister) deems to be of public interest.

The only exemptions are:

- military aerodromes, and
- aerodromes for which the Minister has written an exemption.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What is an aerodrome?

Q2. What is an airport?

Q3. When must an aerodrome be certified?

ANTICIPATED ANSWERS

A1. Any area designed, prepared, equipped or set apart for aircraft to use.

A2. An aerodrome that has been certified by Transport Canada.

A3. An aerodrome must be certified if:

- it is located within the built-up area of a city or town;
- it is a land aerodrome used for scheduled passenger service; or
- the Minister of Transportation deems it to be in the public interest.

Teaching Point 2 — **Explain Types of Aerodromes**

Time: 5 min — Method: Interactive Lecture

PUBLIC AERODROMES

A public aerodrome is open to the general public for use and does not require prior permission from the aerodrome operator. Most airports operated by any level of government (municipal, provincial, or federal), are open for public use.

PRIVATE AERODROMES

A private aerodrome may have restrictions on its use, depending on the aerodrome operator. Examples of restrictions include:

- specific aircraft types (eg, ultralights, gliders),
- club members,
- company aircraft, and
- friends.

Prior Notice Required (PNR)

If an aerodrome is listed as PNR, then the aircraft operator must notify (contact) the aerodrome operator before using the aerodrome. This allows the aerodrome operator to provide the most current information on the aerodrome to the aircraft operator.

Prior Permission Required (PPR)

If an aerodrome is listed as PPR, then the aircraft operator must receive permission from the aerodrome operator before using the aerodrome. All military aerodromes are listed as PPR for civilian aircraft.

If an aircraft is in distress (experiencing an emergency), any aerodrome may be used for a safe landing – public or private.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is a public aerodrome?

Q2. What does PNR stand for?

Q3. What does PPR stand for?

ANTICIPATED ANSWERS

A1. An aerodrome that is open to the general public and does not require permission in advance from the aerodrome operator to use.

A2. Prior Notice Required.

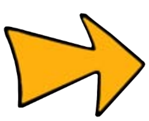
A3. Prior Permission Required.

Teaching Point 3	**Explain Canadian Military Aerodromes**
Time: 5 min	Method: Interactive Lecture

All Canadian military aerodromes require PPR for civilian aircraft, except in the case of an emergency. PPRs may be obtained on an "as needed" basis, or for recurring use by way of a written agreement. Authority to grant the PPR rests with the base/wing commander, although that authority is often delegated further to the base/wing operations officer. Before approving a PPR, the base/wing commander will take into account such factors as:

- impact on flying operations,
- air traffic congestion,
- ramp space availability,
- security risks,
- administrative and technical facilities, and
- competition with civil facilities.

For further details on authorization for civil aircraft to use Canadian military aerodromes, refer to CFAO 55-6 *Authorization for Civil Aircraft to use DND Aerodromes*.



As the operational tempo increases at most Canadian military aerodromes, it is growing more difficult for civilian operators to get permission to land or operate.

As a result of Canada's participation in the British Commonwealth Air Training Plan (BCATP) during WWII, many air bases were built across the country, all with a very similar design (three runways, arranged in a triangle). As the military began disposing of these air bases after the war, many municipalities took over their operations and have kept them operational. In other cases, the air bases were simply abandoned, and in a few cases, private operators took them over.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What do civilian aircraft require prior to landing at a Canadian military aerodrome?

Q2. Why did the military build many air bases during WWII?

ANTICIPATED ANSWERS

A1. Permission.

A2. Due to Canada's participation in the BCATP.

Teaching Point 4	**Explain Types of Civilian Aerodromes**
Time: 10 min	Method: Interactive Lecture

PRIVATE AERODROMES

The most common type of aerodrome in Canada is a private aerodrome (often called a farmer's field). Usually consisting of just a single grass runway, these aerodromes can be found in almost every part of the country, often just miles apart. They are primarily used by the owners of light single-engine aircraft. Usually, the owner lives at the aerodrome, making it very convenient to go flying.

These aerodromes generally offer little to no service to visiting aircraft, and are usually listed as PPR or PNR. They are not certified.

MUNICIPAL AERODROMES

Many municipalities in Canada (large towns and small cities) are involved in the operation of an aerodrome located in (or just outside) the city limits. These aerodromes usually have a hard-surface runway and provide year-round operations. Generally, a municipal aerodrome is for public use.

A municipal aerodrome typically provides the following types of services:

- aircraft storage,
- fuel sales, and
- a multi-purpose terminal building.

Small aviation businesses may operate from a municipal aerodrome. They may include any of the following:

- flight training unit (FTU),
- air charter operator, and
- aviation maintenance facility.

REGIONAL AERODROMES

An aerodrome can be considered to be a regional airport if:

- it has scheduled passenger traffic;
- it is not a national, provincial, or territorial capital; and
- it has a scheduled passenger traffic volume of less than 200 000 passengers per year for three consecutive years.

Regional airports often serve as the starting/ending point in a passenger's air travel. Passengers prefer to fly from the closest regional airport to their home, especially for domestic flights.

INTERNATIONAL AERODROMES

International airports form the backbone of a country's air transportation system. Many flights that originate from a regional airport terminate at an international airport, where passengers can make connections to other regional airports domestically or to international destinations.

At most international airports, cargo flights are more frequent than at a regional airport.

> International airports serve 94 percent of the total annual passenger/cargo traffic in Canada.

CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. Who is the main user of a private aerodrome?

Q2. What types of services are generally offered at a municipal aerodrome?

Q3. What types of aviation businesses may be found at a municipal aerodrome?

ANTICIPATED ANSWERS

A1. Owners of small single-engine aircraft.

A2. The following services are generally offered at a municipal aerodrome:

- aircraft storage,
- fuel sales, and
- multi-purpose terminal building.

A3. The following aviation businesses may be found at a municipal aerodrome:

- flight training unit (FTU),
- air charter operator, and
- aviation maintenance facility.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. What is an aerodrome?

Q2. What do civilian aircraft require prior to landing at a military aerodrome?

Q3. Who is the main user of a private aerodrome?

ANTICIPATED ANSWERS

A1. Any area designed, prepared, equipped or set apart for aircraft to use.

A2. Permission.

A3. Owners of small single-engine aircraft.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Knowing the different types of aerodromes forms the basis of aerodrome operations. The similarities and differences between the different types of aerodromes is a key aspect of appreciating the operational requirements of the aerodrome. This is particularly true when it comes to discerning the requirements for facilities, equipment, and human resources.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C2-044 Transport Canada. (2007). *Aeronautical Information Manual*. Retrieved October 2, 2007, from http://www.tc.gc.ca/publications/EN/TP14371/PDF/HR/TP14371E.PDF.

C3-147 NAV CANADA. (2007). *Canadian Airport Charts*. Retrieved October 9, 2007, from http://www.navcanada.ca/ContentDefinitionFiles/Publications/AeronauticalInfoProducts/CanadianAirportCharts/CanadianAirportCharts_current.pdf.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 2

EO C360.02 – EXPLAIN ASPECTS OF AERODROME LIGHTING

Total Time: 30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the handout located at Annex A for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to clarify, emphasize and summarize aspects of aerodrome lighting.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have explained aspects of aerodrome lighting.

IMPORTANCE

It is important for the cadets to know about aerodrome lighting as most aerodromes have some form of lighting in place. Lights indicate the edges of the movement areas and are inspected daily by aerodrome personnel. Approach lighting systems occupy significant space and care must be taken not to cause damage when working near them.

Teaching Point 1 | **Explain Manoeuvring Lighting**

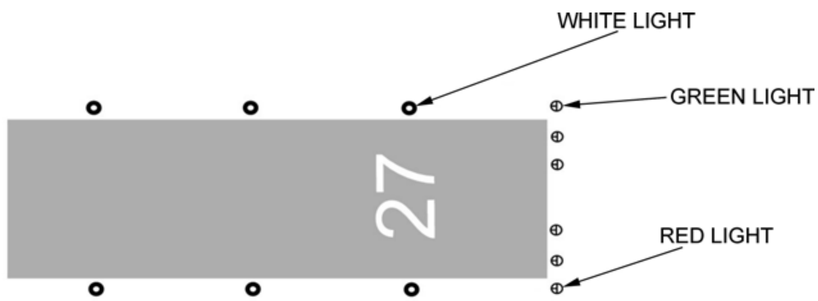
Time: 20 min | Method: Interactive Lecture

MANOEUVRING LIGHTING

Runway Lighting

Edge lights are located along the runway. These lights are white in colour (white light bulb with a clear lens) and provide assistance in identifying the edge of the runway. The lights are spaced evenly along each edge with no more than 60 m (200 feet) between the lights. Each row of lights is the same distance from the runway centreline and may be located along the edge of the runway or no more than 1.5 m away from the edge, except in areas that experience significant accumulations of snow. In areas that experience significant accumulations of snow, edge lights may be placed up to 3 m from the runway edge.

The edge lights that cross the beginning of a runway are green while the lights at the end of a runway are red. This is accomplished by using a two-colour filter under the lens. The red side is located on the runway side so that when an aircraft is on the runway looking at the light, a red light is visible. The green filter is on the other side so that when the aircraft is approaching the runway, a green light is visible.



Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 16-2-1 Runway Lighting

Taxiway Lighting

Edge lights are placed along taxiways in the same way edge lights are placed along runways. The maximum spacing remains at 60 m (200 feet) and will be closer together along a curved section than along a straight section. Taxiway edge lights are blue in colour. The blue colour is created by using a blue lens instead of a clear lens.

Where a taxiway intersects a runway, two blue lights are placed on each side of the taxiway, adjacent to the runway, to indicate the intersection.

Apron Lighting

Apron edge lights are yellow in colour (created by using a yellow lens). Where a taxiway intersects an apron, two yellow lights are placed on each side of the taxiway, adjacent to the apron, to indicate the intersection.

Light Location	Colour
Runway Edge Lights	White
Taxiway Edge Lights	Blue
Apron Edge Lights	Yellow
Runway/Taxiway Intersection	Two blue
Taxiway/Apron Intersection	Two yellow
Runway Threshold (end of runway side)	Red
Runway Threshold (start of runway side)	Green

Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 16-2-2 Runway Lighting Colours

Unserviceable Area Markings

Certain ground markings indicate the status of aerodromes and pilots are required to comply with these markings.

A large cross, either white or yellow and at least 6.1 m in length, displayed at each end of a runway or taxiway indicates that that runway or taxiway is unserviceable. For night operations, any unserviceable portion of a runway is closed off by placing red lights at right angles to the centerline across both ends. In addition, the runway lights for the unserviceable area are turned off.

If an unserviceable portion of any manoeuvring area or taxiway is small enough that it can be bypassed by an aircraft with safety, red flags are used to outline the area. At night, the area is marked with red lights – sometimes flashing.

Approach Lighting System (ALS)

An ALS provides additional guidance to aid a pilot in finding the beginning of the runway during periods of low visibility. These lights are used as part of an instrument landing system (ILS) and aid the pilot in transitioning from the instrument portion of the approach to the visual portion.

The aerodrome operator must ensure that the systems are working properly by inspecting them on a regular basis. During the winter, the snow around the systems must be cleared to keep them visible.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What colour are runway edge lights?

Q2. What colour are taxiway edge lights?

Q3. What colour are apron edge lights?

ANTICIPATED ANSWERS

A1. White.

A2. Blue.

A3. Yellow.

Teaching Point 2 **Explain Navigational Lighting**

Time: 5 min Method: Interactive Lecture

AERODROME BEACON

An aerodrome beacon helps a pilot locate an aerodrome amidst all the other ground lights of a community. The beacon is a white light, visible for about ten nautical miles on a clear night, that rotates at a constant speed producing highly visible light flashes at regular intervals of about 2 – 3 seconds. The aerodrome beacon operates continuously during the night.

OBSTRUCTION LIGHTING

Obstruction lights are used to mark tall buildings and towers that might be flight hazards. These may be red lights that are either steady or flashing or they may be flashing white strobe lights.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. Why are aerodrome beacon lights used ?

Q2. How can an aerodrome beacon be recognized?

Q3. What are the possible colours of obstruction lights?

ANTICIPATED ANSWERS

A1. To help a pilot to locate an aerodrome amidst all the other ground lights of a community.

A2. An aerodrome beacon is a white light that rotates at a constant speed every 2 – 3 seconds.

A3. Red, either steady or flashing, or a flashing white strobe light.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. What colour are runway edge lights?

Q2. What colour are taxiway edge lights?

Q3. How can an aerodrome beacon be recognized?

ANTICIPATED ANSWERS

A1. White.

A2. Blue.

A3. An aerodrome beacon is a white light that rotates at a constant speed every 2 – 3 seconds.

Hand out copies of Annex A to each cadet.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Aerodrome lighting can be complex systems that are crucial to the safe operation of the aerodrome. Personnel must know what the lights represent. Lighting systems are inspected daily to keep them in operational condition.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C2-044 Transport Canada. (2007). *Aeronautical Information Manual*. Retrieved October 2, 2007, from http://www.tc.gc.ca/publications/EN/TP14371/PDF/HR/TP14371E.PDF.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 3

EO C360.03 – CONSTRUCT A MODEL OF THE AIRSPACE AT AN AERODROME

Total Time:	90 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the handouts located at Annexes B to D for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1–3 to introduce the parts of the Canadian Domestic Airspace (CDA).

An in-class activity was chosen for TP 4 as an interactive way to reinforce concepts of the CDA.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have constructed a model of the airspace at an aerodrome.

IMPORTANCE

It is important for the cadets to know about the CDA system as each airspace classification has a set of requirements and operating rules that make it unique. By understanding and adhering to these rules, pilots, ground crew, and aerodrome operations staff can operate safely.

Teaching Point 1 | **Explain Parts of the Canadian Domestic Airspace (CDA) System**

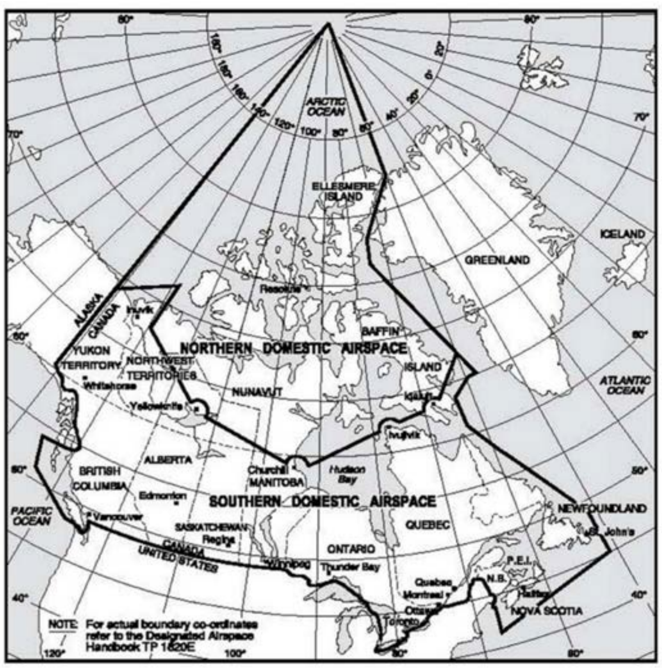
Time: 10 min | Method: Interactive Lecture

Distribute photocopies of Annex B to the cadets.

CDA

CDA includes all airspace over Canadian land mass, the Canadian Arctic, Canadian Archipelago (group of islands) and those areas of the high seas within the airspace boundaries.

CDA is geographically divided into the Northern Domestic Airspace (NDA) and the Southern Domestic Airspace (SDA) (as illustrated in Figure 16-3-1). CDA is also divided vertically into high and low level airspace (as illustrated in Figure 16-3-2).



Aeronautical Information Manual, Ottawa, ON: Her Majesty the Queen in Right of Canada (p. 182)

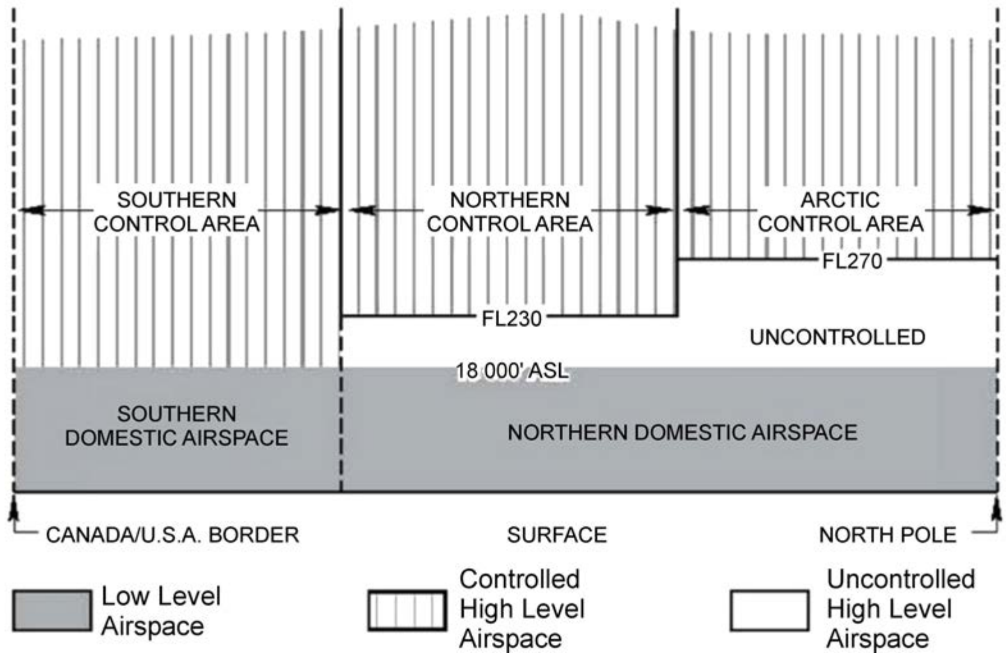
Figure 16-3-1 Boundaries of CDA, NDA, and SDA

NDA

The magnetic north pole is located near the centre of the NDA. Near the pole, the lines of magnetic force dip downwards, almost becoming vertical. This causes the horizontal compass needle to produce unreliable readings. In this region, runway headings are given in degrees true, and true track (the direction the aircraft is travelling) is used to determine cruising altitudes.

SDA

In the SDA, further away from the magnetic north pole, compass readings are reliable as the lines of magnetic force become horizontal. In this region, runway headings are given in degrees magnetic, and magnetic track is used to determine cruising altitudes.



Aeronautical Information Manual, Ottawa, ON: Her Majesty the Queen in Right of Canada (p. 184)

Figure 16-3-2 Vertical Divisions of Airspace

High Level Airspace

High level airspace consists of all airspace above 18 000 feet above sea level (ASL). Aircraft operating in this airspace must be operating in accordance with instrument flight rules (IFR); these are rules that govern the procedures for conducting flight under instrument meteorological conditions (IMC). Traffic operating in accordance with visual flight rules (VFR), which govern the procedures for conducting flight under visual conditions, is excluded from high level airspace.

This is the airspace in which the en route portions of most flights by the following aircraft occur:

- commercial passenger and cargo jets (eg, Boeing 767, Airbus 340), and
- business jets (eg, Citation, LearJet).

Low Level Airspace

Low level airspace consists of all airspace below 18 000 feet ASL. This is the airspace used by general aviation and most commercial turbo-prop aircraft. This is the general classification of airspace used for takeoffs and landings.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. How is CDA geographically divided?

Q2. How is CDA vertically divided?

Q3. Low level airspace is the airspace below what altitude?

ANTICIPATED ANSWERS

A1. Northern and Southern Domestic Airspace.

A2. High and low level airspace.

A3. Below 18 000 feet ASL.

Teaching Point 2	**Explain Types of Airspace**
Time: 10 min	Method: Interactive Lecture

CONTROLLED AIRSPACE

Controlled airspace is the airspace in which air traffic control service is provided. Depending on the specific classification of the airspace, some or all aircraft may be subject to air traffic control. Types of low level controlled airspace include:

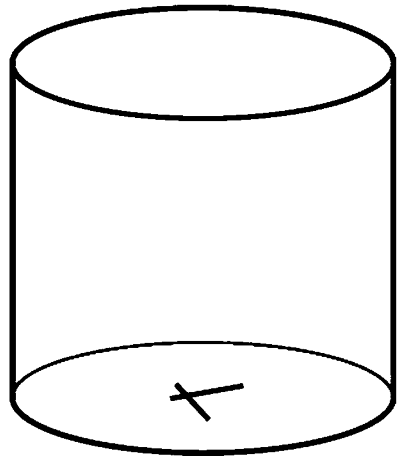
- low level airways,
- control zones,
- terminal control areas,
- transition areas,
- control area extensions, and
- military terminal control areas.

Control Zones (CZs)

CZs are designated around certain aerodromes to keep IFR aircraft within controlled airspace during approaches and to facilitate the control of VFR and IFR traffic. CZs vary in size, with the most common radii being three, five, or seven nautical miles. They are usually capped at 3 000 feet above aerodrome elevation (AAE). CZs will be classified as B, C, D or E depending on the classification of the surrounding airspace.

Military CZs usually have a 10 nautical mile radius and are capped at 6 000 feet AAE.

One can visualize a CZ as a vertical cylinder, with the base of the cylinder centred on the aerodrome (as illustrated in Figure 16-3-3).



Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 16-3-3 A Control Zone

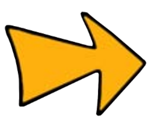
Terminal Control Areas (TCAs)

TCAs are established at high volume traffic aerodromes to provide an IFR control service to arriving, departing and en route aircraft. The TCA operating rules are established by the classification of the airspace. These rules are based on the level of ATC service that is appropriate for the number and type of aircraft using the airspace as well as the nature of the operations being conducted.

A TCA expands the controlled airspace surrounding a major aerodrome.

Transition Areas

Transition areas are established when it is necessary to provide additional controlled airspace for the IFR operations, specifically to control all of the airspace used by aircraft during takeoff and landing. Transition areas are of defined dimensions, generally based at 700 feet above ground level (AGL), and extend upwards to the base of overlying controlled airspace. The area provided around an aerodrome will normally be a 15 nautical mile radius of the aerodrome centre.



The airspace surrounding an aerodrome is best visualized as an “upside down wedding cake” (as illustrated in Figure 16-3-4).

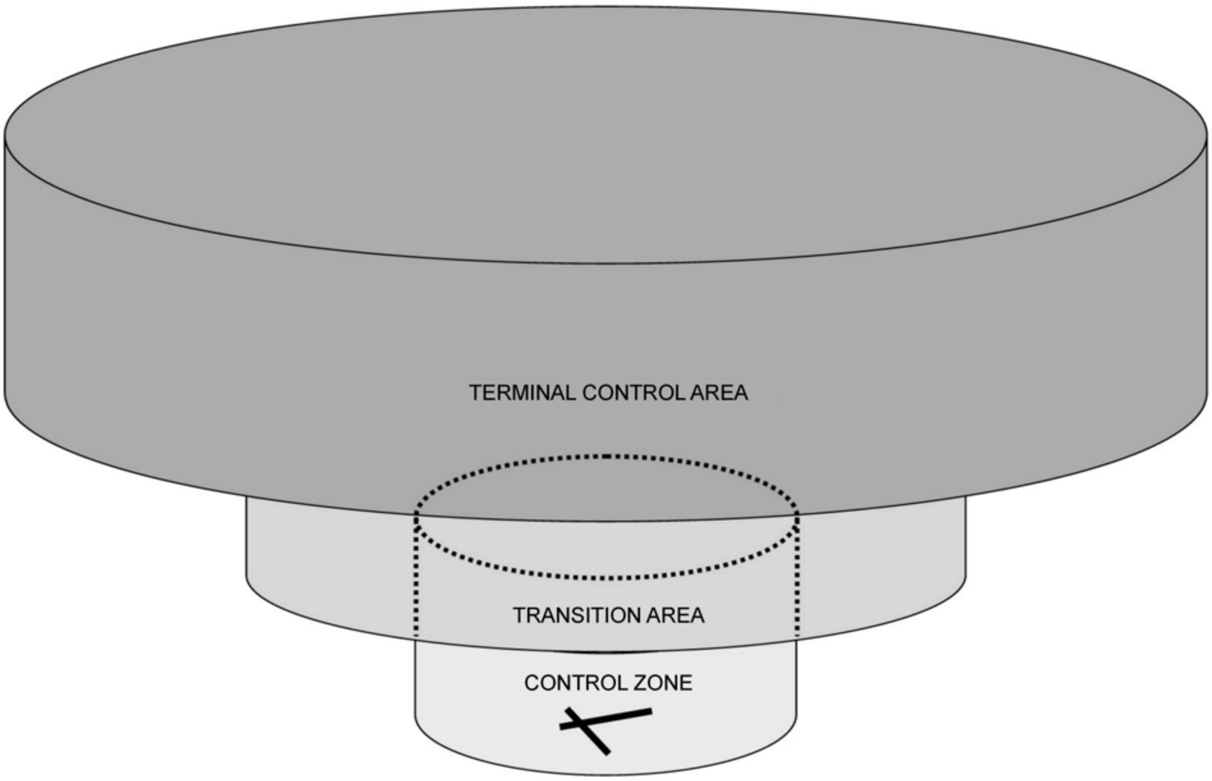


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Figure 16-3-4 Control Zone, Terminal Control Area, and Transition Area

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is the typical radius of a CZ?

Q2. Where are TCAs established?

Q3. At what height does a transition area usually begin?

ANTICIPATED ANSWERS

A1. Three, five, or seven nautical miles (10 nautical miles for a military control zone).

A2. At high volume traffic aerodromes.

A3. At 700 feet AGL.

Teaching Point 3	**Explain Classes of Airspace**
Time: 10 min	Method: Interactive Lecture

AIRSPACE CLASSIFICATIONS

CDA is divided into seven classes, each identified by a single letter: A, B, C, D, E, F, or G. Flight within each class is governed by specific rules applicable to that class.

Class A

Class A airspace is designated where an operational need exists to exclude VFR aircraft. All operations must be conducted under IFR and are subject to Air Traffic Control (ATC) clearances and instructions. An ATC clearance gives authorization to proceed within controlled airspace and an ATC instruction is a directive issued by an ATC unit for air traffic control purposes.

All high level controlled airspace is designated as Class A.

Class B

Class B airspace is designated where an operational need exists to provide air traffic control service to IFR and to control VFR aircraft.

All low level controlled airspace above 12 500 feet ASL or at and above the minimum en route altitude (MEA), whichever is higher, up to but not including 18 000 feet ASL will be Class B airspace. Control zones and associated terminal control areas may also be classified as Class B airspace.

Class C

Class C airspace is controlled airspace in which both IFR and VFR flights are permitted.

Airspace classified as Class C becomes Class E airspace when the appropriate ATC unit is not in operation. Terminal control areas and associated control zones may be classified as Class C airspace.

Class D

Class D airspace is controlled airspace in which both IFR and VFR flights are permitted, but VFR flights must establish two-way communication with the appropriate ATC agency prior to entering the airspace.

Airspace classified as Class D becomes Class E airspace when the appropriate ATC unit is not in operation. A terminal control area and associated control zone could be classified as Class D airspace.

Class E

Class E airspace is designated where an operational need exists for controlled airspace but does not meet the requirements for Class A, B, C, or D.

Low level airways, control area extensions, transition areas, or control zones established without an operating control tower may be classified as Class E airspace.

Class F

Class F airspace is an area in which activities must be restricted, or limitations imposed upon aircraft operations that are not a part of those activities. Typical uses for Class F airspace include:

- military practice areas,
- fire-bombing,
- parachute jumping,
- flight training,
- soaring,
- hang gliders, and
- air shows.

Class F airspace is sometimes known as special use airspace. It may be classified as Class F advisory, or as Class F restricted, and can be controlled airspace, uncontrolled airspace, or a combination of both.

Class G

Class G airspace is airspace that has not been designated Class A, B, C, D, E or F and in which ATC has neither the authority or responsibility for exercising control over air traffic.

To help the cadets remember:

- Classes A to E are controlled airspace,
- Class F may be controlled or uncontrolled, and
- Class G airspace is uncontrolled.

The difference between Class C and Class D is that an ATC clearance is needed to enter Class C, but two-way communication is all you need to enter Class D.

Distribute photocopies of Annex C to the cadets.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What happens to Class C airspace when the ATC unit is not in operation?

Q2. What is another name for Class F airspace?

Q3. Which airspace is uncontrolled?

ANTICIPATED ANSWERS

A1. It becomes Class E airspace.

A2. Special use airspace.

A3. Class G airspace.

Teaching Point 4 **Have the Cadet, as a Member of a Group of No More Than Four, Construct a Model of the Airspace at an Aerodrome**

Time: 55 min Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is for the cadet to construct a model of the airspace at an aerodrome.

RESOURCES

- Checklist located at Annex D.

- Coloured construction paper,
- Transparent tape,
- Scissors,
- Coloured markers, and
- Glue.

Other materials may be used in addition to this list if available. The amount of materials that are needed will depend on class size and the number of groups.

ACTIVITY LAYOUT

Group the tables/desks together to form a large work surface to support the base of the model.

ACTIVITY INSTRUCTIONS

1. Distribute the checklist located at Annex D to each cadet.
2. Divide the cadets into groups of four.
3. Inform the cadets of the materials available for them to use.
4. Inform the cadets they are all to start with a base of two large pieces of construction paper taped together.
5. Have each group create their own model aerodrome airspace using the checklist located at Annex D, ensuring all the required components are included.

While it is not important for the model to be built exactly to scale, care should be taken to construct items that are the correct size, relative to the other components of the aerodrome.

While cadets are encouraged to be creative with the materials provided, recommend the following:

- Brown or green paper should be used for the base.
- Black or grey paper should be used for pavement.
- Airspace can be created by cutting a strip of construction paper and taping the ends together to create a cylinder.
- Airspace areas can be stacked vertically by cutting and taping a circle of construction paper to the cylinders.
- Different colours of paper should be used for each classification of airspace.
- Coloured markers can be used for adding specific details to components.
- Groups that finish early can improve their model by adding a second aerodrome to the model with airspace that overlaps the first aerodrome's airspace, creating an irregular shape for the airspace areas.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 4

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in the construction of a model of the airspace at an aerodrome will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Each airspace classification has a set of requirements and operating rules that make it unique. These rules allow pilots, ground crew, and aerodrome operations staff to operate safely.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C2-044 Transport Canada. (2007). *Aeronautical Information Manual*. Retrieved October 2, 2007, from http://www.tc.gc.ca/publications/EN/TP14371/PDF/HR/TP14371E.PDF.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 4

EO C360.04 – IDENTIFY HOW EQUIPMENT IS USED AT AN AERODROME

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create slides of figures located at Annex E.

Photocopy the activity sheet located at Annex F for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to clarify, emphasize and summarize the equipment used at an aerodrome.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified how equipment is used at an aerodrome.

IMPORTANCE

It is important for the cadets to be able to identify the equipment at an aerodrome and how it is used to understand aerodrome operations. At most aerodromes each vehicle has a specific purpose and, to carry out specialized tasks, certain vehicles have additional equipment added to them.

Teaching Point 1 | **Explain How Trucks Are Used at an Aerodrome**

Time: 15 min | Method: Interactive Lecture

One of the most common vehicles found at an aerodrome is a truck. The trucks found at an aerodrome can be broken down into three general categories:

- pickup truck,
- dump truck, and
- specialty truck.

Show the cadets Figures 16E-1, 16E-2 and 16E-3.

INSPECTIONS

Throughout the course of the day, aerodrome operations staff must conduct inspections of the following areas:

- runways,
- taxiways,
- aprons, and
- roads.

Most of the time, the only equipment required to conduct these inspections is a vehicle with a rotating amber beacon and a two-way radio. A car is usually the most economical vehicle for this kind of task.

While most of the regular inspections at an aerodrome can be conducted using a car, pickup trucks are required for some specific inspections. Specifically, the guidelines for conducting runway friction testing require the use of a pickup truck when using a portable decelerometer (a device that measures deceleration).

A pickup truck transports tools and equipment required to correct deficiencies more easily than a car.

There may also be areas of the aerodrome that need inspections, but that do not have proper roads. In these cases, a four-wheel drive pickup truck may be required to safely reach these areas.

MAINTENANCE

Pickup trucks are used extensively for ongoing maintenance tasks around an aerodrome. They are well-suited to carry the tools and equipment necessary to perform maintenance. Typical maintenance tasks that might be carried out include:

- replacement and repair of lights,
- fence repairs,
- sign repairs, and
- minor pavement and turf repairs.

CONSTRUCTION

During construction at an aerodrome, trucks of all shapes and sizes will be used. Flatbed trucks deliver materials and equipment to the site, as well as move them around the facilities. Dump trucks will be used wherever excavations or earth moving occurs. Pickup trucks will be used to move people, smaller tools and equipment around.

While most of these vehicles will not be owned by the aerodrome, the aerodrome operator will be responsible for ensuring that drivers are properly trained, that the vehicles are properly equipped (eg, two-way radio, rotating amber beacon/strobe light), and that the vehicles move about the aerodrome in a safe and efficient manner.

SNOW REMOVAL

At most Canadian aerodromes, winter is a busy time of year for trucks. All of the snow that falls on the movement areas and the road system has to be cleared in a timely manner to allow operations to continue with minimal disruption.

> Show the cadets Figure 16E-4.

Snowplows are often attached to large trucks. Even pickup trucks can have a plow blade attached for clearing small areas. Piles of snow that accumulate can be moved using dump trucks. Dump trucks or pickup trucks may have hoppers in the back that can be used for spreading chemicals for melting ice or grit to increase traction.

PLATFORMS FOR SPECIALTY EQUIPMENT

Many specialized vehicles at an aerodrome are basic truck frames with the addition of special equipment. Examples of these include:

> Show the cadets Figure 16E-5.

- de-icing trucks,
- fuel delivery,
- air stairs,
- rapid response emergency vehicles, and
- ground servicing equipment (eg, catering truck).

> Show the cadets Figure 16E-6.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have the cadets match the vehicle pictures with the correct name and purpose.

RESOURCES

- Aerodrome vehicle handout located at Annex F, and
- Pen/pencil.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Distribute the handout located at Annex F.
2. Have the cadets complete the handout.
3. Provide assistance and guidance as required.
4. Correct the answers as a group using Annex G.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 2	Describe Runway Maintenance Equipment and How it is Used at an Aerodrome
Time: 5 min	Method: Interactive Lecture

There are several important pieces of equipment that are used extensively at aerodromes: sweepers, snowplows and snow blowers.

Equipment designed for aerodrome use is usually designed to be mounted on a special chassis. The chassis has a standardized mounting bracket and common hydraulic connections which allow different types of equipment to be mounted, depending on the task to be done.

SWEEPERS

Sweepers come in three main configurations:

- self-propelled,
- front mounted, and
- towed.

> Show the cadets Figure 16E-7.

When there has been a light accumulation of snow or slush but not enough to require a snowplow, a sweeper can be used. Sweepers remove debris such as dirt or sand, to prevent foreign object damage (FOD) to propellers or turbine engines.

The rotating brush has bristles made of stainless steel or synthetic materials (usually nylon or polypropylene). Steel bristles cut through ice and snow effectively and synthetic bristles move wet snow or slush well.

Some sweepers have hot air blowers, which direct a steady stream of hot air onto the surface being swept. In addition to blowing away any small particles left behind by the brush, the hot air can melt small ice deposits.

SNOWPLOWS

Any aerodrome that expects snow will have a snowplow, either owned by the aerodrome, or contracted by a third party. A snowplow is the most effective way to remove snow from aircraft movement areas.

> Show the cadets Figures 16E-8 and 16E-9.

SNOW BLOWERS

When a snowplow pushes snow to the side of a runway, it creates a pile of snow known as a windrow. The preferred method of removing the windrow is with a snow blower. The snow blower can move along the edge of the runway blowing the snow in the windrow over the runway edge lights and away from the runway.

> Show the cadets Figures 16E-10 and 16E-11.

Similar to sweepers, snow blowers can be front mounted, rear mounted or self-propelled. The large self-propelled versions have two engines: one for driving, and the other for powering the snow blower. Rear mounted blowers are commonly attached to tractors.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What configurations do sweepers come in?

Q2. What are the differences between a highway snowplow and an aerodrome snowplow?

Q3. What is the primary purpose of a snow blower at an aerodrome?

ANTICIPATED ANSWERS

A1. Self-propelled, front mounted or towed.

A2. An aerodrome snowplow has a wider blade that is reversible (two-way).

A3. Removing windrows left behind by snowplows.

Teaching Point 3	**Describe Refuelling Equipment at an Aerodrome**
Time: 5 min	Method: Interactive Lecture

STATIONARY REFUELLING EQUIPMENT

At most public aerodromes, aviation fuel is available for purchase from the aerodrome operator, or from a third party (or parties at a large aerodrome). Fuel is dispensed in two main ways: from a stationary location or from a mobile refueller. A stationary refuelling system is made up of three main components: tanks, pumps and hoses.

Show the cadets Figures 16E-12 and 16E-13.

MOBILE REFUELLING EQUIPMENT

At a large aerodrome, or at an aerodrome with large aircraft, a stationary refuelling system is not a viable option. In these cases, refuelling is carried out by mobile refuelling equipment that brings fuel to the aircraft.

Show the cadets Figure 16E-14.

Commonly, the fuel is stored in large tanks in a remote location (known as a fuel farm) at the aerodrome. The mobile tanker is filled from the bulk tanks, driven to the aircraft and refuelling is carried out. The tanker can then move on to the next aircraft and repeat the process. When the tanker no longer carries enough fuel to service the next aircraft, it returns to the bulk tank and is refilled.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What are the two main ways that fuel is dispensed to aircraft?

Q2. What is the name of the remote location where fuel is stored for mobile refuelling?

Q3. What are the three main components of a refuelling system?

ANTICIPATED ANSWERS

A1. From a stationary location or from a mobile refueller.

A2. A fuel farm.

A3. Tanks, pumps and hoses.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. What are three types of equipment used at an aerodrome?

Q2. Where is fuel stored at an aerodrome?

Q3. For inspection of which aerodrome facilities is a car usually the most economical vehicle?

ANTICIPATED ANSWERS

A1. Sweepers, snowplows and snow blowers.

A2. At a fuel farm.

A3. Runways, taxiways, aprons, and roads.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for the cadets to be able to identify the equipment at an aerodrome and how it is used. Each piece of equipment has a specific purpose, and is outfitted with specialized equipment to help it perform the required tasks.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-148 (ISBN 0-9739866-0-3) Syme, E. R., & Wells, A. T. (2005). *Airport Development, Management and Operations in Canada: Second Edition*. Barrie, ON: Aviation Education Services.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 5

EO C360.05 – IDENTIFY ASPECTS OF EMERGENCY RESPONSE AND AERODROME SECURITY

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Review the mandate of the Canadian Air Transport Security Authority (CATSA) at website reference C3-098 and update the information presented in the guide if necessary.

Obtain and photocopy an updated list of permitted and prohibited carry-on items from http://www.catsa-acsta.gc.ca for each cadet.

Create a slide of Annex H.

Photocopy the Aerodrome Security Definitions located at Annex I for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to clarify, emphasize and summarize aircraft and aerodrome emergencies, security, the role of CATSA, and types of screening at an aerodrome.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified aspects of emergency response and security at aerodromes.

IMPORTANCE

It is important for cadets to understand the operational requirements of aerodrome emergency response and security. Recognizing the role of CATSA and the types of screening performed will be relevant to cadets who travel through major Canadian aerodromes.

Teaching Point 1 — **Discuss Aircraft Emergencies**

Time: 5 min — Method: Interactive Lecture

AIRCRAFT RESCUE AND FIRE FIGHTING (ARFF)

The primary responsibility of an ARFF service is to provide an escape route for the evacuation of passengers and crew when needed. This service is also known as:

- Crash, Fire and Rescue (CFR), and
- Emergency Response Services (ERS).

ARFF VEHICLES

ARFF must be able to respond within a specific time frame, carry the types and volumes of specified extinguishing agents (water and foam) and be able to dispense the agents.

Show the cadets Figure 16H-1.

ARFF vehicles are similar to standard fire trucks, but have been built specifically for aerodromes. They can handle rough terrain while accelerating quickly to their top speed. The use of turrets to dispense water and foam allows the operator to drive to the edge of the fire and begin dispensing extinguishing agents immediately. Two turrets (nose and roof) are standard equipment and are controlled by the operator inside the cabin. A turret can be combined with a piercing device on the end of a boom. This boom can be extended to the aircraft to create an opening in the aircraft skin and an extinguishing agent can then be delivered directly into the aircraft.

STANDBY REQUESTS

Local Standby. The level of response when an aircraft has or is suspected to have an operational defect that would cause serious difficulty for the aircraft to achieve a safe landing.

Full Emergency Standby. The level of response when an aircraft has or is suspected to have an operational defect that affects normal flight operations to the extent that there is possibility of an accident.

ON-SITE CRASHES

If a crash occurs at an aerodrome, the primary role of the ARFF service is to suppress any fire and provide a safe evacuation route out of the aircraft for the passengers. Many ARFF departments also include paramedics, vehicles and equipment to provide first aid and triage services to the passengers. In the event of a major crash, additional resources from the local area may be required.

OFF-SITE CRASHES

If an aircraft crash occurs near an aerodrome with ARFF, the ARFF services from that aerodrome may be dispatched to the scene. If ARFF services from an aerodrome are not readily available, local fire departments and paramedics will respond. Most aircraft crashes occur during takeoff and landing; the ERS for the municipalities surrounding an aerodrome, such as fire, paramedics and police services, will be prepared to respond to an off-site crash. ERS personnel receive special training on aircraft firefighting and passenger rescue techniques.

JOINT RESPONSES

Aerodromes with ARFF services may have an agreement with the surrounding municipalities to assist in off-site aircraft crashes. The agreement may also cover non-aviation related emergencies near the aerodrome. An example of this would be a fuel tanker crash and fire on a nearby highway. The foam extinguishing agent dispensed by ARFF vehicles can control this type of fire.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What does ARFF stand for?

Q2. How do ARFF vehicles dispense water and/or foam?

Q3. When do most aircraft crashes occur?

ANTICIPATED ANSWERS

A1. Aircraft Rescue and Fire Fighting.

A2. Through turrets.

A3. During takeoff and landing.

Teaching Point 2	**Discuss Aerodrome Emergencies**
Time: 5 min	Method: Interactive Lecture

AERODROME EMERGENCIES

In addition to aircraft emergencies, the aerodrome's emergency plan should include other non-aviation emergencies. Where possible, the ARFF unit is the responding agency. In other cases, local ERS such as fire, paramedics and police would respond. In all cases, simulated emergency exercises are held to test the emergency plan and provide training opportunities for all personnel.

Building Fires

A fire in a terminal building at a large aerodrome would be handled much the same way as a fire in any large building with lots of people (such as a shopping mall). In addition to fire extinguishers throughout the building (designed to put out and control small fires) there are usually water pipes, hoses and standpipe connections. As with any emergency in a location with large numbers of people, preparations to deal with injuries and casualties are necessary.

Bomb Threats

The emergency plan includes a section on bomb threats, both in the terminal and on-board an aircraft. In the terminal, suspicious or unattended baggage is treated seriously. Large international airports usually have personnel and equipment on site to respond. Many state-of-the-art baggage screening systems have isolation chambers that suspicious baggage can be routed to. This chamber is designed to contain an explosion and prevent injuries and damage.

In Canada, making a false declaration that could jeopardize the safety or security of an aircraft or aerodrome can result in a fine up to $5 000.

Medical Crises

Heart attacks, panic attacks and allergic reactions are common in areas where large numbers of people congregate. Large aerodromes have paramedics on site to deal with medical crises. Small aerodromes must ensure that aerodrome personnel have the appropriate first aid qualifications and training to deal with common crises until paramedics can arrive. Advances in technology have resulted in the development of Automated External Defibrillators (AEDs). These machines make it possible for non-medical personnel to restore heart rhythms to help save lives.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. Who can help aerodrome ARFF units respond to emergencies?

Q2. How much could you be fined for making a false declaration that jeopardizes safety or security?

Q3. What machine can help increase the survival rate of heart attack victims?

ANTICIPATED ANSWERS

A1. Local ERS.

A2. $5 000.

A3. AED.

Teaching Point 3	**Explain Components of Aerodrome Site Security**
Time: 5 min	Method: Interactive Lecture

AERODROME SECURITY DEFINITIONS

Hand out a copy of Annex I to each cadet.

Restricted Area. A portion of an aerodrome where access is only granted to authorized persons.

Restricted Area Access Point. A location in a security barrier at which a control system is in place that controls access to a restricted area from a non-restricted area.

Screening. The checking, identification, observation, inspection or authorized search of persons, goods and other things in the possession or control of persons.

Security Barrier. A physical structure or natural feature used to prevent or deter access by unauthorized persons to a restricted area.

Sterile Area. A restricted area, including any passenger loading bridges attached to it. It is used to separate passengers who have been screened, or are exempt from screening, and other authorized persons from unauthorized persons at the aerodrome.

RESTRICTED AREAS

All aircraft movement areas (runways, taxiways and aprons) are restricted areas and only those who are authorized have access to these areas. Restricted areas also exist inside the terminal building. The area used by passengers between the time they are screened and the time they board the aircraft is a restricted area (specifically a sterile area). Other areas inside the terminal building that will be a restricted area include:

- aerodrome and airline operations,
- baggage-handling areas,
- ATC, and
- emergency response.

FENCES

The fences most commonly used as security measures at an aerodrome are chain-link fences erected around the perimeter of the aircraft movement areas. Access through the fence is provided by gates for vehicles and people or through buildings adjacent to the movement areas.

GATES

The gates found in aerodrome fencing can be categorized in several ways: routine, emergency, or occasional access points and vehicle or personnel access points. Additionally, they can be operated manually or mechanically. Gates designed to be operated mechanically should also be able to be opened manually in case of electrical failure. In all cases, a gate that remains open can become a major security problem.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What is a restricted area?

Q2. In addition to identity, what must be confirmed prior to allowing access to a restricted area?

Q3. How can gates be operated?

ANTICIPATED ANSWERS

A1. A portion of an aerodrome where access is only granted to authorized persons.

A2. Authorization.

A3. Manually or mechanically.

Teaching Point 4	**Explain Security Requirements at Different Types of Aerodromes**
Time: 5 min	Method: Interactive Lecture

INTERNATIONAL AND REGIONAL AERODROMES

The security requirements at international and regional aerodromes are governed by Part Three–Aerodrome Security of the Canadian Aviation Security Regulations (CASR). It details identity verification systems and restricted area pass control. CASR Part Three requires that:

- access to restricted areas be controlled by an identity verification system;
- restricted area passes are only issued to those that require them on an ongoing basis, and deactivated when they are no longer required; and
- restricted areas can only be accessed through a restricted area access point.

MUNICIPAL AND PRIVATE AERODROMES

The measures that are implemented depend on the resources available, the types of security risks expected by the aerodrome operator and the level of risk that the aerodrome operator is willing to accept. Most aerodromes of this type will implement measures such as fences, gates, signs and locked doors to prevent unauthorized persons from inadvertently accessing restricted areas. Aerodromes with more resources and those that anticipate a higher degree of security related risks and incidents will implement more formal and stringent procedures.

CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. What part of the CASR pertains only to international and regional airports?

Q2. How can access to restricted areas be controlled?

Q3. Where can a restricted area be accessed?

ANTICIPATED ANSWERS

A1. CASR Part Three – Aerodrome Security.

A2. By an identity verification system.

A3. At a restricted area access point.

Teaching Point 5	**Explain the Role of the Canadian Air Transport Security Authority (CATSA)**
Time: 5 min	Method: Interactive Lecture

CANADIAN AIR TRANSPORT SECURITY AUTHORITY (CATSA)

CATSA's mandate is to protect the public by securing critical elements of the air transportation system as assigned by the government. CATSA was established in April 2002 as part of a comprehensive aviation security initiative. It is a crown corporation that reports to Parliament through the Minister of Transportation. CATSA's many responsibilities include pre-board screening of passengers and their belongings (PBS), hold baggage screening (HBS) and non-passenger screening (NPS).

Updated information on the role and mandate of CATSA can be found at http://www.catsa-acsta.gc.ca.

Pre-Board Screening (PBS)

Distribute the list of permitted and prohibited carry-on items. The list of prohibited items and dangerous goods changes from time to time. An updated list can be obtained from http://www.catsa-acsta.gc.ca/english/travel_voyage/list.shtml.

Passengers and carry-on baggage must pass through screening devices before entering the sterile area. These devices provide a way for screening officers to identify passengers and baggage that should be subjected to a more thorough search. Objects that are not permissible can also be identified with these devices. Passengers and baggage may also be selected at random for a more in-depth search.

Hold Baggage Screening (HBS)

HBS is the screening of checked baggage using explosives detection systems at aerodromes. In 2006 CATSA announced full deployment of HBS at 89 airports across Canada. This state-of-the-art baggage system is multi-level and involves the screening of all checked baggage. HBS is in effect for all domestic and international flights.

Non-Passenger Screening (NPS)

CATSA screens individuals, goods and possessions requiring access to the restricted areas at aerodromes where it is responsible for screening services. Flight crews and airport workers such as caterers, maintenance workers and baggage handlers are randomly selected for screening at Canada's 29 largest airports. Over 1 000 screenings of non-passengers and any goods or possessions occur nationally, at random, on a daily basis.

CONFIRMATION OF TEACHING POINT 5

QUESTIONS

Q1. What does PBS stand for?

Q2. What does HBS stand for?

Q3. What does NPS stand for?

ANTICIPATED ANSWERS

A1. Pre-board Screening.

A2. Hold Baggage Screening.

A3. Non-passenger Screening.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. What are two common types of extinguishing agents carried by ARFF vehicles?

Q2. What is a restricted area?

Q3. What are three types of medical crises that are common where large numbers of people congregate?

ANTICIPATED ANSWERS

A1. Water and foam.

A2. A portion of an aerodrome where access is only granted to authorized persons.

A3. Heart attacks, panic attacks and allergic reactions.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Emergency response and aerodrome security are both necessary to ensure the safety of the travelling public. Both of these areas are complex, with challenges and solutions constantly evolving.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C2-044 Transport Canada. (2007). *Aeronautical Information Manual*. Retrieved October 2, 2007, from http://www.tc.gc.ca/publications/EN/TP14371/PDF/HR/TP14371E.PDF.

C3-098 Canadian Air Transport Security Authority. (2007). *Mandate*. Retrieved October 10, 2007, from http://www.catsa-acsta.gc.ca/English/about_propos/mandat.shtml.

C3-148 (ISBN 0-9739866-0-3) Syme, E. R., & Wells, A. T. (2005). *Airport Development, Management and Operations in Canada: Second Edition*. Barrie, ON: Aviation Education Services.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 6

EO C360.06 – EXPLAIN ASPECTS OF AIR TRAFFIC SERVICES (ATS)

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the handouts located at Annexes J and K for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1 and 3 to clarify, emphasize and summarize aspects of ATS.

An in-class activity was chosen for TP 2 as this is an interactive way to reinforce the difference between ATC clearances and ATC instructions.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have explained aspects of ATS.

IMPORTANCE

It is important for cadets to know that ATS is the provision of control and information services and that it is required to maintain a safe and efficient air transport system. Personnel working at an aerodrome need to be aware of the types of services provided at the aerodrome and to be prepared to communicate with the appropriate ATS unit to ensure smooth and safe operations.

Teaching Point 1 | **Explain Types of ATS**

Time: 10 min | Method: Interactive Lecture

AIR TRAFFIC SERVICES (ATS)

A wide variety of services are provided to pilots and aircraft. Control and information services are both included in this category.

Air Traffic Control (ATC)

ATC service has been established primarily for the prevention of collisions and the efficient flow of traffic. The provision of ATC service will take precedence over the provision of flight information services. ATC service ensures separation between aircraft, especially those that are operating under instrument meteorological conditions (IMC). ATC service is provided to aircraft during all phases of flight and on the ground at busy aerodromes.

Information Services

Information that could be relevant to the safety of a flight is provided to pilots as it becomes available. Sometimes, ATC service suggestions are included. It is up to the pilot to make decisions based on a suggestion. Information provided includes:

- severe weather conditions along the proposed route of flight,
- changes in the serviceability of navigation aids,
- weather conditions reported or forecasted at destination or alternate aerodromes,
- changes in the serviceability of navigation aids,
- condition of airports and associated facilities, and
- other items considered pertinent to the safety of the flight.

Advisory Services

At uncontrolled aerodromes, the information listed below is provided by advisory services (if appropriate) during initial aerodrome advisory communications:

- active or preferred runway,
- wind direction and speed,
- air traffic that warrants attention,
- vehicle traffic,
- wake turbulence cautionary,
- aerodrome conditions,
- weather conditions, and
- additional information of interest for the safety of flight.

Alerting Services

When an aircraft declares an emergency, alerting services notifies the appropriate agency to provide emergency standby services. If an aircraft becomes overdue, search and rescue (SAR) agencies can be notified. Alerting a responsible authority of any unlawful interference (hijack), bomb threat or inability to communicate is also included in this service.

Briefing Services

Briefing services, provided by flight service specialists, consult on meteorological and aeronautical information to assist pilots in pre-flight planning. The flight service specialist adapts meteorological information, including satellite and radar imagery, to fit the needs of flight crew members and operations personnel and provides consultation and advice on special weather problems.

Notice to Airmen (NOTAM) Services

NOTAM services collect information from pilots, aerodrome operators and aeronautical facilities operators and distribute as required and requested. This includes Runway Surface Condition (RSC) reports and Canadian Runway Friction Index (CRFI) information.

Distribute photocopies of Annex J to the cadets.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What type of ATS has priority over provision of flight information services?

Q2. What type of service provides such information as active or preferred runway, wind direction and speed, air traffic and vehicle traffic?

Q3. What type of service assists pilots with flight planning?

ANTICIPATED ANSWERS

A1. ATC service.

A2. Advisory service.

A3. Briefing service.

Teaching Point 2 — **Explain the Difference Between an ATC Clearance and an ATC Instruction**

Time: 10 min — Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to allow the cadets to explain the difference between an ATC clearance and an ATC instruction.

RESOURCES

- One sheet of paper for each cadet, and

- Pens/pencils.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Distribute one handout of Annex K to each cadet.
2. Organize the cadets into groups of four.
3. Explain to the cadets the following definitions:

   (a) **ATC Clearance.** An authorization from ATC for a pilot to proceed with a specific action (eg, takeoff or landing) or along a specific route.

Whenever an ATC clearance is received and accepted by the pilot, compliance shall be made with the clearance. If a clearance is not acceptable, the pilot should immediately inform ATC of this fact as acknowledgement of the clearance alone will be taken by a controller as indicating acceptance. A clearance will be identified by the use of the word “clear” in its contents. Example of clearances are:

“You are cleared to the circuit”.

“You are cleared for take off on runway two niner”.

   (b) **ATC Instruction.** A directive from ATC to do something specific (eg, maintain 5 000 feet).

A pilot shall comply with an ATC instruction that is directed to and received by the pilot, provided the safety of the aircraft is not jeopardized. An instruction will always be worded in such a manner as to be readily identified, although the word “instruct” will seldom be included. Pilots shall comply with and acknowledge receipt of all ATC instructions directed to and received by them. An example of an instruction would be:

“Hold on taxiway”.

“Climb to and maintain one three thousand”.

4. Have each group write down examples of ATC clearances or an ATC instructions that might be given to a person operating an aircraft at an aerodrome.
5. Read out each group’s ATC clearance/instruction and have the class identify it as a clearance or instruction.
6. Continue until all of the ATC clearances/instructions have been read or time runs out.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets’ participation in the ATC clearance and ATC instruction activity will serve as the confirmation of this TP.

Teaching Point 3	**Explain the Functions of ATC**
Time: 5 min	Method: Interactive Lecture

AREA CONTROL CENTRES (ACCS)

Area control service is provided by ACCs to flights operating within specified control areas. These areas typically consist of high level airspace and serve aircraft operating in the en route phase of flight. Information and advisory services are provided when workloads permit.

TERMINAL CONTROL UNITS (TCUS)

Terminal control service is provided by TCUs to flights operating within specified control areas surrounding major aerodromes. The primary purpose is to provide arrival and departure control to aircraft as they transition from the takeoff or landing phase to the en route phase. This type of ATC unit is responsible for sequencing aircraft to ensure an efficient flow of traffic to and from an aerodrome.

CONTROL TOWERS

Control towers are located at busy aerodromes to provide ATC services to aircraft during takeoff and landing. Control of aircraft on the ground is also provided. Workloads in most control towers do not usually permit the provision of information and advisory services so aircraft will obtain the required information from another ATS unit on a different frequency or by telephone before making contact with the control tower.

FLIGHT SERVICE STATIONS (FSSS)

FSSs provide information, advisory, alerting, briefing and NOTAM services. FSSs are responsible for large areas and provide service for all of the aerodromes in their area. Remote communications systems allow flight service specialists to communicate via radio to aircraft and vehicles hundreds of kilometres away.

FSSs are the initial point of contact for pilots during the pre-flight planning stage. They play a key role in the collection and distribution of NOTAMs. FSSs can be contacted by pilots via radio when in the air (and on the ground where remote communications facilities exist) or by telephone.

Vehicle control service at uncontrolled aerodromes with a mandatory frequency is provided by a FSS. The FSS may be hundreds of kilometres away and providing this service to multiple aerodromes. Personnel operating vehicles at aerodromes in this situation must pay close attention to this fact and be very clear and concise about their intentions and location.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. Which unit provides control to aircraft and vehicles on the ground at busy aerodromes?

Q2. Which unit provides control services to aircraft arriving and departing a controlled aerodrome?

Q3. Which unit plays a key role in the provision of NOTAM services?

ANTICIPATED ANSWERS

A1. Control tower.

A2. TCU.

A3. FSS.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. What type of ATS has priority over the provision of flight information services?

Q2. Which ATC communication must a pilot obey provided the safety of the aircraft is not jeopardized?

Q3. What type of service assists pilots with flight planning?

ANTICIPATED ANSWERS

A1. ATC.

A2. An ATC instruction.

A3. Briefing service.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

ATS provides the control and information services that support safe operation at busy aerodromes. Personnel working at an aerodrome need to be aware of the types of services provided at the aerodrome and be prepared to communicate with the appropriate ATS unit.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

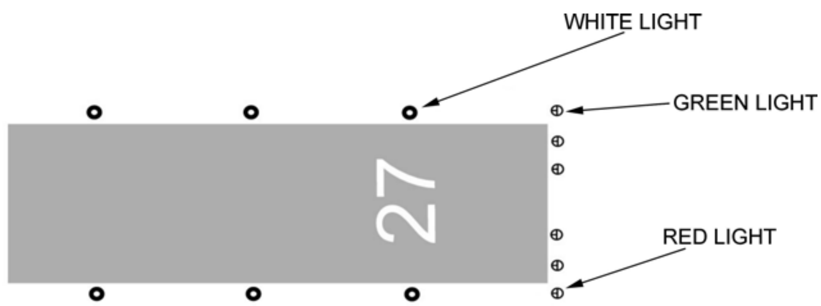
C2-044 Transport Canada. (2007). *Aeronautical Information Manual*. Retrieved October 2, 2007, from http://www.tc.gc.ca/publications/EN/TP14371/PDF/HR/TP14371E.PDF.

MANOEUVRING LIGHTING

RUNWAY LIGHTING

Edge lights are located along the runway. These lights are white in colour (white light bulb with a clear lens) and provide assistance in identifying the edge of the runway. The lights are spaced evenly along each edge with no more than 60 m (200 feet) between the lights. Each row of lights is the same distance from the runway centreline and may be located along the edge of the runway or no more than 1.5 m away from the edge, except in areas that experience significant accumulations of snow. In areas that experience significant accumulations of snow, edge lights may be placed up to 3 m from the runway edge.

The edge lights that cross the beginning of a runway are green while the lights at the end of a runway are red. This is accomplished by using a two-colour filter under the lens. The red side is located on the runway side so that when an aircraft is on the runway looking at the light, a red light is visible. The green filter is on the other side so that when the aircraft is approaching the runway, a green light is visible.



Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 16A-1 Runway Lighting

TAXIWAY LIGHTING

Edge lights are placed along taxiways in the same way edge lights are placed along runways. The maximum spacing remains at 60 m (200 feet) and will be closer together along a curved section than along a straight section. Taxiway edge lights are blue in colour. The blue colour is created by using a blue lens instead of a clear lens.

Where a taxiway intersects a runway, two blue lights are placed on each side of the taxiway, adjacent to the runway, to indicate the intersection.

APRON LIGHTING

Apron edge lights are yellow in colour (created by using a yellow lens). Where a taxiway intersects an apron, two yellow lights are placed on each side of the taxiway, adjacent to the apron, to indicate the intersection.

Light Location	Colour
Runway Edge Lights	White
Taxiway Edge Lights	Blue
Apron Edge Lights	Yellow
Runway/Taxiway Intersection	Two blue
Taxiway/Apron Intersection	Two yellow
Runway Threshold (end of runway side)	Red
Runway Threshold (start of runway side)	Green

Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 16A-2 Runway Lighting Colours

UNSERVICEABLE AREA MARKINGS

Certain ground markings indicate the status of aerodromes and pilots are required to comply with these markings.

A large cross, either white or yellow and at least 6.1 m in length, displayed at each end of a runway or taxiway indicates that that runway or taxiway is unserviceable. For night operations, any unserviceable portion of a runway is closed off by placing red lights at right angles to the centerline across both ends. In addition, the runway lights for the unserviceable area are turned off.

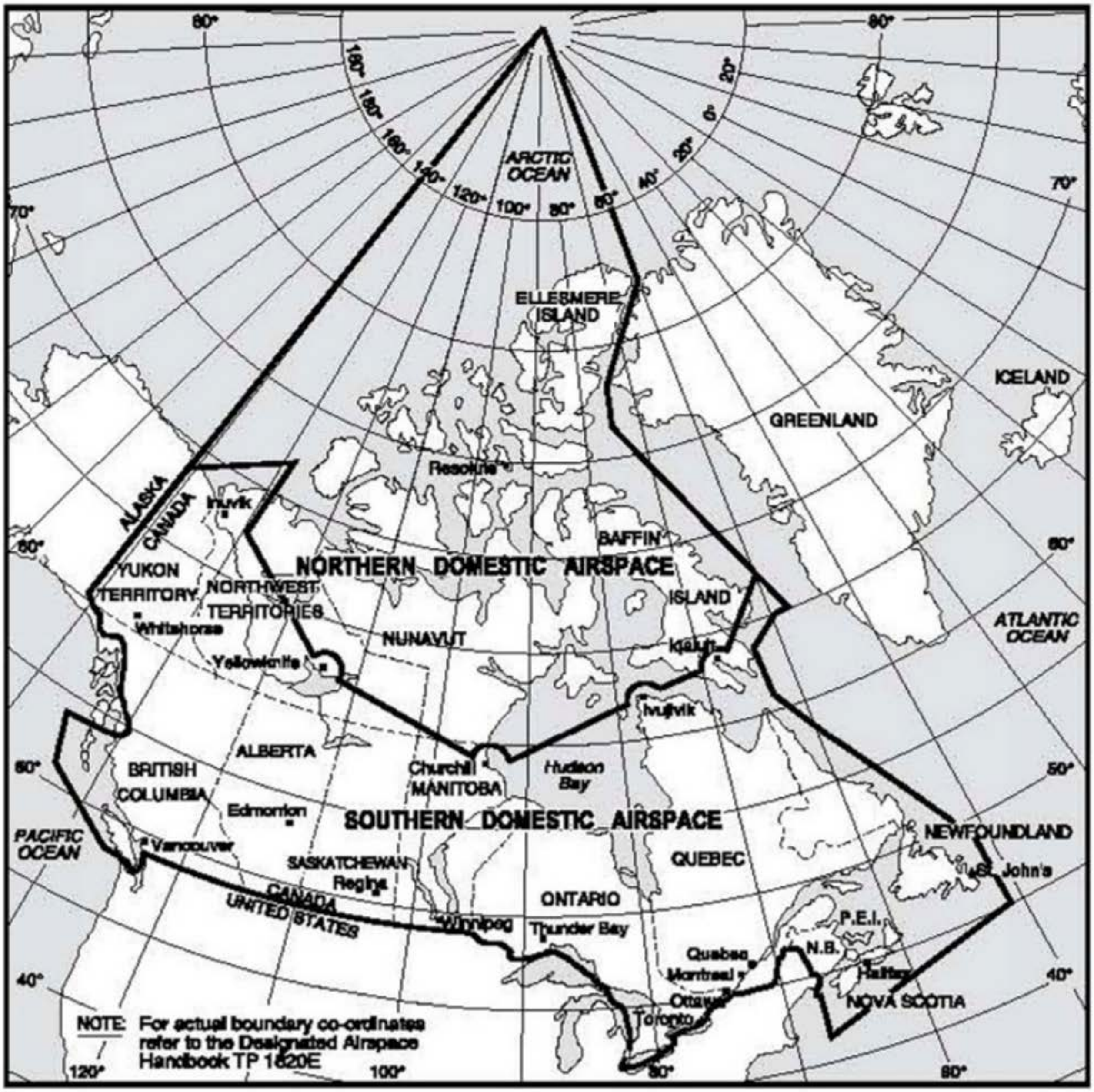
If an unserviceable portion of any manoeuvring area or taxiway is small enough that it can be bypassed by an aircraft with safety, red flags are used to outline the area. At night, the area is marked with red lights – sometimes flashing.

APPROACH LIGHTING SYSTEM (ALS)

An ALS provides additional guidance to aid a pilot in finding the beginning of the runway during periods of low visibility. These lights are used as part of an instrument landing system (ILS) and aid the pilot in transitioning from the instrument portion of the approach to the visual portion.

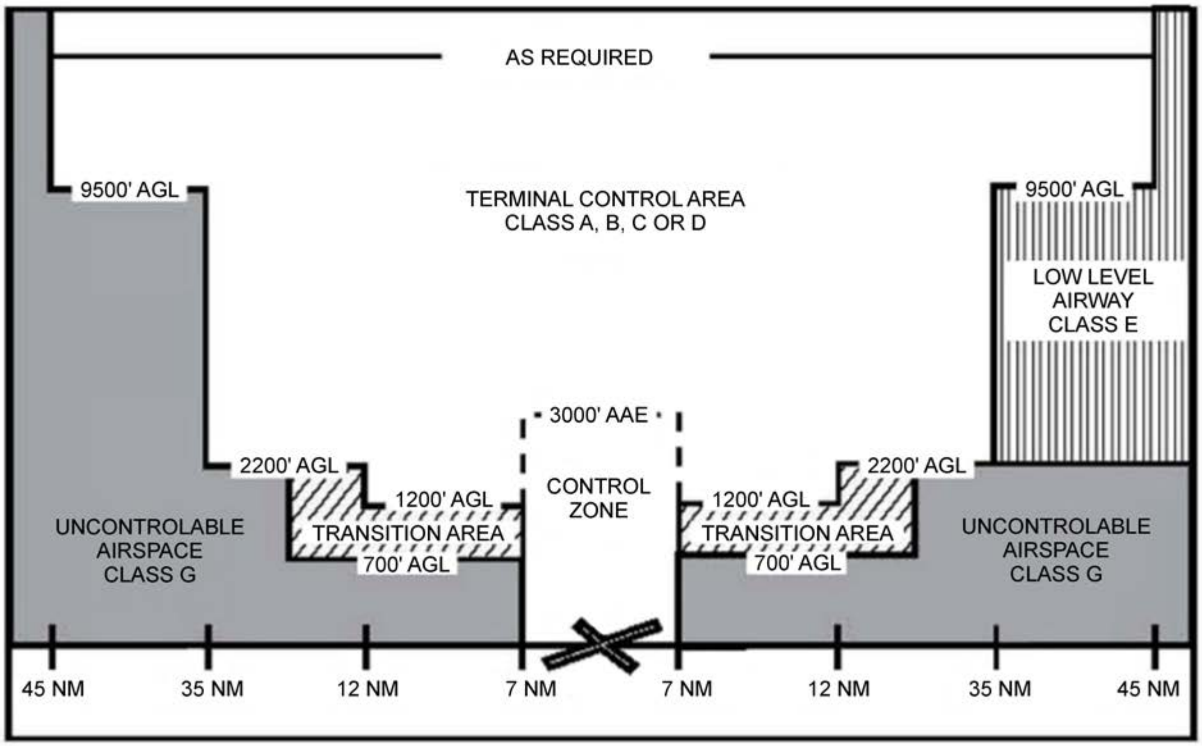
The aerodrome operator must ensure that the systems are working properly by inspecting them on a regular basis. During the winter, the snow around the systems must be cleared to keep them visible.

CANADIAN DOMESTIC AIRSPACE



Aeronautical Information Manual, Ottawa, ON: Her Majesty the Queen in Right of Canada (p. 182)

Figure 16B-1 Boundaries of CDA, NDA, and SDA



Aeronautical Information Manual, Ottawa, ON: Her Majesty the Queen in Right of Canada (p. 186)

Figure 16B-2 Typical Airspace Surrounding an Aerodrome

AIRSPACE CLASSIFICATIONS

CDA is divided into seven classes, each identified by a single letter: A, B, C, D, E, F, or G. Flight within each class is governed by specific rules applicable to that class.

CLASS A

Class A airspace is designated where an operational need exists to exclude VFR aircraft. All operations must be conducted under IFR and are subject to Air Traffic Control (ATC) clearances and instructions. An ATC clearance gives authorization to proceed within controlled airspace and an ATC instruction is a directive issued by an ATC unit for air traffic control purposes.

All high level controlled airspace is designated as Class A.

CLASS B

Class B airspace is designated where an operational need exists to provide air traffic control service to IFR and to control VFR aircraft.

All low level controlled airspace above 12 500 feet ASL or at and above the minimum en route altitude (MEA), whichever is higher, up to but not including 18 000 feet ASL will be Class B airspace. Control zones and associated terminal control areas may also be classified as Class B airspace.

CLASS C

Class C airspace is controlled airspace in which both IFR and VFR flights are permitted.

Airspace classified as Class C becomes Class E airspace when the appropriate ATC unit is not in operation. Terminal control areas and associated control zones may be classified as Class C airspace.

CLASS D

Class D airspace is controlled airspace in which both IFR and VFR flights are permitted, but VFR flights must establish two-way communication with the appropriate ATC agency prior to entering the airspace.

Airspace classified as Class D becomes Class E airspace when the appropriate ATC unit is not in operation. A terminal control area and associated control zone could be classified as Class D airspace.

CLASS E

Class E airspace is designated where an operational need exists for controlled airspace but does not meet the requirements for Class A, B, C, or D.

Low level airways, control area extensions, transition areas, or control zones established without an operating control tower may be classified as Class E airspace.

CLASS F

Class F airspace is an area in which activities must be restricted, or limitations imposed upon aircraft operations that are not a part of those activities. Typical uses for Class F airspace include:

- military practice areas,
- fire-bombing,
- parachute jumping,
- flight training,
- soaring,
- hang gliders, and

- air shows.

Class F airspace is sometimes known as special use airspace. It may be classified as Class F advisory, or as Class F restricted, and can be controlled airspace, uncontrolled airspace, or a combination of both.

CLASS G

Class G airspace is airspace that has not been designated Class A, B, C, D, E or F and in which ATC has neither the authority or responsibility for exercising control over air traffic.

To help remember:

- Classes A to E are controlled airspace,
- Class F may be controlled or uncontrolled, and
- Class G airspace is uncontrolled.

The difference between Class C and Class D is that an ATC clearance is needed to enter Class C, but two-way communication is all you need to enter Class D.

AIRSPACE MODEL CONSTRUCTION CHECKLIST

Use this as a guide to ensure that your model has all the required components. As you add each component to the model, you can check it off the list. If you add something to the model that is not on the list below, write it in the extra spaces provided.

Primary runway

Secondary runway

Control zone

Terminal control area

Transition area

____

____

____

____

____

____

____

____

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VEHICLES USED AT AN AERODROME

Enfield Auto Body, Major Clients and Services. Retrieved November 15, 2007, from http://www.enfieldautobody.com/majorclients.htm

Figure 16E-1 Pickup Truck Used at an Aerodrome

NRRA, Airport Vehicles. Retrieved November 15, 2007, from http://www.nrairport.com/equipment/airport_vehicles.htm

Figure 16E-2 Dump Truck Used at an Aerodrome

Bosserman Aviation Equipment, New Refuelers. Retrieved November 19, 2007, from http://www.bossermanaviationequip.com/refuelers.htm

Figure 16E-3 Mobile Tanker Used at an Aerodrome

Sioux Gateway Airport, Photo Gallery. Retrieved November 15, 2007, from http://www.flysiouxgateway.com/index.php/gallery/image_full/107/

Figure 16E-4 A Snowplow Used at an Aerodrome

Chisholm/Hibbing, 2007, Airport Deicing Service, Copyright 2007 by Chisholm/Hibbing Airport. Retrieved November 15, 2007, from http://www.hibbingairport.com/services/deicer.php

Figure 16E-5 A De-Icing Truck Used at an Aerodrome

Stinar Corporation, Stinar Lavatory and Water Trucks. Retrieved November 19, 2007, from http://www.stinar.com/lav_water_trucks.shtml

Figure 16E-6 A Ground Servicing Truck (Potable Water) Used at an Aerodrome

NRRA, Airport Vehicles. Retrieved November 15, 2007, from http://www.nrairport.com/equipment/airport_vehicles.htm

Figure 16E-7 Front Mounted Sweeper

Viking Cives, Photo Gallery. Retrieved November 16, 2007, from http://vcl.vikingcives.com/ViewPage.aspx?pg=35

Figure 16E-8 One-Way Snowplow Blade Mounted on a Truck

Patria, Airport Equipment. Retrieved November 16, 2007, from http://patria.fi/products/PatriaProductsPublic/search.aspx?selectedcategory=CD498

Figure 16E-9 Two-Way Snowplow Blade Mounted on a Special Chassis

NRRA, Airport Vehicles. Retrieved November 15, 2007, from http://www.nrairport.com/equipment/airport_vehicles.htm

Figure 16E-10 Front Mounted Snow Blower (Mounted on a Tractor)

Eagle Airfield, Used Equipment Inventory. Retrieved November 16, 2007, from http://www.eagleairfield.com/Used.html

Figure 16E-11 Self-Propelled Snow Blower

*Velcon Canada, 2003, Engineered Products and Systems, Copyright 2003 by Velcon Canada.
Retrieved November 19, 2007, from http://www.velconcanada.ca/specialprojects.html*

Figure 16E-12 Above Ground Tank and Refuelling Cabinet

Velcon Canada, 2003, Engineered Products and Systems, Copyright 2003 by Velcon Canada.
Retrieved November 19, 2007, from http://www.velconcanada.ca/specialprojects.html

Figure 16E-13 Refuelling Cabinet

Bosserman Aviation Equipment, New Refuelers. Retrieved November 19, 2007, from http://www.bossermanaviationequip.com/refuelers.htm

Figure 16E-14 Mobile Tanker

VEHICLE IDENTIFICATION

Match the pictures with the most correct name or purpose. Each picture has a matching name and a matching purpose. Not all names or purposes have a matching picture.

A

B

C

D

E

F

Name

_________ Pickup truck

_________ Snowplow

_________ Fire truck

_________ De-icing truck

_________ Ground servicing truck

_________ Mobile tanker

_________ Dump truck

_________ Aircraft tow tractor

_________ Snow blower

Purpose

_________ Push snow.

_________ Respond to aircraft emergencies.

_________ Spray aircraft to remove/prevent ice.

_________ Move aircraft around on apron.

_________ Blow snow.

_________ Deliver supplies to aircraft on the apron.

_________ General aerodrome use.

_________ Carry loads of snow and grit.

_________ Deliver fuel to aircraft.

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ANSWER KEY

A

B

C

D

E

F

Name

___F___ Pickup truck

___B___ Snowplow

_______ Fire truck

___D___ De-icing truck

___C___ Ground servicing truck

___A___ Mobile tanker

___E___ Dump truck

_______ Aircraft tow tractor

_______ Snow blower

Purpose

___B___ Push snow.

_______ Respond to aircraft emergencies.

___D___ Spray aircraft to remove/prevent ice.

_______ Move aircraft around on apron.

_______ Blow snow.

___C___ Deliver supplies to aircraft on the apron.

___F___ General aerodrome use.

___E___ Carry loads of snow and grit.

___A___ Deliver fuel to aircraft.

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ARFF TRUCK

Oshkosh Truck Corporation, 2007, Striker 4500, Copyright 2007 by Oshkosh Truck Corporation. Retrieved November 28, 2007, from http://www.oshkoshtruck.com/pdf/Oshkosh_Striker4500.pdf

Figure 16H-1 ARFF Truck

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AERODROME SECURITY DEFINITIONS

Restricted Area. A portion of an aerodrome where access is only granted to authorized persons.

Restricted Area Access Point. A location in a security barrier at which a control system is in place that controls access to a restricted area from a non-restricted area.

Screening. The checking, identification, observation, inspection or authorized search of persons, goods and other things in the possession or control of persons.

Security Barrier. A physical structure or natural feature used to prevent or deter access by unauthorized persons to a restricted area.

Sterile Area. A restricted area, including any passenger loading bridges attached to it. It is used to separate passengers who have been screened, or are exempt from screening, and other authorized persons from unauthorized persons at the aerodrome.

RESTRICTED AREAS

All aircraft movement areas (runways, taxiways and aprons) are restricted areas and only those who are authorized have access to these areas. Restricted areas also exist inside the terminal building. The area used by passengers between the time they are screened and the time they board the aircraft is a restricted area (specifically a sterile area). Other areas inside the terminal building that will be a restricted area include:

- aerodrome and airline operations,
- baggage-handling areas,
- ATC, and
- emergency response.

FENCES

The fences most commonly used as security measures at an aerodrome are chain-link fences erected around the perimeter of the aircraft movement areas. Access through the fence is provided by gates for vehicles and people or through buildings adjacent to the movement areas.

GATES

The gates found in aerodrome fencing can be categorized in several ways: routine, emergency, or occasional access points and vehicle or personnel access points. Additionally, they can be operated manually or mechanically. Gates designed to be operated mechanically should also be able to be opened manually in case of electrical failure. In all cases, a gate that remains open can become a major security problem.

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EXAMPLE OF A NOTAM FILE

Aerodrome NOTAM file CYYZ

070620 CYYZ TORONTO/LESTER B.PEARSON INTL
CYYZ RWY 15L/33R CLSD DUE CONST DLY 1230/2230 0711291230 TIL 0711302230

061070 CYYZ TORONTO/LESTER B.PEARSON INTL
CYYZ THR 23 DISPLACED 685 FT (200 FT BEYOND PUB DISPLACEMENT OF 485 FT) DUE OBST 615 FT NE OF THR 23, 38 FT AGL, 592 MSL. MARKED BY ORANGE MARKERS AND WING BAR LGT EITHER SIDE OF RWY. FOR RWY 23 DEP, ACFT REQUIRING FULL LEN MUST NOTIFY GROUND CTL UPON INITIAL CTC.
DECLARED DIST:
RWY 05: TORA 11120 TODA 11435 ASDA 11120 LDA 10985
RWY 23: TORA 11120 TODA 12120 ASDA 11120 LDA 10435
CAP 4 ILS OR NDB RWY 23 TCH TO READ 45 FT VICE 55 FT
TIL APRX 0712312000

070270 CYYZ TORONTO/LESTER B.PEARSON INTL
CYYZ CRANE 7353 FT BFR THR 15L AND 131 FT LEFT EXTENDED RWY CL, 115 FT AGL 686 MSL LGTD, 1100/2100 DLY 0706091100/0711032100 AND 1200/2200 DLY 0711041200 TIL 0712072200

070449 CYYZ TORONTO/LESTER B.PEARSON INTL
CYYZ AMEND PUB:
6 SMOKE STACKS WITHIN AN AREA BOUNDED BY 434449N 794048W 434448N 794046W 434446N 794049W 434447N 794050W TO POINT OF ORIGIN (CENTRED APRX 5 NM NNW AD) 215 FT AGL 811 MSL.
LGTD, NOT PAINTED

070584 CYYZ TORONTO/LESTER B.PEARSON INTL
CYYZ PARKING AREAS: TML 1:
TAXILANE 9E AND 9W CLSD.
NEW TAXILANE 10 OPN 246 FT/75 M EAST OF TAXILANE 9, EQUIPPED WITH CL LGT.
UNLGTD OUTER LOOP JOINING TAXILANE 9 TO 10 PAINTED WITH DASHED CL AND RESTRICTED TO ACFT WINGSPAN 118 FT /35.9 M OR LESS.
TIL APRX 0711292000

070592 CYYZ TORONTO/LESTER B.PEARSON INTL
CYYZ CAT III APCH 06L NOT AUTH PENDING INITIAL CERTIFICATION TIL 0802191700

Nav Canada, AWWS - NOTAM Page. Retrieved November 29, 2007, from http://www.flightplanning.navcanada.ca/cgi-bin/CreePage.pl?Langue=anglais&NoSession=NS_Inconnu&Page=Fore-obs%2Fnotam&TypeDoc=htmls

Figure 16J-1 A NOTAM File

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AIR TRAFFIC CONTROL CLEARANCES AND INSTRUCTIONS

Whenever an ATC clearance is received and accepted by the pilot, compliance shall be made with the clearance. If a clearance is not acceptable, the pilot should immediately inform ATC of this fact as acknowledgement of the clearance alone will be taken by a controller as indicating acceptance. A clearance will be identified by the use of the word “clear” in its contents. Example of clearances are:

“You are cleared to the circuit”.

“You are cleared for take off on runway two niner”.

EXAMPLE OF AN ATC CLEARANCE

“Cleared for takeoff on runway zero four.”

Write down an example of an ATC Clearance:

A pilot shall comply with an ATC instruction that is directed to and received by the pilot, provided the safety of the aircraft is not jeopardized. An instruction will always be worded in such a manner as to be readily identified, although the word “instruct” will seldom be included. Pilots shall comply with and acknowledge receipt of all ATC instructions directed to and received by them. An example of an instruction would be:

“Hold on taxiway”.

“Climb to and maintain one three thousand”.

EXAMPLE OF AN ATC INSTRUCTION

“Hold short of taxiway.”

Write down an example of an ATC Instruction:

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CHAPTER 17

PO 370 – RECOGNIZE ASPECTS OF AIRCRAFT MANUFACTURING AND MAINTENANCE

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 1

EO M370.01 – IDENTIFY COMPONENTS OF THE PITOT STATIC SYSTEM

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create slides of Annexes A and B.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to review, clarify, emphasize, and summarize the pitot static system.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified components of the pitot static system used in aircraft.

IMPORTANCE

It is important for cadets to identify components of the pitot static system because it is an important part of most aircraft. Familiarity with this system will allow cadets to gain an understanding of this common aircraft feature as it applies to both manufacturing and maintenance of aircraft.

Teaching Point 1	**Explain the Pitot Static System**
Time: 10 min	Method: Interactive Lecture

Flight instruments enable an aircraft to be operated with maximum performance and safety. One set of flight instruments, those of the pitot static system, measure and utilize air pressure.

Show the cadets Figure 17A-1.

There are two major parts of the pitot static system:

- the static pressure vent and lines, and
- the pitot pressure, also called impact pressure, chamber and lines.

The static pressure line provides the source of ambient (normal outside) air pressure for the operation of the altimeter, vertical speed indicator, and airspeed indicator, while the pitot pressure, or impact pressure line provides impact pressure to the airspeed indicator. The airspeed indicator is the only instrument that requires both air pressures.

STATIC VENT

The static vent is located where the air flowing past the aircraft will not disturb air pressure. This will vary with each model of aircraft. The static vent provides undisturbed air pressure for the static line.

The openings of the static vent must be checked during the pre-flight inspection to ensure that they are free from obstructions. Blocked or partially blocked openings should be cleaned by a certified mechanic. Blowing into these openings is not recommended because this could damage the instruments.

STATIC LINE

The static line is a hollow tube. Since the static line is vented to the free undisturbed air by the static vent, air pressure in the static line will change as the air pressure around the aircraft changes. As the aircraft gains altitude, air pressure in the static line will drop. This pressure change is transmitted through the static line to the instruments which utilize static air pressure. These instruments include the:

- altimeter,
- vertical speed indicator, and
- airspeed indicator.

PITOT PRESSURE CHAMBER

In the pitot static system, the impact air pressure (air striking the airplane because of its forward motion) is taken from a pitot tube. It is mounted in a location that provides minimum disturbance or turbulence caused by the motion of the aircraft through the air. Often, a pitot tube cover is placed over the pitot tube when the aircraft is parked to prevent foreign objects, such as insects, from entering the pitot static system. It is important that the pitot tube cover, if used, is removed prior to takeoff.

As the aircraft moves through the air, the impact pressure on the open pitot tube affects the pressure in the pitot pressure chamber. Any change of pitot (impact) pressure in the pitot pressure chamber is transmitted through a line connected to the airspeed indicator, which uses impact pressure for its operation.

In some aircraft, the static pressure is obtained at the same location as the pitot pressure. This is done by using a hybrid pitot-static tube. In a pitot-static tube, the static vent is combined with the impact tube. The effects are the same.

Show the cadets Figure 17A-2.

The opening of the pitot tube must be checked during the pre-flight inspection to assure that it is free from obstructions. Blocked or partially blocked openings should be cleaned by a certified mechanic. Blowing into these openings is not recommended because this could damage the instruments.

PITOT LINE

Any change of pressure in the pitot chamber is transmitted through a pitot line (a hollow tube) to the airspeed indicator, which uses impact pressure as well as static pressure for its operation.

OPERATION OF THE PITOT STATIC SYSTEM

As described above, the pitot static system of chambers and lines delivers two types of air pressure to flight instruments:

- static pressure, and
- pitot pressure.

When flight instruments are calibrated correctly, they will measure the air pressure that is delivered to them, relative to air pressure at sea level as well as impact pressure relative to static pressure. By measuring the air pressures in the static pressure and impact pressure lines, the calibrated instruments will present useful information about the aircraft's position to the pilot.

Pitot static instrument error will almost always indicate blockage of the pitot tube, the static port, or both.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What is the pitot static system used for?

Q2. How is static pressure change delivered to the instruments?

Q3. Which instrument measures pitot (impact) pressure?

ANTICIPATED ANSWERS

A1. For operating instruments that measure and use air pressure.

A2. It is delivered through lines.

A3. The airspeed indicator.

Teaching Point 2 | **Explain Instruments of the Pitot Static System**

Time: 15 min | Method: Interactive Lecture

AIRSPEED INDICATOR

Show the cadets Figures 17B-1 and 17B-2.

The airspeed indicator is a sensitive, differential pressure gauge, which measures and shows the difference between pitot, or impact, pressure and static pressure. These two pressures will be equal when the airplane is parked on the ground in calm air. When the aircraft moves through the air, the pressure in the pitot line becomes greater than the pressure in the static line. This difference in pressure is registered by the airspeed pointer on the face of the instrument, which is calibrated in miles per hour, knots, or both.

As the pressure in the pitot tube and pitot line increases, the diaphragm in the airspeed indicator expands. The diaphragm will then maintain its size while the impact pressure is stable. As the impact pressure decreases, the diaphragm contracts accordingly. This expansion and contraction of the diaphragm is reflected in the readout of the airspeed indicator via a system of gears and shafts.

Prior to takeoff, the airspeed indicator should read zero unless there is a strong wind blowing directly into the pitot tube.

VERTICAL SPEED INDICATOR

Show the cadets Figures 17B-3 and 17B-4.

The vertical speed indicator (VSI), sometimes called a vertical velocity indicator (VVI), indicates whether the airplane is climbing, descending, or in level flight. The rate of climb or descent is indicated in thousands of feet per minute. If properly calibrated, the VSI indicates zero in level flight.

Although the VSI operates solely from static pressure, it measures pressure difference; the pressure now relative to the pressure a moment ago. It contains a diaphragm with connecting linkage and gearing to the indicator pointer inside an airtight case. The inside of the diaphragm is connected directly to the static line of the pitot static system. The area outside the diaphragm, which is inside the instrument case, is also connected to the static line, but through a restricted orifice (calibrated leak).

Both the diaphragm and the case receive air from the static line at existing atmospheric pressure. When the airplane is on the ground or in level flight, the pressures inside the diaphragm and the instrument case remain the same and the pointer indicates zero.

However, when the aircraft climbs or descends, the pressure inside the diaphragm changes immediately, but due to the metering action of the restricted passage, the case pressure remains higher or lower for a short time, causing the diaphragm to contract or expand. This causes a pressure difference that is relative to climb rate and is indicated on the instrument needle as a climb or descent.

ALTIMETER

> Show the cadets Figures 17B-5 and 17B-6.

The altimeter measures the height of the aircraft above sea level. Since it is the only instrument that gives altitude information, the altimeter is one of the most vital instruments in the aircraft. However, the altimeter is calibrated with respect to standard atmospheric conditions, while air will actually seldom meet those standard conditions. Variations in atmospheric pressure and temperature will introduce errors into the altimeter's measurements. To use the altimeter effectively, its operation and how atmospheric pressure and temperature affect it must be thoroughly understood.

A stack of sealed aneroid wafers comprises the main component of the altimeter. Aneroid wafers expand and contract with changes in atmospheric pressure, in this case, pressure from the static source. The mechanical linkage translates these changes into pointer movements on the indicator.

The pressure altimeter is an adaptation of an aneroid barometer that measures the pressure of the atmosphere at the level where the altimeter is located and presents it as an altitude indication in feet instead of simple air pressure, as a barometer would. The altimeter uses static pressure as its source of operation. Air is denser at sea level than aloft, so as altitude increases, atmospheric pressure decreases. This difference in pressure at various levels causes the altimeter to indicate changes in altitude.

Since altimeters are calibrated with respect to standard atmospheric conditions as described above, it is necessary to adjust altimeters to non-standard static pressures that result from weather fronts. For example, if flying from a high-pressure area to a low-pressure area without adjusting the altimeter, the actual altitude of the aircraft would be LOWER than the indicated altitude because the altimeter was originally set to compensate for a non-standard high air pressure. Arriving in the low-pressure area, it must be reset to compensate for a non-standard low air pressure.

An old saying, "High to low, look out below" is a way of remembering which condition is most dangerous. When flying from a low-pressure area to a high-pressure area without adjusting the altimeter, the actual altitude of the airplane is HIGHER than the indicated altitude because the altimeter was originally set to compensate for a non-standard low air pressure. Arriving in the high-pressure area, it must be reset to compensate for a non-standard high air pressure.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What does an airspeed indicator measure?

Q2. What does a vertical speed indicator measure?

Q3. What does an altimeter measure?

ANTICIPATED ANSWERS

A1. The difference between static pressure and pitot, or impact, pressure.

A2. The difference between static air pressure now and static air pressure a moment ago.

A3. The difference between static air pressure and a standard air pressure, usually at sea level.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. Which flight instrument measures pitot, or impact pressure?

Q2. Why are pitot tube covers used?

Q3. What is the difference between a pitot tube and a pitot-static tube?

ANTICIPATED ANSWERS

A1. The airspeed indicator.

A2. To prevent blockage of the pitot tube when the aircraft is parked.

A3. A pitot-static tube is a combination of a pitot tube with a static vent.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

The pitot static system, which is based on different air pressures, is found on most aircraft. Understanding how the system works allows a pilot or mechanic to use instruments correctly and to diagnose problems that are encountered with pitot static systems.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-116 (ISBN 0-9680390-5-7) MacDonald, A. F., & Peppler, I. L. (2000). *From the Ground Up: Millennium Edition*. Ottawa, ON: Aviation Publishers Co. Limited.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 2

EO M370.02 – IDENTIFY AIRCRAFT MANUFACTURERS

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Update the information located at Annexes C to I using the reference.

Create slides of Annexes C to I.

Prepare the video *Viking Video Profile*. This will be shown in TP 1.

Create slides of aircraft located at Annexes C to H with titles blocked out for use in TP 3.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1 and 2 to orient the cadets to aircraft manufacturing companies, give an overview of them and to generate interest.

An in-class activity was chosen for TP 3 as it is an interactive way to allow cadets to test their ability to identify aircraft manufacturers.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified manufacturers of light and heavy aircraft that are commonly found at Canadian aerodromes.

IMPORTANCE

It is important for cadets to identify manufacturers of aircraft as this will enhance their enjoyment of aviation and will help them identify aircraft they observe at Canadian aerodromes.

Teaching Point 1 — **Discuss Manufacturers of Light Aircraft**

Time: 15 min — Method: Interactive Lecture

CESSNA AIRCRAFT COMPANY

The Cessna Aircraft Company traces its history to June 1911, when Clyde Cessna, a farmer in Rago, Kansas, built a wood-and-fabric plane and became the first person to build and fly an aircraft between the Mississippi River and the Rocky Mountains.

Over the years since 1911, Cessna has produced many different types of aircraft and many of the models had variations.

Show the cadets the list of Cessna aircraft located at Annex C.

A rented Cessna 172 Skyhawk is often used for air cadet familiarization flying exercises.

Show the cadets Figures 17C-2 to 17C-5, identifying each type of aircraft. Mention that the Cessna 305 is used as a glider tow plane in the Air Cadet Gliding Program.

DIAMOND AIRCRAFT INDUSTRIES

The Diamond story began in 1981 when Hoffmann Flugzeugbau was founded in Friesach, Austria, to produce the newly certified H36 Dimona motorglider. In 1992, the company, then known as Dimona Aircraft, established a full production facility in London, Ont., with a view to supplying the US market with its new aircraft. Later, after modifying its name to Diamond, the company grew into an international manufacturer with over 46 000 sq m of modern production facilities, over 800 employees, five distinct product lines, and facilities on three continents. The company's operation at the London, Ont. airport has over 23 000 sq m of state-of-the-art production facilities to design, build and test aircraft.

