ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 3

EO C331.02 – READ PITOT STATIC INSTRUMENTS

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 worksheets located at Annexes D, F, and H for each cadet.

Create OHPs of the answer keys located at Annexes E, G, and I.

Construct a working model of each of the pitot static instruments IAW Annex J.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TPs 1 to 4 to introduce pitot static instruments.

An in-class activity was chosen for TP 5 as an interactive way to confirm the cadets' comprehension of pitot static instruments.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall be expected to read the airspeed indicator (ASI), altimeter, and vertical speed indicator (VSI).

IMPORTANCE

It is important for the cadets to be able to read pitot static instruments so that they are aware of what is happening in the aircraft while participating in familiarization flying or using a flight simulator.

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Teaching point 1 — **Explain That the Basic Instruments of an Aircraft Rely on the Pitot Source and the Static Port as Sources of Information**

Time: 10 min — Method: Interactive Lecture

BASIC INSTRUMENTS OF AN AIRCRAFT

There are two main sources from which the pitot static instruments receive information. The first of these is the pitot source and the second is the static source.

Pitot and Static Sources Provide Information for the ASI

The pitot source on a light aircraft is usually a pitot tube which is attached to the nose or wing of the aircraft. The information from the pitot source goes directly to the ASI, which then translates the pressure into airspeed. Since the pitot source is facing forward, it acts as an intake for air. Therefore the faster the aircraft is moving, the greater the pressure at the pitot source, which in turn means the higher the reading on the ASI.

The ASI also receives information from the static source. This information will allow the ASI to compensate for changes in the air pressure when at different altitudes.

Static Port Provides Information for the Altimeter

The static port is a small vent on the side of the aircraft. This senses the surrounding pressure of the air and feeds it to the altimeter. The static port relies on changes in air pressure to work. For example, as the aircraft increases in altitude, the air pressure decreases. This causes the altimeter to indicate a higher altitude.

Static Port Provides Information for the VSI

The static port also provides information to the VSI. As the aircraft changes its altitude, the VSI will indicate the rate of change. This reading is based on the rate at which the surrounding air pressure is changing.



The ASI is the only pitot static instrument which receives pressure from both sources.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Which is the only instrument that uses the pitot source?

Q2. Where on a light aircraft is the pitot source usually located?

Q3. How does pressure affect the altimeter?

ANTICIPATED ANSWERS

A1. ASI.

A2. The pitot source is usually attached to the nose or wing.

A3. As pressure decreases, the indicated altitude on the altimeter will increase.

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Teaching point 2 **Explain How to Read an ASI**

Time: 10 min Method: Interactive Lecture

READ THE AIRSPEED INDICATOR (ASI)

Reading the ASI is straightforward, and is nearly the same as reading a speedometer in a car. There is one needle and it points to the speed at which the aircraft is travelling. The biggest difference between the speedometer and the ASI is that the ASI has a colour code lining the speed scale.

Each of these arcs represent a speed range for certain flying conditions. The three colours common to all ASIs are:

- green,
- yellow, and
- red.



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

Figure 1 Airspeed Indicator

Normal Operating Range

The green arc indicates safe and normal flying speeds. During normal flying the pilot will modify engine power and pitch attitude so that the airspeed flown is somewhere within the green arc. This does not apply for the early part of takeoff or the last part of landing, and may not apply during aerobatic manoeuvres.

Cautionary Range

The yellow arc indicates the cautionary speed range. The aircraft can fly safely at speeds in the yellow arc range, but only if manoeuvres are kept small and gentle. Aggressive manoeuvres at speeds in the yellow arc can cause structural damage to the aircraft.

Never Exceed Speed

The red line indicates the maximum speed that the aircraft should be flown at under any circumstances. If the airspeed exceeds the red line speed, then the aircraft has to be grounded and undergo a structural inspection. Exceeding the red line may cause structural damage.

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Units of Measurement

When reading the ASI, it is very important to know what units of measurement are used. In most ASIs, the unit of measurement is knots indicated airspeed (KIAS). In slower aircraft ASIs may use miles per hour (mph) as the unit of measurement. The difference between the two units is that one nautical mile (used for KIAS) is 6 080 feet, whereas one statute mile is 5 280 feet.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is for the cadet to practice reading an ASI.

RESOURCES

- ASI worksheet located at Annex D, and
- OHP of the answer key located at Annex E.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into pairs.
2. Distribute the ASI worksheet to each cadet.
3. Allow the cadets two to three minutes to complete the worksheet.
4. Allow the cadets two minutes to share and review answers with their partner.
5. Show the OHP of the answer key.

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 How to Read an Altimeter**

Time: 10 min Method: Interactive Lecture

READ AN ALTIMETER

The altimeter is the instrument which tells the pilot how high above sea level (ASL) the aircraft is. In North America the altimeter measures in feet ASL.

