ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL TWO

INSTRUCTIONAL GUIDE

SECTION 2

EO M270.02 – IDENTIFY REQUIREMENTS FOR AIRCRAFT MAINTENANCE

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-802/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 orient the cadets to aircraft maintenance, generate an interest and present basic material.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall be expected to identify requirements for aircraft maintenance.

IMPORTANCE

It is important for cadets to identify the different components and aircraft systems for which maintenance technicians are responsible for the upkeep of the aircraft. Identifying the requirements of aircraft maintenance may stimulate an interest in the subject and this may lead to future aircraft maintenance course opportunities within the Air Cadet Program.

Teaching Point 1 **Introduce Aircraft Maintenance**

Time: 10 min Method: Interactive Lecture

AIRCRAFT MAINTENANCE

In air operations, maintenance, overhaul, and repair are ongoing duties performed to maintain the performance and safety of the aircraft. In air operations, maintenance, overhaul and repair are defined as follows:

Maintenance. Continuing repair work; work that is done regularly to keep a machine, building, or piece of equipment in good condition and working order.

Overhaul. Checking for mechanical faults; to examine a piece of machinery thoroughly to identify faults and improve or repair as necessary.

Repair. Fixing or mending something; to restore something broken or damaged to good condition.

AIRCRAFT INSTRUMENT SYSTEMS

Maintenance technicians must be familiar with the various types of instruments used to convey information to the pilot. Some are flight instruments that depict the attitude, airspeed, and altitude of the aircraft. Other instruments provide information such as engine operational parameters and electrical system performance.

The aircraft instrument systems group includes mechanics and technicians who install, adjust, repair and overhaul aircraft instruments and electrical or avionics systems on aircraft. This group also includes avionics inspectors who inspect instrument, electrical and avionics systems following assembly, modification, repair or overhaul. Workers in this group are employed by aircraft manufacturing, maintenance, repair and overhaul establishments and by airlines, the Canadian Forces and other aircraft operators.

AIRFRAME ELECTRICAL SYSTEMS

An aviation maintenance technician must be familiar with aircraft electrical systems, including ways in which electricity is generated and routed to various aircraft components. By understanding the principles of electricity and electrical system designs, a technician can effectively diagnose, isolate and repair malfunctions.

HYDRAULIC AND PNEUMATIC POWER SYSTEMS

Work performed by liquids is called ‘hydraulic’ whereas work performed by air is called “pneumatic”. Today’s aviation maintenance technician must be familiar with the principles of hydraulic and pneumatic systems as well as how the different aircraft systems utilize these principles.

AIRCRAFT LANDING GEAR SYSTEMS

The landing gear of the very first airplanes was not very complex. The Wright Flyer, for instance, took off from a rail and landed on skids. However, soon after the basic problems of flight were solved, attention was turned to providing better control and stability of the aircraft while it was operated on the ground. Bicycle and motorcycle designs were first used, which in turn, gave way to specially designed landing gear and wheels that absorbed the extreme loads imparted during takeoffs and landings. In addition, braking systems were installed to provide safer and more efficient control of slowing an airplane after landing.

In later years, as aircraft designs improved to increase speed and efficiency, retraction systems were provided to allow the landing gear to be stowed during flight to reduce aerodynamic loads or drag. With continued improvements in technology, landing gear systems on modern aircraft are highly reliable and capable of handling extreme conditions, enabling safe transitions between flight and ground mobility.

The industry regulation requires the strictest performance of scheduled maintenance, repairs, and overhauls on aircraft landing gear systems.

AIRCRAFT FUEL SYSTEMS

Modern aircraft fuel is generally stored in the wings, and on ultra-long-range jetliners, extra fuel storage is located in the tail area. Volatile fuels are crucial to the performance of fuel systems in modern aircraft. Although the fuel systems are relatively simple, the safety and reliability of these systems is dependent on proper inspection and maintenance.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Define maintenance.

Q2. What systems were installed, in addition to the landing gear, to provide safer and more efficient control of slowing an airplane after landing?