Diamond produces a variety of aircraft types, including:

- DA20, a single-engine propeller-driven aircraft,
- DA42, a twin-engine propeller-driven aircraft, and
- D-JET, a single-engine gas turbine fanjet.

Show the cadets the figures located at Annex D, identifying each type of aircraft.

PIPER AIRCRAFT, INC

Originally founded as the Taylor Brothers Aircraft Manufacturing Company in September 1927, the company was renamed Taylor Brothers Aircraft Corporation in April of 1928 and then Piper Aircraft Corporation in November 1937.

Now located at Vero Beach, Florida, Piper's manufacturing capabilities cover a wide variety of fabrication, assembly, paint and inspection processes. The company also designs and builds its own tooling. Piper's engineering design work is also comprehensive, with separate engineering groups responsible for aircraft certification, production support, customer service engineering, product development, engineering administration and test operations.

Show the cadets the figures located at Annex E, identifying each type of aircraft.

VIKING AIR

Viking Air is a manufacturing, maintenance and leasing company located at the Victoria International Airport in Sidney, B.C.

Viking Air, although a very small company by Canadian aviation standards, purchased the type certificates for seven de Havilland heritage aircraft, giving Viking the exclusive right to re-start production for any of these seven de Havilland Canada aircraft types.

Viking Air holds the Type Certificates for the following de Havilland aircraft:

- DHC-1 Chipmunk,
- DHC-2 Beaver,
- DHC-3 Otter,
- DHC-4 Caribou,
- DHC-5 Buffalo,
- DHC-6 Twin Otter, and
- DHC-7 Dash 7.

The DHC-6 Twin Otter and DHC-2 Beaver remain popular in commercial aviation, while the DHC-5 Buffalo continues to serve the CF in a Search and Rescue capacity.

Show the cadets the figures located at Annex F, identifying each type of aircraft.

Show the cadets the six-minute video *Viking Video Profile* (Reference C3-203).

CONFIRMATION OF TEACHING POINT 1

Participation in the aircraft identification activity at the end of this lesson will serve as the confirmation of TP 1.

Teaching Point 2	**Discuss Manufacturers of Heavy Aircraft**
Time: 5 min	Method: Interactive Lecture

AIRBUS

Airbus is one of the world's two leading aircraft manufacturers. The company employs 57 000 people and produces a comprehensive range of heavy commercial aircraft.

Manufacturing, production and sub-assembly of parts for Airbus aircraft are distributed around 16 sites in Europe, with final assembly in Toulouse, France and Hamburg, Germany. Airbus draws on a global network of more than 1 500 suppliers in over 30 countries.

There are also centres for engineering design, sales and customer support in North America; and sales and customer support centres in Japan and China. Airbus has a joint engineering centre in Russia with Kaskol, a Russian aircraft manufacturer.

Around the world, Airbus has 5 spare parts centres, 160 field sites, 3 training centres in Toulouse, Miami and Beijing and one A320 maintenance training centre in Hamburg. Airbus has an agreement with CAE (formerly Canadian Aviation Electronics Ltd.) to provide Airbus-approved training courses in many other sites around the world.

Show the cadets the figures located at Annex G, identifying each type of aircraft.

THE BOEING COMPANY

Headquartered in Chicago, Illinois, Boeing employs more than 150 000 people across the United States and in 70 other countries, with major operations in the Puget Sound area of Washington State, southern California and St. Louis, Missouri.

For more than a century, Boeing has produced a vast number of aircraft types. Some Boeing aircraft had historical significance that extended well beyond aviation; they actually changed the world. For example, America entered the age of jet transport on July 15, 1954, when the Boeing 707 prototype, the model

367-80, made its maiden flight from Renton Field, south of Seattle, Washington. Forerunner of the more than 14 000 Boeing jetliners built afterwards, the prototype, nicknamed the "Dash 80," served 18 years as a flying test laboratory before it was turned over to the Smithsonian Air and Space Museum in May 1972. The Boeing 707 was a very successful aircraft type.

Show the cadets the Figure 17H-1.

Other popular Boeing aircraft, that are commonly seen, include the:

- Boeing 737,
- Boeing 747,
- Boeing 767, and
- Boeing 777.

Show the cadets the remaining figures located at Annex H, identifying each type of aircraft.

Different aircraft are suitable for different routes, depending on such things as traffic volume. A large carrier such as Air Canada requires a variety of aircraft to suit a variety of applications.

Show the cadets Figure 17I-1.

CONFIRMATION OF TEACHING POINT 2

Participation in the aircraft identification activity at the end of this lesson will serve as the confirmation of TP 2.

Teaching Point 3	**Conduct an Activity to Allow the Cadets to Test Their Ability to Identify Aircraft Manufacturers**
Time: 5 min	Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to give the cadets an opportunity to test their ability to identify aircraft manufacturers.

RESOURCES

Pictures of aircraft located at Annexes C to H, with titles blocked out (with sticky notes).

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into two teams on opposite sides of the room.
2. Display a picture of an aircraft discussed during this lesson.
3. Have one team attempt to identify the aircraft and its manufacturer in 10 seconds.
4. Award one point for the aircraft's name and another for the manufacturer.
5. If the first team is unable to name the aircraft or its manufacturer, the second team may try.
6. Award two points for successful aircraft or manufacturer naming by the second team.
7. Alternate the successive pictures and opportunities between the two teams.
8. The team with the most points after five minutes is the winner.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 3

Participation in the activity will serve as the confirmation of TP 3.

END OF LESSON CONFIRMATION

Participation in the aircraft identification activity will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Aircraft manufacturers, like their product lines, are constantly changing. To make aircraft that can compete in sophisticated markets, the organizations themselves must improve to meet the ever-evolving competition.

INSTRUCTOR NOTES/REMARKS

The manufacturers and the aircraft included in this lesson were chosen because cadets frequently encounter these aircraft. Time limitations prevented more manufacturers and aircraft from being included.

REFERENCES

C3-232 Cessna Aircraft Company. (2008). *Welcome to Cessna.com*. Retrieved February 8, 2008, from http://cessna.com/.

C3-233 Diamond Aircraft Industries. (2008). *Diamond Aircraft*. Retrieved February 8, 2008, from http://www.diamondair.com/mainpage.php.

C3-234 Piper Aircraft, Inc. (2008) *Piper: Freedom of Flight*. Retrieved February 8, 2008, from http://www.newpiper.com/.

C3-235 Viking Air. (2008). *Viking*. Retrieved February 8, 2008, from http://www.vikingair.com/.

C3-236 Airbus. (2008). *Airbus*. Retrieved February 8, 2008, from http://www.airbus.com/en/.

C3-237 Boeing. (2008). *Boeing*. Retrieved February 8, 2008, from http://www.boeing.com/.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 3

EO M370.03 – DESCRIBE ROUTINE AIRCRAFT INSPECTION PROCEDURES

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create a slide of Annex J.

Photocopy handout of Annex J for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to orient the cadets to routine aircraft inspections, give an overview of them, and to generate interest.

INTRODUCTION

REVIEW

IAW EO M370.01 (Identify Components of the Pitot Static System, Section 1), the cadet will review the purpose and importance of pitot tubes and static pressure vents.

OBJECTIVES

By the end of this lesson the cadet shall be expected to describe routine aircraft inspection procedures.

IMPORTANCE

It is important for cadets to be able to describe routine aircraft inspection procedures so they may appreciate the attention that must be given to safety in aviation.

Teaching Point 1 **Describe the Pilot's Inspection Prior to Flight**

Time: 10 min Method: Interactive Lecture

An aircraft operating in Canada is subject to inspections that allow the aircraft to operate safely. There are two main types of inspections:

1. inspections performed by the pilot prior to flight, and
2. inspections performed by a certified Aircraft Maintenance Engineer (AME) at designated intervals appropriate to the aircraft.

This inspection overview and all others described in this instructional guide are examples only. Always refer to and follow the recommendations of the manufacturer when carrying out any inspections and procedures. Individual models of aircraft may have special procedures and inspection guidelines that will vary from those described here.

PILOT'S INSPECTION PRIOR TO FLIGHT

Prior to every flight, a pilot completes a thorough inspection of the aircraft.

Overall Appearance of the Aircraft

The pilot stands a short distance away from the aircraft and observes the general overall appearance of the aircraft, looking for obvious defects. This is important because it may indicate large defects that could affect aerodynamics.

Before beginning the walk-around inspection, enter the cockpit and ensure that the aircraft is prepared for inspection, ensuring:

- battery and ignition switches are OFF,
- control locks are REMOVED, and
- landing gear switch is in the gear DOWN position.

Fuselage/Empennage

Inspection of the fuselage/empennage will include:

- baggage compartment: contents properly arranged and secured,
- static air pressure vents: free from obstructions,
- pitot tube: free from obstructions – cover REMOVED,
- conditions of the aircraft covering: missing or loose rivets, cracks, tears, etc.,
- anti-collision and navigation lights: condition,
- avionics antennas: cracks, oil or dirt, proper mounting and damage,
- wheel and tires: cuts, bruises, excessive wear, and proper inflation,
- oleo shock absorber and shock strut: proper inflation and cleanliness,
- wheel well and fairing: general condition and secure,
- limit and position switches: cleanliness and secure, and

- ground safety lock: REMOVED.

Wings

Inspection of the wings will include:

- control surface locks: REMOVED,
- control surfaces: dents, cracks, excess play, condition of hinge pins and bolts,
- covering: missing or loose rivets, cracks, tears, etc,
- wing tip and navigation light: wing tip and light secure and undamaged,
- landing light: condition, cleanliness, secure, and
- stall warning vane: freedom of movement.

Prior to inspection, turn the master switch ON so that the stall warning signal can be checked when the vane is deflected.

Fuel

Inspection of the aircraft fuel systems will include:

- fuel quantity in tank: type and amount of fuel visually checked,
- fuel tank filler cap and fairing covers secure,
- fuel tank vents: clear of obstructions,
- drain valve: free of contaminants (drain fuel into a container to check), and
- drain cocks: operating properly without drips.

Engine/Propeller

Inspection of the engine/propeller will include:

- engine oil quantity: oil sump filled and filler cap and dipstick secured,
- general condition and evidence of fuel and oil leaks,
- cowling, access doors, and cowl flaps: condition checked and all secure,
- carburetor air filter: clean and secure,
- exhaust stacks: no cracks and studs tight,
- spark plugs: terminals secure and clean,
- engine mount: cracks and mounts secure,
- main fuel strainer: free of water or sediment (drain fuel into a container to check),
- cowling and baffle: seals snug and in place for proper engine cooling,
- propeller and spinner: security, oil leakage and condition. No deep nicks or scratches, and
- ground area under the propeller: free of loose stones, cinders, etc.

Instruments Check

Check all instruments for proper reading and, where applicable, fluid levels.

Emergency Locator Transmitter (ELT)

Inspection of the ELT to ensure:

- it is mounted securely,
- tight connections,
- general condition (no corrosion),
- antenna secure,
- annual recertification completed and current,
- battery not time-expired, and
- ELT switch in ARMED position.

Seat Belts

Check that seat belts are secure and in good condition. Secure seat belts in unoccupied seats.

Doors and Windows

Close and secure doors, windows and canopy top.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. When does a pilot perform an inspection of the aircraft?

Q2. When does an AME perform an inspection of the aircraft?

Q3. What is an ELT?

ANTICIPATED ANSWERS

A1. Prior to flight.

A2. At designated intervals appropriate to the aircraft.

A3. Emergency Locator Transmitter.

Teaching Point 2	**Describe the Pilot's Cockpit Check Prior to Flight**
Time: 10 min	Method: Interactive Lecture

PILOT'S COCKPIT CHECK PRIOR TO FLIGHT

A systematic and careful cockpit check will be carried out prior to flight. It is extremely important to carry out a thorough pre-flight inspection. Small clues indicating a malfunctioning or damaged component may easily be missed in a hurried pre-flight check. Be vigilant after maintenance, painting or a modification job has been performed on the airplane. It is possible for components to be reinstalled incorrectly.

Written Checklist for the Specific Aircraft Type

The cockpit check will be made deliberately without haste using a written checklist. A definite sequence will be followed, moving clockwise around the cockpit. Each control will be touched and named aloud. Always work from a written checklist, not a memorized list, no matter how small the aircraft.

Show the cadets the slide of Figure 17J-1.

There are many checklists relating to the various phases in the operation of an aircraft: pre-flight, before starting engines, before taxiing, engine run-up, before takeoff, takeoff and climb, cruise, descent, before landing, aborted landing, after landing and after shutdown, as well as checklists relating to emergency situations. Larger aircraft use them all. Whenever checklists are required for an aircraft, they must be used during all phases of the aircraft's operation to which they apply.

Run-Up of the Engine(s)

Position the aircraft into the wind when running up the engine(s) for engine cooling. Open and close the throttle slowly while checking operation, to include:

- oil pressure and temperature,
- RPM at full throttle,
- magneto operation,
- instruments, to include:
  - voltmeter,
  - ammeter,
  - manifold pressure gauge,
  - fuel pressure gauge,
  - tachometer,
  - vacuum, and
  - other instruments as shown on the written checklist;
- carburetor heat,
- fuel mixture control,
- idling speed,
- working engine temperature, and
- other parameters as shown on the written checklist.

Switches

Check switch positions for takeoff as per written checklist (eg, magneto ON, generator ON, anti-collision beacon ON, navigation lights ON, etc).

Flaps Set for Takeoff

Adjust the flaps to the takeoff position when ready for takeoff.

Control Surface Operation

Check freedom of all controls, to include:

- ailerons,

- elevators, and
- rudders.

While moving the control column and rudder pedals, check that the control surfaces are responding in the proper direction of travel. This check is particularly important if the aircraft has undergone maintenance.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to allow the cadets to experience completing a pilot checklist.

RESOURCES

Photocopies of Annex J for each cadet.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Give each cadet a photocopy of Figure 17J-1.
2. Divide the cadets into pairs.
3. Have one cadet, acting as pilot in command (PIC), call out the checklist steps for Pre-flight Inspection Cockpit.
4. Have the second cadet, acting as co-pilot, repeat commands and act out the procedure in any manner that the PIC deems appropriate.
5. Have the cadets trade roles and have the new PIC call out the checklist steps for Before Takeoff.
6. Have the new co-pilot repeat commands and act out the procedure.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is used to guide a cockpit check?

Q2. Why is it important to be vigilant after maintenance, painting or a modification job has been performed on the airplane?

Q3. Why position the aircraft into the wind when running up the engine(s)?

ANTICIPATED ANSWERS

A1. A written checklist.

A2. It is possible for components to be reinstalled incorrectly.

A3. For engine cooling.

Teaching Point 3	**Discuss an Aircraft's Required Inspections**
Time: 5 min	Method: Interactive Lecture

AN AIRCRAFT'S REQUIRED INSPECTIONS

Certificate of Airworthiness (C of A)

A Transport Canada (TC) C of A can be issued for an aircraft, which fully complies with all standards of airworthiness certification (for its applicable type).

TC regulations require that an aircraft carry its C of A on every flight.

Annual Airworthiness Information Report (AAIR)

The owner of a Canadian aircraft, other than an ultralight aeroplane, must submit an AAIR using the prescribed report form. The aircraft owner will complete the annual report by entering all data required and signing the certification to vouch that the information supplied is correct.

Approved Maintenance Schedules

All Canadian aircraft, other than ultralight or hang gliders, shall be maintained in accordance with an approved maintenance schedule, approved by the Minister of Transport, which meets the Aircraft Equipment and Maintenance Standard.

Approved maintenance schedules shall:

- be based upon data obtained from an approved maintenance review board (MRB) report; or
- where no current MRB report exists, be based upon data obtained from:
  - the current recommendations of the aircraft manufacturer,
  - a maintenance schedule approved by the Minister for use by another operator, or
  - any other data acceptable to the Minister.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. When can a C of A be issued?

Q2. How often must an AAIR be submitted?

Q3. Who approves a maintenance schedule?

ANTICIPATED ANSWERS

A1. When an aircraft fully complies with all standards of airworthiness certification (for its applicable type).

A2. Annually.

A3. The Minister of Transport.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. When does a pilot perform an inspection of the aircraft?

Q2. What is used to guide a cockpit check?

Q3. What requires an aircraft to carry its C of A on every flight?

ANTICIPATED ANSWERS

A1. Prior to flight.

A2. A written checklist.

A3. TC regulations.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Safety in aviation requires attention to detail and it can only be successful through careful planning and preparation.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-116 (ISBN 0-9680390-5-7) MacDonald, A. F., & Peppler, I. L. (2000). *From the Ground Up: Millennium edition*. Ottawa, ON: Aviation Publishers Co. Limited.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 4

EO C370.01 – IDENTIFY TASKS REQUIRED TO MAINTAIN AIRCRAFT

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy handouts located at Annexes K to M for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to review, clarify, emphasize and summarize the tasks required to maintain aircraft.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified tasks required to maintain aircraft.

IMPORTANCE

It is important for cadets to identify tasks required to maintain aircraft so that they will have an appreciation for the aircraft maintenance industry, including an understanding of safety requirements.

Teaching Point 1	Discuss Aircraft Maintenance Work
Time: 10 min	Method: Interactive Lecture

During the early days of aviation it was discovered that flying posed safety hazards. As aviation matured, organizations were formed to develop and enforce safety procedures. Faster aircraft and increasing air traffic became essential parts of Canadian commerce and industry. Air regulations have developed to keep pace with technological and social changes. Each regulation has a purpose and was put in place with the intention of supporting safe aviation.

MAINTENANCE CERTIFICATION

Aircraft maintenance in Canada is regulated by the Canadian Aviation Regulations (CARs). CARs are a compilation of regulatory requirements designed to enhance both safety and the competitiveness of the Canadian aviation industry. Parts I–VIII of the CARs correspond to eight broad areas of aviation:

- Part I – General Provisions,
- Part II – Aircraft Identification and Registration,
- Part III – Aerodromes, Airports and Heliports,
- Part IV – Personnel Licensing and Training,
- Part V – Airworthiness,
- Part VI – General Operating and Flight Rules,
- Part VII – Commercial Air Services, and
- Part VIII – Air Navigation Services.

EXAMPLES OF MAINTENANCE REQUIRING CERTIFICATION

CARs Part V – Airworthiness and Part VI – General Operating and Flight Rules, include the regulations for aircraft maintenance and elementary work. Generally, maintenance done on an aircraft in Canada must be followed by a maintenance release signed by a licensed aircraft maintenance engineer (AME) before the aircraft can be flown. Certain routine tasks have been designated as elementary work and do not require an AME's signature. Instead, the aircraft owner or appointee must record the work done in the aircraft's technical record, such as the journey logbook and technical logbooks.

A maintenance release signed by an AME is required for activities such as:

- modifying, repairing or replacing structural airframe parts;
- overhauling the engine;
- re-contouring or straightening a propeller blade;
- repairing avionics; and
- welding fuel tanks.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What does the acronym CARs mean in Canadian aviation?

Q2. What does the acronym AME mean in Canadian aviation?

Q3. Who must sign a maintenance release?

ANTICIPATED ANSWERS

A1. Canadian Aviation Regulations.

A2. Aircraft Maintenance Engineer.

A3. An AME.

Teaching Point 2	**Discuss Elementary Work**
Time: 15 min	Method: Individual Activity

Although performing and recording elementary work is less restrictive by aviation standards, it is still very rigorous by typical standards in such fields as private automobile maintenance. To understand aviation maintenance, cadets must recognize the difference between flying at hundreds of km/h at thousands of feet above the ground and parking a stalled car on the shoulder of the road when a fan belt breaks.

SPECIFIC TASKS DESIGNATED AS ELEMENTARY WORK

The difference between maintenance requiring a maintenance release and elementary work has been made easy to recognize in CAR Part VI, Standard 625, Appendix A–Elementary Work.

Elementary work task listings include 29 specific items that cover many routine activities including, under specified circumstances, changing engine oil, changing spark plugs, removing and replacing glider wings and tail surfaces, checking and replacing batteries, changing light bulbs, repairing upholstery, etc.

Distribute a copy of Annex K to each cadet.

The CARs carefully limit the activities in elementary work. For example, checking tire pressures over 100 psi is not elementary work and will require a maintenance release.

RECORDING ELEMENTARY WORK

Elementary work performed on light aircraft is recorded in the aircraft's technical record. The entry in the technical record of the work performed must be signed by the person who performed the work. Since aviation maintenance is a safety consideration, the accurate recording of all maintenance is important. Aircraft logbooks are often the first documents to be collected by investigators in the event of an accident.

Transport Canada (TC) regulations stipulate that all maintenance must be logged before the aircraft is flown.

Distribute Annexes L and M to each cadet.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to familiarize the cadets with recording elementary work.

RESOURCES

Handouts of Annexes L and M.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Demonstrate how to fill out the logbook pages as per the examples located at Annex M.
2. Have each cadet fill in the top line of their blank journey logbook flight record at Annex L to show a fictitious flight from CNT7 (Picton, Ont.) to CYSN (Welland, Ont.), establishing a history for an imaginary aircraft. Except for the date, the details of that data line should look similar to the 26 Aug 07 data line entered by M. Calvert and shown at Annex M.
3. Upon arrival at Welland, have each cadet record the addition of a litre of engine oil and adjustment of tire pressure in their logbook pages, as well as two other items of elementary work selected from the list located at Annex K.
4. If cadets do not complete all this work in the time, have them complete it after class. Ensure that the flight details and the engine oil addition are recorded correctly.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. Who must sign a maintenance release?

Q2. What tasks may be performed on an aircraft without a maintenance release?

Q3. How many specific tasks has TC designated as elementary work?

ANTICIPATED ANSWERS

A1. An AME.

A2. Tasks designated as elementary work by the TC CARs.

A3. 29.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Aircraft maintenance is a critical part of aviation and of Canadian transportation, commerce and industry. Professionally performed, aircraft maintenance serves the requirements of both safety and efficiency.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-096 (ISBN 1715-7382) Transport Canada. (2006). *Aeronautical Information Manual*. Ottawa, ON: Her Majesty the Queen in Right of Canada.

C3-210 (ISBN 0-660-62327-7) Transport Canada. (2003). *Aircraft Journey Log*. Ottawa, ON: Her Majesty the Queen in Right of Canada.

C3-211 (ISBN 0-660-19017-6) Transport Canada. (2005). *Airframe Log*. Ottawa, ON.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 5

EO C370.02 – DESCRIBE MATERIALS USED IN AIRCRAFT CONSTRUCTION

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create slides of figures located at Annexes N to P.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to review, clarify, emphasize and summarize materials used in aircraft construction.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall be expected to describe materials used in aircraft construction.

IMPORTANCE

It is important for cadets to learn about materials used in aircraft construction as it will enhance their understanding of the materials used to build aircraft and why they are chosen.

Teaching Point 1	Describe Wood and Fabrics Used in Aircraft Construction
Time: 5 min	Method: Interactive Lecture

WOOD

Although wood was used for the first airplanes because of its high strength and low weight, the cost of manpower needed for wood construction and maintenance has caused wood to be almost entirely replaced by other materials, particularly metal.

Species of Wood

If wood is used, it must be carefully selected to meet aviation requirements. Aircraft grade Sitka spruce, sometimes referred to as Airplane spruce, is the preferred reference wood for aviation because of its uniformity, strength and shock-resistance.

Assessment of Wood

If other wood is substituted for aircraft grade Sitka spruce, the replacement wood must meet the same requirements.

Laminated wood is constructed of two or more layers of wood that are bonded together with a glue or resin.

Assessing wood requires the examination of many characteristics such as grain, knots and pitch pockets. A defect might make a piece of wood unusable.

FABRIC

Organic Fabric

Early aircraft were constructed using organic fabrics, such as linen, for the skin of the fuselage and wings. The earliest builders did not use any process to increase the strength of the material. The material was not airtight and it loosened and wrinkled with changes in humidity. Soon, rubberized and varnished coatings came into use to improve the fabric. Later, cotton fibres dissolved in nitric acid were used to make a dope that was worked into the fabric to produce a more durable finish.

Show the cadets the Black Maria, an example of fabric construction, at Annex N.

The Black Maria can be seen today in the National Aviation Museum in Ottawa, ON.

The next step in fabric improvement was to paint enamel over the doped fabric. It cracked and peeled with time, so aluminum powder was blended into the paint. The aluminum powder pigmentation proved very effective in blocking harmful sunlight and reflecting heat away from the fabric.

Other improvements in doping followed, but eventually advances in chemical technology led to new finishes on durable synthetic materials. Although various high grades of cotton are still sometimes used, man-made inorganic fabrics have become the most popular fabric for covering an aircraft.

Inorganic Fabric

Polyester fibres, woven into cloth with different weights are sold under various trade names. Other inorganic fibres include fibreglass and composites.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Why has wood been used less for modern aircraft?

Q2. What species is the preferred reference wood for aircraft construction?

Q3. What is laminated wood?

ANTICIPATED ANSWERS

A1. Wood construction has high costs for manpower.

A2. The reference species is Sitka spruce.

A3. Laminated wood is constructed of two or more layers of wood that are bonded together with a glue or resin.

Teaching Point 2	**Describe Composites Used in Aircraft Construction**
Time: 15 min	Method: Interactive Lecture

COMPOSITE CONSTRUCTION

> The term composite in this lesson refers to a combination of two or more materials that differ in composition or form. Composite is sometimes used to mean any synthetic building material.

Composite structures differ from metallic structures in important ways: excellent elastic properties, high strength combined with light weight and the ability to be customized in strength and stiffness. The fundamental nature of many composites comes from the characteristics of a strong fibre cloth imbedded in a resin.

Fibreglass

Fibreglass is made from strands of silica glass that are spun together and woven into cloth. Fibreglass weighs more and has less strength than most other composite fibres. However, improved matrix materials now allow fibreglass to be used in advanced composite aviation applications.

> A matrix is any material that sticks other materials together.

There are different types of glass used in fibreglass: E-glass, which has a high resistance to electric current, and S-glass, which has a higher tensile strength, meaning that the fabric made from it resists tearing.

Aramid

Aramid is a polymer. A polymer is composed of one or more large molecules that are formed from repeated units of smaller molecules.

Ask the cadets to name all the applications they are aware of for Kevlar® .

The best-known aramid material is Kevlar®, which has a tensile strength approximately four times greater then the best aluminum alloy. This cloth material is used in many applications where great strength is needed: canoes, body armour and helicopter rotors. Aramid is ideal for aircraft parts that are subject to high stress and vibration. The aramid's flexibility allows it to twist and bend in flight, absorbing much of the stress. In contrast, a metal aircraft part would develop fatigue and stress cracks sooner under the same conditions.

Carbon/Graphite

The term carbon is often used interchangeably with the term graphite; however, they are not quite the same material. Carbon fibres are formed at 1315 degrees Celsius (2400 degrees Fahrenheit), but graphite fibres are produced only above 1900 degrees Celsius (3450 degrees Fahrenheit). As well, their actual carbon content differs – but both carbon and graphite materials have high compressive strength and stiffness.

Carbon molecules will form long strings that are extremely tough (this is what makes diamonds so strong). These minute hair-like strands of carbon (a very common and inexpensive element) are, per unit of weight, many times stronger than steel. Individual carbon fibres are flexible, rather than stiff, and bend easily despite having high tensile strength. To stiffen the fibres, cross-directional layers are immersed in a matrix material such as epoxy plastic.

The term epoxy refers to a substance derived from an epoxide. An epoxide is a carbon compound containing an oxygen atom bonded in a triangular arrangement to two carbon atoms. So, an epoxy matrix is itself carbon-based, as are the fibres that it binds.

Show the cadets Figure 17O-1.

The passenger cabin of airliners must be pressurized so that passengers will not have to wear oxygen masks during flight. The large two-level cabin of the A380 Airbus requires a bulkhead (wall) to keep this pressurized air from leaking into the unpressurized tail section. Airbus' facility in Stade, Germany specializes in the design and production of carbon fibre reinforced plastic (CFRP) components and the A380 rear pressure bulkhead was produced there.

Ceramic

Ceramic fibre is a form of glass fibre designed for use in high temperature applications. It can withstand temperatures approaching 1650 degrees Celsius (3000 degrees Fahrenheit), making it effective for use around engines and exhaust systems.

Show the cadets Figure 17O-2.

Ceramic's disadvantages include both weight and expense, but sometimes no other known material will do the job. One of the most famous applications of ceramic is the Thermal Protection System used on the space shuttle. The properties of aluminum demand that the maximum temperature of the shuttle's structure be kept below 175 degrees Celsius (350 degrees Fahrenheit) during operations. Heating during re-entry (in other words, heating caused by friction with the air) creates surface temperatures high above this level and in many places will push the temperature well above the melting point of aluminum (660 degrees Celsius or 1220 degrees Fahrenheit).

Underneath its protective layer of tiles and other materials, the space shuttle has an ordinary aluminum construction, similar to many large aircraft.

Show the cadets Figure 17O-3.

A space shuttle's Thermal Protection System is very complex and it contains highly sophisticated materials. Thousands of tiles of various sizes and shapes cover a large percentage of the space shuttle's exterior surface. There are two main types of silica ceramic tiles used on the space shuttle:

- **Low-Temperature Reusable Surface Insulation (LRSI).** LRSI tiles cover relatively low-temperature areas of one of the shuttles, the Columbia, where the maximum surface temperature runs between 370 and 650 degrees Celsius (700 and 1200 degrees Fahrenheit), primarily on the upper surface of fuselage around the cockpit. These tiles have a white ceramic coating that reflects solar radiation while in space, keeping the Columbia cool.

Show the cadets Figure 17O-4.

- **High-Temperature Reusable Surface Insulation (HRSI).** HRSI tiles cover areas where the maximum surface temperature runs between 650 and 1260 degrees Celsius (1200 and 2300 degrees Fahrenheit). They have a black ceramic coating, which helps them radiate heat during re-entry.

Both LRSI and HRSI tiles are manufactured from the same material and their primary difference is the coating.

A different and even more sophisticated material, Reinforced Carbon-Carbon (RCC), is used for the nose cone and leading edges of the space shuttle. It is a composite material consisting of carbon fibre reinforcement in a matrix of graphite, often with a silicon carbide coating to prevent oxidation.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What type of glass is used in fibreglass strands?

Q2. What is best known aramid material?

Q3. What method is used to stiffen carbon fibre materials?

ANTICIPATED ANSWERS

A1. Silica glass.

A2. Kevlar®.

A3. Immersing cross-directional layers of carbon fibres in a matrix compound such as epoxy plastic.

Teaching Point 3	Describe Metals Used in Aircraft Construction
Time: 5 min	Method: Interactive Lecture

METALS USED IN AIRCRAFT CONSTRUCTION

Aluminum

Pure aluminum lacks sufficient strength to be used for aircraft construction. However, its strength increases considerably when it is alloyed or mixed with other compatible metals. For example, when aluminum is mixed with copper or zinc, the resultant aluminum alloy is as strong as steel, with only one-third the weight. As well, the corrosion resistance possessed by the aluminum carries over to the newly formed alloy.

Alclad®

Most external aircraft surfaces are made of clad aluminum. Alclad® consists of a pure aluminum coating rolled onto the surface of heat-treated aluminum alloy. The thickness of the aluminum coating is approximately five percent of the alloy thickness, on each side of the alloy sheet. This clad surface greatly increases the corrosion resistance of the aluminum alloy. However, if the aluminum coating is penetrated, corrosion can attack the alloy within.

Magnesium

Magnesium is one of the lightest metals with sufficient strength and suitable working characteristics for use in aircraft structures. In its pure form it lacks sufficient strength, but like aluminum, mixing it with other metals to create an alloy produces strength characteristics that make magnesium useful.

Titanium

Titanium and its alloys are lightweight metals with very high strength. Pure titanium weighs only half as much as stainless steel and is soft and ductile. Titanium's alloys have excellent corrosion resistance, particularly to salt water.

Show the cadets Figure 17P-1 and Figure 17P-2.

Stainless Steel

Stainless steel is a classification of corrosion-resistant steel that contain large amounts of chromium and nickel. It is well suited to high-temperature applications such as firewalls and exhaust system components.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. Why is pure aluminum unsuitable for use in aircraft components?

Q2. What three characteristics make titanium useful for aircraft components?

Q3. What two metals are mixed with steel to make stainless steel?

ANTICIPATED ANSWERS

A1. Pure aluminum lacks sufficient strength.

A2. Titanium alloys have high strength, are lightweight and are resistant to corrosion.

A3. Steel is mixed with chromium and nickel.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. What species is the reference wood for aircraft construction?

Q2. What is the name used to commonly identify aramid material?

Q3. What two metals are mixed with steel to make stainless steel?

ANTICIPATED ANSWERS

A1. The reference wood is Sitka spruce.

A2. Aramid is commonly called Kevlar®.

A3. Steel is mixed with chromium and nickel.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Materials used in aircraft construction have evolved and improved since the earliest construction and the rate of change is accelerating. Advances in associated technologies are continually integrated with aircraft construction as aircraft become larger, more powerful and more complex.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-136 (ISBN 0-88487-207-6) Sanderson Training Systems. (2001). *A&P Technician Airframe Textbook*. Englewood, CO: Jeppesen Sanderson Inc.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 6

EO C370.03 – IDENTIFY BASIC POWER TOOLS USED IN AIRCRAFT MANUFACTURING AND MAINTENANCE

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create slides of figures located at Annexes Q to S.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1–3 to identify basic power tools used in aircraft manufacturing and maintenance and to give an overview of them.

An in-class activity was chosen for TP 4 as it is an interactive way to confirm the cadets' comprehension of the material.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet will have identified basic power tools used in aircraft manufacturing and maintenance.

IMPORTANCE

It is important for the cadets to know about basic power tools used in aircraft manufacturing and maintenance because this will enhance their knowledge of aircraft construction and the aviation maintenance field.

Teaching Point 1	Describe the Characteristics and Methods of Application for Power Hand Tools Used With Aircraft
Time: 5 min	Method: Interactive Lecture

POWER HAND TOOLS

Power hand tools were originally developed to speed up work. However, some hand tools have improved to the point that they allow a novice to produce a degree of precision and excellence that was previously only attainable by expert master craftsmen.

Power hand tools also create safety concerns. Their power allows them to do a lot of damage in a very short time and their power also makes them hard to control. A twisting or reciprocating power tool can easily cause the user to lose their balance when it is first applied to the work piece. This loss of balance can result in damage to the work piece and injuries to the worker.

Show the cadets the slide of each tool at Annex Q, as they are discussed.

Drill. If there were no restrictions on technician's space or movement, there would only need to be one type of drill. However, when working in and around aircraft, drill requirements become more complex, which has given rise to various types and shapes of drills, to include:

- electric,
- pneumatic,
- right angle,
- flexible drive right angle,
- flexible drive straight, and
- long drill bit.

The drills in Figure 17Q-1 look like dentists' tools because the functions are similar. Aircraft construction and maintenance has very confined, hard-to-reach spaces that need to be worked on and worked in.

Electric hand drills can perform a number of tasks. They can drill small round holes using drill bits and they can drill large round holes using hole saw bits. There are many specialty attachments, such as screwdriver bits and sanding disks.

Reciprocating Saw. A reciprocating saw is used to make rough cuts. Reciprocating saw blades are easily replaced. They come in a variety of grades for different materials and cutting speeds. When blades are worn, they are recycled appropriately and replaced.

Sander. A disk sander is used to trim curved cuts in sheet metal, wood or plastic after they have been rough cut. Disks for sanders are easily replaced and they come in a variety of grades and materials for different applications. When worn they are discarded.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Why are there many different styles of drills?

Q2. What is a reciprocating saw used for?

Q3. What materials can a disk sander be used for?

ANTICIPATED ANSWERS

A1. Drills have to be used in confined, hard-to-reach spaces.

A2. It is used to make rough cuts.

A3. A disk sander can be used on metal, wood or plastic.

Teaching Point 2	Describe the Characteristics and Methods of Application for Shop Equipment Used With Aircraft
Time: 5 min	Method: Interactive Lecture

Aircraft are characterized by smooth curved and rounded streamlined shapes intended to reduce turbulence and drag. To form the skin of the aircraft into these shapes, sheet metals must be formed very carefully. A number of tools have developed, which allow fast, accurate metal cutting and forming.

Sheet metal gauges are numbered so that the thicker materials have lower designation numbers. Therefore, 12 gauge metals are thicker than 24 gauge metals.

Show the cadets the slide of each tool at Annex R, as they are discussed.

FORMING TOOLS

Bar Folding Machine. A bar folding machine is used to bend the edges of relatively light sheet metal stock, up to 22 gauge thickness.

Cornice Brake. Cornice brakes, or leaf brakes as they are sometimes called, are used for bending sheet metal of a wide range of thicknesses, including heavier materials up to 12 gauge.

Slip Roll Former. A slip roll former is used to make gentle bends and to fabricate parts such as contoured fuselage skin.

COMPOUND CURVE TOOLS

Mechanical Compound Curve Tools. Large volumes of smaller compound curve components can be fabricated in a hydropress, which uses a rubber blanket and water pressure to form the component from a carefully shaped die.

Manual Compound Curve Tools. Sandbags and hammers are often used when only one compound curve component is to be formed.

CUTTING TOOLS

Squaring Shear. A squaring shear is used to make straight cuts across sheet metal.

Scroll Shear. Scroll shears are used to make irregular cuts on the inside of a sheet of metal without cutting through to the edge.

Band Saw. A band saw is used for cutting curved lines in metal, wood or plastic. The blade speed can be varied for each material.

Drill Press. A drill press is used to increase accuracy and straightness beyond what a hand-held drill can accomplish.

Lathe. A lathe is used for spinning objects so that they can be cut into a circular shape. A lathe makes circular objects in the way that a drill press makes circular holes.

Rotary Punch Press. A rotary punch press is used to punch holes or make circular cuts in metal parts.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What are scroll shears used for?

Q2. What is another name for a cornice break?

Q3. What are two tools used to make components with compound curves?

ANTICIPATED ANSWERS

A1. Scroll shears are used to make irregular cuts on the inside of a sheet of metal without cutting through to the edge.

A2. A cornice break is also called a leaf break.

A3. A hydropress or a sandbag and hammer can be used for compound curves.

Teaching Point 3	**Describe the Characteristics and Methods of Application for Fastening Tools and Associated Fasteners Used With Aircraft**
Time: 5 min	Method: Interactive Lecture

Show the cadets the slide of each tool at Annex S, as they are discussed.

FASTENING TOOLS

Rivet Gun. Most rivets in aircraft construction are driven by a rivet gun. This is because a rivet gun is fast and can get into tight spaces. However, a rivet gun does less perfect riveting than a compression riveting tool.

Lighter rivet guns are used for placing rivets with small diameter shanks and heavier rivet guns are used for rivets with large shanks.

Rivet Cutter. Rivet cutters have holes for common-size rivet shank diameters. If a rivet is too long for the intended application, the rivet cutter is used to shorten the shank length. To reduce stocking requirements, some shops only stock rivets with long shanks and then cut them to the desired length. A rivet cutter has holes for common shank diameters and leaves that can be selected for the desired shank length.

Bucking Bar. Bucking bars are placed against the opposite end of the rivet from the rivet gun or hammer during the riveting operation. The rivet is flattened between the bucking bar and the hammer or rivet gun. The bucking bar gets its name from the way it bucks, or jumps, on the end of the rivet. There are many shapes and sizes of bucking bars and one of the important challenges of this work begins with the careful selection of the correct bucking bar. It must clear the structure and yet fit perfectly squarely on the end of the rivet.

Squeezer. A squeezer, or compression riveter, is used in place of a rivet gun or hammer. The squeezer is fast and produces a more uniform riveting shape than either hammers or rivet guns, but a squeezer can only operate on easily accessible locations near the edge of the material.

ASSOCIATED FASTENERS

Rivet. Rivets have been used since sheet metal was first used in aircraft construction and they remain the single most common aircraft fastener. Rivets change in dimension to fill their hole during riveting. This makes for a very solid attachment. The rivet part number designation conveys much information, including the style of rivet head, the material it is made from, the shank diameter and the shank length.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What tool places most aircraft rivets?

Q2. What tool is fastest and produces the best rivet shapes?

Q3. How did the bucking bar get its name?

ANTICIPATED ANSWERS

A1. The rivet gun.

A2. The compression riveting tool, sometimes referred to as a squeezer.

A3. Bucking bars are called that because of the way they buck, or jump, during riveting.

Teaching Point 4	**Conduct a Tool Identification Activity**
Time: 10 min	Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to give the cadets an opportunity to test their knowledge of basic power tools used in aircraft manufacturing and maintenance.

RESOURCES

Pictures of shop tools located at Annexes Q to S, with titles blocked out (with sticky notes).

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into two teams on opposite sides of the room.
2. Display a picture of a shop tool.
3. Have one team attempt to identify the tool and its use in 10 seconds.
4. Award one point for the tool's name and another for the tool's use.
5. If the first team is unable to name the tool or its use, offer an opportunity to the second team.
6. Award two points for successful tool or application naming by the second team.
7. Alternate the successive pictures and opportunities between the two teams.
8. The team with the most points after 10 minutes is the winner.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 4

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in the tool identification activity will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Tools and equipment used in aircraft manufacturing and maintenance have developed over the years to increase the speed of the work to be done and to allow a more consistent product. The variety of these tools presents both a challenge and an opportunity to aviation technicians.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-136 (ISBN 0-88487-207-6) Sanderson Training Systems. (2001). *A&P Technician Airframe Textbook*. Englewood, CO: Jeppesen Sanderson Inc.

C3-137 (ISBN 0-88487-203-3) Sanderson Training Systems. (2000). *A&P Technician General Textbook*. Englewood, CO: Jeppesen Sanderson Inc.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 7

EO C370.04 – CONSTRUCT AN ALUMINUM MODEL BIPLANE

Total Time:	360 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

View reference C3-160 *Building the B.C. Air Originals Biplane* DVD.

Photocopy all templates and construct one set of wood jigs and wood templates located at Annex T for the cadets. Make Mylar templates of Figures 17T-1 and 17T-2. Using these templates and wood jigs, create parts for two aluminum model biplanes.

Assemble one aluminum model biplane for demonstration purposes, as shown at Annex AG.

Assemble one part for each assembly line.

Photocopy assembly line instructions at Annexes U to AF for each assembly line.

Photocopy one set of final assembly plans at Annex AG for each cadet.

Set up the classroom for the first set of assembly lines outlined in TP 1.

The workstations using power tools for cutting and tapering wood require supervisors.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

A practical activity was chosen for this lesson as it is an interactive way to introduce cadets to aluminum model biplane construction in a safe, controlled environment. This activity contributes to the development of these skills and knowledge in a fun and challenging setting.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have constructed an aluminum model biplane.

IMPORTANCE

It is important for cadets to construct an aluminum model biplane because it will allow them to learn about mass production. The aircraft manufacturing industry employs precision mass production techniques to produce modern aircraft.

Teaching Point 1	**Explain and Prepare Mass Production of Aluminum Model Biplane Parts**
Time: 70 min	Method: Practical Activity

Show the cadets a completed aluminum model biplane.

At the beginning of the 20th century, vehicles were produced one at a time in a manner that today would be called customized. An American named Ransome Eli Olds applied the idea of an assembly line to produce his 1901 Curved Dash Oldsmobile in greater numbers. Henry Ford then improved the assembly line so that his 1914 Model T Ford was assembled in 93 minutes, thus making it possible for the majority of people to afford an automobile.

The Wright brother’s 1903 Flyer was produced in a customized manner as well, but Olds’ methods were soon applied to aeronautical manufacture when the Wright Aircraft Company was formed in Dayton, Ohio in 1909. Although the mass market for aircraft was slower to grow than the market for automobiles, World War I prompted the United States government to order thousands of aircraft.

Mass production is not limited to large assemblies. It can also be applied to production of models.

Production of parts for the aluminum model biplane will be carried out using a simple assembly line. However, final assembly will be by customization so that each cadet can make a unique model using mass-produced parts.

Show the cadets the parts needed for one aluminum model biplane as well as the templates, tools and raw materials that will be used in mass production.

This EO is intended to introduce the cadets to the methods of mass production. All the parts for the aluminum model biplane will be fabricated by cadets working in assembly lines. However, this cannot be one big assembly line. There are more than 30 pieces, but because each part is very simple, the assembly lines are small and also simple. Some parts must be fabricated first, since other assemblies require them. To begin the process, start as many of the following 13 assembly lines as resources permit, providing work for each cadet:

- raw aluminum material assembly line (described at Annex U),
- wood assembly line (Annex V),
- aluminum billet assembly line (Annex W),
- aluminum panel shearing assembly line (Annex X) using billets from the previous line,
- cardboard insert assembly line (Annex Y),
- wire station assembly line (Annex Z), and
- drill station assembly line for bottle caps (Annex AA).

As soon as these assembly lines have produced materials for stock, the fuselage assembly line, the top wing assembly line, the empennage assembly line and the propeller assembly line can be formed to begin those processes.

Except for certain assembly lines, such as the Wood Assembly Line and the Drill Assembly Line, the cadets will be seated at their tables or desks within proximity of each other so that materials can be passed on for processing. For example, once a cadet with the template has marked an aluminum billet with the shape of the horizontal stabilizer, the billet must be passed on to the next cadet with scissors to be cut out. This is also the case with cardboard inserts. All such work takes place at a desk or table.

Beyond the initial start-up phase, timings for other assembly lines cannot be predicted since this depends on the speed at which individual lines work and the parts for aluminum model biplanes are made. As well, additional manpower may have to be provided for assembly lines that cannot keep up; any cadet can do this work but some cadets will be faster than others. The instructor is expected to balance manpower as work progresses.

To allow for spare parts, an additional 10 per cent of parts should be made above the amounts required. This is due to inevitable losses as a result of poor workmanship. Make enough parts so that each cadet can assemble at least one aluminum model biplane. If some cadets finish ahead of others, they can make additional models or be assigned to making additional parts for additional models.

ACTIVITY

Time: 65 min

OBJECTIVE

Two objectives of this activity are for the cadets in each work group to set up their work area and also for the cadets to learn to mass produce the parts for aluminum model biplanes.

RESOURCES

- Instructions for constructing an aluminum model biplane,
- Example parts for each assembly line,
- Templates for constructing aluminum model biplane parts,
- Mechanic's gloves,
- Aluminum cans (36 per cadet),
- Softwood, 20 mm thick (fence boards),
- Bottle caps (ten per cadet),
- Corrugated cardboard,
- Tape (masking),
- Glue (two-part epoxy),
- Poster board (thin cardboard not corrugated),
- Mylar,
- Copper-coated welding rod or music wire (two sizes 1/16 inch and 3/32 inch),
- Ball-peen hammer,
- Pliers,
- Flat screwdriver,
- Rasp,
- Hand stapler,
- Staple gun,
- Push-pin,
- Hot glue gun,
- Awl,
- Wire cutter,
- Box knife,
- Scissors,
- Ruler,
- Felt-tipped pen,
- Needle-nose pliers,
- Adjustable wrench,
- Electric hand drill, and
- Hole saw bits (2-3/4 inch and 1-7/8 inch).

ACTIVITY LAYOUT

- Arrange assembly lines as shown in the layout figures located at Annexes U to AA.

- Provide a shop environment for the wood assembly line.

ACTIVITY INSTRUCTIONS

1. Organize the cadets into the work groups described at Annexes U to AA, providing them with wood jigs and prefabricated wood templates constructed from the templates in reference C3-146, or those located at Annex T, as required.

2. Assembly line assignments include:
Raw Aluminum Material Assembly Line (Annex U)
Prepare aluminum billets from aluminum cans by:

   (a) washing the aluminum cans and removing the pull tabs;

   (b) removing the bottom from one can per biplane (parts B-1 to stock);

   (c) removing the bottom from one can per biplane leaving 2-inch tops (parts B-3 to stock); and

   (d) removing the top and bottom from fifteen cans per biplane (raw blanks to stock).
   Wood Assembly Line (Annex V)
   Produce wood rounds for aluminum model biplane fuselages by:

      (a) cutting 3/4 inch thick rounds (2-3/4 inch and 1-7/8 inch diameters); and

      (b) tapering wood rounds 10 degrees to create F-1 and F-2.
   Aluminum Billet Assembly Line (Annex W)
   Cut cans vertically on the nutrition label (blanks).
   Aluminum Panel Shearing Assembly Line (Annex X)
   Using raw aluminum billets from stock, fabricate the following parts:

      (a) aluminum panels (dimensions 2-5/8 inch by 8-1/8 inch) for under-wing panels, and

      (b) aluminum panels (dimensions 3-5/8 inch by 8-1/8 inch) for wing panels bent 90 degrees on the1/8 inch edge.
   Cardboard Insert Assembly Line (Annex Y)
   Fabricate the following parts from corrugated cardboard sheets:

      (a) cardboard inserts for Bottom Wing (BWC) 7-1/4 inch by 2-5/8 inch,

      (b) cardboard inserts for Bottom Wing (BWAS) 6-1/2 inch by 3/4 inch,

      (c) cardboard inserts for Top Wing (TWC) 18-1/4 inch by 2-3/4 inch,

      (d) cardboard inserts for Top Wing (TWAS) 18-1/4 inch by 3/4 inch,

      (e) cardboard inserts for Horizontal Stabilizer (HS) from Template No. 8, and

      (f) cardboard inserts for Vertical Stabilizers (VS) from Templates No. 9/10.
   Wire Station Assembly Line (Annex Z)
   Fabricate the following parts from wire stock:

      (a) 3/32-inch welding rods 7-3/4 inches long and bend landing gear wire,

      (b) 1/16-inch welding rods 6-3/4 inches and bend landing gear support wire,

      (c) 3/32-inch wire 15-3/4 inches long for wing spars, and

      (d) 3/32-inch wire 18 inches long for propeller shaft.
   Drill Station Assembly Line (Annex AA)
   Perform the following operations:

(a) Drill a 3/32-inch hole in the centre of bottle caps for wheels.

(b) Drill a 3/32-inch hole in the centre of can B-1 for front fuselage.

(c) Drill a 3/32-inch hole in the centre of can P-2 for propeller.

(d) Drill a 3/32-inch hole in the centre of can P-1 for propeller face.

(e) Enlarge holes A, B and C in fuselage assembly to 3/32 inch.

(f) Enlarge hole D in fuselage assembly to 1/16 inch.

(g) Enlarge holes E and F in fuselage assembly to 10-24 bolt size, as required.

(h) Enlarge eight bolt holes in top wing for 10-24 bolts as required.

(i) Enlarge four bolt holes for 10-24 bolts in bottom wing as required.

3. Inform the cadets that they will be rotated among the workstations.

4. Assign the cadets to workstations.

5. Have each work group produce units for prototype assembly as well as stock for assembly line start-up in subsequent mass production sessions.

6. When sufficient parts have been fabricated for building more than two aluminum model biplanes, halt production and, as a demonstration in front of the class, assemble a prototype aluminum model biplane by combining the fuselage, upper wing and empennage. Do not attach propeller or landing gear at this stage.

SAFETY

- Supervised assembly lines, including the hole-saw station and the rasp station, will be used by one cadet at a time. Each of the supervised stations, using electric power tools, must be constantly supervised.
- Before beginning, ensure each cadet can perform the activity safely.
- Cadets shall wear mechanic's gloves while working with sharp materials.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 2	**Demonstrate, Explain and Have the Cadets Manufacture the Parts for Aluminum Model Biplanes**
Time: 120 min	Method: Practical Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets experience mass production of various aluminum model biplane parts at a variety of workstations.

RESOURCES

- Instructions for constructing an aluminum model biplane,

- Templates for constructing aluminum model biplane parts,
- Mechanic's gloves (one pair per cadet),
- Empty aluminum beverage cans (36 per cadet),
- Bottle caps (ten per cadet),
- Corrugated cardboard,
- Tape,
- Glue (two-part epoxy),
- Poster board (thin cardboard not corrugated),
- Mylar,
- Copper-coated welding rod or music wire (two sizes 1/16 inch and 3/32 inch),
- Ball-peen hammer,
- Pliers,
- Flat screwdriver,
- Hand stapler,
- Staple gun,
- Push-pin,
- Hot glue gun,
- Awl,
- Wire cutters,
- Box knife,
- Scissors,
- Ruler,
- Felt-tipped pen,
- Needle-nose pliers,
- Adjustable wrench,
- Electric hand drill, and
- Hole saw bits (2-3/4 inch and 1-7/8 inch).

ACTIVITY LAYOUT

A classroom with desks or tables for work groups with assignments.

Assembly lines can be combined to work together if space and manpower permit. Lines should be selected and set up based on resources such as cadet manpower, working area and also manufactured parts that are available from previous work sessions. For example, the Top Wing assembly line cannot begin without the aluminum panels and cardboard panels provided by previous assembly lines. However, the Top Wing Assembly Line (Annex AD) can operate concurrently with the Aluminum Panel Shearing Assembly Line (Annex X) and the Cardboard Insert Assembly Line (Annex Y) if space and manpower permit.

ACTIVITY INSTRUCTIONS

1. Assign cadets to workstations.

2. In addition to the work groups and assembly lines already used, if still required, the following work groups and assembly lines will be established as manpower becomes available:
Aluminum Rear Fuselage Assembly Line (Annex AB)
Fabricate the rear fuselage from the following parts:

   (a) raw billets from scissor station,

   (b) softwood parts F-1 from stock,

   (c) softwood parts F-2 from stock, and

   (d) fabricated rear fuselages from assembly stations 1–6.

   Fuselage and Bottom Wing Assembly Line (Annex AC)
   Combine parts B-1, B-2, wood rounds and staples to make fuselages and bottom wings.
   Top Wing Assembly Line (Annex AD)
   To fabricate top wings:

   (a) combine cardboard parts TWC, TWAS and three pre-bent aluminum panels dimensions of 3-5/8 inch by 8-1/8 inch to form top wing (all from stock);

   (b) insert panels (dimensions of 2-5/8 inch by 8-1/8 inch) under wing (from stock);

   (c) staple top wing (ten staples); and

   (d) apply Wing Bolt Hole Placement Template (WBHPT) to top of top wing and with a push-pin, make eight holes for bolts in the top wing (top wing to stock).

   Empennage Assembly Line (Annex AE)
   Fabricate the empennage by combining the following parts:

   (a) aluminum horizontal stabilizer – Bottom,

   (b) aluminum horizontal stabilizer – Top Right,

   (c) aluminum horizontal stabilizer – Top Left,

   (d) cardboard insert HS – Horizontal Stabilizer, and

   (e) cardboard insert VS – Vertical Stabilizer.

   Propeller Assembly Line (Annex AF)
   Fabricate the fan propeller by combining the following parts:

   (a) aluminum propeller, and

   (b) aluminum propeller cover.

3. Inform each work group of the number of parts they will make.

4. As each work group completes fabrication of a particular part, have the cadets produce other parts until all parts required are in stock.

5. Ensure that each cadet fabricates a variety of parts.

SAFETY

- Supervised assembly lines, including the hole-saw station and the rasp station, will be used by one cadet at a time. Each of the supervised stations, using electric power tools, must be constantly supervised.

- Before beginning, ensure each cadet can perform the activity safely.
- Cadets shall wear mechanic's gloves while working with sharp materials.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 3 — **Demonstrate, Explain and Have the Cadet Construct an Aluminum Model Biplane**

Time: 150 min — Method: Practical Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadet assemble an aluminum model biplane.

RESOURCES

- One complete set of parts for one aluminum model biplane per cadet,
- Instructions for assembling an aluminum model biplane parts located at Annex AG,
- Tape (masking),
- Glue, and
- Tools, to include:
  - ball-peen hammer,
  - pliers,
  - flat screwdriver,
  - hand stapler,
  - staple gun,
  - glue gun,
  - awl,
  - wire cutters,
  - box knife,
  - scissors,
  - ruler,
  - felt-tipped pen,
  - needle-nose pliers, and
  - adjustable wrench.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into groups of four.
2. Demonstrate the assembly of the aluminum model biplane.
3. Ensure that every cadet is ready to proceed before moving to the next step in the assembly.
4. Assist each cadet with installation of landing gear to prevent tearing the aluminum fuselage.

SAFETY

Cadets shall wear mechanic's gloves while working with sharp material.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in aluminum model biplane parts fabrication and aluminum model biplane assembly will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Construction of an aluminum model biplane using mass production of parts demonstrates one of the ways that society produces large volumes of equipment, including increasingly complex aircraft.

INSTRUCTOR NOTES/REMARKS

Templates, models and spare parts should be preserved for future training years.

Scheduling this lesson as a weekend activity will reduce preparation and cleanup.

Before beginning the instruction of this EO the instructor shall be familiar with the aluminum model biplane assembly techniques shown at references C3-146 and C3-160.

This lesson may be conducted over a number of separate sessions.

REFERENCES

C3-146 Mathis, D. P. (2005). *Step by Step Construction Plans: Classic Biplane*. Helena, MT: BC Air Originals.

C3-160 Mathis, D. P. (2007). *Building the B.C. Air Originals Biplane*. Helena, MT: B.C. Air Originals.

PITOT STATIC SYSTEM AND TUBES

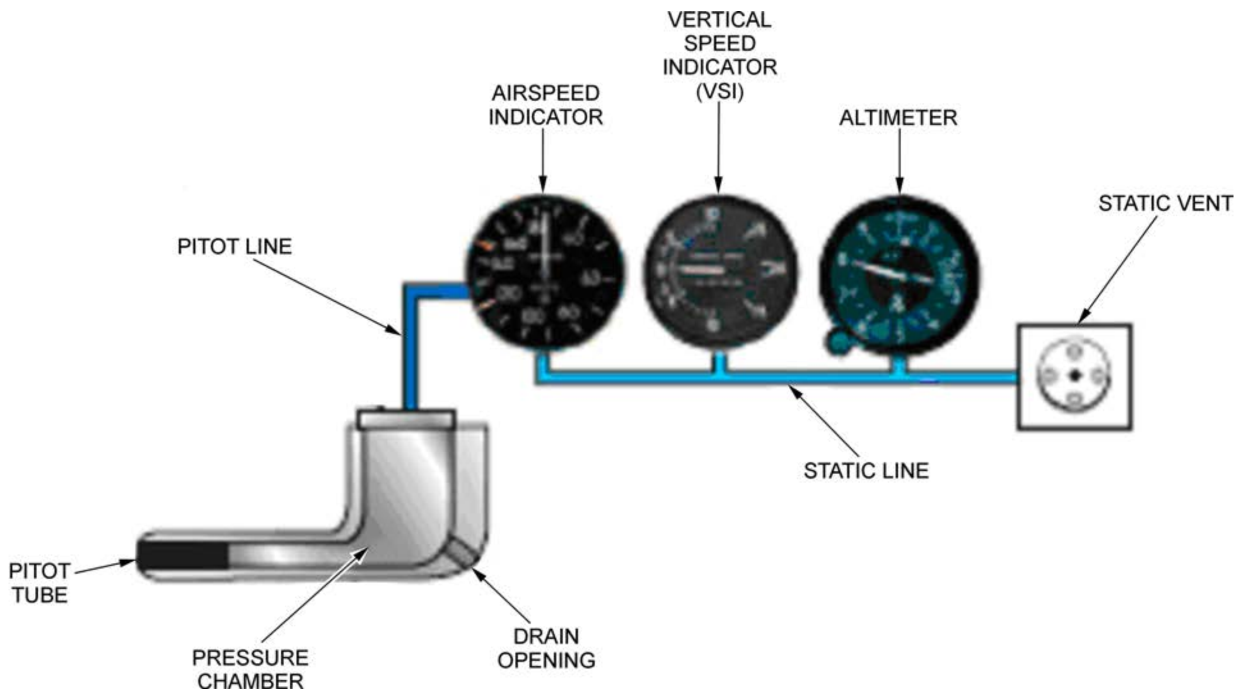

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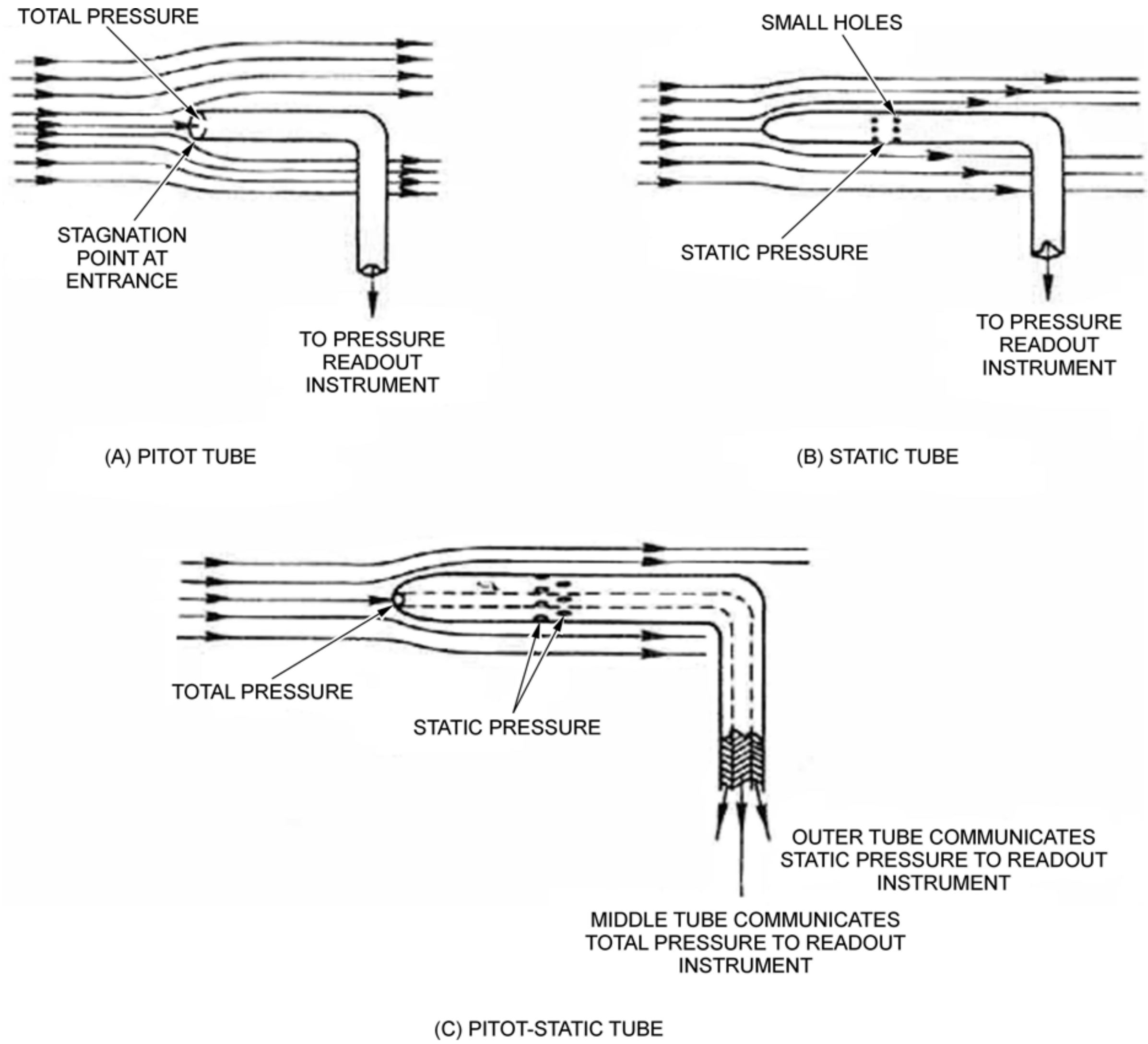
Figure 17A-1 The Pitot Static System



NASA SP-367 Introduction to the Aerodynamics of Flight by T. A. Talay (1975), "Ideal Fluid Flow". Retrieved March 6, 2008, from http://history.nasa.gov/SP-367/chapt3.htm#f27

Figure 17A-2 Pitot Tubes, Static Tubes and Pitot Static Tubes

INDICATORS

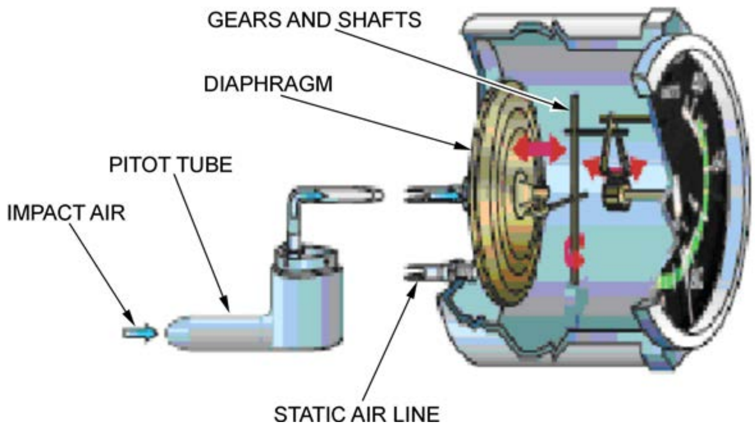


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Figure 17B-1 Airspeed Indicator

North American Powered Parachute Federation, "Flight Instruments". Retrieved October 30, 2007, from http://www.nappf.com/nappf_flight_instruments.htm

Figure 17B-2 Airspeed Indicator Face

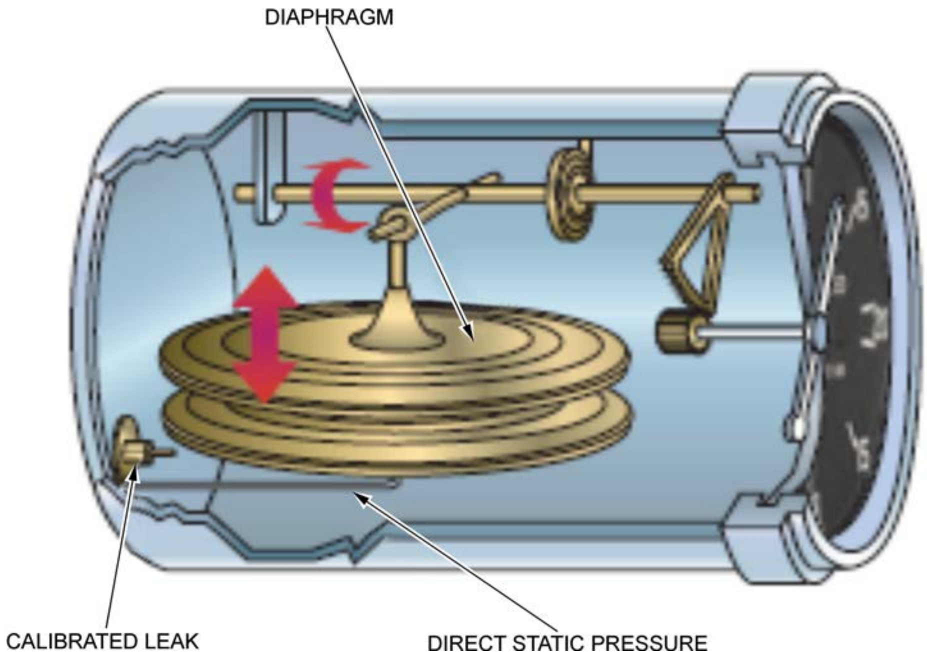

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Figure 17B-3 Vertical Speed Indicator Parts

North American Powered Parachute Federation, "Flight Instruments". Retrieved October 30, 2007, from http://www.nappf.com/nappf_flight_instruments.htm

Figure 17B-4 Vertical Speed Indicator Face

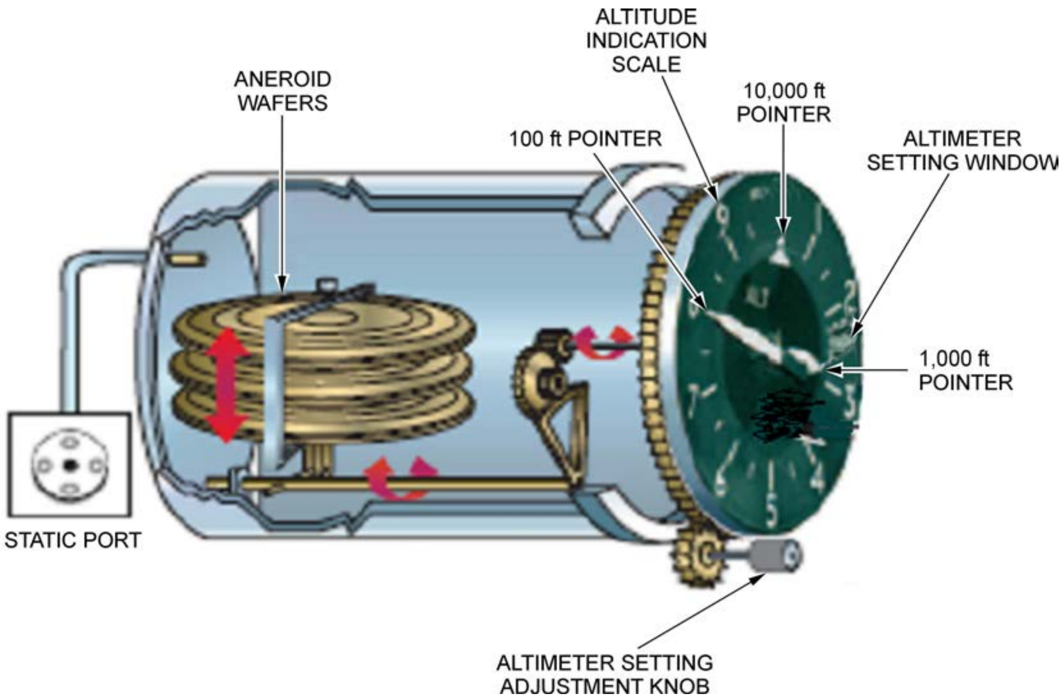

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Figure 17B-5 Altimeter Parts

North American Powered Parachute Federation, "Flight Instruments". Retrieved October 30, 2007, from http://www.nappf.com/nappf_flight_instruments.htm

Figure 17B-6 Altimeter Face

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TYPES OF CESSNA AIRCRAFT

Cessna NGP
Cessna CH-1 Helicopter
Cessna A
Cessna BA
Cessna AW
Cessna AT-17 Bobcat
Cessna C-34 Airmaster
Cessna T-37
Cessna 120
Cessna 140
Cessna 150 Commuter, Patroller & Aerobat
Cessna 152
Cessna 160
Cessna 162 Skycatcher
Cessna 165 Airmaster
Cessna 170
Cessna 172 Skyhawk, T-41 Mescalero
Cessna 175 Skylark
Cessna 177 Cardinal
Cessna 180 Skywagon
Cessna 182 Skylane
Cessna 185 Skywagon
Cessna 187
Cessna 188 AGwagon, AGpickup, AGtruck, and AGhusky
Cessna 190
Cessna 195
Cessna 205 Super Skywagon
Cessna 206 Stationair & Super Skylane
Cessna 207 Skywagon, Stationair 7 & 8
Cessna 208 Caravan
Cessna 210 Centurion
Cessna 303
Cessna 305 Bird Dog
Cessna 310
Cessna 320 Skynight
Cessna 335
Cessna 336 Skymaster, O-2 Skymaster
Cessna 337 Skymaster
Cessna 340
Cessna 350 formerly the Columbia 350
Cessna 400 formerly the Columbia 400
Cessna 401 Utiliner and Businessliner
Cessna 402 Utiliner and Businessliner
Cessna 404 Titan II
Cessna 406 Caravan II
Cessna 411
Cessna 414 Chancellor
Cessna 421 Golden Eagle
Cessna 425 Conquest I
Cessna 441 Conquest II
Cessna 500 Citation I
Cessna 501 Citation ISP
Cessna 510 Citation Mustang
Cessna 525 Citation Jet, CJ1, CJ1+
Cessna 525A CJ2, CJ2+
Cessna 525B CJ3
Cessna 550 Citation II, Cessna Citation Bravo
Cessna 551 Citation IISP
Cessna S550 Citation SII
Cessna 560 Citation V, Citation Ultra, Citation Encore, Citation Encore+
Cessna Citation 560XL Excel, XLS, XLS+
Cessna 620
Cessna 650 Citation III, Citation VI, Citation VII
Cessna 680 Citation Sovereign
Cessna 750 Citation X
Cessna 850 Citation Columbus

Wikimedia Commons by Adrian Pingstone, 2005, “Cessna 172G”. Retrieved March 10, 2008, from http://en.wikipedia.org/wiki/Image:Cessna.f172g.g-bgmp.arp.jpg

Figure 17C-1 Cessna 172 Skyhawk

Cessna.com: Our Aircraft, 2008, "Amphibian Cessna Caravan". Retrieved March 16, 2008, from http://caravanamphib.cessna.com/#

Figure 17C-2 Cessna 208 Caravan Amphibian

Wikimedia Commons by Adrian Pingstone, 2005, "Cessna 404". Retrieved March 10, 2008, from http://en.wikipedia.org/wiki/Cessna_404

Figure 17C-3 Cessna 404 Titan II

Cessna emedia, 2008, "Citation image gallery". Retrieved March 16, 2008, from http://cessna.com/news/gallery/index.php?model=mustang

Figure 17C-4 Cessna 510 Citation Mustang

RCA OPS (PAC), 2005, "Aircraft operating instructions Cessna 305 aircraft". Retrieved March 16, 2008, from http://www.regions.cadets.forces.gc.ca/pac/rgs/doc/L19%20AOIs%201%20Jun%2006%20-%20Complete%20version.pdf

Figure 17C-5 Cessna 305 (L-19 Bird Dog)

DIAMOND

Diamond Aircraft: The Ultimate Fleet, 2008, "DA20 Eclipse". Retrieved March 16, 2008, from http://www.diamondair.com/aircraft.php

Figure 17D-1 Diamond DA20 Eclipse

Diamond Aircraft: The Ultimate Fleet, 2008, “DA42 Twin”. Retrieved March 16, 2008, from http://www.diamondair.com/aircraft.php

Figure 17D-2 Diamond DA42 Twin Star

Diamond Aircraft D-Jet, 2006, "D-Jet: The features". Retrieved March 16, 2008 from http://www.diamond-air.at/fileadmin/uploads/files/productfacts/d-jet/D_JETbrochure.pdf

Figure 17D-3 Diamond D-Jet

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PIPER

Piper Aircraft Inc., 2008, "Piper freedom of flight: Heritage" at website
Retrieved March 16, 2008, from http://www.piper.com/company/heritage.asp

Figure 17E-1 Forerunner of the Piper Cub

Controller, "1979 Piper Aztec F", Copyright 2008 by Sandhills Publishing Company. Retrieved March 16, 2008, from http://www.controller.com/listings/aircraft-for-sale/PIPER-AZTEC-F/1979-PIPER-AZTEC-F/1126249.htm?guid=450D7ACC60104829A0081C4C7E88EFED

Figure 17E-2 Piper Aztek on Final

Piper Freedom of Flight "Piper unveils the revolutionary piperjet" Retrieved March 12, 2008, from http://www.prnewswire.com/mnr/carlisle/25816/

Figure 17E-3 Piper Jet

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VIKING AIR (DE HAVILLAND ORIGINAL PRODUCTS)

"Canada's Air Force", Image Gallery photo search (2007). Retrieved March 8, 2008, from http://www.airforce.forces.gc.ca/site/imagery/search_e.asp

Figure 17F-1 de Havilland DHC-6 Twin Otter (CC-138 Twin Otter)

Viking Air A New Beginning for a Canadian Legend, 2008, DHC-2T Turbo Beaver. Retrieved March 16, 2008, from http://www.vikingair.com/content.aspx?id=270#

Figure 17F-2 de Havilland DHC-2T Turbo Beaver

"Canada's Air Force", Image Gallery photo search (2007). Retrieved March 8, 2008, from http://www.airforce.forces.gc.ca/site/imagery/search_e.asp

Figure 17F-3 de Havilland DHC 5 Buffalo (CC-115 Buffalo)

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AIRBUS

Wikimedia Commons by Adrian Pingstone, 2005, "Airbus A300B4-603". Retrieved March 10, 2008, from http://en.wikipedia.org/wiki/Image:Luft.a300b4.d-aias.750pix..jpg

Figure 17G-1 Airbus A300

Wikimedia Commons by Adrian Pingstone, 2005, "Airbus A310-200". Retrieved March 10, 2008, from http://en.wikipedia.org/wiki/Image:Fedex.a310-200.n420fe.arp.jpg

Figure 17G-2 Airbus A310

Air Canada: Our Fleet, 2007, "Airbus A320-200 (320)". Retrieved March 16, 2008, from http://www.aircanada.com/en/about/fleet/a320-200xm.html

Figure 17G-3 Airbus A320

Air Canada: Our Fleet, 2007, "Airbus A330-300 (333)". Retrieved March 16, 2008, from http://www.aircanada.com/en/about/fleet/a330-300.html

Figure 17G-4 Airbus A330

Air Canada: Our Fleet, 2007, "Airbus A340-300 (343)". Retrieved March 16, 2008, from http://www.aircanada.com/en/about/fleet/a340-300.html

Figure 17G-5 Airbus A340

Airbus Multimedia Library Images, 2007, "The A380". Retrieved March 16, 2008, from http://www.airbus.com/store/photolibrary/AIRCRAFT/AIRBUS/A380/att00009804/media_object_image_lowres_A380_touchdown

Figure 17G-6 Airbus A380

THE BOEING COMPANY

Boeing Commercial Airplanes: Out of Production, "707". Copyright 2008. Retrieved March 16, 2008, from http://www.boeing.com/commercial/gallery/707-04.html

Figure 17H-1 Dash-80 First Boeing 707

Air Canada: Historical Fleet, 2007, "737-200". Retrieved March 16, 2008, from http://www.aircanada.com/shared/images/common/fleet/pictures/737b.jpg

Figure 17H-2 Boeing 737

Air Canada: Historical Fleet, 2007, "747-400". Retrieved March 16, 2008, from http://www.aircanada.com/shared/images/common/fleet/pictures/747combi.jpg

Figure 17H-3 Boeing 747

Air Canada: Our Fleet, 2007, “767-300”. Retrieved March 16, 2008, from http://www.aircanada.com/en/about/fleet/b767-300er.html

Figure 17H-4 Boeing 767

Air Canada: Our Fleet, 2007, "777-300ER". Retrieved March 16, 2008, from http://www.aircanada.com/en/about/fleet/77W.html

Figure 17H-5 Boeing 777

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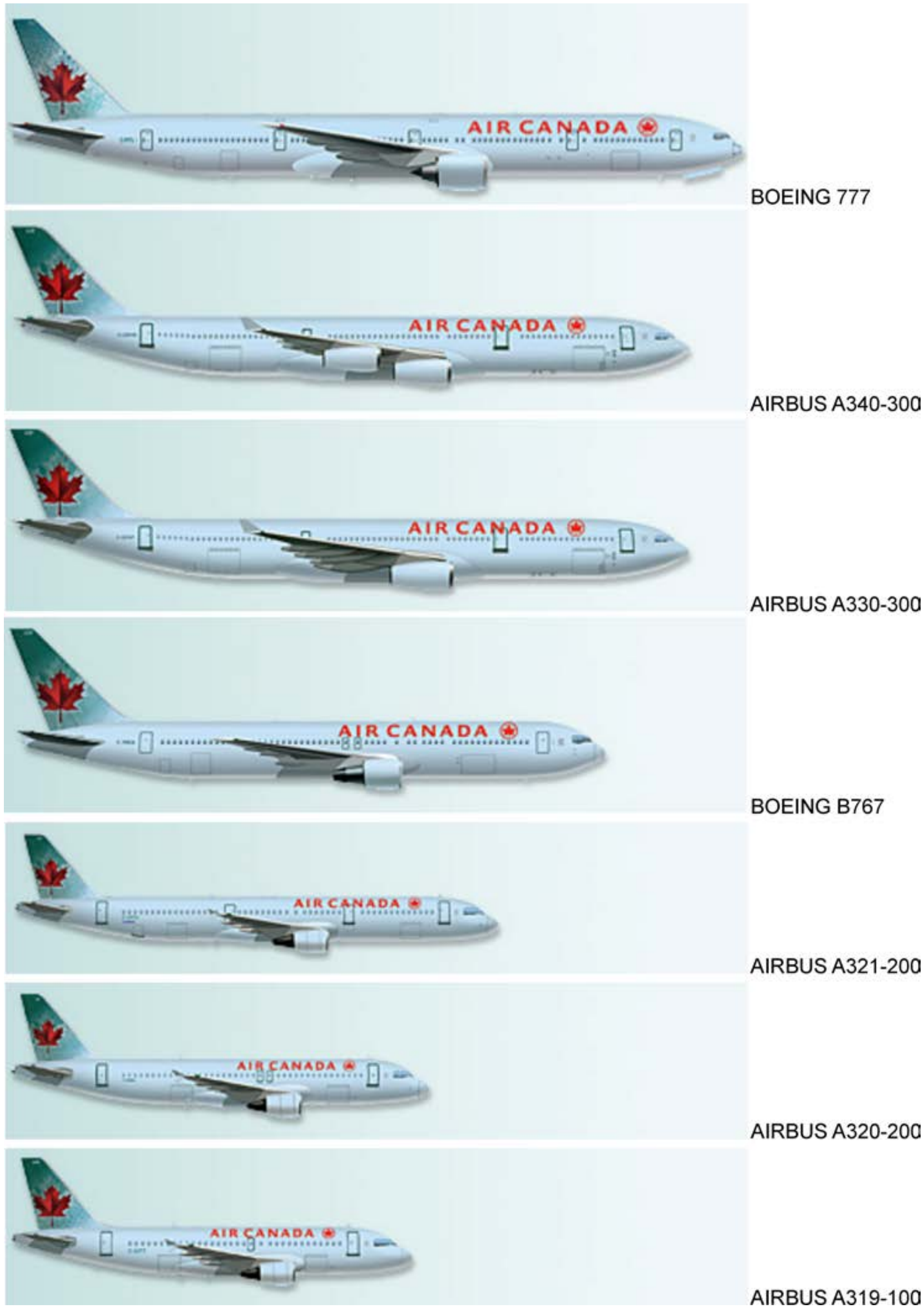
AIR CANADA'S FLEET



Air Canada, 2008, "Our Fleet". Retrieved March 16, 2008, from http://www.aircanada.com/en/about/fleet/

Figure 17I-1 Air Canada Fleet Comparison

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SKYHAWK CHECKLIST

Cessna 172 Preflight

Preflight Inspection Cockpit

Aircraft docs (ARROW)	Check
Weight & Balance	Check
Parking Brake	Set
Control wheel lock	Remove
Hobbs/Tach	Check/Remove
Ignition	Off
Avionics Power Switch	Off
Master Switch	On
Fuel quantity indicators	Check
Pitot Heat	On
Avionics Master Switch	On
Avionics Cooling Fan	Audible
Avionics Master Switch	Off
Static Pressure Alt Src Valve	Off
Annunciator Panel Switch	Test
Annunciator's Illuminate	Check
Annunciator Panel Switch	Off
Flaps	Extend
Pitot Heat	Off
Master Switch	Off
Pitot Tube	Test for Heat
Fuel shutoff valve	On (In)

Fuselage and Empenage

Baggage Door	Closed & Locked
Rivets	Check
Rudder Gust Lock	Remove
Tail Tie-Down	Disconnect
Control surfaces	Free & Secure
Trim Tab	Check Security
Antennas	Check Security

Right wing

Wing tie-down	Disconnect
Aileron	Free and Secure
Flaps	Secure
Main wheel tire	Inflated/Cond
Brakes	Not Leaking
Fuel tank sump	Sample
Fuel Quantity	Check
Fuel Filler cap	Secure

Nose

Engine oil level	Check
Fuel strainer	Sample
Propeller and spinner	Check
Alternator belt	Check
Air intake	Check
Carburetor air filter	Check
Landing lights	Check
Nose wheel strut & tire	Check
Nose-Tie down	Disconnect
Static source opening	Check

Left Wing

Wing tie-down	Disconnect
Aileron	Free and Secure
Flaps	Secure
Main wheel tire	Inflated/Cond
Brakes	Not Leaking
Fuel tank vent open	Check
Fuel tank sump	Sample
Fuel Quantity	Check
Fuel Filler cap	Secure
Pitot tube	Uncover and Check
Stall warning	Check
Landing/Taxi Light(s)	Clean/Cond

Before starting engine

Preflight inspection	Complete
Passenger Briefing	Complete
Seats, belts	Adjust & Lock
Doors	Closed & Locked
Brakes	Test & Set
Circuit breakers	Check In
Electrical Equip/Autopilot	Off
Avionics Power Switch	Off
Fuel Selector Valve	Both
Fuel shutoff valve	On (In)

Starting Engine

Throttle	Open 1/4 inch
Mixture	Rich (IN)
Carb heat	Cold (IN)
Prime	As required; locked
Aux Fuel Pump	On
Propeller area	Clear
Master Switch	On
Beacon	On
Ignition	Start
Throttle	Adjust 1000 rpm
Oil Pressure	Check normal
Aux Fuel Pump	Off
Avionics Master Switch	On
Radios	On

Cessna 172 In Flight

Transponder	Standby
Flaps	Up
Ammeter	Check
Heading Indicator	Set
ATIS/AWOS/ASOS	Obtain
Altimeter	Set
Autopilot	Engage
Flight Controls	Move Against AP
Autopilot	Disconnect (Sound)
Departure &Taxi Clrnce	Contact

Before Takeoff

Parking brake	Set
Cabin doors	Closed & Locked
Seats, belts	Adjust & Lock
Flight controls	Free & Correct
Instruments (4)	Set
Fuel Quantity	Check
Fuel Shutoff Valve	On
Mixture	Rich (IN)
Fuel Selector Valve	Both
Elevator Trim	Set for TAKEOFF
Throttle	1800 rpm
Magnetos	Check
Suction gage	Check
Engine Instruments	Check
Ammeter	Check
Mixture	Set for Density Alt
Carb heat	On
Annunciator Panel	Clear
Throttle	1000 rpm
Throttle Friction Lock	Adjust
Strobe Lights	On
Radios/Avionics	Set
Autopilot	Off
Flaps	Set for Takeoff (0°-10°)
Parking Brake	Release
Windows	Closed

Takeoff

Flaps	Up
Carb heat	Cold (In)
Transponder	Altitude
Trim	set for TAKEOFF
Throttle	Full
Tach, oil, airspeed	Check
Elevator	Lift at 55 KIAS
Climb	70-80 KIAS

Cruise

Pitch	Set
Throttle	As required
Trim	Set
Mixture	Adjust

Pre-landing checklist

Fuel selector	On
Mixture	Rich
Carb Heat	On
Seatbelts	Fastened

Approach

Flight instruments	Ckd & Set
Radios	Checked
ATIS	Checked
Carb Heat	On (Out)
Mixture	Rich
Landing light	On
Airspeed	65-75 KIAS (Flaps Up) 60-70 KIAS (Flaps Dn)

After landing

Flaps	Up
Carb Heat	Cold (In)
Transponder	Standby
Landing light	Off

Parking

Avionics	Off
Electrical	Off
Throttle	1000 RPM
Mixture	Cut-off
Ignition switch	Off
Master switch	Off

Securing the aircraft

Control Lock	Install
Hobbs/Tach	Record
Door/Window	Secure
Tie-downs	Secure

Comm Freq

ATIS	
Ground	
Tower	
Club	
Fuel	

International Flying Club, 2005, "Cessna 172 Preflight Cessna 172 In Flight". Retrieved March 17, 2008, from http://www.internationalflyingclub.org/docs/c172-chklist.pdf

Figure 17J-1 Skyhawk Checklist

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ELEMENTARY WORK TASK LISTINGS FROM STANDARD 625 APPENDIX A – ELEMENTARY WORK, CANADIAN AVIATION REGULATIONS PART VI – GENERAL OPERATING AND FLIGHT RULES

1. fabric patches measuring not more than 15 cm (6 in) in any direction and not requiring rib stitching or the removal of control surfaces or structural parts, on small privately operated aircraft;
2. removal and replacement of tires, wheels, landing skids or skid shoes, not requiring separation of any hydraulic lines, on small privately operated aircraft;
3. removal and replacement of skis on fixed landing gear, not requiring separation of any hydraulic lines, on small privately operated aircraft;
4. repair of non-structural fairings, cover plates and cowlings, on small privately operated aircraft;
5. cleaning and replacement of spark plugs, on small privately operated aircraft;
6. checking of cylinder compression, on small privately operated aircraft;
7. cleaning or changing of fuel, oil, and air filters, on small privately operated aircraft;
8. draining and replenishing engine oil, on small privately operated aircraft;
9. checking the electrolyte level and specific gravity of lead acid batteries, on small privately operated aircraft;
10. adjustment of generator or alternator drive belt tension, on small privately operated aircraft;
11. cleaning of balloon burner nozzles;
12. removal and replacement of balloon baskets, burners and gas tanks that are designed for rapid change in service;
13. removal and replacement of glider wings and tail surfaces that are designed for quick assembly;
14. repair of upholstery, trim and cabin furnishings;
15. removal and replacement of role equipment designed for rapid removal and replacement;
16. removal and replacement of passenger seat belts and harnesses;
17. removal and replacement of fuses, light bulbs and reflectors;
18. removal and replacement of avionics components that are rack mounted or otherwise designed for rapid removal and replacement, where the work does not require testing other than an operational check;
19. removal and replacement of aircraft batteries;
20. removal and replacement of co-pilot control levers, wheels, pedals and pedal guard plates that are designed for rapid removal and replacement, on other than transport category aircraft;
21. opening and closing of non-structural access panels;
22. removal and replacement of cabin doors on unpressurized aircraft, where the door is designed for rapid removal and replacement;
23. removal, replacement and repositioning of non structural partitions in the passenger cabin;
24. inspection and continuity checking of self-sealing chip detectors;
25. removal and replacement of induction system anti-icing baffles, scoops and deflectors that are designed for rapid removal and replacement;

26. removal, cleaning, replacement and adjustment of external components of chemical dispersal systems that are designed for rapid removal and replacement;

27. deactivating or securing inoperative systems in accordance with sections 605.09 or 605.10 of the CARs, including the installation of devices specifically intended for system deactivation, where the work does not involve disassembly, the installation of parts, or testing other than operational checks;

28. checking and adjusting air pressure in helicopter floats, and aircraft tires having an operating pressure below 100 psi, except on aircraft operated under CAR 704 and CAR 705; and

29. repetitive visual inspections or operational checks (including inspections and tests required by airworthiness directives) not involving disassembly or the use of visual aids, performed out of phase with the aircraft's scheduled check cycle at intervals of less than 100 hours air time, provided the tasks are also included in the most frequent scheduled maintenance check.

