Scanning is a systematic method of looking for objects such as downed aircraft or missing persons. The Mission Scanner’s primary responsibility is to maintain constant visual contact with the ground while over the search area. This responsibility makes each scanner a key member of the search aircrew.

The Mission Observer is a scanner with expanded duties who usually sits in the right front seat. In addition to the primary duty of scanning while in the search area, the observer assists the pilot with planning, navigation, and communication. The observer may also serve as mission commander, ensuring that all mission objectives are met.

The Mission SAR/DR Pilot is the aircraft commander and is responsible for the safety of the crew and the aircraft. The Mission Pilot must fly the aircraft precisely in order to execute mission procedures and search patterns so that the scanners have the best possible chance to achieve mission objectives. Naturally, as Pilot-in-Command the pilot must satisfy all pertinent FAA regulations pertaining to certification, currency and the operation of the aircraft; this text concentrates on mission-specific duties and responsibilities.

The importance of safety is emphasized throughout the text. Lessons learned in this text will enable aircrew members to operate in a safe and efficient manner, thus reducing accidents and incidents.
This text is an adaptation of the Civil Air Patrols Aircrew Reference Text as developed by the Emergency Services Curriculum Project. The original text is not copyright protected however permission has been sought from the National Headquarters, CAP for the use of this non-CAP specific version.

It was agreed with the NHQ DOS that because of our common goal to help save and protect lives as well as to operate as safely as possible, sharing of this information contributes to reaching that goal.
References