Q3. What are the safety and reliability of fuel systems dependent on?

ANTICIPATED ANSWERS

A1. Maintenance is defined as continuing repair work; work that is done regularly to keep a machine, building, or piece of equipment in good condition and working order.

A2. Braking systems were installed to provide safer and more efficient control of slowing an airplane after landing.

A3. The safety and reliability of fuel systems are dependent on proper inspection and maintenance.

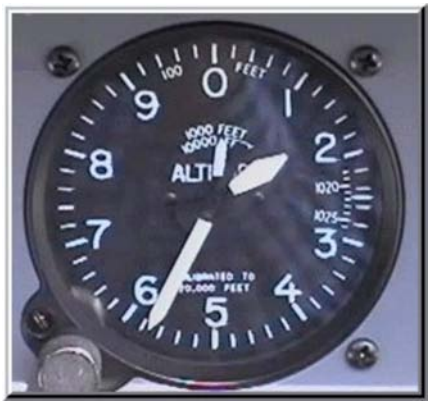
Teaching Point 2 **Discuss the Maintenance of Aircraft Instruments**

Time: 20 min Method: Interactive Lecture

Maintenance technicians must be familiar with various types of instruments used to convey information to the pilot. Some are flight instruments that depict the attitude, airspeed, and altitude of the aircraft. Other instruments provide information such as engine operational parameter and electrical system performance. Maintenance technicians must maintain the components that support the instruments, such as electrical wiring and fluid-line plumbing.

The following aircraft systems are maintained by aircraft maintenance technicians:

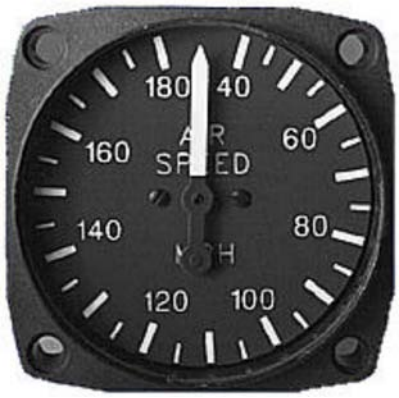
Altimeter. An altimeter is simply a barometer that measures the absolute pressure of the air. This pressure is caused by the weight of the air above the instrument. As an aircraft climbs, there is less atmosphere above the aircraft and the absolute pressure decreases. The instrument is calibrated to indicate higher altitude with decreased pressure and is usually referenced to sea level. The altimeter is one of the most important instruments used on an aircraft especially when the aircraft is operated in instrument meteorological conditions. Regulations require that the altimeter system be tested and inspected by the aircraft manufacturer or a certified and approved repair station.



"Google Images", Willkommen, Altimeter. Retrieved 23 April 2007, from www.lspl.ch/Images/Pictures/Altimeter.jpg

Figure 15-2-1 Altimeter

Air Speed Indicator. An air speed indicator is a differential pressure gauge that measures the difference between the pitot, or ram air pressure, and the static, or ambient air pressure. It consists of an airtight case that is vented to the static source. The diaphragm is also mechanically linked to a pointer on the instrument face, which indicates air speed.



"Google Images", Global Aviation, Air Speed Indicator. Retrieved 23 April 2007, from www.globalav.com.au/uma_flight_instruments.html

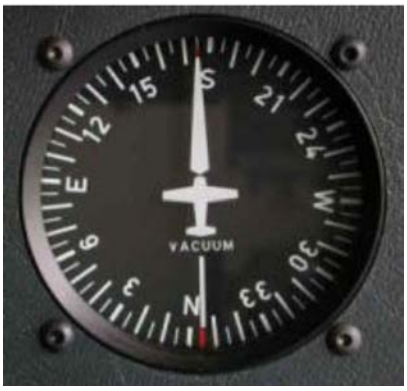
Figure 15-2-2 Air Speed Indicator

Gyroscope. Gyroscopes or gyros, have made it possible to fly an aircraft more precisely without an outside visual reference. A gyro is simply a rotating mass similar to a child's toy top. In most general aviation airplanes, there are three gyro instruments: the heading indicator, the attitude indicator and the turn and slip indicator.