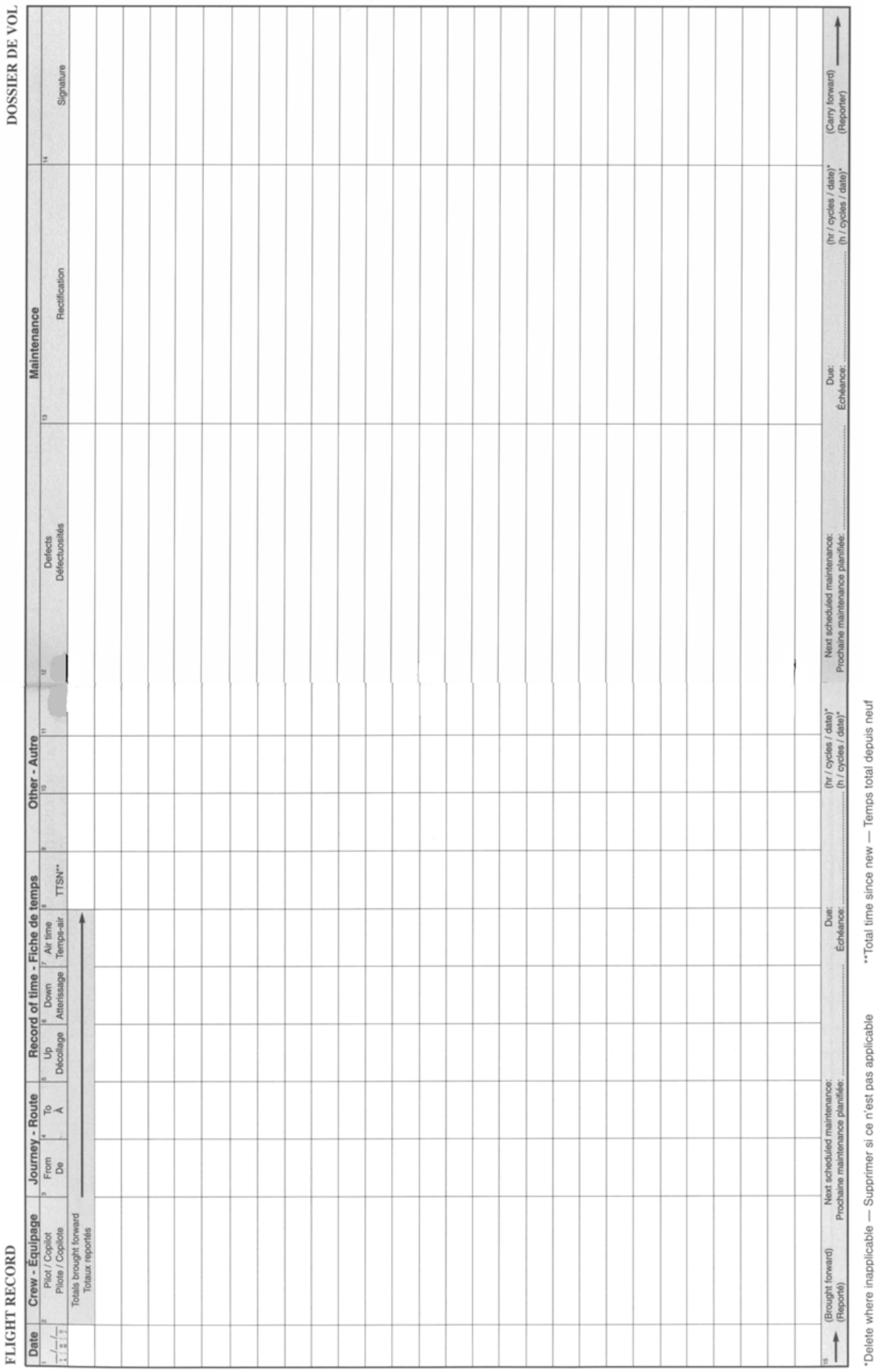
JOURNEY LOG FLIGHT RECORD

Section 1: Record of maintenance and elementary work 1

Date / /	Total air time	Total landings/cycle	Details of task	Signature	AME or AMO/ACA

Transport Canada, Airframe Log, Minister of Transport (p. 1)

Figure 17L-1 Airframe Logbook Page 1



FLIGHT RECORD | DOSSIER DE VOL

Date	Crew - Équipage	Journey - Route		Record of time - Fiche de temps				Other - Autre			Maintenance		
1	2 Pilot / Copilot Pilote / Copilote	3 From De	4 To À	5 Up Décollage	6 Down Atterrissage	7 Air time Temps-air	8 TTSN**	9	10	11	12 Defects Défectuosités	13 Rectification	14 Signature
	Totals brought forward Totaux reportés												

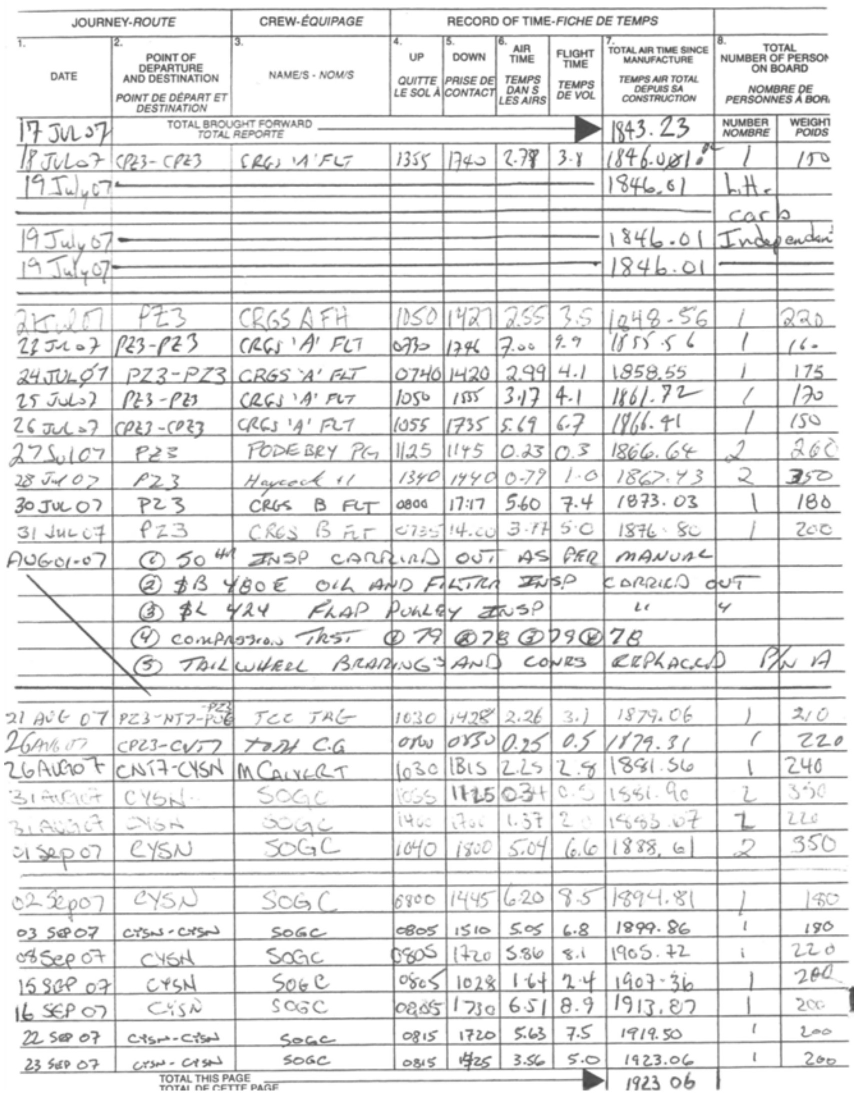
15 (Brought forward) (Reporté) Next scheduled maintenance: Prochaine maintenance planifiée: Due: Échéance: (hr / cycles / date)* (h / cycles / date)* Next scheduled maintenance: Prochaine maintenance planifiée: Due: Échéance: (hr / cycles / date)* (h / cycles / date)* (Carry forward) (Reporter)

*Delete where inapplicable — Supprimer si ce n'est pas applicable **Total time since new — Temps total depuis neuf

Transport Canada, Aircraft Journey Log, Minister of Transport (p. 1)

Figure 17L-2 Journey Logbook Flight Record Page 2

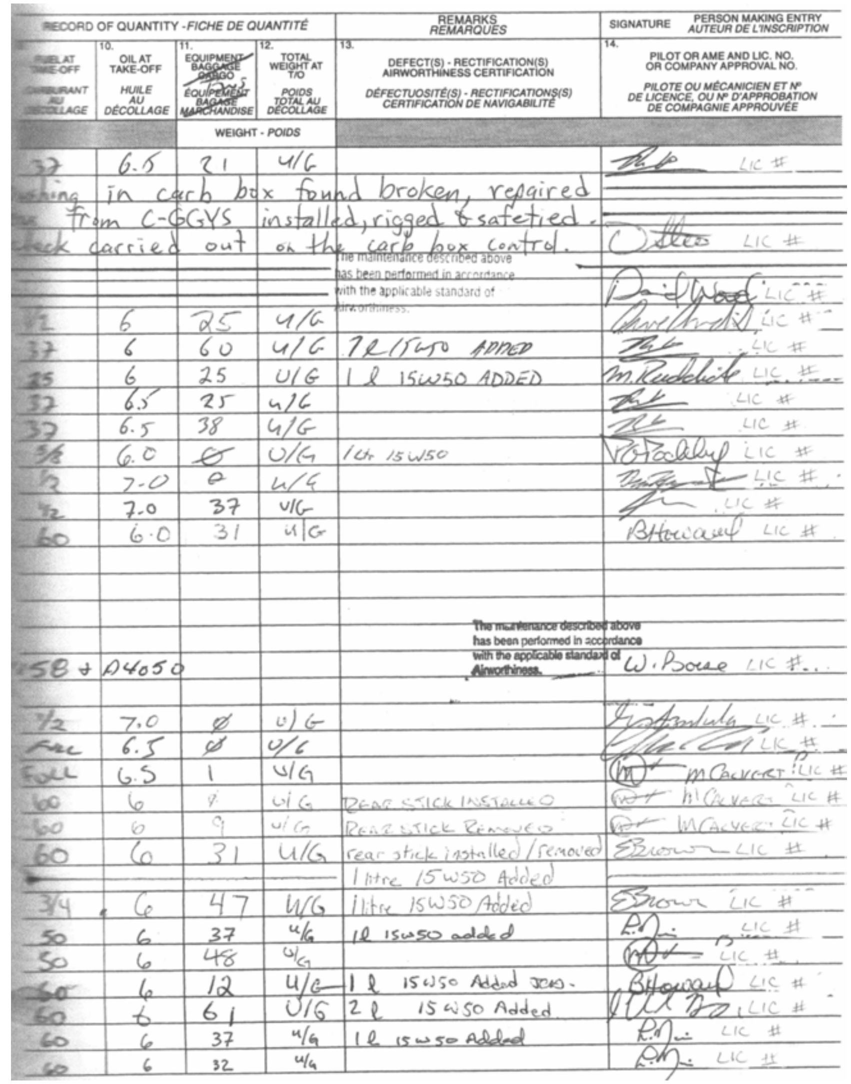
JOURNEY LOGBOOK



1. DATE	2. POINT OF DEPARTURE AND DESTINATION / POINT DE DÉPART ET DESTINATION	3. NAME/S - NOM/S	4. UP / QUITTE LE SOL À	5. DOWN / PRISE DE CONTACT	6. AIR TIME / TEMPS DANS LES AIRS	FLIGHT TIME / TEMPS DE VOL	7. TOTAL AIR TIME SINCE MANUFACTURE / TEMPS AIR TOTAL DEPUIS SA CONSTRUCTION	8. NUMBER / NOMBRE	WEIGHT / POIDS
17 JUL 07	TOTAL BROUGHT FORWARD / TOTAL REPORTÉ						1843.23		
18 JUL 07	CPZ3-CPZ3	CRGS 'A' FLT	1355	1740	2.78	3.8	1846.01	1	150
19 July 07							1846.01	L.H. carb	
19 July 07							1846.01	Independent	
19 July 07							1846.01		
21 Jul 07	PZ3	CRGS AFH	1050	1427	2.55	3.5	1848.56	1	220
22 Jul 07	PZ3-PZ3	CRGS 'A' FLT	0730	1746	7.00	9.9	1855.56	1	160
24 JUL 07	PZ3-PZ3	CRGS 'A' FLT	0740	1420	2.99	4.1	1858.55	1	175
25 Jul 07	PZ3-PZ3	CRGS 'A' FLT	1050	1555	3.17	4.1	1861.72	1	170
26 Jul 07	CPZ3-CPZ3	CRGS 'A' FLT	1055	1735	5.69	6.7	1866.41	1	150
27 Jul 07	PZ3	PODEBRY PG	1125	1145	0.23	0.3	1866.64	2	260
28 Jul 07	PZ3	Haycock 11	1340	1440	0.79	1.0	1867.43	2	350
30 JUL 07	PZ3	CRGS B FLT	0800	17:17	5.60	7.4	1873.03	1	180
31 JUL 07	PZ3	CRGS B FLT	0735	14.00	3.77	5.0	1876.80	1	200
AUG 01-07	(1) 50 HR INSP CARRIED OUT AS PER MANUAL								
	(2) $B 480E OIL AND FILTER INSP CARRIED OUT								
	(3) $L 424 FLAP PULLEY INSP " "								
	(4) COMPRESSION TEST (1) 79 (2) 78 (3) 79 (4) 78								
	(5) TAILWHEEL BEARINGS AND CONES REPLACED P/N A								
21 AUG 07	PZ3-NT7-PZ3	TCC TAG	1030	1428	2.26	3.1	1879.06	1	210
26 AUG 07	CPZ3-CNT7	TODH C.G	0740	0830	0.25	0.5	1879.31	1	220
26 AUG 07	CNT7-CYSN	M CALVERT	1030	1815	2.25	2.8	1881.56	1	240
31 AUG 07	CYSN	SOGC	1055	1125	0.34	0.5	1881.90	2	350
31 AUG 07	CYSN	SOGC	1400	1700	1.37	2.0	[illegible]	2	220
01 Sep 07	CYSN	SOGC	1040	1800	5.04	6.6	1888.61	2	350
02 Sep 07	CYSN	SOGC	0800	1445	6.20	8.5	1894.81	1	180
03 SEP 07	CYSN-CYSN	SOGC	0805	1510	5.05	6.8	1899.86	1	190
08 Sep 07	CYSN	SOGC	0805	1720	5.86	8.1	1905.72	1	220
15 SEP 07	CYSN	SOGC	0805	1028	1.64	2.4	1907.36	1	200
16 SEP 07	CYSN	SOGC	0805	1730	6.51	8.9	1913.87	1	200
22 SEP 07	CYSN-CYSN	SOGC	0815	1720	5.63	7.5	1919.50	1	200
23 SEP 07	CYSN-CYSN	SOGC	0815	1425	3.56	5.0	1923.06	1	200
	TOTAL THIS PAGE / TOTAL DE CETTE PAGE						1923.06		

Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 17M-3 Example of Journey Logbook First Page



FUEL AT TAKE-OFF / CARBURANT AU DÉCOLLAGE	10. OIL AT TAKE-OFF / HUILE AU DÉCOLLAGE	11. EQUIPMENT BAGGAGE CARGO / ÉQUIPEMENT BAGAGE MARCHANDISE	12. TOTAL WEIGHT AT T/O / POIDS TOTAL AU DÉCOLLAGE	13. DEFECT(S) - RECTIFICATION(S) AIRWORTHINESS CERTIFICATION / DÉFECTUOSITÉ(S) - RECTIFICATIONS(S) CERTIFICATION DE NAVIGABILITÉ	14. PILOT OR AME AND LIC. NO. OR COMPANY APPROVAL NO. / PILOTE OU MÉCANICIEN ET Nº DE LICENCE, OU Nº D'APPROBATION DE COMPAGNIE APPROUVÉE
37	6.5	21	U/G		LIC #
…hing in carb box found broken, repaired … from C-GGYS installed, rigged & safetied. …eck carried out on the carb box control.				The maintenance described above has been performed in accordance with the applicable standard of airworthiness.	LIC #
					LIC #
1/2	6	25	U/G		LIC #
37	6	60	U/G	1L 15W50 ADDED	LIC #
25	6	25	U/G	1 l 15W50 ADDED	M Ruddick LIC #
37	6.5	25	U/G		LIC #
37	6.5	38	U/G		LIC #
3/8	6.0	Ø	U/G	1 Lt 15W50	LIC #
1/2	7.0	Ø	U/G		LIC #
1/2	7.0	37	U/G		LIC #
60	6.0	31	U/G		B Howard LIC #
58 + A4050				The maintenance described above has been performed in accordance with the applicable standard of Airworthiness.	W. Boue LIC #
1/2	7.0	Ø	U/G		LIC #
Full	6.5	Ø	U/G		LIC #
Full	6.5	1	U/G		M Calvert LIC #
60	6	9	U/G	REAR STICK INSTALLED	M Calvert LIC #
60	6	9	U/G	REAR STICK REMOVED	M Calvert LIC #
60	6	31	U/G	rear stick installed/removed / 1 litre 15W50 Added	E Brown LIC #
3/4	6	47	U/G	1 litre 15W50 Added	E Brown LIC #
50	6	37	U/G	1l 15W50 added	LIC #
50	6	48	U/G		LIC #
60	6	12	U/G	1 l 15W50 Added	B Howard LIC #
60	6	61	U/G	2 l 15W50 Added	LIC #
60	6	37	U/G	1l 15W50 Added	LIC #
60	6	32	U/G		LIC #

Director Cadets 3, 2007 Ottawa, ON: Department of National Defence

Figure 17M-4 Example of Journey Logbook Second Page

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WOODEN AIRCRAFT

"The Aviation History Online Museum", 2007, Aircraft: Sopwith Triplane. Retrieved November 25, 2007, from http://www.aviation-history.com/sopwith/triplane.htm

Figure 17N-1 The Black Maria Sopwith Triplane

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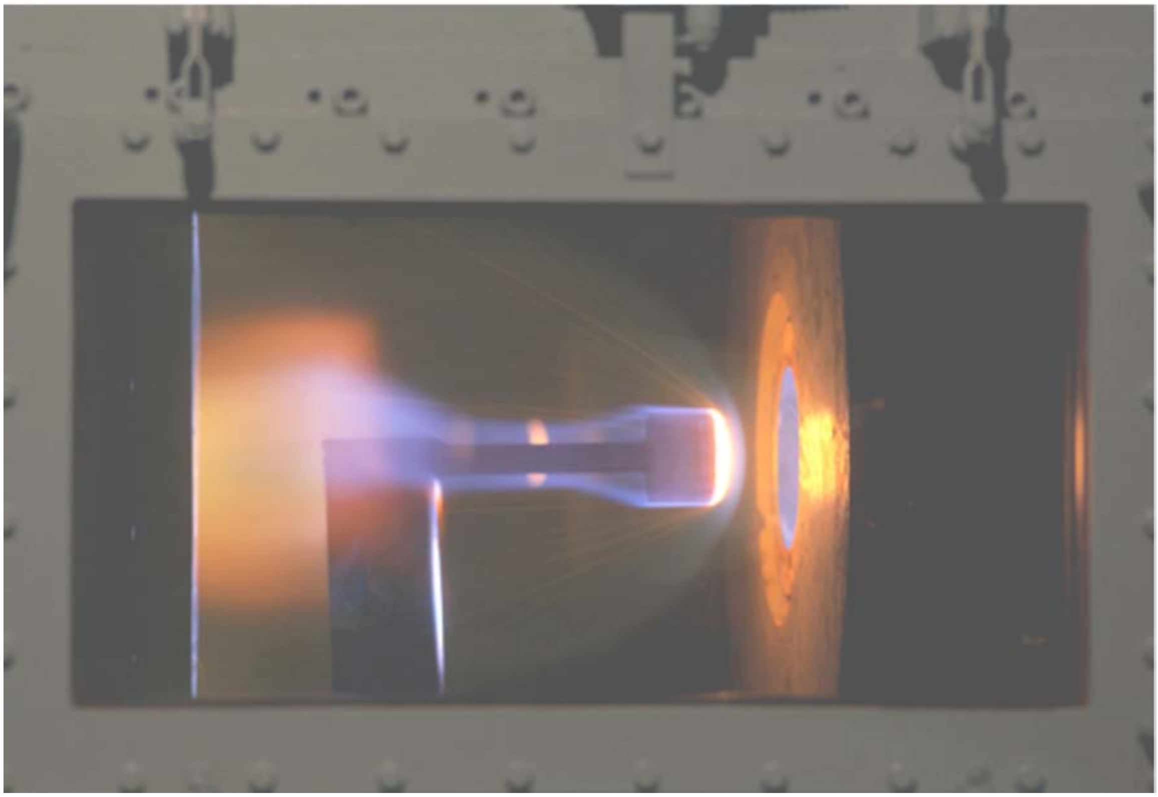
COMPOSITE MATERIALS USED IN AIRCRAFT CONSTRUCTION

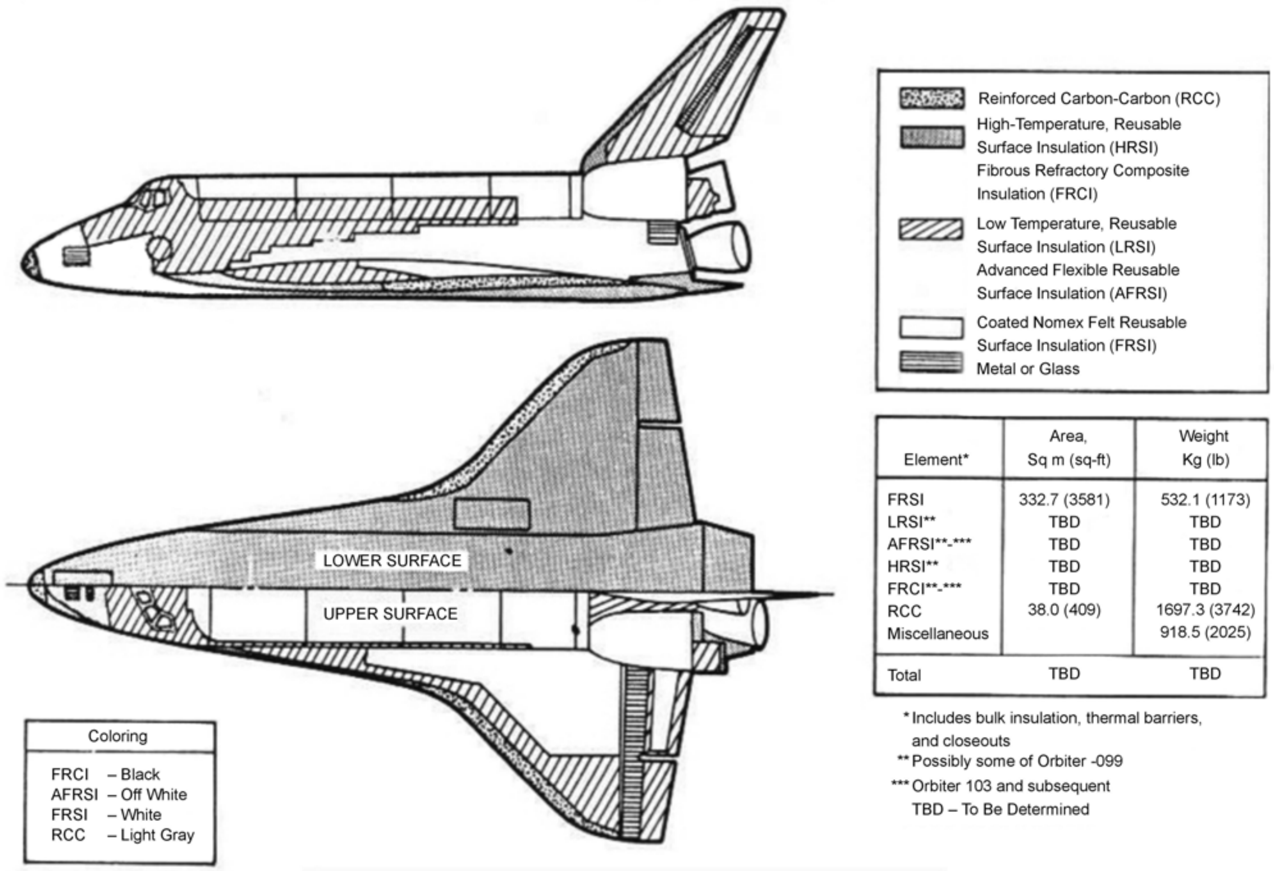
"A380 Navigator", 2007, Manufacturing Process. Retrieved November 24, 2007, from http://events.airbus.com/A380/Default2.aspx?ArtId=644

Figure 17O-1 A380 Rear Pressure Bulkhead



"US Centennial of Flight Commission", 2004, Shuttle Thermal Protection System. Retrieved November 25, 2007, from http://www.centennialofflight.gov/essay/Evolution_of_Technology/TPS/Tech41.htm

Figure 17O-2 Testing Thermal Insulation in a Wind Tunnel



Element*	Area, Sq m (sq-ft)	Weight Kg (lb)
FRSI	332.7 (3581)	532.1 (1173)
LRSI**	TBD	TBD
AFRSI**-***	TBD	TBD
HRSI**	TBD	TBD
FRCI**-***	TBD	TBD
RCC	38.0 (409)	1697.3 (3742)
Miscellaneous		918.5 (2025)
Total	TBD	TBD

* Includes bulk insulation, thermal barriers, and closeouts
** Possibly some of Orbiter -099
*** Orbiter 103 and subsequent
TBD – To Be Determined

“US Centennial of Flight Commission”, 2004, Shuttle Thermal Protection System. Retrieved November 25, 2007, from http://www.centennialofflight.gov/essay/Evolution_of_Technology/TPS/Tech41.htm

Figure 17O-3 Orbiter Thermal Protection System

"US Centennial of Flight Commission", 2004, Shuttle Thermal Protection System. Retrieved November 25, 2007, from http://www.centennialofflight.gov/essay/Evolution_of_Technology/TPS/Tech41.htm

Figure 17O-4 Repairing TPS on Columbia

METAL USED IN AIRCRAFT CONSTRUCTION

"A380 Navigator", 2007, Manufacturing Process. Retrieved November 24, 2007, from http://events.airbus.com/A380/Default2.aspx?ArtId=644

Figure 17P-1 Titanium Pylon for an A380 Airbus Engine

"A380 Navigator", 2007, Manufacturing Process. Retrieved November 24, 2007, from http://events.airbus.com/A3

Figure 17P-2 Empty Pylons on an A380 Airbus

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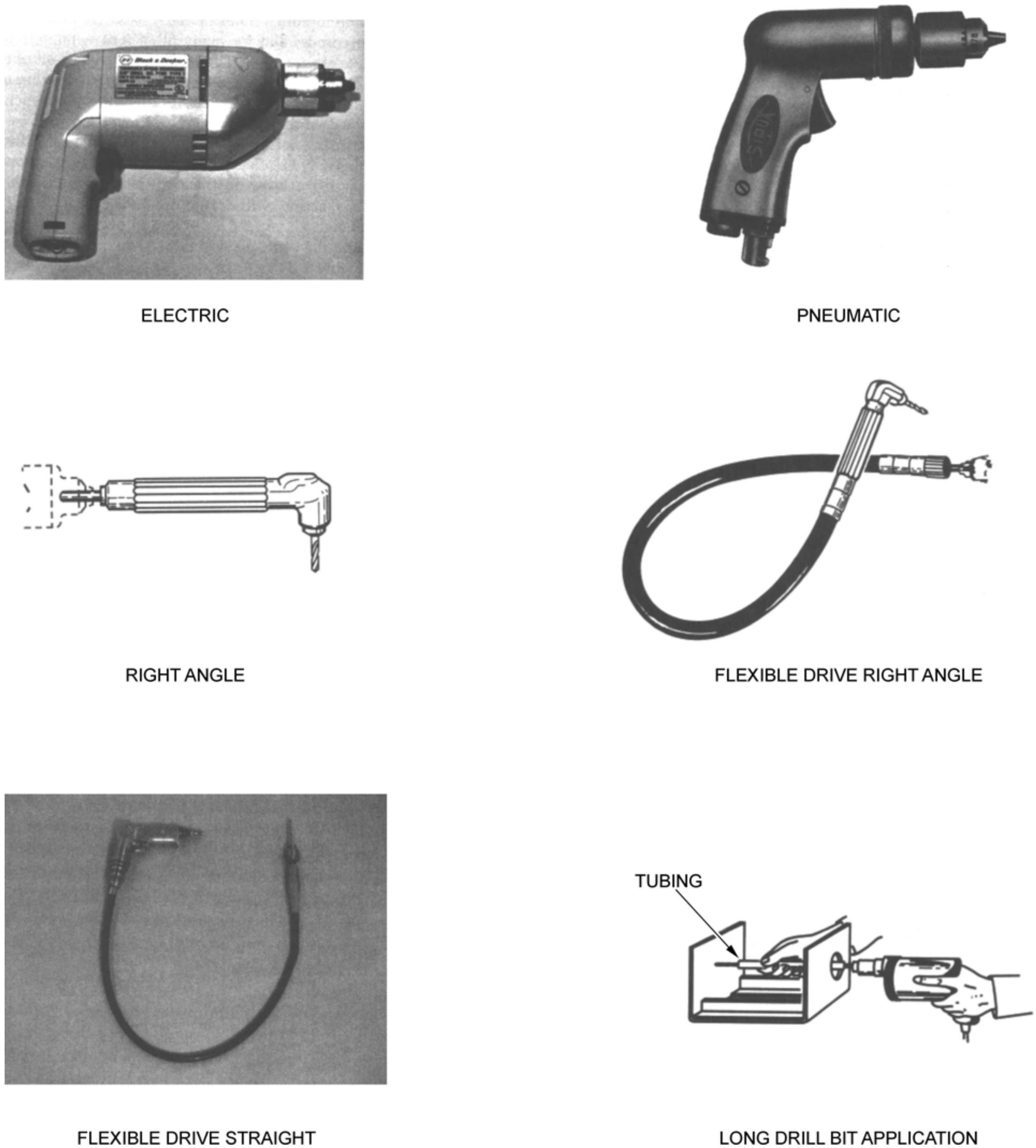
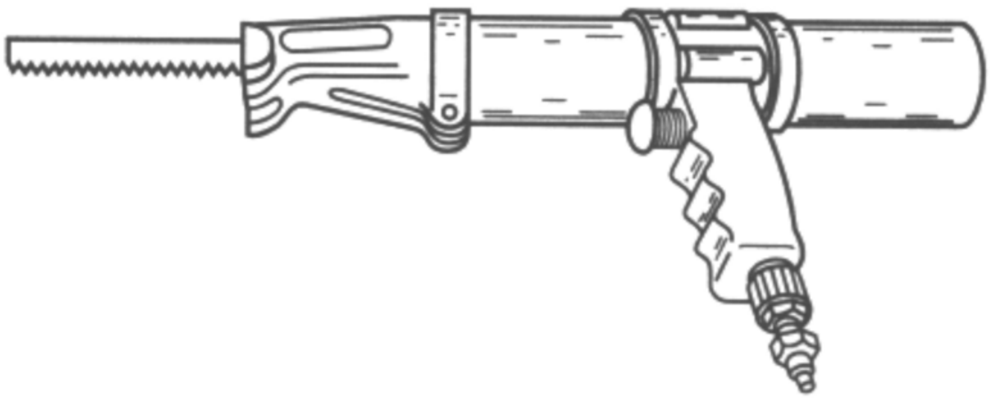
POWER TOOLS



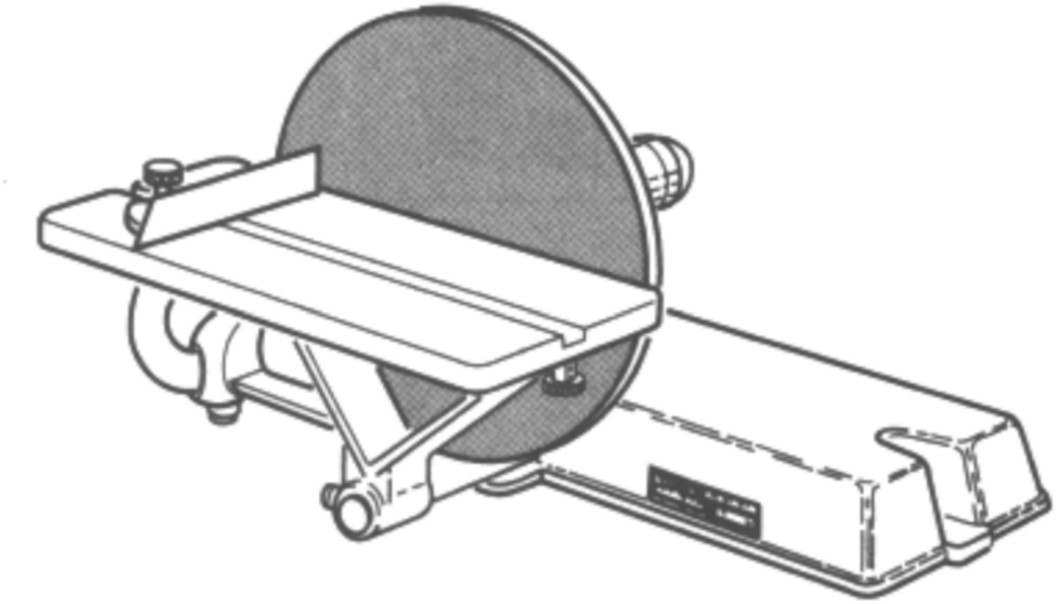
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-24 to 2-26)

Figure 17Q-1 Various Drill Types



A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-19)

Figure 17Q-2 Reciprocating Saw



A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-24)

Figure 17Q-3 Disk Sander

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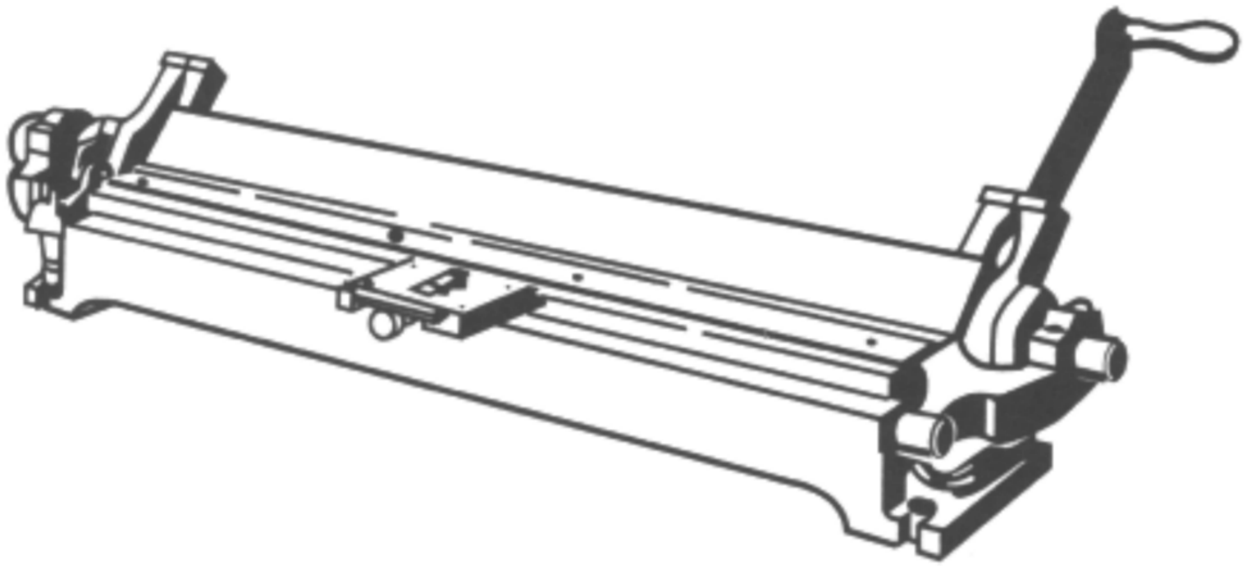
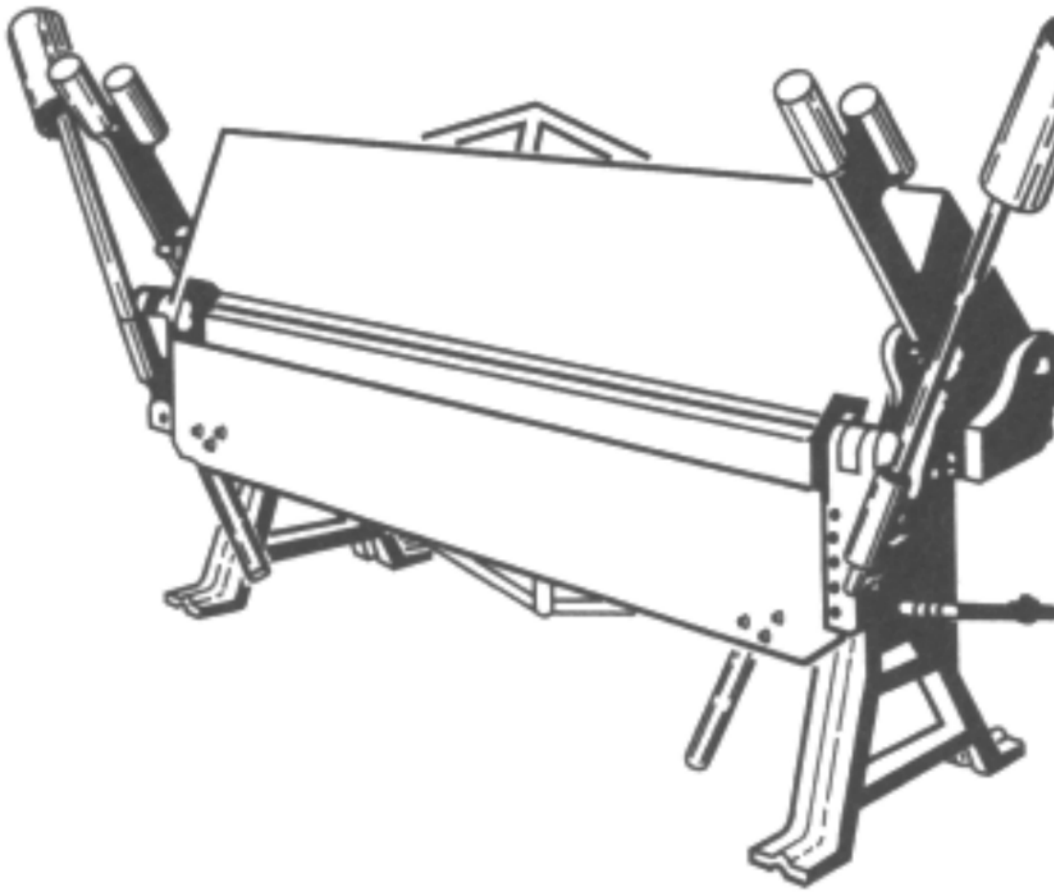
FORMING AND CUTTING TOOLS



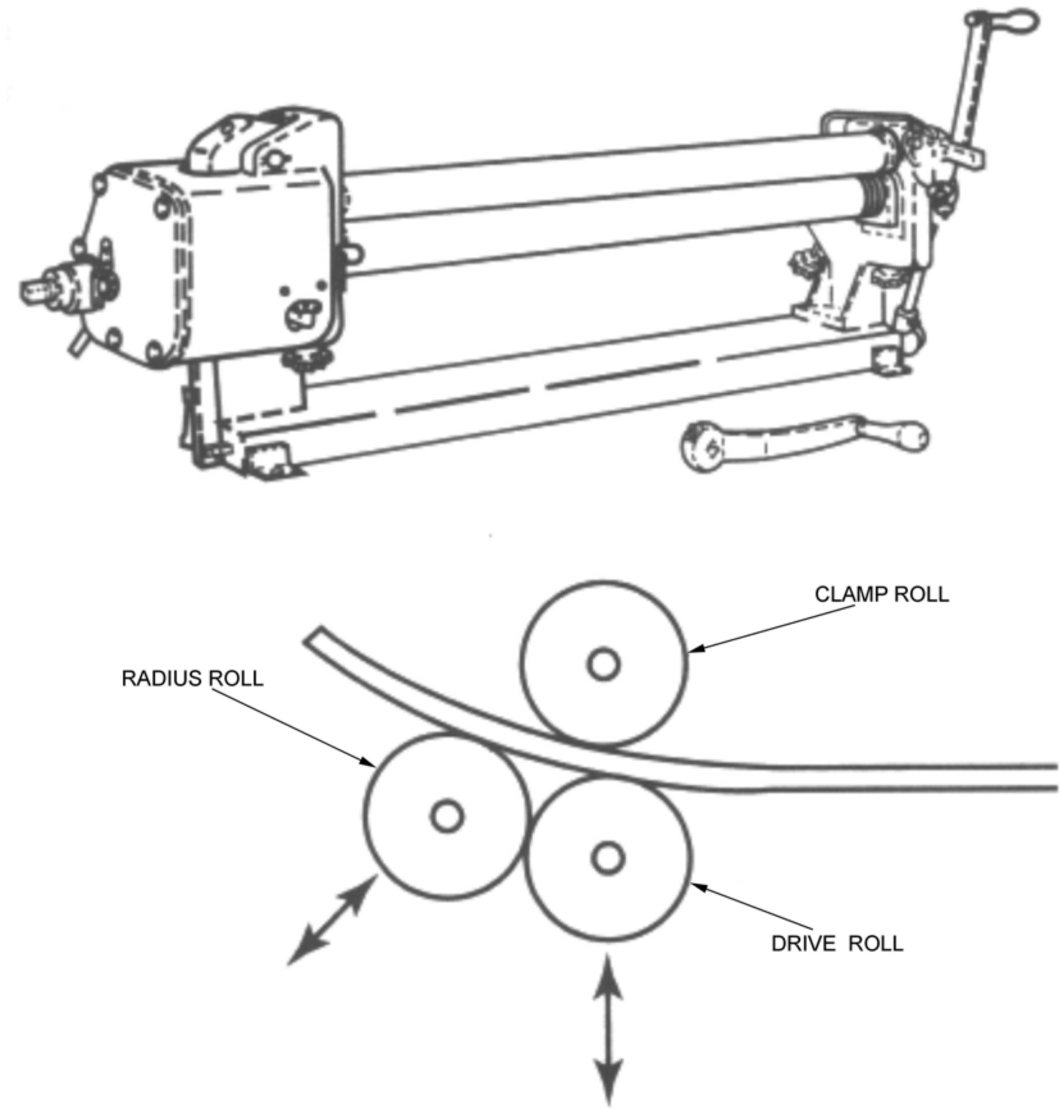
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-30)

Figure 17R-1 Bar Folding Machine



A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-29)

Figure 17R-2 Cornice Break

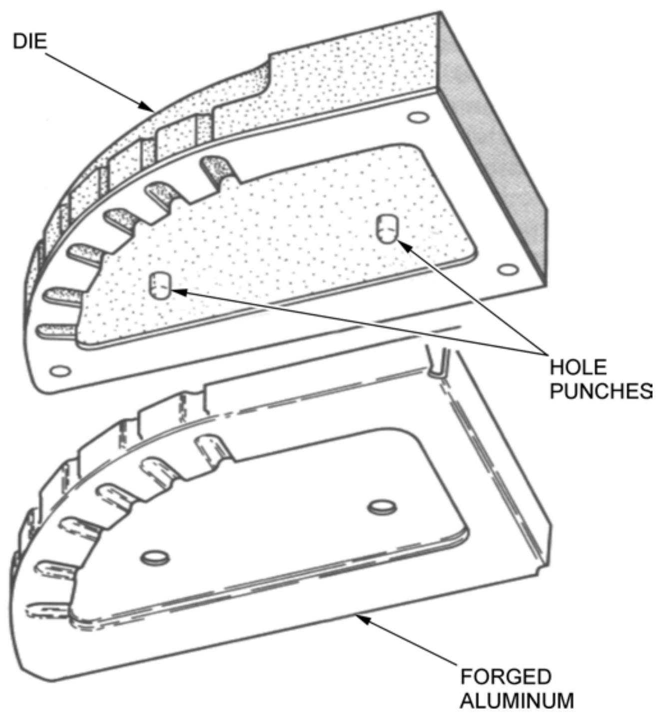


A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-31)

Figure 17R-3 Slip Roll Former

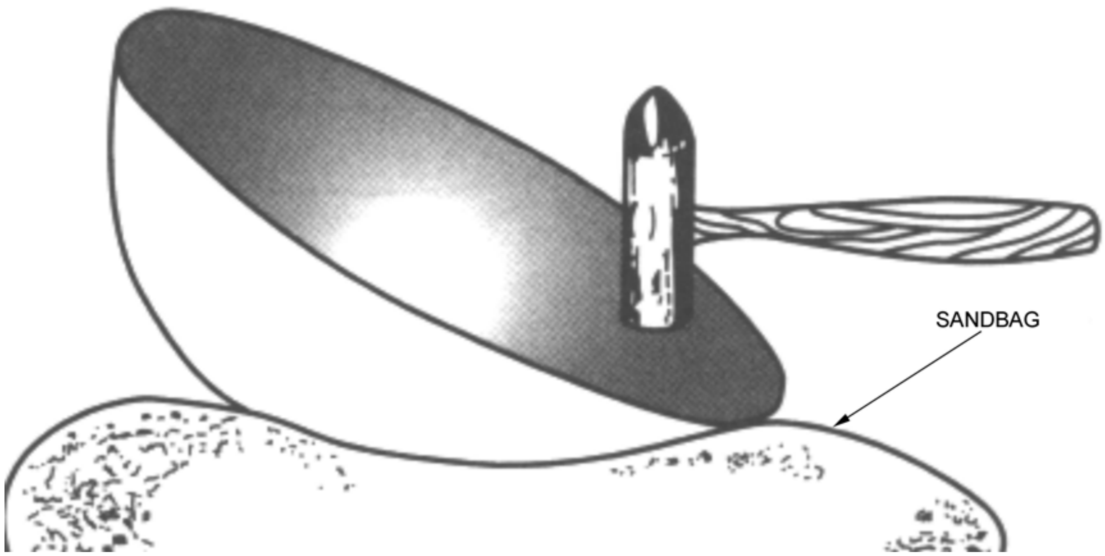
Triway YangZhong International Trade Company, Hydropress. Retrieved November 17, 2007, from http://www.nantex-triway.com/equipment.htm

Figure 17R-4 Hydropress



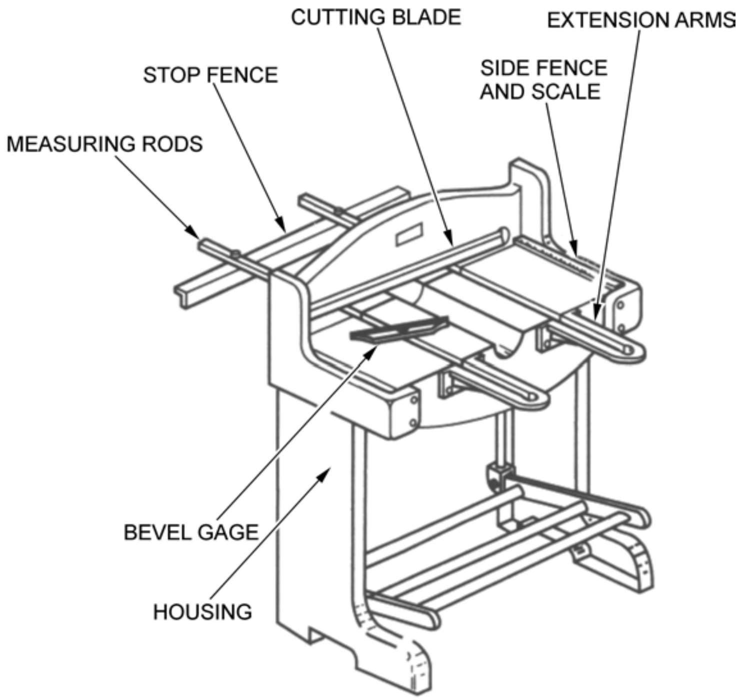
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-32)

Figure 17R-5 Hydropress Die With Forged Aluminum Product



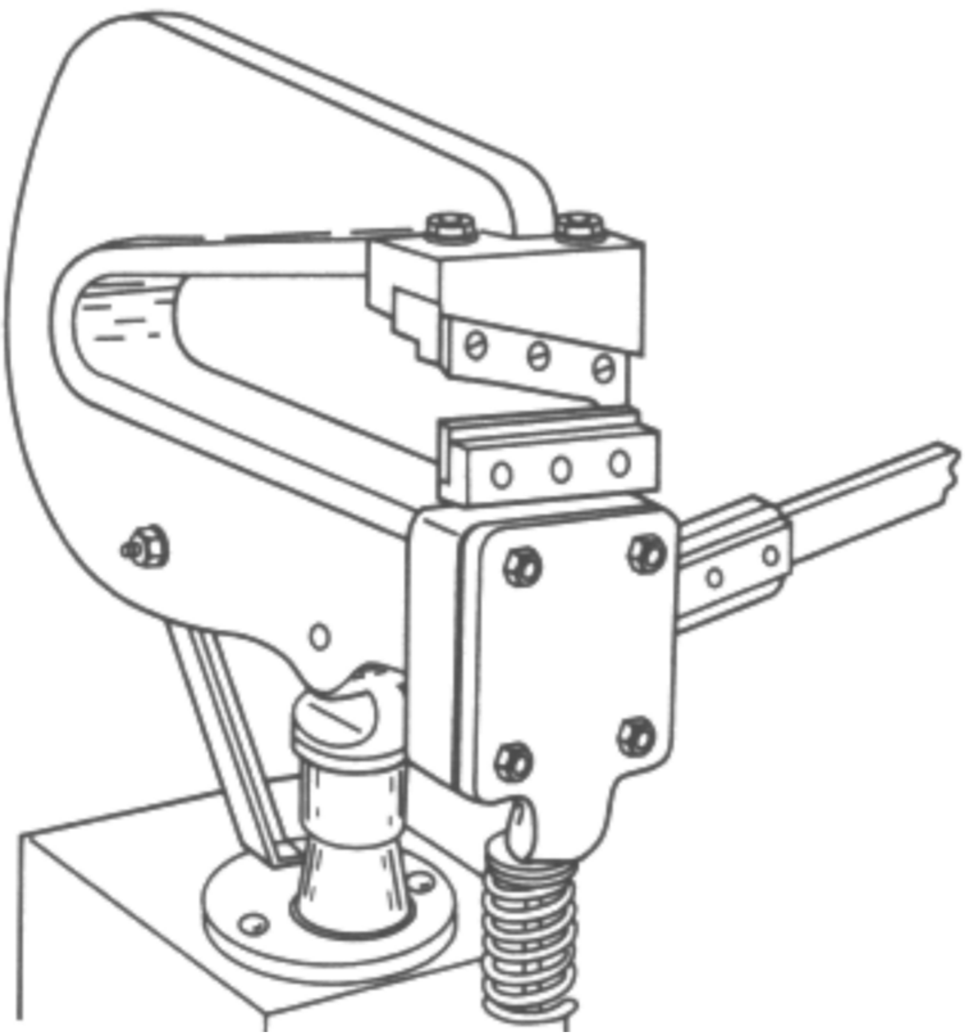
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-32)

Figure 17R-6 Sandbag Forming



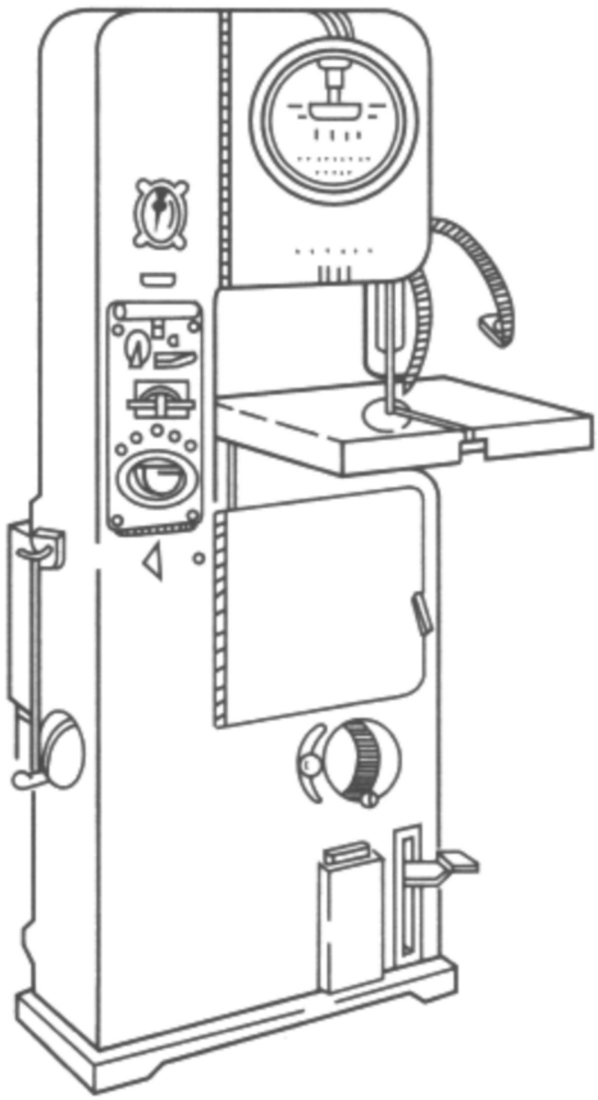
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-22)

Figure 17R-7 Squaring Shear



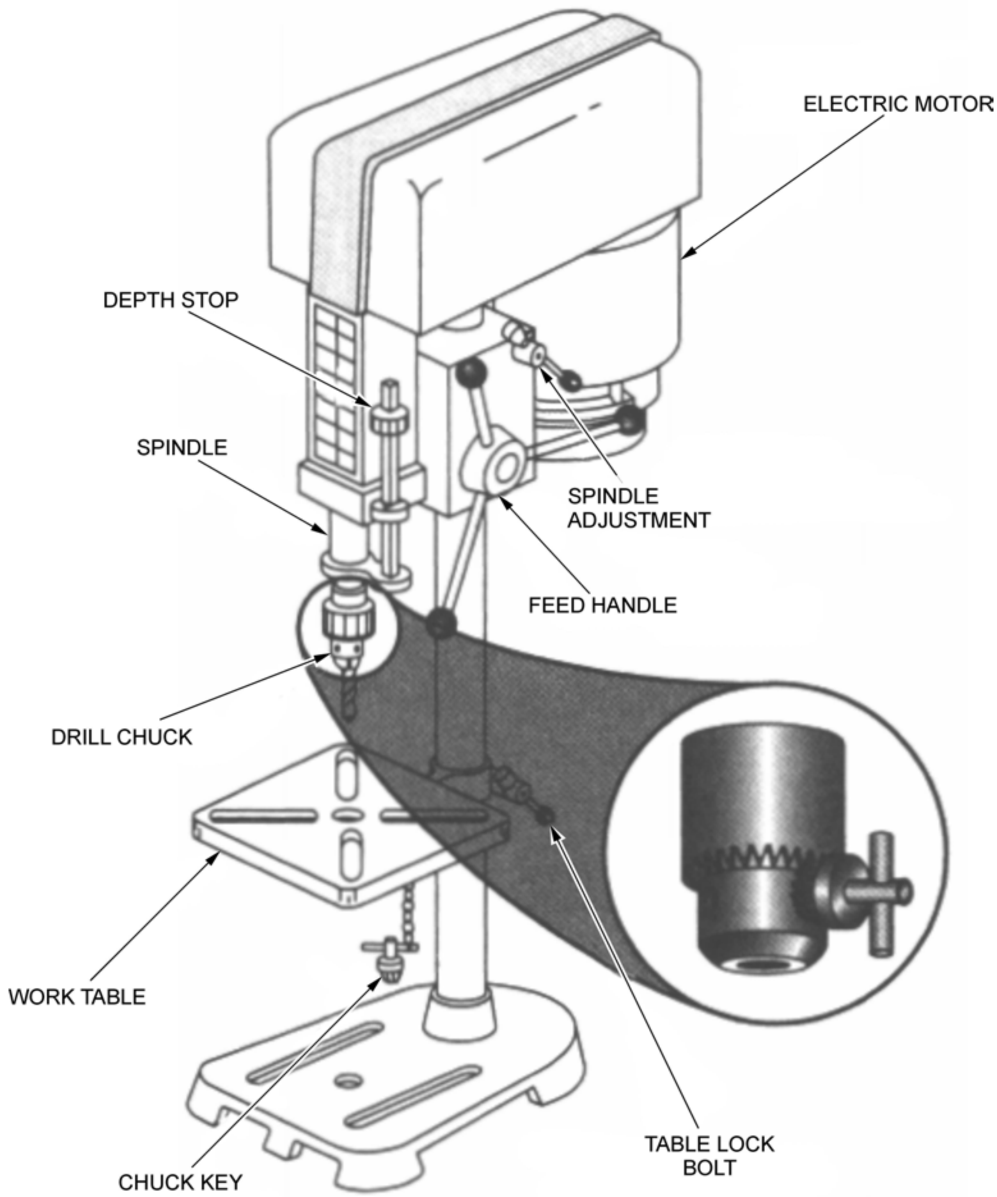
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-24)

Figure 17R-8 Scroll Shears



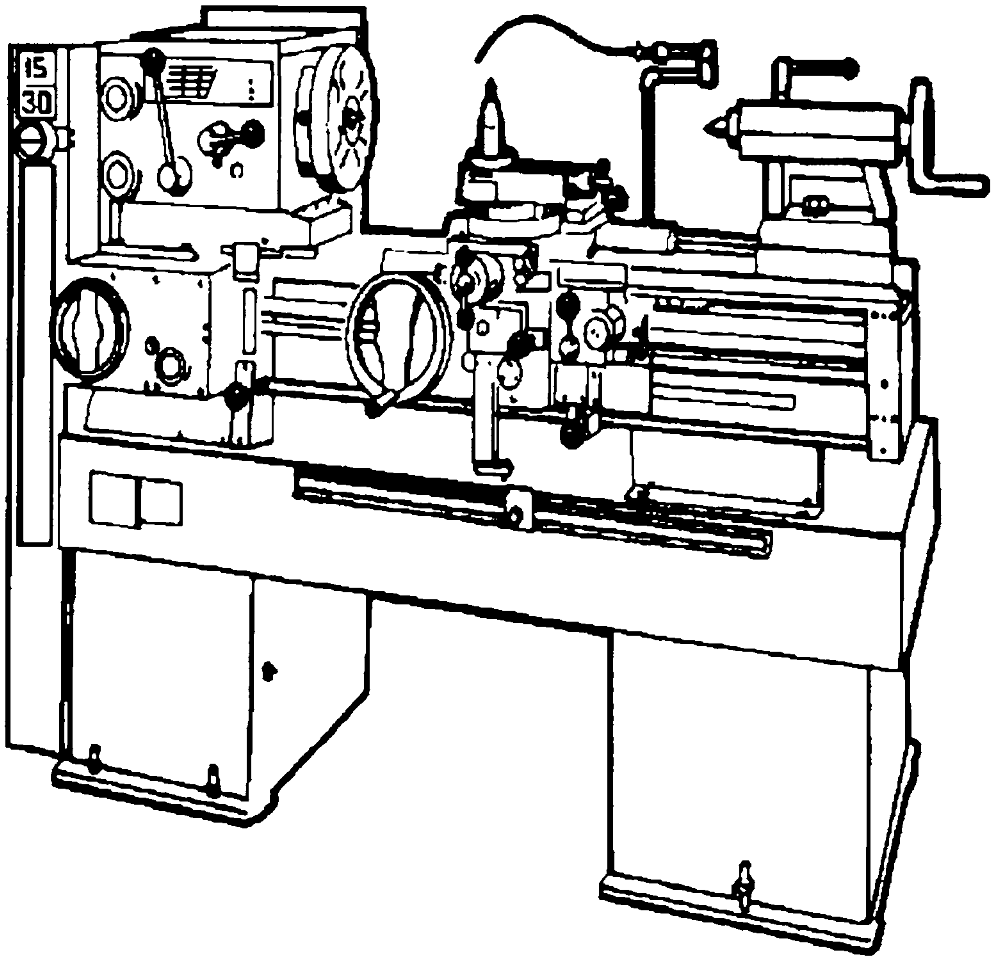
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-23)

Figure 17R-9 Band Saw



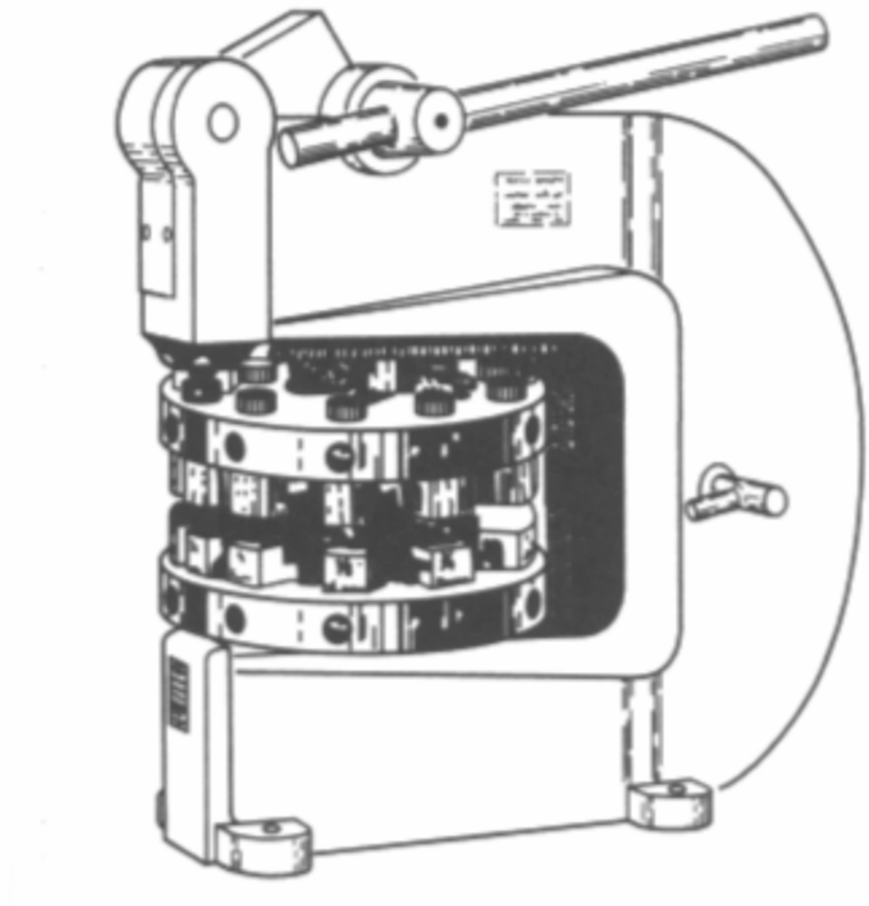
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-26)

Figure 17R-10 Drill Press



Fundamentals of Machine Tools, Headquarters Department of the Army Washington DC ,1996, Training Circular No. 9-524. Retrieved November 23, 2007, from http://metalworking.com/tutorials/army-TC-9-524/TOC.pdf

Figure 17R-11 Metal Lathe



A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-23)

Figure 17R-12 Rotary Punch

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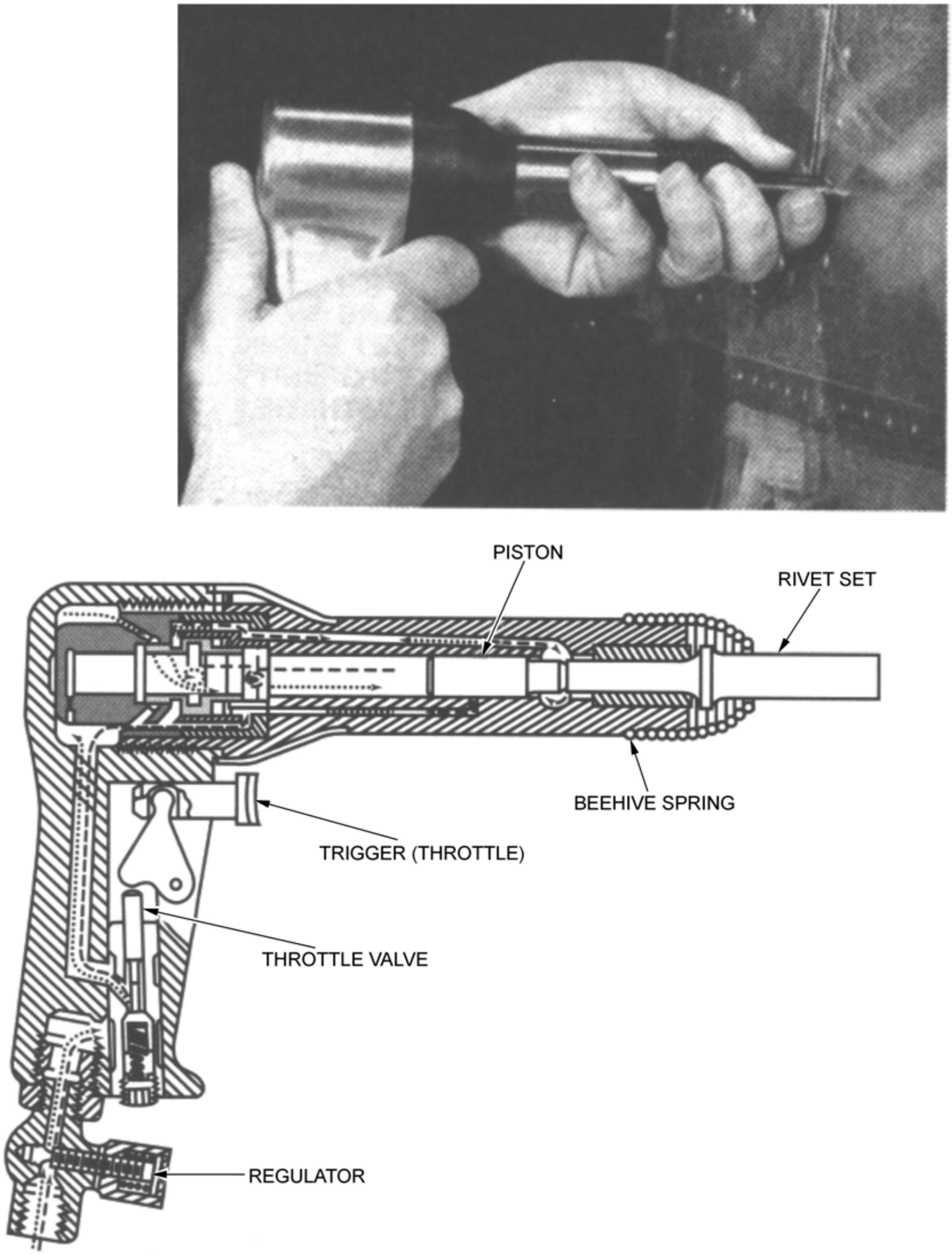
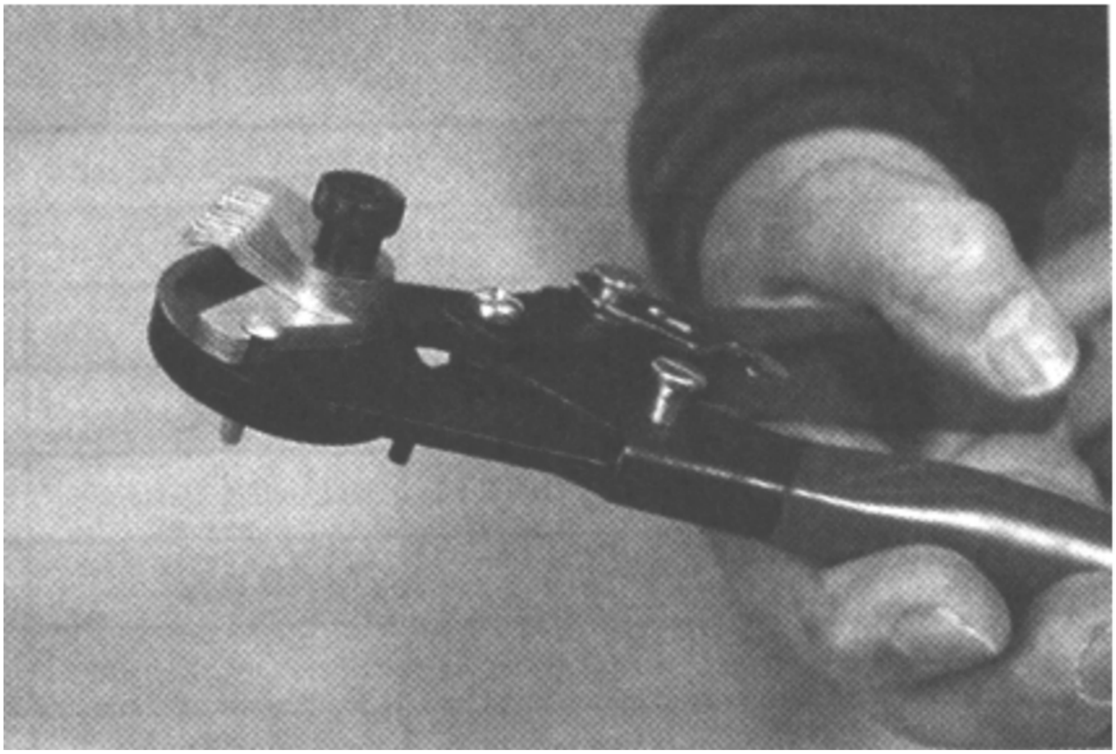
FASTENING TOOLS



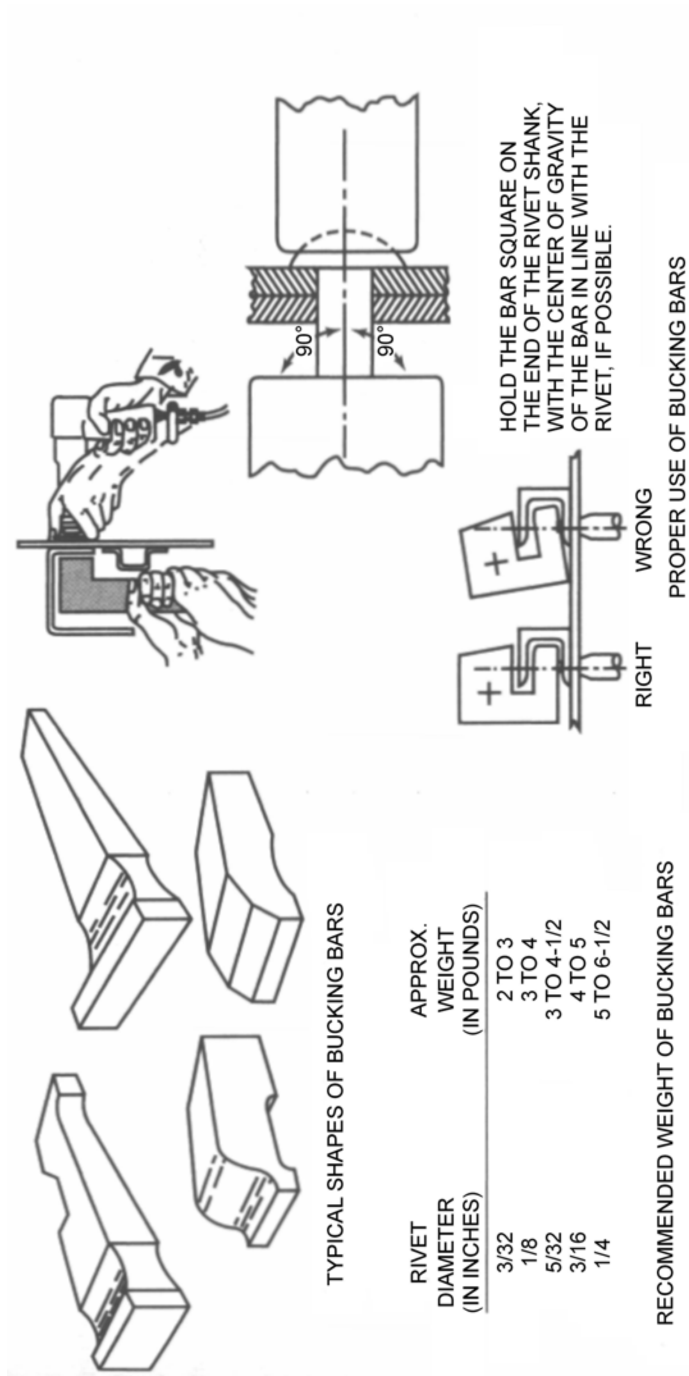
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-63 and 2-66)

Figure 17S-1 Rivet Gun



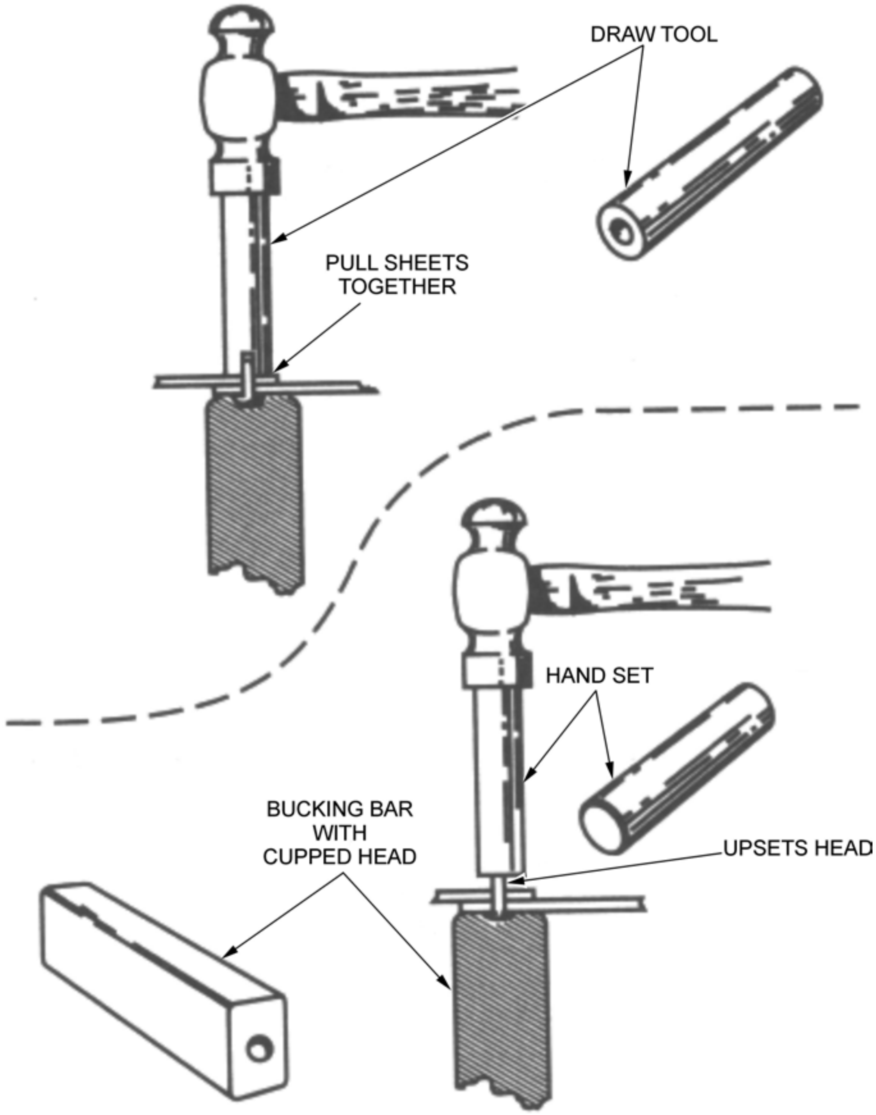
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-53)

Figure 17S-2 Rivet Cutter



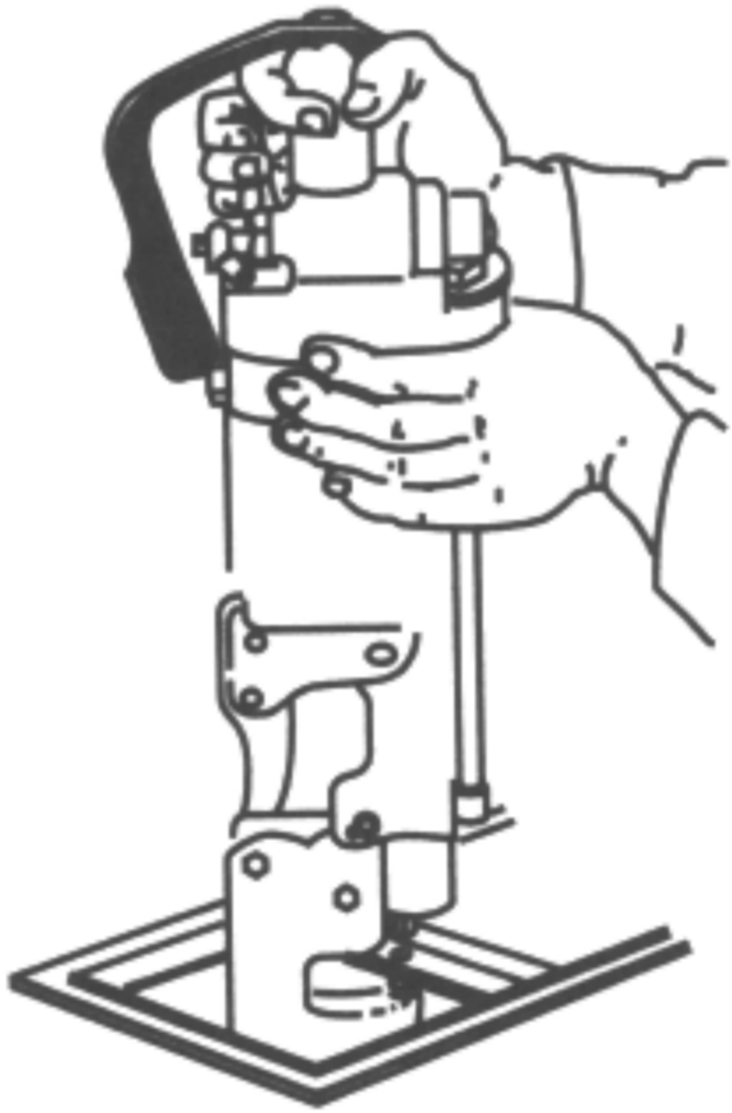
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-65)

Figure 17S-3 Bucking Bars



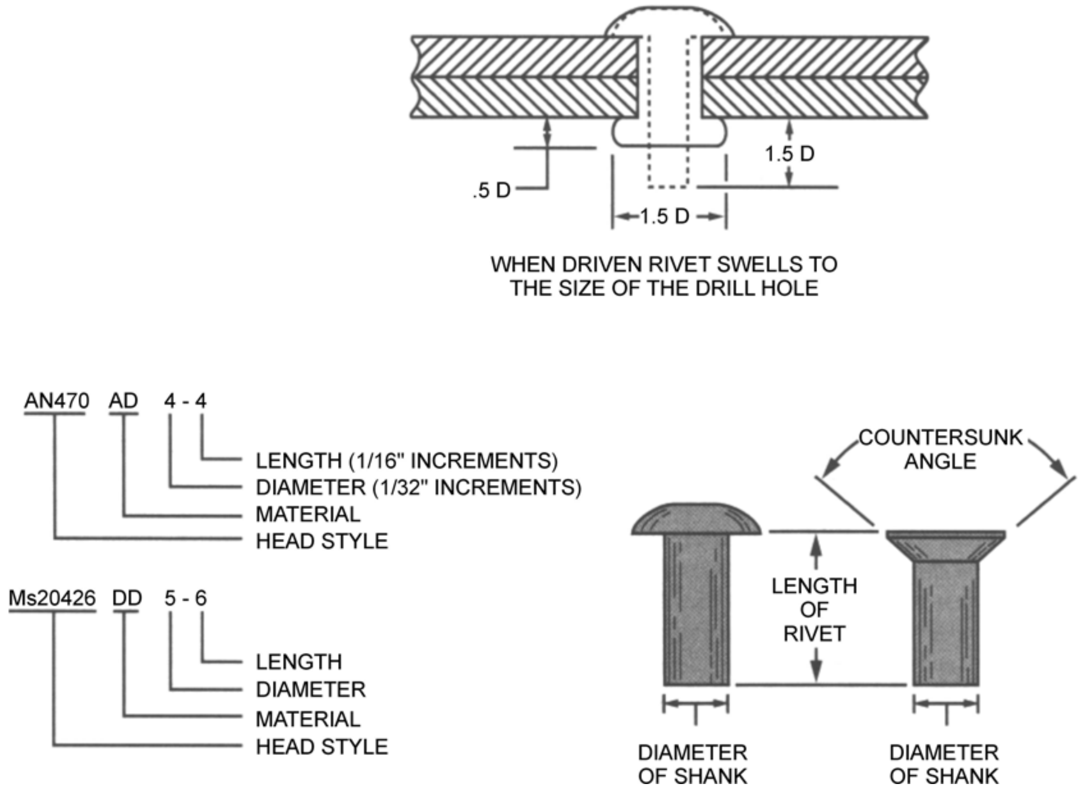
A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-61)

Figure 17S-4 Hand Riveting



A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-61)

Figure 17S-5 Squeezer



A&P Technician Airframe Textbook, Sanderson Training Systems (pp. 2-36)

Figure 17S-6 Rivet Applications, Dimensions and Designations

TOOLS AND MATERIALS REQUIRED TO CONSTRUCT AN ALUMINUM MODEL BIPLANE

Tools

- Mechanic's gloves,
- Ball-peen hammer,
- Pliers,
- Flat screwdriver,
- Rasp,
- Hand stapler,
- Staple gun,
- Push-pin,
- Hot glue gun,
- Awl,
- Wire cutters,
- Box knife,
- Scissors,
- Ruler,
- Felt-tipped pen,
- Needle-nose pliers,
- Adjustable wrench,
- Electric hand drill,
- Hole saw 2-3/4 inch bits, and
- Hole saw 1-7/8 inch bits.

Materials

- Empty aluminum beverage cans (36 per cadet),
- Softwood, 20 mm thick (fence boards),
- Bottle caps (ten per cadet),
- Corrugated cardboard,
- Poster board,
- Tape (masking),
- Glue,
- Mylar,
- Copper-coated welding rod (2 sizes 1/16 inch and 3/32 inch),
- Cap nuts or toothpaste tube caps (two per aluminum model biplane),
- Bolts, 2-1/2 inch 10-24, with nuts (four per aluminum model biplane),

- Bolts, 3-1/2 inch 10-24, with nuts (eight per aluminum model biplane), and
- Wire clip (speed nut) to fit the copper coated welding rod (two per aluminum model biplane).

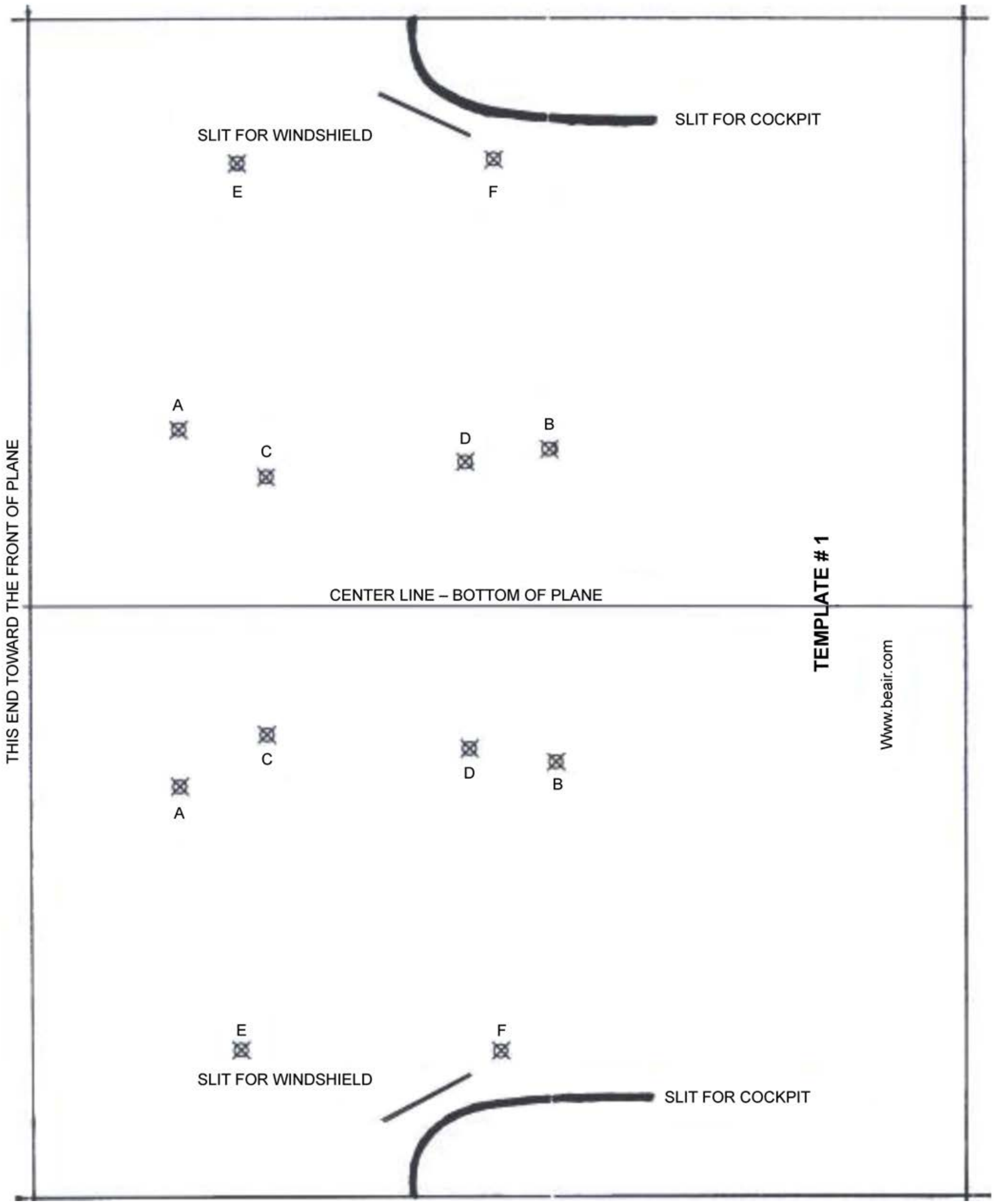


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Figure 17T-1 Fuselage Template

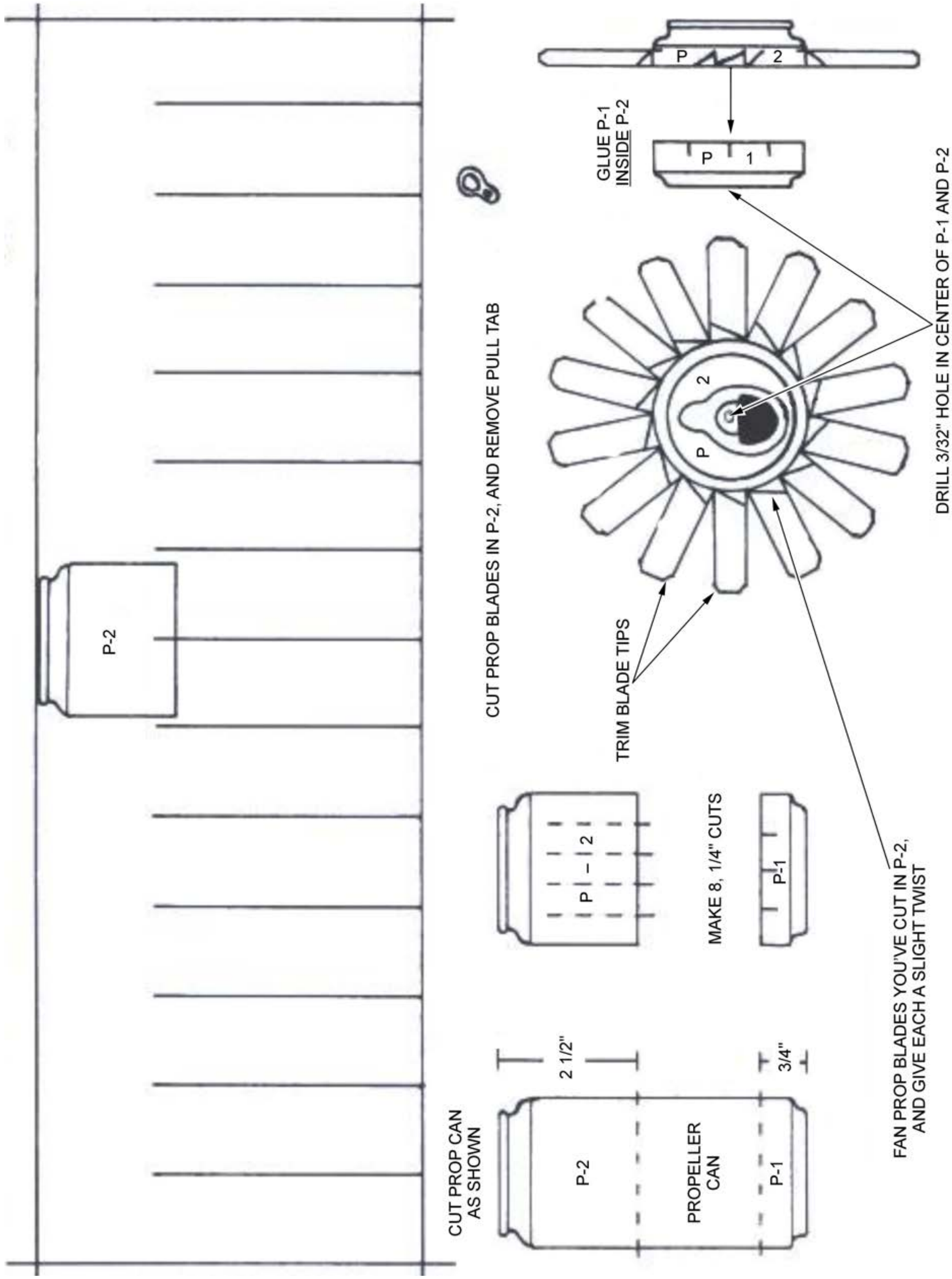

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Figure 17T-2 Fuselage Template

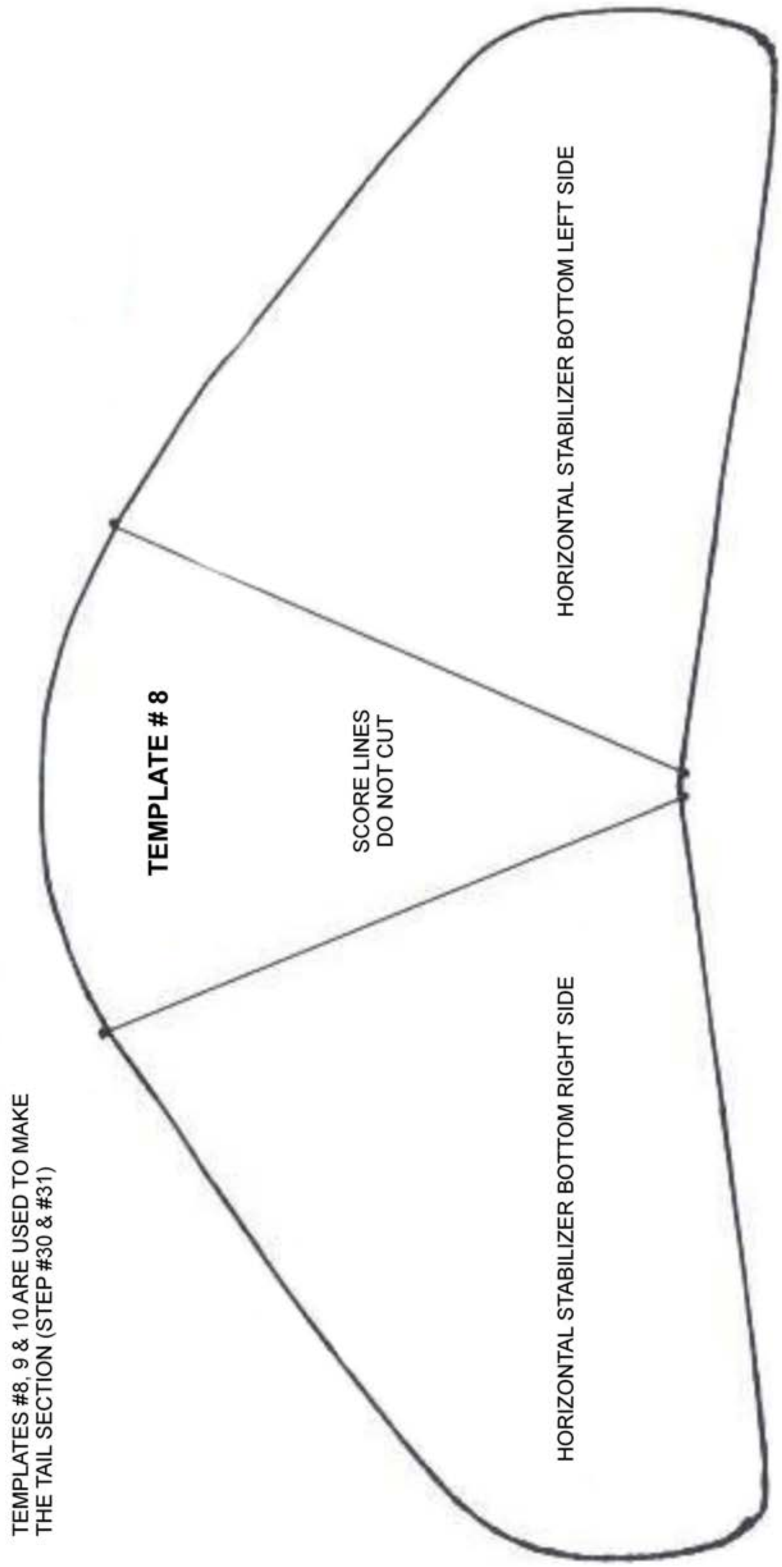

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Figure 17T-3 Horizontal Stabilizer Bottom Template

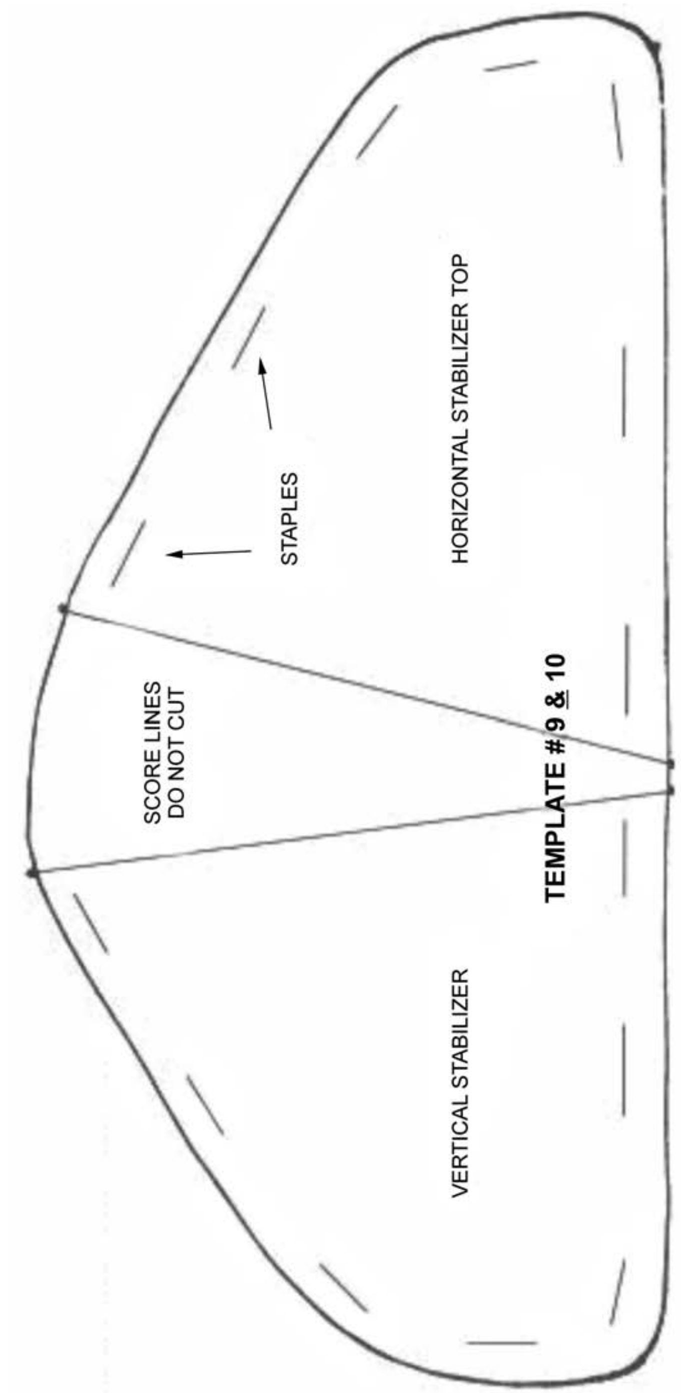

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Figure 17T-4 Left and Right Vertical Stabilizer Template

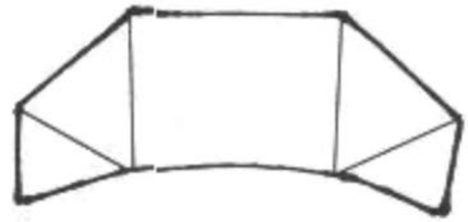

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Figure 17T-5 Windshield Template

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RAW ALUMINUM MATERIAL ASSEMBLY LINE

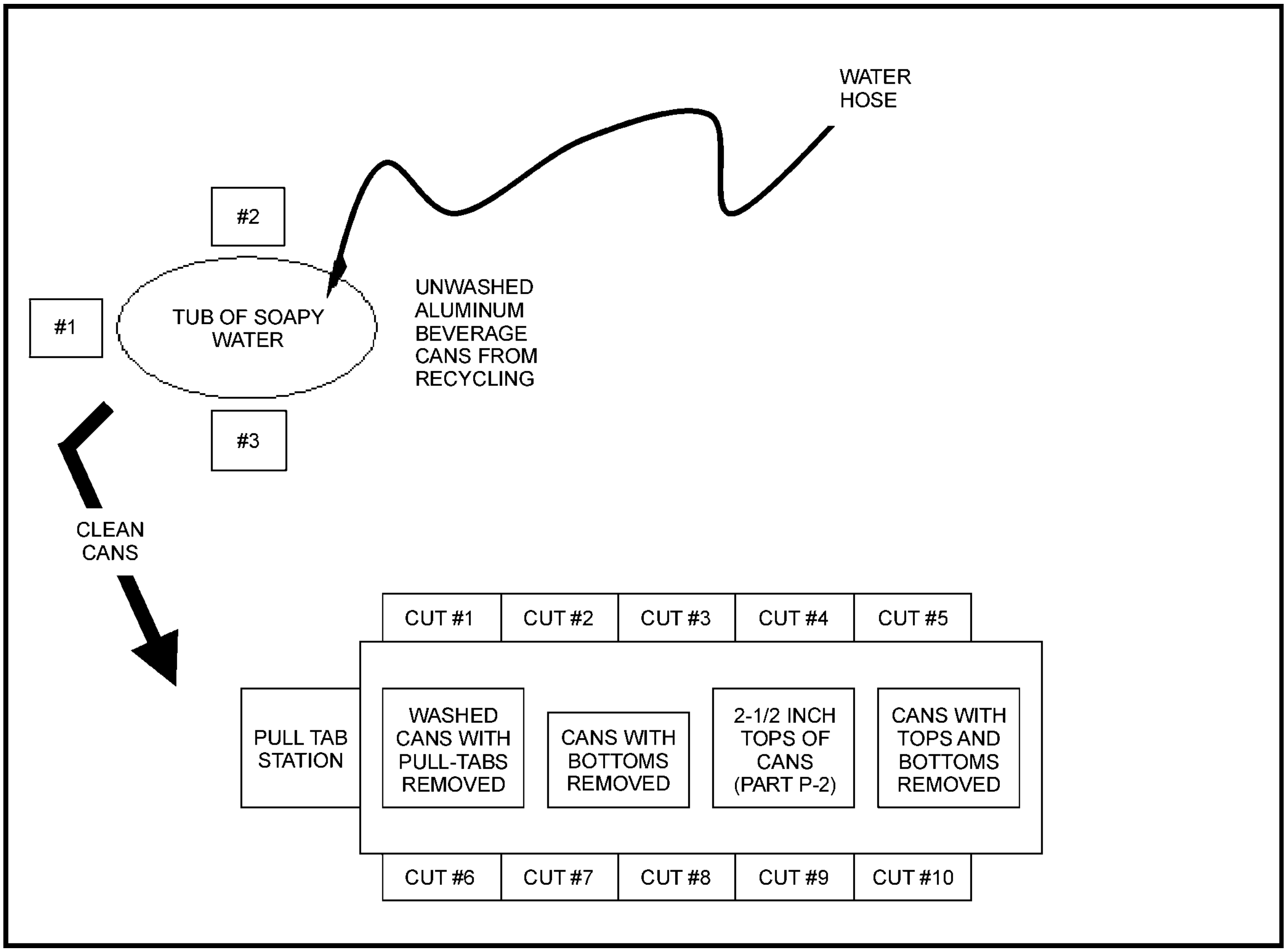

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Figure 17U-1 Raw Aluminum Material Assembly Line

1. Wash 17 cans.
2. Remove pull-tabs from all cans.
3. Cut tops and bottoms from 15 cans using box knives (to stock as raw material) (Figure 17U-2).
4. Cut bottom from one can (can B-1 to stock for fuselage) (Figure 17U-3).
5. Cut one 2-1/2-inch top from can for propeller (can-top P2 to stock) (Figure 17U-4).
6. Cut one 3/4-inch bottom from can for propeller cover (can bottom P1 to stock).