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Units of Measurement

Every altimeter has at least three hands: one long, one short and stubby, and one long and thin with a triangle on the end.



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

Figure 2 The Altimeter

The long hand measures altitude in hundreds of feet ASL. This is the fastest moving hand of the three and a change in altitude will make it move.

The short hand measures altitude in thousands of feet ASL. This hand moves slowly as the altitude changes. Every time the long hand goes through a 360-degree rotation, the short hand will move to the next number on the dial.

The third hand is the thinnest and the slowest moving. It measures altitude in tens of thousands of feet ASL. As the short hand goes through a 360-degree rotation the short hand will move to the next number indicating ten thousand, twenty thousand, thirty thousand feet ASL and so on.

Pressure Sub-Scale

On the right hand side of the altimeter, there is a sub-scale. This sub-scale is used to adjust the altimeter to account for differences in the pressure of the surrounding air. The altimeter is sensitive to air pressure, and readings will change as pressure changes. Pilots have to be diligent and ensure that the sub-scale is set properly.

Field Elevation Versus Pressure Altitude

The sub-scale relies on pressure altitude to calibrate the altimeter. Pressure altitude is the perceived altitude based on the current air pressure. If this information is not available, pilots can set their altimeter to the elevation of the airfield, called field elevation. This will set the altimeter sub-scale to the proper reading.

Height Above Sea Level (ASL)/Above Ground Level (AGL)

The altimeter is designed to be used relative to sea level and is used on long flights where the ground changes in elevation. When arriving and departing an airport, all procedures are followed relative to the height above the ground. This is known as height AGL.

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Reading an altimeter is very similar to reading an analog clock. Every time the second hand passes 12, the minute hand advances to the next minute. Every time the minute hand passes 12, the hour hand advances to the next hour. The altimeter works the same way.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to allow the cadet to practice reading an altimeter.

RESOURCES

- Altimeter worksheet located at Annex F, and
- OHP of the answer key located at Annex G.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Distribute the altimeter worksheet to each cadet.
2. Using the first two questions as examples, show the cadets how to read the altimeter.
3. Have the cadets complete the worksheet with a partner.
4. Show the OHP of the answer key.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 3

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

Teaching point 4 **Explain How to Read a VSI**

Time: 10 min Method: Interactive Lecture

READ A VERTICAL SPEED INDICATOR (VSI)

The VSI is an instrument, which measures the rate at which the aircraft is changing altitude.

Units of Measurement

The VSI is different than the altimeter in that the altimeter measures the exact height ASL, whereas the VSI measures how fast the aircraft is gaining or losing altitude in feet per minute.

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Positive/Negative Rates of Climb

The VSI is divided in half, top and bottom. Both halves are measured in increments of 100 feet, represented by the numbers 1–10 or 1–20. When the needle on the VSI is pointed to the number 1, it means 100 feet per minute. The top half is a positive rate of change in altitude or rate of climb, while the bottom half is a negative rate of change in altitude or rate of descent.



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

Figure 3 The Vertical Speed Indicator

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to allow the cadet to practice reading the VSI.

RESOURCES

- VSI worksheet located at Annex H, and
- OHP of the answer key located at Annex I.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Distribute VSI worksheet to each cadet.
2. Have the cadets to complete the worksheet.
3. Show the OHP of the answer key.

SAFETY

N/A.

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CONFIRMATION OF TEACHING POINT 4

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

Teaching point 5 **Have the Cadet Read Pitot Static Instruments**

Time: 10 min Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is for the cadet to practice reading pitot static instruments.

RESOURCES

- One working model of each of the pitot static instruments, including:
  - ASI,
  - Altimeter, and
  - VSI; and
- Questions located at Annex K.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Divide the cadets into two teams.
2. Set one model at a time (in no particular order) and allow each team five seconds to read the instrument.
3. Alternate which team answers. The teams get one point for every correct answer that they give.
4. If a team cannot correctly answer the question within five seconds then the other team can steal the point.
5. The team which answers the most questions correctly wins.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 5

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

END OF LESSON CONFIRMATION

The cadets' participation in each of the activities will serve as the confirmation of this lesson.

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CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Knowing how to read the pitot static instruments is essential in order to fly an aircraft. Even if a pilot is not flying under IFR conditions, these three instruments are required in order to safely operate the aircraft. They also allow the pilot to coordinate with other pilots and ATS to ensure traffic avoidance or to fly circuits at an aerodrome.

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.

C3-139 (ISBN 0-7715511-5-0) Transport Canada. (1999). *Flight Training Manual: 4th Edition Revised*. Ottawa, ON: Transport Canada.

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