5. EA-AC 00-6A, *Aviation Weather*.
6. AC 00-45E, *Aviation Weather Services*.
8. *Federal Aviation Regulations*.
10. AOPA/ASA Safety Advisors.
11. Cessna *Pilot Operating Handbooks*.
12. Cessna *Pilot Safety and Warning Supplements*.
14. Revised Code of Washington 47.68.380
15. Washington Administrative Code 468-200
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<td>A/C</td>
<td>Aircraft</td>
</tr>
<tr>
<td>A/P</td>
<td>Airport</td>
</tr>
<tr>
<td>ADF</td>
<td>Automatic Direction Finder</td>
</tr>
<tr>
<td>A/FD</td>
<td>Airport/Facility Directory</td>
</tr>
<tr>
<td>AFRCC</td>
<td>Air Force Rescue Coordination Center</td>
</tr>
<tr>
<td>ARTCC</td>
<td>Air Route Traffic Control Center</td>
</tr>
<tr>
<td>AGL</td>
<td>Above Ground Level</td>
</tr>
<tr>
<td>AIM</td>
<td>Airman's Information Manual</td>
</tr>
<tr>
<td>AM</td>
<td>Amplitude Modulated</td>
</tr>
<tr>
<td>ASAP</td>
<td>As Soon As Possible</td>
</tr>
<tr>
<td>ASOS</td>
<td>Automated Surface Observing System</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
<tr>
<td>ATD</td>
<td>Actual Time of Departure</td>
</tr>
<tr>
<td>ATIS</td>
<td>Automatic Terminal Information Service</td>
</tr>
<tr>
<td>AWOS</td>
<td>Automated Weather Observing System</td>
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<tr>
<td>C172</td>
<td>Cessna aircraft model</td>
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<td>C182</td>
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<td>C206</td>
<td>Cessna aircraft model</td>
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<td>Civil Air Patrol Inc.</td>
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<tr>
<td>CAPF</td>
<td>CAP Form</td>
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<td>CAPR</td>
<td>CAP Regulation</td>
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<tr>
<td>CD</td>
<td>Counter drug</td>
</tr>
<tr>
<td>CDI</td>
<td>Course Deviation Indicator</td>
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<tr>
<td>COM/COMM</td>
<td>Communication</td>
</tr>
<tr>
<td>CONUS</td>
<td>Continental United States (excludes Alaska and Hawaii)</td>
</tr>
<tr>
<td>COSPAS</td>
<td>Cosmicheskaya Sistyema Poiska Avariynich Sudov (Space System for the Search of Vessels in Distress)</td>
</tr>
<tr>
<td>CTAF</td>
<td>Common Traffic Advisory Frequency</td>
</tr>
<tr>
<td>CRM</td>
<td>Crew Resource Management</td>
</tr>
<tr>
<td>DCO</td>
<td>Defense Coordinating Officer</td>
</tr>
<tr>
<td>DF</td>
<td>Direction Finder</td>
</tr>
<tr>
<td>DME</td>
<td>Distance Measuring Equipment</td>
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<tr>
<td>DoD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DR</td>
<td>Disaster Relief</td>
</tr>
<tr>
<td>DUAT</td>
<td>Direct User Access Terminal</td>
</tr>
<tr>
<td>EFAS</td>
<td>Enroute Flight Advisory Service</td>
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<tr>
<td>ELT</td>
<td>Emergency Locator Transmitter</td>
</tr>
<tr>
<td>EPIRB</td>
<td>Marine Emergency Position Indicating Radio Beacon</td>
</tr>
<tr>
<td>ES</td>
<td>Emergency Services</td>
</tr>
<tr>
<td>ESCAT</td>
<td>Emergency Security and Control of Air Traffic</td>
</tr>
<tr>
<td>ETD</td>
<td>Estimated Time of Departure</td>
</tr>
<tr>
<td>ETE</td>
<td>Estimated Time Enroute</td>
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<td>FAA</td>
<td>Federal Aviation Administration</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<td>---------</td>
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<tr>
<td>FAR</td>
<td>Federal Aviation Regulation</td>
</tr>
<tr>
<td>FBO</td>
<td>Fixed Base Operator</td>
</tr>
<tr>
<td>FCC</td>
<td>Federal Communications Commission</td>
</tr>
<tr>
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<td>Federal Employee Compensation Act</td>
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<tr>
<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
</tr>
<tr>
<td>FM</td>
<td>Frequency Modulated</td>
</tr>
<tr>
<td>FRO</td>
<td>Flight Release Officer</td>
</tr>
<tr>
<td>FSS</td>
<td>Flight Service Station</td>
</tr>
<tr>
<td>FTCA</td>
<td>Federal Tort Claims Act</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HIWAS</td>
<td>Hazardous In-Flight Weather Advisory Service</td>
</tr>
<tr>
<td>IAW</td>
<td>In Accordance With</td>
</tr>
<tr>
<td>IFR</td>
<td>Instrument Flight Rules</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>LDG</td>
<td>Landing (time)</td>
</tr>
<tr>
<td>LFA</td>
<td>Lead Federal Agency</td>
</tr>
<tr>
<td>MHz</td>
<td>Megahertz</td>
</tr>
<tr>
<td>MO</td>
<td>Mission Observer</td>
</tr>
<tr>
<td>MOA</td>
<td>Military Operations Area</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MP</td>
<td>Mission SAR/DR Pilot</td>
</tr>
<tr>
<td>MRE</td>
<td>Meals Ready to Eat</td>
</tr>
<tr>
<td>MSCA</td>
<td>Military Support to Civil Authorities</td>
</tr>
<tr>
<td>MS</td>
<td>Mission Scanner</td>
</tr>
<tr>
<td>MSL</td>
<td>Mean Sea Level</td>
</tr>
<tr>
<td>MTR</td>
<td>Military Training Route</td>
</tr>
<tr>
<td>NIMS</td>
<td>National Incident Management System</td>
</tr>
<tr>
<td>NOS</td>
<td>National Ocean Service</td>
</tr>
<tr>
<td>NOTAM</td>
<td>Notice to Airmen</td>
</tr>
<tr>
<td>NTSB</td>
<td>National Transportation Safety Board</td>
</tr>
<tr>
<td>NWS</td>
<td>National Weather Service</td>
</tr>
<tr>
<td>ORM</td>
<td>Operational Risk Management</td>
</tr>
<tr>
<td>PA</td>
<td>Prohibited Area</td>
</tr>
<tr>
<td>PIC</td>
<td>Pilot-in-Command</td>
</tr>
<tr>
<td>PIREP</td>
<td>Pilot Weather Report</td>
</tr>
<tr>
<td>PLB</td>
<td>Personal Locator Beacon</td>
</tr>
<tr>
<td>RA</td>
<td>Restricted Area</td>
</tr>
<tr>
<td>RCC</td>
<td>Rescue Coordination Center</td>
</tr>
<tr>
<td>ROA</td>
<td>Radio Operator Authorization</td>
</tr>
<tr>
<td>SA</td>
<td>Situational Awareness</td>
</tr>
<tr>
<td>SAR</td>
<td>Search and Rescue</td>
</tr>
<tr>
<td>SARDA</td>
<td>State and Regional Disaster Airlift</td>
</tr>
<tr>
<td>SARSAT</td>
<td>Search and Rescue Satellite-Aided Tracking</td>
</tr>
<tr>
<td>SCATANA</td>
<td>Security Control of Air Traffic and Air Navigation Aids</td>
</tr>
<tr>
<td>SO</td>
<td>Safety Officer</td>
</tr>
<tr>
<td>SUA</td>
<td>Special Use Airspace</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<td>--------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>TPA</td>
<td>Traffic Pattern Altitude</td>
</tr>
<tr>
<td>TFR</td>
<td>Temporary Flight Restriction</td>
</tr>
<tr>
<td>TWEB</td>
<td>Transcribed Weather Broadcast</td>
</tr>
<tr>
<td>USAF</td>
<td>United States Air Force</td>
</tr>
<tr>
<td>UTC</td>
<td>Coordinated Universal Time</td>
</tr>
<tr>
<td>UHF</td>
<td>Ultra High Frequency</td>
</tr>
<tr>
<td>VHF</td>
<td>Very High Frequency</td>
</tr>
<tr>
<td>VMC</td>
<td>Visual Meteorological Conditions</td>
</tr>
<tr>
<td>VOR</td>
<td>Very High Frequency Omni-directional Range</td>
</tr>
<tr>
<td>VOX</td>
<td>Voice Activated</td>
</tr>
<tr>
<td>WSDOT</td>
<td>Washington State Department of Transportation</td>
</tr>
<tr>
<td>WASAR</td>
<td>Washington Air Search and Rescue Inc.</td>
</tr>
<tr>
<td>ZULU</td>
<td>Coordinated Universal Time</td>
</tr>
</tbody>
</table>
1. Scanner/Observer Duties