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Figure 17U-2 Unended Can

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Figure 17U-3 Bottomless Can

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Figure 17U-4 Can Top P-2

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WOOD ASSEMBLY LINE

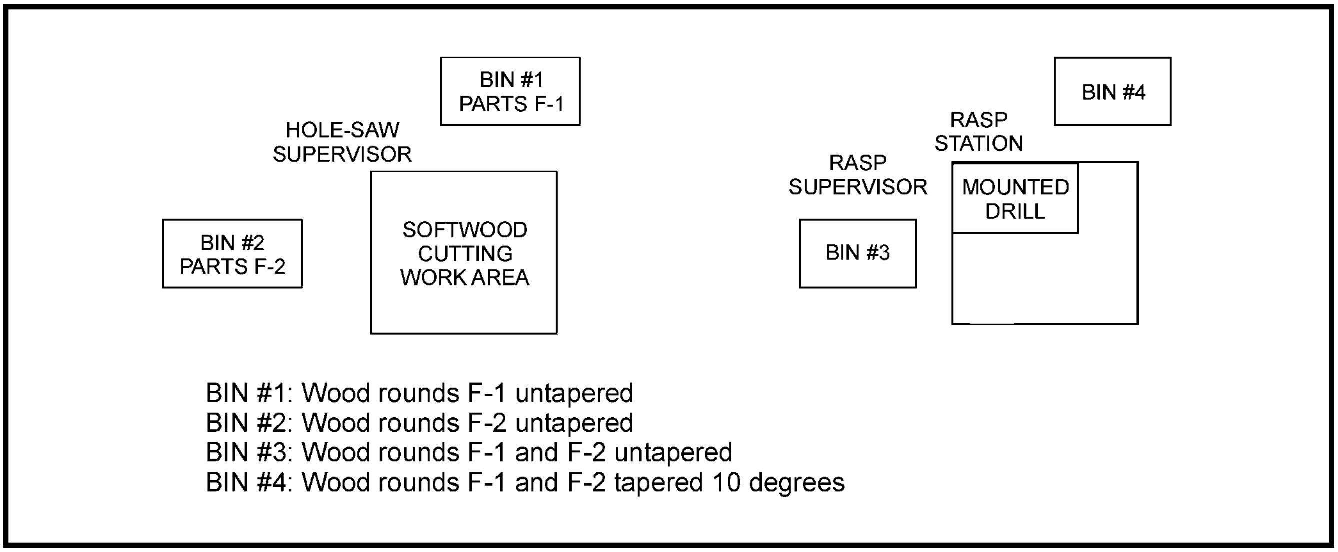

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Figure 17V-1 Wood Assembly Line

For each aluminum model biplane to be constructed:

1. Cut one 3/4 inch thick softwood round 2-1/2 inch diameter for F-1.
2. Cut one 3/4 inch thick softwood round 1-5/8 inch diameter for F-2.
3. Place bolt through hole in centre of wood round.
4. Place nut on bolt and tighten.
5. Place bolt with wood round in electric drill.
6. Use the drill to spin the wood round (F-1) and use the rasp to taper the edge to 10 degrees (to stock as F-1).
7. Use the drill to spin the wood round (F-2) and use the rasp to taper the edge to 10 degrees (to stock as F-2).

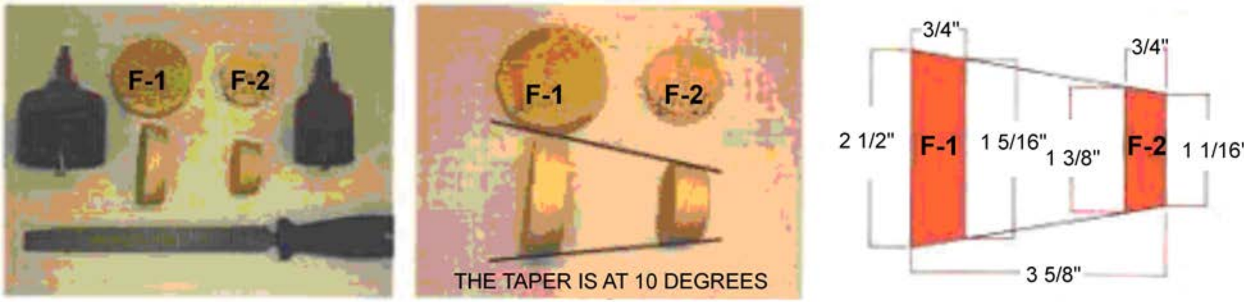

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Figure 17V-2 Steps to Make Rear Fuselage Parts

ALUMINUM BILLET ASSEMBLY LINE

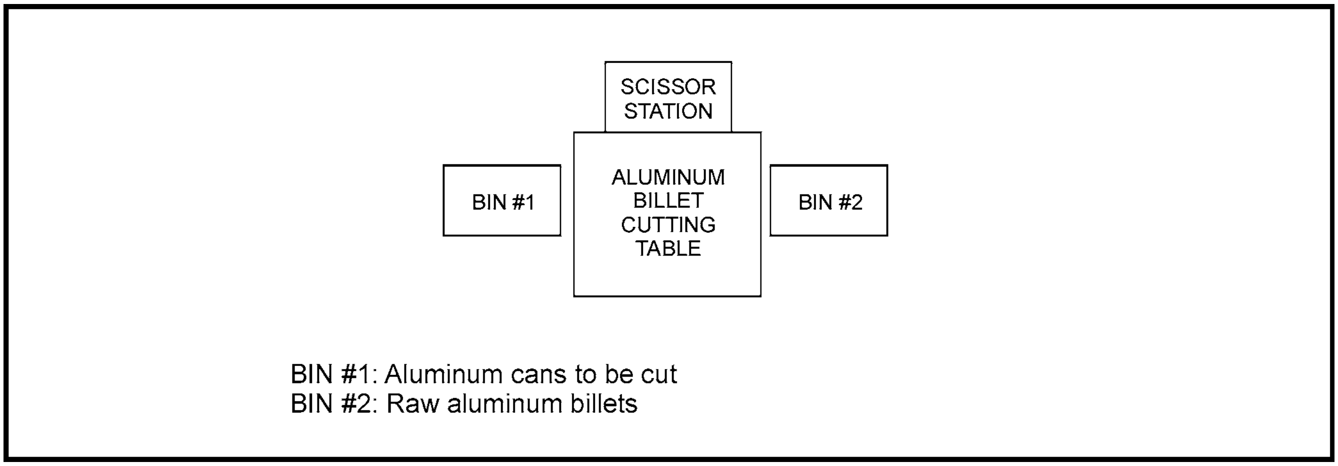

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Figure 17W-1 Aluminum Billet Assembly Line

For each aluminum model biplane to be constructed:

1. Cut 15 unended cans vertically through the nutrition label.
2. Do not attempt to flatten cans (to stock as raw billets).

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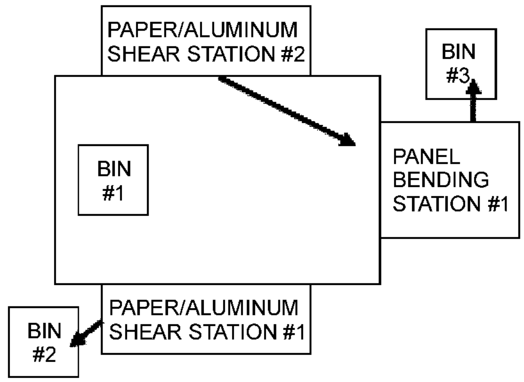
ALUMINUM PANEL SHEARING ASSEMBLY LINE



BIN #1: Raw aluminum billets from stock
BIN #2: Aluminum billets (dimensions of 2-5/8 inch by 8-1/8 inch) for under-wing panels
BIN #3: Aluminum billets (dimensions of 3-5/8 inch by 8-1/8 inch) for wing panels bent to 90 degrees on the 1/8-inch edge

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Figure 17X-1 Aluminum Panel Shearing Assembly Line

For each aluminum model biplane to be constructed:

1. Cut five billets to dimensions of 3-5/8 inch by 8-1/8 inch for wing panels (Figure 17X-2).
2. Bend these wing panels edges down 90 degrees on each 8-1/8 inch edge (to stock).
3. Cut five cans to dimensions of 2-5/8 inch by 8-1/8 inch for under-wing panels (Figure 17X-3) (to stock).

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Figure 17X-2 Wing Top Panels

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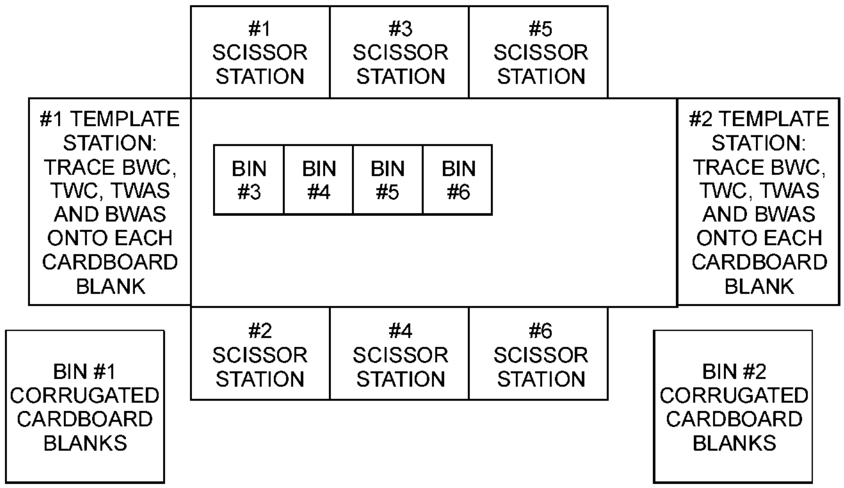
Figure 17X-3 Under-Wing Panels

CARDBOARD INSERT ASSEMBLY LINE



BIN #1: Corrugated cardboard blanks
BIN #2: Corrugated cardboard blanks
BIN #3: Bottom wing cardboard (BWC: 8-1/8 inch by 2-5/8 inch)
BIN #4: Bottom wing airfoil shaper (BWAS: 6-1/2 inch by 3/4 inch)
BIN #5: Top wing cardboard (TWC: 18-1/4 inch by 2-3/4 inch)
BIN #6: Top wing airfoil shaper (18-1/4 inch by 3/4 inch)

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Figure 17Y-1 Cardboard Insert Assembly Line

For each aluminum model biplane to be constructed, cut and place into stock:

1. two bottom wing cardboard sections (BWC) 8-1/8 inch by 2-5/8 inch,
2. two cardboard bottom wing airfoil sections (BWAS) 6-1/2 inch by 3/4 inch,
3. two top wing cardboard sections (TWC) 18-1/4 inch by 2-3/4 inch, and
4. two cardboard top wing airfoil sections (TWAS) 18-1/4 inch by 3/4 inch.

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WIRE STATION ASSEMBLY LINE

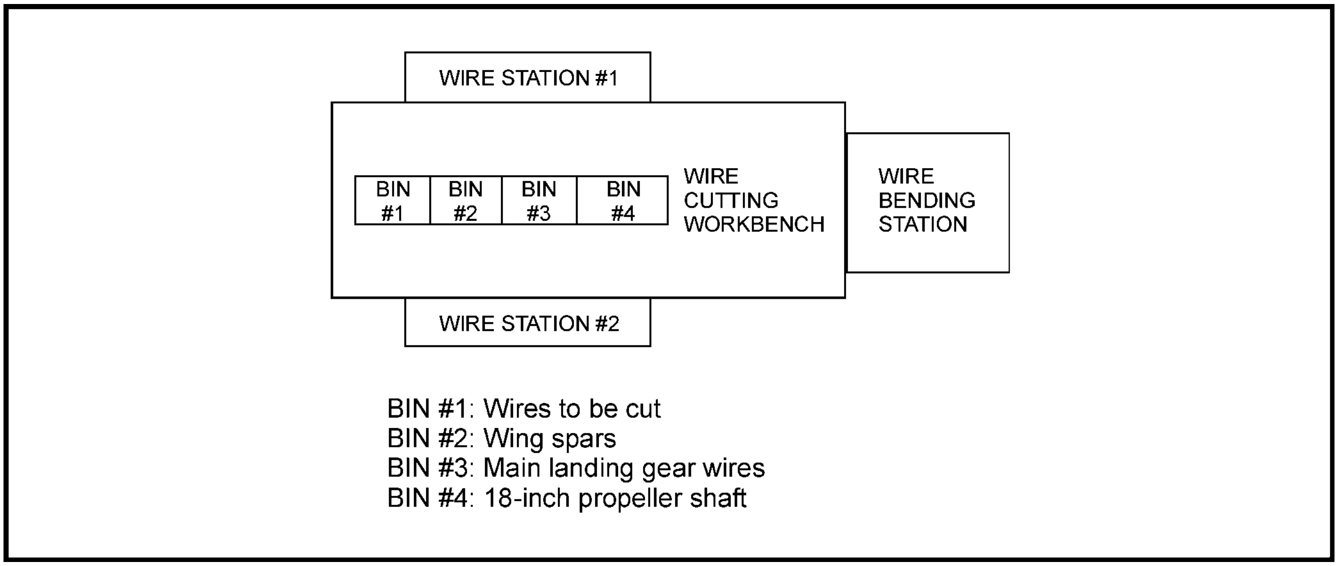

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Figure 17Z-1 Wire Station Assembly Line

For each aluminum model biplane to be constructed:

1. Cut two pieces of 3/32-inch wire 15-3/4 inches long (to stock for wing spars).
2. Cut one piece of 3/32-inch wire 18 inches long (to stock for propeller shaft).
3. Cut one piece of 3/32-inch wire 7-3/4 inches long (for main landing gear).
4. Bend the wire that is 7-3/4 inches long to main landing gear shape (Figure 17Z-2) (to stock).

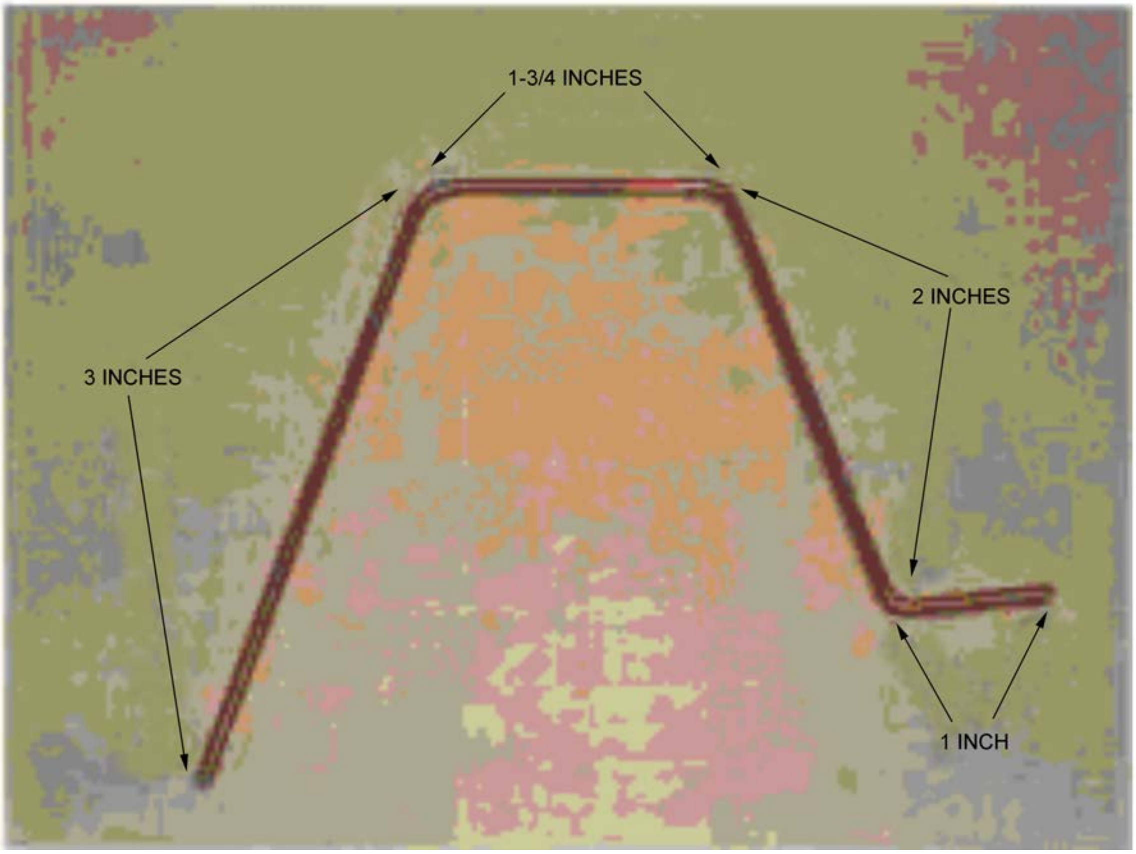

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Figure 17Z-2 First Bends of the Landing Gear

DRILL STATION ASSEMBLY LINE

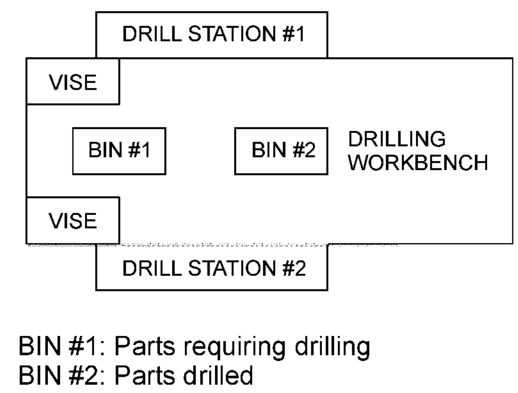

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Figure 17AA-1 Drill Station Assembly Line

For each aluminum model biplane to be constructed:

1. Drill a 3/32-inch hole in the centre of four bottle caps (to stock for wheels).
2. Drill a 3/32-inch hole in the centre of one can B-1 (Figure 17AA-2) (to stock for front fuselage).
3. Drill a 3/32-inch hole in the centre of one can P-2 (to stock for propeller).
4. Drill a 3/32-inch hole in the centre of one can P-1 (to stock for propeller face).
5. Get fuselage from stock.
6. Enlarge holes A, B and C in fuselage assembly to 3/32 inch (fuselage from stock).
7. Enlarge hole D in fuselage assembly to 1/16 inch (fuselage from stock).
8. Enlarge holes E and F in fuselage assembly to bolt size, as required.
9. Get top wing from stock.
10. Enlarge eight bolt holes in top wing for bolts as required (return top wing to stock).
11. Get fuselage and attached bottom wing from stock.
12. Enlarge four bolt holes in bottom wing as required (return fuselage and bottom wing to stock).
13. Insert under-wing panel (dimensions 2-5/8 inch by 8-1/8 inch) into right wing.

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Figure 17AA-2 The Fuselage Centre-Line Hole

ALUMINUM REAR FUSELAGE ASSEMBLY LINE

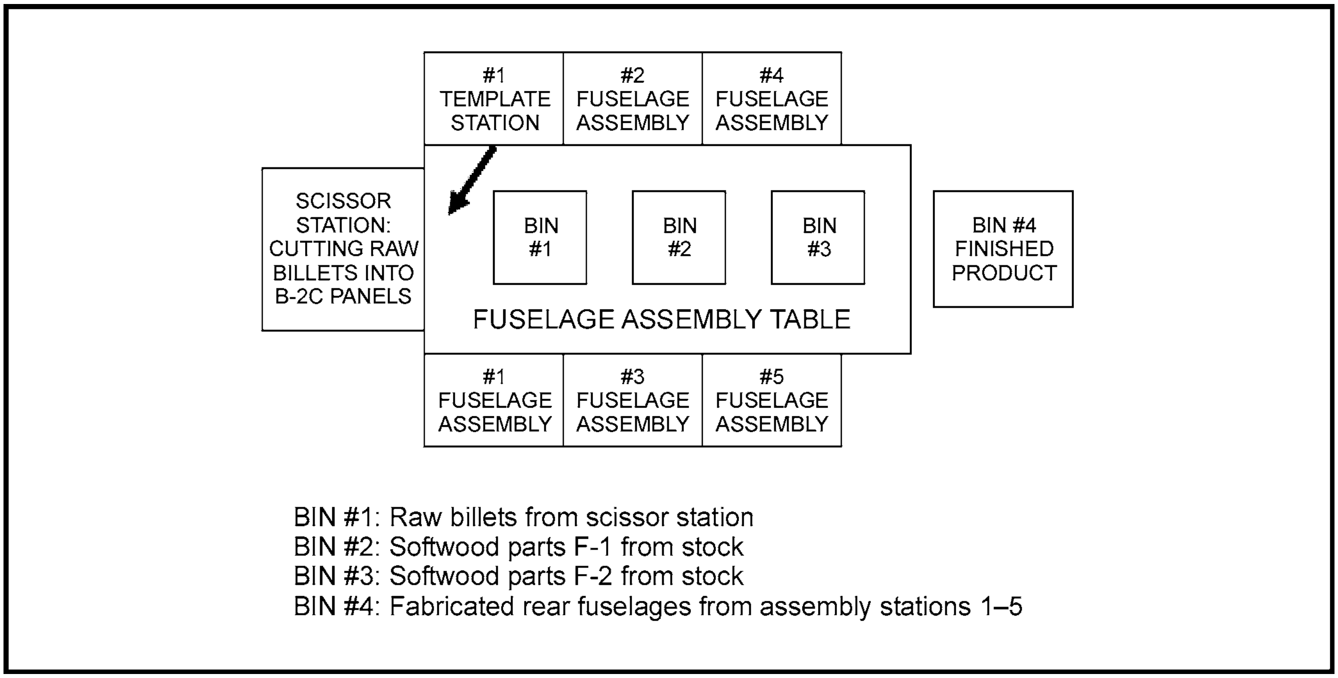

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Figure 17AB-1 Aluminum Rear Fuselage Assembly Line

For each aluminum model biplane to be constructed:

1. Mark one raw billet as B-2C rear fuselage.

2. Cut triangle from one raw billet to create B-2C rear fuselage (Figure 17AB-2) (to stock as B-2C).

3. Combine wood F1 and F2 with B-2C and staple to make rear fuselage B-2 (Figure 17AB-3) (to stock as B-2).

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Figure 17AB-2 Triangle Cut

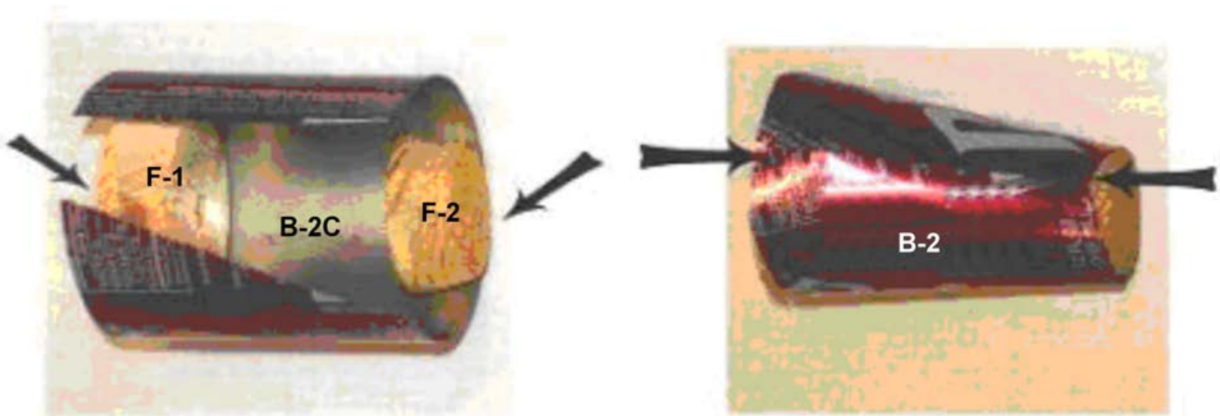

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Figure 17AB-3 Completing the Rear Fuselage

FUSELAGE AND BOTTOM WING ASSEMBLY LINE

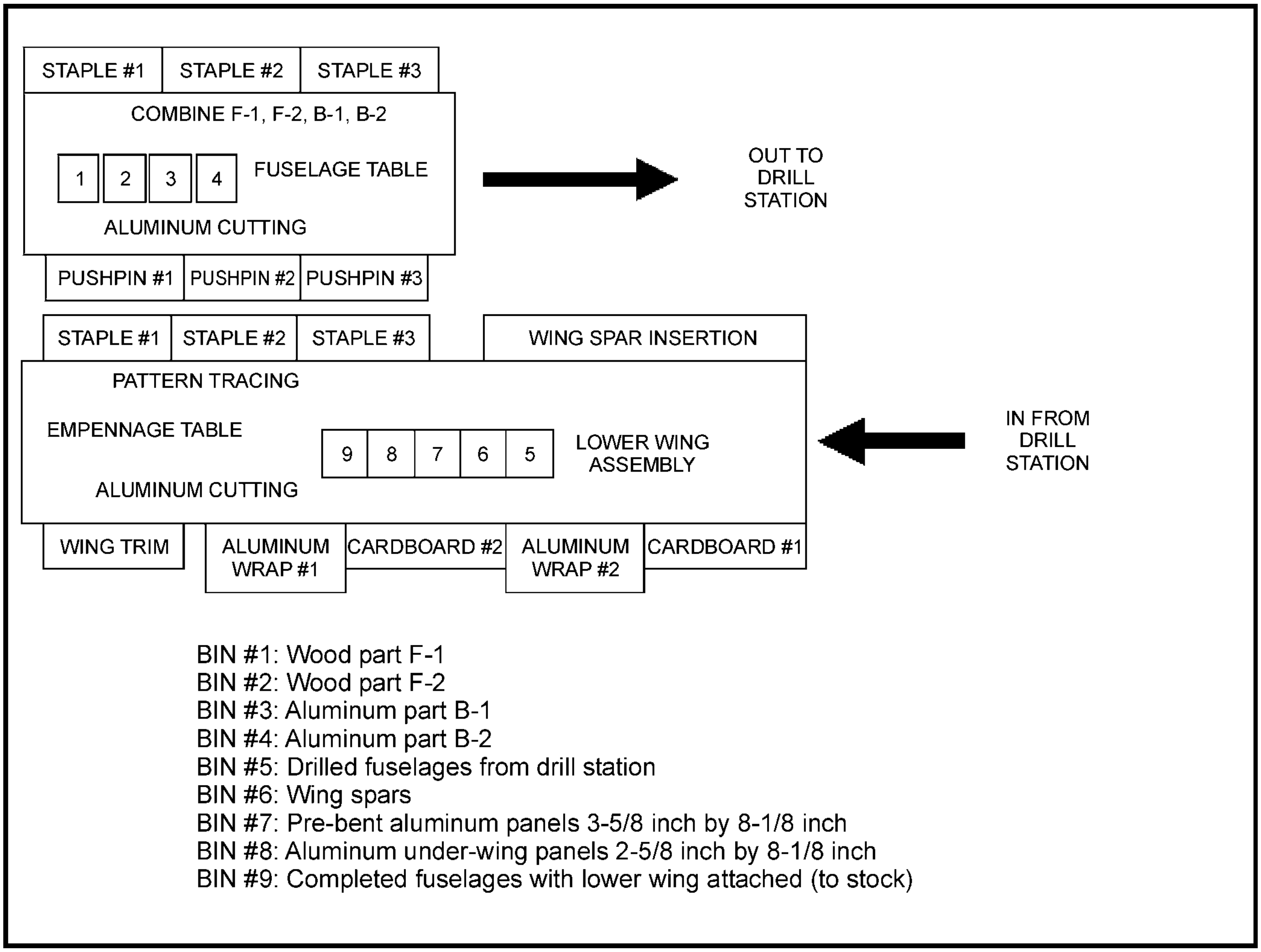

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Figure 17AC-1 Fuselage and Bottom Wing Assembly Line

For each aluminum model biplane to be constructed:

1. Combine parts F-1, F-2, B-1 and B-2 with staples to make a full fuselage (Figure 17AC-2).
2. Slide Template No. 1 over full fuselage (Figure 17AC-3).
3. Use push-pins to create holes in fuselage through Template No. 1.
4. Trace, but do not cut, the openings for the cockpit and windshield.
5. Remove Template No. 1 from fuselage (to stock for Drill Station).
6. Insert bottom wing spars in fuselage holes A and B (spars/fuselage from stock).
7. Tape cardboard parts BWC to bottom wing spars (BWC and spars from stock) (Figure 17AC-4).
8. Tape or glue cardboard part BWAS to top of BWC (BWAS/BWC from stock).
9. Repeat Steps 7. and 8. for other wing.
10. Wrap top of left bottom wing with pre-bent aluminum panel (from stock) (Figure 17AC-5).

11. Wrap top of right bottom wing with pre-bent aluminum panel (Figure 17AC-6) (from stock).
12. Insert under-wing panel (dimensions 2-5/8 inch by 8-1/8 inch) into left wing (Figure 17AC-7).
13. Insert under-wing panel (dimensions 2-5/8 inch by 8-1/8 inch) into right wing (Figure 17AC-7).
14. Staple panels (three staples) at left wing tip (Figure 17AC-8).
15. Staple panels (three staples) at right wing tip (Figure 17AC-8).
16. Trim wing tips to desired shape.
17. Make two slits for the windshield (Figure 17AC-9).
18. Trim cockpit aluminum to avoid blocking pilot hole in F-1 (Figure 17AC-10).
19. Carefully turn biplane upside down.
20. Split cockpit back in half so it will fold down and place wire insulation on cockpit edging (Figure 17AC-11).
21. Turn the Wing Bolt Hole Placement Template (WBHPT) upside down also, and apply WBHPT to the underside of the bottom wing Figure 17AC-12).
22. With a push-pin, make holes for four outer bolts in the bottom wing near the wing tips. Do not make holes near the fuselage (fuselage with bottom wing to stock).

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Figure 17AC-2 Fuselage Assembly

Building the B.C. Air Originals Biplane, by D. P. Mathis, B.C. Air Originals (p. 6)

Figure 17AC-3 Fuselage With Clear Mylar Template Placed Around

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Figure 17AC-4 Getting Its Wings

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Figure 17AC-5 Cladding the Wings

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Figure 17AC-6 Under the Wings

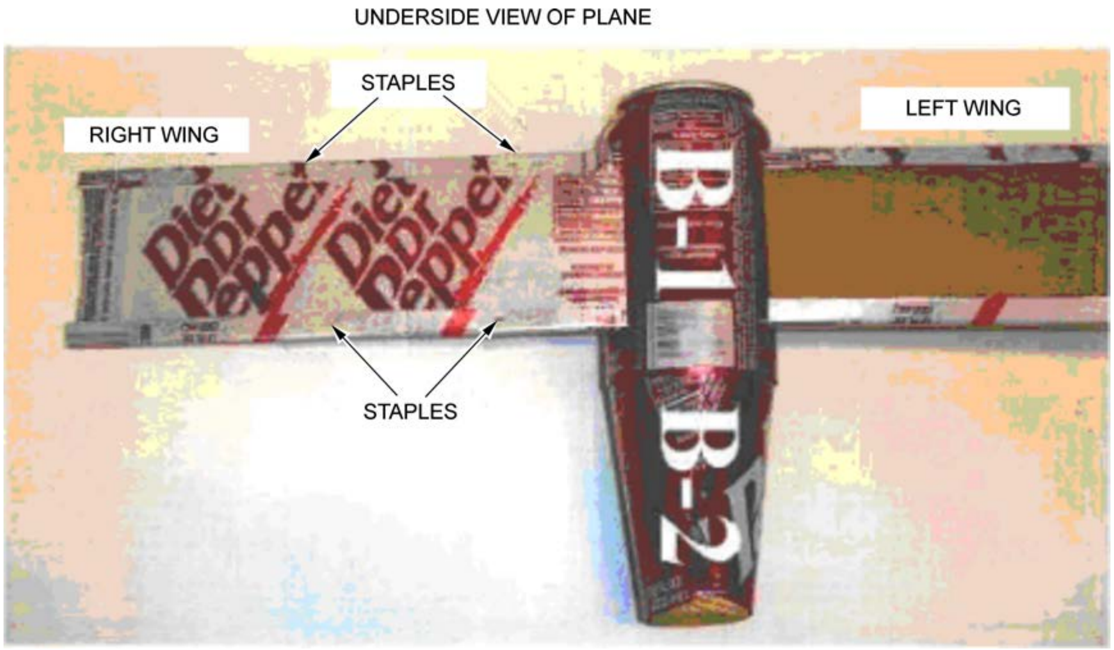

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Figure 17AC-7 Cladding the Under-wing

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Figure 17AC-8 Securing the Wing Tip

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Figure 17AC-9 Roughing the Cockpit and Windscreen

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Figure 17AC-10 Clearing the Centre Line

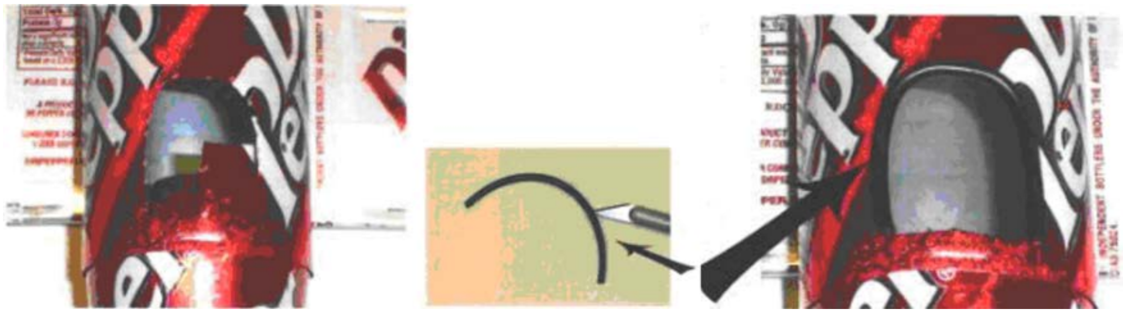

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Figure 17AC-11 Opening and Trimming the Cockpit

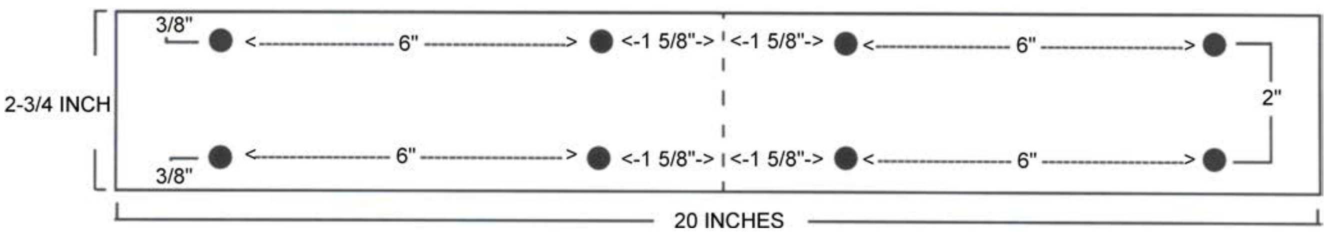

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Figure 17AC-12 Wing Bolt Hole Placement Template (WBHPT)

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TOP WING ASSEMBLY LINE

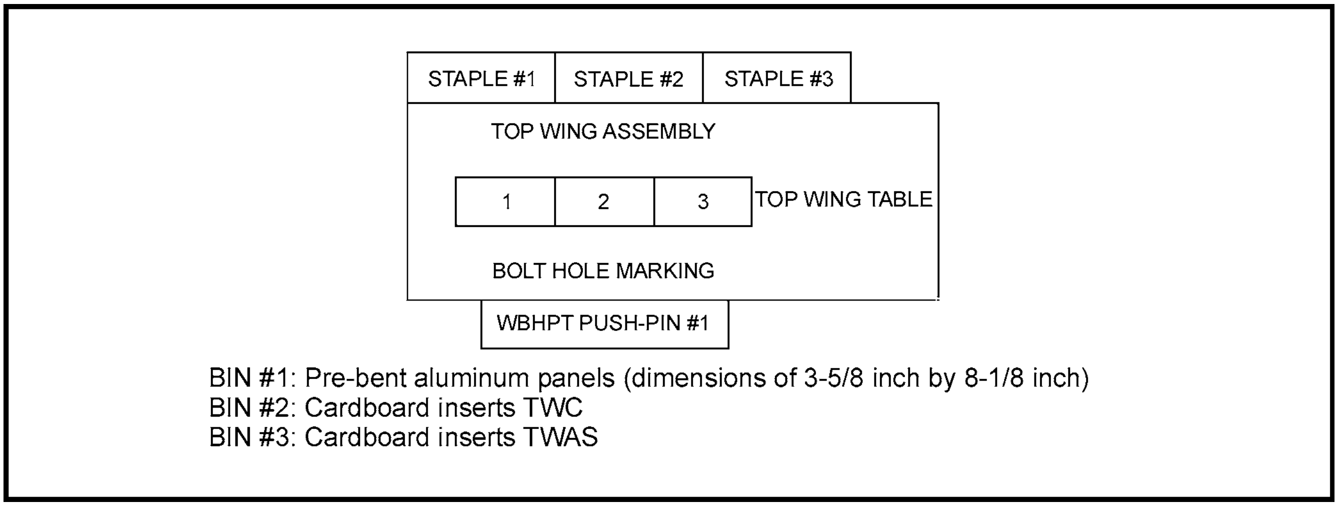

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Figure 17AD-1 Top Wing Assembly Line

For each aluminum model biplane to be constructed:

1. Combine cardboard parts TWC, TWAS and three pre-bent aluminum panels (dimensions of 3-5/8 inch by 8-1/8 inch) to form top wing (all from stock).
2. Insert panels (dimensions of 2-5/8 inch by 8-1/8 inch) under wing (from stock).
3. Staple top wing (ten staples).
4. Apply Wing Bolt Hole Placement Template (WBHPT) to top of top wing and with a push-pin, make eight holes for bolts in the top wing (top wing to stock).

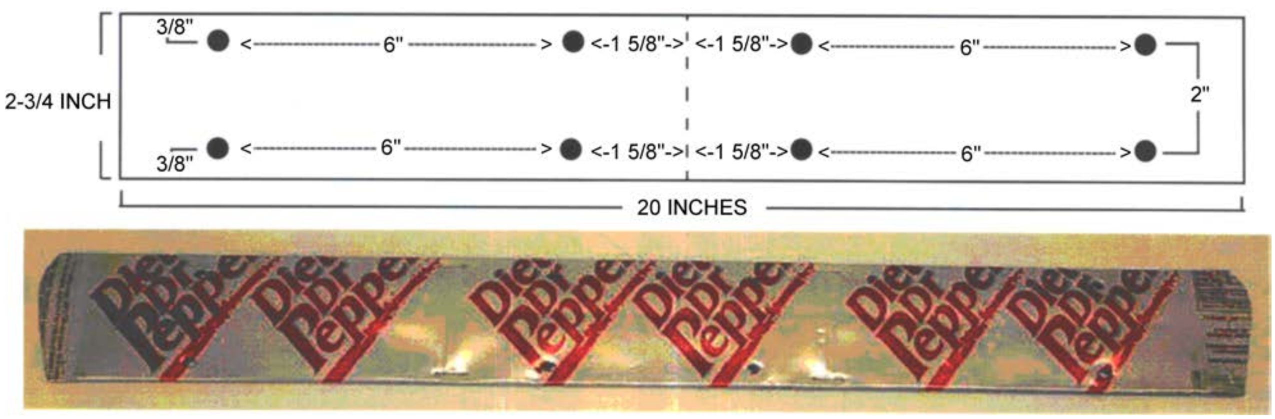

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Figure 17AD-2 Wing Bolt Hole Placement Template (WBHPT)

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EMPENNAGE ASSEMBLY LINE

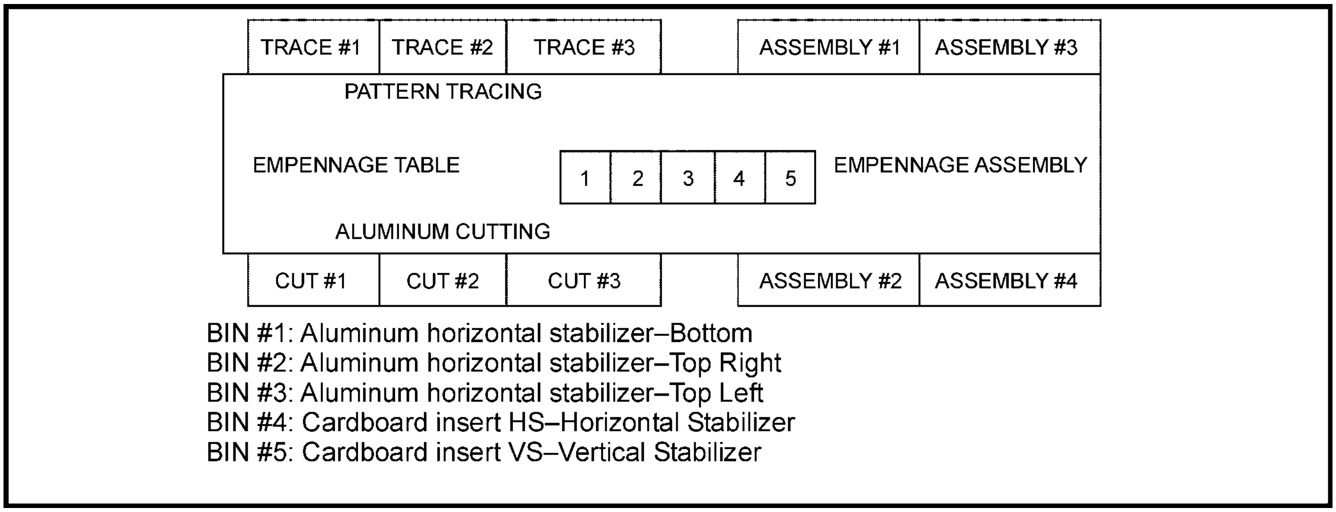

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Figure 17AE-1 Empennage Assembly Line

For each aluminum model biplane to be constructed:

1. Trace Template No. 8 onto one raw aluminum billet (from stock).
2. Cut with scissors (Figure 17AE-2).
3. Trace Template No. 9 onto one raw aluminum billet (from stock).
4. Cut with scissors one horizontal stabilizer top right (Template No. 9) (Figure 17AE-2).
5. Trace Template No. 10 onto one raw aluminum billet (from stock).
6. Cut with scissors one horizontal stabilizer top left (Template No. 10) (Figure 17AE-2).
7. Score one horizontal stabilizer bottom (Template No. 8).
8. Score one horizontal stabilizer top right (Template No. 9).
9. Score one horizontal stabilizer top left (Template No. 10).
10. Combine cardboard pieces HS and VS with aluminum parts (Figure 17AE-3), to include:
    (a) one scored horizontal stabilizer bottom (Template No. 8),
    (b) one scored horizontal stabilizer top right (Template No. 9), and
    (c) one scored horizontal stabilizer top left (Template No. 10).
11. Carefully bend the aluminum parts to form a complete empennage (Figure 17AE-4).
12. Staple the complete empennage.

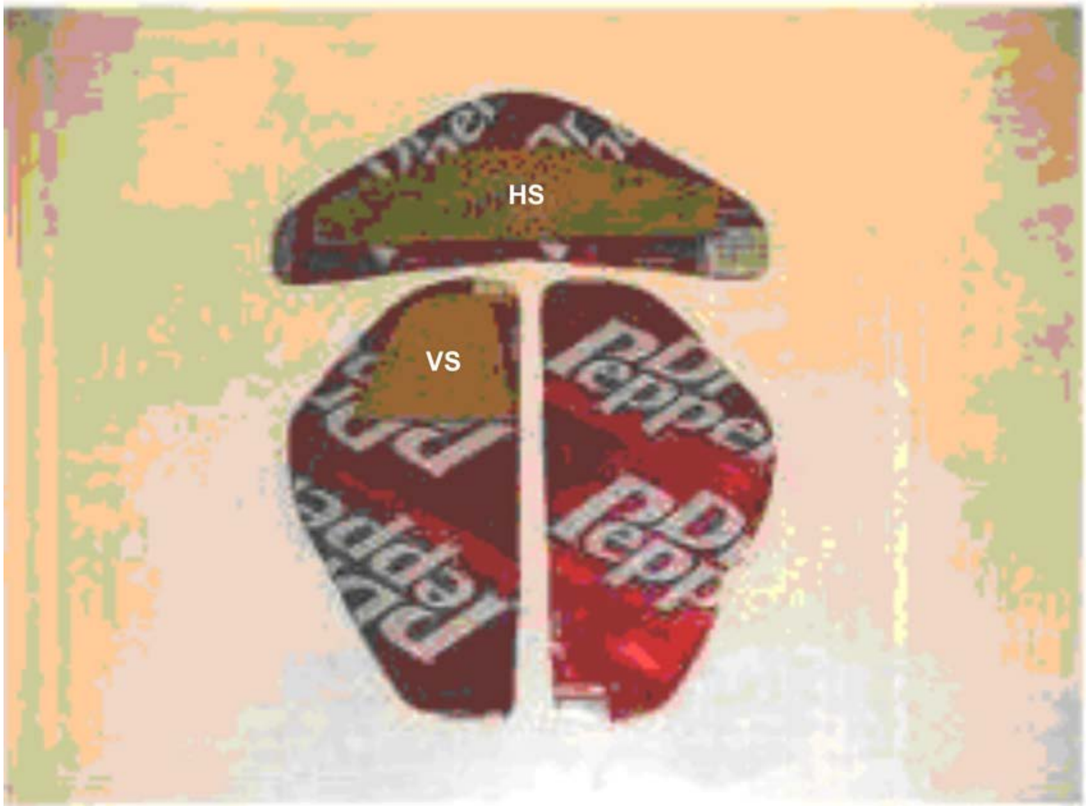

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Figure 17AE-2 Parts of the Empennage

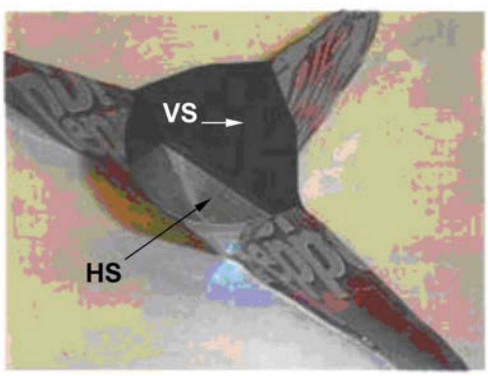

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Figure 17AE-3 Forming the Empennage

Match up the left and right Vertical Stabilizer parts and staple them together, placing staples approximately 3/8 inch from the outside edge. Insert cardboard VS between the two Vertical Stabilizer halves.

Match up the Horizontal Stabilizer parts and staple only the back end together. Insert the cardboard HS between the Horizontal Stabilizer panels.

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Figure 17AE-4 Forming the Empennage

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PROPELLER ASSEMBLY LINE

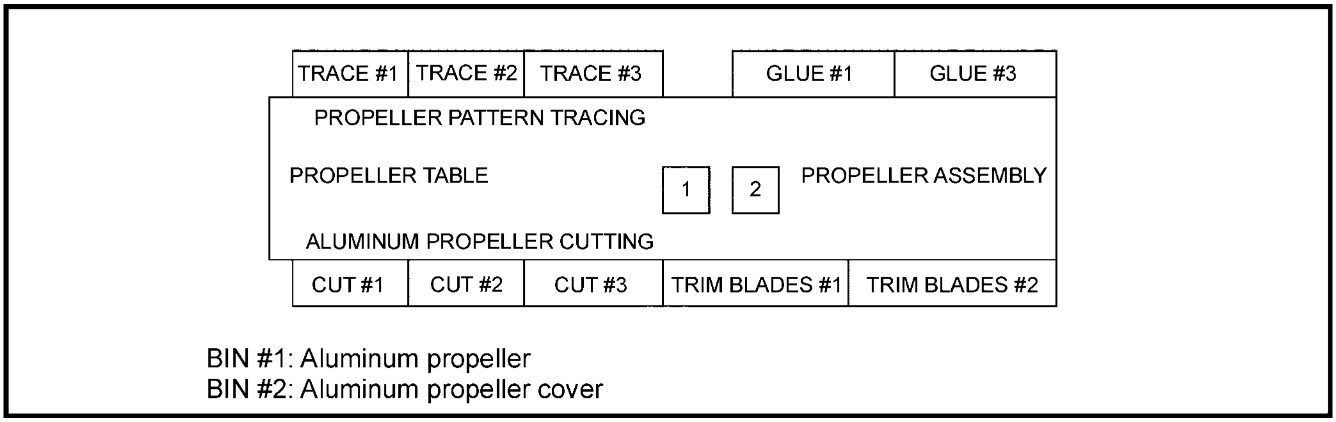

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Figure 17AF-1 Propeller Assembly Line

For each aluminum model biplane to be constructed:

1. Place fan propeller template over part P-2 (from stock) and mark propeller blades of part P-2.
2. Cut propeller blades into part P-2.
3. Bend propeller blades out from part P-2 (Figure 17AF-3).
4. Trim propeller blade tip corner edges (completed propeller to stock).

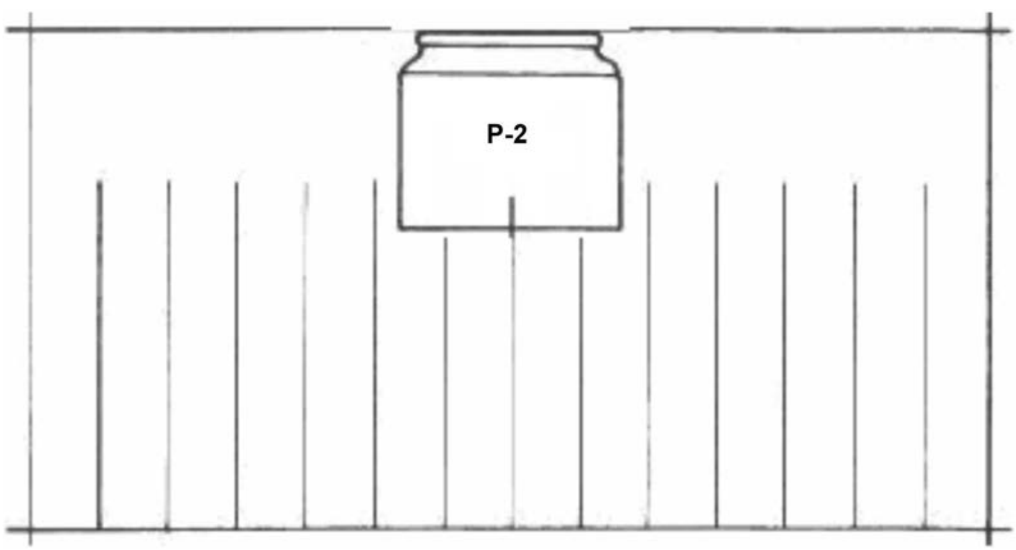

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Figure 17AF-2 Marking the Propeller

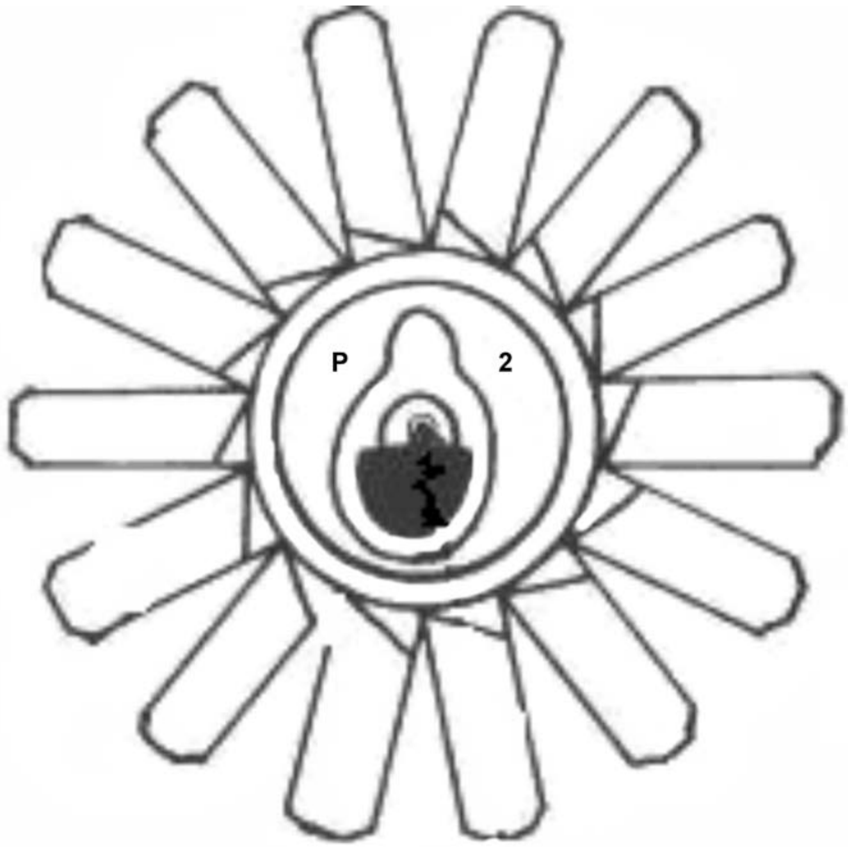

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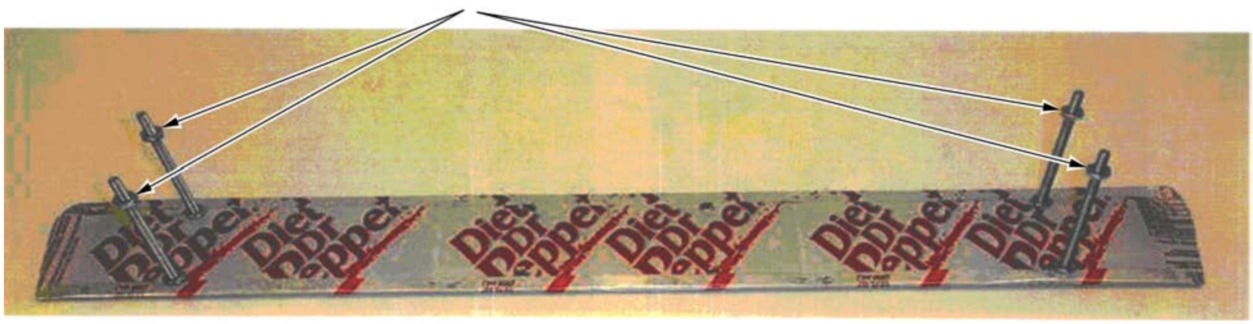
Figure 17AF-3 Fan Propeller

FINAL ASSEMBLY

Each cadet will receive a full set of aluminum model biplane assemblies and parts, to include:

- one completed empennage assembly,
- one completed fan propeller assembly,
- one completed top wing assembly,
- one completed fuselage with bottom wing assembly,
- one landing gear wire,
- four 3-1/2-inch 10/24 bolts c/w 12 nuts to act as interplane struts,
- four 2-1/2-inch 10/24 bolts c/w eight nuts to act as cabane or centre-section struts,
- one metre of heavy-duty black thread to act as flying and landing wires,
- a length of 3/32-inch wire 18 inches long to act as the propeller shaft, and
- a length of 1/16-inch wire 6-3/4 inches long for a landing gear support wire.

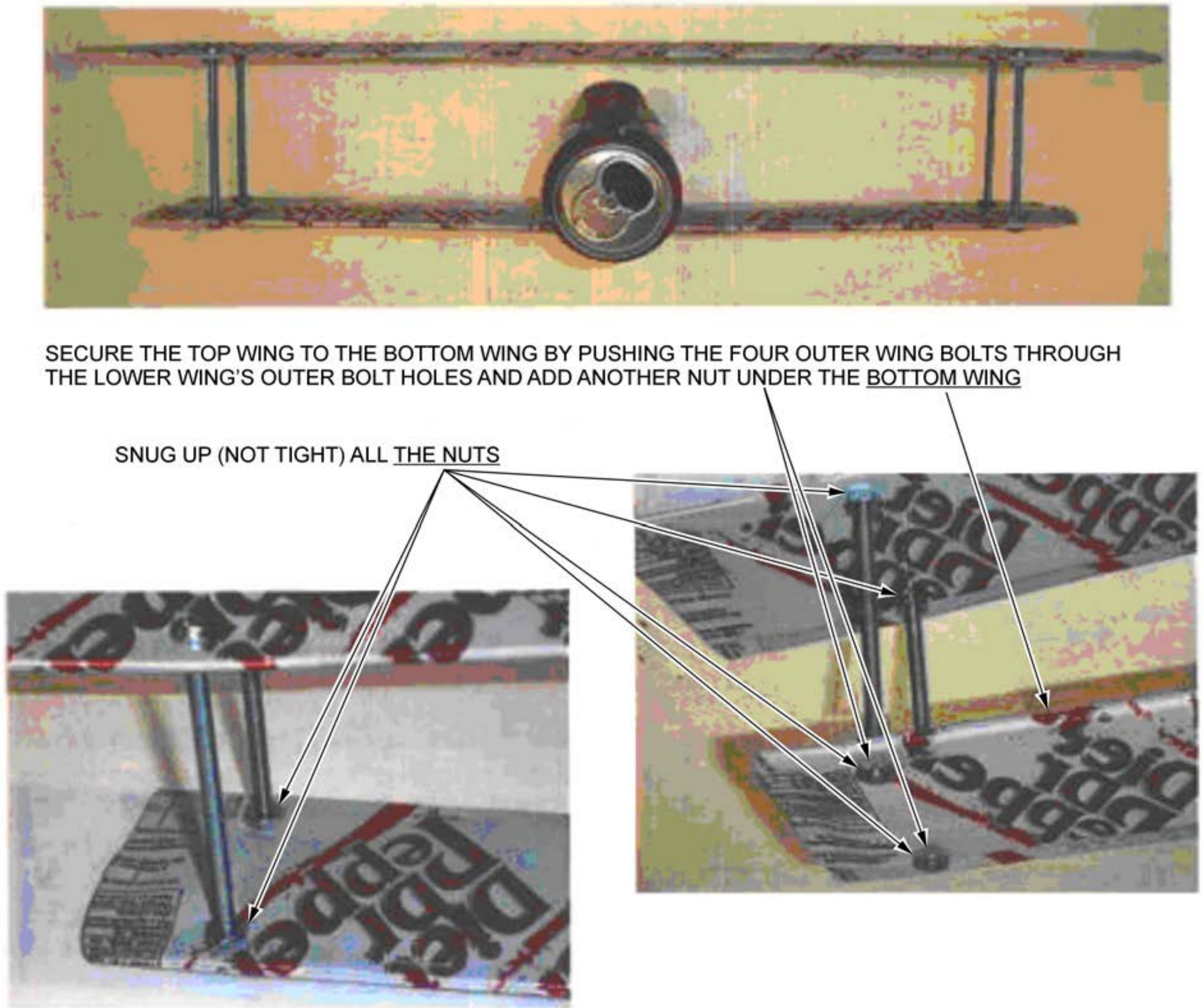
1. Place four 3-1/2-inch 10/24 bolts through the outer holes in the top wing and secure snugly with a nut under the top wing and place another nut near the bottom of the bolts.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 12)

Figure 17AG-1 Interplane Struts

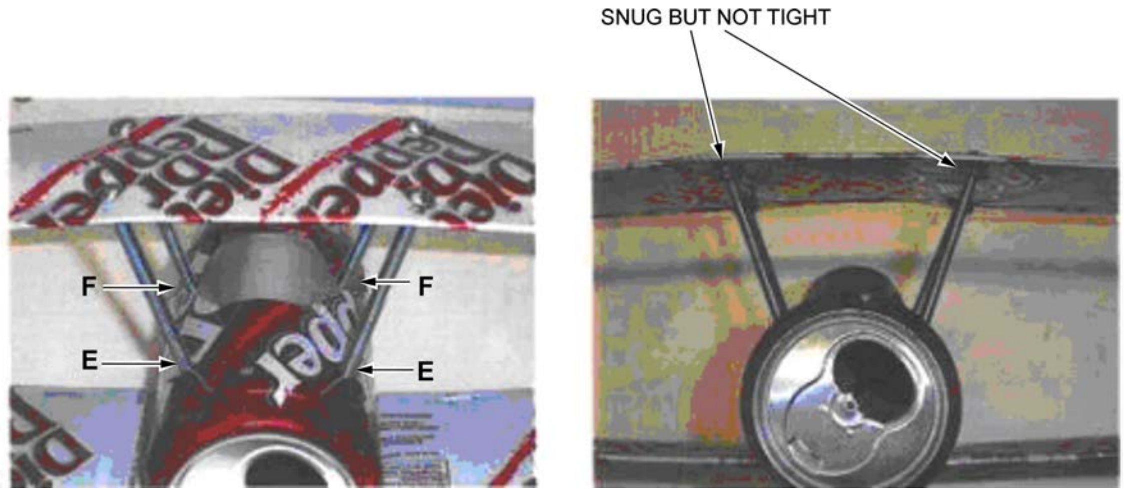
2. Secure the top wing to the bottom wing by pushing the four outer bolts through the bottom wing outer holes and threading the nuts down the bolts until they touch the upper surface of the bottom wing.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 13)

Figure 17AG-2 Top Wing

3. Secure the top wing to the fuselage by inserting four 2-1/2-inch 10/24 bolts through the top wing and threading two nuts on the ends of the bolts; then thread the bolt ends into the two front holes E and the two back holes F in the fuselage, making the nuts snug against the underside of the top wing and also the fuselage.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 13)

Figure 17AG-3 Cabane Struts

4. Install the landing wires.

D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 14)

Figure 17AG-4 Landing Wires

(a) To rig the plane, start by loosening the nut under the top wing outer front bolt (position 1 above).

(b) Wrap the line twice, between the nut and the aluminum, then tighten the nut.

(c) Now draw the line down to where the front wing spar goes into hole A in B-1 (position 2 above).

(d) Thread the line around the front wing spar, then draw it to the back wing spar (position 3 above).

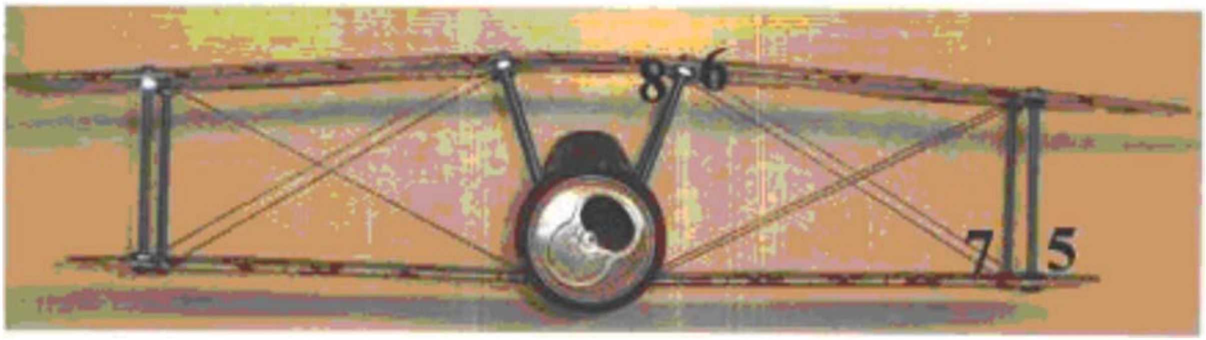
(e) Thread the line around the back wing spar where it goes into hole B in B-1, then draw it up to the nut under the top wing outer back (position 4 above).

(f) Loosen this nut, wrap the line twice around the bolt between the nut and the aluminum, then tighten the nut.

(g) Repeat this on the other wing of the biplane.

5. Install the flying wires.

   (a) Loosen the outer front nut on the top of the bottom wing (position 5 below) and wrap the line twice around the bolt, between the nut and the aluminum, and then tighten the nut.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 14)

Figure 17AG-5 Flying Wires

   (b) Draw the line up to the inner front nut on the top wing (position 6 above).

   (c) Loosen the nut, wrap the line twice around the bolt, between the nut and the aluminum, and tighten the nut.

   (d) Repeat this on the other wing of the biplane.

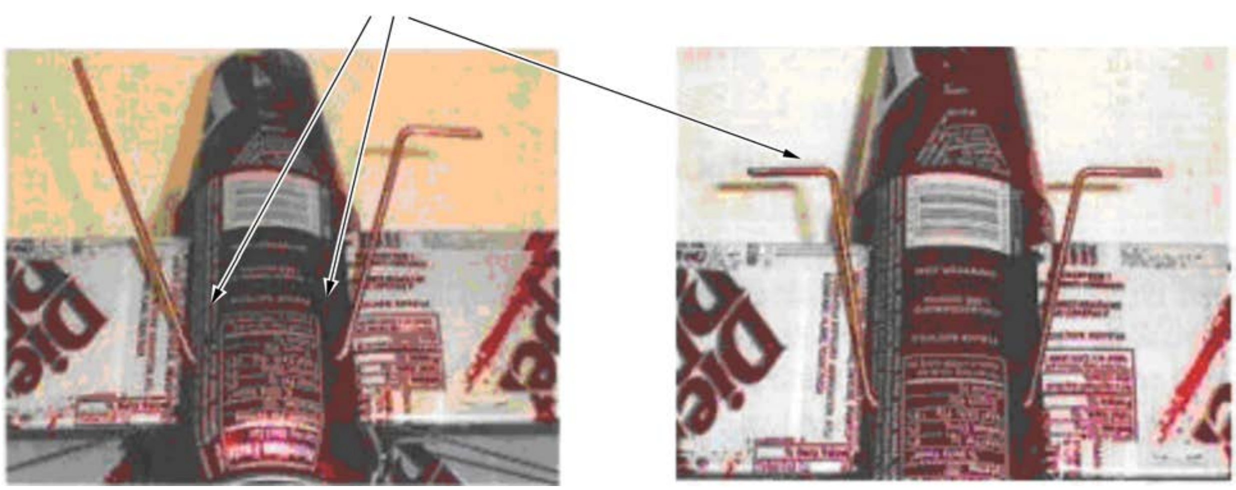
   (e) Loosen the outer back nut on the top of the bottom wing (position 7 above) and wrap the line twice around the bolt, between the nut and the aluminum, then tighten the nut.

   (f) Draw the line up to the inner back nut on the top wing (8). Loosen the nut and wrap the line twice around the bolt and tighten the nut.

   (g) Cut off all excess line.

   (h) Repeat this on the other wing of the biplane.

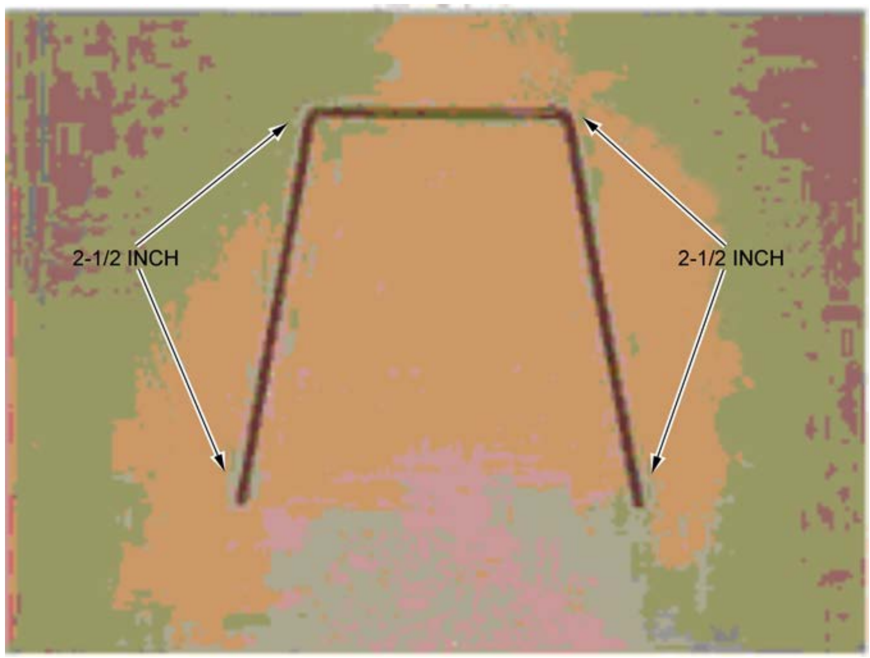
6. Insert the landing gear wire through holes C and have the instructor make the final bend.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 15)

Figure 17AG-6 Main Landing Gear

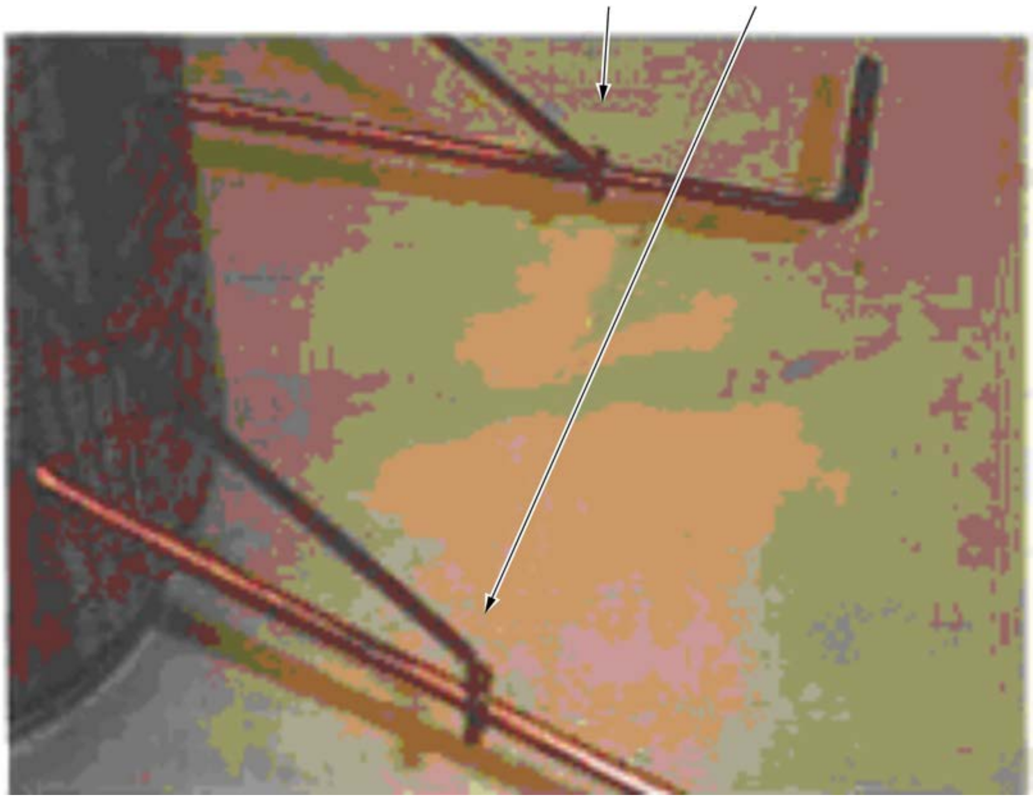
7. Bend the 1/16-inch wire that is 6-3/4 inches long into shape as a support wire.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 15)

Figure 17AG-7 Main Landing Gear Support Structure

8. Insert the support wire through holes D in the fuselage and crimp it around the main landing gear wire.

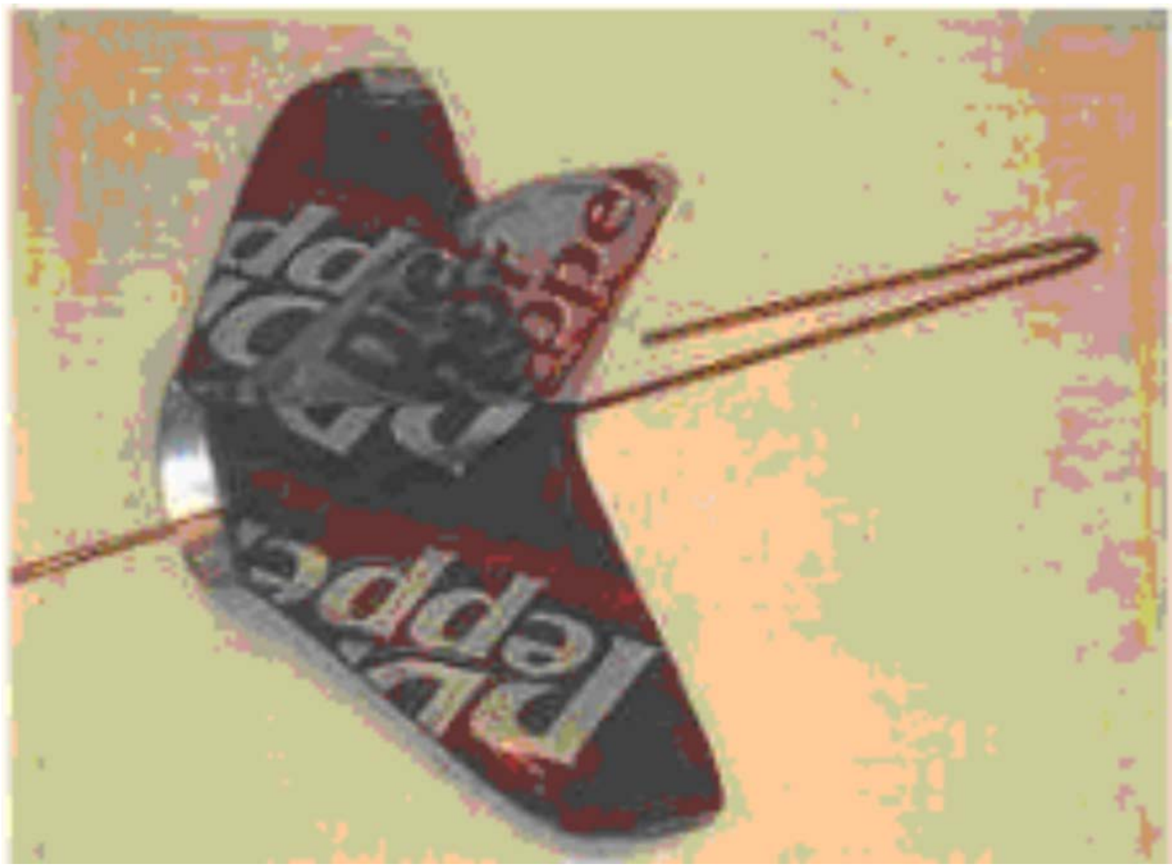


D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 15)

Figure 17AG-8 Crimping the Landing Gear Support

9. To attach the empennage to the fuselage, take a piece of 3/32-inch wire 18 inches long and make a 4-inch hook on one end to make the propeller shaft:

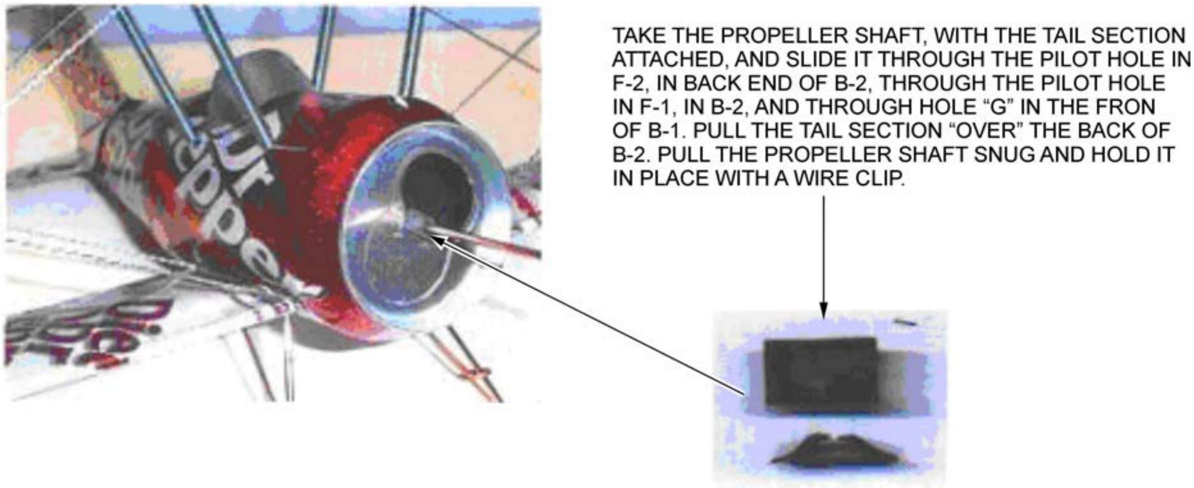
   (a) insert the propeller shaft through the hole in the back of the empennage under the horizontal stabilizer cardboard and the smaller section of wire goes over the horizontal stabilizer cardboard; and



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 16)

Figure 17AG-9 Propeller Shaft Installation

   (b) insert the propeller shaft, with the empennage attached, through the pilot hole in the wood piece F-2, through the pilot hole in wood piece F-1 and through hole G in the front fuselage section part B-1. Pull the empennage over the rear of part B-2 at the rear of the fuselage. Pull the propeller shaft snug and hold it in place with a wire clip at the front of the fuselage part B-1.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 17)

Figure 17AG-10 Propeller Shaft Wire Clip Installation

10. To fabricate the rear skid, take a piece of 3/32-inch wire and form it into the shape shown. Drill a hole through the fuselage into the bottom of wood piece F-2. Insert and glue the tail skid into place.

D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 17)

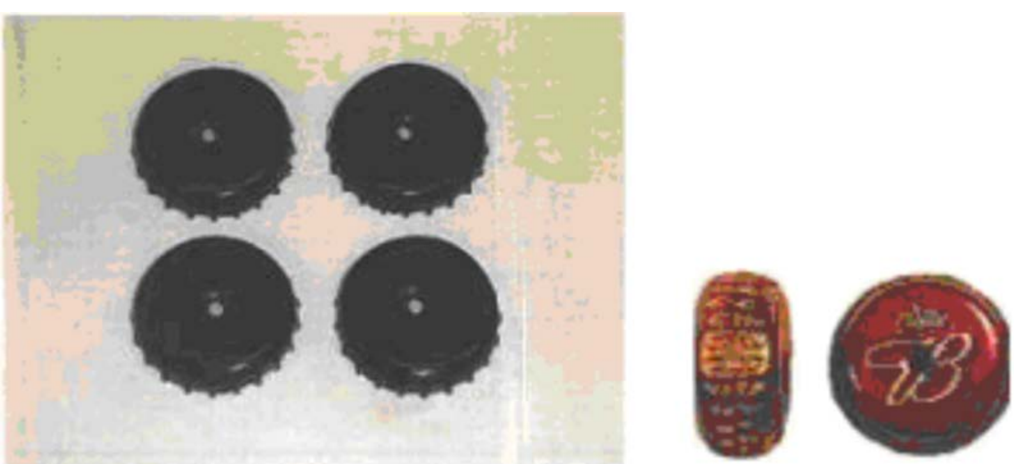
Figure 17AG-11 Tail Skid Fabrication

11. Insert two windshield tabs into their slits as shown. Glue the windshield and the cockpit rubber into place.

D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 17)

Figure 17AG-12 Windscreen Installation

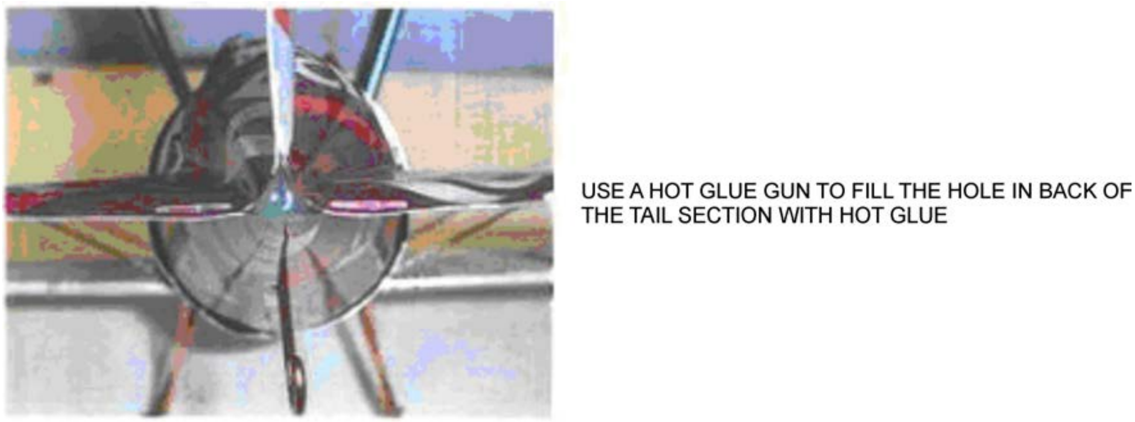
12. Using four bottle caps with holes through the centre, glue pairs together to make wheels as shown. Place and glue the two wheels on the main landing gear wires.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 18)

Figure 17AG-13 Bottle-Cap Wheels

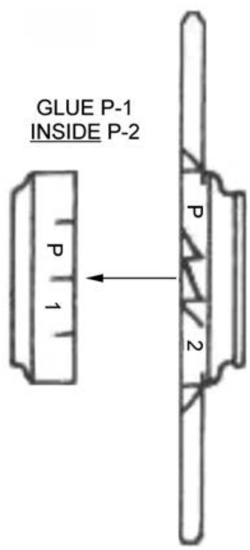
13. Fill the hole at the rear of the empennage with glue.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 17)

Figure 17AG-14 Tail Light

14. Attach the propeller part P-2 to the front of the fuselage by slipping it over the propeller shaft. Place the propeller cover part P-1 over the face of P-2 and glue it into place inside of P-2.



D. P. Mathis, Building the B.C. Air Originals Biplane, B.C. Air Originals (p. 21)

Figure 17AG-15 Finishing Touch

B.C. Air Originals "FAQ" Biplane. Retrieved November 19, 2007, from http://www.bcair.com/faq/index.htm

Figure 17AG-16 Aluminum Model Biplane

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CHAPTER 18

PO 390 – NAVIGATE A ROUTE USING A MAP AND COMPASS

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 1

EO M390.01 – IDENTIFY PARTS OF THE COMPASS

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1 and 2 to present background material and introduce the parts of a compass to the cadets.

Demonstration and performance was chosen for TP 3 as it allows the instructor to explain and demonstrate the skill the cadet is expected to acquire while providing an opportunity for the cadets to practice setting a predetermined declination under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified the parts of the compass and set a predetermined declination.

IMPORTANCE

It is important for cadets to understand the principles on how a compass works, recognize the parts of the compass and be able to set the magnetic declination on the compass. This basic knowledge will aid the cadet in learning how to use the compass as a navigational tool.

Teaching Point 1 | **Explain the Principles Behind the Workings of a Compass**

Time: 5 min | Method: Interactive Lecture

INTRODUCTION

The compass is an important tool used in wilderness navigation. It is not a replacement for good map-reading skills; however it is a trustworthy tool to complement and complete ground navigation. A compass user must take care to be precise in compass measurements. A small error in calculation or measurement can equal a significant error in the field.

A magnetic compass remains viable as a navigational aid, even with the advent of Global Positioning System devices, because it does not require batteries and remains reliable year after year.

CHINESE FLOATING COMPASS

Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-33)

Figure 18-1-1 Chinese Floating Compass

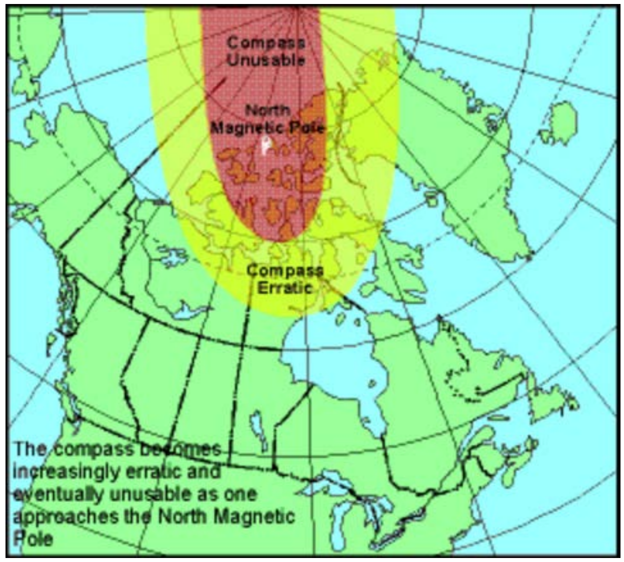
The Chinese had discovered the orienting effect of magnetite, or lodestone as early as the 4th century BC. In 101 BC, Chinese ships reached the east coast of India for the first time, possibly with help from a magnetic compass. By the 10th century, they had developed a floating compass for use at sea. Western Europeans had developed one by 1187, Arabs by 1220, and Scandinavians by 1300. Columbus used a magnetic compass on his first transatlantic trip in 1492.

HOW A COMPASS WORKS

Regardless of intended purpose or complexity of construction, most compasses operate on the same basic principle. A small, elongated, permanently magnetized needle is placed on a pivot so that it may rotate freely on the horizontal plane. The earth's magnetic field, which is shaped approximately like the field around a simple bar magnet, exerts forces on the compass needle causing it to rotate until it comes to rest in the same horizontal direction as the magnetic field. Over much of the earth this direction is roughly running between north and south, which accounts for the compass's importance in navigation.

The earth has a north and south magnetic pole. These magnetic poles correspond roughly with the actual geographical poles. The north magnetic pole is located (2005 estimate) at approximately 82.7 degrees N latitude and 114.4 degrees W longitude, which lies over 800 km from the north geographic pole.

The horizontal force of the magnetic field, responsible for the direction in which a compass needle is oriented, decreases in strength as one approaches the north magnetic pole. This decrease is due to the lines of force changing direction towards the vertical as they bend back into the earth at the north magnetic pole towards the south magnetic pole. The compass starts to behave erratically, and eventually as the horizontal force decreases even more, the compass becomes unusable.



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-33)

Figure 18-1-2 Earth's Magnetic Field

The nature of the earth's magnetic field is such that the magnetic north pole shifts geographic position about 5–10 km per year. Natural phenomena, like earthquakes, may also shift the magnetic field.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Why is the compass such an important navigational tool?

Q2. Approximately how far can the north magnetic pole shift in a year?

Q3. Why does a compass become less accurate the further north a person travels?

ANTICIPATED ANSWERS

A1. Over much of the earth, a compass roughly indicates the direction of true north, which accounts for the compass's importance in navigation.

A2. The magnetic north pole shifts geographic position about 5–10 km per year.

A3. The horizontal force of the magnetic field, responsible for the direction in which a compass needle is oriented, decreases in strength as one approaches the north magnetic pole. This decrease is due to the lines of force changing direction towards the vertical as they bend back into the earth at the north magnetic pole towards the south magnetic pole. The compass starts to behave erratically, and eventually as the horizontal force decreases even more, the compass becomes unusable.

Teaching Point 2 — **Identify and Describe the Parts of the Compass**

Time: 10 min — Method: Interactive Lecture

Divide the cadets into equal groups according to the number of compasses available. Starting with the compass opened, use Figures 8-1-3 and 8-1-4 to identify the parts of the compass.

PARTS OF THE COMPASS

A – Sight. Located at the top of the compass cover. Used to align on an objective when taking a bearing or to observe one along a given bearing.

B – Compass Cover. Protects the compass dial and houses the sighting mirror.

C – Sighting Mirror. Used to see the compass dial while taking a bearing.

D – Sighting Line. Used when aligning an objective or observing along a bearing.

E – Luminous Index Point. At the top of the compass dial and where a bearing is set or read from.

F – Compass Dial. Houses the magnetic needle, the orienting arrow, the meridian lines, the declination scale (on the inside) and the dial graduations (on the outside).

G – Dial Graduations. The compass dial is graduated in 2-degree divisions from 0 to 360 degrees. The dial is rotated by hand.

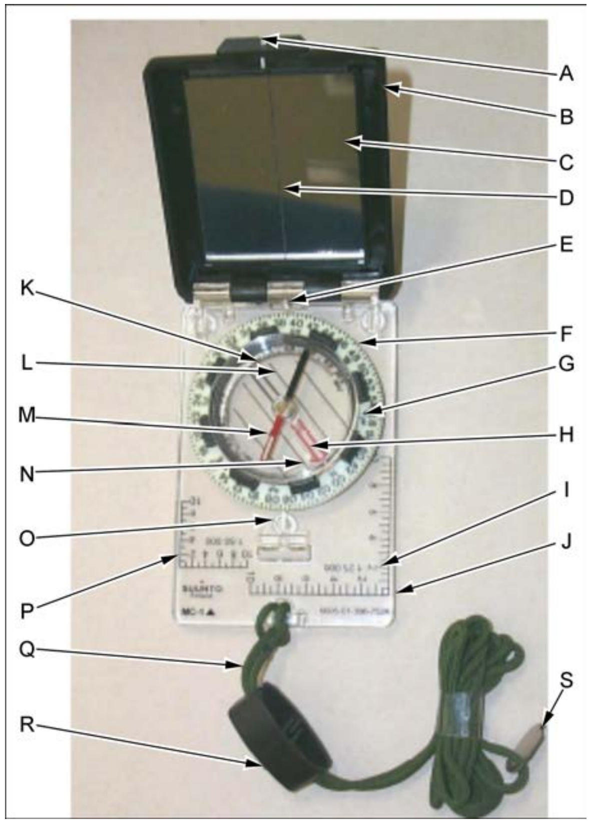
H – Orienting Arrow. The black and red orienting arrow is located inside the compass dial and is used to line up with the magnetic needle when taking a bearing on the ground. The orienting arrow is what is adjusted when the magnetic declination is set.