"Google Images", Murphy Design, Gyroscope. Retrieved 23 April 2007, from www.cmurphydesign.com/images/gyroscope.jpg

Figure 15-2-3 Gyroscope

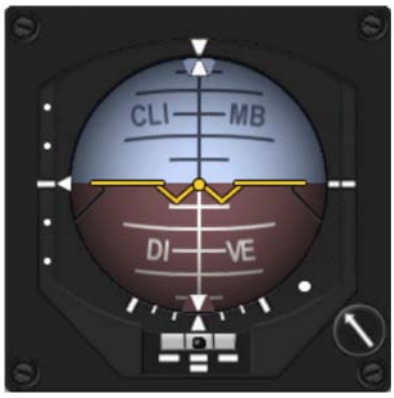
Heading Indicator (Directional Gyro). The heading indicator is an instrument designed to indicate the heading of the airplane and, because it is steady and accurate, to enable the pilot to steer that heading with the least effort.



"Google Images", Sea Gull, Heading Indicator. Retrieved 23 April 2007, from www.sgsim.com/instruments/DSCN7513-gyro-200.jpg

Figure 15-2-4 Heading Indicator

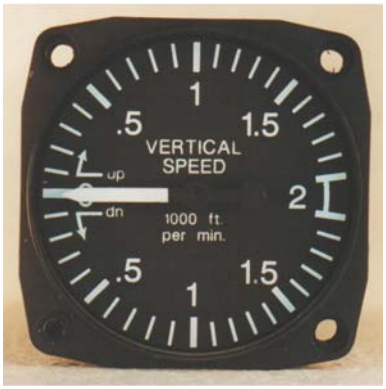
Attitude Indicator (Artificial Horizon/Gyro Horizon). The attitude indicator provides the pilot with an artificial horizon as a means of reference when the natural horizon cannot be seen because of clouds, fog, rain or other obstructions to visibility. It shows the pilot the relationship between the wings and nose of the airplane and the horizon of the Earth.



"Google Images", F-16C Reference Library, Attitude Indicator. Retrieved 23 April 2007, from www.xflight.de/f16/original/parts/center_console/adi/adi.gif

Figure 15-2-5 Attitude Indicator

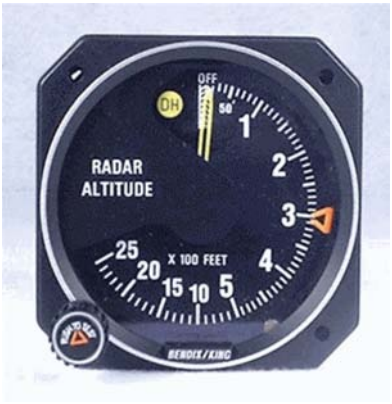
Vertical Speed Indicator (VSI). The rate of climb or descent indicator, more properly called a vertical speed indicator (VSI), helps a pilot establish the rate of climb or descent, to allow arrival at a specified altitude at a given time. The VSI also backs up other instruments, such as the altimeter, by providing early indication of changes in pitch.



"Google Images", MSA, Vertical Speed Indicator. Retrieved 23 April 2007, from www.microlightsport.co.uk/Catalogue/Instruments/Instruments_List/VSI_vs2K.jpg

Figure 15-2-6 Vertical Speed Indicator

Radar Altimeter (Radio Altimeter). Displays the aircraft's altitude as measured by a radio signal, instead of by atmospheric pressure. It sends a high-frequency signal toward the ground, which is reflected back to the aircraft's radio altimeter receiver. Typically, this instrument is used at altitudes within 2500 feet of the ground, and provides a digital display of the aircraft's absolute altitude above ground level (AGL).



"Google Images", Willkommen, Altimeter. Retrieved 23 April 2007, from http://us.st11.yimg.com/us.st.yimg.com/l/yhst-10237233231589_1940_15587562

Figure 15-2-7 Radar Altimeter

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is one of the most important instruments used on an aircraft?