I – Romer 1 : 25 000. Used to measure six-figure grid references (GRs) on maps with a 1 : 25 000 scale.

J – Compass Base Plate. A clear piece of flat plastic to which the cover, dial and lanyard are attached.

K – Declination Scale. Used when adjusting the orienting arrow and while setting the magnetic declination for the map being used. It is graduated in 2-degree divisions.

L – Compass Meridian Lines. Black or red lines inside the compass dial. They are used to line up the compass dial with the grid lines (eastings) on a map.



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-33)

Figure 18-1-3 Compass

M – Magnetic Needle. Spins freely and points towards magnetic north. The south end of the compass needle is black and the north end, with a luminous patch, is red.

When the magnetic needle is lined up in the red end of the orienting arrow, the mnemonic device "Red in the Bed" is used to remember that the red end of the needle belongs in the red end of the arrow.

N – Luminous Orienting Points. There are two luminous orienting points located on either side of the red end of the orienting arrow.

O – Luminous Index Point. At the bottom of the compass dial; where a back bearing is read from.

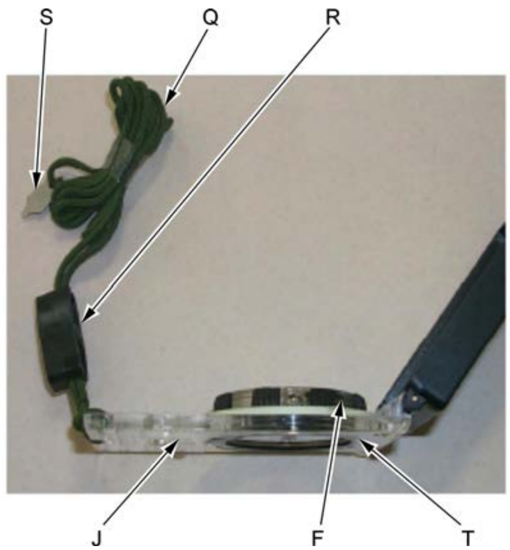
P – Romer 1 : 50 000. Used to measure six-figure GRs on maps with a 1 : 50 000 scale.

Q – Safety Cord or Lanyard. Used to fasten the compass to the wrist (never around the neck).

R – Adjustable Wrist Lock. Used to attach the compass to the wrist.

S – Screwdriver. Located at the end of the safety cord and is used to turn the screw to adjust the orienting arrow's position on the declination scale.

T – Declination Adjusting Screw. Located on the back side of the compass dial and is used to adjust the orienting arrow's position on the declination scale.



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-34)

Figure 18-1-4 Compass

After being exposed to a strong light source, the luminous parts of the compass will glow in the dark making operating the compass at night possible.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is the purpose of the 1 : 25 000 and 1 : 50 000 romers?

Q2. What colour is the north end of the magnetic needle?

Q3. Where should the safety cord or lanyard of the compass never be placed?

ANTICIPATED ANSWERS

A1. The purpose of these romers is to measure six-figure GRs on maps with 1 : 25 000 and 1 : 50 000 scale respectively.

A2. The north end of the magnetic needle is red.

A3. The safety cord or lanyard of the compass should never be placed around a person's neck.

Teaching Point 3	**Explain, Demonstrate and Have Cadets Set a Predetermined Declination**
Time: 10 min	Method: Demonstration and Performance

Explain and demonstrate setting a predetermined declination as listed below, prior to the cadets' practicing. Calculating declination may be taught in EO C390.05 (Calculate Magnetic Declination, Section 10).

Do not go into too much detail about the three norths as this material will be covered in EO M390.05 (Determine Bearings on a Map and on the Ground, Section 5).

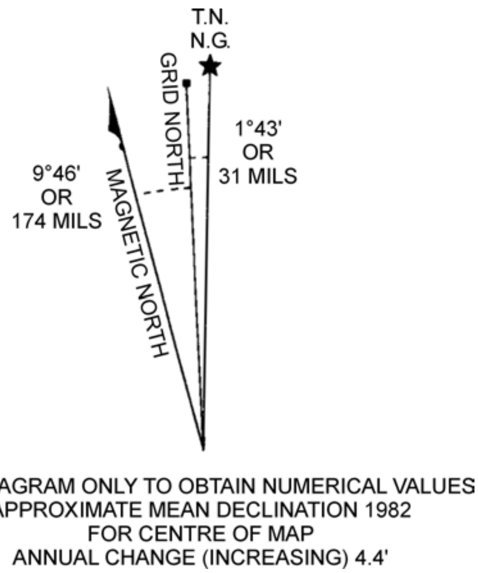
DECLINATION

Magnetic declination is the difference in bearing either between grid north and magnetic north or between true north and magnetic north. Declination will change for each topographical map and it also changes annually due to the shifting north magnetic pole.

Cadets will almost always use the magnetic declination value between grid north and magnetic north (grid declination) when navigating using a map and compass. By setting the magnetic declination on the compass, magnetic bearings are converted to grid bearings which allow bearings taken from the map to be used on the ground and vice versa.

Declination is further described by stating whether the declination is east or west of magnetic north. The declination for the map being used is calculated using the information in the declination diagram (as illustrated in Figure 18-1-5) found in the marginal information of the map.

Declinations are stated in degrees and minutes. Each degree is subdivided into 60 minutes. This is important when setting the declination as the declination scale is graduated in 2-degree divisions.



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-39)

Figure 18-1-5 Declination Diagram

ADJUSTING THE DECLINATION ON A COMPASS

The compass's declination scale must be set to compensate for the difference between grid north and magnetic north. To do this we must first have the amount of declination in degrees east or west. Then, turn the compass over and look at the back of the dial.

From the zero point, using the screwdriver, turn the declination adjusting screw to the right for west and to the left for east declination (as illustrated in Figure 18-1-6). Each small black line represents two degrees of declination.

When setting declination on a compass, it is easier to hold the screwdriver and turn the compass, especially in cold weather. The declination shall *never* be turned past the last number of the declination scale.

Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-1-6 Declination Screw

If a person were to follow a compass bearing for one km without first adjusting for declination, for every one degree of declination, that person would be over 17 m to the left or right of their plotted bearing. This is how important declination is.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have cadets set magnetic declination on a compass.

RESOURCES

- Compasses, and
- Predetermined declination.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into groups based on the number of compasses available.
2. Give the cadets a declination value.
3. Have the cadets turn the compass over (on its back with the declination adjusting screw facing up).
4. With the other hand have the cadet grasp the screwdriver that is attached to the safety cord/lanyard.
5. Using the screwdriver, have the cadet turn the declination adjusting screw to the right for west and to the left for east declination values.
6. Check the set declination.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in setting declination will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. A compass is a tool used to complement what other ground navigation skill?

Q2. What must be done to the luminous marks of the compass to make them glow?

Q3. In what direction would the declination adjusting screw be turned for an east declination value?

ANTICIPATED ANSWERS

A1. A compass is used to complement map-reading skills.

A2. The luminous marks need to be exposed to a strong light source.

A3. The declination adjusting screw would be turned to the left.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

CLOSING STATEMENT

Map and compass skills are the core of the cadets' Proficiency Level Three survival training. Being familiar with the compass and how it works is one of the bases on which the rest of the lessons are anchored.

INSTRUCTOR NOTES/REMARKS

TP 2 may need to be modified to reflect the type of compass used for the lesson.

REFERENCES

A2-036 A-CR-CCP-121/PT-001 Director Cadets 3. (2003). *Royal Canadian Army Cadet Reference Book*. Ottawa, ON: Department of National Defence.

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 2

EO M390.02 – IDENTIFY MARGINAL INFORMATION AND CONVENTIONAL SIGNS

Total Time:	60 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Distribute topographical maps before beginning the lesson.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 to introduce the details of marginal information to the cadet.

An in-class activity was chosen for TP 2 as it is an interactive way to introduce conventional signs to the cadet.

INTRODUCTION

REVIEW

The review for this lesson will be from EO M390.01 (Identify Parts of the Compass, Section 1).

QUESTIONS

Q1. What is the purpose of the sighting mirror?

Q2. What is the function of the meridian lines found inside the compass dial?

Q3. The mnemonic device “Red in the Bed” is used to remember what?

ANTICIPATED ANSWERS

A1. The sighting mirror is used to see the compass dial while taking a bearing.

A2. Compass meridian lines are used to line up the compass dial with the grid lines (eastings) on a map.

A3. The mnemonic device “Red in the Bed” is used to remember that the red end of magnetic needle is lined up within the red end of the orienting arrow.

OBJECTIVES

By the end of this lesson the cadet shall have to identified marginal information and conventional signs found on a topographical map.

IMPORTANCE

Cadets need to be able to identify features on the map as they relate to objects on the ground. The cadets will apply this knowledge during training where any type of map is used.

Teaching Point 1 | **Identify and Describe Marginal Information on a Topographical Map**

Time: 20 min | Method: Interactive Lecture

MARGINAL INFORMATION

The margins provide information important to the understanding and use of the map. Before using an unfamiliar map, it is important to have a good look at the information contained in its margins. The layout and contents of the marginal information is normally in the same place for all topographical maps, but will always be found within the margins. This information includes:

Have cadets point out each piece of marginal information on a topographical map as it is being described.

Name of Map Sheet. For ease of reference the name of the map is usually a major community or district located on the map (found at the bottom centre of the margin, as well as in the top or bottom right corner).

Number of the Map and Index of Adjoining Maps. A diagram showing the position of the map sheet in relation to adjoining sheets is shown near the lower right-hand margin. The diagram shows the sheet numbers of the adjoining sheets and accentuates the sheet in hand.

Date of Map Data. Helps to indicate the amount of change that may have occurred since the map was printed (found in the bottom left corner).

Map Scale. Indicates the scale of the map, most commonly 1 : 25 000 or 1 : 50 000. Scale is used to represent distances on the map in direct relation to the ground. On a 1 : 50 000 scale map 1 cm on the map represents 50 000 cm (500 m) on the ground.

Scale Bars. Used as a measuring aid for determining distance on the map (found bottom centre below the map name). The left end of the scale bars is divided into tenths for measuring distances more accurately.

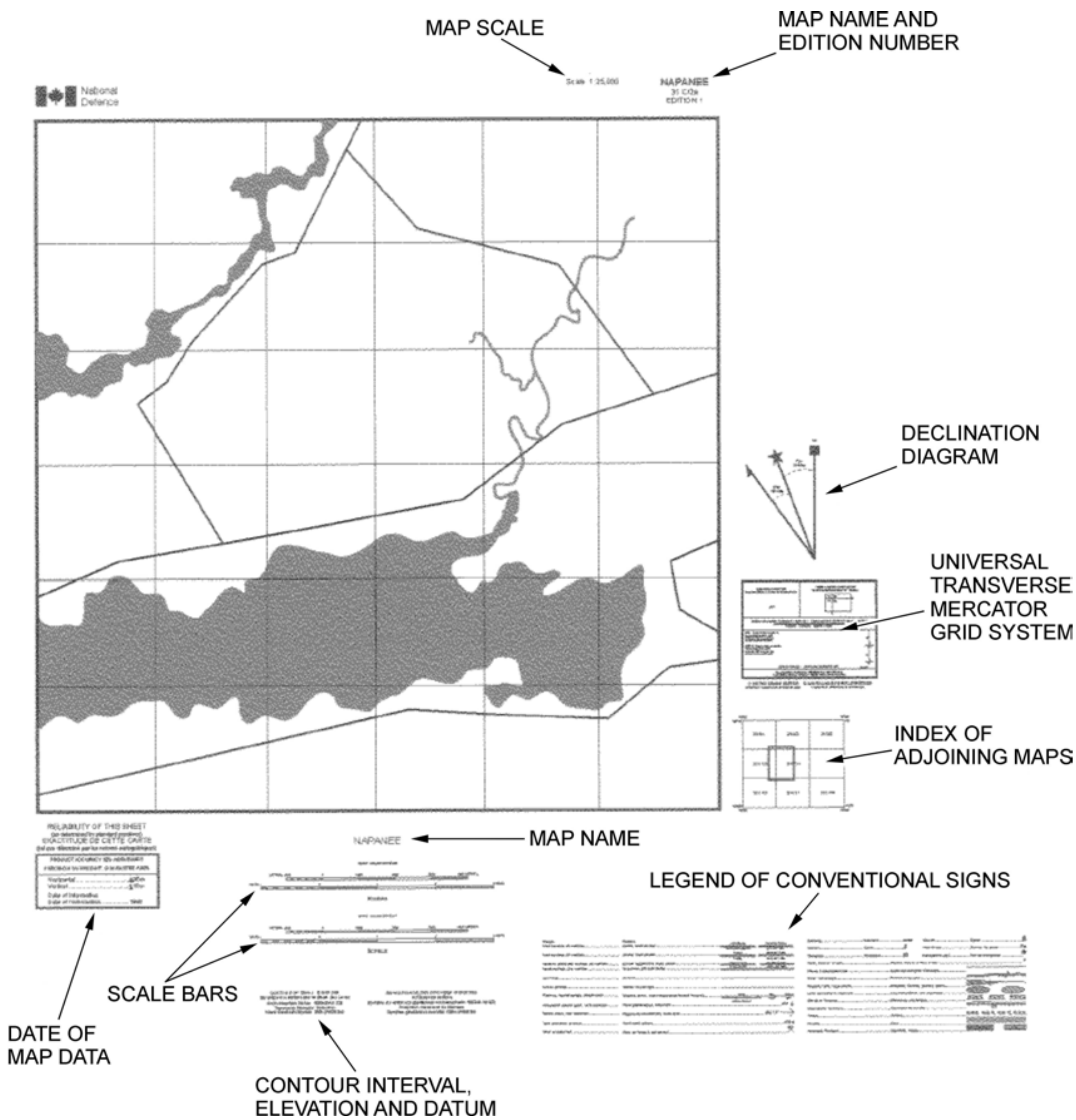
Contour Interval. Indicates the vertical (height) interval between contour lines and is given in metres or feet. The contour interval is found in the bottom margin.

Legend of Conventional Signs. A table showing the conventional signs used on the sheet in their correct colours with their descriptions is shown in the bottom or side margin, plus in a more complete list on the back of the map.

Military Index Number. The index is found in the top right corner of the map sheet and used for ordering additional maps.

Declination Diagram. Contains the information for the map on how true, grid, and magnetic north relate to each other. This information is given in the form of a diagram with explanatory notes. The diagram is in the right side margin.

Universal Transverse Mercator Grid System (UTM). The UTM grid system divides the earth's surface into zones, each covering six degrees of longitude and eight degrees of latitude. The 60 longitude bands are numbered and the 20 latitude bands are lettered. Each grid zone is one rectangle of the grid pattern, established by the bands and designated by the figures of the longitude band followed by the letter of latitude band.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 11)

Figure 18-2-1 Marginal Information

Military users, refer to this map as:	SERIES **A901** MCE 320 EDITION 1

Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 12)

Figure 18-2-2 Military Index Number

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Besides the margins, where else may the legend of conventional signs be found?

Q2. How is a map usually named?

Q3. What is the purpose of the declination diagram?

ANTICIPATED ANSWERS

A1. The legend of conventional signs may also be found on the back of the map.

A2. A map is usually named for a major community or district located on the map.

A3. The declination diagram contains the information for the map on how true, grid, and magnetic north relate to each other.

Teaching Point 2 — **Conduct an Activity Where the Cadets Identify Conventional Signs by Colour**

Time: 30 min — Method: In-Class Activity

Discuss the information with the cadets prior to the commencement of the activity outlined below.

CONVENTIONAL SIGNS

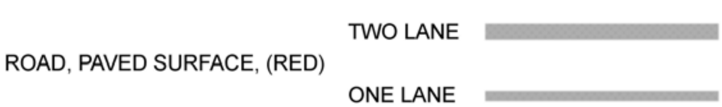
A number of symbols are used to indicate an object or item of detail that cannot be shown either by outline or by a line symbol. Most have been established through long usage and standardization agreements. The meaning of most symbols is obvious. However, if there is doubt consult the table of conventional symbols located on every map. Located on the back of most maps you will find many additional conventional signs.

Map-reading not only involves the ability to interpret the symbols shown on the map and to understand the information given in pictorial or written form, but it also involves a true understanding of the ground portrayed and an appreciation of the reliability and value of the particular map being used.

Where the symbol may have more than one meaning, the sign or symbol will be accompanied by a descriptive word (eg, tank or tower).

The use of colour aids in distinguishing details.

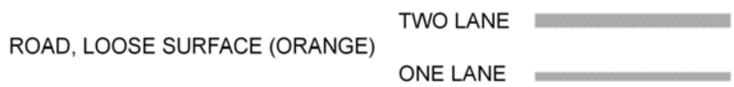
Red. Used to identify paved roads and highway numbers. Red is also used to shade in areas of urban development.



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-2-3 Red Conventional Signs

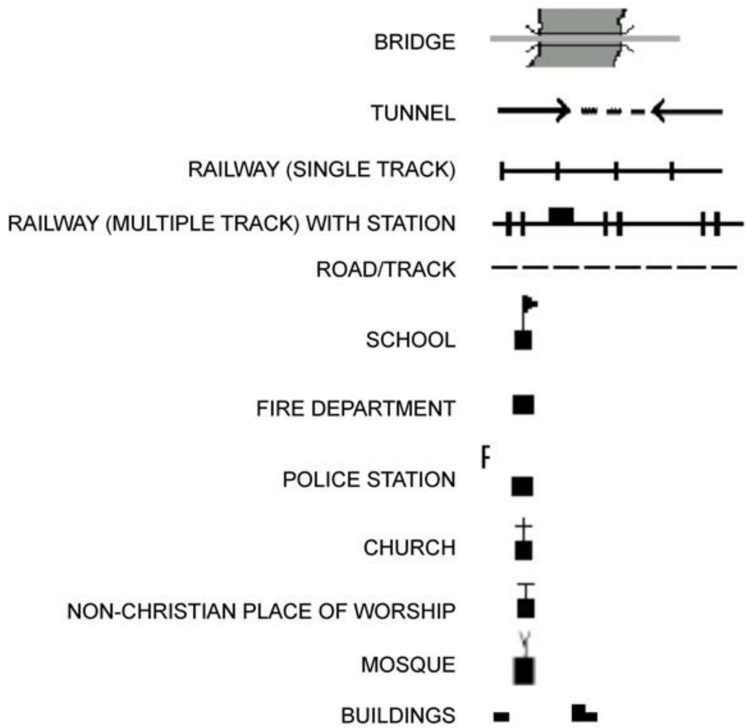
Orange. Used to represent unpaved roads.



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-2-4 Orange Conventional Signs

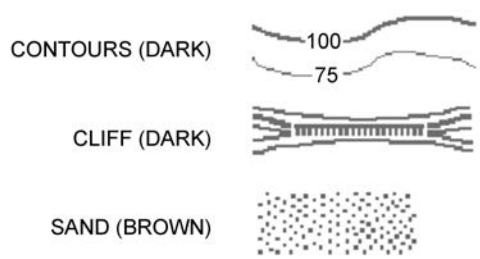
Black. Used for cultural features, toponyms (place names), some symbols and precise elevations.



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-2-5 Black Conventional Signs

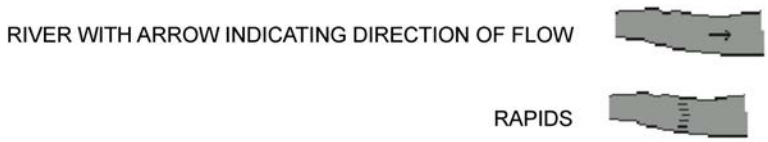
Brown. Used for contour lines, contour elevations, spot elevations, sand, cliffs, and other geographical features.



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-2-6 Brown Conventional Signs

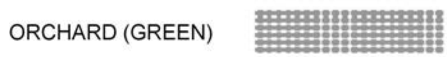
Blue. Used for water or permanent ice features (eg, rivers, lakes, swamps and ice fields), names of water features and the grid lines.



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-2-7 Blue Conventional Signs

Green. Used for vegetation features such as woods, orchards and vineyards.



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-2-8 Green Conventional Signs

White. Used to represent open fields.

Grey. Used for the legend of conventional signs on the back of the map.

Purple. Used for updates that are made over top of the original map information.

ACTIVITY

Time: 20 min

OBJECTIVE

The objective of this activity is to have the cadet identify conventional signs through the creation of a topographical map of Mapville.

RESOURCES

- Flip chart/whiteboard,
- Markers/dry erase markers, and
- Topographical maps.

ACTIVITY LAYOUT

The cadets should be seated in front of a flip chart/whiteboard with topographical maps available.

ACTIVITY INSTRUCTIONS

1. Draw a large outline of a topographical map on the flip chart/whiteboard at the front of the room.
2. Have the cadets approach the front, one at a time, and draw a conventional sign on the developing map of Mapville.
3. Have the cadets explain what the sign is for and why they chose to put it where they did. No sign may be used more than once.
4. Have cadets continue to add conventional signs until the time is used up.

Based upon the number of cadets in the class, each cadet may have to add several different conventional signs to the map.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the in-class activity will serve as confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in the creation of the topographical map of Mapville will serve as confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

CLOSING STATEMENT

Map-reading not only involves the ability to interpret the symbols shown on the map and to understand the information given in pictorial or written form, but it also involves a true understanding of the ground portrayed and an appreciation of the reliability and value of the particular map being used. This information will aid the cadet during their map and compass practical assessment.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 3

EO M390.03 – DETERMINE GRID REFERENCES (GRS)

Total Time:	60 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Topographical maps are the preferred training aid for TP 2, however, the worksheet located at Annex A may be used. If required, photocopy Annex A for each cadet.

Create a slide or photocopy the training aid located at Annex B for each cadet.

Photocopy the worksheet located at Annex C for each cadet.

Based on the topographical map being used, create a list of objects for the cadets to determine six-figure GRs for, and a list of six-figure GRs for the cadets to determine what objects they represent.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1 and 4 to introduce the grid system used to identify locations on a map.

Demonstration and performance was chosen for TPs 2, 3, 5 and 6 as it allows the instructor to explain and demonstrate determining four- and six-figure GRs and the construction and use of romers while providing an opportunity for the cadet to practice these skills under supervision.

INTRODUCTION

REVIEW

The following questions are a review of EO M390.02 (Identify Marginal Information and Conventional Signs, Section 2).

QUESTIONS

Q1. What does the contour interval on a topographical map represent?

Q2. What are conventional signs?

Q3. What is the colour green used for on topographical maps?

ANTICIPATED ANSWERS

A1. Indicates the vertical (height) interval between contour lines and is given in metres or feet.

A2. These are symbols used to indicate an object or item of detail that cannot be shown either by an outline or by a line symbol.

A3. It is used for vegetation features such as woods, orchards and vineyards.

OBJECTIVES

By the end of this lesson the cadet shall have determined four- and six-figure GRs.

IMPORTANCE

It is important for cadets to accurately determine four- and six-figure GRs in order to convey their location to others, for others to convey their location, and to plot a route on a topographical map.

Teaching Point 1	**Explain the Use of Grid Lines and GR Accuracy**
Time: 5 min	Method: Interactive Lecture

USE OF GRID LINES

Grid lines are used to convey a person's location to others and to plot a route on a topographical map using GRs.

The grid system is a network of intersecting vertical and horizontal blue lines superimposed on a topographical map. Maps are normally printed so that north is at the top of the sheet. The lines of the grid system are drawn evenly spaced, one scale kilometre apart, so that one set of lines run north-south (vertically) and the second set of lines run east-west (horizontally). The lines are assigned a sequential number and count up from the bottom left corner. The numbers are written along the edges of the map and occasionally within it. The intersecting grid lines at the lower left corner designate a grid square.

Eastings. Similar to the X-axis in mathematical graphing, eastings are a series of vertical parallel lines plotted as an overlay to the map sheet, which are drawn from top to bottom and numbered, with two digits, sequentially from west to east. They run north-south, similar to lines of longitude.

> It is important to note that while eastings run parallel to each other, lines of longitude do not. The spacing between lines of longitude is widest at the equator and come together at the north and south poles. It is because of this difference that a bearing taken from a topographical map is a grid bearing, not a true bearing.

Northings. Similar to the Y-axis in mathematical graphing, northings are a series of horizontal parallel lines plotted as an overlay to the map sheet, which are drawn from left to right and numbered, with two digits, sequentially from south to north. They run east-west, the same as lines of latitude.

GR ACCURACY

A four-figure GR represents one grid square and is accurate within a 1 000 m square (1 km^2 or 1 000 000 m^2).

A six-figure GR represents one one-hundredth of a grid square and is accurate within a 100 m square (0.01 km^2 or 10 000 m^2).

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What is the grid system of a topographical map?

Q2. What is the spacing between lines of the grid system of a topographical map?

Q3. What is a northing?

ANTICIPATED ANSWERS

A1. The grid system is a network of intersecting vertical and horizontal blue lines superimposed on a topographical map.

A2. The lines of the grid system are drawn evenly spaced, 1 km apart.

A3. Similar to the Y-axis in mathematical graphing, northings are a series of horizontal parallel lines plotted as an overlay to the map sheet, which are drawn from left to right and numbered, with two digits, sequentially from south to north. They run east-west, the same as lines of latitude.

Teaching Point 2	**Explain, Demonstrate, and Have the Cadet Practice Determining a Four-Figure GR**
Time: 10 min	Method: Demonstration and Performance

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Characteristics of a four-figure GR:

- Four-figure GRs will have four numerical digits derived from the numbers assigned to the eastings and northings on the map sheet.
- The numbers are listed by recording the two-digit easting followed by the two-digit northing.

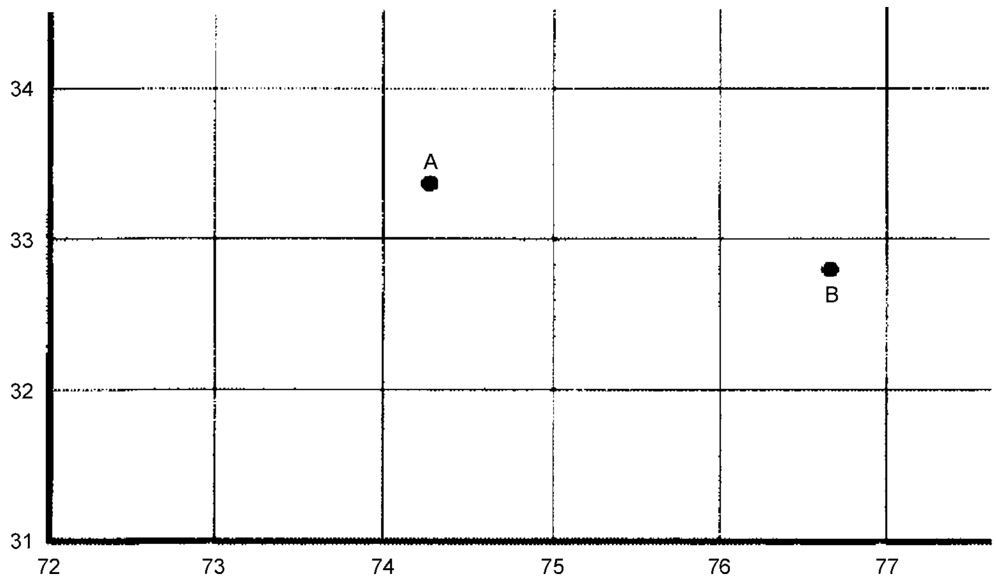
The grid lines that intersect in the bottom left corner of the grid square are used to identify that grid square.

Steps to determine a four-figure GR:

1. Confirm the correct grid square.
2. Place a finger at the bottom left corner of the map.
3. Move that finger along the bottom of the map (left to right) up to the grid line (easting) before the grid square.

4. Record the two-digit easting.
5. Place a finger at the bottom left corner of the map.
6. Move that finger along the left side of the map (bottom to top) up to the grid line (northing) before the grid square.
7. Record the two-digit northing after the two-digit easting to create the four-figure GR.
8. Confirm the four-figure GR.

In Figure 18-3-1 Building A is located at GR 7433 and Building B at GR 7632.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 37)

Figure 18-3-1 Four-Figure Grid References

Steps to determine a grid square using a four-figure GR:

1. Confirm the four-figure GR.
2. Place a right-hand finger at the bottom left corner of the map.
3. Move that finger along the bottom of the map (left to right) up to the grid line (easting) numbered the same as the first two digits of the four-figure GR.
4. Place a left-hand finger at the bottom left corner of the map.
5. Move that finger along the left side of the map (bottom to top) up to the grid line (northing) numbered the same as the last two digits of the four-figure GR.
6. Move the right-hand finger up the grid line and the left-hand finger right along the grid line.
7. Where the two grid lines intersect is the bottom left corner of the grid square.
8. Confirm the correct grid square.

In Figure 18-3-1, GR 7532 represents the grid square southeast of Building A and west of Building B.

Have the cadets practice the skill either on a topographical map or the worksheet located at Annex A.

If using Annex A, check the cadets' answers using the answer key located at Annex D.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 3 — **Explain, Demonstrate, and Have the Cadet Practice Estimating a Six-Figure GR**

Time: 10 min — Method: Demonstration and Performance

Using either the overhead or the handout created from Annex B, explain and demonstrate how to determine a six-figure GR. Care must be taken to ensure that all cadets understand each step before proceeding to the next step.

For this skill lesson, it is recommended that instruction takes the following format:

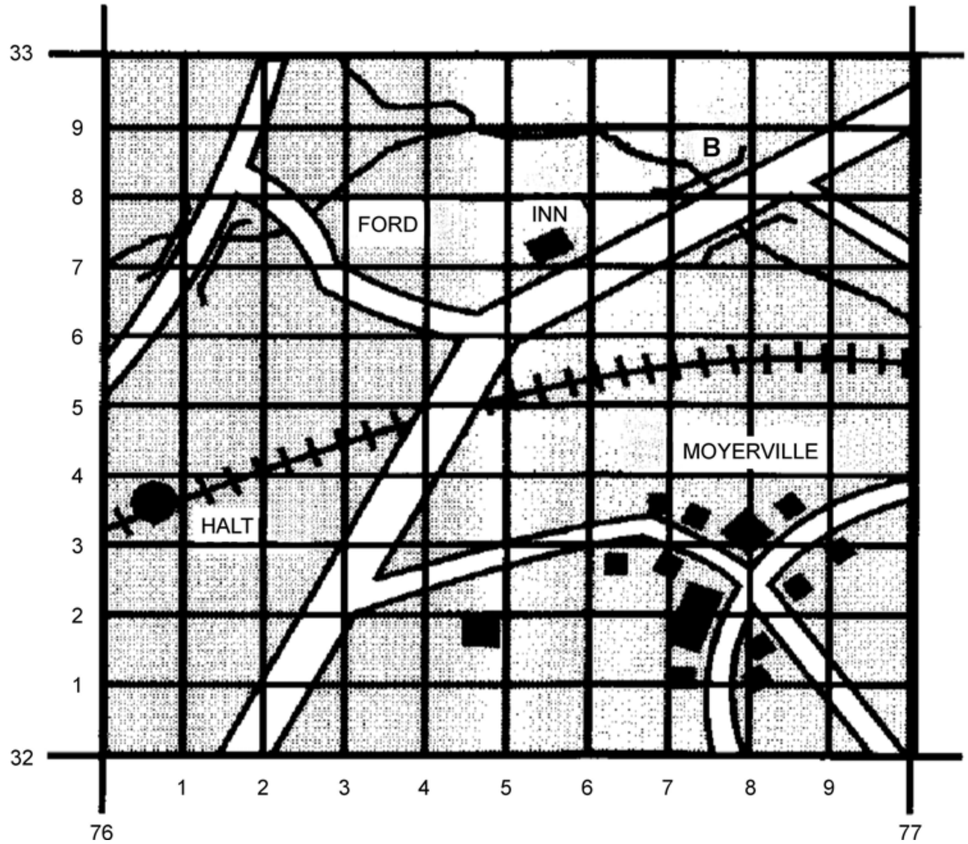
1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Estimate a six-figure GR by:

1. creating an imaginary grid system to divide a grid square into 100 equally sized smaller grid squares with 10 along the bottom edge and 10 along the left-side edge (as illustrated at Figure 18-3-2);
2. noting that six-figure GRs will have six numerical digits derived from the numbers assigned to the eastings and northings on the map sheet and their estimated tenths;
3. recognizing that the numbers are listed by recording the three-digit easting followed by the three-digit northing; and
4. remembering that the grid lines that intersect in the bottom left corner of the grid square are used to identify that imaginary grid square.
   Steps to determine a six-figure GR:
   (1) Identify the object within the grid square. Note the four-figure GR.
   (2) Using the imaginary grid within the square, determine the three-digit easting by using the two digits of the easting combined with the number of tenths, measured from the left, to the line before the object.
   (3) Using the imaginary grid within the square, determine the three-digit northing by using the two digits of the northing combined with the number of tenths, measured from the bottom, to the line before the object.

(4) Combine the two sets of numbers to create the six-figure GR.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 38)

Figure 18-3-2 Six-Figure Grid References

Example 1: Determine the six-figure GR for the building west of the town of Moyerville.

1. Building west of the town of Moyerville is within GR 7632.
2. 76 combined with 4 tenths creates ’764’.
3. 32 combined with 1 tenth creates ’321’.
4. Building west of the town of Moyerville is located at GR 764321.

Example 2: Determine the six-figure GR for the Inn north-north-west of the town of Moyerville.

1. The Inn at the north part of the grid square at GR 7632.
2. 76 combined with 5 tenths creates ’765’.
3. 32 combined with 7 tenths creates ’327’.
4. The Inn at the north part of the grid square is located at GR 765327.

Have the cadets complete the worksheet located at Annex C.

CONFIRMATION OF TEACHING POINT 3

The cadets' completion of the worksheet will serve as the confirmation of this TP.

Teaching Point 4 — **Define a Romer as a Device Used for Measuring a Point Within a Grid Square and Identify the Types of Romers Available for Use and Where to Find Them**

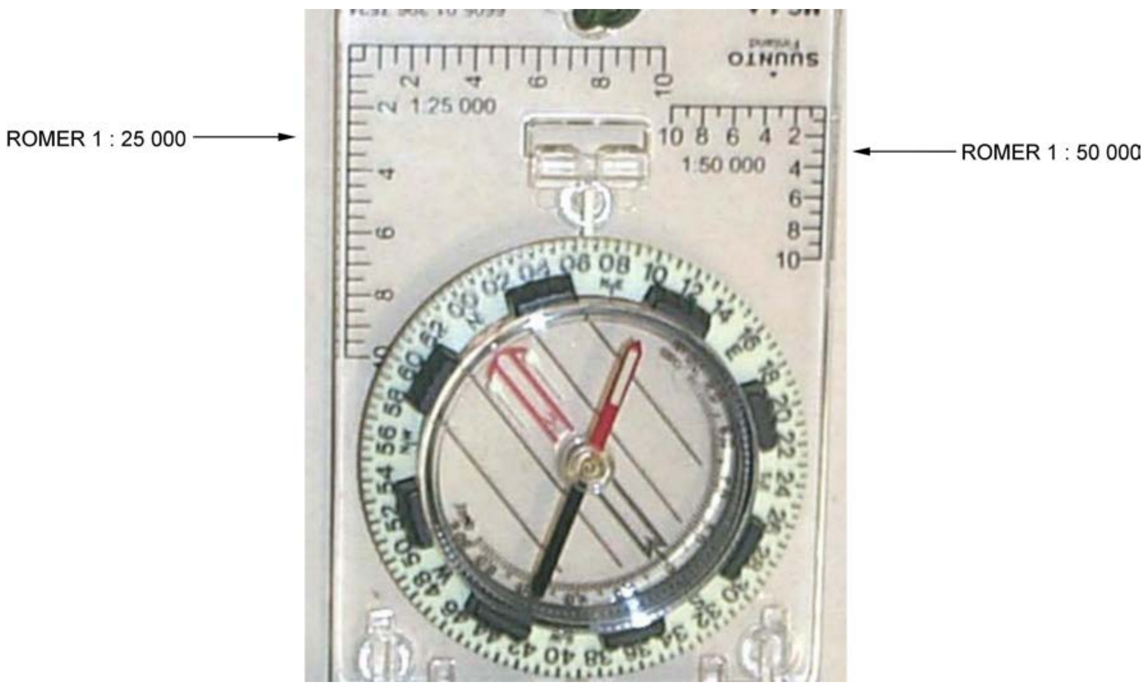
Time: 5 min — Method: Interactive Lecture

Romer. A device used for measuring a point within a grid square to determine its six-figure GR.

Romers may be purchased or created. Purchased romers include compasses and protractors. Constructed romers use a small piece of paper and the scale bars of a topographical map.

COMPASS

Many compasses include romers already printed on the compass base plate. There are commonly two romers, for use with 1 : 25 000 and 1 : 50 000 scale topographical maps.

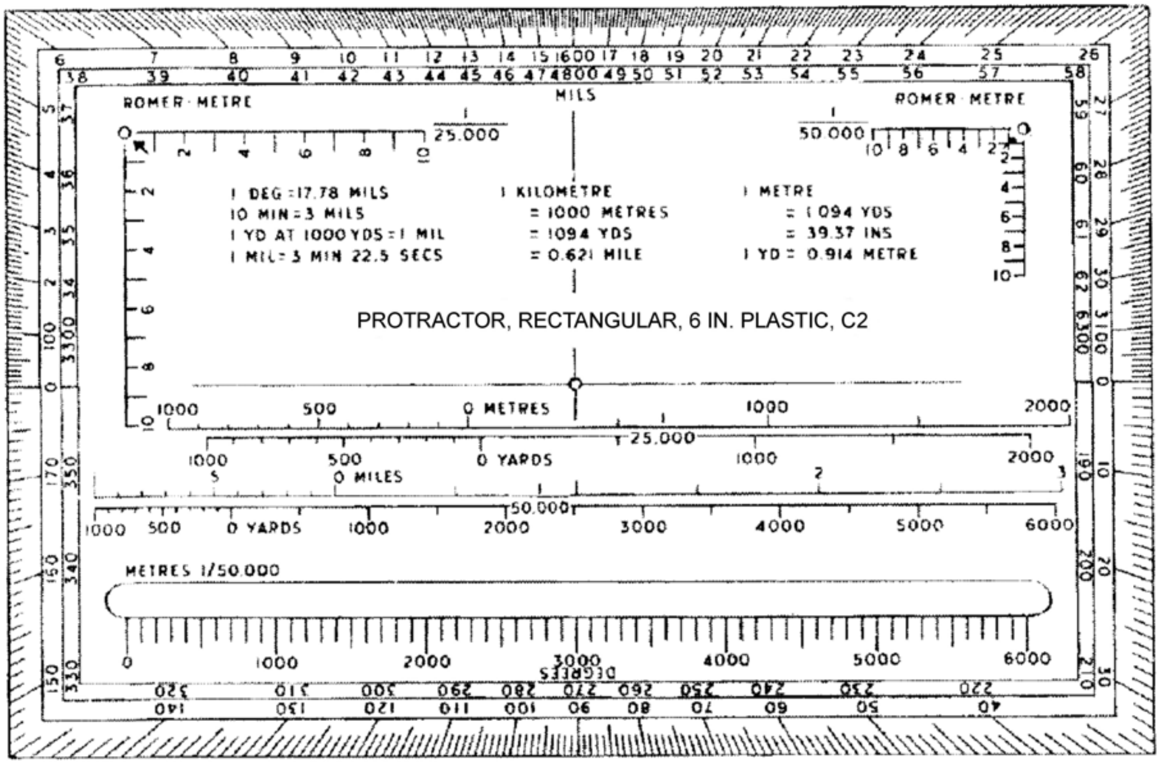


Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-3-3 Compass

PROTRACTOR

All protractors may be used to determine a bearing on a map, however, few have romers already printed on them. The Canadian Forces has created the C2 protractor (as illustrated in Figure 18-3-4) specifically designed for use on topographical maps.

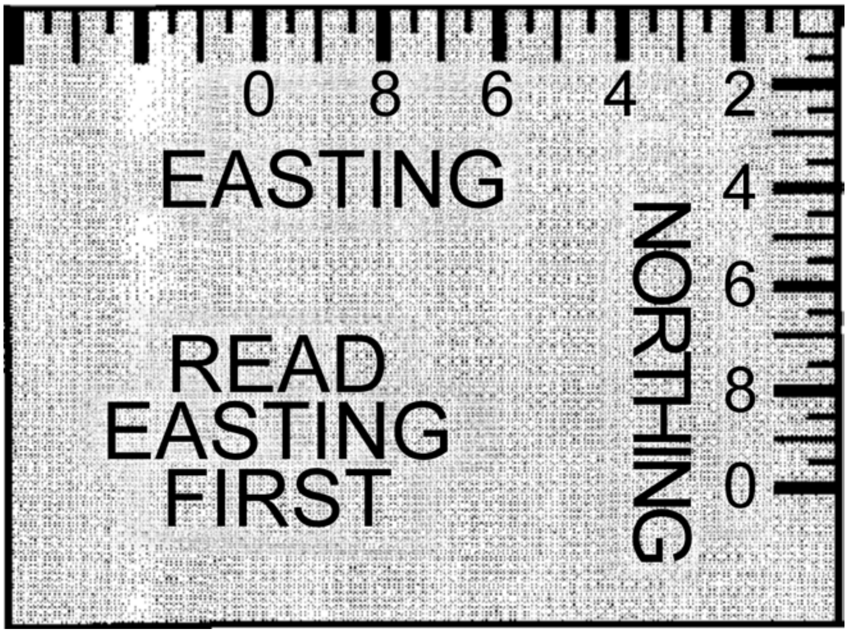


Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 41)

Figure 18-3-4 C2 Protractor

CONSTRUCTED

A constructed romer requires a piece of paper with at least one square corner and the scale bars of the topographical map. Using the scale bars of the topographical map, a romer can be constructed as illustrated in Figure 18-3-5.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 41)

Figure 18-3-5 Constructed Romer

CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. What is a romer?

Q2. Where are the romers on a compass found?

Q3. What two things are required to construct a romer?

ANTICIPATED ANSWERS

A1. A device used for measuring a point within a grid square to determine its six-figure GR.

A2. The romers are printed on the compass base plate.

A3. A constructed romer requires a piece of paper with at least one square corner and the scale bars of the topographical map.

Teaching Point 5 | **Explain, Demonstrate, and Have the Cadet Construct a Romer for Use in Determining Six-Figure GRs**

Time: 10 min | Method: Demonstration and Performance

Accuracy must be stressed to the cadets when constructing a romer. Have the cadets ensure that their pencils are sharp or their pens are fine tipped.

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Construct a romer for determining six-figure GRs by:

1. obtaining a blank piece of paper with a square edge;
2. placing one side of the square edge along the 100-m scale bars;
3. marking off 100-m segments beginning at the corner of the paper and working outward;
4. numbering these markings from zero (at the corner of the paper) to ten; and
5. repeating Steps 2. to 4. on the adjacent edge (eg, completed romer as illustrated in Figure 18-3-5).

It is important to use the correct scale bar. The constructed romer's markings should match the grid lines of the topographical map; the side of a grid square must be equal to ten 100-m marks on each of the romer's two edges.

CONFIRMATION OF TEACHING POINT 5

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 6 — **Explain, Demonstrate, and Have Cadet Practice Determining a Six-Figure GR Using a Constructed Romer**

Time: 10 min — Method: Demonstration and Performance

This TP uses all the skills from the previous TPs and it is essential that this TP not be covered until problems from the previous TPs have been corrected.

Unlike TP 3, where the cadets used the very visible ’imaginary’ grid (eg, Figure 18-3-2) to determine a six-figure GR, the cadets will now be using their constructed romer from TP 5 to determine a six-figure GR and to locate objects with a six-figure GR. Much greater care and attention to detail must used by the cadets in order to ensure accuracy.

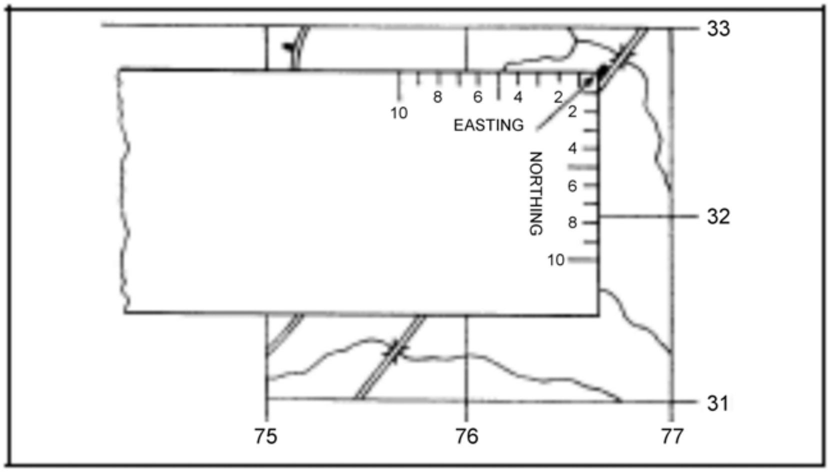
For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets’ performance as they practice the complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

Determine a six-figure GR using a constructed romer, by:

1. placing the corner of the constructed romer on the bottom left corner of the grid square, noting the four-figure GR;
2. moving the constructed romer to the right the number of tenths required to align the romer directly to or before (never past) the conventional sign or location for which the GR is being determined;
3. reading the value along the X-axis of the romer where it crosses the easting on the map sheet (the value at this intersection becomes the value for the third digit of the six-figure GR);
4. moving the constructed romer up the number of tenths required for the corner of the romer to be positioned on or before (never past) the conventional sign or location for which the GR is being determined;
5. reading the value along the Y-axis of the romer where it crosses the northing on the map sheet (the value at this intersection becomes the value for the sixth digit of the six-figure GR); and
6. combining the two sets of digits to create the six-figure GR.



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-20)

Figure 18-3-6 Using a Constructed Romer

Determine what a six-figure GR represents using a constructed romer, by:

1. determining the four-figure GR, by removing the third and sixth digits from the six-figure GR, to identify and locate the correct grid square;
2. placing the corner of the constructed romer on the bottom left corner of the grid square;
3. moving the constructed romer to the right the number of tenths, as identified by the third digit;
4. moving the constructed romer up the number of tenths, as identified by the sixth digit; and
5. determining the object (that is up and to the right from the tip of the romer).

Examples used will be from Annex C.

Example 1:

From Figure 18C-1, determine the six-figure GR for the Post Office.

1. Grid square GR 7632.
2. Four tenths to the right.
3. 76 combined with 4 tenths creates ‘764’.
4. Four tenths up.
5. 32 combined with 4 tenths creates ‘324’.
6. The Post Office is located at GR 764324.

Example 2:

From Figure 18C-1, determine the object located at GR 766323.

1. Four-figure GR is 7632.

2. Place romer at the bottom left corner of grid square 7632.
3. Move the romer to the right six tenths.
4. Move the romer up three tenths.
5. GR 766323 identifies the Train Station.

Have the cadets practice using the lists created before the lesson, of objects for the cadets to determine six-figure GRs for, and of six-figure GRs for the cadets to determine what objects they represent, on the appropriate topographical map.

CONFIRMATION OF TEACHING POINT 6

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in determining six-figure GRs will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

CLOSING STATEMENT

It is important for cadets to accurately determine four- and six-figure GRs in order to convey their location to others, determine where others are, and to plot a route on a topographical map. This skill will be of great benefit whenever the cadets are using topographical maps.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 4

EO M390.04 – DETERMINE DISTANCE ON A MAP AND ON THE GROUND

Total Time:	90 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create five ’point-to-point’ and five ’along a route between two points’ distances for the topographical map being used. Four- and six-figure grid references (GRs) should be used to designate the start and end points.

Measure and mark three 100-m pace courses. One should be on a flat trail/road, another through light bush, and the last through heavier bush, with slopes if possible. Pace courses should be wide enough to allow several cadets to use them at the same time.

Calculate personal pace for 100 m.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

Demonstration and performance was chosen for TPs 1 and 2 as it allows the instructor to explain and demonstrate measuring distances on a map and determining personal pace, while providing an opportunity for the cadet to practice these skills under supervision.

An interactive lecture was chosen for TP 3 to introduce the factors that can affect the cadets’ personal pace.

A practical activity was chosen for TP 4 as it is an interactive way for the cadet to experience pacing and the factors that affect it in a safe, controlled environment. This activity contributes to the development of pacing skills and knowledge in a fun and challenging setting.

INTRODUCTION

REVIEW

The following questions are a review of EO M390.03 (Determine Grid References [GRs], Section 3).

QUESTIONS

Q1. What are eastings?

Q2. Which grid line intersection is used to represent a grid square?

Q3. What is a romer?

ANTICIPATED ANSWERS

A1. Similar to the X-axis in mathematical graphing, eastings are a series of vertical parallel lines plotted as an overlay to the map sheet, which are drawn from top to bottom and numbered, with two digits, sequentially from west to east. They run north-south, similar to lines of longitude.

A2. The grid lines that intersect in the bottom left corner of the grid square are used to identify that grid square.

A3. A device used for measuring a point within a grid square to determine its six-figure GR.

OBJECTIVES

By the end of this lesson the cadet shall have determined distance on the map and on the ground.

IMPORTANCE

It is important for cadets to be able to accurately determine distance on the map and on the ground in order to effectively use a topographical map to plot a route that will be followed on the ground.

Teaching Point 1	**Explain, Demonstrate and Have the Cadet Determine Distance on a Map**
Time: 30 min	Method: Demonstration and Performance

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

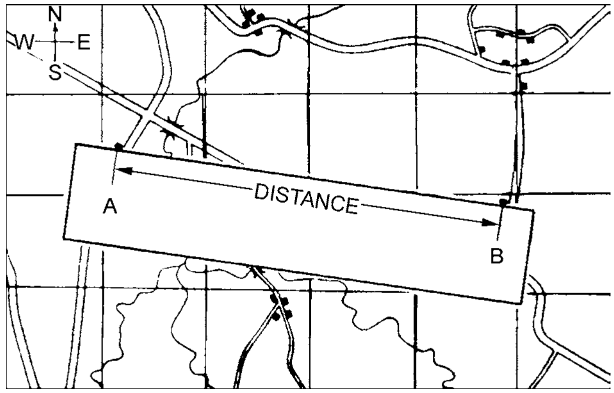
Note: Assistant instructors may be used to monitor cadet performance.

DETERMINING DISTANCE ON A MAP

Cadets can use a map to measure the distance between two points (eg, points A and B as illustrated at Figure 18-4-1) on the ground. All maps are drawn to scale; therefore, a specified distance on a map equals a specified distance on the ground. The scale of a map is printed at the top and bottom of each map (eg, scale 1 : 50 000). This means that 1 cm on the map equals 50 000 cm (500 m) on the ground.

There are two ways to determine distance on a topographical map – point-to-point and along a route.

Measuring Point-to-Point

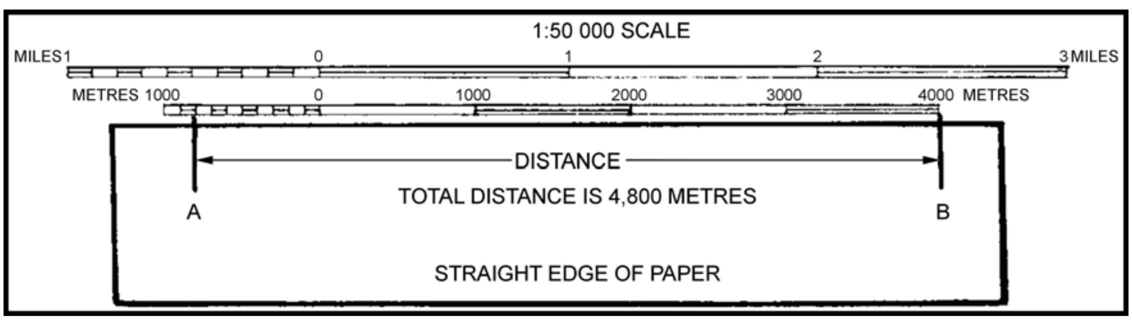


Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-24)

Figure 18-4-1 Measure Distance Point-to-Point

To measure a distance point-to-point:

1. Lay the straight edge of a piece of paper against the two points.
2. With a sharp pencil, mark the paper at the A (start) and B (end) points.
3. Lay the paper just under the metres scale bar with the B mark at the right end of the scale. Move the paper to the left aligning the B mark with each thousand metre mark until the A mark falls within the subdivided thousands (hundreds) to the left of the zero.
4. To calculate the total distance, add the number of thousands where the B mark is, plus the number of subdivided thousands where the A mark is to the left of the zero.



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-25)

Figure 18-4-2 Calculate Distance

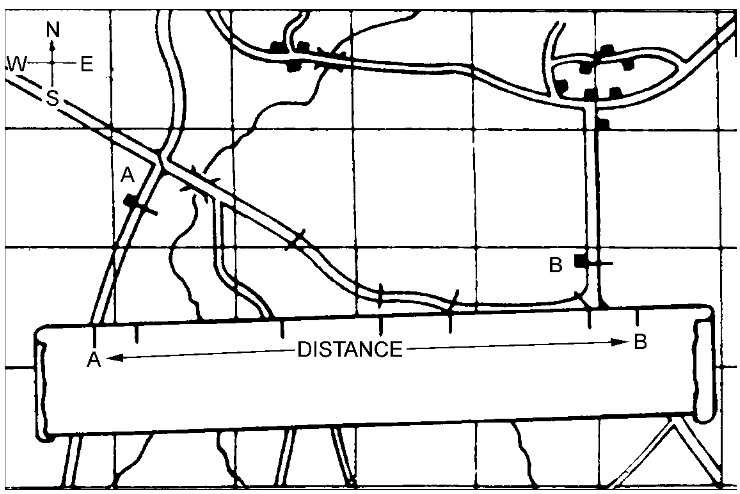
For a distance that is longer than 5 000 m, measure the first 5 000 m and mark the paper with a new line and label it '5 000 m'. Place the new mark at the zero or thousands mark until the A mark fits within the subdivided thousands (hundreds) bar. Add the total of that distance to the 5 000 m to create the total distance.

Measuring Along a Route Between Two Points

Sometimes cadets need to find the distance between A and B around the curves in a road along a planned route.

To measure a distance along a route between two points:

1. Lay the straight edge of a piece of paper against point A.
2. With a sharp pencil, mark point A on the paper and the map.
3. Line up the paper with the edge of the road until a curve is reached and make another mark on the paper and on the map.
4. Pivot the paper so that it continues to follow the road edge. Repeat until you reach point B.
5. Mark the paper and the map at point B.
6. Lay the paper just under the metres scale bar with the B mark at the right end of the scale. Move the paper to the left aligning the B mark with each thousand metre mark until the A mark falls within the subdivided thousands (hundreds) to the left of the zero.
7. Add the number of thousands where the B mark is, plus the number of subdivided thousands (hundreds) where the A mark is to the left of the zero, to determine the total distance.



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-25)

Figure 18-4-3 Measure Distance Along a Route

ACTIVITY

Time: 15 min

OBJECTIVE

The objective of this activity is to have the cadets measure distance on a map.

RESOURCES

- Topographical map,
- Paper, and

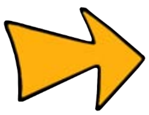
- Pencil.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into pairs.
2. Distribute a map to each pair.
3. Have the cadets determine the distance:
   (a) point-to-point, and
   (b) along a route.
4. Check answers.
5. Repeat Steps 3. to 4. until complete or the time is up.



All marks should be carefully erased from the map after each distance is determined.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in determining distance on a map will serve as the confirmation of this TP.

Teaching Point 2	**Explain, Demonstrate and Have the Cadet Pace**
Time: 15 min	Method: Demonstration and Performance

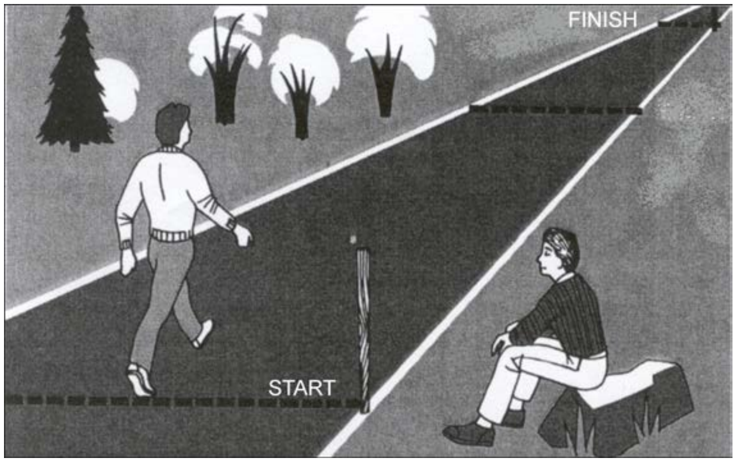
For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be used to monitor cadet performance.

DETERMINING A PERSONAL PACE FOR 100 M

Being able to determine distance is a key skill for ground navigation. By learning how to determine distance using a personal pace, a cadet will have the skill to determine how far they have travelled, and how far they have to travel to reach their destination.



B. Kjellstrom, Be Expert With Map & Compass, Hungry Minds, Inc. (p. 53)

Figure 18-4-4 Determining Distance Using Pacing

Personal Pace. The number of paces a person walks over a distance of 100 m.

COUNTING PACES

There are two basic methods to count pace:

- count every pace (count every step); or
- count every other pace (count every left or every right step).

For example:

- count every pace: 140 paces = 100 m; or
- count every other pace: 70 paces = 100 m.

CALCULATING DISTANCE

In order to determine distance travelled, the total number of paces travelled is divided by the personal pace and multiplied by 100 m to calculate the number of metres travelled.

Formula:

$$\frac{\text{total number of paces}}{\text{personal pace}} \times 100 \text{ m} = \text{total distance travelled (m)}$$

Example:

$$\frac{140 \text{ paces}}{70} \times 100 \text{ m} = 200 \text{ m}$$

Common methods of keeping track of the number of paces travelled include:

- transferring pebbles from one pocket to another: one pebble for each 100 paces;
- using a length of cord with knots – the knotted cord is held with the hand gripping a knot and the hand is advanced one knot down the cord for every 100 paces; and

- combining the knotted cord and pebbles (eg, cord with 10 knots, pebbles transferred for each completed cord [10 knots x 100 paces each = 1000 paces/pebble]).

ACTIVITY

Time: 10 min

OBJECTIVE

The objective of this activity is to have the cadets determine their personal pace.

RESOURCES

- Calculator (one per pair of cadets),
- Paper, and
- Pen/pencil.

ACTIVITY LAYOUT

Measure a 100-m course and mark it with a clearly defined start and end point on a flat trail/road.

ACTIVITY INSTRUCTIONS

1. Have the cadets walk the pace course, counting out loud, being careful to keep an accurate count.
2. Have the cadets walk the pace course three times, noting their pace count each time.
3. Have the cadets calculate their personal pace by averaging their three pace counts.
4. Have the cadets record their personal pace.

Do not walk with someone when determining a personal pace. When people walk together, they automatically adjust their pace length to match the other person's in order to stay together.

SAFETY

Boundaries must be marked and supervised.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in determining personal pace will serve as the confirmation of this TP.

Teaching Point 3	**Describe Factors That Affect Pacing**
Time: 5 min	Method: Interactive Lecture

FACTORS THAT AFFECT PACING

This teaching point should be presented by asking the cadets what they think could affect their personal pace. Ensure to cover any points that are not suggested by the cadets.

Factors that will affect personal pace include:

Terrain. The rougher the ground, the shorter the pace.

Slopes. Pace is shorter going uphill and longer going downhill.

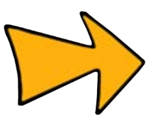
Fatigue. Will shorten a person's pace.

Equipment. Footwear with poor traction will shorten a person's pace. Carrying a heavy load will also shorten a person's pace.

Weather. Snow and rain will shorten a person's pace. The wind will increase/decrease pace length if a person is travelling with/against the wind.

Obstacles. Going around small features (eg, trees, bushes) will affect pace count unless compensated for. Compensation methods include:

- **Sidestepping.** Stepping to the side (left/right) enough paces to bypass the obstacle, pacing forward past the obstacle and sidestepping back (right/left) to return to the original line of travel. This method maintains pace accuracy, but takes time.



The paces that the cadets sidestep are not added to their total pace count.

- **Alternating sides.** In this method, the cadet alternates which side (left/right) of the obstacle they pass (eg, last obstacle was passed on the left, next will be on the right). This method is less accurate, but faster.

If obstacles are always bypassed on the same side, the line of travel will veer off in that direction unless a distant steering point (eg, tall tree, hill top, building) is used as a guide.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. How does slope affect pace?

Q2. How will weather affect pace?

Q3. What can happen if you always bypass obstacles on the same side?

ANTICIPATED ANSWERS

A1. Pace is shorter going uphill, and longer going downhill.

A2. Snow and rain will shorten a person's pace, the wind will increase/decrease pace length if a person is travelling with/against the wind.

A3. The line of travel will veer off in that direction unless a distant steering point (eg, tall tree, hill top, building) is used as a guide.

Teaching Point 4	**Demonstrate and Have the Cadet Practice Determining Distance Using the Pace-Counting Method Over Varied Terrain**
Time: 30 min	Method: Practical Activity

This activity combines the cadets' personal pace determined in TP 2 with the knowledge taught in TP 3. This allows the cadets to gain experience pacing and the effect varied terrain will have on their pace.

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets determine their personal pace over varied terrain.

RESOURCES

- Calculator (one per pair of cadets),
- Paper, and
- Pen/pencil.

ACTIVITY LAYOUT

Measure two 100-m pace courses and mark each of them with clearly defined start and end points. One should be through light bush and the second through heavier bush, with slopes if possible.

ACTIVITY INSTRUCTIONS

1. Inform the cadets that they will be using their personal pace on two courses to determine the effect of terrain on pace.
2. Divide the cadets into two groups. Assign one group to each course.
3. Have the cadets, individually, pace the course five times, and then determine the difference between this count and their personal pace.
4. After 15 minutes, have the cadets switch courses.
5. Have the cadets, individually, pace the course five times, and then determine the difference between this count and their personal pace.
6. Have the cadets record their findings.

SAFETY

Boundaries must be marked and supervised.

CONFIRMATION OF TEACHING POINT 4

The cadets' participation in the pacing activities will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in determining distance on a map and determining their personal pace will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

CLOSING STATEMENT

It is important for cadets to be able to accurately determine distance on the map and on the ground in order to effectively use a topographical map to plot a route that will be followed on the ground. The skill gives the map reader confidence in their ability to know where they are at all times.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

A2-041 (B-GL-382-005/PT-001) Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2nd ed.). Lebanon, NH: Leonard Paul Tawrell.

C2-041 (ISBN 0-07-136110-3) Seidman, D., & Cleveland, P. (1995). *The Essential Wilderness Navigator*. Camden, ME: Ragged Mountain Press.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 5

EO M390.05 – DETERMINE BEARINGS ON A MAP AND ON THE GROUND

Total Time:	60 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Ensure sufficient topographical maps of the exercise area are available.

Create a list of points (designated by description and by grid reference [GR]) from the topographical map of the exercise area for the cadets to determine in TP 5.

A reconnaissance (recce) of the exercise area should be made to determine a site with several distinctive features to be used as prominent objects for the cadets to take bearings.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1–4 to introduce the cadets to the compass, the degree system, the three norths, and bearings.

Demonstration and performance was chosen for TPs 5 and 6 as it allows the instructor to explain and demonstrate determining bearings on a map and on the ground while providing an opportunity for the cadets to practice these skills under supervision.

INTRODUCTION

REVIEW

The following questions are a review of EO M390.04 (Determine Distance on a Map and on the Ground, Section 4).

QUESTIONS

Q1. After marking a map to assist in determining distance, what should be done with the marks?

Q2. Define personal pace.

Q3. What effect does weather have on a person's pace?

ANTICIPATED ANSWERS

A1. All marks should be carefully erased from the map after each distance is determined.

A2. The number of paces a person walks over a distance of 100 m.

A3. Snow and rain will shorten a person's pace while wind will increase/decrease the pace length if a person is travelling with/against the wind.

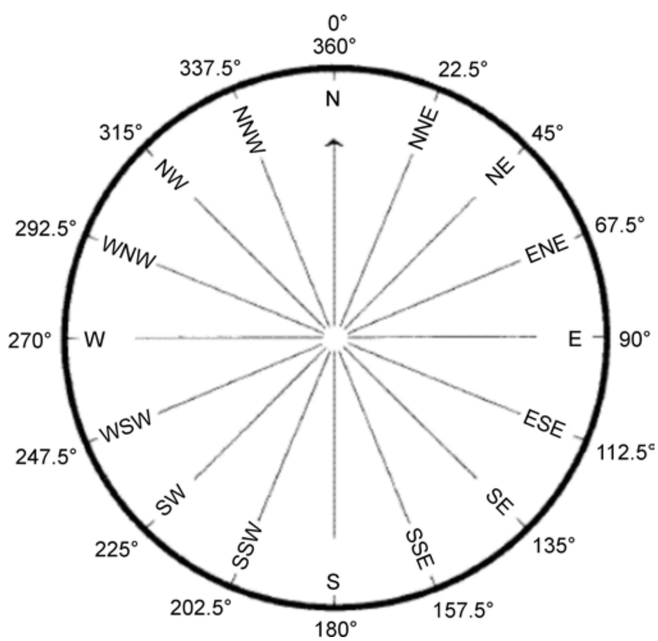
OBJECTIVES

By the end of this lesson the cadet shall have determined bearings on a map and on the ground.

IMPORTANCE

It is important for cadets to be able to determine bearings on a map and on the ground as this is one of the key skills required to navigate using a map and compass.

Teaching Point 1	**Identify and Explain the 16 Points of a Compass**
Time: 10 min	Method: Interactive Lecture



Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 18-5-1 Compass Rose

FOUR CARDINAL POINTS

The four cardinal points of the compass, measured at right angles clockwise from north are:

- north (N) at 0 and 360 degrees,
- east (E) at 90 degrees,
- south (S) at 180 degrees, and

- west (W) at 270 degrees.

FOUR INTER-CARDINAL POINTS

The four inter-cardinal points are located halfway between each of the cardinal points. Measured clockwise from north, they are:

- northeast (NE) at 45 degrees,
- southeast (SE) at 135 degrees,
- southwest (SW) at 225 degrees, and
- northwest (NW) at 315 degrees.

EIGHT INTERMEDIATE POINTS

The eight intermediate points are located halfway between each cardinal point and inter-cardinal point. Measured clockwise from north, they are:

- north-northeast (NNE) at 22.5 degrees,
- east-northeast (ENE) at 67.5 degrees,
- east-southeast (ESE) at 112.5 degrees,
- south-southeast (SSE) at 157.5 degrees,
- south-southwest (SSW) at 202.5 degrees,
- west-southwest (WSW) at 247.5 degrees,
- west-northwest (WNW) at 292.5 degrees, and
- north-northwest (NNW) at 237.5 degrees.

As an aid to remember the different types of points:

- cardinal points are designated by one letter;
- inter-cardinal points are designated by two letters; and
- intermediate points are designated by three letters.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Which two degree values may be used for north?

Q2. How many inter-cardinal points are there?

Q3. Name one of the intermediate points.

ANTICIPATED ANSWERS

A1. 0 and 360 degrees.

A2. Four.

A3. Either NNE, ENE, ESE, SSE, SSW, WSW, WNW, or NNW.

Teaching Point 2 **Explain the Degree System on a Compass**

Time: 5 min Method: Interactive Lecture

The cardinal, inter-cardinal, and intermediate points describe directions only to within one-sixteenth of a full circle. For a more precise indication of direction it is necessary to use the sub-divisions of the circle called degrees. This measurement starts and ends at north (top) and is measured in a clockwise rotation.

Degrees. The most common method of dividing a circle is by degrees. These degrees represent 360 equal angles in a complete circle and they are represented by the symbol “°” (eg, 222°).

It is important to emphasize that degrees should always be measured clockwise and always using north as the start point.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. Degrees are measured in which direction?

Q2. What is the most common method of dividing a circle?

Q3. How many degrees are in a full circle?

ANTICIPATED ANSWERS

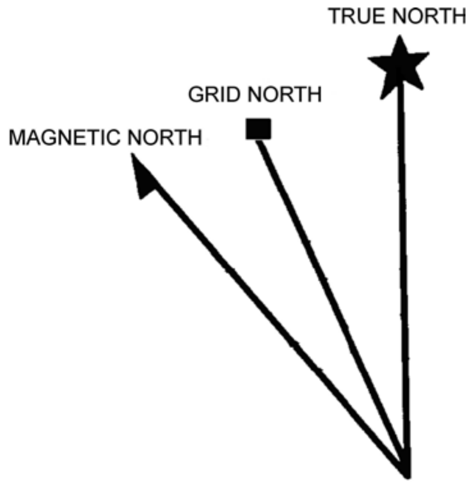
A1. Degrees are measured clockwise from north.

A2. Degrees.

A3. 360 degrees.

Teaching Point 3 **Identify and Explain the Three Norths**

Time: 5 min Method: Interactive Lecture



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-5-2 The Three Norths

THE THREE NORTHS

The relationship between the three norths, especially grid and magnetic, is key to using a compass on both a map and on the ground.

True North. True north is located at the top of the earth where the geographic North Pole is located, where all lines of longitude meet. In the declination diagram on the map, true north is represented by the symbol of a star, which represents the North Star, Polaris.

Grid North. Grid north is the north indicated by the grid lines (eastings) on a topographical map. The easting lines run parallel to each other and will never meet at the geographic North Pole; because of this, grid north points off slightly from true north. In the declination diagram on the map, grid north is represented by a square, which represents a map grid.

Magnetic North. Magnetic north is the location of the north magnetic pole, where the Earth's magnetic field bends back into the Earth toward the south magnetic pole. It is located in the Canadian arctic and is different from true north. It is the direction in which the compass needle points. In the declination diagram on the map, magnetic north is represented by a needle as on a compass.

The differences between the three norths affect navigation for the map and compass user, in the form of magnetic declination. Magnetic declination is the difference in bearing either between true north and magnetic north or between grid north and magnetic north.

Cadets will normally use the magnetic declination value between grid north and magnetic north when navigating using a map and compass. By setting the magnetic declination on the compass, magnetic bearings are converted to grid bearings which allow bearings taken from the map to be used on the ground and vice versa.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. Which north is represented by a star?

Q2. Which north does a compass needle point towards?

Q3. Which magnetic declination value is most important to topographical map users?

ANTICIPATED ANSWERS

A1. True north.

A2. Magnetic north.

A3. The magnetic declination value between grid north and magnetic north.

Teaching Point 4	**Explain Bearings**
Time: 5 min	Method: Interactive Lecture

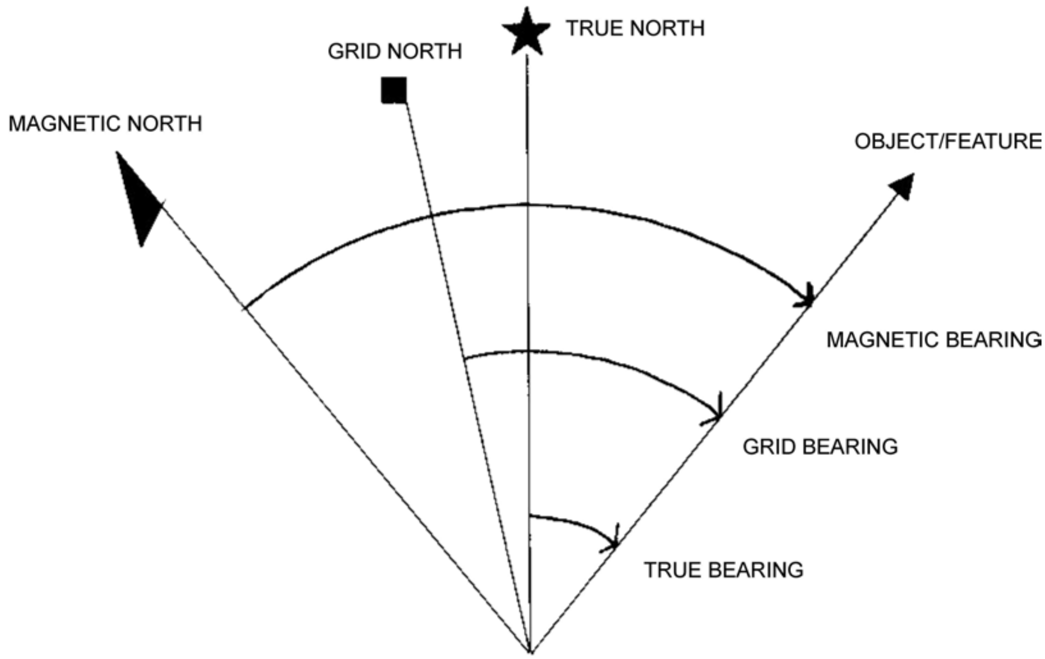
DEFINITION OF A BEARING

Bearing. A bearing is an angle that is measured clockwise, from north. It is measured in degrees and is relative to the observer.

In geometry, an angle is based on three points; a vertex, and two points, each of which designates a ray. For a bearing, the vertex is the point where the bearing is taken from, another point is north, and the last point is where the bearing is directed to. The north (either true, grid or magnetic) used identifies the type of bearing.

In ground navigation, one ray of the angle points north (usually grid north) and the other ray, known as a plotting ray, points to the object/direction.

TYPES OF BEARINGS



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-5-3 Types of Bearings

True Bearings. A true bearing is a bearing measured from true north. While map users rarely use them, directions determined using the sun, moon and stars are true bearings. Global Positioning System (GPS) receivers also use true bearings.

Grid Bearings. A grid bearing is a bearing measured from grid north. The ability to determine a bearing from a map allows a map user to plan routes or activities before going into the field, and allows an easy method of communicating information about movement or location.

Magnetic Bearings. A magnetic bearing is measured from magnetic north and is measured using a compass, which either has no option of setting magnetic declination or has the magnetic declination set to zero. A magnetic bearing is a quick and efficient method of describing a route when a map is not being used.

If a compass has its declination set to zero, bearings to objects on the ground determined by that compass are magnetic bearings. Setting the magnetic declination on a compass converts the magnetic bearings determined by that compass into grid bearings for the map being used.

Back Bearing. A back bearing is a bearing that is in exactly the opposite direction of the bearing that has been measured. A back bearing can be useful for different reasons: to return to the start location after a hike, or to calculate the bearing from an object to one's current location. The steps to calculate a back bearing are:

- if the bearing is less than 180 degrees, add 180 degrees; and
- if the bearing is greater than 180 degrees, subtract 180 degrees.

CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. A bearing is another name for what?

Q2. Directions determined using the sun, moon and stars are what type of bearing?

Q3. How is knowing a back bearing useful?

ANTICIPATED ANSWERS

A1. A bearing is another name for an angle.

A2. True bearings.

A3. A back bearing can be useful for different reasons: to return to the start location after a hike, or to calculate the bearing from an object to one's current location.

Teaching Point 5	**Explain, Demonstrate and Have the Cadets Practice Determining a Bearing on a Map**
Time: 15 min	Method: Demonstration and Performance

The ability to determine a bearing from a map allows cadets to plan routes or activities before going into the field, and allows an easy method of communicating information about movement or location. When a compass is adjusted to compensate for magnetic declination, it will allow bearings taken on the map to be used on the ground and vice versa.

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be employed to monitor cadet performance.

Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 18-5-4 Measuring a Bearing on a Map

A cadet will accidentally measure a back bearing if they determine the bearing in the wrong direction (eg, bearing from point B to point A instead of point A to point B).

Prior to measuring a bearing on a map it is good practice to first estimate the bearing by drawing a compass rose and looking at where the bearing would be on the compass rose. This serves as a good check to ensure the cadet has not accidentally measured the back bearing.

To measure a bearing on a map:

1. Set the predetermined declination on the compass.
2. Identify and mark the start (point A) and finish (point B) points on a map.
3. Draw a plotting ray from point A to point B.
4. Lay the fully opened compass with the edge of the compass base plate along the plotting ray, and the sighting arrow pointed in the direction of travel (point A to point B).
5. Hold the compass in place, rotate the compass dial so that the compass meridian lines align with the easting lines on the map, ensuring north on the dial indicates north on the map.
6. Read the number on the compass dial at the luminous index pointer.

If the bearing is taken from point B to point A, the compass will be pointing 180 degrees in exactly the opposite direction of travel wanted. This is called a back bearing.

Have the cadets practice determining bearings on a map from the list created (before the lesson) from the topographical map of the exercise area.

CONFIRMATION OF TEACHING POINT 5

The cadets' participation in determining bearings on a map will serve as the confirmation of this TP.

Teaching Point 6 — **Explain, Demonstrate, and Have Cadets Determine the Bearing of a Prominent Object**

Time: 10 min — Method: Demonstration and Performance

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while the cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor the cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be employed to monitor the cadets' performance.

A compass can be used to determine the bearing for a direction of travel and from one's current location to a prominent object. The ability to take a bearing of a prominent object also allows the cadet to look for a prominent object as a steering point when they need to follow a given bearing. A bearing is a quick and accurate method for describing the direction of travel.

A prominent object is something that is usually tall and easily recognizable (eg, church steeple, tall tree or hilltop).

Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-5-5 Determining a Bearing

After the cadets have demonstrated the skill, have them practice determining the bearings of other prominent objects. This location should be predetermined by the recce IAW the pre-lesson instructions.

To determine the bearing of a prominent object:

1. Set the predetermined declination on the compass.
2. Hold the compass at eye level and at arm's length, and turn to face the prominent object (as illustrated in Figure 18-5-5).
3. Aim at the object using the compass sight, ensuring the sighting line is in line with the index pointer.
4. Adjust the compass cover so the compass dial is seen in the sighting mirror.
5. Look in the mirror and turn the compass dial until the magnetic needle is over the orienting arrow (put the red in the bed).
6. Read the number on the compass dial at the luminous index pointer.

Inform the cadets that when taking a bearing of a prominent object they will get different readings than other cadets unless they are all using the same line of sight to that prominent object (eg, standing in the same spot).

CONFIRMATION OF TEACHING POINT 6

The cadets' participation in determining bearings on the ground will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in determining bearings on a map and on the ground will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

CLOSING STATEMENT

It is important for cadets to be able to determine bearings on a map and on the ground as this is one of the key skills required to navigate using a map and compass. Experience in this skill will give the cadets confidence in their ability to navigate in the field.

INSTRUCTOR NOTES/REMARKS

To preserve and reuse the maps, the maps should be covered or coated to allow the use of wet-erase markers instead of pencils or pens.

REFERENCES

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 6

EO C390.01 – IDENTIFY TYPES OF MAPS

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the handout located at Annex E for each cadet.

The following maps are the minimum required to instruct this lesson: topographical, orienteering, street, and road. However, as many examples of different types of maps should be collected.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1–3 to orient the cadets to maps and present basic or background material on the purposes, types, and care of maps.

Demonstration and performance was chosen for TP 4 as it allows the instructor to explain and demonstrate folding a map while providing an opportunity for the cadets to practice folding a map under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified types of maps.

IMPORTANCE

It is important for cadets to understand the types of maps in order to choose the appropriate map to meet their needs.

Teaching Point 1	**Explain the Purpose of a Map**
Time: 5 min	Method: Interactive Lecture

THE PURPOSE OF A MAP

Maps are designed to give the user specific information based on its type. While there are many different types of maps, there is information that is common to most types.

> The art and science of making maps is called cartography. The oldest known maps are preserved on Babylonian clay tablets from about 2300 B.C.

A MAP IS A SCALE REPRESENTATION OF THE GROUND

A map is usually drawn to scale, that is, it is a proportionately smaller representation of the area depicted. However, many maps distort key features to highlight or emphasize them on the map. For example, roads are almost always depicted wider than they would be to scale. Scales may range from 1 : 5 000 (very high detail map) to 1 : 10 000 000 (a globe or a map of the world).

A MAP USES SYMBOLS TO REPRESENT BOTH PHYSICAL AND MAN-MADE FEATURES FOUND ON THE GROUND

Many features on a map are too small to see if depicted to scale. Cartographers (map-makers) use internationally accepted symbols to represent both natural and man-made features. These symbols are commonly known as conventional signs.

Maps Identify Locations Such as Towns, Lakes, and Rivers, by Name

Locations such as towns, lakes, and rivers are identified by name. Other important features such as mountains, highways, and political boundaries are also identified.

Map Designs Reflect the Needs of the User

Map designs reflect the individual needs of the user. Urban planners need a map that shows where water, sewer, and electrical lines are located. Travellers need to get to where they want to be, whether it is within a city or across the country. Education providers need maps that show the demographics (the statistical data of a population such as age, education, etc) of the region to know where their students may be coming from. Cadets need a map that will help them navigate, whether it is planning a flight or using a compass to trek to a survival site.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What is the purpose of a map?

Q2. Internationally accepted symbols used to represent both natural and man-made features are known as what?

Q3. Maps identify many types of locations by name. Identify three.

ANTICIPATED ANSWERS

A1. Maps are designed to give the user specific information based on its type.

A2. These symbols are commonly known as conventional signs.

A3. Locations such as towns, lakes, and rivers are identified by name. Other important features such as mountains, highways, and political boundaries are also identified.

Teaching Point 2 | **Describe the Various Types of Maps**

Time: 5 min | Method: Interactive Lecture

VARIOUS TYPES OF MAPS

Maps contain information based on their type.

If the type of map is available as a training aid, it should be displayed when it is being discussed.

Topographical

This type of map is commonly used by the military. The purpose of a topographical map is to present a picture of the ground as it really exists. Topographical maps show as much detail as the scale allows, generally 1 : 25 000, 1 : 50 000, or 1 : 250 000. This is the main type of map used by cadets for ground navigation.

Orienteering

Through the International Orienteering Federation (IOF), specific rules and standards have been set for the production of orienteering maps, including colour, symbols, and scales. They are more detailed than topographical maps, with reference to vegetation and landforms.

Political

Political maps show countries, provinces, counties and other political borders. Most globes show the political boundaries of the world.

Street

Street maps are designed to help commuters and tourists locate key sites such as roads and highways, police stations, fire halls, hospitals, schools, parks and more within a metropolitan area (eg, town, city).

Road

Road maps are designed to show the roads and highways over a large area like a province or territory. They show how to travel between cities, towns, parks, etc.

Statistical

Statistical maps show statistical information such as the production levels of crops or minerals across a country.

Relief

Relief maps are a three-dimensional representation, usually of terrain. The terrain elevation is usually exaggerated by a factor between five and ten. This helps to visually recognize the terrain features.

Outline

Outline maps show large areas with only borders, and coastlines showing. They normally have a high map scale (eg, 1 : 10 000 000).

Air Photo

Air photo maps are actual pictures used in reconnaissance or to create many of the maps listed. They are the most accurate in that they show the actual area. Satellites pictures now represent the next level of air photo maps with the ability to zoom in on almost any area in the world.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is the main type of map used by cadets for ground navigation?

Q2. To travel from one city to another, what type of map is best?

Q3. Most maps are flat (two dimensional). What type discussed is not?

ANTICIPATED ANSWERS

A1. Topographical maps.

A2. A road map.

A3. Relief maps.

Teaching Point 3	**Describe How to Care for a Topographical Map**
Time: 5 min	Method: Interactive Lecture

HOW TO CARE FOR A TOPOGRAPHICAL MAP

Some maps produced are already waterproofed, however, most maps are not. Paper maps are expensive and may be easily damaged. Precautions must be taken to protect them from water, dirt and wind. Maps, when exposed to water, will become soggy, start to deteriorate and become very easy to tear.

Waterproofing the Map

Preparing a map for exposure to the elements is a vital step in prolonging the life of the map. Ways to prepare a map for waterproofing include:

- **Resealable Plastic Bag Method.** This method requires a large heavyweight resealable clear plastic bag and waterproof tape (eg, clear packing tape). Place the folded map into the bag with one edge at the sealed opening and an adjacent edge along one of the two sides of the bag. Cut enough tape to completely adhere to one edge of the bag from corner to corner. Stick one half of the tape along one edge of the bag that overhangs the map, from corner to corner. Flip the bag over (on to the side of the map that is not being used) and fold the tape down on itself and the other side of the bag. Fold the empty portion of the bag over the backside of the map and tape it down.
- **Contact Paper.** Sometimes called Map Tac, this is a clear plastic that has an adhesive on one side. Covering the map with contact paper will waterproof the map; however, it will become very stiff. A wet-erase marker or grease pencil will be required to write on the map. Use rubbing alcohol to remove permanent marker.
- **Chemical Coatings.** Chemical coatings are effective in waterproofing maps; however, they must be applied carefully in a well-ventilated area. They are sprayed or brushed onto the map. The coating must be allowed to fully dry before using the map.

Drying Technique

If a map gets wet, carefully open it fully and let it dry completely on a flat clean surface. If it dries when it is folded, it may stick together, ruining the map.

Only Partially Opening in a Strong Wind

A map should never be fully opened in a strong wind. It should be opened to the area being used, and refolded along the original fold lines.

Using Pencil and Erasing When Work is Complete

Use only pencil to mark your maps and erase all markings gently. Maps that are protected by plastic can be marked using wet-erase markers or grease pencils.

Storing the Map

Maps should be stored in a dry place, rolled, folded, or laid flat.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. Name the three types of waterproofing techniques discussed.

Q2. How should a map be handled in a strong wind?

Q3. Where should maps be stored?

ANTICIPATED ANSWERS

A1. Resealable plastic bag method, contact paper, and chemical coatings.

A2. It should be opened to the area being used, and refolded along the original fold lines.

A3. Maps should be stored in a dry place.

Teaching Point 4	**Explain, Demonstrate, and Have Cadets Practice Folding a Map**
Time: 10 min	Method: Demonstration and Performance

For this skill lesson, it is recommended that the instruction take the following format:

1. Explain and demonstrate folding the map.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

The cadets will use Annex E as their map. This annex also shows the steps in pictorial format.

Note: Assistant instructors may be used to monitor the cadets' performance.

The steps to fold a map:

Lay map face up (north at the top), fold map in half by bringing the top of the map sheet down to the bottom of the map sheet.

Fold the top half of the map sheet up in half again, then turn the map over and fold the bottom half to match the top half.

Fold the ends of the map in half from left to right.

Fold each of the open ends back into half again so that the map name and index to adjacent map sheet appears on the outside.

If the map is folded correctly, it should now open like an accordion in the shape of an M with the map name visible on top.

CONFIRMATION OF TEACHING POINT 4

The cadets' participation in folding a map will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. A map is usually drawn to scale. What does this mean?

Q2. What type of map should be used to travel from the Same City Museum to the Same City Zoo?

Q3. If the map is folded correctly, how should it now look?

ANTICIPATED ANSWERS

A1. A map is a proportionately smaller representation of the area depicted.

A2. A street map.

A3. The map should now open like an accordion in the shape of an M with the map name visible on top.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for cadets to understand the types of maps in order to choose the appropriate map.

INSTRUCTOR NOTES/REMARKS

The following types of maps are the minimum required to instruct this lesson:

- topographical,
- orienteering,
- street, and
- road.

REFERENCES

A2-036 A-CR-CCP-121/PT-001 Director Cadets 3. (2003). *Royal Canadian Army Cadet Reference Book*. Ottawa, ON: Department of National Defence.

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

C0-007 (ISBN 0-02-029265-1) Kjellstrom, B. (1994). *Be Expert With Map and Compass: The Complete Orienteering Handbook*. New York, NY: Hungry Minds, Inc.

C2-041 (ISBN 0-07-136110-3) Seidman, D., & Cleveland, P. (1995). *The Essential Wilderness Navigator*. Camden, ME: Ragged Mountain Press.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 7

EO C390.02 – INTERPRET CONTOUR LINES

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the handouts located at Annexes F and H for each cadet.

Create slides of Annexes G and I.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 to illustrate to the cadets how to interpret contour lines.

A practical activity was chosen for TP 2 as it is an interactive way to introduce cadets to interpreting contour lines in a safe, controlled environment. This activity contributes to the development of ground navigation skills and knowledge in a fun and challenging setting.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have interpreted contour lines.

IMPORTANCE

It is important for cadets to be able to interpret contour lines in order for them to navigate through or around different elevations.

Teaching Point 1	Explain How Contour Lines Are Interpreted to Indicate the Shape of the Ground
Time: 15 min	Method: Interactive Lecture

HOW CONTOUR LINES ARE INTERPRETED TO INDICATE THE SHAPE OF THE GROUND

Through learning how to interpret contour lines, cadets will be better able to understand the relationship between contour lines on the map to the features on the ground.

Relief

Relief, or elevation, is the shape of the ground on a vertical plane. Relief on a map is the representation of the height and shape of the ground in intervals of metres or feet.

There are two distinct elements in the representation of relief, including:

- **Representation of Height.** This is a fact-based representation of the height of the land and of landforms. Differences in appearance on the map (as compared to the ground) will arise from the type, density and accuracy of the information provided.
- **Representation of Shape.** This may be largely artistic, and the methods used will vary between maps.

Contour Lines and Intervals

A contour line joins points of equal elevation in relationship to sea level, and is the standard method of showing relief on topographical maps.

Contour lines are shown at a regular vertical interval. This difference in height between contours lines is called contour interval. The contour interval is always stated in the margin of the map, normally near the graphic scales.

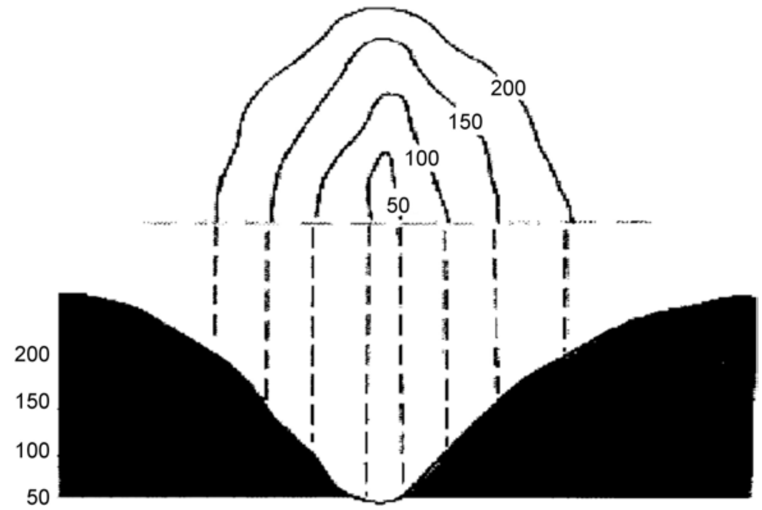
Contour lines are normally drawn as continuous brown lines. Every fourth or fifth contour line is called an "Index Contour" and is shown by a thicker brown line. This helps when reading and counting the contour lines to determine a height.

The Shape of the Ground

Interpreting contour lines provides a visualization of the shape of the ground, which is shown on the map by contour lines and contour intervals. Correct interpretation of the shape of the ground from interpreting contour lines requires practice. It is essential to study the various features, comparing the map to the ground in each case.

Types of Slopes

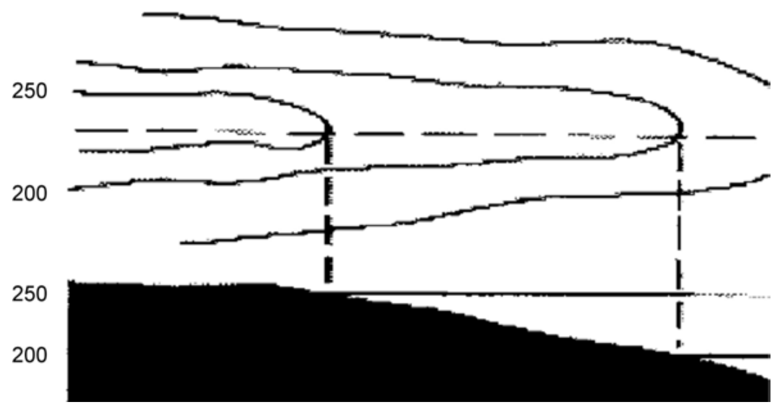
- **Steep.** Contour lines are close together. There is less distance to travel to gain or lose elevation.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-1 Steep Slopes

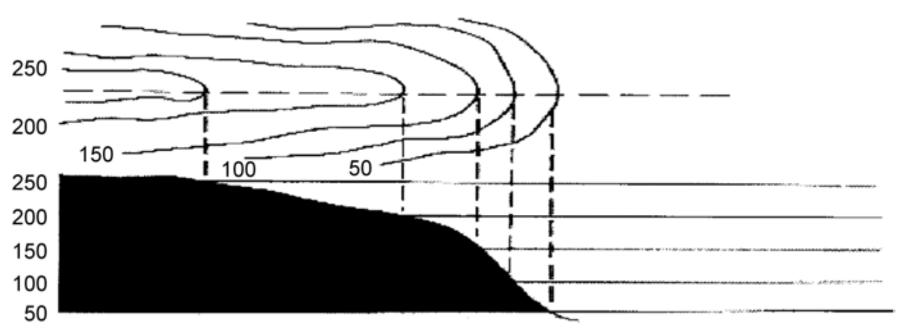
- **Gentle.** Contour lines are further apart. There is a greater distance to travel to gain or lose elevation.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-2 Gentle Slope

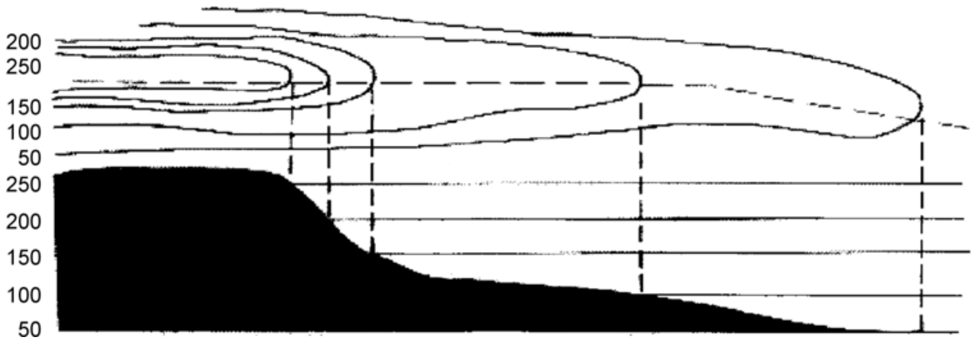
- **Uniform.** Contours are an equal distance apart. The slope remains constant in its rise/decline, whether the slope is steep or gentle.
- **Convex.** The spacing between contour lines moving down a slope decreases. The middle of the slope seems to bulge outward – appearing convex.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-3 Convex Slope

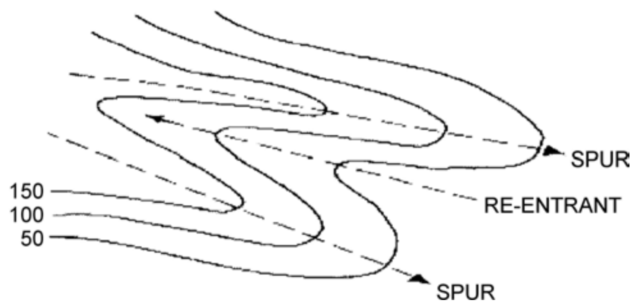
- **Concave.** The spacing of the contour lines increases towards the bottom of the slope. The middle of the slope seems to depress inward – appearing concave.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-4 Concave Slope

- **Spurs.** A contour feature that extends out from a slope.
- **Re-Entrants.** A contour feature that cuts back into a slope.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-5 Spurs and Re-Entrant

Distribute Annex F to each cadet and have them complete the worksheet. Correct the answers using the answer key located at Annex G.

CONFIRMATION OF TEACHING POINT 1

The cadets' completion of the matching contour line worksheet will serve as the confirmation of this TP.

Teaching Point 2 — **Have the Cadets Interpret Contour Lines**

Time: 10 min — Method: Practical Activity

Have cadets work independently (or in small groups if it suits the needs of the class).

The cadets will choose the easiest route, based on slope as indicated by the contour lines.

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadet interpret contour lines on a map.

RESOURCES

- Contour line worksheet located at Annex H, and
- Relief version of map located at Annex I.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Hand out contour line worksheet.
2. Have cadets draw a route, based on the features (especially elevations), on their map.
3. Have cadets explain why they chose their route, emphasizing the contour lines that would be traversed.
4. When cadets have finished, display the slide of Annex I and discuss the terrain and its affects on possible routes.

Inform the cadets that there is no right answer. Routes chosen can be based on many factors, such as: differing hiking abilities, fitness levels, personal preferences, etc.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' completion of the two contour line worksheets will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for cadets to be able to interpret contour lines in order to navigate through or around differences of elevation. This skill will require practice.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 8

EO C390.03 – ORIENT A MAP BY INSPECTION

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy Annex J. Cut the first page along the dotted lines and post the three locations around the training area (eg, on walls, trees, etc). Ensure that the locations match the demonstration map.

Ensure sufficient topographical maps of the exercise area are available.

A recce of the exercise area should be made to determine a site where the topographical map of the exercise area may be oriented by inspection. The site chosen should have a minimum of three distinctive features to be used as prominent objects by the cadets in order to orient their maps.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 to give the cadets an overview of the purpose of orienting a map.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate orienting a map by inspection while providing an opportunity for the cadets to practice the skill under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have oriented a map by inspection.

IMPORTANCE

It is important for cadets to be able to orient a map by inspection in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

Teaching Point 1 — **Explain the Purpose of Orienting a Map**

Time: 5 min — Method: Interactive Lecture

PURPOSE OF ORIENTING A MAP

Orienting a map by inspection means to rotate the map so that the map directions and map detail correspond with those on the ground. This is a simple and quick way of orienting a map, if the person's approximate location is known. If the approximate location is unknown, orienting a map by inspection is much more difficult as similar features may confuse map readers and thereby they orient themselves incorrectly. If more unique features are visible and shown on the map, it will be easier to find one's approximate location.

Orienting the map does a number of things:

- it makes it easy to relate the map to the ground;
- it helps to confirm, or possibly find, a person's approximate location; and
- when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What is physically done to the map when it is being oriented?

Q2. What key piece of information makes orienting a map by inspection simple and quick?

Q3. Orienting the map does a number of things. Describe one.

ANTICIPATED ANSWERS

A1. The map is rotated so that the map directions and map detail correspond with those on the ground.

A2. The person's approximate location.

A3. Three possible answers include:

- it makes it easy to relate the map to the ground;
- it helps to confirm, or possibly find, a person's approximate location; and
- when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

Teaching Point 2 | **Explain and Demonstrate How to Orient a Map**

Time: 20 min | Method: Demonstration and Performance

After explaining each step, demonstrate using the training aids.

After the demonstration, have the cadets orient a topographical map of the exercise area using the prominent objects they observe.

To orient a map, complete the following steps:

Identify the approximate location on the map (the 'You').

Select three prominent objects around your current location and find them on the map (house, church and bridge).

Rotate the map until all identified objects on the map line up with the objects located on the ground.

Ensure that all features line up with the positions on the map.

Show page 18J-2.

ACTIVITY

Time: 15 min

OBJECTIVE

The objective of this activity is to have the cadets orient a map by inspection.

RESOURCES

- Topographical map of the exercise area, and
- The cadet's location on the map.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Have cadets confirm their location on the map.
2. Have cadets select three prominent objects around their current location and find them on the map.
3. Have cadets rotate the map until all identified objects on the map line up with the objects located on the ground.
4. Ensure all features line up with the positions on the map.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in orienting a map by inspection will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for cadets to be able to orient a map by inspection in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 9

EO C390.04 – ORIENT A MAP USING A COMPASS

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Ensure sufficient topographical maps of the exercise area are available.

Photocopy Annex K. Cut the first page along the dotted lines and post the three locations around the training area (eg, on walls, trees, etc). Ensure that the locations match the demonstration map. Ensure that the north of the demonstration map corresponds to the north of the training area, which will allow the map to be oriented with a compass.

Calculate the magnetic declination for the topographical map of the exercise area.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 to give the cadets an overview of the purpose of orienting a map.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate orienting a map using a compass while providing an opportunity for the cadets to practice the skill under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have oriented a map using a compass.

IMPORTANCE

It is important for cadets to orient a map using a compass in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

Teaching Point 1	**Explain the Purpose of Orienting a Map**
Time: 5 min	Method: Interactive Lecture

PURPOSE OF ORIENTING A MAP

Orienting a map using a compass means to rotate the map so that the north of the map matches the north of the ground. This is confirmed, visually, with the map directions and map detail corresponding with those on the ground. This is a simple and quick way of orienting a map if the person's approximate location is known. If the approximate location is unknown, orienting a map using a compass can still be done, but this does not determine the map reader's location. Similar features may confuse map readers and thereby they orient themselves incorrectly. If more unique features are visible and are shown on the map it will be easier to find one's approximate location.

Orienting the map does a number of things:

- it makes it easy to relate the map to the ground;
- it helps to confirm, or possibly find, a person's approximate location; and
- when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. What is physically done to the map when it is being oriented?

Q2. Can a map be oriented using a compass if the person's location is unknown?

Q3. Orienting the map does a number of things. Describe one.

ANTICIPATED ANSWERS

A1. The map is rotated so that the map directions and map detail correspond with those on the ground.

A2. Yes. Also, the oriented map may assist map readers in discovering their location.

A3. Three possible answers include:

- it makes it easy to relate the map to the ground;
- it helps to confirm, or possibly find, a person's approximate location; and
- when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

Teaching Point 2 — **Explain, Demonstrate and Have the Cadets Practice Orienting a Map Using a Compass**

Time: 20 min — Method: Demonstration and Performance

> After explaining each step, demonstrate using the training aids.
>
> After the demonstration, the cadets will orient the topographical map of the training area.

To orient a map using a compass, complete the following steps:

1. Identify the cadet's approximate location on the map (the 'You').
2. Set the magnetic declination.
3. Set the compass dial to north.
4. Lay the compass flat on the map with the cover open.
5. Point the mirror to north (top of the map).
6. Align the compass meridian lines with the map easting lines (use the arrow beside the 'You' on the demonstration map).
7. Turn the map until the magnetic needle lines up with the orienting arrow.
8. Ensure that all features (the house, church and bridge) line up with their positions on the map.

> Show page 18K-2.

ACTIVITY

Time: 10 min

OBJECTIVE

The objective of this activity is to have the cadets orient a map using a compass.

RESOURCES

- Topographical map of the exercise area,
- Compass,
- Predetermined magnetic declination, and
- The cadet's location on the map.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Have cadets confirm their location on the map.
2. Have cadets set the magnetic declination.
3. Have cadets set the compass dial to north.
4. Have cadets lay the compass flat on the map with the cover open.
5. Have cadets point the mirror to north (top of the map).
6. Have cadets align the compass meridian lines with the map easting lines.
7. Have cadets rotate the map until the magnetic needle lines up with the orienting arrow.
8. Have cadets ensure that all features line up with their positions on the map.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in orienting a map using a compass will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for cadets to orient a map using a compass in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 10

EO C390.05 – CALCULATE MAGNETIC DECLINATION

Total Time:	60 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the handouts located at Annexes L and N for each cadet.

Create slides of Annex M.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 to orient the cadet to calculating magnetic declination and present basic material.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate calculating magnetic declination while providing an opportunity for the cadets to practice calculating magnetic declination under supervision.

An in-class activity was chosen for TP 3 as it is an interactive way to reinforce calculating magnetic declination.

INTRODUCTION

REVIEW

N/A.

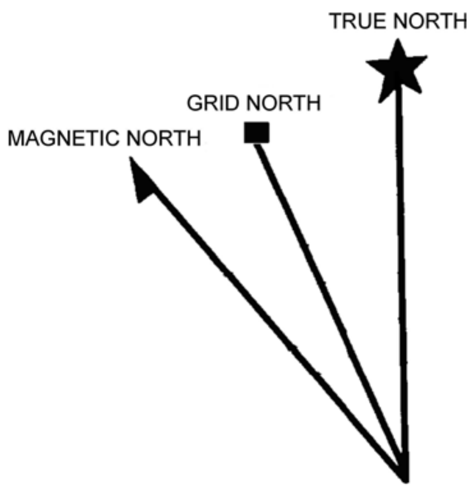
OBJECTIVES

By the end of this lesson the cadet shall have calculated magnetic declination.

IMPORTANCE

It is important for cadets to know how to calculate magnetic declination as it provides the cadet with confidence that they will arrive at their destination when navigating on a bearing. Not accounting for magnetic declination may affect navigation, as the cadet may travel off the intended route. For every one degree of magnetic declination not accounted for, a person would be approximately 17 m off for each kilometre travelled.

Teaching Point 1	**Discuss the Three Norths and Magnetic Declination**
Time: 5 min	Method: Interactive Lecture



Director Cadets 3, 2008, Ottawa, ON: Department of National Defence

Figure 18-10-1 The Three Norths

THE THREE NORTHS

The relationship between the three norths, especially grid and magnetic, is key to using a compass on both a map and on the ground.

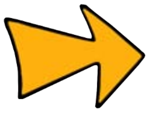
True North. True north is located at the top of the earth where the geographic North Pole is located and where all lines of longitude meet. In the declination diagram on the map, true north is represented by the symbol of a star, which represents the North Star, Polaris.

Grid North. Grid north is the north indicated by the grid lines (eastings) on a topographical map. The easting lines run parallel to each other and will never meet at the geographic North Pole; because of this, grid north points off slightly from true north. In the declination diagram on the map, grid north is represented by a square, which represents a map grid.

Magnetic North. Magnetic north is the location of the magnetic north pole, where the Earth's magnetic field bends back into the Earth toward the south magnetic pole. It is located in the Canadian arctic and is different from true north. It is the direction in which the compass needle points. In the declination diagram on the map, magnetic north is represented by a needle as on a compass.

MAGNETIC DECLINATION

The differences between the three norths affect navigation for the map and compass user, in the form of magnetic declination. Magnetic declination is the difference in bearing either between true north and magnetic north or between grid north and magnetic north.



The line of zero declination, as of 2008, runs through Baker Lake, Nunavut, Churchill, Man., and Sioux Lookout, Ont.

> Cadets will normally use the magnetic declination value between grid north and magnetic north when navigating using a map and compass. By setting the magnetic declination on the compass, magnetic bearings are converted to grid bearings which allow bearings taken from the map to be used on the ground and vice versa.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Which north is represented by a star?

Q2. Which north does a compass needle point towards?

Q3. Which magnetic declination value is most important to topographical map users?

ANTICIPATED ANSWERS

A1. True north.

A2. Magnetic north.

A3. The magnetic declination value between grid north and magnetic north.

Teaching Point 2 — **Explain, Demonstrate and Have Cadets Calculate Magnetic Declination**

Time: 15 min — Method: Demonstration and Performance

> Distribute Fact Sheet located at Annex L. When using the slides from Annex M, cover the right section (the equations) and reveal each step as required. Example 1 should be used as the demonstration and Example 2 to be performed step-by-step by the cadets. If more examples are required, use the questions from the worksheet. However, Question 9 should not be used as an example, only as a question for the cadets to calculate as it involves an east/west declination switch.
>
> For this skill lesson, it is recommended that instruction take the following format:
>
> 1. Explain and demonstrate the complete skill while cadets observe.
> 2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
> 3. Monitor the cadets' performance as they practice the complete skill.
>
> **Note:** Assistant instructors may be employed to monitor cadet performance.

LOCATING DECLINATION DIAGRAM

Calculating current declination uses the information provided by the declination diagram on a map and the information printed directly underneath. This diagram is most often found on the right side of the map in the marginal information.

IDENTIFING THE FORMULA USED TO CALCULATE MAGNETIC DECLINATION

Several mathematical principles are used in the formula to calculate magnetic declination. Understanding of the mathematical order of operations is essential.

Formula: Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination

Grid Magnetic Angle. The angle between grid north and magnetic north, found on the declination diagram. Written in degrees and minutes.

> 1 degree (°) = 60 minutes ('), similar to calculating time (eg, 1 hour = 60 minutes).
>
> This ratio is very important to remember when adjusting the grid magnetic angle to the current declination. This is where many errors occur.

Current Year. The current calendar year.

Year of Declination Information. Found below the declination diagram.

Annual Change. Found below the declination diagram and is written in minutes.

> It is important that the annual change be inserted into the formula correctly:
>
> - If annual change is **increasing**, insert into formula as a **positive** number.
> - If annual change is **decreasing**, insert into formula as a **negative** number.

Current Declination. This is the result of the formula. It is the magnetic declination to be set on the compass.

West Declination. When magnetic north is west (to the left) of grid north on the declination diagram.

East Declination. When magnetic north is east (to the right) of grid north on the declination diagram.

> If the current declination calculates to a negative number, an east declination changes to a west declination and vice versa.

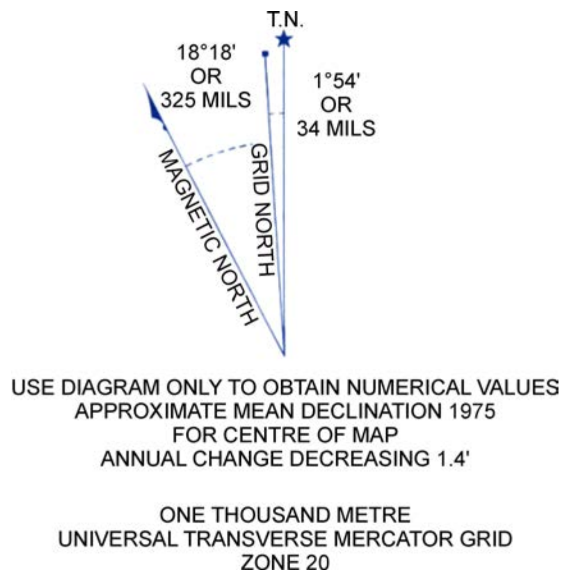
CALCULATING MAGNETIC DECLINATION

Steps to calculate magnetic declination:

1. Identify grid magnetic angle.
2. Identify current year.
3. Identify year of declination information.
4. Identify annual change.
5. Determine whether the annual change is positive or negative.
6. Input the information into the formula.
7. Solve for current declination.
8. Determine whether the magnetic declination is east or west.

Show slide of Example 1 of Calculating Magnetic Declination located at Annex M.

Example 1:



Natural Resources Canada, 2008, Topo Declination Diagram. Retrieved April 11, 2008, from http://gsc.nrcan.gc.ca/geomag/field/magdec_e.php?p=1

Figure 18-10-2 Declination Diagram

From Figure 18-10-2:

1. Grid Magnetic Angle: 18° 18'
2. Current Year: 2008 (used for this example)
3. Year of Declination Information: 1975
4. Annual Change: decreasing 1.4'
5. Decreasing means 1.4' becomes -1.4'
6. Input the information into the formula:
   18° 18' + [(2008 - 1975) x (-1.4')] = Current Declination
7. Solve for current declination.
   (a) 18° 18' + [(33) x (-1.4')] = Current Declination
   (b) 18° 18' + [-46.2'] = Current Declination
   (c) 18° 18' - 46.2' = Current Declination

Since 46.2' cannot be easily subtracted from 18° 18', 1° is converted into 60' (similar to time calculations), which converts 18° 18' to 17° 78'.

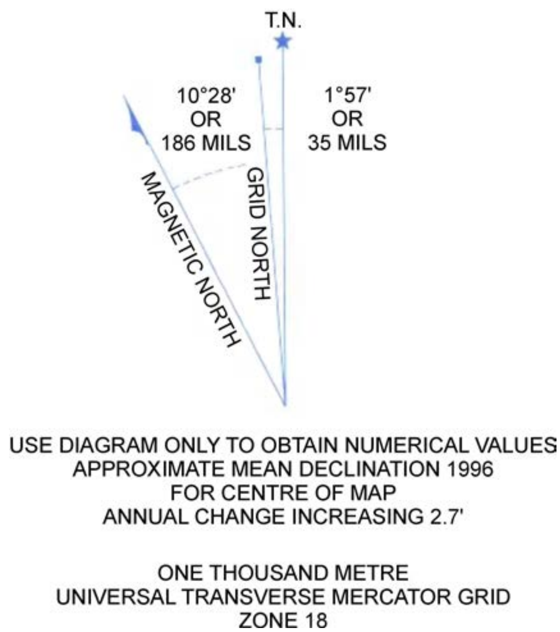
(d) 17° 78' - 46.2' = Current Declination

(e) 17° 31.8' = Current Declination

8. Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 17° 31.8' west declination.

Show slide of Example 2 of Calculating Magnetic Declination located at Annex M.

Example 2:



Canada Centre for Mapping, Bancroft 31 F/4, Natural Resources Canada

Figure 18-10-3 Declination Diagram

From Figure 18-10-3:

1. Grid Magnetic Angle: 10° 28'

2. Current Year: 2008 (used for this example)

3. Year of Declination Information: 1996

4. Annual Change: increasing 2.7'

5. Increasing means 2.7' becomes +2.7'

6. Input the information into the formula:
10° 28' + [(2008 - 1996) x (+2.7')] = Current Declination

7. Solve for current declination.

(a) 10° 28' + [(12) x (+2.7')] = Current Declination

(b) 10° 28' + [+32.4'] = Current Declination

(c) 10° 28' + 32.4' = Current Declination

(d) 10° 60.4' = Current Declination

> Since 60.4' is greater than 1°, 60' is converted into 1° (similar to time calculations), which converts 10° 60.4' to 11° 0.4'.

(e) 11° 0.4' = Current Declination

8. Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 11° 0.4' west declination.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 3	**Have Cadets Calculate Magnetic Declination**
Time: 30 min	Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets calculate magnetic declination.

RESOURCES

- Magnetic declination worksheet located at Annex N, and
- Pen/pencil.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Distribute a worksheet to each cadet.
2. Have the cadets individually complete as many problems on the worksheet as possible in 20 minutes.
3. Correct the worksheet with the cadets using the answer key located at Annex O.
4. Answer any questions the cadets may have on calculating magnetic declination.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in the in-class activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets’ calculation of magnetic declination will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Knowing how to calculate magnetic declination provides the cadet with confidence that they will arrive at their destination when navigating on a bearing.

INSTRUCTOR NOTES/REMARKS

Cadets may use a calculator if they wish.

REFERENCES

A2-041 B-GL-382-005-PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 11

EO C390.06 – DETERMINE DIRECTION USING THE SUN

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

Demonstration and performance was chosen for this lesson as it allows the instructor to explain and demonstrate determining direction using the sun while providing an opportunity for the cadets to practice the skill under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have determined direction using the sun.

IMPORTANCE

It is important for the cadets to be able to determine direction using the sun so in a survival situation they can navigate to and from their survival site without the aid of a compass or map.

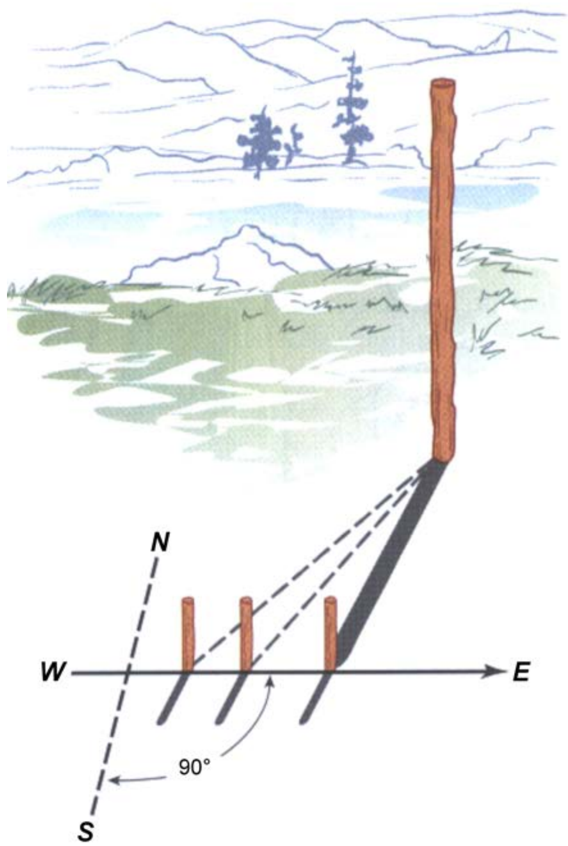
Teaching Point 1 | **Explain, Demonstrate and Have Cadets Determine Direction Using a Shadow Stick**

Time: 15 min | Method: Demonstration and Performance

DETERMINE DIRECTION USING A SHADOW STICK

In a survival situation, one may not have a map of the area, a compass or the use of a watch. On this occasion, it may be necessary to use natural guides, such as the sun to determine direction. The sun can be used to find north using a branch or stick to cast a shadow on the ground.

A shadow stick works because the sun always travels east to west, even though it may not rise at exactly 90 degrees or set at exactly 270 degrees. The tip of the shadow stick's shadow moves in the opposite direction, so the first shadow tip is always west of the second, anywhere on earth. Improvised methods are only general indicators of direction. The shadow stick is more accurate and easier to read when the stick is narrow.



National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 76)

Figure 18-11-1 Shadow Stick

ACTIVITY

Time: 10 min

OBJECTIVE

The objective of this activity is to have the cadets construct a shadow stick and determine direction using the sun.

RESOURCES

Stick.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into groups of three or four.
2. Have the cadets find a 45–60 cm straight stick.
3. Find a level vegetation-free spot. Push the 45–60 cm straight stick into the ground about 10 cm so it will remain upright, inclining it by 5–10 degrees to create a longer, bigger shadow.
4. Mark the tip of the shadow with a stone. Wait until the shadow tip moves several centimetres (10–15 minutes with a 45 cm stick).

Use the time interval required for Step 4. to instruct TP 2.

5. Mark the position of the new shadow tip.
6. Draw a straight line from the first mark through the second mark and continue about 30 cm past it (as illustrated in Figure 18-11-1).
7. Have the instructor or a supervisor verify the bearings with a compass.

The line drawn indicates the east–west line. The first mark made is west and the last mark made is east. A line perpendicular to the east–west line is a north–south line.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in this activity will serve as the confirmation of this TP.

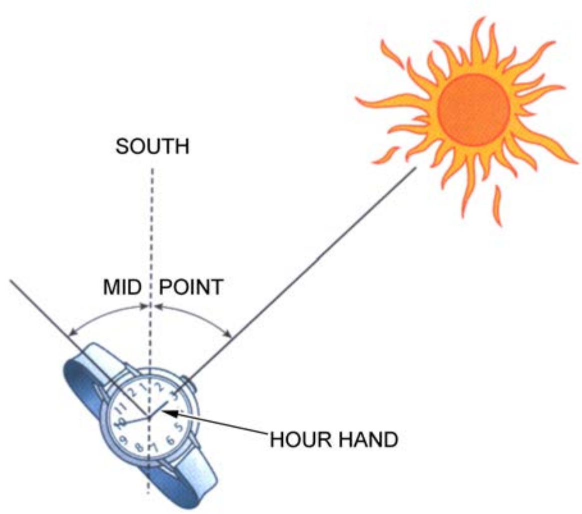
Teaching Point 2	Explain, Demonstrate and Have Cadets Determine Direction Using an Analog Watch
Time: 10 min	Method: Demonstration and Performance

> Use an analog wall clock for demonstration purposes instead of an analog watch. Ask the cadets if any of them have an analog watch. Since digital watches are more common than analog watches, the cadets should understand that without one, they cannot use this method.

DETERMINE DIRECTION USING AN ANALOG WATCH

An analog watch can help establish direction using either standard or daylight savings time. The analog watch method is based on the principle that at noon (or 1 pm for daylight savings time) the sun is approximately due south in the northern hemisphere and approximately due north in the southern hemisphere. Using this principle, an analog watch's (with the correct time) hour hand, at noon, pointed at the sun, also points approximately due south/north. At times other than noon, bisecting the angle between the hour hand (pointing at the sun) and the 12 (or the 1 for daylight savings time) on the watch face, creates an imaginary line that points approximately due south/north.

> This method becomes less accurate the closer a person is to the equator.



National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 76)

Figure 18-11-2 Analog Watch

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have the cadets determine direction using an analog watch.

RESOURCES

Analog watch (with the correct time).

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Point the hour hand towards the sun.
2. Determine the halfway point between the hour hand and noon (or 1 pm for daylight savings time).
3. Create an imaginary line between the centre of the watch face and the halfway point (as illustrated in Figure 18-11-2).

> The imaginary line is a north–south line (points to the south in the northern hemisphere and to the north in the southern hemisphere).

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in this activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in constructing a shadow stick and determining direction using an analog watch will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for the cadets to be able to determine direction using the sun so in a survival situation they can navigate to and from their survival site without the aid of a compass or map.

INSTRUCTOR NOTES/REMARKS

Sticks are to be collected by the cadets in the field.

REFERENCES

C3-002 (ISBN 0-00-653140-7) Wiseman, J. (1999). *The SAS Survival Handbook*. Hammersmith, London: HarperCollins Publishers.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 12

EO C390.07 – DETERMINE DIRECTION AT NIGHT

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Choose a suitable night to perform this activity by checking both a moon calendar and local weather conditions.

A sky map should be created for the date and location where the lesson will be taught. Annex P is an example created for reference of what a sky map looks like and how it is used to locate constellations. Photocopy the created sky map for each cadet.

Photocopy the handout located at Annex Q for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

Demonstration and performance was chosen for this lesson as it allows the instructor to demonstrate determining direction at night while providing an opportunity for the cadet to practice the skill under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have determined direction at night.

IMPORTANCE

It is important for the cadets to be able to navigate at night so they will have the skills to find their way in the dark. In a survival situation, being able to determine direction in the dark is a skill that can assist in being rescued.

Teaching Point 1 | **Explain, Demonstrate and Have Cadets Determine Direction Using the Moon**

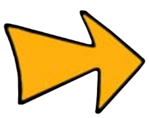
Time: 10 min | Method: Demonstration and Performance

This TP must be conducted during a clear night when the moon is in one of its crescent phases. Determine the phases of the moon on a moon calendar or through the internet.

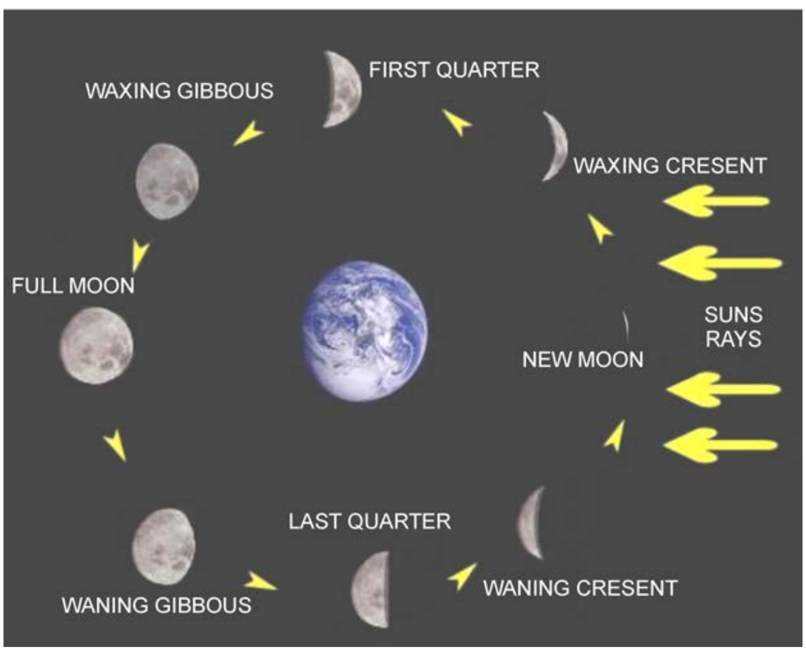
IDENTIFYING THE PHASES OF THE MOON

The phases of the moon are caused by the relative positions of the earth, sun, and moon. The moon rotates around the earth, on average, once every 27 days, 7 hours and 43 minutes.

The sun always illuminates the half of the moon facing the sun (except during lunar eclipses). When the sun and moon are on opposite sides of the earth, the moon appears "full" like a bright, round disk. When the moon is between the earth and the sun, it appears dark, a "new" moon. In between these phases, the moon's illuminated surface appears to grow (waxing) to full, and then shrink (waning) to the next new moon.



The moon's familiar crescent shape is formed by the shadow of the earth on the moon's surface and always points relatively north and south in the sky.

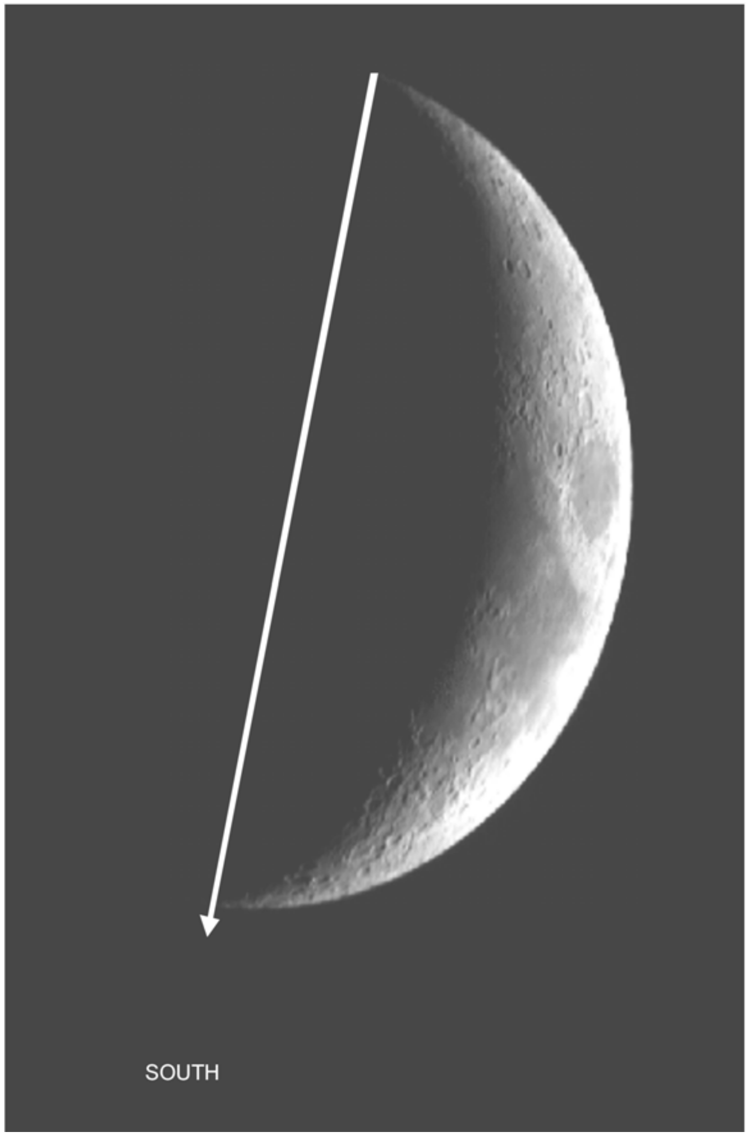


Afreshhorizon.co.uk, Copyright 2008 by A Fresh Horizon. Retrieved November 14, 2007, from http://www.afreshhorizon.co.uk/images/moon_phases.jpg

Figure 18-12-1 Moon Phases

DETERMINING SOUTH

Drop a line along the points of the crescent moon and project it to the horizon. This point on the horizon is in the general direction of south.



The Calvin College Observatory, 2001, The Crescent Moon, Copyright 2001 by The Calvin College Observatory. Retrieved November 14, 2007, from http://www.calvin.edu/academic/phys/observatory/images/moon/

Figure 18-12-2 Determining South by the Moon

This method will give a general direction of north and south.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have the cadets determine direction using the moon.

RESOURCES

N/A.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

Explain, demonstrate and have the cadets drop an imaginary line along the points of the crescent moon and project that line to the horizon (as illustrated in Figure 18-12-2). This point on the horizon is in the general direction of south.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 2	Explain, Demonstrate and Have Cadets Identify the Major Constellations Required to Find Polaris
Time: 10 min	Method: Demonstration and Performance

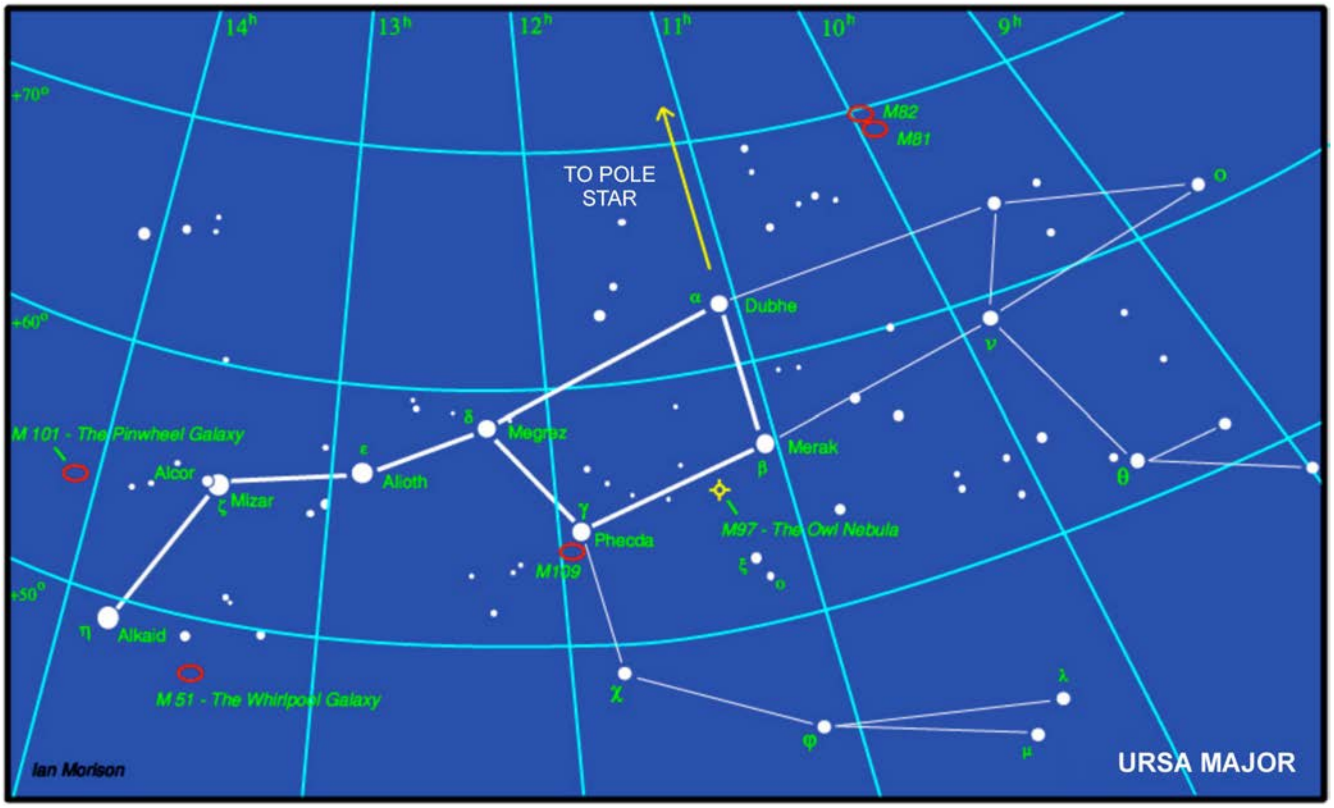
The best watching time for stars is between the moon's last quarter and the first, and three hours after sunset so the sky is dark enough to see the low intensity stars.

CONSTELLATIONS

Constellations are groupings of stars that have been given legendary or historical significance. These groups have been joined together with lines, outlining a figure or symbol, so that they may be found in the sky.

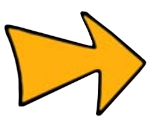
Ursa Major (Big Dipper)

Ursa Major is visible throughout most of the year in the northern hemisphere and is known as the "Great Bear" in Latin. The seven brightest stars are located in the bear's hindquarters and tail and form the well known asterism Big Dipper as it appears to form the shape of a ladle, or dipper shape. The stars Dubhe and Merak, located on the outside edge of the dipper, are also known as "The Pointer" since they point in the direction of Polaris.



Jobrell Bank Observatory, 2006, Ursa Major, Copyright 2006 by The University of Manchester. Retrieved November 14, 2007, from http://www.jb.man.ac.uk/public/Ursamjor.jpg

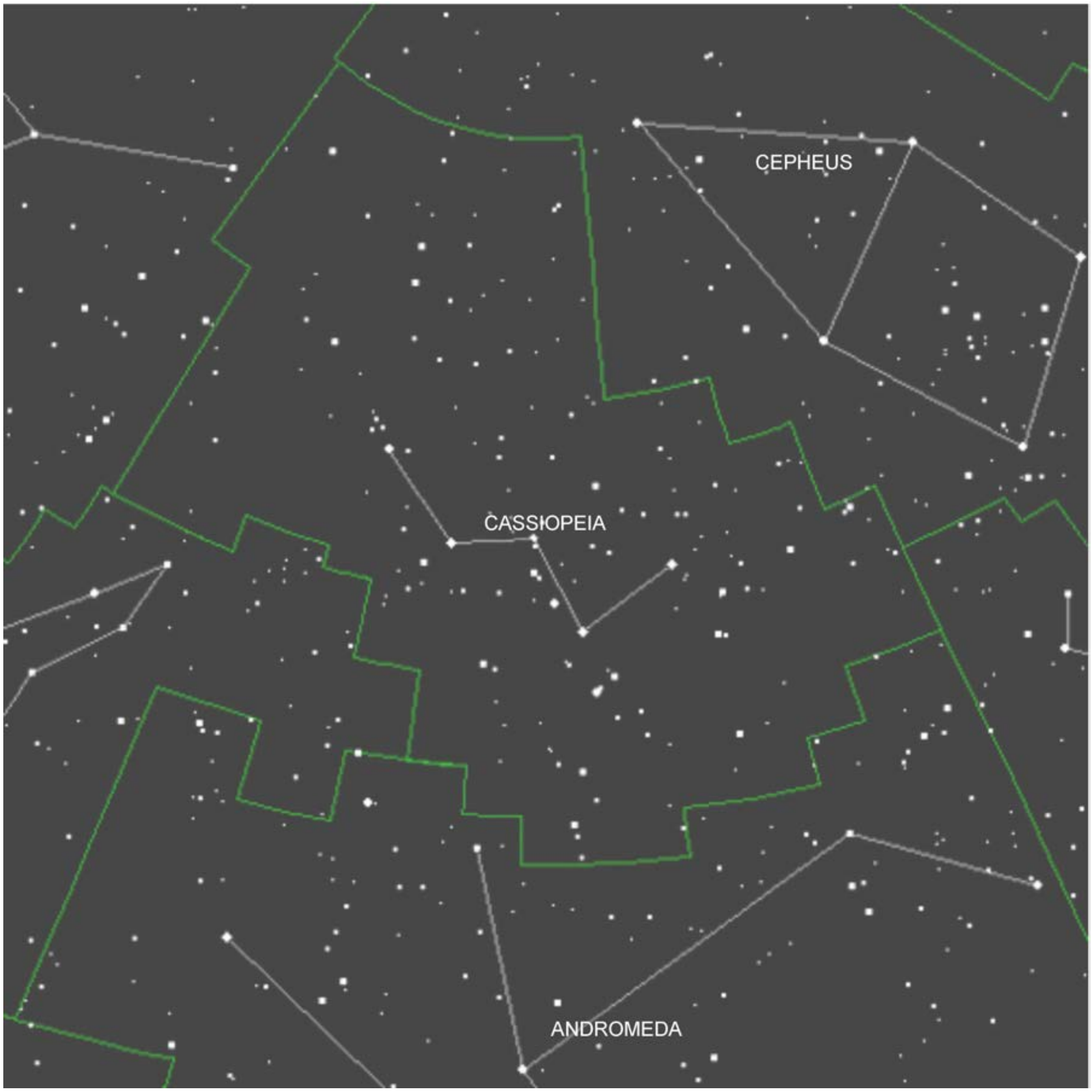
Figure 18-12-3 Ursa Major



The Big Dipper is not a constellation. It is part of Ursa Major, the Great Bear. The Big Dipper is an asterism – a recognized, but not official, grouping of stars. Some asterisms fall within a single constellation, others span across constellations.

Cassiopeia

Cassiopeia is a northern constellation which in Greek mythology represents a vain queen who boasted about her unrivalled beauty. It is made up of five stars that resemble a lopsided "M" or "W" depending on its position in the sky. Viewing the constellation as an "M", connect the three bottom stars with an imaginary line. From the right-most star create an imaginary line straight down to find Polaris.

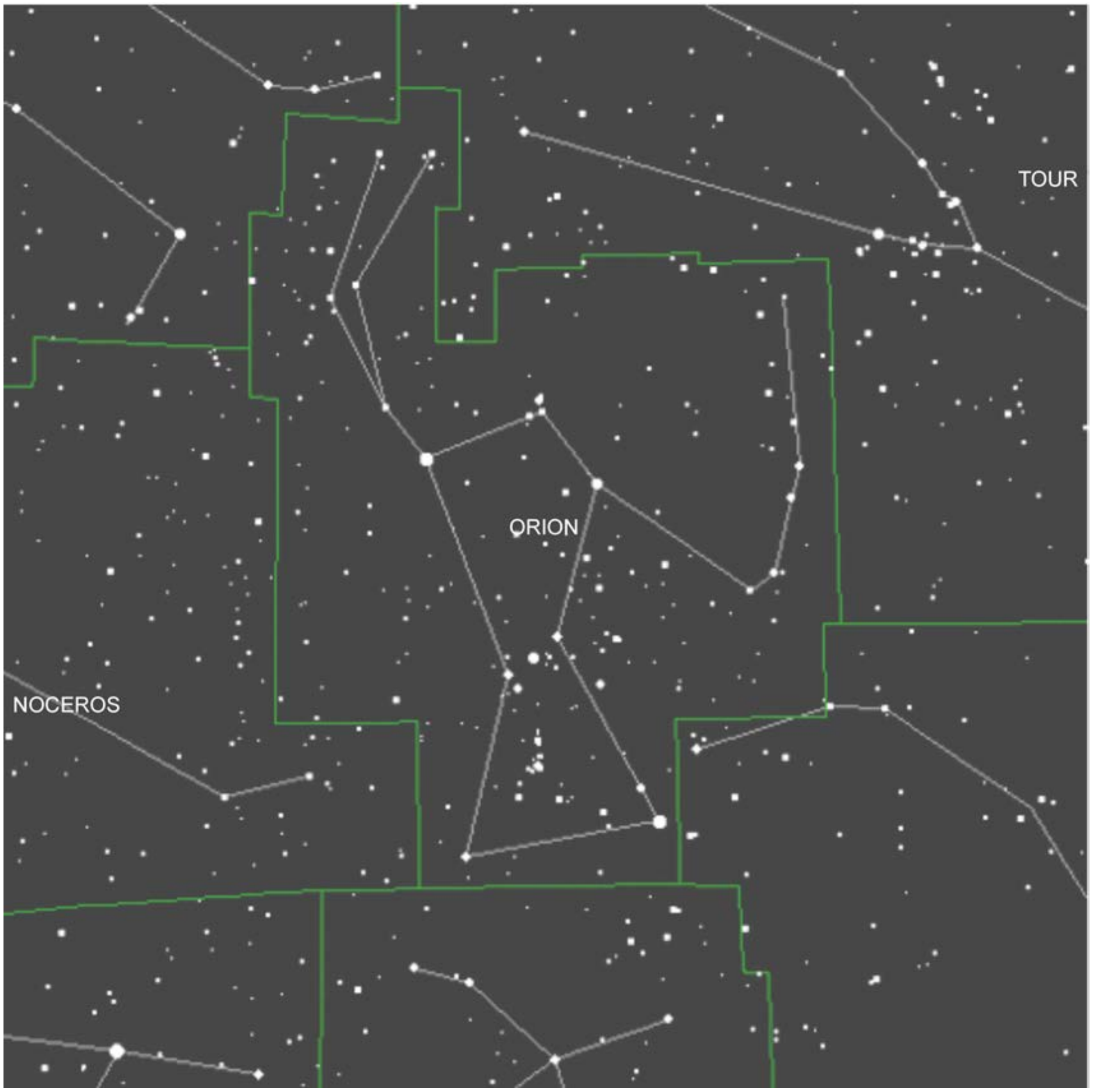


About.com, 2007, Cassiopeia, Copyright 2007 by About Inc. Retrieved November 14, 2007, from http://space.about.com/od/starsplanetsgalaxies/ig/Constellations-Pictures/cassiopeia.htm

Figure 18-12-4 Cassiopeia

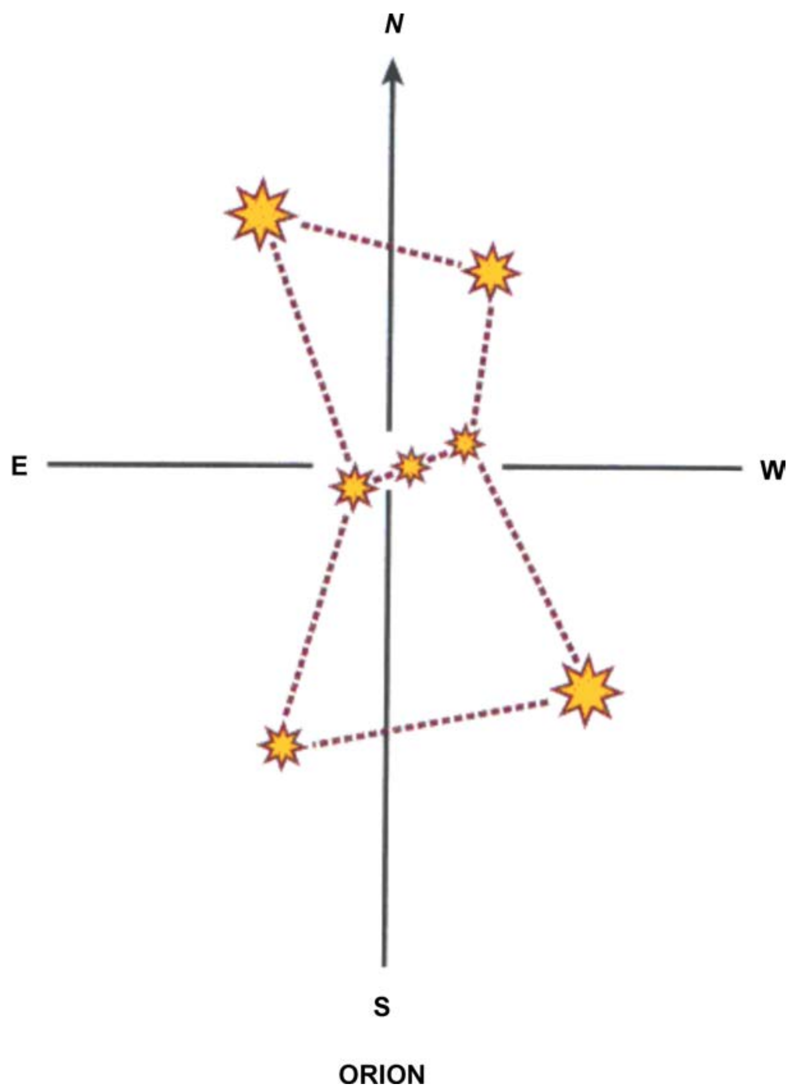
Orion

Orion is a constellation often referred to as The Hunter. It is one of the largest and most visible constellations in the sky. Its brilliant stars are found on the celestial equator and are visible throughout the world. From mid-northern latitudes, Orion is visible in the evening from November to early May and in the morning from late July to November. The constellation of Orion consists of seven stars. The three stars that are close together are the belt of the constellation. The Orion constellation, rises on the horizon due east and sets due west. At the equator it will pass directly overhead, and in the northern hemisphere it will pass south directly overhead. The top of Orion points in the direction of the Pole Star.



About.com, 2007, Orion, Copyright 2007 by About Inc. Retrieved November 14, 2007, from http://space.about.com/od/starsplanetsgalaxies/ig/Constellations-Pictures/orion.htm

Figure 18-12-5 Orion

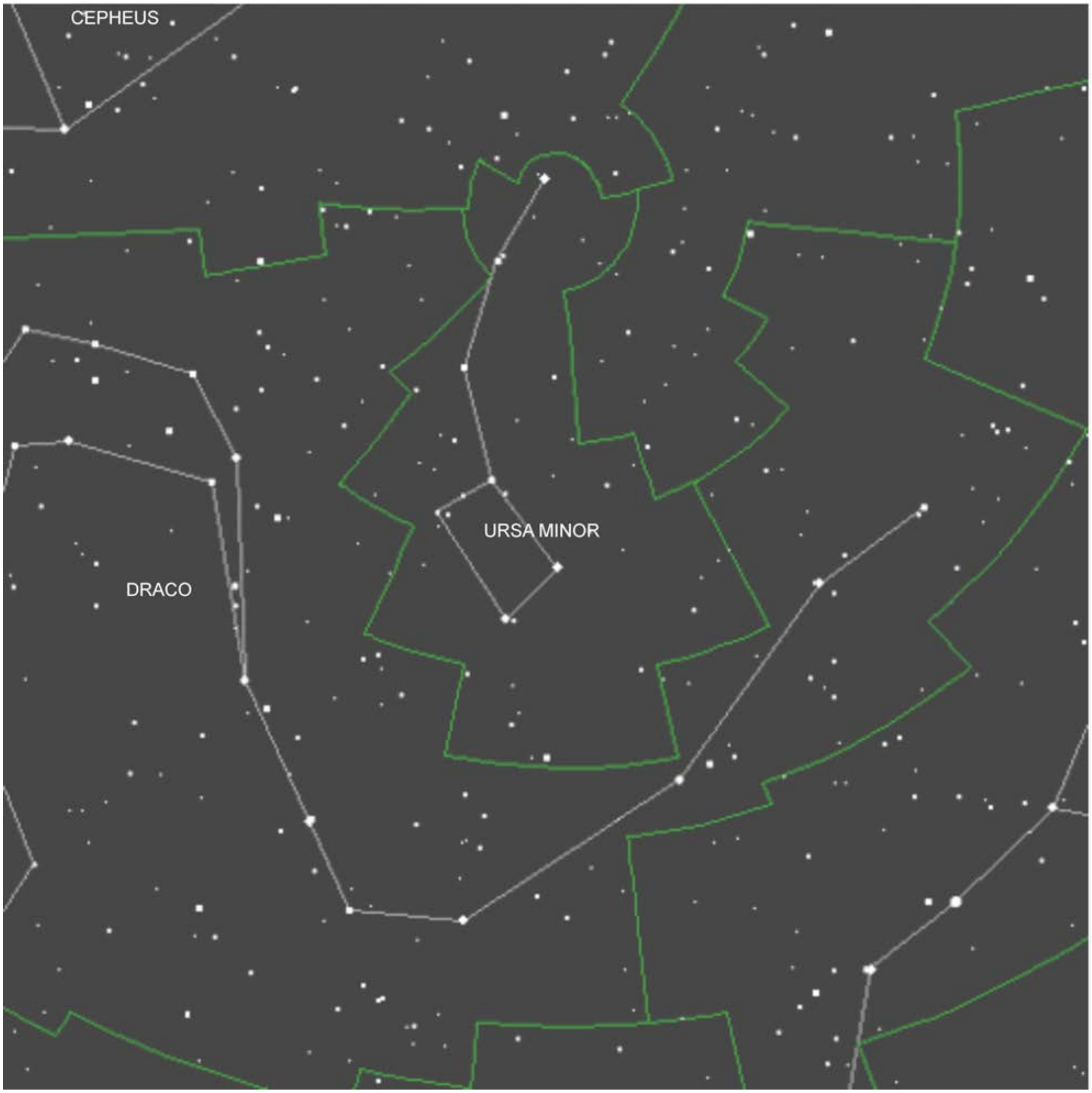


National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 78)

Figure 18-12-6 Orion and North

Ursa Minor (Little Dipper)

Ursa Major is a constellation in the northern hemisphere. Its name means “Little Bear” in Latin. Ursa Minor is known as Little Dipper because its seven brightest stars appear to form a ladle, or dipper shape. The star at the end of the dipper’s handle is Polaris, the North or Pole Star.



About.com, 2007, Ursa Minor, Copyright 2007 by About Inc. Retrieved November 14, 2007, from http://z.about.com/d/space/1/7/f/P/ursaminor.gif

Figure 18-12-7 Ursa Minor

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have cadets locate various constellations.

RESOURCES

- Sky map, and
- Red-filtered flashlight.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Indicate north to the cadets (use compass if necessary).
2. Hold the sky map upside-down (allowing the cadet to look at it) and overhead with the “N” on the map pointing north.

The east and west printed on the sky map are on the opposite side of the east and west of an earth map. The reason is that when the map is held above the head, the east and west markings will then be the same as on the ground. To better read a sky map in the dark, use a flashlight with a red filter so night vision is not affected.

3. With the aid of a local sky map, have the cadets locate:
   (a) Ursa Major,
   (b) Cassiopeia,
   (c) Orion, and
   (d) Ursa Minor.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets’ participation in the activity will serve as the confirmation of this TP.

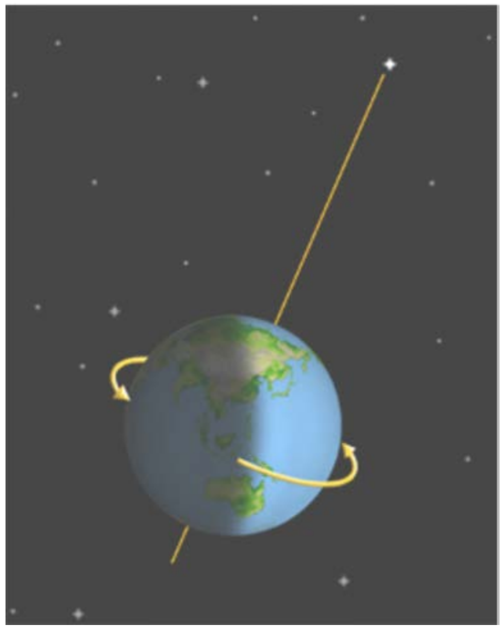
Teaching Point 3	**Explain, Demonstrate and Have Cadets Locate Polaris Using the Major Constellations Identified in TP2**
Time: 5 min	Method: Demonstration and Performance

POLARIS

Polaris is more commonly known as the North Star. It is the brightest star in the constellation Ursa Minor. It is very close to the celestial pole (0.7 degrees away from the pole rotation), making it the current Pole Star. The star lies in a direct axis above the North Pole and appears to stand almost motionless in the sky and the other stars seem to rotate around it. Polaris has been close to the actual position of north for the past 1000 years and during the course of the 21st century it will continue to close in on being in line with True North and will be closest on March 24, 2100 (almost 0.45 degrees away). After that date it will start to pull away and eventually another star will become the new Pole Star.

Locating the North Star

Polaris is located in the constellation Ursa Minor, which contains the group of stars that make up the Little Dipper (as illustrated in Figure 18-12-7). Polaris is the star in the end of the Little Dipper's handle. Often the Little Dipper is not very bright and can be challenging to find.



Lunar and Planetary Institute, 2007, Polaris, Copyright 2007 by Lunar and Planetary Institute. Retrieved November 14, 2007, from http://www.lpi.usra.edu/education/skytellers/polaris/about.shtml

Figure 18-12-8 Polaris

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have the cadets locate Polaris.

RESOURCES

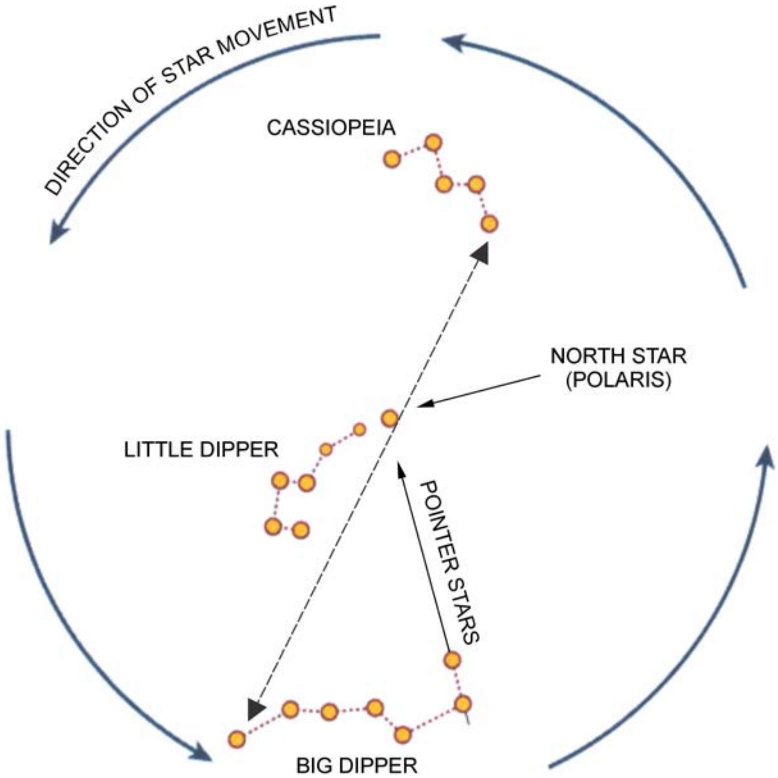
Handout located at Annex Q.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Hand out copies of Annex Q to each cadet.
2. Have the cadets find the constellation Ursa Major (Big Dipper).
3. Have the cadets draw an imaginary line between the two stars (the pointers Merak and Dubhe) at the end of the big dipper's bowl as they will point toward the Pole Star. The distance to the Pole Star is about five times the distance between the pointers.



National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 76)

Figure 18-12-9 Finding Polaris

4. Have the cadets locate the constellation Cassiopeia, which is directly across from Ursa Major.
5. Have the cadets draw an imaginary line between the star at the end of Cassiopeia and the last star in the handle of Ursa Major (as illustrated in Figure 18-12-9). Polaris is almost equidistant between Ursa Major and Cassiopeia.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in determining south by the phases of the moon, locating the various constellations and locating Polaris will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for the cadets to be able to navigate at night so they can find their way in the dark. In a survival situation being able to determine direction in the dark is a skill that can assist in being rescued.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2nd ed.). Lebanon, NH: Leonard Paul Tawrell.

C3-002 (ISBN 0-00-653140-7) Wiseman, J. (1999). *The SAS Survival Handbook*. Hammersmith, London: HarperCollins Publishers.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 13

EO C390.08 – USE BLAZING TECHNIQUES

Total Time:	30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Blaze a route using grass and rocks for the demonstration in TP 2.

Prepare a route that is 100 m long for the cadets to use during the activity in TP 3.

Photocopy the handout located at Annex R for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 to present basic material on blazing.

Demonstration was chosen for TP 2 as it allows the instructor to explain and demonstrate blazing techniques.

Performance was chosen for TP 3 as it provides an opportunity for the cadet to practice blazing techniques under supervision.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have used blazing techniques.

IMPORTANCE

It is important for the cadets to know how to use blazing techniques in a survival situation. Blazing techniques can be used when a cadet leaves a site to find water or build a signal fire and needs to find their way back. Blazing techniques may also help searchers find a survival site.

Teaching Point 1	**Explain the Reasons for Blazing**
Time: 5 min	Method: Interactive Lecture

REASONS FOR BLAZING

Leaving and Returning to the Site

When searching for water or finding higher ground to build a signal fire, the survivor may have to walk for a kilometre or more. Blazing will help to establish the route. If one loses their sense of direction they can follow it back to the survival site.

> Most trails are spotted (marked) coming and going so that they can be seen from both directions of travel.

Acting as a Guide to a Ground Search and Rescue (SAR) Party

Signs in the area will act as a clue to any presence or past presence and the direction markers will help rescuers follow someone's trail.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Why are trails spotted (marked) in two directions?

Q2. What does blazing help to establish?

Q3. What do signs in the area act as a clue to?

ANTICIPATED ANSWERS

A1. Most trails are spotted (marked) coming and going so that they can be seen from both directions of travel.

A2. Blazing will help to establish the route. If one loses their sense of direction they can follow it back to the survival site.

A3. Signs in the area will act as a clue to any presence or past presence and the direction markers will help rescuers follow someone's trail.

Teaching Point 2	**Explain and Demonstrate Blazing Techniques**
Time: 10 min	Method: Demonstration

BLAZING TECHNIQUES

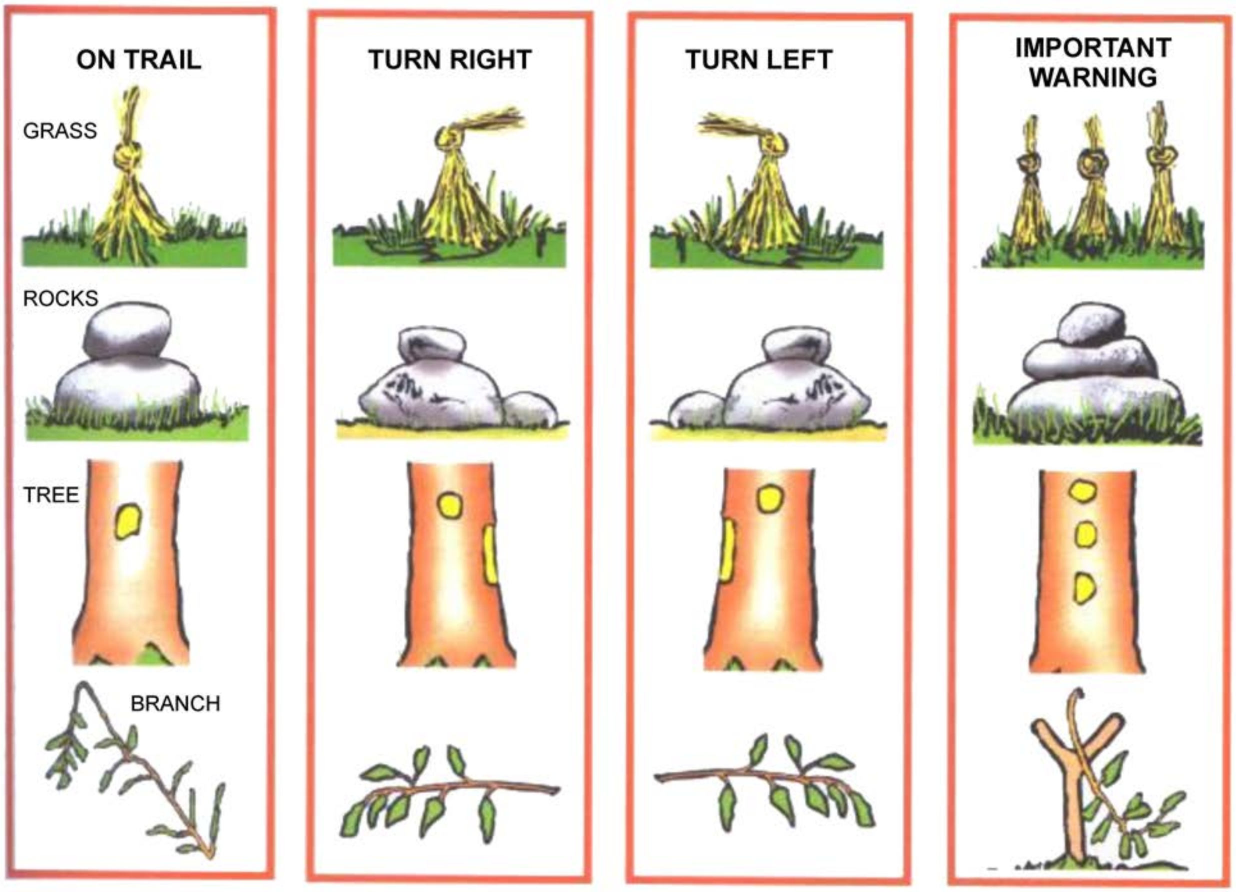
Blazing. Signals left behind if leaving the scene of a crash or moving to and from, or abandoning a survival site. These may include any of the following:

- A large arrow shape made to indicate the direction in which one is travelling. It will be visible from the air and other direction markers which can be interpreted at ground level. Direction markers could include:
  - rocks or debris placed in an arrow shape,
  - a stick left in a crooked support, with the top pointing in the direction taken,
  - grass tied in an overhand knot with the end hanging in the direction followed,
  - forked branches laid with the fork pointing in the direction followed,
  - arrowhead-shaped notches cut out of tree trunks indicating a turn,
  - small rocks set upon larger rocks, with small rocks beside, and
  - a cross of sticks or stones meaning “not this way”.
- Trail-blazing signals, not only for people to follow but to establish a route to retrace and guide someone if they lose their sense of direction.
- In case rescuers find the survival site while the lost person is away, written messages left in containers with details of planned movements. Hang them from tripods or trees and draw attention to them with markers.

Show the cadets the previously blazed trail with grass and rocks.

Allow the cadets to ask questions.

EXAMPLES OF BLAZING



P. Tawrell, Camping and Wilderness Survival: The Ultimate Outdoors Book, Paul Tawrell (p. 547)

Figure 18-13-1 Blazing Techniques

STEPS TO BLAZE A TRAIL

To blaze a trail with branches:

1. Find a route to follow for 100 m.
2. Gather branches which are already on the ground (deadfall or debris).
3. Create blazes by placing the branches along the route for 100 m.
4. At each created blaze, examine it from the point of view of returning along that trail. If necessary, create another blaze that will direct the person back along the trail.
5. Return the branches to the environment, when finished.

Demonstrate blazing with branches as the cadets observe.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What can direction markers include?

Q2. What is blazing?

Q3. What should be left at the survival site?

ANTICIPATED ANSWERS

A1. Direction markers may include:

- rocks or debris placed in an arrow shape,
- a stick left in a crooked support, with the top pointing in the direction taken,
- grass tied in an overhand knot with the end hanging in the direction followed,
- forked branches laid with the fork pointing in the direction followed,
- arrowhead-shaped notches cut out of tree trunks indicating a turn,
- small rocks set upon larger rocks, with small rocks beside, and
- a cross of sticks or stones meaning “not this way”.

A2. Signals left behind if you leave the scene of a crash or abandon a survival site.

A3. In case rescuers find the survival site while the lost person is away, written messages should be left in containers with details of planned movements.

Teaching Point 3 **Have Cadets Blaze a Trail**

Time: 10 min Method: Performance

Have cadets blaze a trail using branches.

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets blaze a trail using branches.

RESOURCES

Handout of blazing techniques located at Annex R.

ACTIVITY LAYOUT

A route that is 100 m long.

ACTIVITY INSTRUCTIONS

1. Distribute the handout located at Annex R to each cadet.
2. Have the cadets:
   (a) gather branches which are already on the ground (deadfall or debris);
   (b) place the branches along the route for 100 m;
   (c) turn the branches around when returning to the starting point; and
   (d) return the branches to the environment when the activity is complete.

SAFETY

Ensure the cadets stay in the designated area during this TP.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in blazing a trail will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for the cadets to know how to use blazing techniques in a survival situation. Blazing techniques can be used when the survivor leaves their site to find water or build a signal fire and needs to find their way back. Blazing techniques also help searchers find a survival site.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

A3-016 B-GG-217-001/PT-001 Director Air Operations and Training. (1983). *Down But Not Out*. Ottawa, ON: Department of National Defence.

C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2nd ed.). Lebanon, NH: Leonard Paul Tawrell.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 14

EO C390.09 – IDENTIFY ELEMENTS OF THE NIGHT SKY

Total Time:	120 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

If there are insufficient quantities of planispheres and red-filtered flashlights, divide the cadets into groups based on the quantities available.

Planispheres may be created from Figures 15U-4 and 15U-5.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 in order to orient the cadets to the conditions required to observe the elements of the night sky.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate how to use a planisphere star chart while providing an opportunity for the cadets to practice the skill under supervision.

A practical activity was chosen for TP 3 as it is an interactive way to introduce the cadets to elements of the night sky. This activity contributes to the development of astronomy skills and knowledge in a fun and challenging setting.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified elements of the night sky.

IMPORTANCE

It is important for cadets to be able to identify the elements of the night sky so they can apply the knowledge acquired in a practical setting. Observing the night sky will allow the cadets to observe the moon, planets, stars and constellations. This may also assist in overcoming the sixth and seventh enemies of survival: boredom and loneliness.

Teaching Point 1	**Describe Conditions Required to View the Elements of the Night Sky**
Time: 5 min	Method: Interactive Lecture

CLOUDS

The presence of clouds will inhibit observations of the elements of the night sky. Even partial cloud cover will make it more difficult to identify specific constellations by hiding parts of the constellation or obscuring elements used to find the constellation. It is best to observe the night sky on a cloudless night.

MOON

The moon is the brightest object in the night sky. The moon itself does not shine, it reflects sunlight. When the moon is full, its light overpowers the light of the dim stars near it. For example, looking at a small flashlight that is next to a million candlepower flashlight, the light of the smaller flashlight is not any less, but its light is overpowered by the brighter flashlight.

> The best time to look for stars is between the moon's last quarter and the first quarter, three hours after sunset so the sky is dark enough to see the low intensity stars.

The moon is second only to the sun as the largest source of natural light pollution.

LIGHT POLLUTION

T. Dickinson, NightWatch: A Practical Guide to Viewing the Universe, Firefly Books Ltd. (p. 48)

Figure 18-14-1 Light Pollution's Effects

The sun and moon are the main sources of light pollution. However, artificial light pollution exists near built-up areas and makes the sky appear yellowish-gray as opposed to black. This happens because outdoor lighting illuminates the air as well as the ground. To clearly see stars at night, find a location that is free from lights. This includes individual lights, like street lights, as well as the glow that appears from built-up areas (eg, towns and cities). Figure 18-14-1 illustrates the effect of light pollution by contrasting the same section of sky with and without light pollution.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Which natural phenomenon may inhibit the view of part or all of the night sky?

Q2. What is the second brightest object that may be seen from Earth?

Q3. What are examples of artificial light pollution?

ANTICIPATED ANSWERS

A1. Clouds.

A2. The moon.

A3. This includes individual lights, like street lights, as well as the glow that appears from built-up areas (eg, towns and cities).

Teaching Point 2	**Explain, Demonstrate and Have the Cadets Use a Planisphere Star Chart**
Time: 10 min	Method: Demonstration and Performance

Instruct the cadets on the use of the specific planisphere star chart according to directions provided with the planisphere.

Note: Directions, for the *Firefly Planisphere: Latitude 42 deg N*, are included and may serve as an example of directions for the type of planisphere used.

Distribute one each, planisphere and red-filtered flashlight, per group of cadets and have the cadets orient their planisphere.

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

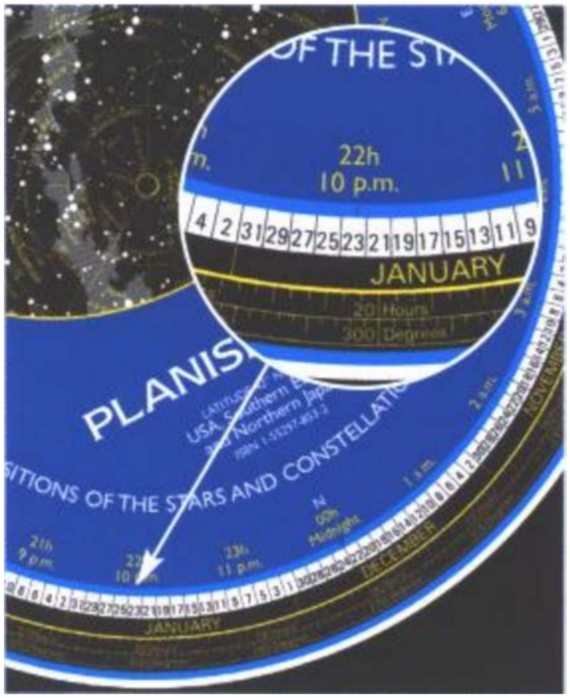
Note: Assistant instructors may be employed to monitor cadet performance.

Elements of the night sky can be identified with the naked eye, star charts, a planisphere star chart, binoculars or a telescope.

Planisphere Star Chart. An analog computer for calculating the position of stars. It has this name because the celestial sphere is represented on a flat plane, such as paper. Since the Earth is constantly in motion, the time of day, time of year and location influence the appearance of the sky. An individual star chart cannot accurately represent all of these combinations. This would take many different star charts. A preferable method is to use a planisphere star chart which allows the user to twist a dial to show the true position of the stars.

Steps to use the *Firefly Planisphere: Latitude 42 deg N*:

1. Find the date around the outer edge of the disk, and the time of night on the inner, movable wheel. (As illustrated in Figure 18-14-2, the planisphere is set for 10 p.m. (22h) on the evening of January 23.)



R. Scagell, Firefly Planisphere: Latitude 42 deg N, Firefly Books Ltd.

Figure 18-14-2 Step 1

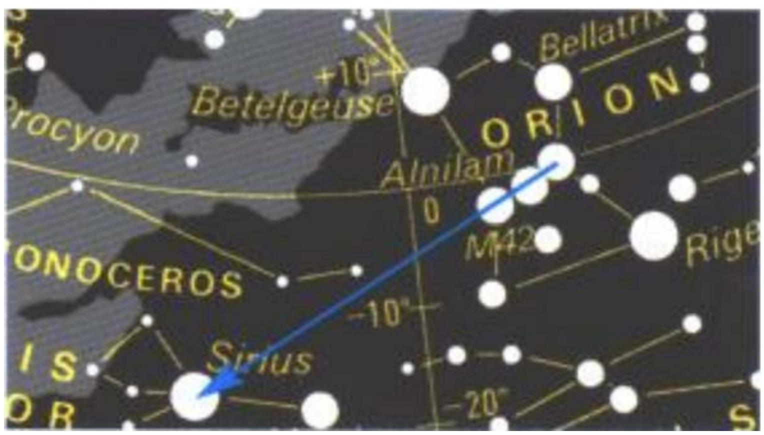
> Remember to allow for Daylight Savings Time (mid-spring to mid-fall) if it is in effect. This means subtracting one hour from the current time.

2. Hold the planisphere over your head. The oval map shows the entire sky, with the horizon around the edges of the map and the overhead point in the middle (as illustrated in Figure 18-14-3). Rotate the planisphere so that the eastern horizon, western horizon and the ‘N’ by the Midnight marker correspond with the ground.

R. Scagell, Firefly Planisphere: Latitude 42 deg N, Firefly Books Ltd.

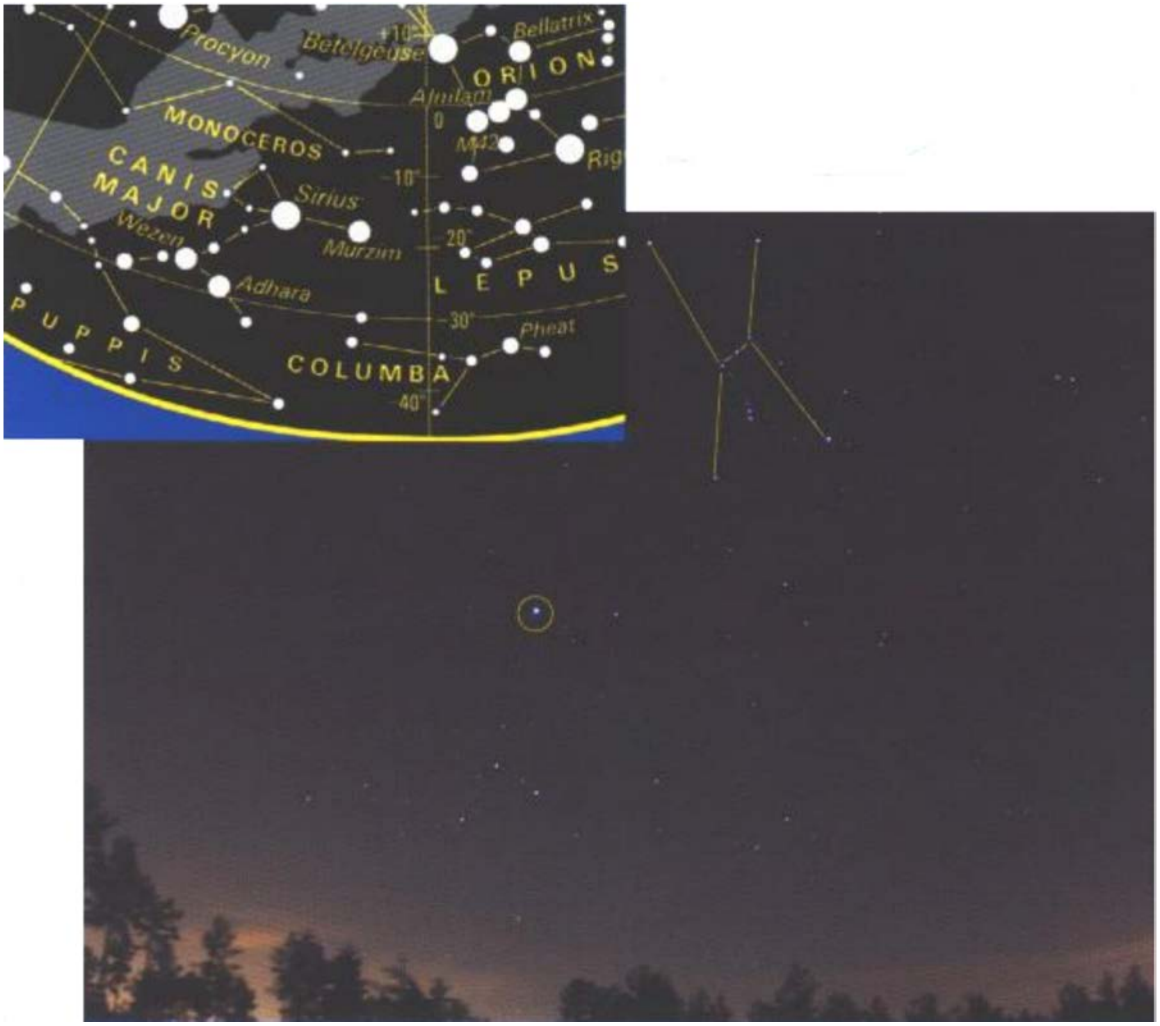
Figure 18-14-3 Step 2

3. Pick out a major constellation by its shape. Remember that the map shows the whole sky, so what looks like a small pattern on the map may cover a large area of the sky. Once one constellation is found, it is used as a guide to locate other constellations. (as illustrated in Figure 18-14-4, the three central stars of Orion, known as Orion's Belt, will be used as a pointer to Sirius in Canis Major. Figure 18-14-5 illustrates a section of the planisphere and a section of night sky with Orion marked and Sirius circled.)



R. Scagell, Firefly Planisphere: Latitude 42 deg N, Firefly Books Ltd.

Figure 18-14-4 Step 3 Locating Sirius Using Orion's Belt



R. Scagell, Firefly Planisphere: Latitude 42 deg N, Firefly Books Ltd.

Figure 18-14-5 Step 3 Sirius Located

> The above example used Orion as a guide; however, Orion is visible in Canada only from approximately November to April. If Orion is not visible, choose another constellation.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in using a planisphere will serve as the confirmation of this TP.

Teaching Point 3 | **Describe and Have the Cadets Identify Elements of the Night Sky**

Time: 95 min | Method: Practical Activity

Depending on viewing opportunities, handouts may be created for the moon and Venus located at Annexes S and T.

MOON

The moon is the brightest object in the night sky. If the moon dominates the night sky making observing other elements of the night sky difficult, the opportunity should be used to observe the moon itself. While it may be a source of light pollution, when the Moon is at least half full, many features may be observed on its surface (see Annex S).

VENUS

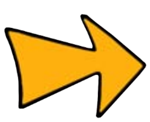
The planet Venus and the Moon are the only natural objects that can be seen while the Sun is in the sky. Venus is normally seen either around dawn or dusk depending on where it is relative to Earth in its orbit (see Annex T).

POLARIS

Polaris is more commonly known as the North Star. It is the brightest star in the constellation Ursa Minor. It is very close to the celestial pole (0.7 degrees away from the pole rotation), making it the current North Star. The star lies in a direct axis above the North Pole and appears to stand almost motionless in the sky. Other stars seem to rotate around it. Polaris has been close to the actual position of north for the past 1000 years and during the course of the 21st century it will continue to close in on being in line with True North and will be closest on March 24, 2100 (approximately 0.45 degrees away). After that date it will start to pull away and eventually another star will become the new North Star.

CONSTELLATIONS

Throughout history humanity has gazed upon the stars and created patterns called constellations. These celestial groups are steeped in mythology and, in the case of the signs of the zodiac, embellished with the symbolism of astrology. One of the best known (in Canada) group of stars is known as the Big Dipper, however, it is not a constellation.



The Big Dipper is not a constellation. It is part of Ursa Major, the Great Bear. The Big Dipper is an asterism, a recognized, but not official, grouping of stars. Some asterisms fall within a single constellation; others cross constellations.

Ursa Major

Ursa Major means “Great Bear” in Latin. The seven brightest stars are located in the bear’s hindquarters and tail and form the well known asterism, the Big Dipper, as it appears to form the shape of a ladle, or dipper shape. The stars Dubhe and Merak, located on the outside edge of the dipper, are also known as “The Pointer” since they point in the direction of Polaris. Most of Ursa Major is visible year-round in Canada.

Ursa Minor

Ursa Minor means "Little Bear" in Latin. Ursa Minor is known as Little Dipper because its seven brightest stars appear to form a ladle, or dipper shape. The star at the end of the dipper's handle is Polaris, the North or Pole Star. Ursa Minor is visible year-round in Canada.

Cassiopeia

Cassiopeia is a northern constellation which in Greek mythology represented a vain queen who boasted about her unrivalled beauty. It is made up of five stars that resemble a lopsided "M" or "W" depending on its position in the sky. It is visible year-round in Canada.

Orion

Orion is a constellation often referred to as The Hunter. It is one of the largest and most visible constellations in the sky. The constellation consists of seven stars. The three stars that are close together at the centre of the constellation are known as Orion's Belt. Orion is visible in Canada from approximately November to April.

The Signs of the Zodiac

All of the signs of the zodiac will not be visible at the same time. This is due to the location of the signs around the celestial sphere, which means that several signs will be below the horizon at any one time.

The twelve signs of the zodiac are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, and Pisces.

See Annex U for more details of the 16 constellations. Use this information to answer questions the cadets may have about these constellations.

ACTIVITY

Time: 85 min

OBJECTIVE

The objective of this activity is to have the cadets identify elements of the night sky.

RESOURCES

- Planisphere star chart, and
- Red-filtered flashlight.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Have the cadets locate the Moon (if visible).
2. Have the cadets locate Venus (if visible, see Annex T).
3. Have the cadets locate Polaris (always visible).

4. Have the cadets locate Ursa Major (always visible).
5. Have the cadets locate Ursa Minor (always visible).
6. Have the cadets locate Orion (if visible).
7. Have the cadets locate Cassiopeia (always visible).
8. Have the cadets, using a planisphere, locate signs of the zodiac.

SAFETY

The site chosen for observing the night sky should be flat as the cadets will be concentrating on the sky and not where they are stepping.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' identification of elements of the night sky will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Observing the night sky will allow the cadets to observe the moon, planet, star and constellations. This may assist in overcoming the sixth and seventh enemies of survival: boredom and loneliness.

INSTRUCTOR NOTES/REMARKS

It is recommended this lesson be conducted after EO C340.04 (Describe Elements of the Night Sky, Chapter 15, Section 6).

REFERENCES

C3-179 (ISBN 1-55209-302-6) Dickenson, T. (2006). *Night Watch: A Practical Guide to Viewing the Universe*. Richmond Hill, ON: Firefly Books Ltd.

C3-180 (ISBN 1-55297-853-2) Scagell, R. (2004). *Firefly Planisphere: Latitude 42 Deg N*. Toronto, ON: Firefly Books Ltd.

C3-221 National Research Council of Canada. (2007). *Explore the Night Sky*. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/eng/education/astronomy/constellations/html.html.

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 15

EO C390.10 – IDENTIFY METHODS OF PREPARING AND COOKING A SMALL ANIMAL OR FISH

Total Time:	60 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and practice skinning a small animal or preparing a fish and cooking a small animal or fish with the equipment provided prior to delivering the lesson.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

Demonstration was chosen for this lesson as it allows the instructor to explain and demonstrate skinning a small animal, preparing a fish and cooking a small animal or fish.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have identified methods of preparing and cooking a small animal or fish.

IMPORTANCE

It is important for the cadets to identify the methods of preparing and cooking a small animal or fish that can be used in a survival situation. While food is the last component of the survival pattern (a person can live for weeks without eating), if it is readily available, the efforts made in catching, preparing and cooking a small animal or a fish are worthwhile. Proper preparation and cooking minimizes the chances of getting sick and helps to preserve the food.

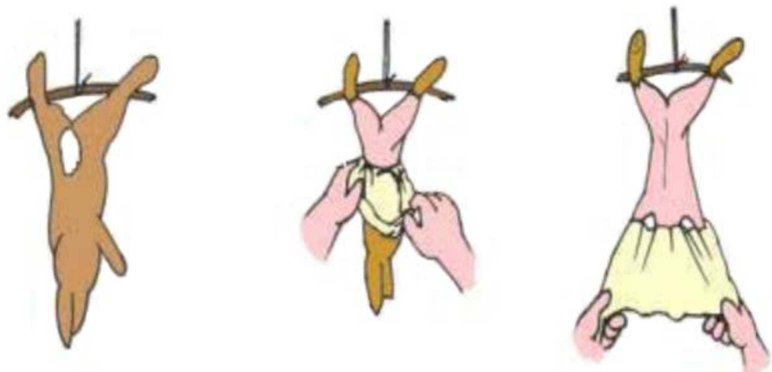
Teaching Point 1 — **Explain and Demonstrate Skinning a Small Animal**

Time: 15 min — Method: Demonstration

SKINNING A SMALL ANIMAL

For best results, the steps for skinning a small animal should be done in the sequence outlined below.

1. Remove urine by holding the animal's forelegs and gradually squeeze down on the body from the chest to the bowels.
2. Cut a hole in the belly area.
3. Pull the skin apart at the hole exposing the guts. Remove the guts.
4. Cut the skin around the front and hind paws and between the hind legs.
5. Hang the small animal and pull off the skin by pulling it down and over the head.
6. Cut the head off the small animal.



Note. From "Dressing", Simple Survival. Retrieved March 15, 2007, from http://www.simplesurvival.net/dressing.htm

Figure 18-15-1 Skinning a Small Animal

The guts (innards or entrails) can be used as bait or buried as the odour will attract insects and scavengers.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. How do you remove urine from the animal's body?

Q2. What area of the animal's body is first cut?

Q3. What is the last step in skinning an animal?

ANTICIPATED ANSWERS

A1. Remove the urine by holding the animal's forelegs and gradually squeeze down on the body from the chest to the bowels.

A2. The first cut is made in the belly area.

A3. Cutting the head off the small animal.

Teaching Point 2	**Explain and Demonstrate Preparing a Fish**
Time: 15 min	Method: Demonstration

PREPARING A FISH

To prevent spoilage, prepare the fish as soon as possible. The innards (guts or entrails) can be used as bait or buried as the odour will attract insects and scavengers. Keep the fish cool and cook as soon as possible.

1. **Bleeding.** As soon as a fish is caught, cut its throat and allow it to bleed. Wipe the slime off the fish to make it less slippery. Do not let any slime get into your eyes as it may cause Fisherman's Conjunctivitis (pink eye). Cut out the gills (these are the flaps on both sides and just behind the fish's head) as they will quickly spoil.

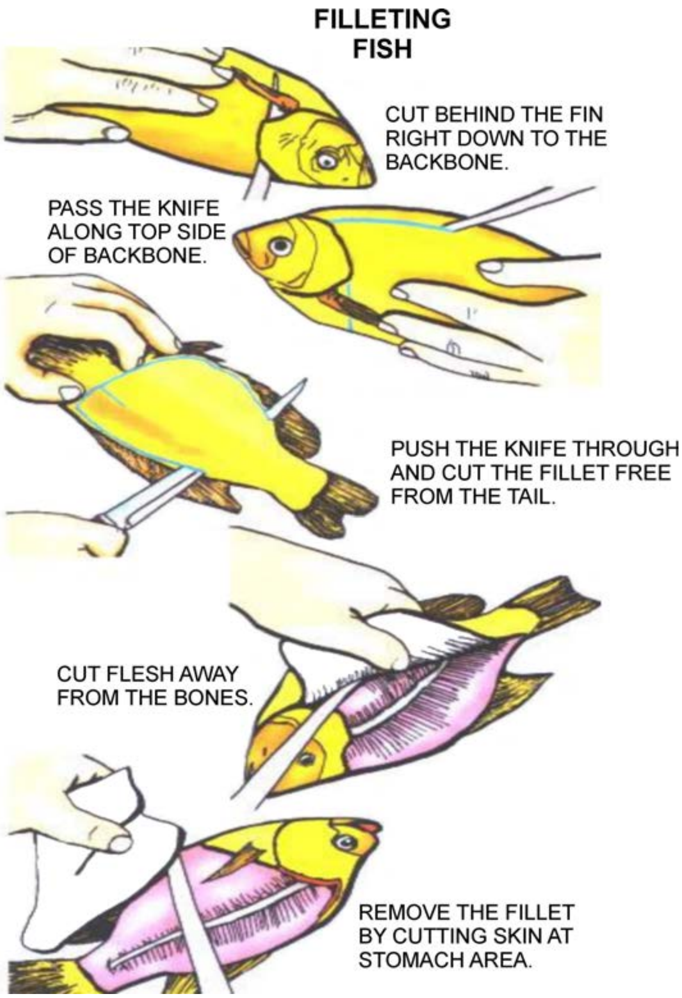
2. **Gutting.** Make an incision from the anal orifice to where the throat was cut. Remove the entrails – you can use them for bait. Keep the roe, which runs down the side of the fish. It is hard in females and soft in males; it is very nutritious.

The roe of a fish are within the sexual organs (hard roe are eggs, soft roe is sperm). It is recommended that this is not explained to the cadets.

3. **Scaling.** Scaling is not necessary and fish can be cooked with scales on, but if there is time, scrape them off. Remove scales by holding the tail and pushing a dull knife across the skin at a forty-five degree angle. Draw the knife from tail to head.

Catfish have skin, not scales and should be skinned like a small animal.

4. **Filleting.** Pass the knife along the top side of the backbone. Cut behind the fin down to the backbone. Push the knife through and cut the fillet free from the tail. Cut the flesh away from the bones. Remove the fillet by cutting the skin at the stomach area.



P. Tawrell, Camping and Wilderness Survival, Paul Tawrell (p. 144)

Figure 18-15-2 Filleting a Fish

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is done as soon as a fish is caught?

Q2. What should you do with the entrails?

Q3. What is the process for filleting?

ANTICIPATED ANSWERS

A1. As soon as a fish is caught, its throat is cut and allowed to bleed.

A2. Remove the entrails – you can use them for bait.

A3. Filleting:

(1) Pass the knife along the top side of the backbone.

(2) Cut behind the fin down to the backbone.

(3) Push the knife through and cut the fillet free from the tail.

(4) Cut the flesh away from the bones.

(5) Remove the fillet by cutting the skin at the stomach area.