Q2. Where do regulations state an altimeter must be tested and inspected?

Q3. What shows the pilot the relationship between the wings and nose of the airplane and the horizon of the Earth?

ANTICIPATED ANSWERS

A1. The altimeter is one of the most important instruments used on an aircraft.

A2. Regulations require that the altimeter system be tested and inspected by the aircraft manufacturer or a certified and approved repair station.

A3. Attitude indicator (artificial horizon/gyro horizon) shows the pilot the relationship between the wings and nose of the airplane and the horizon of the Earth.

Teaching Point 3 **Discuss Landing Gear Maintenance**

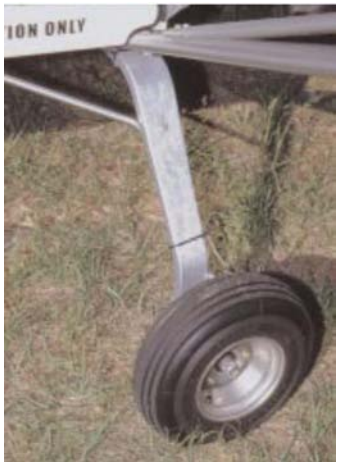
Time: 20 min Method: Interactive Lecture

The function of the landing gear is to take the shock of landing and also to support the weight of the airplane and enable it to manoeuvre on the ground. The earliest type of main landing gear was a through axle, similar to the wheel and axle arrangement on a cart or wagon. This is now completely obsolete, having been replaced with more sophisticated, shock absorbing landing gear systems.

Landing gear systems require maintenance technicians to test hydraulic and pneumatic systems and components made up of diverse materials that make up the landing gear of an aircraft.

TYPES OF LANDING GEAR

Fixed Undercarriage. On land airplanes, there are two basic classes of a fixed gear undercarriage: a main gear with a nose wheel, commonly called a tricycle gear, and a main gear with a tail wheel. There are several types of undercarriages in use for the main gear. These are used with both the tail wheel and the tricycle gear configuration.



"Google Images", ByDanJohnson.com, Fixed Landing Gear. Retrieved 23 April 2007, from http://www.bydanjohnson.com/picture0.cfm?330_5

Figure 15-2-8 Fixed Landing Gear

Slower aircraft lose little efficiency by using the lighter-weight fixed landing gear. The fixed landing gear decreases drag markedly by enclosing the wheels in streamlined fairings, called wheel pants. Many light airplanes utilize fixed landing gear that consists of spring or tubular steel landing gear legs with small frontal areas that produce minimum drag.

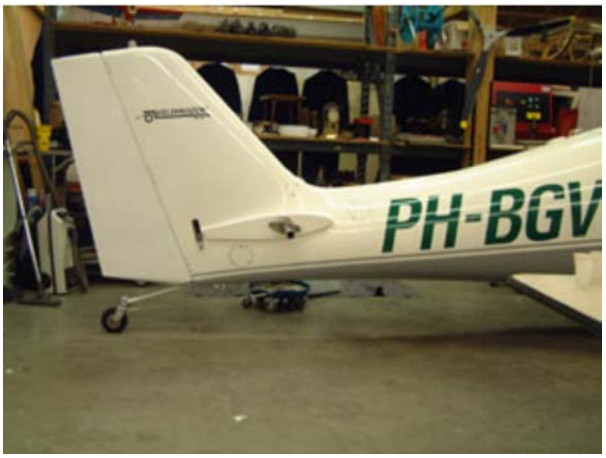
Retractable Landing Gear. Retractable landing gear is made to retract or fold up into the wing or fuselage in flight. The mechanical means and methods for accomplishing this are varied. The wheel may fold sideways, outward toward the wing or inward toward the fuselage. The latter is most common on high speed military airplanes when the wing camber is shallow. On some multi-engine airplanes, the wheels fold straight back or forward into the nacelle and is left partly projecting in order to protect the belly of the ship in the case of a wheels-up landing. Some retractable undercarriages are made to turn through 90 degrees as they travel up and fold into the side of the fuselage.