Teaching Point 3 **Explain Methods of Cooking a Small Animal or Fish and Demonstrate One of the Methods**

Time: 20 min Method: Demonstration

While only one method will be demonstrated, all three are explained.

COOKING A SMALL ANIMAL OR FISH

In addition to killing parasites and bacteria, cooking food can make it more palatable. The methods chosen for cooking a small animal or fish are based on the items one may have in a survival situation.

Practice cooking a small animal or fish before demonstrating one of the following procedures to the cadets. Prepare all materials before the start of the class. The small animals and fish prepared during the instructor's practice should be cooked using all three methods and used as examples of the finished (fully cooked) products.

GRILLING

The following are some considerations for grilling food:

- Grilling is a quick way of cooking large amounts of food but it requires a support – such as wire mesh or a grid of green sticks – rested on rocks over the embers of the fire.
- It should only be used when food is plentiful since it wastes most of the fat from the meat.
- Hot rocks beside the fire can be used as grilling surfaces.

Grilling:

1. Place the large rocks on either side of the fire for the wire mesh/green sticks to rest on.
2. Place the wire mesh/green sticks (in grid formation) on the rocks above the fire.
3. Place food on the wire mesh/green sticks and cook until the meat is no longer pink. Fresh water fish are normally germ free and may be eaten raw, however it is more palatable when cooked.

J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 284)

Figure 18-15-3 Grilling

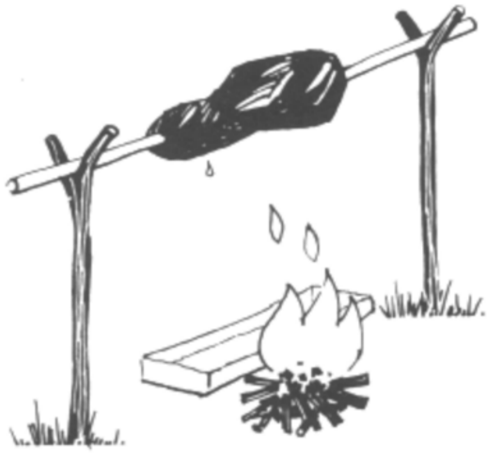
ROASTING

The following are some considerations for roasting food:

- Roasted meat cooks in its own fat.
- Continually turning the meat keeps the fat moving over the surface.
- The easiest method is to skewer the meat on a spit and turn it over the hot embers of a fire or beside a blazing fire where it is hot enough to cook.
- Roasting makes a very tasty dish but has two disadvantages:
  - Valuable fat is lost unless a drip tray is placed beneath the spit. Regularly baste the meat with fat from the tray.
  - Roasting by a fierce fire can cook and seal the outside, leaving the inner meat uncooked and harmful bacteria alive. A slow roast is preferable, and the inner meat can continue cooking after the outer meat has been cut off.

Roasting:

1. Build a spit with two Y shaped sticks and a green stick as the centrepiece.
2. Place the spit over the fire.
3. Skewer the meat and place it on the spit. Turn it over the hot embers of the fire or place the spit beside a blazing fire where it is hot enough to cook. If possible, place a drip pan under the meat to catch the fat.
4. Continue turning the meat so the fat moves over the surface.



J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 284)

Figure 18-15-4 Roasting

FRYING

The following are some considerations for frying:

- Frying is an excellent way of adding variety to your diet if fat is available and you have a container in which to fry food.
- Any sheet of metal that you can fashion into a curve or give a slight lip can serve as a pan.
- In some areas, you may find a large leaf which contains enough oil that will not dry out before the cooking is done. Before you risk valuable food on them, try the leaves first. See if the leaves burn when placed over the embers. If you use a large leaf, fry only over embers, not over flames.

Frying

1. Place a flat rock, large leaf, or sheet of metal on or next to the fire. (Avoid rocks with high moisture content, they may explode when heated).
2. Let the rock or metal heat up and cook on it as you would a frying pan.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What are three types of cooking methods?

Q2. Which type of cooking should only be used when food is plentiful?

Q3. What material can serve as a pan?

ANTICIPATED ANSWERS

A1. Grilling, roasting and frying.

A2. Grilling should only be used when food is plentiful since it wastes most of the fat from the meat.

A3. Any sheet of metal that you can fashion into a curve or give a slight lip can serve as a pan.

END OF LESSON CONFIRMATION

The cadets' participation in identifying methods of preparing and cooking a small animal or fish will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for the cadets to identify the methods of preparing and cooking a small animal or fish in a survival situation because before you can eat what you have caught you have to prepare and cook it. Proper preparation and cooking minimizes the chances of getting sick and helps to preserve the food.

INSTRUCTOR NOTES/REMARKS

Cadets who feel uncomfortable with skinning a small animal do not have to participate in that portion of the class but should be present for the TP on preparing a small animal or fish.

If a rabbit or squirrel cannot be caught in a snare, it may be bought at a farmers' market or a similar venue.

If a fish cannot be caught, it may be bought at a farmers' market or a similar venue.

REFERENCES

C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2nd ed.). Lebanon, NH: Leonard Paul Tawrell.

C3-002 (ISBN 0-00-653140-7) Wiseman, J. (1999). *The SAS Survival Handbook*. Hammersmith, London: HarperCollins Publishers.

C3-003 (ISBN 1-896713-00-9) Tawrell, P. (1996). *Camping and Wilderness Survival: The Ultimate Outdoors Book*. Green Valley, ON: Paul Tawrell.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 16

EO C390.11 – CONSTRUCT CAMP CRAFTS

Total Time:	120 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Prepare three camp crafts for demonstration purposes.

Photocopy the diagrams detailing camp craft construction for the selected camp crafts located at Annexes V to AJ for each pair of cadets.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

A practical activity was chosen for this lesson as it is an interactive way to allow the cadets to practice constructing camp crafts in a safe, controlled environment.

INTRODUCTION

REVIEW

EO C190.03 (Tie Knots and Lashings, A-CR-CCP-801/PF-001, Chapter 15, Section 9) may serve as the review for this lesson.

OBJECTIVES

By the end of this lesson the cadet shall have constructed two camp crafts.

IMPORTANCE

It is important for the cadets to be able to construct camp crafts in a survival situation so they will be able to combat both the elements and psychological factors (eg, boredom and loneliness). It is important to construct camp crafts that serve a purpose in a survival situation (eg, a fishing pole does not have a purpose if there is no water present). The amount of energy put into constructing a camp craft should be relative to its usefulness.

Teaching Point 1 | **Have the Cadets, in Pairs, Construct Two Camp Crafts**

Time: 110 min | Method: Practical Activity

For this skill lesson, it is recommended that the instruction take the following format:

1. Explain how the camp crafts that were prepared prior to the lesson were constructed.
2. Divide the cadets into pairs and distribute the handouts.
3. Have groups choose two camp crafts to construct.
4. Supervise the cadets as they construct camp crafts.

Cadets will choose the camp crafts they want to construct. If time allows, have each group construct a third camp craft.

CAMP CRAFTS

Two camp crafts will be chosen from the following:

- a ladder bed,
- a pack frame,
- a shower,
- a washstand,
- a drying rack,
- a tool rack,
- a camp craft for cooking, including:
  - a pot rod,
  - a swinging pot holder, or
  - a Chippewa kitchen;
- a wheelbarrow,
- a coat hanger,
- a simple bench,
- a bench with back rest,
- a camp table, or
- a friction-lock table.

ACTIVITY

Time: 100 min

OBJECTIVE

The objective of this activity is to have the cadets, in pairs, construct two camp crafts.

RESOURCES

- Knife,
- Cord,
- Axe,
- Bow saw,
- Other resources based on camp craft chosen, and
- Diagrams detailing camp craft construction (located at Annexes V to AJ).

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into pairs and hand out diagrams detailing camp craft construction.
2. Have the cadets construct two camp crafts.
3. When camp crafts are completed, have the groups view all of the constructed crafts.
4. Do not leave camp crafts behind. Have the cadets redistribute all natural material used into the bush at the end of the lesson or exercise.

SAFETY

Tools shall be handled in a safe manner.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in constructing camp crafts will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for the cadets to be able to construct camp crafts in a survival situation so they will be able to combat both the elements and psychological factors (eg, boredom and loneliness). It is important to construct camp crafts that serve a purpose for each survival situation (eg, a fishing pole does not have a purpose if there is no water present). The amount of energy put into constructing a camp craft should be relative to its usefulness.

INSTRUCTOR NOTES/REMARKS

Natural resources found in the field, such as fallen or dead wood, are to be used for construction.

The directives found in CATO 11-08, *Environmental Protection and Stewardship*, are to be followed during this lesson.

The more difficult camp crafts should be constructed in advance for demonstration purposes.

REFERENCES

A0-039 CATO 11-08 Director Cadets 3. (1997). *Environmental Protection and Stewardship*. Ottawa, ON: Department of National Defence.

C2-046 PioneeringProjects.org. (2004). *PioneeringProjects.org*. Retrieved February 20, 2007, from http://www.pioneeringprojects.org/projects/index.htm.

C3-002 (ISBN 0-00-653140-7) Wiseman, J. (1999). *The SAS Survival Handbook*. Hammersmith, London: HarperCollins Publishers.

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 17

EO C390.12 – PERFORM MINOR FIRST AID IN A FIELD SETTING

Total Time:	120 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

There is no requirement for a qualified first aid instructor to teach the material contained in this lesson, as the cadets are not required to qualify in first aid; however, the instructor should be a qualified first-aider.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

Demonstration and performance was chosen for TPs 1–3 and 5 as it allows the instructor to explain and demonstrate minor first aid while providing an opportunity for the cadet to practice and develop these skills under supervision.

An interactive lecture was chosen for TP 4 to introduce the cadets to the treatment of minor wounds and burns.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have performed minor first aid in a field setting.

IMPORTANCE

It is important for the cadets to be able to perform the selected minor first aid skills as injuries are a common occurrence in field settings. Having a basic understanding of minor first aid will allow the cadets to take action in an emergency situation.

Teaching Point 1 — **Demonstrate and Have the Cadets Perform Minor First Aid**

Time: 25 min — Method: Demonstration and Performance

When performing first aid in the field there are certain considerations regardless of what the injury or illness is. The following are the first to be addressed:

- breathing problems,
- exposure,
- shock, and
- dehydration.

BREATHING PROBLEMS

Many people have died in the wilderness because they were left on their back while someone went to seek assistance. In most cases the person became unconscious and their relaxed tongue fell to the back of their throat blocking the air passage. In some cases the wounded individual vomited and it entered the lungs. In other cases blood from the nose or mouth collected in the airway and caused asphyxiation.

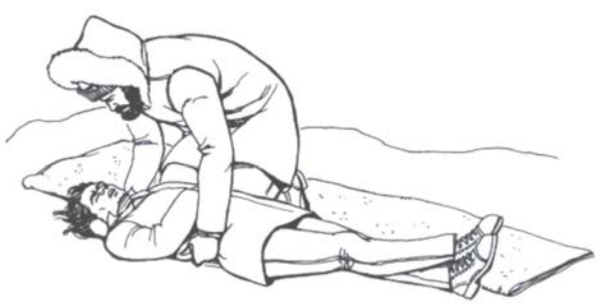
Placing a casualty in the recovery position is one of the basics of first aid. The recovery position protects an unconscious or injured casualty against fluid entering the lungs. If the casualty is on the snow or damp ground, a blanket or pad should be placed underneath to protect the face and reduce heat loss.

Have two assistants demonstrate each step as it is described.

The Recovery Position

The recovery position is adopted as follows:

1. Cross the casualty's legs at the ankles, with the leg further from you on top.
2. Place the arm that is closer to you along their side and the arm further from you across their chest (as illustrated in Figure 18-17-1).



W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)

Figure 18-17-1 Preparing the Roll

3. Support their head with one hand and grip their clothing at the waist on the far side.

4. Roll the person gently toward you, protecting their head and neck, and rest them against your knees (as illustrated in Figure 18-17-2).

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)

Figure 18-17-2 Making the Roll

5. Bend their upper knee toward you to form a support (as illustrated in Figure 18-17-3).

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)

Figure 18-17-3 Leg Position

6. Position their head with the chin slightly extended to keep their airway open.

7. Place the upper arm above the head to keep the casualty from rolling onto their face (as illustrated in Figure 18-17-4).

8. Place the lower arm along their back so they cannot roll onto their back.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)

Figure 18-17-4 Final Position

If the individual is conscious and having breathing problems it is best to place them in a seated position. Causalities have died because they cannot get enough air into their lungs. A person lying down cannot breathe as well as someone who is sitting up.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 4)

Figure 18-17-5 Semi-Sitting Position

EXPOSURE

Exposure is a common hazard in a survival situation. It occurs when a person is exposed to the elements (eg, rain, snow, wind, immersed in water) and the body starts losing heat faster than it produces it. Hypothermia occurs when the body's core temperature falls below 33.7 degrees Celsius. If a person is wet, even in a mild wind, hypothermia may occur in temperatures as high as 15 degrees Celsius.

Anyone who is sick or injured is in more danger from exposure than a healthy person. They may get hypothermia or frostbite, because their bodies are unable to produce sufficient heat. A first-aider must protect a casualty from exposure even in a warm environment.

Protecting a casualty from exposure is as simple as covering them with a sleeping bag, blanket or extra clothing. It is also necessary to place something underneath the casualty as body heat is easily lost into the ground. Keep the casualty warm and dry as an injured person is extremely sensitive to changes in temperature.

SHOCK

Shock may be present with many injuries or illnesses and is usually present in serious injuries. Shock occurs when there is inadequate organ perfusion (decreased blood flow through the organs).

The Circulatory System

The heart is a pump. The arteries and veins work like flexible hoses: carrying blood to and from every part of the body, bringing oxygen and food, and removing carbon dioxide and waste products. The food and oxygen are "burned", keeping the body healthy and producing heat. When organs are not getting enough oxygen to work properly the signs of shock will begin to show.

Causes of Shock

Shock is caused by a drop in blood pressure. This pressure is provided by the heart and maintained by a system of veins and arteries. Several things may cause this pressure to drop; medications, prolonged rest, a variety of illnesses, and if there is a "leak" in the system from a bad cut or injury. With such a "leak", blood flows out of the system and the pressure drops.

Signs and Symptoms of Shock

Signs and symptoms of shock include:

- pale, cool clammy skin,
- rapid pulse rate,
- rapid breathing,
- thirst,
- gasping for air,
- anxiety,
- nervousness,
- confusion, and
- decreased amounts of urine.

Shock Prevention and Treatment

> Fainting is not the same as shock. It is caused by a shortage of blood flow to the brain.

Once shock begins, it may be difficult to stop. Always expect shock in any severe injury or illness and prevent/treat it by:

- ensuring a good airway;
- controlling bleeding;
- lying the casualty down on their back, with their feet raised 20–30 cm (8–12 inches) (do not tilt the entire body if there is difficulty breathing);
- keeping the casualty warm and comfortable;
- avoiding rough handling;

- reducing pain as much as possible (eg, by splinting fractures); and
- reassuring the casualty.

DEHYDRATION

> Dehydration is not usually a factor in urban first aid. In the wilderness, however, it often affects a person more than is realized.

Dehydration occurs when the body loses more water than it takes in. Dehydration is usually caused by:

- not drinking enough water;
- losing too much water through the skin by perspiration;
- losing too much water through the lungs by evaporation;
- losing water through vomiting or diarrhea; and
- frequently urinating.

A person who is working hard outdoors in a survival situation for several days with little opportunity to drink may become severely dehydrated and may show signs similar to shock. With the cold, very dry air in more northern regions, dehydration occurs more rapidly.

Signs and Symptoms of Dehydration

Signs and symptoms of dehydration include:

- thirst,
- dry tongue,
- discomfort,
- tiredness,
- nausea,
- sleepiness,
- pale, cool and clammy skin,
- faster pulse,
- pinched skin on back of hand is slow to flatten out, and
- little urine, dark in colour.

A person who drinks an adequate amount of fluids and is healthy will produce at least 1 000 ml of urine per day.

Prevention of Dehydration

Drink more water during outdoor activities. Try to drink even if there is no feeling of thirst. Remember that drinks containing caffeine are diuretics and will make one urinate more often. Although one can reduce thirst for a short time by nibbling on snow, remember that melting any amount of snow in the mouth takes an enormous amount of heat from the body and produces little water. Any water one can get, no matter how cold, will use up less body heat than eating snow.

There are stories of people who have survived for long periods of time by drinking their own urine, but it is more likely that they survived in spite of drinking urine since urine and sea water contain large amounts of salt which draw water away from the tissues, having an overall negative effect on hydration.

ACTIVITY

Time: 10 min

OBJECTIVE

The objective of this activity is to have the cadets practice putting a casualty in the recovery position.

RESOURCES

N/A.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets in groups of three or four.
2. Have one cadet act as the casualty, one act as the first-aider and one or two observe and assist.
3. The first-aider will put the casualty in the recovery position by:
   (a) crossing the casualty's legs at the ankles, with the leg furthest from the first-aider on top;
   (b) placing the arm closest to the first-aider along their side, the arm furthest from the first-aider across their chest;
   (c) supporting their head with one hand and grip their clothing at the waist on the far side with the other hand;
   (d) rolling the person gently toward the first-aider, protecting their head and neck, and resting them against the first-aider's knees;
   (e) bending their upper knee toward the first-aider to form a support;
   (f) positioning their head with the chin slightly extended to keep their airway open;
   (g) placing their upper arm to keep the casualty from rolling onto their face; and
   (h) placing the lower arm along their back so they cannot roll onto their back.
4. Have the cadets rotate through positions.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in putting a casualty into the recovery position will serve as the confirmation of this TP.

Teaching Point 2 | **Demonstrate and Have the Cadets Practice Actions to be Taken at an Emergency Scene**

Time: 30 min | Method: Demonstration and Performance

For this skill lesson, it is recommended that the instructor take the following format:

1. Explain and demonstrate the steps in the Priority Action Approach while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be used to monitor the cadets' performance.

ENSURE PERSONAL SAFETY

With serious injuries it is often difficult to know how to assist. Most people react well to less serious problems. When a person gets a cut or scrape or breaks an arm, it is easy to see and understand what is wrong and handle it without emotion or confusion.

In every first aid situation, before doing anything else, a person must make sure there is no further hazard threatening oneself or the casualty. Take care of the hazard first or get the casualty away from it.

Rescuer panic usually happens when the casualty is unconscious or dazed, when there is a lot of blood or disfigurement, or when we do not know what is exactly wrong with the casualty but suspect it is quite serious. Rescuers who are panicked need to regain control of themselves before performing first aid.

FOLLOW THE STEPS IN A PRIORITY ACTION APPROACH

First aid employs the Priority Action Approach to identify and treat the most life threatening items first. Then the less critical areas are taken care of next. If the exact cause of the injury is known, either directly witnessed or the casualty is conscious and can describe the accident, there is no need to go through all the steps of the Priority Action Approach. However, if the cause is unknown it is necessary to follow a checklist of tasks.

The most common approach uses the first four letters of the alphabet as clues:

A = Airway and cervical spine

B = Breathing

C = Circulation

D = Deadly bleeds

Also, include "S" for shock, because it may be present in any serious injury or illness.

Check the level of consciousness (LOC), by talking to the casualty in a loud voice. If the casualty is unresponsive, immediately begin the Priority Action Approach.

(A) Airway and Cervical Spine. Check the airway. Is it open? Is there anything blocking the airway (eg, packed snow or blood)? Clear it. Is the tongue falling back blocking the airway? To open the airway, move the lower jaw upward without moving the neck.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 15)

Figure 18-17-6 Chin Lift

If there is a possibility of neck injury, immobilize the neck with a cervical or improvised collar. Ensure airway is open.

(B) Breathing. Be sure the casualty is breathing. Remember, they can only live for minutes without air. Press an ear next to their lips. Listen for breathing, feel for their breath on the ear or cheek and watch for the chest to rise and fall. If the casualty is not breathing, start rescue breathing immediately.

Rescue Breathing

With the chin lifted, as illustrated in Figure 18-17-6, place the mouth over the casualty's mouth and establish a seal. Close the nostrils and breathe into the casualty's mouth. Then lift the mouth away, permitting the casualty to exhale. The rescuer breathes 12 times each minute (15 times for a child and 20 for an infant) into the casualty's mouth.

Rescue breathing and cardiopulmonary resuscitation (CPR) are very different in purpose. Rescue breathing only addresses the casualty's breathing problems. CPR addresses both breathing and circulatory problems. CPR requires extensive practice and will not be covered in this lesson.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 15)

Figure 18-17-7 Breathing

(C) Circulation. Check the circulation. Is there a pulse? The pulse in the neck (carotid pulse) is the easiest to check, because it is strongest. Fingers can be slipped onto the neck without removing clothing and risking frostbite. If there is no pulse and the first-aider has CPR training, start CPR.

Breathing and circulation go hand in hand and a casualty cannot survive without either. If there is no pulse, chances are unlikely that the casualty will be breathing. They can still have a heartbeat and not be breathing if the injuries are recent. Start rescue breathing in this situation.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 16)

Figure 18-17-8 Pulse

(D) Deadly Bleeds. Make sure that the casualty is not bleeding severely from somewhere unseen. While wearing latex or surgical gloves, slide a hand gently beneath the casualty then remove and look for blood on the gloves. If the casualty is bleeding severely, try to stop it. Next, feel carefully underneath the casualty for any obvious bumps, irregularities or tenderness in the spine indicating damage.

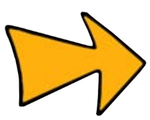
W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 16)

Figure 18-17-9 Bleeding

(S) Shock. Shock is a life-threatening disability. If the casualty shows or is likely to show the signs of shock, begin treatment immediately.

Shock is covered in TP 1.

Completing the Priority Action Approach should only take a couple of minutes.



First-aiders should wear latex gloves whenever they may be exposed to bodily fluids because of the increasing danger of HIV (the AIDS virus), hepatitis (A, B, C, D, and E) and other diseases. Every first aid kit should include one or more pairs of gloves. They can be obtained at a drug store, nursing station or hospital. After use, the contaminated gloves should be carefully removed and burned. Any blood that accidentally spatters onto skin must be washed off immediately with soap and water.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in completing the Priority Action Approach will serve as the confirmation of this TP.

Teaching Point 3 — **Demonstrate and Have the Cadets Move a Casualty to Shelter**

Time: 30 min — Method: Demonstration and Performance

For this skill lesson, it is recommended that the instructor take the following format:

1. Explain and demonstrate each carry while the cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor the cadets as they imitate each step in groups of two or three.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be used to assist with carries and monitor the cadets' performance.

MOVING AND CARRYING OVER SHORT DISTANCES

Many wilderness emergencies require moving or carrying a casualty a short distance, with usually only one or two rescuers. It is difficult to carry an adult for any distance and it is easy to injure them further while carrying.

Drags

A casualty should be dragged only if they must be moved quickly out of danger, severe cold, strong winds, blowing snow or water. It is important to assess the casualty before attempting a drag because some injuries, if not yet stabilized, may be aggravated by premature movement. If there is only one rescuer, dragging may be the only means of moving a casualty.

When dragging a casualty, observe the following rules:

- Drag a casualty headfirst. This allows the head and neck to be supported and keeps the body straight.
- Keep the body in-line. The casualty's body must not twist or bend. Avoid major bumps.
- The neck should not bend sharply, nor should the head fall forward or to the side.

Steps to drag a person:

1. If possible, secure the casualty's hands before beginning the drag.
2. Reach under the casualty's body and grip their clothing just below their shoulder on either side while supporting the head and neck using the forearms.
3. Crouch or kneel and walk backwards (as illustrated in Figure 18-17-10).
4. Stop when the casualty is out of danger.

This drag is hard on the rescuer's back, so be careful.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 21)

Figure 18-17-10 Drag

5. If the casualty's clothing pulls up too much or tears, place a shirt or jacket over their chest and bring the sleeves under their back to provide a firm grip (as illustrated in Figure 18-17-11).

> The first-aider can use cuff buttons or Velcro, mitten ties or a piece of cord to assist in this drag.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 21)

Figure 18-17-11 Modified Drag

Tarp Drag Method

> Rarely should lifts or carries be done on snow because of the possibility of the rescuer slipping; it is safer and easier to drag a casualty on a tarp or sled.

The tarp drag method works well on snow. A rescuer may make a ramp of snow and slide a casualty onto a sled. This drag is also a good way to move a casualty onto insulating material to protect them from the cold ground or snow.

One may wish to leave the tarp under the casualty to aid in another lift. Always put the casualty into a basket stretcher with a backboard, blanket or tarp under them, as it is otherwise difficult to remove them without excessive movement.

> Be careful when using the tarp drag method on sloping snow as control may be lost on a downhill slope.

Dragging a casualty on a tarp, blanket, sail, tent or large hide can be accomplished by following these steps:

1. Place the tarp next to the casualty.
2. Fold the tarp into accordion folds of about 1 m (3 feet) wide.
3. Log-roll the casualty toward the first-aider and brace them there with your knees while the first-aider use one hand to slide the folds close against their back.
4. Roll the casualty gently back onto the accordion folds.
5. Reach under the casualty and pull the folds out straight.

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Figure 18-17-12 Rolling Onto a Tarp

6. Grip the tarp and hold the casualty's head and shoulders off the ground and drag carefully.

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Figure 18-17-13 Tarp Drag

Single-Rescue Carries

Most single-rescue carries are for short distances and cannot be used to transport a casualty with major injuries. All are extremely strenuous. They are often used to transport casualties with injuries of the lower extremities but care must be taken as it is easy to cause further injuries.

Packstrap Carry

This is a quick, easy carry for very short distances. The casualty must be able to stand to get into position with their arms across the shoulders like packstraps. Bring the casualties arms across the shoulders, crossing their wrists in front. Hold their wrists while bending forward and lift the casualty's feet off the ground. Be sure their arms are bent at the elbow.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 23)

Figure 18-17-14 Packstrap Carry

Pickaback Carry

This familiar carry is good for short-distance transport of conscious casualties with minor injuries and may be used to carry children for long distances.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 23)

Figure 18-17-15 Pickaback Carry

Carrying Seat

A quick and easy backpack seat to assist the pickaback system may be made with a simple loop of wide strap. It may be necessary to adjust the length once or twice for maximum comfort. This seat is best used if the casualty is lighter than the rescuer, otherwise it may put pressure on the rescuer’s neck and shoulders.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 23)

Figure 18-17-16 Carrying Seat With Wide Strap

CARRYING OVER LONG DISTANCES USING TWO-PERSON CARRIES

Lifting is half as strenuous if there are two rescuers; however carrying for any distance is usually not easier because two carriers must compensate for each other's movements to keep balanced. The chance of error is multiplied with each added person in a lifting team and injury to the casualty often occurs if lifts are poor. Whenever more than one person lifts, observe the following rules:

- One person must be clearly designated as the leader and be responsible for giving all of the commands.
- The partner(s) must be told exactly what is to be done and what the commands will be.
- The lift should first be practiced without the casualty or on an uninjured person.
- Rescuers should maintain eye contact while lifting.

The Fore-and-Aft Lift and Carry

This should be used only if the casualty has minor injuries. On uneven terrain, it may be the easiest method of lifting a casualty onto a stretcher or another means of transport. As it produces some pressure against the chest, it will restrict the casualty's air flow. Follow these steps:

1. If the casualty is conscious, help them sit up. If the casualty is unconscious, have a partner take the casualty's hands and pull them into the sitting position.
2. Cross the casualty's arms on their chest.
3. Crouch behind them, reach under their arms and grasp the opposite wrists.
4. Have your partner crouch between the casualty's knees, facing the casualty's feet and take a leg under each arm.
5. At the leader's signal, rise, keeping your back straight.

W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 26)

Figure 18-17-17 Fore-and-Aft Lift and Carry

Two-Hand Seat

This two-person lift and carry is good for casualties who cannot hold onto the rescuer's shoulders for support, or who are not fully alert.

1. Rescuers crouch on either side of the casualty.
2. Each rescuer will slide one hand under the casualty's thighs and lock fingers over a pad or while wearing mittens or gloves so that fingernails do not dig into each other (as illustrated in Figure 18-17-18).

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Figure 18-17-18 Hand Grip

3. Reach across the casualty's back and grip their belt and pants at the opposite hip; the rescuers' arms are crossed (as illustrated in Figure 18-17-19).
4. Rise on command and step off with the inside foot. This supports the casualty's back; however, the fingers of the gripping hands will tire quickly.

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Figure 18-17-19 Two-Person Lift

For longer carries, try gripping your partner's wrists rather than their fingers. If wearing mittens, gripping the wrist will be more secure than gripping the hand. If the casualty is unconscious, they may be lifted easily to a sitting position. One rescuer pulls on the casualty's hands while the other lifts and supports their head; then the rescuers move into position while supporting the casualty's head and back.

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Figure 18-17-20 Two-Person Carry

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in completing all the carries will serve as the confirmation of this TP.

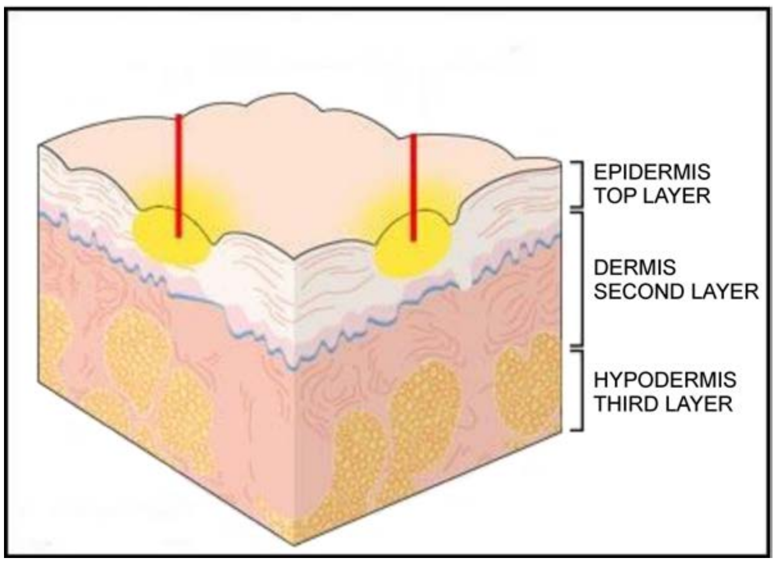
Teaching Point 4	**Have the Cadets Identify Minor Wounds and Types of Burns**
Time: 10 min	Method: Interactive Lecture

MINOR WOUNDS

Minor wounds are those that do not have severe bleeding; bleeding wounds can be internal (inside the body) or external (outside the body). Common external bleeding wounds are:

- abrasions and scrapes, and
- nicks and cuts.

There is always a risk of infection when the skin's top layer is broken. Knowing how to identify and treat minor wounds can reduce the risk of infection or aggravation.



Irishhealth.com, Copyright 2007 by Irishhealth.com. Retrieved March 17, 2007, from http://irishhealth.com/index.html?level=4&con=467

Figure 18-17-21 Layers of Skin

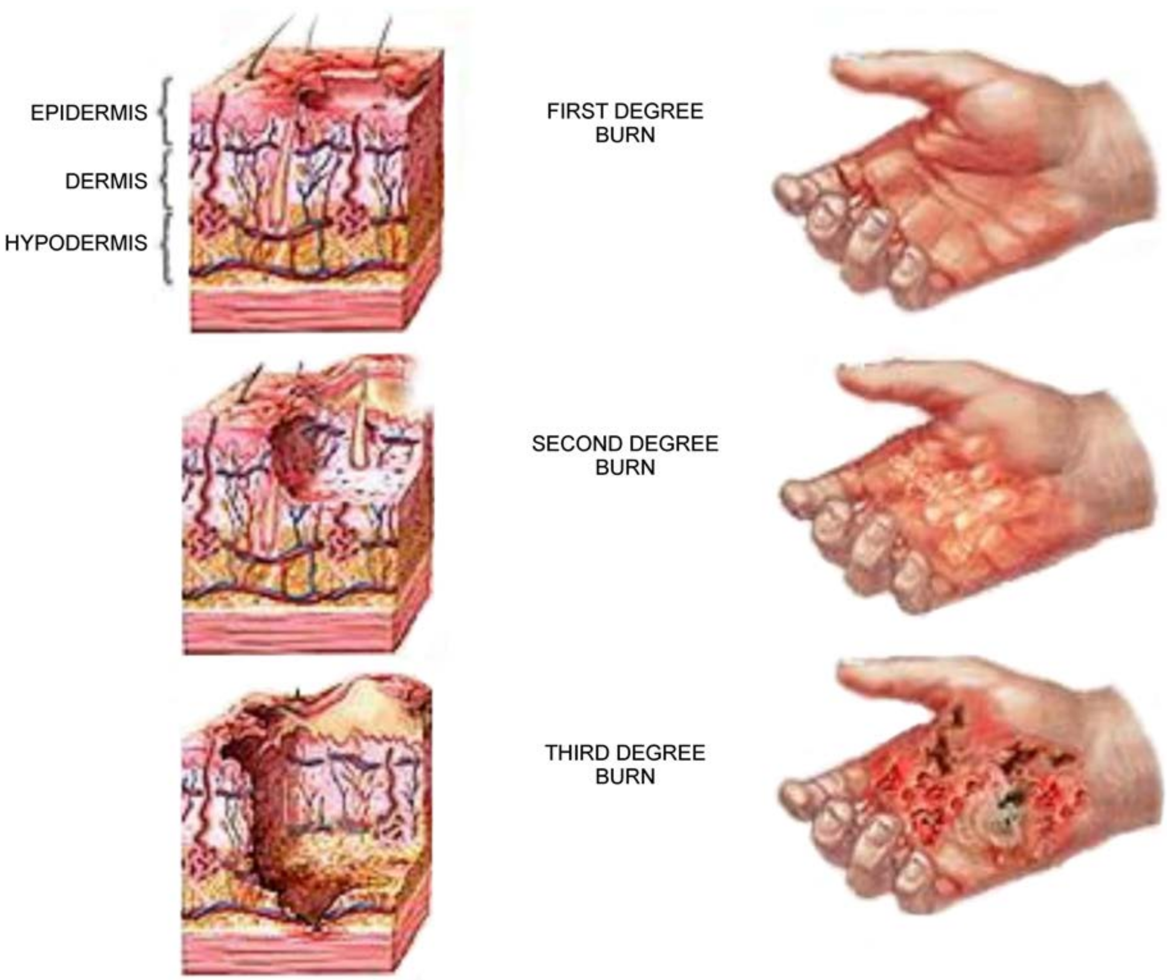
Abrasions and Scrapes. These occur on the top layer of the skin, when the skin is scraped or rubbed away. They are often painful and may bleed in small amounts.

Nicks and Cuts. Cuts are breaks in the top or second layer of the skin; there is often minor bleeding involved.

TheFatManWalking.com, Copyright 2006 by FatManWalking.com. Retrieved March 6, 2007, from http://www.thefatmanwalking.com/page/65492/;jsessionid=mni5xlvqdm9

Figure 18-17-22 Leg Scrape

TYPES OF BURNS



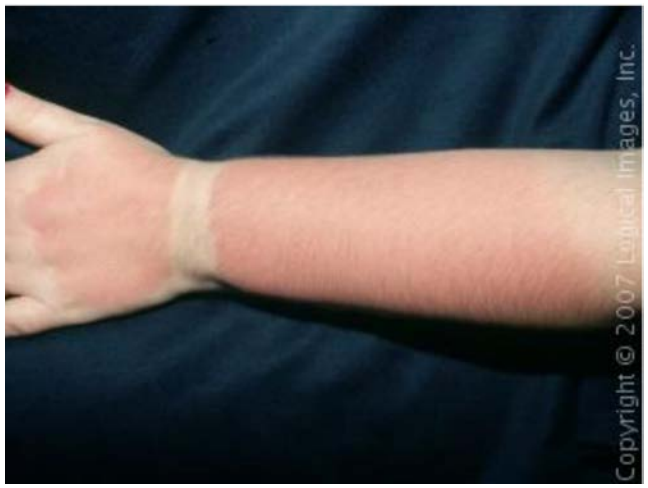
Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from http://www.nlm.nih.gov/medecineplus/ency/presentations/100208_4.htm

Figure 18-17-23 Types of Burns

First-Degree Burns. Called superficial burns and only affect the top layer of skin. Hot liquids, heat, and the sun are the main causes of these burns.

Signs and symptoms of a first-degree burn include:

- pinkish-reddish skin,
- slight swelling of the area,
- mild to moderate pain in the area, and
- sore, dry skin.



VisualDxHealth, 2006-2008, Sunburn, Copyright 2007 by Logical Images, Inc. Retrieved March 17, 2008, from http://www.visualdxhealth.com/images/dx/webChild/sunburn_43305_lg.jpg

Figure 18-17-24 First-Degree Burn

Sunburns are first-degree burns.

Second-Degree Burns. Affect the second layer of skin. Hot liquids, the sun, chemicals, and fire are the main causes of these burns.

Signs and symptoms of a second-degree burn include:

- raw-looking, moist skin,
- skin colouring that may range from white to cherry red,
- blisters containing clear fluid, and
- extreme pain in the area.

Figure 18-17-25 Second-Degree Burn

Third-Degree Burns. Affect the third layer of skin and can extend into the muscle. Contact with extreme heat sources (eg, hot liquids and solids, direct flame, chemicals) and electricity are the main causes of these burns.

Signs and symptoms of a third-degree burn include:

- dry, leathery skin,
- pearly white, tan, grey, or charred black skin,
- blood vessels or bone may be visible,
- little or no pain (nerves are destroyed),
- breathing problems, and
- shock.

Sickkids.ca. Copyright 1999 by The Hospital for Sick Children. Retrieved March 6, 2007, from http://www.sickkids.ca/plasticsurgery/section.asp?s=Burns&s ID=4489&ss=About+Burns&ssID=4496

Figure 18-17-26 Third-Degree Burn

CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. Where do abrasions and scrapes occur?

Q2. What layer of the skin does first-degree burn affect and what are the main causes?

Q3. What are the main causes of third-degree burns?

ANTICIPATED ANSWERS

A1. They occur on the top layer of the skin, when the skin is scraped or rubbed away. They are often painful and may bleed in small amounts.

A2. Called superficial burns and only affect the top layer of skin. Hot liquids, heat and the sun are the main causes of these burns.

A3. Contact with extreme heat sources (eg, hot liquids and solids, direct flame, chemicals) and electricity are the main causes of these burns.

Teaching Point 5 | **Demonstrate and Have the Cadets Treat Minor Wounds and First-Degree Burns**

Time: 150 min | Method: Demonstration and Performance

For this skill lesson, it is recommended that the instructor take the following format:

1. Explain and demonstrate treating minor wounds and first-degree burns while the cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor the cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

Note: Assistant instructors may be used to assist with carries and to monitor the cadets' performance.

TREATMENT FOR MINOR WOUNDS

There are three basic objectives when treating abrasions, scrapes, nicks and cuts:

- to control bleeding;
- to prevent further injury; and
- to reduce the risk of infection.

Have cadets, in pairs, practice the principles of cleaning and treating a wound, using the following resources:

- gauze,
- gloves,
- scissors,
- sterile dressing, and
- tape.

Principles of cleaning and treating a minor wound to avoid infection:

1. Wash hands with soap and water and put gloves on. Do not cough or breathe directly over the wound.
2. Fully expose the wound, without touching it.
3. Gently wash loose material from the surface of the wound. Wash and dry the surrounding skin with clean dressings, cleaning the wound with clean gauze wiping from the centre of the wound to the edge of the wound (an antibiotic cream can be used on surface wounds and abrasions).
4. Cover the wound promptly with a sterile dressing.

Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from http://www.nlm.nih.gov/medecineplus/ency/presentations/100208_4.htm

Figure 18-17-27 Washing the Wound

5. Tape the dressing in place.

6. Remove and dispose of the gloves and wash your hands and any other skin area that may have been in contact with the casualty's blood.

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Figure 18-17-28 Dressing and Taping the Wound

TREATMENT FOR FIRST-DEGREE BURNS

Have cadets, in pairs, practice the principles of cleaning and treating heat and radiation burns, using the following resources:

- gauze,
- gloves,
- scissors,
- sterile dressing, and
- tape.

Heat Burns. The most common types of burns; caused by sources of heat such as flames from stoves, lanterns, and fires. A scald is a heat burn caused by hot liquid or steam.

To treat a heat burn:

1. Immerse the burn in cool water until the pain is reduced. If it is not possible to immerse the burn in cool water, flush the burn with cool water and cover it with a clean, wet cloth.

Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from http://www.nlm.nih.gov/medecineplus/ency/presentations/100213_1.htm

Figure 18-17-29 Cooling the Burn

2. Cover the burn with a clean, lint-free dressing.
3. Seek further medical attention, if necessary.

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Figure 18-17-30 Dressing the Burn

Radiation Burns (Sunburns). These are caused by over-exposure to sunlight and can be prevented by wearing sunscreen of a high sun protection factor (SPF), long sleeves, and wide-brimmed hats. Sunburns range from mild to serious.

SPF indicates the time a person using sunscreen can be exposed to sunlight before getting sunburn. For example, a person who would normally burn after 12 minutes in the sun would expect to burn after 120 minutes if protected by a sunscreen with SPF 10. The higher the SPF, the more protection sunscreen offers against ultraviolet radiation (UV).

To treat radiation burns:

1. Seek shade.
2. Gently sponge the area with cool water.
3. Cover the area with a cool wet towel.
4. Repeat as needed to relieve pain.
5. Pat the skin dry.
6. Apply medicated sunburn lotion (ointment).
7. Seek medical attention, if necessary.

Blisters caused by sunburns should not be broken. Fevers and vomiting indicate a serious sunburn and medical attention should be sought immediately.

CONFIRMATION OF TEACHING POINT 5

The cadets' participation in treating minor wounds and first-degree burns will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in placing a casualty in the recovery position, practicing the Priority Action Approach, moving a casualty to shelter and treating minor wounds and first-degree burns will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

It is important for the cadets to be able to perform the selected minor first aid skills as injuries are a common occurrence in field settings. Having a basic understanding of minor first aid will allow the cadets to take action in an emergency situation.

INSTRUCTOR NOTES/REMARKS

There is no requirement for a qualified first aid instructor to teach the material contained in this lesson, as the cadets are not required to qualify in first aid; however, the instructor should be a qualified first-aider.

REFERENCES

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ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 18

EO C390.13 – ACT AS A MEMBER OF A GROUND SEARCH AND RESCUE (SAR) PARTY

Total Time:	120 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Examples of confinement methods and clues are to be created prior to the lesson.

The lost person's survival site is to be created prior to the lesson.

The briefing to be presented in TP 4 should be created based on the details of the lost person that will be found at the scenario's survival site. A sample briefing is located at Annex AK.

Additional staff will be required during TP 4 for supervision and assistance in the search.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP 1 to present the categories of lost persons and other general information to the cadets.

Demonstration was chosen for TPs 2 and 3 as it allows the instructor to explain and demonstrate limiting the search area and clue orientation which the cadet is expected to learn.

A practical activity was chosen for TP 4 as it is an interactive way to experience being a member of a search and rescue party. This activity contributes to the development of search and rescue skills and knowledge in a fun and challenging setting.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet, in pairs, shall have acted as a member of a ground SAR party.

IMPORTANCE

It is important for the cadets to know how a ground SAR party operates so they know what to look for when searching for a lost person. It is easier for them to plan their rescue in a survival situation.

Teaching Point 1	**Explain Lost Person Behaviour and General Information**
Time: 10 min	Method: Interactive Lecture

LOST PERSON BEHAVIOUR

Profiling. Recording and analyzing a person's psychological and behavioural characteristics, to assess or predict their capabilities or to assist in identifying a particular subgroup of people.

People that become lost exhibit specific traits that have been profiled from SAR statistics. These traits, if known to the SAR party, will greatly help in the search effort. While there will always be exceptions, lost persons will generally react to their situation based on these specific traits.

Children (1–3 Years)

Children will rarely be far from the point they were last seen, unless some mode of transportation is available (eg, a river, boat, vehicle). In general, children in this age group exhibit the following traits:

- unaware of the concept of being lost;
- navigation skills and sense of direction are practically non-existent;
- tend to wander aimlessly with no specific objective; and
- will seek out the most convenient location to lie down and go to sleep, for example:
  - inside a hollow log,
  - under a thick bush,
  - under an overhanging rock, or
  - under a picnic table.

Children (3–6 Years)

Children will rarely be far from the point they were last seen, unless some mode of transportation is available (eg, a river, boat, vehicle, bicycle). In general, children in this age group exhibit the following traits:

- more mobile and capable of walking further than children aged 1–3 years;
- have a concept of being lost and will generally try to return home or go back to a place they are familiar with;
- have definite interests and may be drawn away by animals, older children or just exploring;
- when tired, generally try to find a spot to sleep; and
- some have been instructed to stay away from strangers and as a result will not answer or talk to searchers when called by name.

Children (6–12 Years)

This group is much more complex than the previous groups in that they may intentionally be running away. They may also seek out some mode of transportation (eg, boat, vehicle, bicycle). In general, members of this group exhibit the following traits:

- navigational and directional skills are much more developed;
- generally oriented to their normal, familiar surroundings and become confused in a strange environment;
- may intentionally run away to avoid punishment, gain attention, or sulk;
- often will not answer when called;
- darkness usually brings on a willingness to accept help and be found;
- suffer from the same fears and problems an adult would, but with a greater sense of helplessness; and
- the circumstances of becoming lost often reflect they are being taken to an unknown environment or surroundings by parents or other adults they know.

Older Persons

Older persons have a wide variety of capabilities, but the many physical and mental conditions of this group define their behavioural characteristics. In general, members of this group exhibit the following traits:

- may be suffering from senility or Alzheimer’s disease;
- may be easily attracted by something that catches their attention;
- their orientation may be to previously known environments rather than the present;
- some may have conditions that require the same type of supervision that children do;
- more lucid older persons may be more likely to over-extend and exhaust themselves rapidly, which can result in a heart attack or other fatal complications; and
- they may be hard-of-hearing or deaf which presents problems with detection.

People With Intellectual Disabilities (All Ages)

This group is very difficult to categorize due to the wide variety of disabilities; however some general behavioural characteristics are:

- they act and react in much the same way as children from the age of 6–12;
- they generally will not respond to their spoken name;
- they most often will be hidden from view as a result of fright or seeking shelter from the elements;
- many times they will stay in one place for days; and
- they usually have no physical impairments but may do nothing to help themselves.

Hikers

Hikers are one of the groups more likely to become lost and their behavioural characteristics include:

- they usually rely on trails with a set destination in mind;
- problems or complications may arise with navigation when trail conditions change or become obscure, for example:
    - a slide over the trail,

- the trail is not maintained,
- the trail is covered intermittently with snow in the spring, or
- poorly defined trail junctions;

- often hiking party members may be mismatched in abilities and one person falls behind, becomes disoriented and ultimately lost;
- cutting switchbacks (a type of road/trail used to ascend/descend a slope by using almost 180 degree turns to follow the slope at a gentler angle for ease of driving/walking) will many times lead to disorientation or going down the wrong hill or drainage; and
- they may be dependent on travel aids and trails for navigation.

GENERAL INFORMATION

Most adults and older youth do not have specific traits that may be used to predict their behaviour. The most important clue to predicting their behaviour is the reason (eg, hiking) they were in the wilderness in the first place. The following general information is relevant (to all groups) and may be used when trying to predict the behaviour of a lost person, their movements and whereabouts.

Category and Circumstances

Can a lost person be categorized? Children are different from hikers, who are different from the elderly, etc. By categorizing a lost person, the search effort may be orientated to the most likely area. The circumstances surrounding the person before they become lost contribute greatly to predicting their behaviour. Effort must be made to discover these circumstances.

Terrain

The terrain affects travel. The area should be examined for barriers, escape routes, drainages, ridges, etc. Flat terrain generally yields different travel distances (farther) than mountainous.

Weather

Weather may restrict the lost person’s movement. It is also a principle contributor to hypothermia, which may affect movement and decision making. Poor weather increases the importance of the length of time a person has been lost (eg, increased risk of hypothermia) and may require increased SAR efforts.

Personality

It has a substantial effect on the lost person’s ability to survive. Consider the aggressive personality versus the ponderer or pessimist.

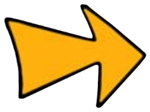
Physical Conditions

Are the lost person’s physical capabilities limited in any way? A poor physical condition means an increased susceptibility to hypothermia. It also has a direct bearing on the distance a lost person will travel.

Medical Problems

Is there any condition that could possibly precipitate abnormal behaviour? This could have a direct bearing on the distance a lost person will travel. Examples of medical problems that may affect a person’s behaviour:

- weak heart,
- diabetes,
- allergies, and
- not having taken medication when needed (they do not have their prescription with them).



Through determining if the lost person is affected by any of the discussed conditions, logical assumptions may be made on their possible behaviour in order to determine the most likely area to focus the search effort.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Where are the most likely places to find a lost child between the ages of 1–3?

Q2. Where would a hiker most likely be found?

Q3. How does weather affect the behaviour of a lost person and the need to find them?

ANTICIPATED ANSWERS

A1. Lying down/asleep inside a hollow log, under a thick bush, under an overhanging rock, or under a picnic table.

A2. On or near a trail.

A3. Weather restricts the lost person's movement and is a principle contributor to hypothermia. Poor weather increases the importance of the length of time a person has been lost (eg, increased risk of hypothermia) and may require increased SAR efforts.

Teaching Point 2	**Explain and Demonstrate Limiting the Search Area**
Time: 20 min	Method: Demonstration

Demonstrate examples of limiting techniques, based on the types (eg, road block, track trap, string line) created (based on terrain) for the lesson, when it is being discussed.

LIMITING THE SEARCH AREA

Why Limit the Search Area?

The search area should be limited as the smaller the area, the less time that will be required to effectively cover it. In addition, fewer searchers are required, or smaller spacing can exist between party members.

Confinement. An effort made to establish a search perimeter which encompasses the lost person and beyond which the person is unlikely to pass without being detected.

Confinement Methods

Confinement methods are used to establish a perimeter around the area being searched and to detect a lost person that may wander out of the search area. Types of confinement methods include:

- **Road Block/Trail Block/Patrols.** Blocks and patrols are designed to cover the parts of the perimeter made up of roads and trails. Blocks serve to confine the search area and also inform through traffic of a search in progress. Patrols serve to cover stretches of roads and trails between the blocks.

- **Lookouts.** While aerial search has replaced the need for most fixed lookout towers, stationing lookouts on high ground is also a viable method of establishing a perimeter.
- **Track Traps.** Sections of trail or a road edge that has been brushed clear of all traces of use. Patrols would, on a regular basis, examine track traps for footprints for an indication that the lost person may have left the confinement area.
- **String Lines.** A method of confinement where a large spool of string is mounted in a backpack. As a SAR member walks through an area, the string unrolls, which is then tied by another SAR member approximately one metre (three feet) above the ground leaving a very visible perimeter. Arrows could also be placed on the string directing the lost person that comes across the string line to the closest SAR group, usually located at a road or trail block.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. Why limit the search area?

Q2. Define confinement.

Q3. What is a string line?

ANTICIPATED ANSWERS

A1. The search area should be limited as the smaller the area, the less time that will be required to effectively cover it. In addition, fewer searchers are required, or smaller spacing can exist between party members.

A2. Confinement is an effort made to establish a search perimeter which encompasses the lost person and beyond which the person is unlikely to pass without being detected.

A3. A string line is a method of confinement where a string is tied approximately one metre (three feet) above the ground leaving a very visible perimeter for the lost person.

Teaching Point 3	**Explain and Demonstrate Clue Orientation**
Time: 10 min	Method: Demonstration

Demonstrate examples of clues, based on the types (eg, footprint, food wrapper, trip plan, an eyewitness account, light flashing in the distance) created for the lesson, when it is being discussed.

CLUE ORIENTATION

Searching for clues helps discover the characteristics and possible behaviour of the lost person that are key to limiting the search area.

General Principles

The general principles of clue orientation are as follows:

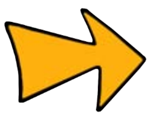
- Clue seeking is a learned skill and must be practiced to develop a sense of what is the minimum information needed to decide on how to categorize a lost person. Clues found and deciphered allow the SAR leader to orientate the search effort to the most likely area.

- Avoid forming opinions and then gathering information to support that opinion. It may limit the searcher to only accepting clues that support their opinion.
- A SAR leader gathers information from everyone, as no one person can know all the facts.
- Assemble a complete profile of the missing person and their situation and let it offer direction.

Searching for Clues

Types of clues that SAR leaders search for:

- **Physical.** Examples include footprints, food wrappers and dropped/lost items.
- **Recorded.** Examples include a trail register, summit logs and a trip plan.
- **People.** These are eyewitness accounts, the point last seen, family and friends.
- **Event.** Examples include a flashing light, a campfire or a ground-to-air signal.



The cadets should evaluate any physical clues they find for relevance. For example, a fresh candy wrapper possibly dropped by the lost person versus one that has been there for some time (dirty and weathered).

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. Why is searching for clues important?

Q2. Why should a searcher avoid making an opinion and then search for clues?

Q3. Name the four types of clues.

ANTICIPATED ANSWERS

A1. Searching for clues helps discover the characteristics and possible behaviour of the lost person that are key to limiting the search area.

A2. It may limit the searcher to only accepting clues that support their opinion.

A3. The four types are: physical, recorded, people and an event.

Teaching Point 4	**Cadets, in Pairs, Will Participate in a Ground SAR Exercise**
Time: 70 min	Method: Practical Activity

Planning and preparation are key to the running of this activity. Ensure the lost person is in position before beginning the search.

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets, in pairs, act as a member of a SAR party.

RESOURCES

- Prepared briefing,
- Compasses (one per pair),
- Two first aid kits (to be given to the anchor [end] pairs),
- Hand-held radios (one per pair),
- Spare batteries, and
- Whistle (one per cadet).

ACTIVITY LAYOUT

A large confined outdoor area.

ACTIVITY INSTRUCTIONS

1. Issue equipment, to include:
   (a) compass,
   (b) first aid kit,
   (c) hand-held radio,
   (d) spare batteries, and
   (e) whistle.
2. Give a briefing, to include:
   (a) situation,
   (b) details of the confinement area,
   (c) formation: creeping line (as when cadets do a garbage sweep),
   (d) distance between pairs: 10–20 m (30–60 ft) based on the terrain,
   (e) call signs and radio frequency to be used,
   (f) magnetic bearing (search direction),
   (g) safety bearing (if lost or disoriented), and
   (h) actions to take if the cadets discover a clue/lost person: radio in, wait for instructions.
3. Have the cadets deploy to the search start line.
4. Have the cadets respond to a radio check.
5. Begin the search.

6. Have the cadets radio in if they find a clue.
7. Have the cadets radio in if they find the lost person.
8. Have first-aid trained cadets perform first aid on simulated minor injuries of the lost person (only if designed into the scenario).
9. Have the cadets examine the (mock) survival site.
10. Have the SAR leader conduct a debriefing of the activity.
11. Have the cadets return equipment.

SAFETY

- A safety bearing shall be given to the cadets.
- Staff should be placed in the centre and at the ends of the search formation.

CONFIRMATION OF TEACHING POINT 4

The cadets' participation in the activity will serve as confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in the SAR activity will serve as confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Understanding how a SAR party operates, a person in a survival situation will have a better idea of knowing what is being looked for and where. If you know how to search, you should know how to be found. This information should allow the cadets to better plan for being rescued through selecting their site location, signal placement and clues known and also found.

INSTRUCTOR NOTES/REMARKS

A briefing will be conducted before the practical activity, to inlcude the scenario (eg, downed pilot, lost hiker), the confinement area, search bearing, and call signs.

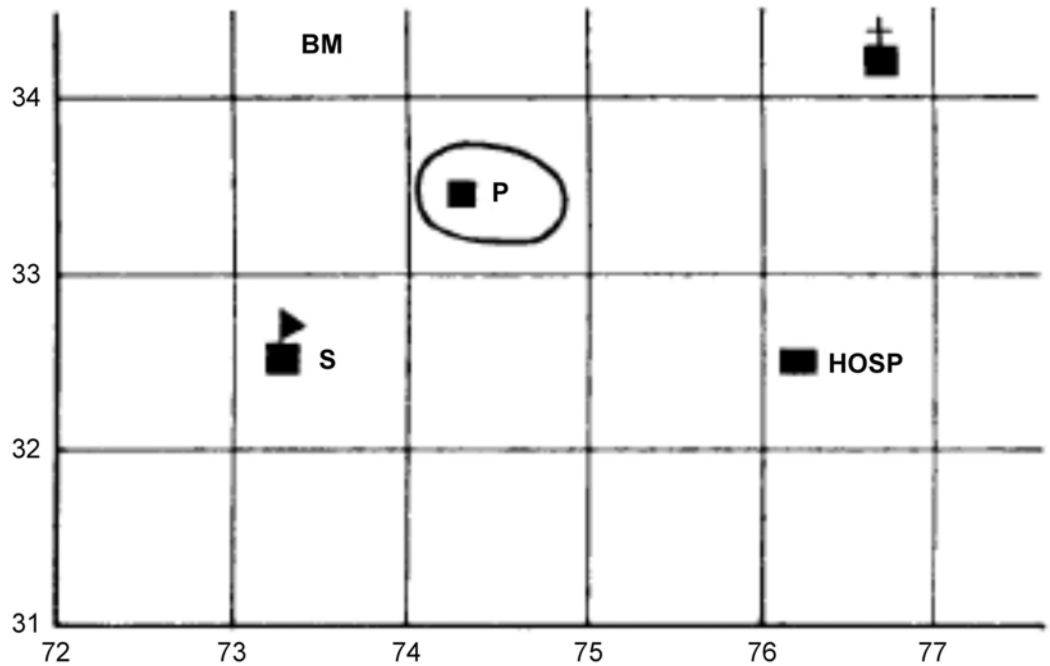
The scenario's survival site should be set up prior to the activity.

REFERENCES

A3-052 (ISBN 0-913724-30-0) LaValla, P. (1999). *Search is an Emergency*. Olympia, WA: ERI International Inc.

C3-208 (ISBN 0-7637-4807-2) National Association for Search and Rescue. (2005). *Fundamentals of Search and Rescue*. Mississauga, ON: Jones and Bartlett Publishers Canada.

WORKSHEET FOR FOUR-FIGURE GRID REFERENCES



Determine the four-figure grid references for the following:

Post Office: ____________

Hospital: ____________

Christian Church: ____________

Bench Mark: ____________

School: ____________

Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-18)

Figure 18A-1 Four-Figure Grid Reference Worksheet

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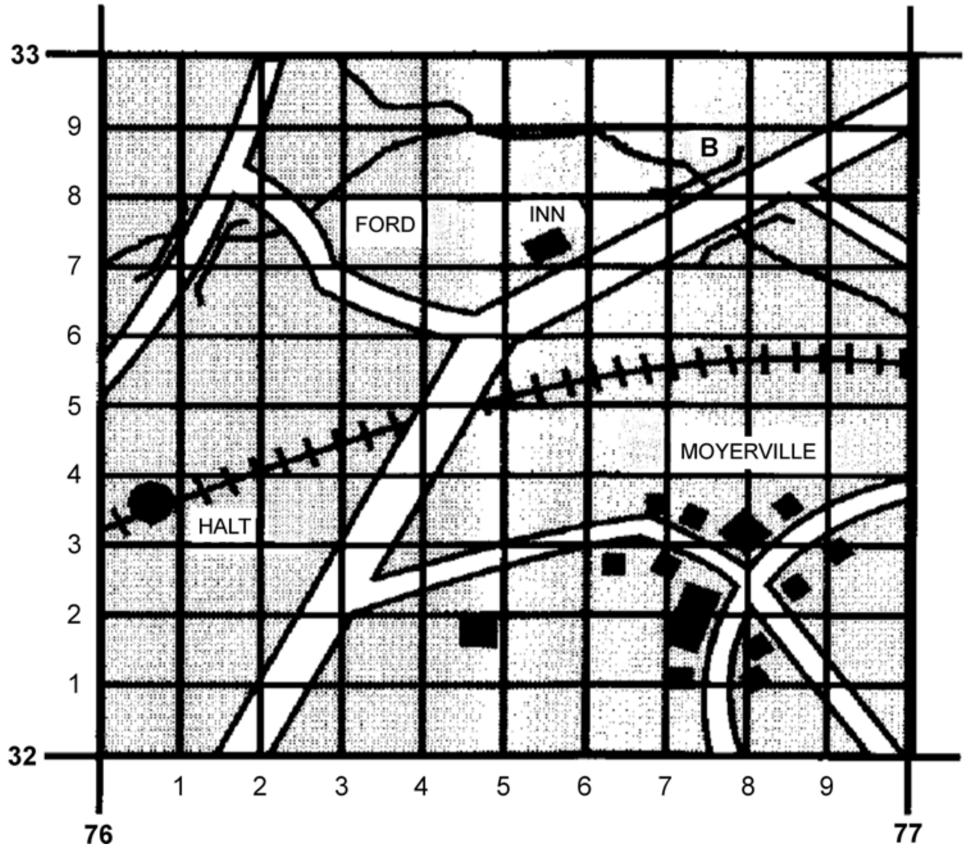
SIX-FIGURE GRID REFERENCES



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 38)

Figure 18B-1 Six-Figure Grid References

Steps to Determine a Six-Figure GR:

1. Identify the object within the grid square. Note the four-figure GR.
2. Using the imaginary grid within the square, determine the three-digit easting by using the two digits of the easting combined with the number of tenths, measured from the left, to the line before the object.
3. Using the imaginary grid within the square, determine the three-digit northing by using the two digits of the northing combined with the number of tenths, measured from the bottom, to the line before the object.
4. Combine the two sets of numbers to create the six-figure GR.

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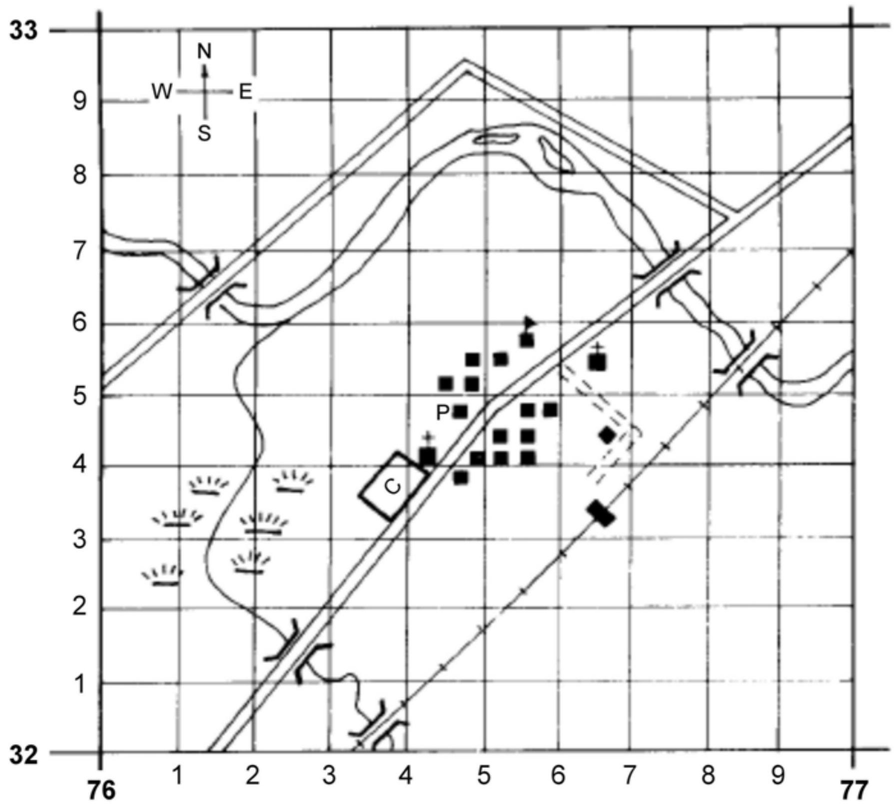
WORKSHEET FOR SIX-FIGURE GRID REFERENCES



Determine the six-figure grid references for the five bridges:

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Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-18)

Figure 18C-1 Six-Figure Grid Reference Worksheet

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ANSWER KEY FOR WORKSHEETS AT ANNEXES A AND C

Answer Key for Worksheet for Four-Figure Grid References

Post Office:	GR 7433
Hospital:	GR 7632
Christian Church:	GR 7634
Bench Mark:	GR 7334
School:	GR 7332

Answer Key for Worksheet for Six-Figure Grid References

GR 761326

GR 762321

GR 763320

GR 767326

GR 768325

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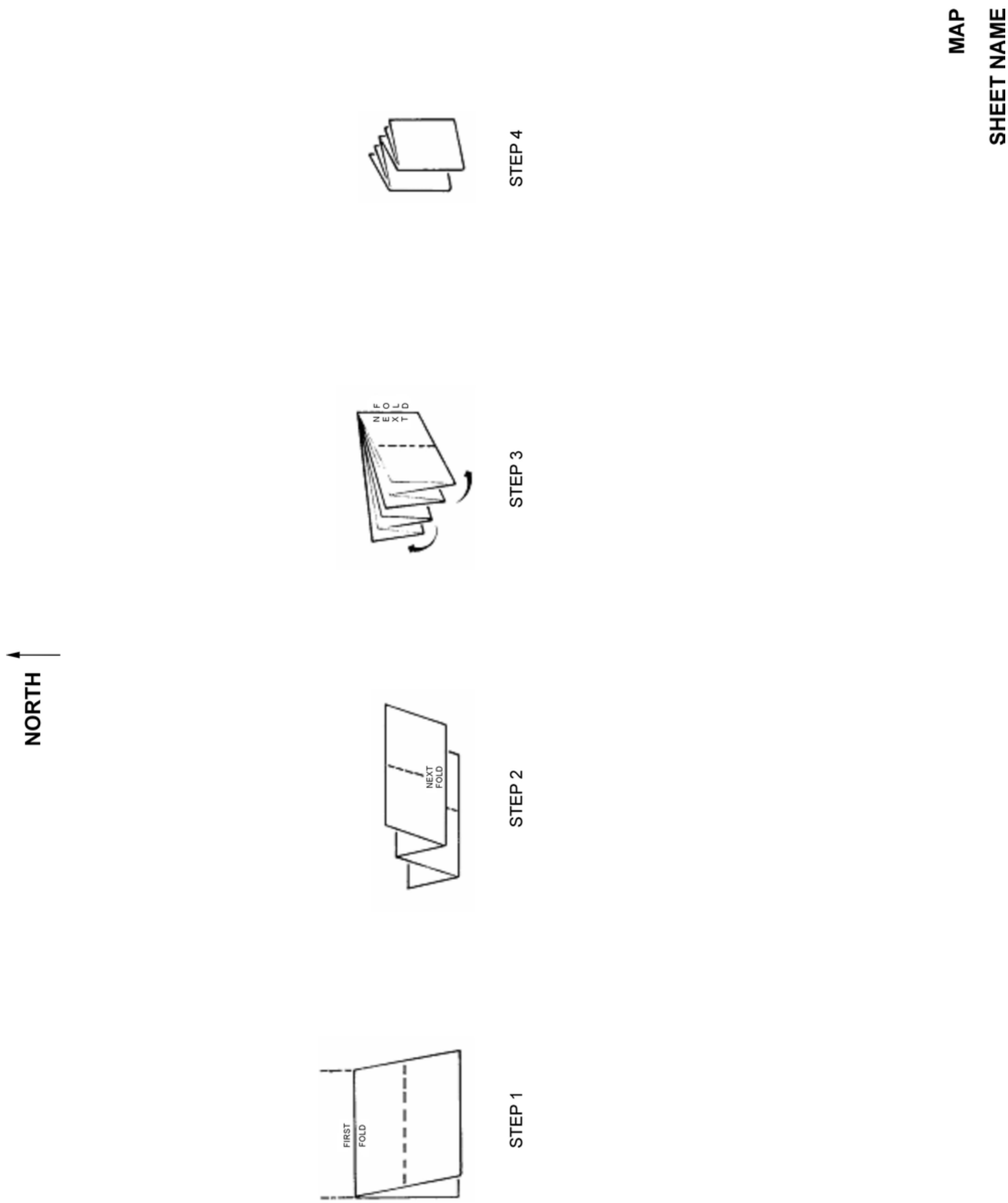
STEPS TO FOLD A MAP



Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-5)

Figure 18E-1 Steps to Fold a Map

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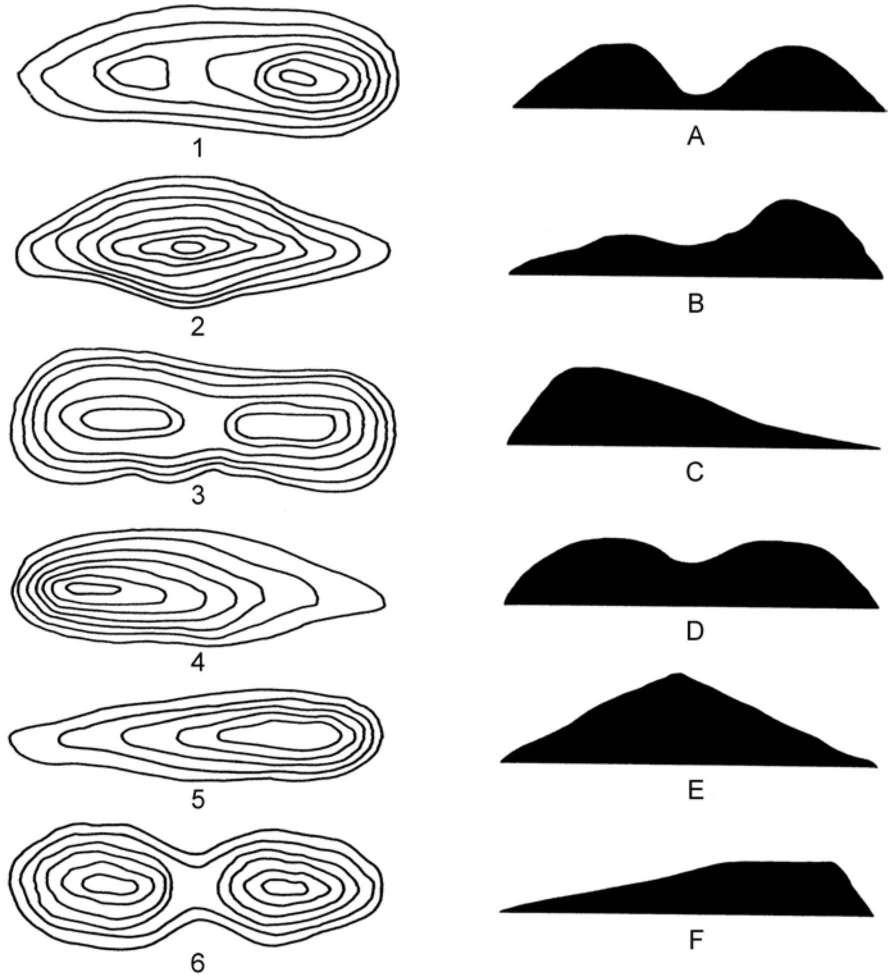
MATCH THE CONTOUR DIAGRAM ON THE LEFT TO THE APPLICABLE DEPICTION OF A LANDFORM ON THE RIGHT



1. ___	4. ___
2. ___	5. ___
3. ___	6. ___

Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 18F-1 Contour Lines Matching Sheet

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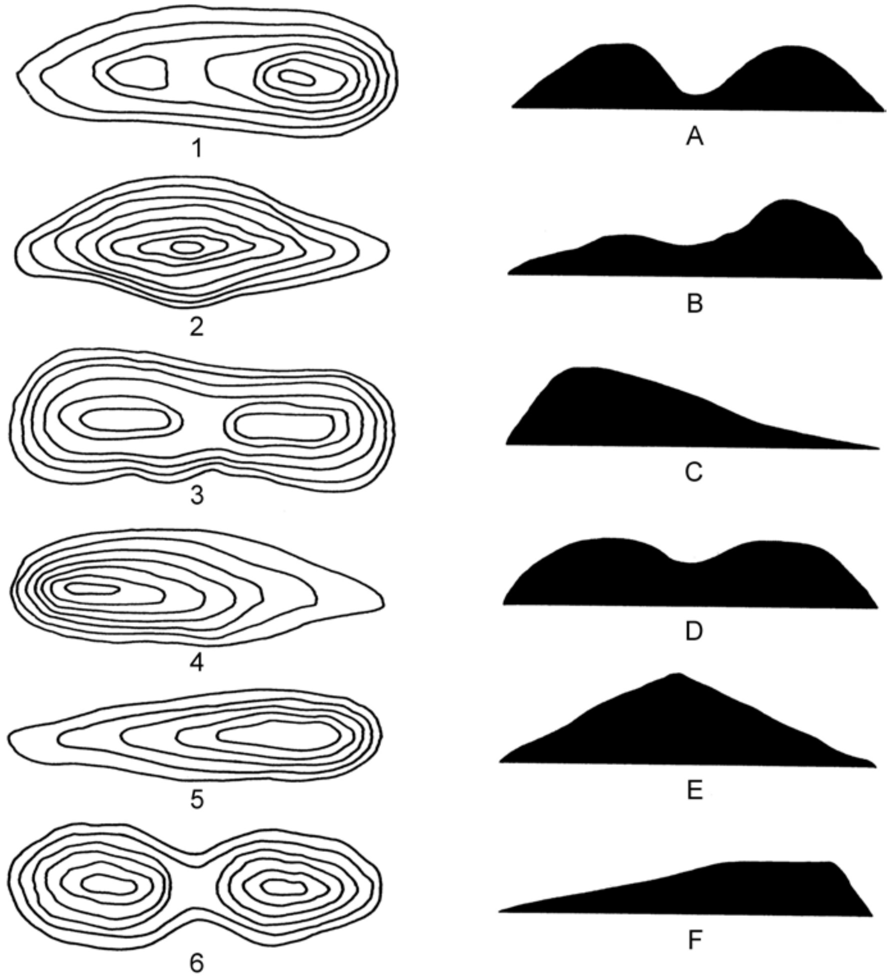
MATCH THE CONTOUR DIAGRAM ON THE LEFT TO THE APPLICABLE DEPICTION OF A LANDFORM ON THE RIGHT



1.	B	4.	C
2.	E	5.	F
3.	D	6.	A

Director Cadets 3, 2007, Ottawa, ON: Department of National Defence

Figure 18G-1 Contour Line Matching Answer Key

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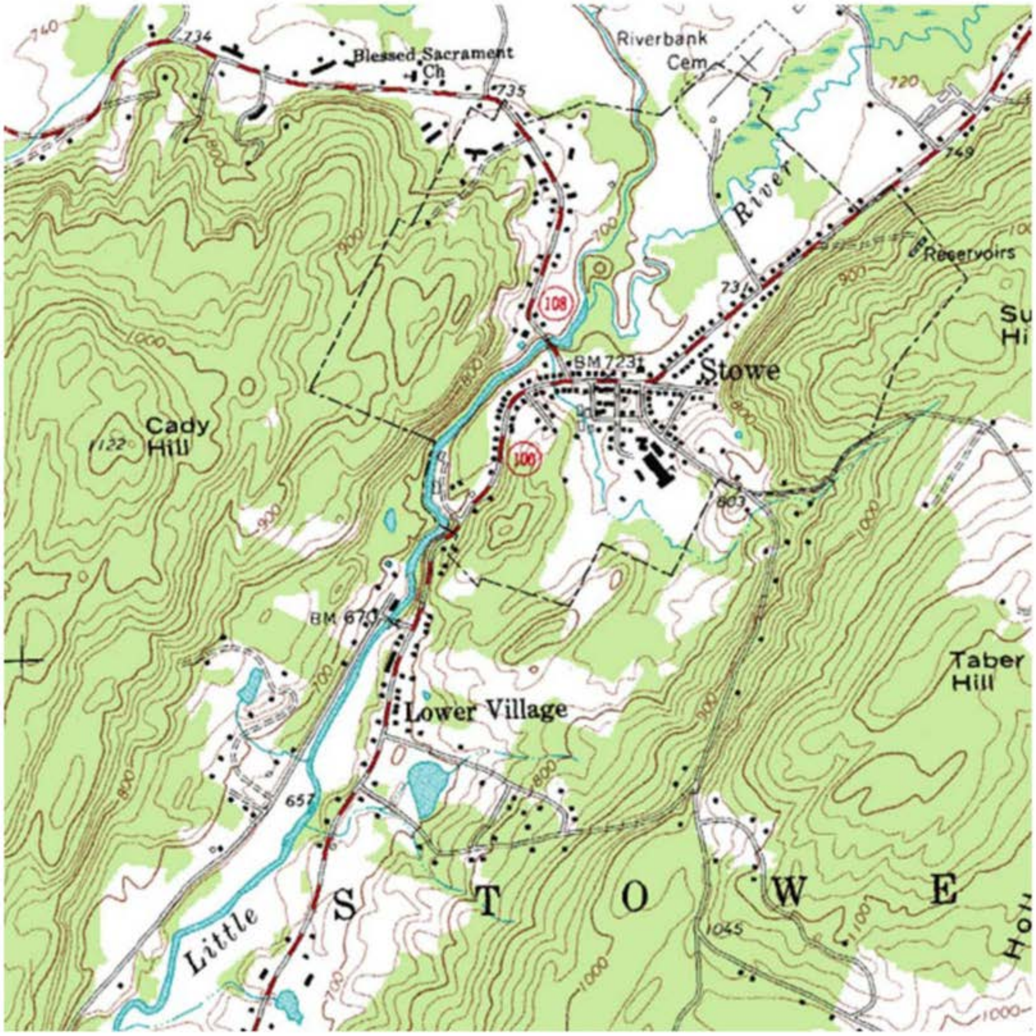
TOPOGRAPHICAL MAP EXAMPLE

Instructions: Draw a line to represent a route you would take to travel from your house on Taber Hill to the peak of Cady Hill.



Explain why you picked your route, emphasizing the contour lines you crossed over.

____

____

____

____

Wikimedia.org, 2006, Topographic Map Example. Retrieved March 26, 2008, from http://upload.wikimedia.org/wikipedia/commons/7/79/Topographic_map_example.png

Figure 18H-1 Topographical Map Example

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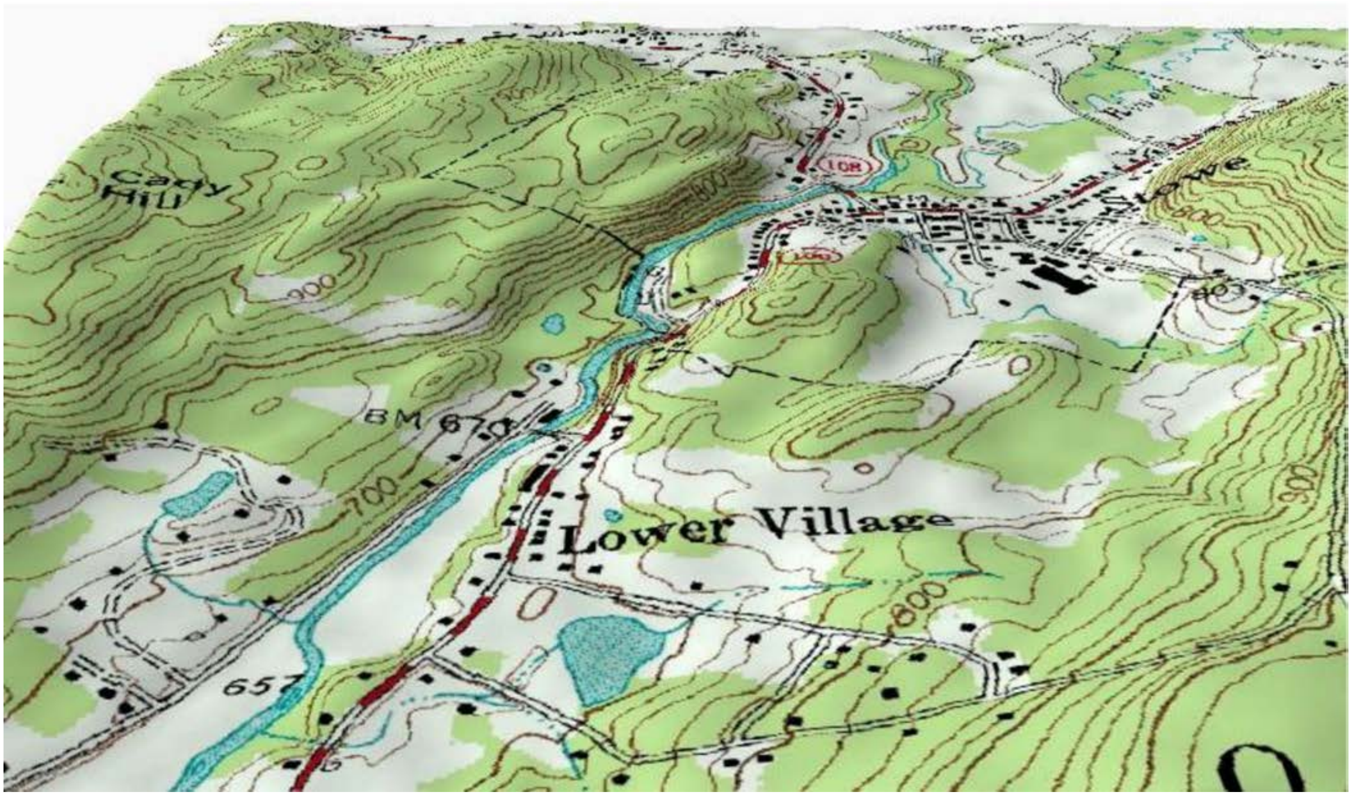
TOPOGRAPHICAL MAP EXAMPLE

Relief Version of Map at Figure 18H-1



Wikimedia.org, 2007, Topographic Relief Perspective Sample. Retrieved March 26, 2008 from http://upload.wikimedia.org/wikipedia/en/4/4c/Topographic-Relief-perspective-sample.jpg

Figure 18I-1 Topographical Relief Perspective Sample

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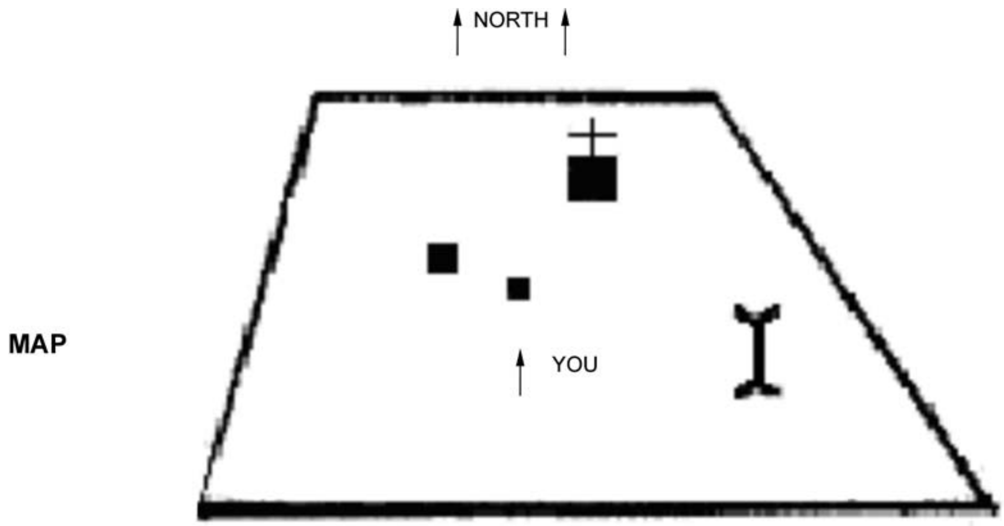
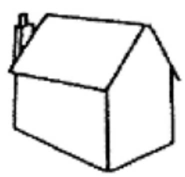
ORIENTING A MAP BY INSPECTION



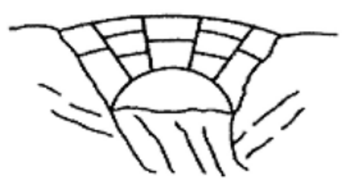
Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 79)

Figure 18J-1 Demonstration Map

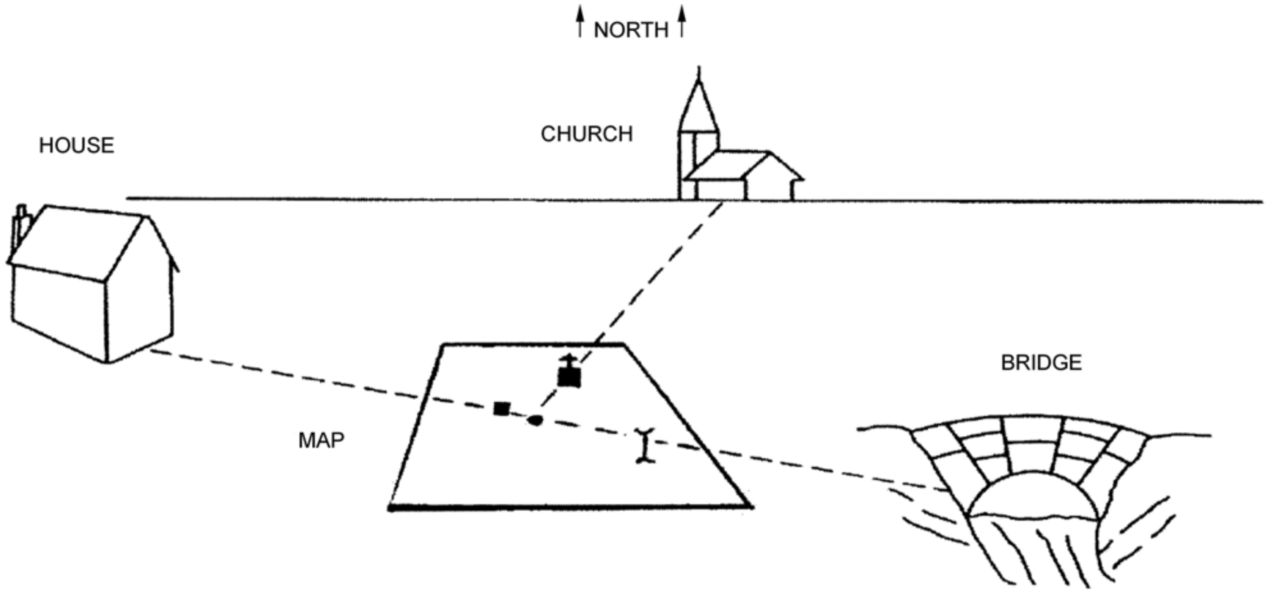


House

Church



Bridge

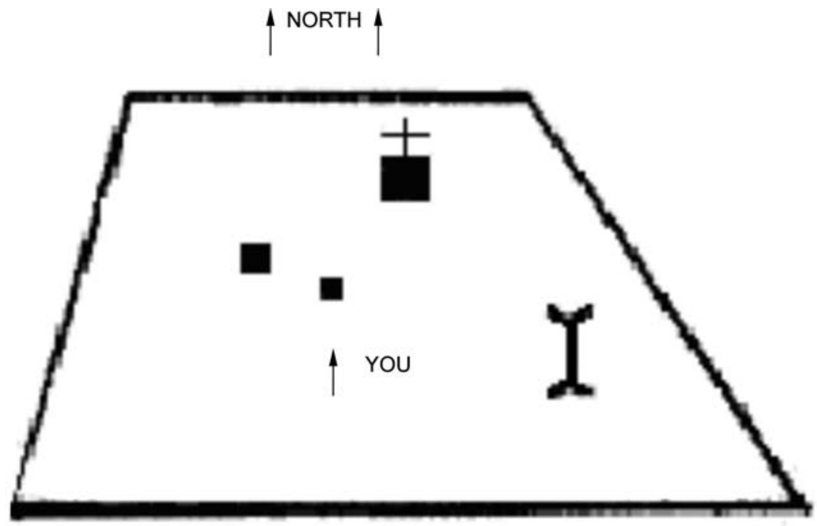


Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 79)

Figure 18J-2 Orienting a Map by Inspection

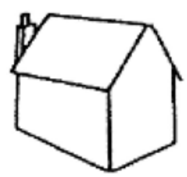
ORIENTING A MAP USING A COMPASS

MAP



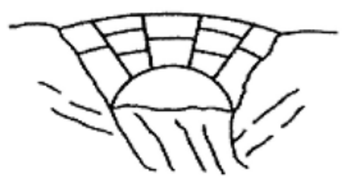
Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 79)

Figure 18K-1 Demonstration Map

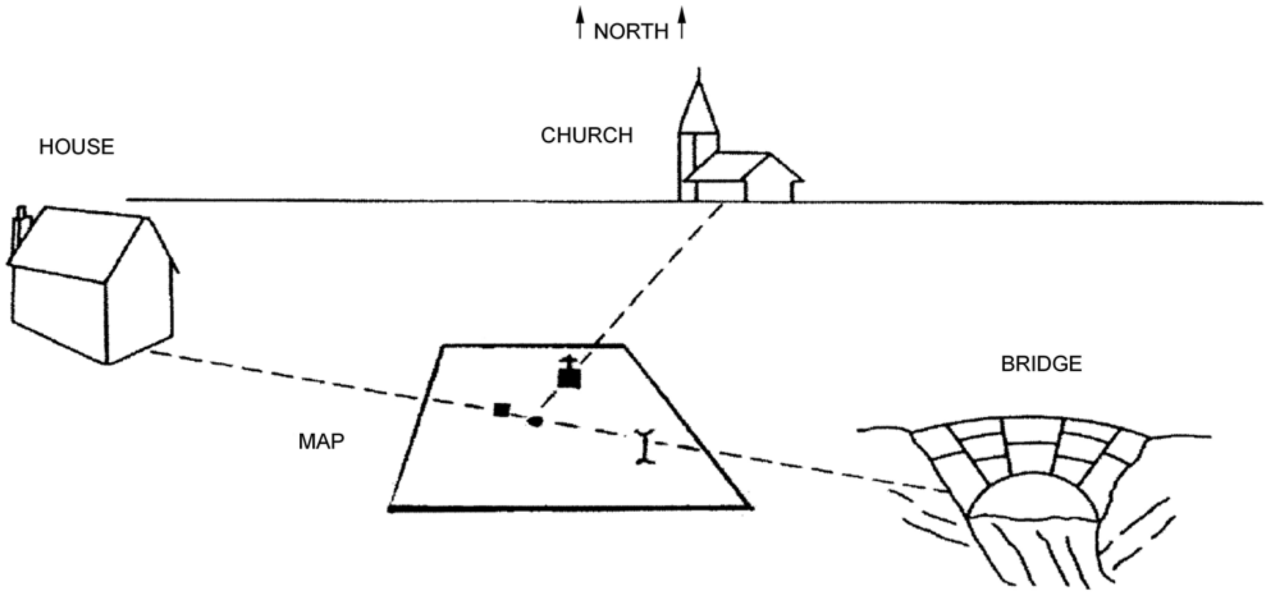


House

Church



Bridge



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 79)

Figure 18K-2 Orienting a Map Using a Compass

FACT SHEET: CALCULATING MAGNETIC DECLINATION

Formula: Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination

Grid Magnetic Angle. The angle between grid north and magnetic north, found on the declination diagram. Written in degrees and minutes.

> 1 degree (°) = 60 minutes ('), similar to calculating time (eg, 1 hour = 60 minutes).
>
> This ratio is very important to remember when adjusting the grid magnetic angle to the current declination. This is where most errors occur.

Current Year. The current calendar year.

Year of Declination Information. Found below the declination diagram.

Annual Change. Found below the declination diagram and is written in minutes.

> It is important that the annual change be inserted into the formula correctly:
>
> - If annual change is **increasing**, insert into formula as a **positive** number.
> - If annual change is **decreasing**, insert into formula as a **negative** number.

Current Declination. This is the result of the formula. It is the magnetic declination to be set on the compass.

East Declination. When magnetic north is east (to the left) of grid north on the declination diagram.

West Declination. When magnetic north is west (to the right) of grid north on the declination diagram.

> If the current declination calculates to a negative number, an east declination changes to a west declination and vice versa.

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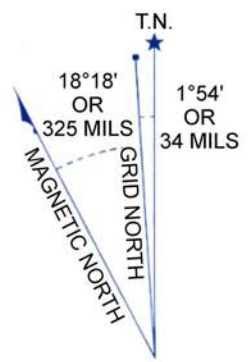
DECLINATION DIAGRAMS

EXAMPLE 1: CALCULATING MAGNETIC DECLINATION



USE DIAGRAM ONLY TO OBTAIN NUMERICAL VALUES
APPROXIMATE MEAN DECLINATION 1975
FOR CENTRE OF MAP
ANNUAL CHANGE DECREASING 1.4'

ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 20

Grid Magnetic Angle: 18° 18'

Current Year: 2008 (used for this example)

Year of Declination Information: 1975

Annual Change: decreasing 1.4' (decreasing means 1.4' becomes -1.4')

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination

Inputting the information into the formula:

18° 18' + [(2008 - 1975) x (-1.4')] = Current Declination

Solving for current declination.

18° 18' + [(33) x (-1.4')] = Current Declination

18° 18' + [-46.2'] = Current Declination

18° 18' - 46.2' = Current Declination

Note: Since 46.2' cannot be easily subtracted from 18° 18', 1° is converted into 60' (similar to time calculations), which converts 18° 18' to 17° 78'.

17° 78' - 46.2' = Current Declination

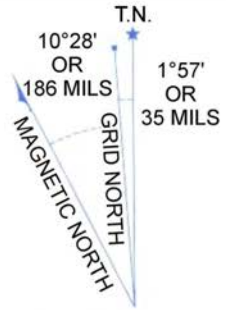
17° 31.8' = Current Declination

Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 17° 31.8' west declination.

Natural Resources Canada, 2008, Topo Declination Diagram. Retrieved April 11, 2008, from http://gsc.nrcan.gc.ca/geomag/field/magdec_e.php?p=1

Figure 18M-1 Declination Diagram

EXAMPLE 2: CALCULATING MAGNETIC DECLINATION



USE DIAGRAM ONLY TO OBTAIN NUMERICAL VALUES
APPROXIMATE MEAN DECLINATION 1996
FOR CENTRE OF MAP
ANNUAL CHANGE DECREASING 2.7'

ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 18

Grid Magnetic Angle: 10° 28'

Current Year: 2008 (used for this example)

Year of Declination Information: 1996

Annual Change: increasing 2.7'

Increasing means 2.7' becomes +2.7'

Inputting the information into the formula:

10° 28' + [(2008 - 1996) x (+2.7')] = Current Declination

Solving for current declination.

10° 28' + [(12) x (+2.7')] = Current Declination

10° 28' + [+32.4'] = Current Declination

10° 28' + 32.4' = Current Declination

10° 60.4' = Current Declination

Note: Since 60.4' is greater than 1°, 60' is converted into 1° (similar to time calculations), which converts 10° 60.4' to 11° 0.4'.

11° 0.4' = Current Declination

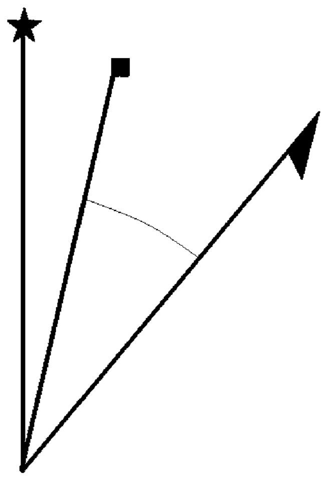
Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 11° 0.4' west declination.

Canada Centre for Mapping, Bancroft 31 F/4, Natural Resources Canada

Figure 18M-2 Declination Diagram

MAGNETIC DECLINATION WORKSHEET

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



Question 1:

Grid Magnetic Angle:	10° 46'
Current Year:	2011
Year of Declination Information:	1988
Annual Change:	decreasing 5.2'

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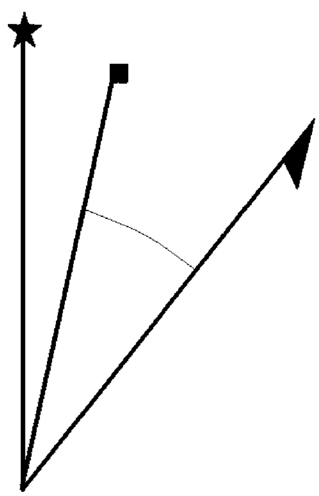
Answer: ____________ E/W declination (circle correct one)



Question 2:

Grid Magnetic Angle:	11° 2'
Current Year:	2014
Year of Declination Information:	1995
Annual Change:	increasing 3.8'

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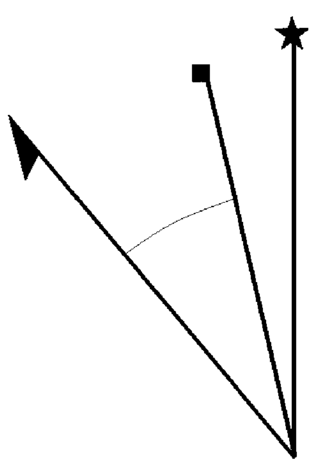
Answer: ____________ E/W declination (circle correct one)



Question 3:

Grid Magnetic Angle:	18° 43'
Current Year:	2013
Year of Declination Information:	1986
Annual Change:	decreasing 6.5'

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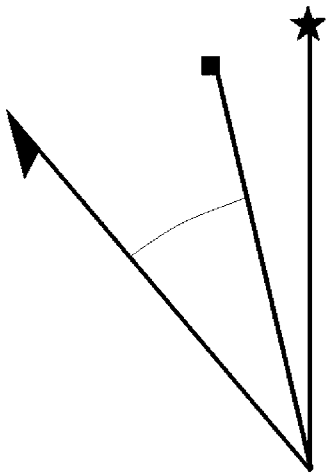
____

Answer: ____________ E/W declination (circle correct one)

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



Question 4:

Grid Magnetic Angle: 9° 14'

Current Year: 2018

Year of Declination Information: 1999

Annual Change: increasing 4.1'

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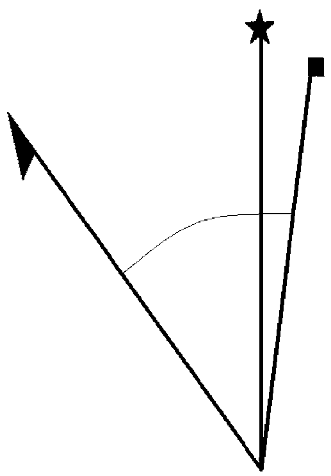
Answer: ____________ E/W declination (circle correct one)



Question 5:

Grid Magnetic Angle: 19° 35'

Current Year: 2016

Year of Declination Information: 1981

Annual Change: decreasing 5.4'

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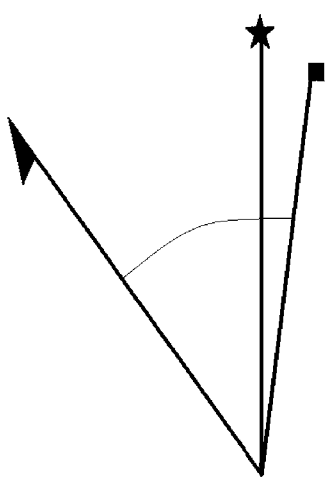
Answer: ____________ E/W declination (circle correct one)



Question 6:

Grid Magnetic Angle: 18° 22'

Current Year: 2010

Year of Declination Information: 1976

Annual Change: increasing 4.7'

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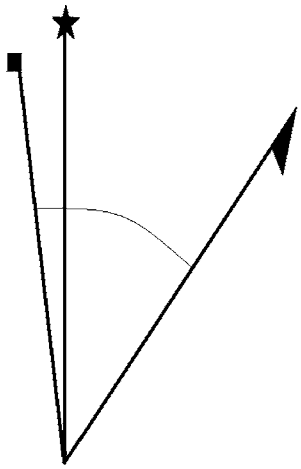
Answer: ____________ E/W declination (circle correct one)

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



Question 7:

Grid Magnetic Angle: 12° 34'

Current Year: 2020

Year of Declination Information: 1991

Annual Change: increasing 1.2'

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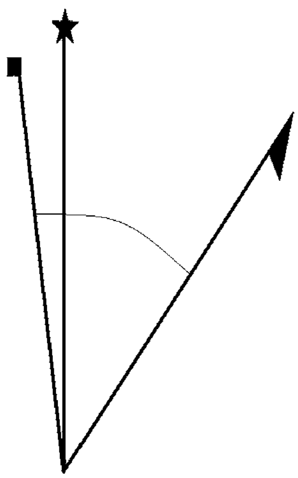
Answer: ____________ E/W declination (circle correct one)



Question 8:

Grid Magnetic Angle: 13° 21'

Current Year: 2017

Year of Declination Information: 1994

Annual Change: decreasing 2.9'

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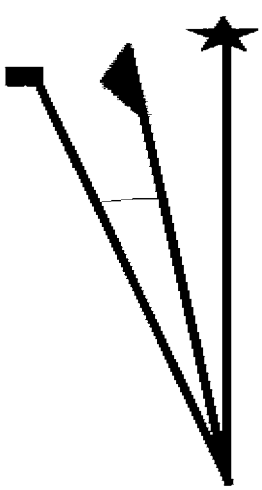
Answer: ____________ E/W declination (circle correct one)



Question 9:

Grid Magnetic Angle: 3° 16'

Current Year: 2012

Year of Declination Information: 1980

Annual Change: decreasing 6.2'

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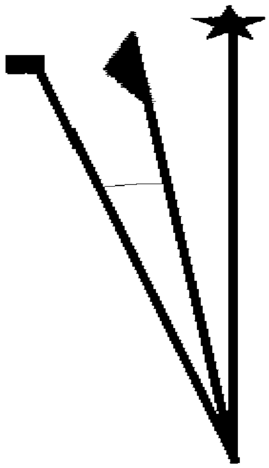
Answer: ____________ E/W declination (circle correct one)

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



Question 10:

Grid Magnetic Angle:	4° 27'
Current Year:	2019
Year of Declination Information:	1977
Annual Change:	increasing 2.2'

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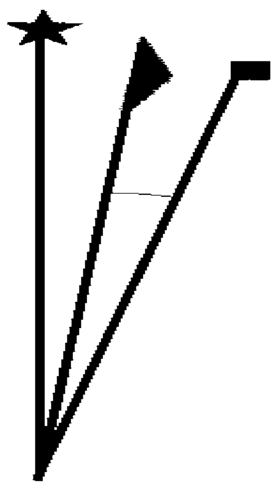
Answer: ____________ E/W declination (circle correct one)



Question 11:

Grid Magnetic Angle:	7° 7'
Current Year:	2021
Year of Declination Information:	1992
Annual Change:	increasing 5.5'

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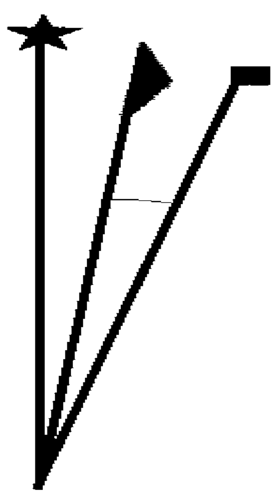
Answer: ____________ E/W declination (circle correct one)



Question 12:

Grid Magnetic Angle:	9° 36'
Current Year:	2015
Year of Declination Information:	1983
Annual Change:	decreasing 3.3'

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Answer: ____________ E/W declination (circle correct one)

MAGNETIC DECLINATION WORKSHEET: ANSWER KEY

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination

Question 1:

Grid Magnetic Angle:	10° 46'
Current Year	2011
Year of Declination Information:	1988
Annual Change:	decreasing 5.2'

10° 46' + [(2011 - 1988) × (-5.2')] = Current Declination

10° 46' + [(23) × (-5.2')] = Current Declination

10° 46' + [-119.6'] = Current Declination

10° 46' - 119.6' = Current Declination

9° 106' - 119.6' = Current Declination

8° 166' - 119.6' = Current Declination

8° 46.4' = Current Declination

Magnetic declination is 8° 46.4' east.

Question 2:

Grid Magnetic Angle:	11° 2'
Current Year:	2014
Year of Declination Information:	1995
Annual Change:	increasing 3.8'

11° 2' + [(2014 - 1995) × (+3.8')] = Current Declination

11° 2' + [(19) × (+3.8')] = Current Declination

11° 2' + [+72.2'] = Current Declination

11° 2' + 72.2' = Current Declination

11° 74.2' = Current Declination

12° 14.2' = Current Declination

Magnetic declination is 12° 14.2' east.

Question 3:

Grid Magnetic Angle:	18° 43'
Current Year:	2013
Year of Declination Information:	1986
Annual Change:	decreasing 6.5'

18° 43' + [(2013 - 1986) × (-6.5')] = Current Declination

18° 43' + [(27) × (-6.5')] = Current Declination

18° 43' + [-175.5'] = Current Declination

18° 43' - 175.5' = Current Declination

17° 103' - 175.5' = Current Declination

16° 163' - 175.5' = Current Declination

15° 223' - 175.5' = Current Declination

15° 47.5' = Current Declination

Magnetic declination is 15° 47.5' west.

Question 4:

Grid Magnetic Angle:	9° 14'
Current Year:	2018
Year of Declination Information:	1999
Annual Change:	increasing 4.1'

9° 14' + [(2018 - 1999) × (+4.1')] = Current Declination

9° 14' + [(19) × (+4.1')] = Current Declination

9° 14' + [+77.6'] = Current Declination

9° 14' + 77.6' = Current Declination

9° 91.9' = Current Declination

10° 31.9' = Current Declination

Magnetic declination is 10° 31.9' west.

Question 5:

Grid Magnetic Angle:	19° 35'
Current Year:	2016
Year of Declination Information:	1981
Annual Change:	decreasing 5.4'

19° 35' + [(2016 - 1981) × (-5.4')] = Current Declination

19° 35' + [(35) × (-5.4')] = Current Declination

19° 35' + [-189'] = Current Declination

19° 35' - 189' = Current Declination

18° 95' - 189' = Current Declination

17° 155' - 189' = Current Declination

16° 215' - 189' = Current Declination

16° 26' = Current Declination

Magnetic declination is 16° 26' west.

Question 6:

Grid Magnetic Angle:	18° 22'
Current Year:	2010
Year of Declination Information:	1976
Annual Change:	increasing 4.7'

18° 22' + [(2010 - 1976) × (+4.7')] = Current Declination

18° 22' + [(34) × (+4.7')] = Current Declination

18° 22' + [+159.8] = Current Declination

18° 22' + 159.8' = Current Declination

18° 181.8' = Current Declination

19° 121.8' = Current Declination

20° 61.8' = Current Declination

21° 1.8' = Current Declination

Magnetic declination is 21° 1.8' west.

Question 7:

Grid Magnetic Angle:	12° 34'
Current Year:	2020
Year of Declination Information:	1991
Annual Change:	increasing 1.2'

12° 34' + [(2020 - 1991) × (+1.2')] = Current Declination

12° 34' + [(29) × (+1.2')] = Current Declination

12° 34' + [+34.8'] = Current Declination

12° 34' + 34.8' = Current Declination

12° 68.8' = Current Declination

13° 8.8' = Current Declination

Magnetic declination is 13° 8.8' east.

Question 8:

Grid Magnetic Angle:	13° 21'
Current Year:	2017
Year of Declination Information:	1994
Annual Change:	decreasing 2.9'

13° 21' + [(2017 - 1994) × (-2.9')] = Current Declination

13° 21' + [(23) × (-2.9')] = Current Declination

13° 21' + [-66.7'] = Current Declination

13° 21' - 66.7' = Current Declination

12° 81' - 66.7' = Current Declination

12° 14.3' = Current Declination

Magnetic declination is 12° 14.3' east.

Question 9:

Grid Magnetic Angle:	3° 16'
Current Year:	2012
Year of Declination Information:	1980
Annual Change:	decreasing 6.2'

3° 16' + [(2012 - 1980) × (-6.2')] = Current Declination

3° 16' + [(32) × (-6.2')] = Current Declination

3° 16' + [-198.4'] = Current Declination

3° 16' - 198.4' = Current Declination

2° 76' - 198.4' = Current Declination

1° 136' - 198.4' = Current Declination

196' - 198.4' = Current Declination

-2.4' = Current Declination

Since the current declination calculated has a negative value, the east declination, as shown on the declination diagram, becomes a west declination.

Magnetic declination is 2.4' west.

Question 10:

Grid Magnetic Angle:	4° 27'
Current Year:	2019
Year of Declination Information:	1977
Annual Change:	increasing 2.2'

4° 27' + [(2019 - 1977) × (+2.2')] = Current Declination

4° 27' + [(42) × (+2.2')] = Current Declination

4° 27' + [+92.4'] = Current Declination

4° 27' + 92.4' = Current Declination

4° 119.4' = Current Declination

5° 59.4' = Current Declination

Magnetic declination is 5° 59.4' east.

Question 11:

Grid Magnetic Angle:	7° 7'
Current Year:	2021
Year of Declination Information:	1992
Annual Change:	increasing 5.5'

7° 7' + [(2021 - 1992) × (+5.5')] = Current Declination

7° 7' + [(29) × (+5.5')] = Current Declination

7° 7' + [+159.5'] = Current Declination

7° 7' + 159.5' = Current Declination

7° 166.5' = Current Declination

8° 106.5' = Current Declination

9° 46.5' = Current Declination

Magnetic declination is 9° 46.5' west.

Question 12:

Grid Magnetic Angle:	9° 36'
Current Year:	2015
Year of Declination Information:	1983
Annual Change:	decreasing 3.3'

9° 36' + [(2015 - 1983) × (-3.3')] = Current Declination

9° 36' + [(32) × (-3.3')] = Current Declination

9° 36' + [-105.6'] = Current Declination

9° 36' - 105.6' = Current Declination

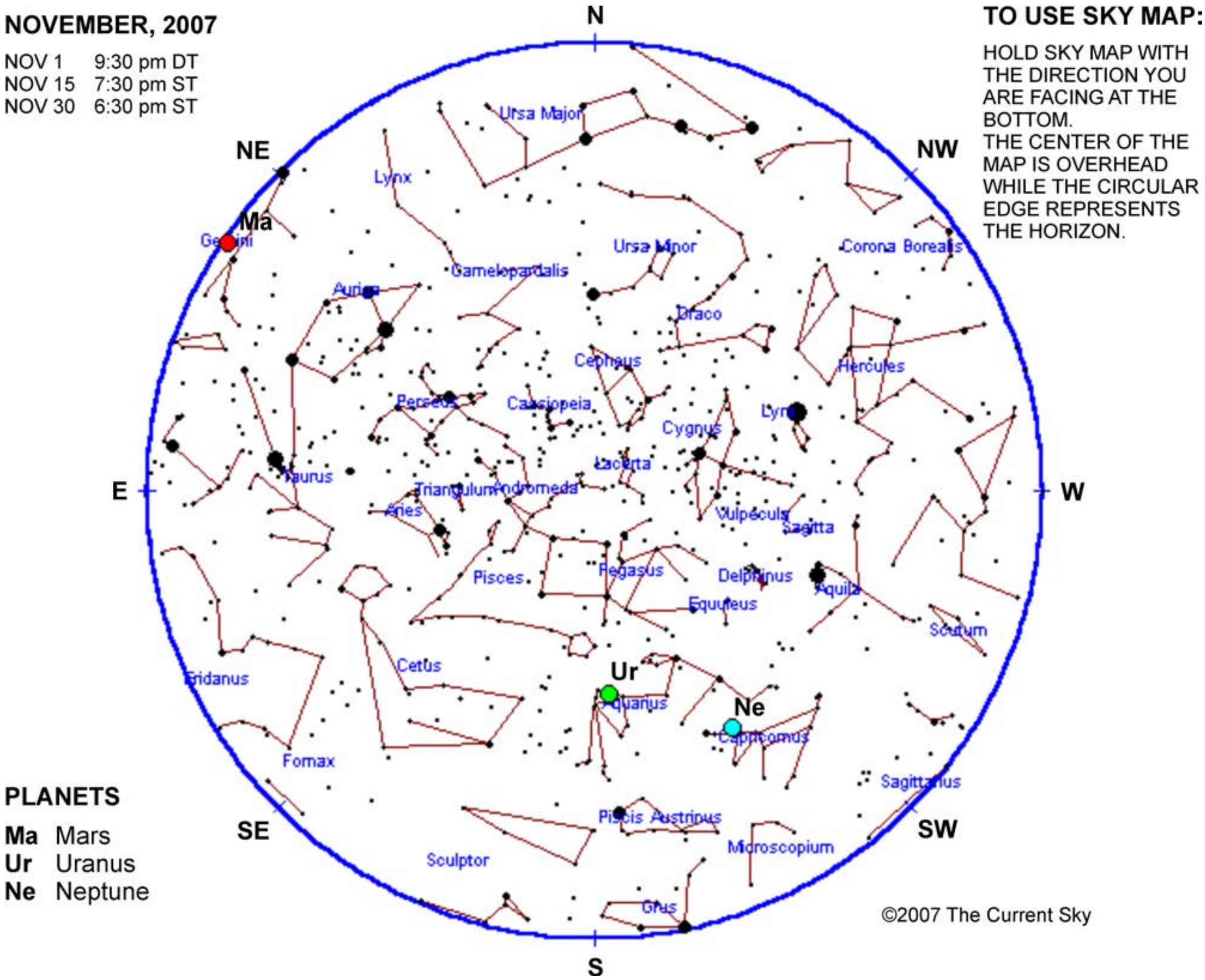
8° 96' - 105.6' = Current Declination

7° 156' - 105.6' = Current Declination

7° 50.4' = Current Declination

Magnetic declination is 7° 50.4' west.

SKY MAP



Sky Map, 2007, Sky Map for Chicago, IL, November 2007, Copyright 2007 by CyberSky 3.3.1. Retrieved November 30, 2007, from http://77illinois.homestead.com/files/astro/skypage.html

Figure 18P-1 Sky Map

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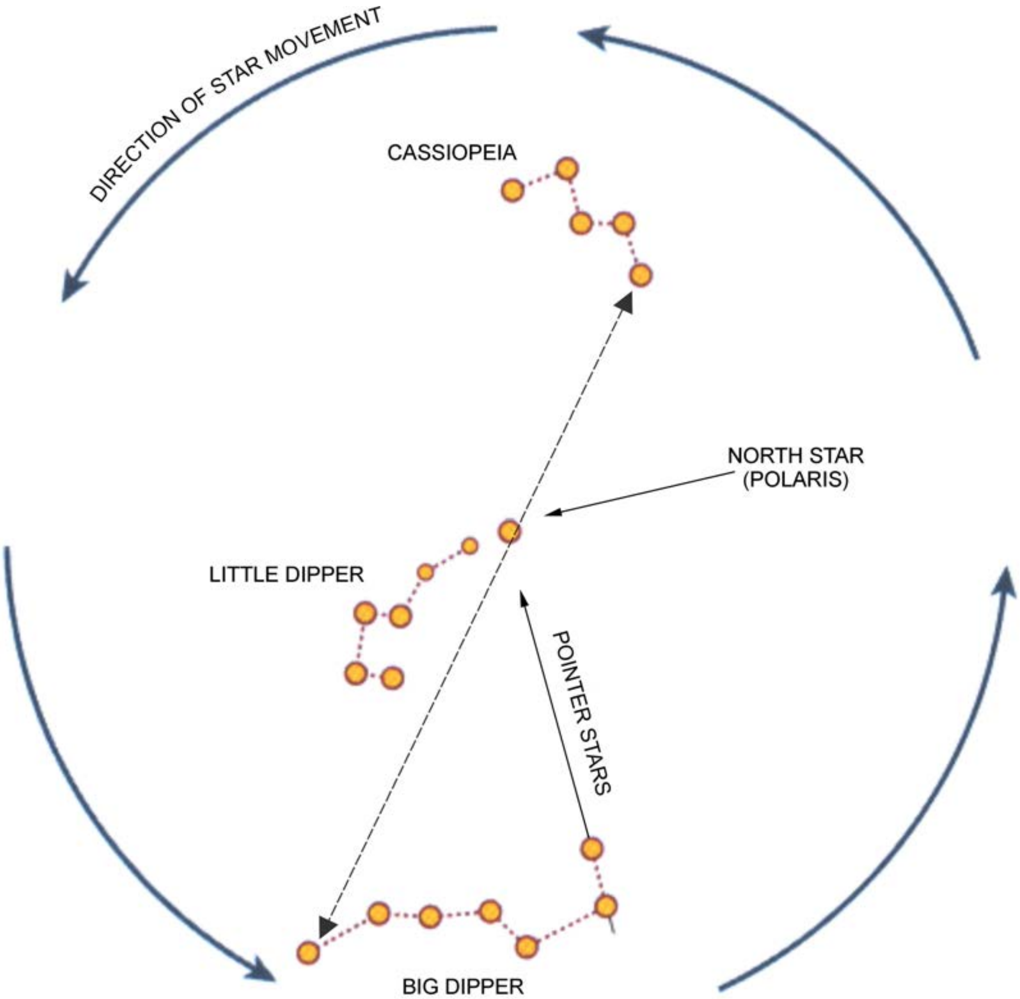
FINDING POLARIS



National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. Copyright 2005 by Jones and Bartlett Publishing (p. 76)

Figure 18Q-1 Finding Polaris

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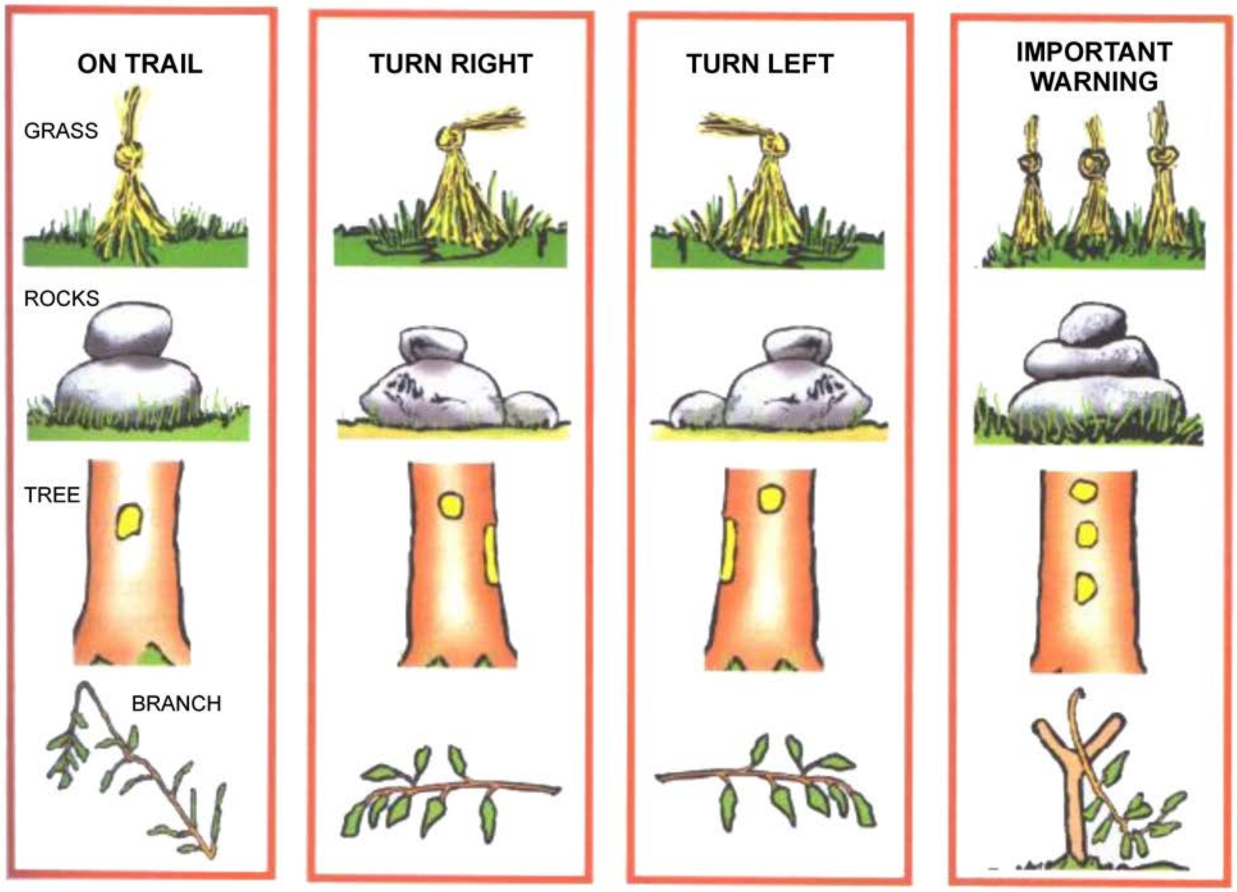
BLAZING TECHNIQUES



P. Tawrell, Camping and Wilderness Survival: The Ultimate Outdoors Book, Paul Tawrell (p. 547)

Figure 18R-1 Blazing Techniques

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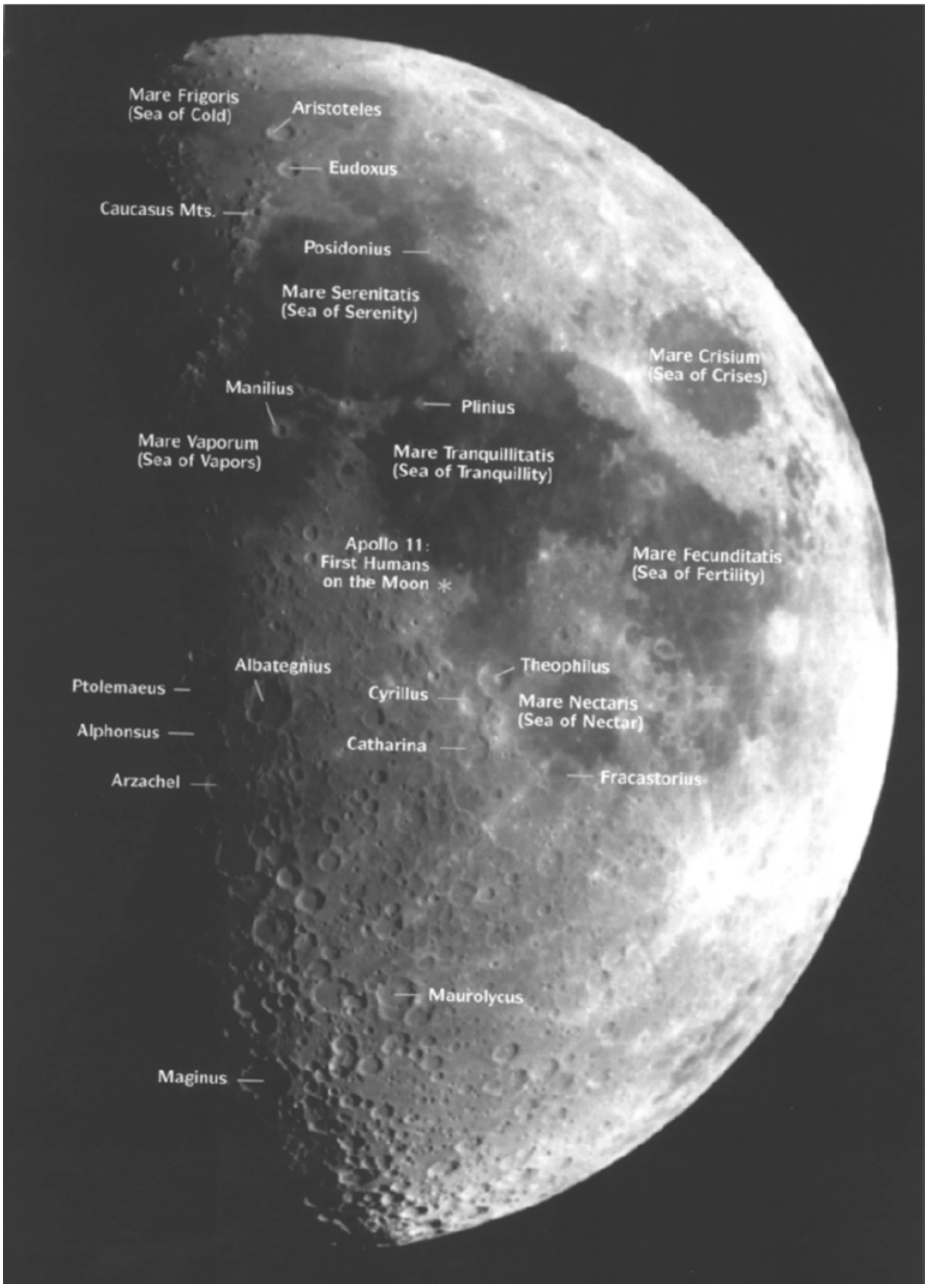
MOON QUARTERS

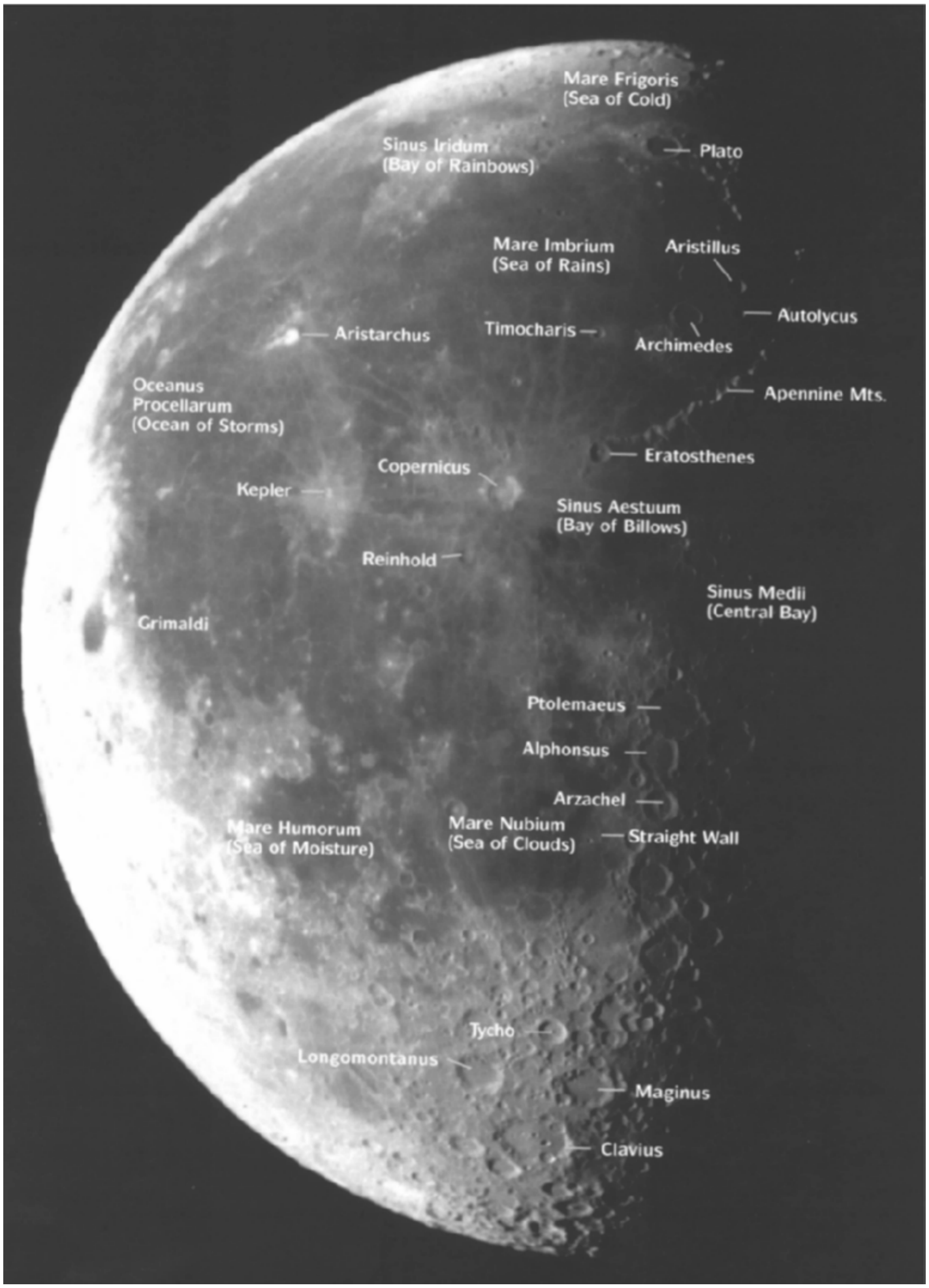
FIRST QUARTER MOON



T. Dickinson, NightWatch: A Practical Guide to Viewing the Universe, Firefly Books Ltd. (p. 141)

Figure 18S-1 The First Quarter of the Moon

LAST QUARTER MOON



T. Dickinson, NightWatch: A Practical Guide to Viewing the Universe, Firefly Books Ltd. (p. 140)

Figure 18S-2 The Last Quarter of the Moon

VENUS: PERIODS OF PROMINENT VISIBILITY

Although Venus is the brightest object in the night sky, apart from the moon, it is often close to the horizon. If possible, observe from a location with an unobstructed horizon in the specified direction.

Western Sky at Dusk

- early March 2010 to mid-September 2010
- early November 2011 to mid-May 2012
- late May 2013 to late December 2013
- early January 2015 to mid-July 2015
- mid-September 2016 to mid-March 2017
- mid-March 2018 to early September 2018

Eastern Sky at Dawn

- mid-November 2010 to mid-March 2011
- late June 2012 to late December 2012
- late January 2014 to late August 2014
- late August 2015 to mid-February 2016
- mid-April 2017 to late October 2017
- mid-November 2018 to early April 2019

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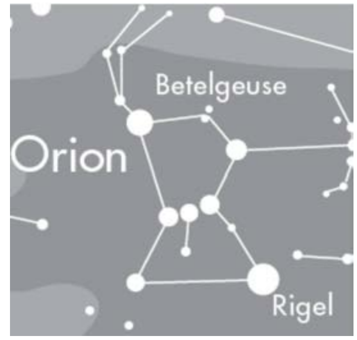
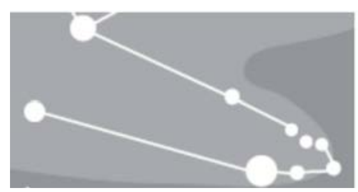
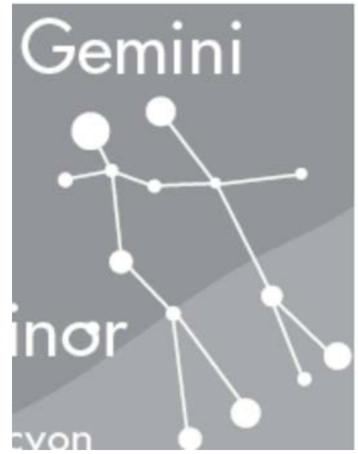
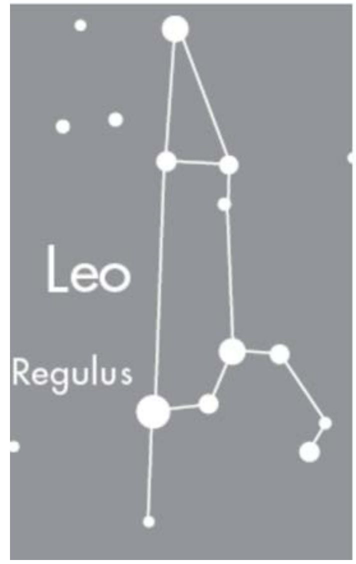
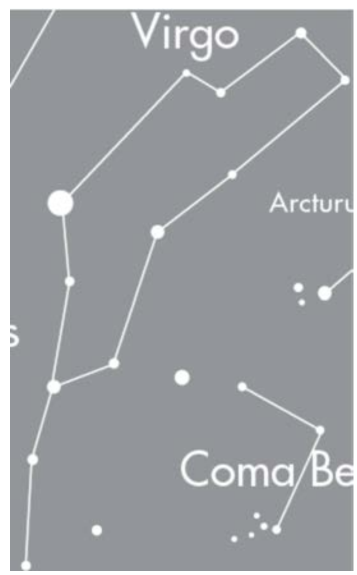
CONSTELLATIONS

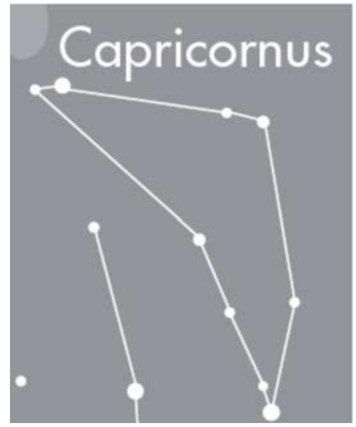
Constellations	Description	Picture
Ursa Major (the Great Bear) and Ursa Minor (the Little Bear)	The Great Bear was actually a beautiful nymph named Callisto. Callisto was turned into a bear by Zeus to protect her from his jealous wife Hera. One day, Callisto ran into her son, Arcas, who was hunting in the woods. Arcas raised his spear towards the bear, his mother. Zeus, watching from above, acted quickly to save his beloved, Callisto. He turned Arcas into a bear and hoisted them both into the sky by their tails. In doing so, Zeus stretched the bears' tails and they now appear that way in the sky. The legends of some Canadian First Nations, including the Micmac and Iroquois, also identify this constellation as a bear. Ursa Major includes the Big Dipper which is also known as "The Plough" in Europe. The Big Dipper's handle is the bear's tail, while its scoop is the bear's side. The second star from the end of the Big Dipper's handle is really two stars. In ancient times these stars were used to test eyesight. An individual had good eyesight if they could see two distinct stars. At the end of the Little Dipper, Ursa Minor, is the pole star, Polaris. Polaris, also known as the North Star, is about 50 times larger than the sun but it appears very faint as it is 600 light years away. Polaris is due north and was important in early northern hemisphere navigation.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-1 Ursa Major  *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-2 Ursa Minor
Cassiopeia (the Queen of Ethiopia)	When Cassiopeia died, she was placed next to her husband, Cepheus, in the sky. Her vanity and cruelty had never been forgotten by her enemy, Poseidon, who tilted her throne as she was placed in the sky. For half the night Cassiopeia is sitting upright, but for the rest of the night she must cling to her throne as she hangs upside-down in the sky.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-3 Cassiopeia

Constellations	Description	Picture
Orion (the hunter)	Orion was a famous hunter who claimed he could kill any animal. Nothing could protect him from the scorpion that stung his heel and killed him. Orion and Scorpius are placed at opposite ends of the sky so they will not fight again. Look for a star with a fuzzy appearance just below Orion's belt as this is the Orion Nebula where baby stars are born. Betelgeuse, or the "armpit" of Orion, is a red supergiant star that is 300–400 times the diameter of the sun and is among the best candidates to become a supernova in northern skies. Betelgeuse is a variable star; its brightness varies, but on average it is the 12th brightest star in the sky.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-4 Orion
Aries (the ram)	Aries was a magical ram who could speak, think and fly. The god Hermes gave Aries two children, Helle and Phrixus, who wanted to escape their evil stepmother. Helle fell off Aries during the escape, but Phrixus made it to safety and sacrificed Aries to show his thanks. He gave Aries' fleece to King Aeetes, who sent Draco the dragon to guard it. Eventually, Aries' Golden Fleece was stolen by Jason and the Argonauts. Aries' brightest star is Hamal, which means "the lamb." It is one of the few stars that has had its apparent size measured. Most stars are so far away they appear as just a point of light, but astronomers have measured the size of Hamal to be 0.00680 arcseconds. That is the same size as a penny would seem to be if you held it 60 km away.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-5 Aries
Taurus (the bull)	Taurus represents a bull. When Zeus fell in love with Europa, he transformed himself into a white bull. One day, as Europa was playing near the seashore, she noticed the new white bull. She went over for a closer look, and the bull knelt down to allow her to climb up. Once she was on, the bull leapt into to the sea and swam to the island of Crete. Then Zeus changed back into human form and told Europa of his love for her. Taurus is easy to spot from the constellation Orion. Follow the three stars of Orion's belt towards the west until a bright red-orange star is encountered. This is Aldebaran, the Eye of the Bull. Nearby are five more stars that make a V with Aldebaran and trace out the face of the bull.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-6 Taurus

Constellations	Description	Picture
Gemini (the twins)	The Twins, Castor and Pollux, were born to Leda, who was seduced by Zeus in the form of a beautiful swan. Every December, meteors appear to spray out of this constellation. This event is called the "Geminid meteor shower." Castor and Pollux, the heads of the Twins, are the two brightest stars in the constellation Gemini. Castor, "the Beaver" and Pollux, "much wine" are the 20th and 16th brightest stars in the night sky respectively.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-7 Gemini
Cancer (the crab)	Cancer represents a crab that played a small role in the story of Hercules whose stepmother, the goddess Hera, was his mortal enemy. Hera sent the crab to try to distract Hercules who was battling the dreaded Hydra. The crab grabbed on to Hercules' toe with its claws, but Hercules just shook him off and crushed him underfoot. To thank the crab for its brave attempt, Hera placed it in the sky.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-8 Cancer

Constellations	Description	Picture
Leo (the lion)	Leo was a lion that was sent from the moon down to Earth by Hera, the stepmother and mortal enemy of Hercules. Leo lived in a cave and would attack the people who lived nearby. Hercules was sent to fight Leo but his spears and arrows just bounced off the lion’s invincible skin. Hercules finally decided to wrestle Leo and eventually managed to strangle the lion to death. Hercules then made a cloak from the lion’s skin so that he could be invincible too. Regulus, the brightest star in the constellation Leo, means “the little king” in Latin. It is the 25th brightest star in our night sky and is relatively close to the Earth at a distance of 77 light years. Regulus is much brighter than our own star; it shines 350 times more brightly than the sun. The easiest way to find Leo in the sky is to look for a backwards question mark. This shape, often called The Sickle, marks the head and front paws of the lion.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-9 Leo
Virgo (the goddess of agriculture)	To the ancient Greeks, Virgo represented Demeter, the goddess of agriculture. Demeter’s daughter, Persephone, was kidnapped by Hades, the god of the underworld, and taken to be his wife. Demeter searched high and low for her daughter neglecting the crops. Eventually, Zeus persuaded Hades to release Persephone. While she was in the underworld, Persephone had eaten some pomegranate seeds and could never fully leave. Each year Persephone returns to the underworld for a time and winter occurs as the crops die and her mother mourns. When Persephone returns, her mother rejoices and the earth becomes fruitful again. The brightest star in Virgo is called Spica. It is easy to find by following the arc of the Big Dipper’s handle to Arcturus and then continuing in a straight line: “Arc to Arcturus, then speed on to Spica”.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-10 Virgo

Constellations	Description	Picture
Libra (the scales)	To the ancient Babylonians, Libra represented scales or balance. This might be because the sun was in front of the stars of Libra during their autumnal equinox, when days and nights were of equal length. To the Greeks, the stars of Libra were not their own constellation but rather the claws of the scorpion Scorpio. The Romans resurrected the idea of Libra representing scales and sometimes drew Virgo holding the scales, just like the goddess of justice. The two brightest stars in Libra have interesting Arabic names: Zubenelgenubi, “the southern claw,” and Zubenelchemale, “the northern claw.”	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-11 Libra
Scorpius (the scorpion)	Scorpius represents the scorpion that killed the hunter Orion. Orion was so proud of his hunting skills that he boasted he could track down and kill any animal on earth. His claim was so outrageous that the earth trembled in rage and cracked open. Out of the crack crawled a scorpion which stung and killed Orion. Out of pity, the gods placed Orion and Scorpius on opposite sides of the sky so there could be no more trouble between them. The brightest star in Scorpius is called Antares. This star is quite red and many people mistake it for Mars.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-12 Scorpius
Sagittarius (the archer)	Sagittarius was the ultimate archer, keen-eyed and with deadly aim. He is usually drawn as the Babylonians saw him, a centaur: half-man and half-horse. To the Greeks, though, he was a satyr: half-man and half-goat. He was the son of the pipe-playing god Pan and invented archery.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-13 Sagittarius

Constellations	Description	Picture
Capricornus (the goat-fish)	Capricornus is one of the oldest known constellations. The ancient Babylonians called it the goat-fish and said it ruled the part of the sky from which the mighty Tigris and Euphrates rivers flowed. The Greeks also saw Capricornus as a creature that was half-goat and half-fish. They associated it with the god Pan, who had a human torso and face, but goat legs and goat horns. One story about Pan is that he jumped in the river Nile to escape the sea monster, Typhon. The part of him below the water turned into a fish, while the rest of his body remained a goat. Capricornus is a hard constellation to find because it does not have any bright stars and it never gets very high in the sky.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-14 Capricornus
Aquarius (young man pouring water from a pitcher)	To the Babylonians, Aquarius was the ruler of all the watery constellations – Pisces, Capricornus, Piscis Austrinus and Cetus. To the Egyptians, Aquarius caused the yearly flooding of the river Nile. The Greeks personified Aquarius, drawing him as a young man pouring water from a pitcher.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-15 Aquarius

Constellations	Description	Picture
Pisces (two fish)	Pisces represents two fish in the sky. One day, the goddess Aphrodite and her son Eros were fleeing the terrible sea monster Typhon. They hid in the rushes along the bank of the river Euphrates but could not escape. The monster was just about to attack when two fish swam up and carried Aphrodite and Eros to safety. As a reward for their help, the fish were placed in the sky as the constellation Pisces. Pisces is a hard constellation to find. The easiest way is to locate the square of Pegasus and look underneath it towards the south. A ring of stars, called the Circlet of Pisces may be seen. This represents the body of one of the fish.	 *Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf* Figure 18U-16 Pisces

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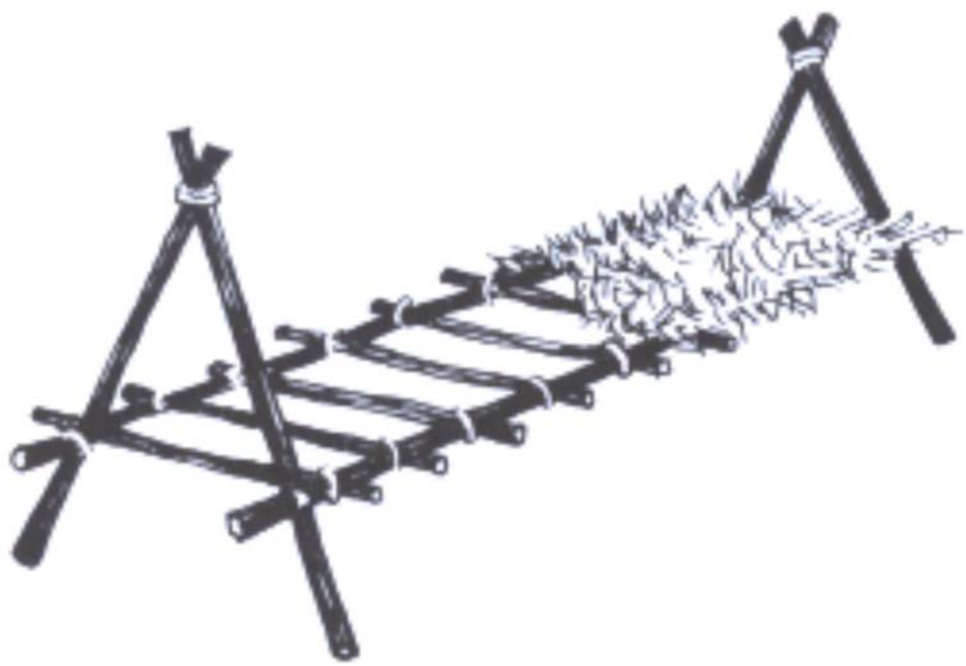
LADDER BED

Using natural resources and cord, a ladder bed can be constructed. Steps to constructing a ladder bed:

1. Collect the natural resources, including:
    (a) four poles 75–100 cm long to construct the A-frames,
    (b) two sturdy poles approximately 180 cm long to make the frame (length will depend on the height of the person), and
    (c) several crosspieces 50–60 cm long, the more flexible the better; length will depend on the width of the person.
2. Construct two A-frame supports using round lashings.
3. Attach the two frame poles to the A-frames, ensuring that the knots and wood are strong and will hold the weight of the individual.
4. Tie the crosspieces making a ladder along the frame.
5. Lay a bedding of boughs, leaves or moss, as desired. Ensure there is enough material to prevent heat from being transferred away from the body during the night.



J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 309)

Figure 18V-1 Ladder Bed

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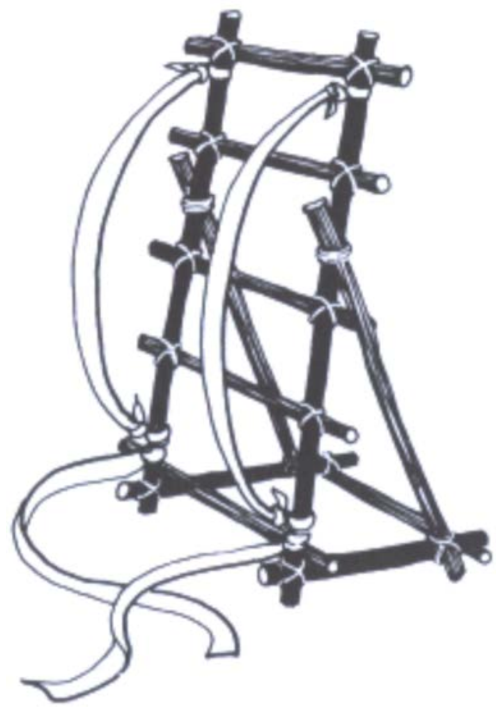
PACK FRAME

Using natural resources, cord and two straps, a pack frame can be constructed. Steps to constructing a pack frame:

1. Collect natural resources, including:
   (a) two poles to make the frame 75–100 cm long (length will depend on the height of the person),
   (b) several crosspieces 50–60 cm long, (length and number will depend on the width of the person), and
   (c) five pieces (two 15–20 cm long , two 50 cm long and one 50–60 cm long) to construct the right angle projection at the bottom.
2. Construct the ladder frame to the size of the individual.
3. Construct the right angle projection at the bottom and ensure the knots and wood are strong and will not break with a load.
4. Attach straps made from cord or from improvisation and adjust it to a comfortable position.



J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 372)

Figure 18W-1 Pack Frame

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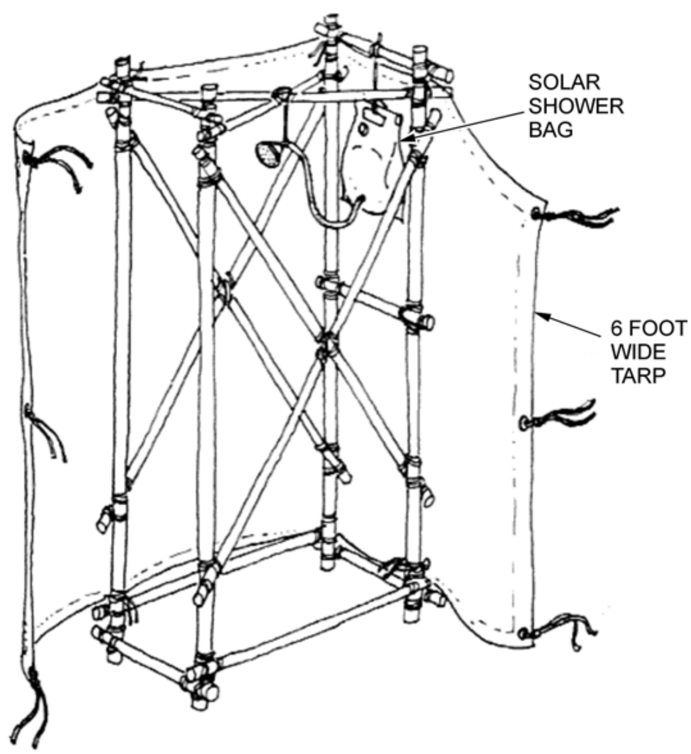
SHOWER

Using natural resources, cord, a large tarp and a shower bag or bucket; a camp shower can be constructed. Steps to constructing a shower:

1. Collect the natural resources, including:
   (a) four poles at least 180 cm in length, but may depend on the height of the person,
   (b) several poles for supports, (number and length will depend on the size of the shower being constructed and the strength of the material being used),
   (c) a tarp at least 180 cm in width and 240 cm in length, and
   (d) a shower bag or a bucket.
2. Lash the four poles at least to a square base frame and a cross-frame top.
3. Add cross-braces on two sides of the shower for support, remembering to leave one side open for accessibility.
4. Tie a large tarp with grommets to the outside of the frame and rig a latch on the open side.
5. Attach the shower bag or bucket to the top of the frame.



PioneeringProjects.org, 2001, Camp Shower, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion39.gif

Figure 18X-1 Shower

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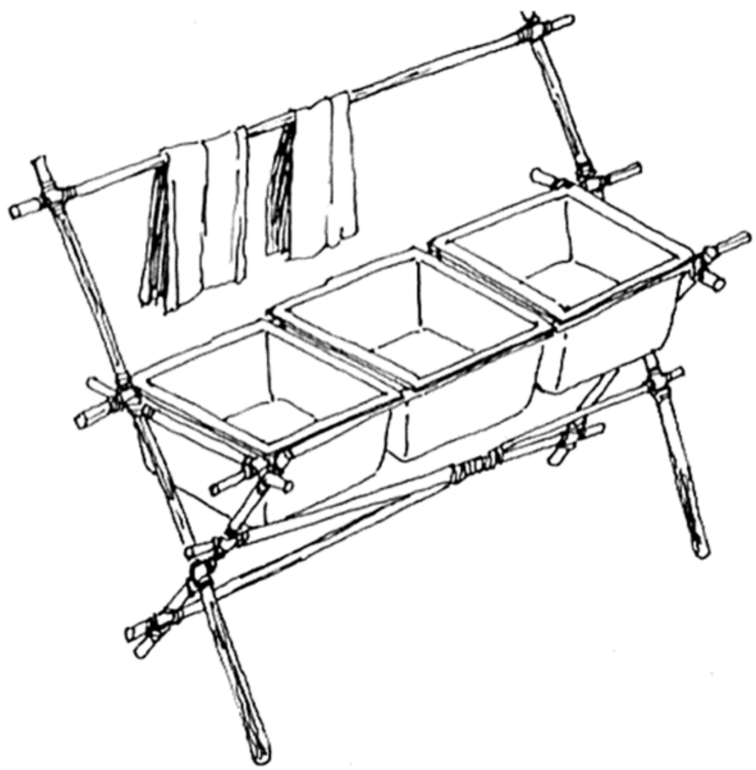
WASHSTAND

Using natural resources, cord and several wash basins or tubs, a washstand can be constructed. Steps to constructing a washstand:

1. Collect the natural resources, including:
   (a) four poles to construct the table top (the dimensions will depend on the size and number of wash basins the washstand is being constructed for),
   (b) four poles to construct the stand, two poles 180 cm in length and two 120 cm in length, and
   (c) two poles the length of the washstand to form a cross-brace at the bottom.
2. Construct a box frame for the wash basins to sit in using square lashings; use the wash basin as a measuring tool.
3. Lash two sets of poles (one pole 180 cm and the other 120 cm long) using square lashings to form the stand.
4. Lash the table top to the sides and add supports as necessary.



PioneeringProjects.org, 2001, Three Compartment Sink, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion33.gif

Figure 18Y-1 Washstand

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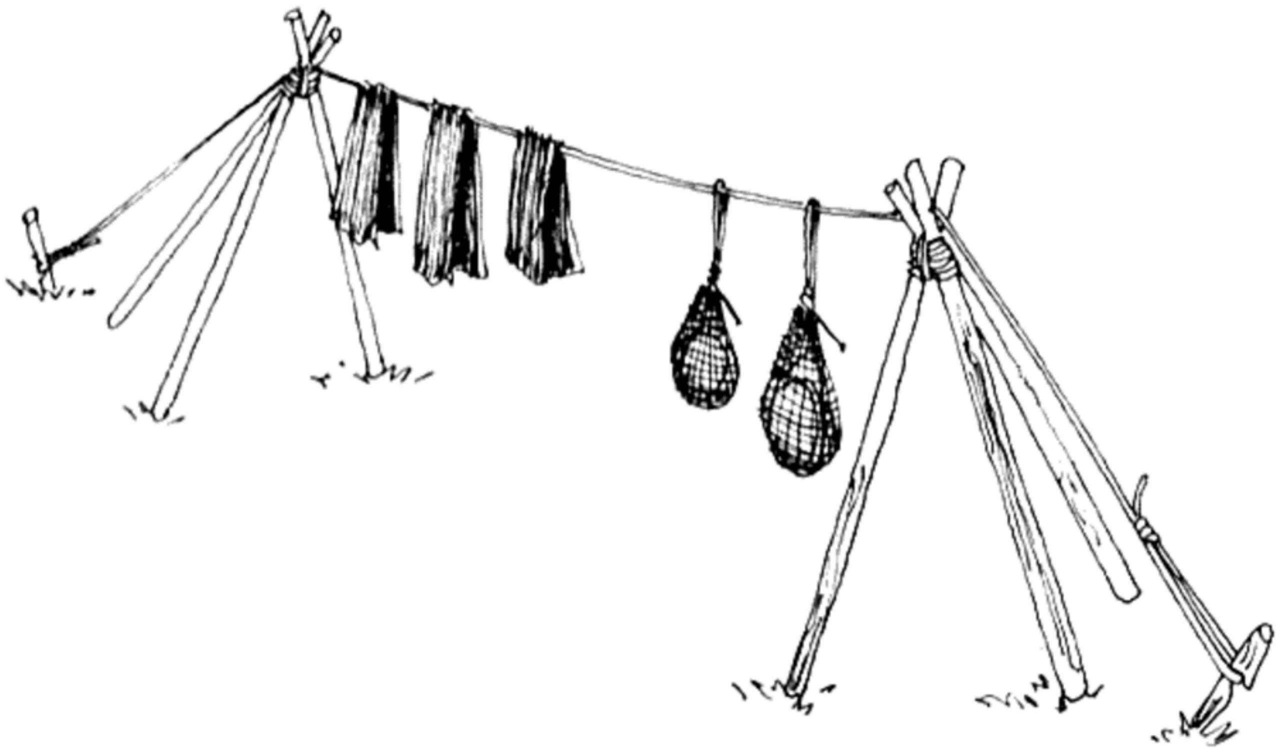
DRYING RACK

Using natural resources and cord, a drying rack can be constructed. Steps to constructing a drying rack:

1. Collect six poles 180 cm in length to construct two tripods.
2. Drive two uprights (piece of wood) into the ground and then lash a crosspiece of cord to join them across the top.
3. To ensure the structure is sturdy, add further poles lashed at an angle to form a simple ‘A’ frame at either end.
4. Attach guy wires to the two ends and peg out to keep the clothes rack on the ground in high winds. Add extra drying lines by lashing cord across the uprights.

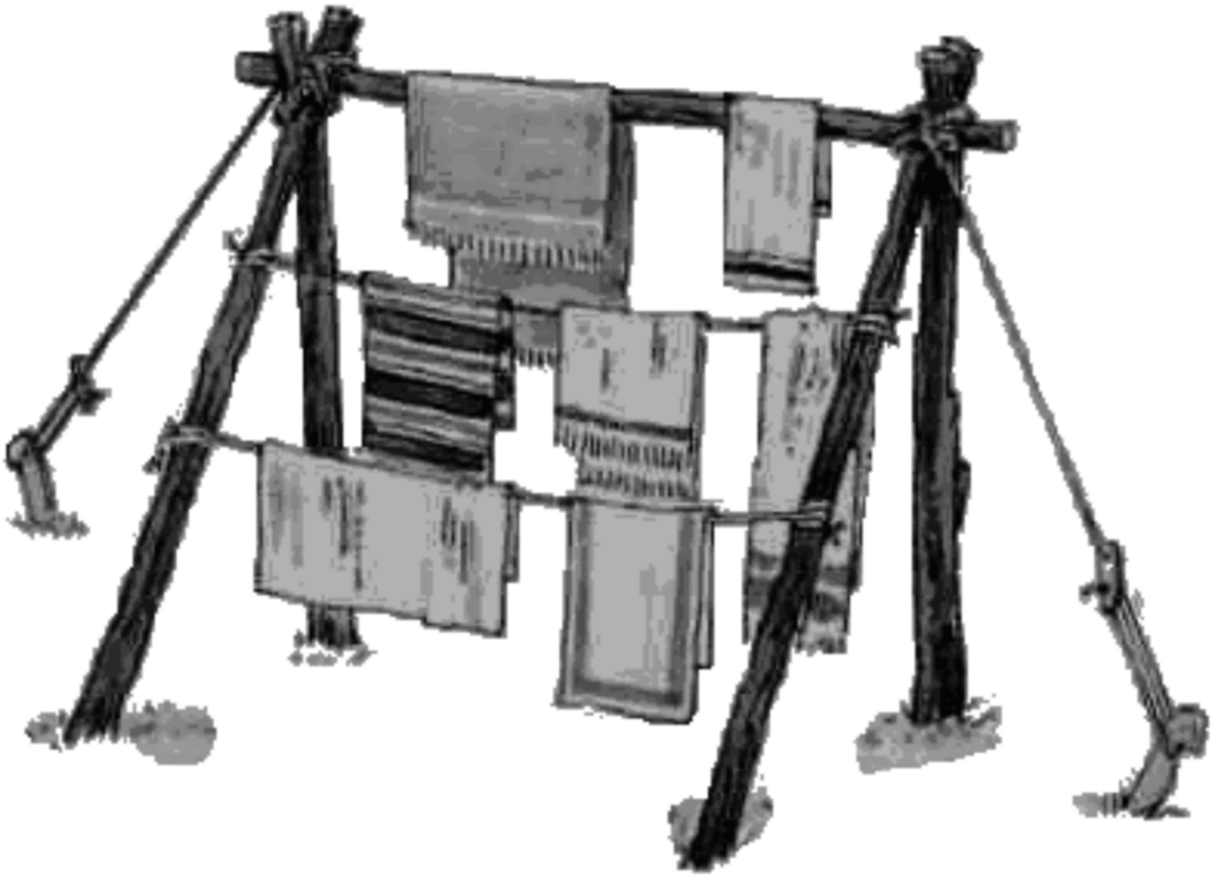
Dry clothing is essential in a survival situation to avoid exposure and possible hypothermia.



PioneeringProjects.org, 2001, Clothesline, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion24.gif

Figure 18Z-1 Drying Rack 1

Another option (as illustrated in Figure 18Z-2) is to build the entire frame out of wood.



PioneeringProjects.org, 2001, Drying Rack, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/pioneering/index.htm

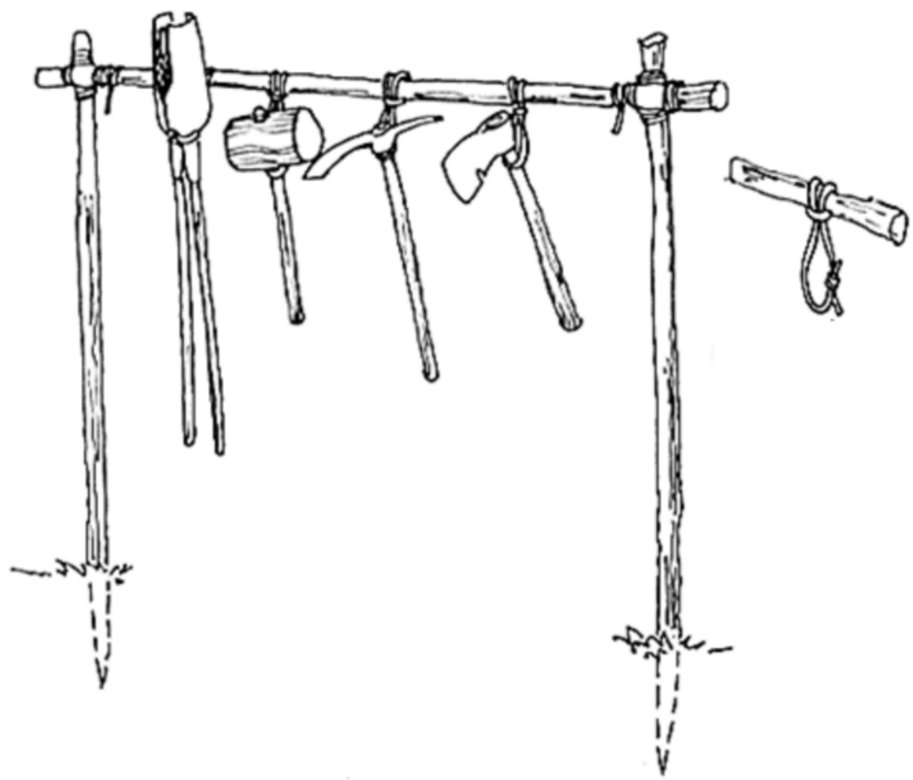
Figure 18Z-2 Drying Rack 2

TOOL RACK

Using natural resources and cord, a tool rack can be constructed. Steps to constructing a tool rack:

1. Collect the three poles 180 cm long from natural resources.
2. Drive two uprights into the ground or use two trees.
3. Lash a ridge pole between the two uprights to hang the tools from.
4. Tie pieces of cord into a loop using a reef knot and then loop it over the ridge pole (as illustrated in Figure 18AA-1).

A tool rack will keep tools off of the ground and prevent them from rusting or becoming dull too quickly. By having tools kept in one place they are less likely to go missing and site safety is increased.



PioneeringProjects.org, 2001, Tool Rack, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion27.gif

Figure 18AA-1 Tool Rack 1

Another example (as illustrated in Figure 18AA-2) has two crosspieces of wood for increased stability.

Scoutmaster, Knots and Pioneering, Retrieved November 18, 2007, from http://scoutmaster.typepad.com/.shared/image.html?/photos/uncategorized/chip5_copy_copy.jpg

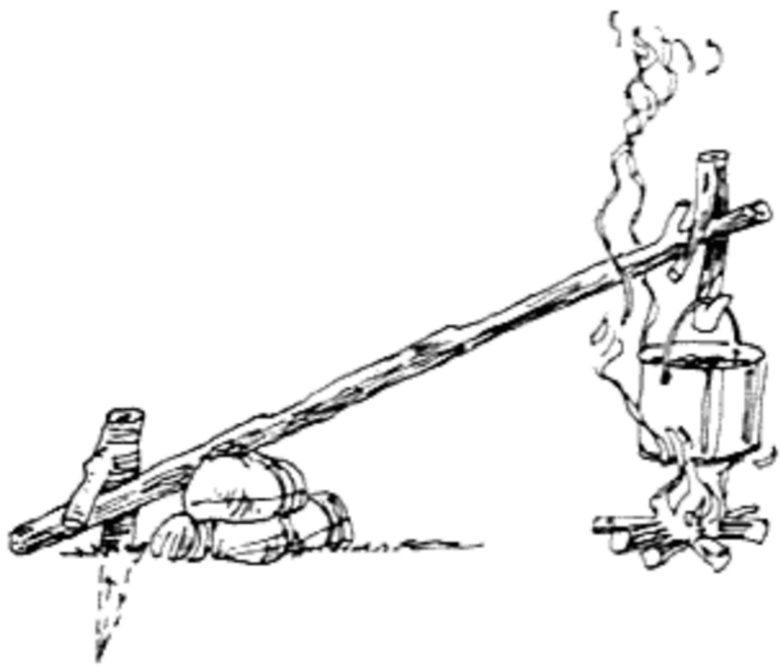
Figure 18AA-2 Tool Rack 2

CAMP CRAFTS FOR COOKING

Pot Rod

Using natural materials, cord and a pot, a pot rod for cooking over a fire can be constructed. Steps to constructing a pot rod:

1. Collect the natural resources, including:
   (a) one pole 180 cm long, and
   (b) two forked sticks, match size and shape to the pole.
2. Drive a forked stick into the ground near the fire, so that the forked part is facing down (as illustrated in Figure 18AB-1). Be careful in the placement so it does not catch on fire.
3. Pile rocks on the fire side of the forked stick and insert a long pole between the forked stick and the rocks so that the end is over the fire; add rocks to achieve the desired height.
4. Secure the pot by either lashing another forked stick (as illustrated in Figure 18AB-1) or by notching a groove so the handle stays in one spot.



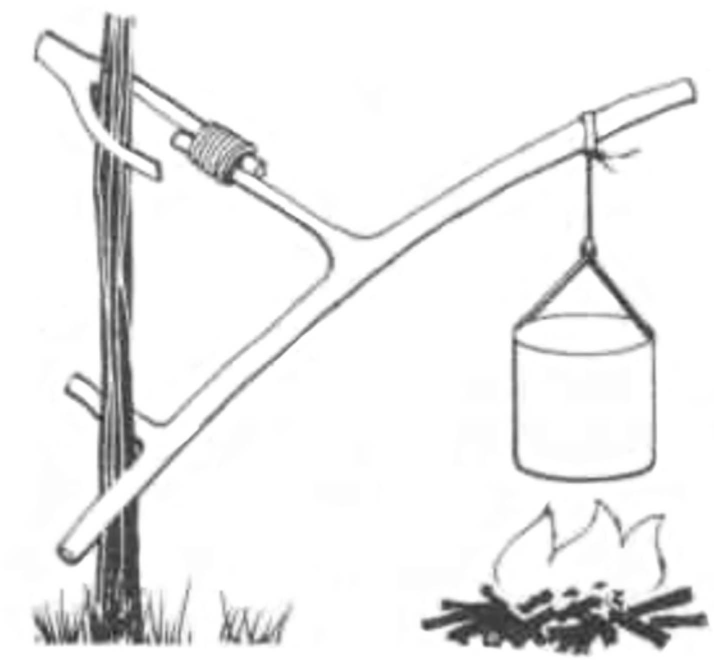
PioneeringProjects.org, 2001, Various Utensils, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion29.gif

Figure 18AB-1 Pot Rod

Swinging Pot Holder

Using natural materials, cord and a pot, a swinging pot holder for cooking over a fire can be constructed. A swinging pot holder is an extremely useful version of the simple pot rod. Steps to constructing a swinging pot holder:

1. Collect the natural resources, including:
   (a) one pole 150 cm long, with a forked end and another fork at the midway point,
   (b) one pole 90 cm long for an upright, and
   (c) one short stick with a fork (as illustrated in Figure 18AB-2).
2. Drive the 90-cm long upright 15 cm into the ground.
3. Lash the two forked sticks so that the forks fit in opposite directions on the upright. This will produce a cantilever action which not only maintains the height that it is set at, but will also swing freely allowing the pot to move away from the flames. Note that with a longer upright, the cooking height can be better controlled.
4. Secure the pot by either lashing another forked stick (as illustrated in Figure 18AB-2) or by notching a groove so the handle stays in one spot.



J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 288)

Figure 18AB-2 Swinging Pot Holder

Chippewa Kitchen

Using natural materials and cord, a Chippewa kitchen for cooking over a fire can be constructed. A challenging camp craft, but a nice set-up for long-term cooking, the Chippewa kitchen (as illustrated in Figure 18AB-3) is constructed by the following steps:

1. Collect the natural resources, including:
    (a) eight straight poles 240-cm long and 4 cm thick,
    (b) four straight poles 50 cm long and 4 cm thick, and
    (c) poles 50-cm long to create a table top.
2. Using round lashings and four 240-cm poles, lash two sets of ‘A’ frames.
3. Lash two 50 cm poles to each of the ‘A’ frames for support.
4. Lash the two ‘A’ frames together with the remaining four 240-cm poles (as illustrated in Figure 18AB-3).
5. Add poles to create a table top.

Scale the kitchen to available materials or conditions as appropriate.

Scoutmaster, Knots and Pioneering. Retrieved November 18, 2007, from http://scoutmaster.typepad.com/my_weblog/2006/05/chippewa_kitche.html

Figure 18AB-3 Chippewa Kitchen

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WHEELBARROW

Using natural materials and cord, a wheelbarrow can be constructed. A wheelbarrow is a tool that assists in gathering firewood or moving heavy objects around a survival site. Steps to constructing a wheelbarrow:

1. Collect the natural resources, including:
   - (a) two poles 60–100 cm long,
   - (b) two poles for crosspieces,
   - (c) one cross-section of a log approximately 15 cm in diameter and 4 cm thick, and
   - (d) one rod matched to the size of the hole.
2. Construct the wheel from a cross-section of a small tree that has been bored out and a rod to create an axle. The wheel portion can take a lot of time to create depending on available tools.
3. Insert a rod that has been shaped to fit into the hole.
4. Make a notch into each of the longer poles to match the diameter of the rod.
5. Tightly lash the two poles with a crosspiece as close to the wheel as possible. This crosspiece will hold the wheel in place and must be very tight.
6. Lash another crosspiece near the top of the two poles for support.
7. Add other crosspieces if necessary.

Ropesandpoles.blogspot.com. Retrieved November 18, 2007, from http://ropesandpoles.blogspot.com/2006/01/camp-wheelbarrow.html

Figure 18AC-1 Wheelbarrow

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COAT HANGER

Using natural materials and cord, a coat hanger can be constructed. Good for using on a drying rack, the coat hanger is one of the easier crafts to construct. Steps to constructing a coat hanger:

1. Collect the natural resources, including:
   (a) one slightly bent pole 60 cm long, and
   (b) one forked stick approximately 15 cm long or a bent stick approximately 30 cm long.
2. Lash either a forked stick or bent stick (as illustrated in Figure 18AD-1), to the slightly bent pole.

PioneeringProjects.org, 2001, Various Utensils, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion29.gif

Figure 18AD-1 Coat Hanger

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SIMPLE BENCH

Using natural materials and cord, a bench can be constructed. A simple bench can double as a tool storage area or a work bench. Steps to constructing a simple bench:

1. Collect the natural resources, including:
   (a) six sturdy logs approximately 100 cm long and 15 cm thick, and
   (b) one sturdy log approximately 150 cm long and 15 cm thick.
2. Using round lashings, create two tripod frames.
3. Attach a sturdy log to the tripod frames to sit on.

PioneeringProjects.org, 2001, Miscellaneous, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/images/pioneering/Miscellaneous.JPG

Figure 18AE-1 Simple Bench

Figure 18AE-1 shows the legs as a pair instead of a tripod frame. Tripod frames are required to make the bench stable.

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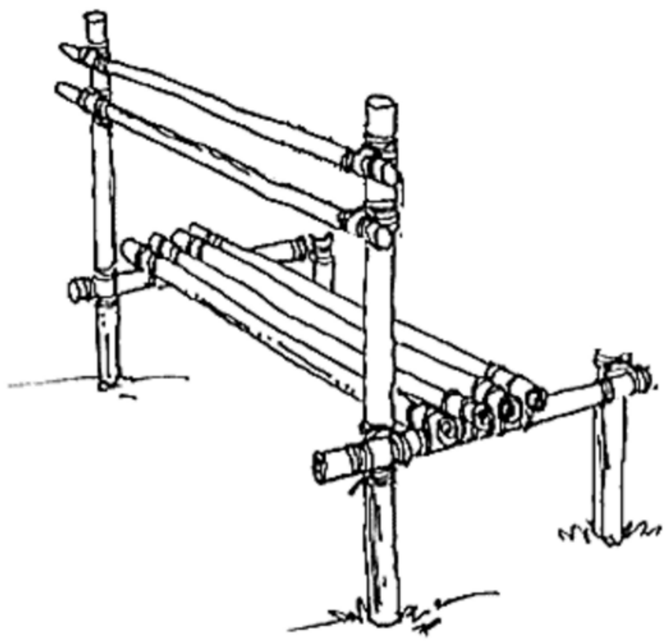
BENCH WITH BACK REST

Another example of a bench (as illustrated in Figure 18AF-1) uses more poles and has a back rest. Steps to constructing a bench with a back rest:

1. Collect the natural resources, including:
   (a) eight poles approximately 2 m each,
   (b) two poles approximately 1 m each, and
   (c) two poles approximately 0.5 m each.
2. Construct the sitting portion of the bench by attaching four long pieces of wood to the 1 m pieces, using square lashings.
3. Drive the two long and two short pieces of wood that will be used as the legs of the bench into the ground.
4. Lash the sitting portion onto the legs, using square lashings.
5. Construct the back rest using square lashings and attach it to the long legs in the ground.



PioneeringProjects.org, 2001, Bench With Back Rest, Copyright 2001 by PioneeringProjects.org. Retrieved February 20, 2007, from http://www.pioneeringprojects.org/projects/index.htm

Figure 18AF-1 Bench with Back Rest

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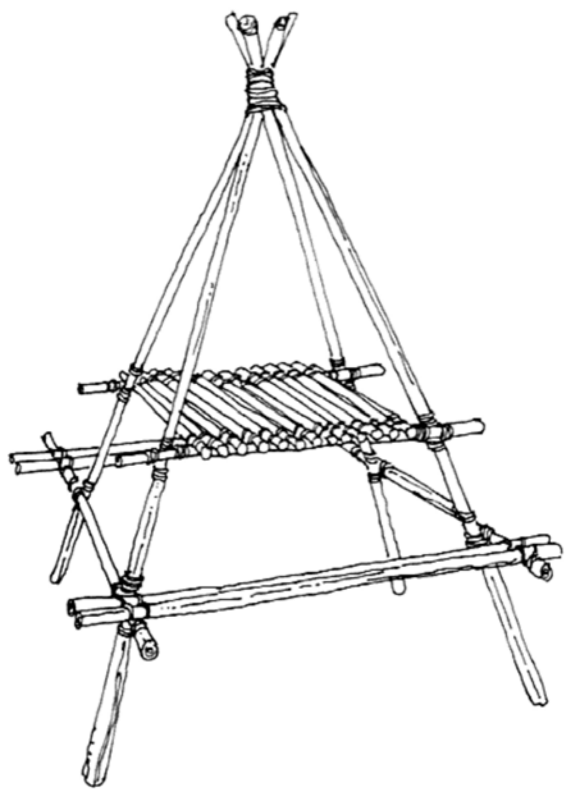
CAMP TABLE 1

Using natural materials and cord a table can be constructed (as illustrated in Figure 18AG-1). Steps to constructing a camp table:

1. Collect the natural resources, including:
    (a) four poles approximately 3 m long,
    (b) six poles approximately 2 m long,
    (c) two poles approximately 1.5 m long, and
    (d) fourteen poles approximately 0.5 m long.
2. Construct a figure-of-eight lashing around the four long pieces of wood, to make an A-frame.
3. Construct the table top, using square lashings.
4. Attach the table top portion to the long poles, using square lashings.
5. Make the sitting portion using square lashings and attach it to the long poles using square lashings.



PioneeringProjects.org, 2001, Camp Table, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion35.gif

Figure 18AG-1 Camp Table 1

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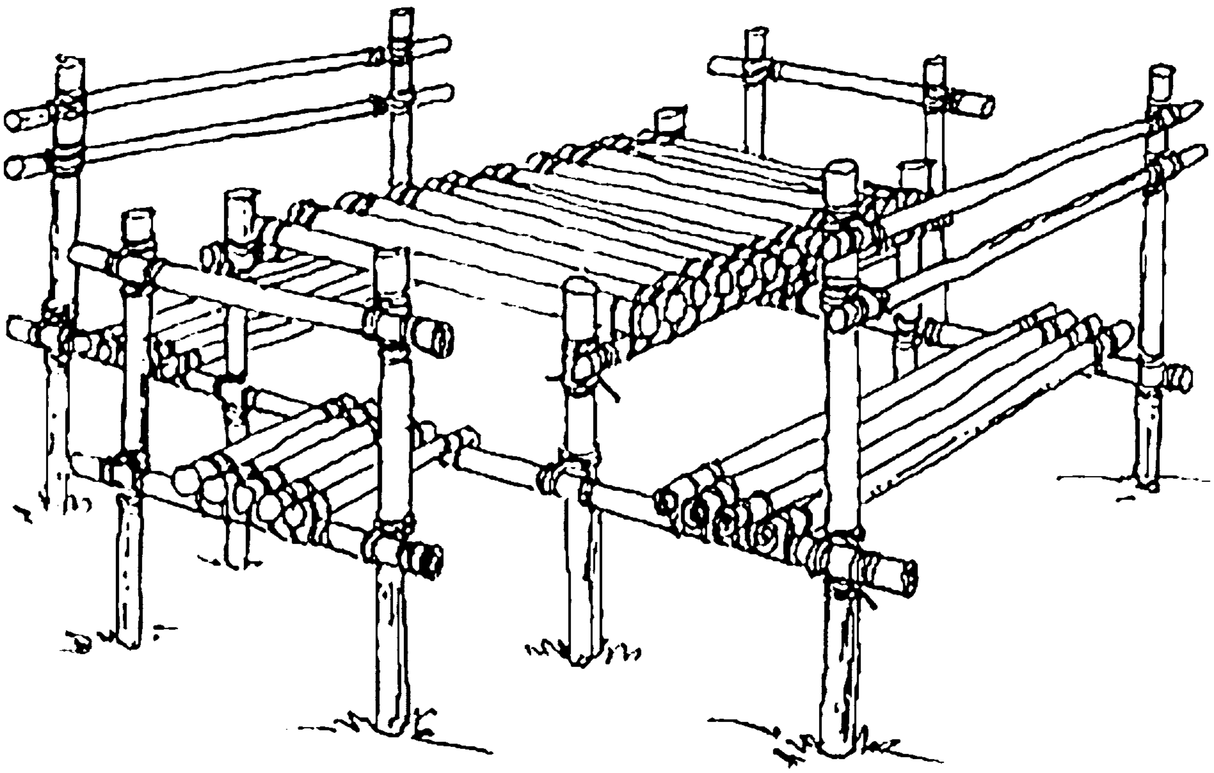
CAMP TABLE 2

An alternative to Camp Table 1, this camp table is a combination of the steps in Bench with a Back Rest combined with a variation of the steps in Camp Table 1. Steps to constructing camp table 2:

1. Collect the natural resources, including:
   (a) thirty poles approximately 1 m long,
   (b) fourteen poles approximately 2 m long,
   (c) two poles approximately 3 m long, and
   (d) ten poles approximately 0.5 m long.
2. Construct the table by lashing together the four 1-m uprights with two 1-m poles and two 2-m poles.
3. Add twelve 1-m poles as a table top.
4. Lash the two 3-m poles to either end of the table using square lashings.
5. Lash the four 1-m uprights to the end of the 3-m poles using square lashings at each end.
6. Lash eight 2-m long poles to the seat and two 2-m long poles to form the backrest.
7. Lash the five 0.5-m poles to the sides of the table and lash a 1-m long pole to the other end. Repeat on the other side.
8. Then using the 1-m long pole from Step 7., lash two 1-m uprights using square lashings. Repeat on the other side.
9. Finish the end seats by lashing the final 1-m long pole to the top to form a backrest. Repeat on the other side.

This elaborate camp craft can take many hours to build, a lot of personnel and resources are required.



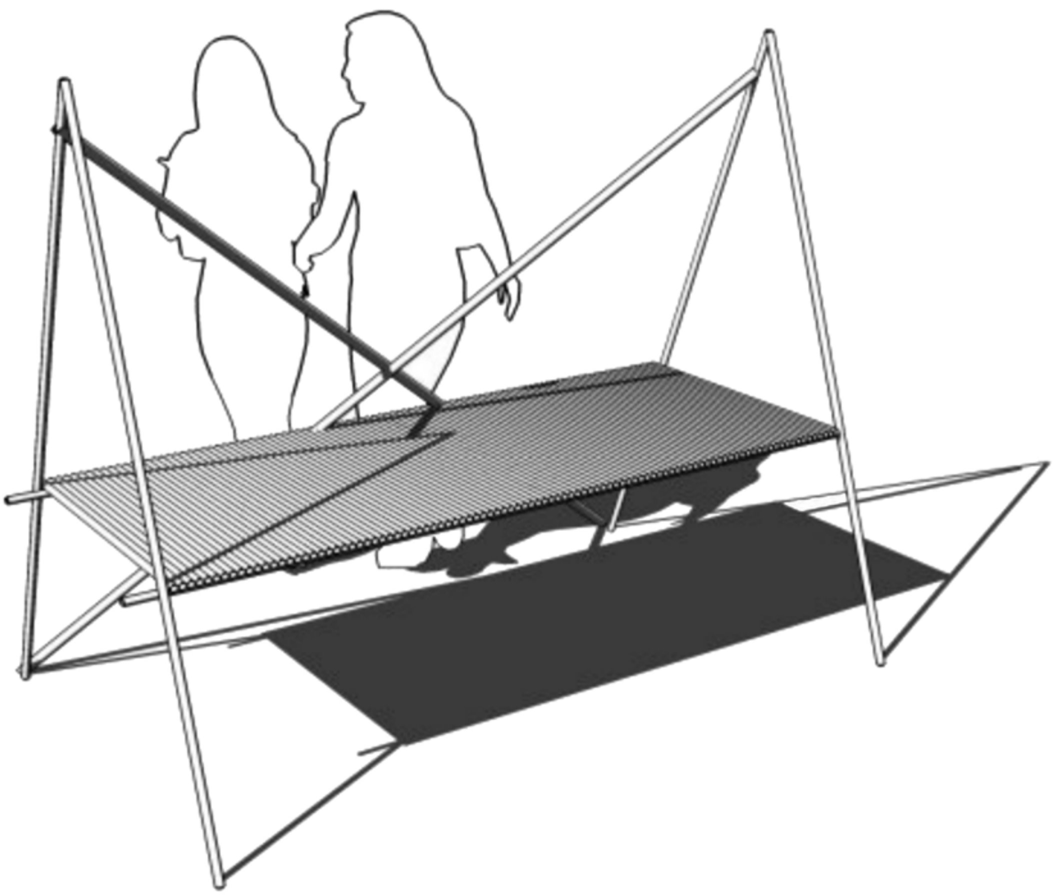
PioneeringProjects.org, 2001, Camp Table With Bench & Seat, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from http://www.pioneeringprojects.org/projects/images/pion38.gif

Figure 18AH-1 Camp Table 2

CAMP TABLE 3

Using natural materials and cord another example of a camp table (as illustrated in Figure 18AI-1).

1. Collect the natural resources, including:
   (a) two poles approximately 2 m long,
   (b) two poles approximately 2.5 m long,
   (c) two poles approximately 3 m, and
   (d) poles approximately 0.5 m long to create the table top.
2. Lash the two 2-m pole to make two ‘A’ frames.
3. Lash a cross-brace the two ‘A’ frames using two 3-m poles.
4. Lash the two 2.5-m poles to the frame to form the table top.
5. Add poles to the table top to complete the structure.



Ropesandpoles.blogspot.com. Retrieved November 18, 2007, from http://ropesandpoles.blogspot.com/2006/01/camp-table.html

Figure 18AI-1 Camp Table 3

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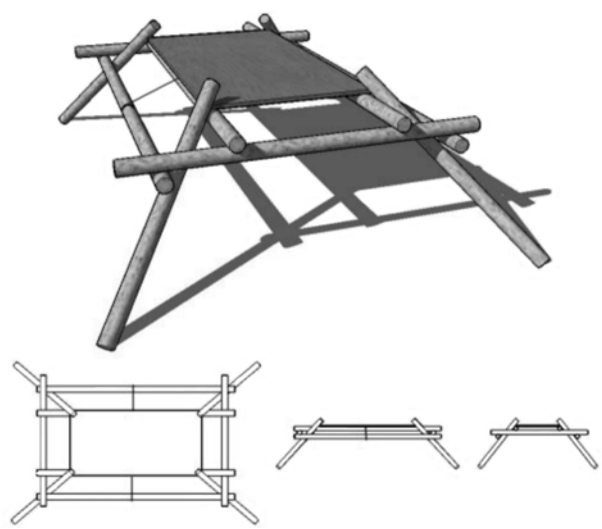
FRICTION-LOCK TABLE

Using natural resources and cord, a friction lock table can be constructed. This table only uses one piece of cord (as illustrated in Figure 18AJ-1). Friction locks the whole table together. There is one rope stopping the entire thing from spreading out and falling apart, running across the table (from left to right, under the table top). No lashings are used at all in this construction.

Steps to constructing a friction lock table:

1. Collect the natural resources, including:
   (a) four poles 180 cm in length and at least 15 cm thick, all poles used to construct this table should be of the same thickness to ensure a proper fit,
   (b) six poles 120 cm in length and at least 15 cm thick, and
   (c) natural materials to construct the tabletop.
2. Lay out the four parallel poles (the ones pointing towards the screen (as illustrated in Figure 18AJ-1) and tie together with clove hitches on each pole.
3. Lifting the two centre poles that were just tied, place the two cross-poles under these but over the outside poles.
4. Place natural materials or a piece of plywood to make a table top.
5. Lift the table (by the two outside tied poles) and hold up while the legs are inserted.



Ropesandpoles.blogspot.com. Retrieved November 18, 2007, from http://photos1.blogger.com/blogger/3732/1264/1600/friction%20lock%20tableS.jpg

Figure 18AJ-1 Friction-Lock Table

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SAMPLE BRIEFING

Situation

A 26-year-old male, Jim Grapevine, was a member of a group of hikers travelling through the park towards Hope Lake. He was lagging behind the group and was told to catch up. An hour after the group reached the lake, he still had not caught up. The group decided to look for him on their own and by nightfall, they returned to the lake without finding any sign of him. All the next day they backtracked along their trail to the point he was last seen. They searched back towards the lake, still finding no signs. After a day and a half of searching, they decided to contact the authorities. As there was no cell phone signal at the lake, they hiked the next morning to where they could make the emergency call. It has now been two days since Jim was last seen and through examining the clues we have, I have decided to concentrate the search in this area (point to the area on the map). Jim is an inexperienced hiker but very cool-headed. He has a very creative personality and was tired but in good spirits when he was last seen. He was only carrying his own gear. No other member of the group can say what he had except for a sleeping bag and clothes.

Details of the Confinement Area

A lookout has been airlifted to the top of Cloud Hill, which overlooks the area. Increasing low cloud cover will make the lookout ineffective in about two hours. The main road is being patrolled by vehicle and the Hope River is being patrolled by boat. Track traps have been set on the main trail from the lake.

Formation

The formation we will be using is the creeping line (as when cadets do a garbage sweep). Remember to move slowly so as to not get too far ahead of the other pairs.

Distance Between Pairs

Based on the type of terrain we will be encountering, the distance between pairs will be 10 m (30 ft).

Call Signs and Radio Frequency to be Used

Call signs that will be used are:

SAR leader: Sierra

Left anchor (end) team: Lima Major

Right anchor (end) team: Romeo Major

First pair to the left of the SAR leader: Lima One

Second pair to the left of the SAR leader: Lima Two

etc...

First pair to the right of the SAR leader: Romeo One

Second pair to the right of the SAR leader: Romeo Two

etc...

The radio frequency will be 6.07, check your radio now to ensure it is on the correct frequency.

Magnetic Bearing (Search Direction)

The magnetic bearing you will be searching on will be 72 degrees. It is important that you stay in your search lane and not veer into a neighbouring team’s lane. Remember your pacing techniques when bypassing obstacles. If possible, use a steering point.

Safety Bearing (If Lost or Disoriented)

If you become lost or disoriented, radio the SAR leader, who will assist you to get back on track. If you are also out of radio contact, use a magnetic bearing of 260 degrees which will bring you to Highway 43, which is being patrolled. Wait on the side of the road and flag down the patrol vehicle when you see it.

Actions to Take if the Cadets Discover a Clue/Lost Person: Radio In, Wait for Instructions

If you find a clue, stop and radio the SAR leader. Follow the instructions given. All other teams should stop and wait for instructions. Depending on the type of clue found, the search may be reoriented based on the new information.

If you find the lost person, one of you shall evaluate the situation to assess whether it is safe to approach. The other person should radio the SAR leader with the discovery and wait for instructions.

Does anyone have any questions?