"Google Images", Xalasys Gallery, Retractable Landing Gear. Retrieved 23 April 2007, from http://gallery.xalasys.com/albums/speyer2005/DSCN4940.thumb.jpg

Figure 15-2-9 Retractable Landing Gear

Faster aircraft retract the landing gear into the structure and thus gain efficiency even at the cost of slightly more weight.

Tail-wheel. The landing gear configuration, in which the third wheel is rearward of the main gear (e.g. at the stern of the airplane), is referred to as a tail-wheel configuration (also known as "tail-draggers").



"Google Images", Loginet, Tail-Wheel. Retrieved 23 April 2007, from http://www.loginet.nl/europa/img/tailwheel2.jpg

Figure 15-2-10 Tail-wheel

Nose Wheel (Tricycle Gear Configuration). The practice of placing a steerable third wheel forward of the main gear has found universal acceptance in modern airplane design and is referred to as being a tricycle gear configuration. The prevalence of tricycle gear configurations, as used by most of today's manufacturers, is the result of certain advantages that this type of landing gear has over tail-wheel configuration.

The majority of modern aircraft do not utilize a conventional landing gear, resulting in a generation of pilots who have never flown an airplane with a tail-wheel arrangement. Tail-wheel aircraft are configured with the two main wheels located ahead of the aircraft's centre of gravity and a much smaller wheel at the tail. Moving the rudder pedals that are linked to the tail-wheel steers the aircraft on the ground.

Prior to WWII, almost all airplanes used the tail-wheel type landing gear. During WWII such airplanes as the Lockheed Lightning, the Consolidated Liberator, and the Boeing Superfortress, as well as the commercial Douglas DC-4, proved that the tricycle gear configuration was superior in ground handling ease. The tricycle gear configuration has since become the most widely used landing gear arrangement.

"Google Images", Acme Aerospace, Nose Wheel. Retrieved 23 April 2007, from http://www.acmeelec.com/aerospace/images/boeing777.gif

Figure 15-2-11 Nose Wheel

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What is the function of the landing gear?

Q2. State the types of landing gear.

Q3. What is another name for the nose wheel landing gear?

ANTICIPATED ANSWERS

A1. The function of the landing gear is to take the shock of landing and also to support the weight of the airplane and enable it to manoeuvre on the ground.

A2. Fixed gear, retractable gear, tail wheel, and nose wheel.

A3. Tricycle gear configuration.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. What are the ongoing duties performed to maintain the performance and safety of the aircraft?

Q2. List three aircraft systems that are maintained by aircraft maintenance technicians.

Q3. What is the function of the landing gear?

ANTICIPATED ANSWERS

A1. Maintenance, overhaul, and repair are ongoing duties performed to maintain the performance and safety of the aircraft.

A2. Three aircraft systems that are maintained by aircraft maintenance technicians, include (any of the following):

- altimeter,
- airspeed indicator,
- gyroscope,
- heading indicator (directional gyro),
- attitude indicator (artificial horizon/gyro horizon),
- vertical speed indicator (vsi), and
- radar altimeter (radio altimeter).

A3. The function of the landing gear is to take the shock of landing and also to support the weight of the airplane and enable it to manoeuvre on the ground.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Identifying the requirements for aircraft maintenance will familiarize the cadets with the importance of aircraft maintenance in the aviation industry. The knowledge gained in this lesson may assist in stimulating an interest in aircraft maintenance in the Air Cadet Program.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-109 (ISBN 1-894777-00-X) Canadian Aviation Maintenance Council (CAMC). (2002). *Aviation Maintenance Orientation Program.* Ottawa, ON: CAMC.

C3-116 A-CR-CCP-263/PT-001/(ISBN 0-9680390-5-7) MacDonald, A. F. and Peppler, I. L. (2000). *From the Ground Up: Millennium Edition.* Ottawa, ON: Aviation Publishers Co. Ltd.