OBJECTIVES:

1. Mission scanner duties and responsibilities.
3. Discuss WSDOT - Aviation missions.
4. List the general rules for entering data into forms.
1.1 **Mission Scanner duties and responsibilities**

The scanner’s primary mission role is effective visual search. “Scanning” is a method of looking for downed aircraft (or other objects) that makes it possible to search an assigned area in a systematic way. Scanners are those people trained in these methods and whose primary responsibility is to maintain constant eye contact with the ground while flying over the search area. This responsibility makes the scanner a key member of each aircrew. While the mission observer has further duties, his or her primary responsibility while in the search area is also visual search.

The following outlines the duties and responsibilities of scanners for a typical mission:

- Report for duty IAW the "IM SAFE" criteria:

  **Illness** - Even a minor illness suffered in day-to-day living can seriously degrade performance of many piloting tasks vital to safe flight. The safest rule is not to fly while suffering from any illness. If this rule is considered too stringent for a particular illness, the pilot should contact an Aviation Medical Examiner for advice.

  **Medication** - Pilot performance can be seriously degraded by both prescribed and over-the-counter medications, as well as by the medical conditions for which they are taken. Federal regulations prohibit pilots from performing crewmember duties while using any medication that affects the faculties in any way contrary to safety.

  **Stress** - Stress from everyday living can impair performance, often in very subtle ways. Stress and fatigue (lack of adequate rest) can be an extremely hazardous combination.

  **Alcohol** - Extensive research has provided a number of facts about hazards of alcohol consumption and flying. As little as one ounce of liquor, one bottle of beer or four ounces of wine can impair flying skills.

  **Fatigue** - Fatigue and lack of adequate sleep continue to be some of the most treacherous hazards to flight safety, as it may not be apparent to a pilot until serious errors are made.

  **Emotion** - The emotions of anger, depression, and anxiety may lead to taking risks that border on self-destruction.
• Wear appropriate dress for the mission (e.g., gloves, sunglasses, and uniform appropriate for climate and terrain).
• Carry and properly use equipment (e.g., charts and maps, headsets, binoculars, camera, clipboard, and survival equipment).
• Carry current credentials. Assist in avoiding obstacles during taxiing.
• Obey sterile cockpit rules. These require the crew to limit conversation to mission- and safety-related topics while in critical phases of flight. They are typically enforced during taxi, takeoff, departure, approach, and landing, as well as anytime the crew is executing a high-workload task.
• Employ effective scanning techniques.
• Report observations accurately. Record all sightings to include the time and geographical location. Include such things as other aircraft, ground parties, descriptive information concerning your search area, weather conditions (e.g., sun position, clouds, and search visibility), old wreckage, and possible sightings.
• Keep accurate sketches and notes.
• Properly complete all pertinent paperwork associated with the mission.
• Report availability for additional assignments.
• On completion of the day's assignments, return borrowed or assigned equipment.

1.2 Mission Observer duties and responsibilities

The mission observer has a key role in WSDOT - Aviation missions, and has expanded duties that mainly pertain to assisting the mission pilot. This assistance may be in the planning phase, handling radio communications, assisting in navigation, and crew management. The proficient observer makes it possible for the pilot to perform his duties with a greater degree of accuracy and safety by assuming these aspects of the workload.

In addition to the scanner duties, observers must also:
• Depending on conditions, you may report with the mission pilot for briefing.
• Assist in planning the mission.
• Assist in avoiding collisions and obstacles during taxiing.
• Assist in setting up and operating aircraft radios.
• Assist in setting up and operating aircraft navigational equipment (e.g., VORs and GPS).
• Assist enforcing the sterile cockpit rules.
• Maintain situational awareness at all times.
• Assist in monitoring fuel status.
• Monitor the electronic search devices aboard the aircraft and advise the pilot when making course corrections in response to ELT signals.
• Keep mission base and/or high bird appraised of status.
• Coordinate scanner assignments and ensure proper breaks for the scanners (including yourself). Monitor crew for fatigue and dehydration (ensure the crew drinks plenty of fluids).
• Maintain a chronological flight log of all observations of note, including precise locations, sketches and any other noteworthy information.

• Depending on conditions, report with the mission pilot for debriefing immediately upon return to mission base. The applicable portions on the reverse of mission flight plan should be completed prior to debrief.

• Keep track of assigned supplies and equipment.

Once team members have been briefed on the mission and accomplished the necessary planning, observers determine that all necessary equipment is aboard the airplane. Checklists help ensure that all essential equipment is included, and vary according to geographic location, climate, and terrain of the search area. Items on the observer's checklist should include specialty qualification cards, current charts and maps of the search area, flashlights, notebook and pencils, binoculars, and survival gear (prohibited items, such as firearms, should be listed too, to ensure none is included). A camera may be included to assist in describing the location and condition of the search objective or survivors. Unnecessary items or personal belongings should be left behind. The mission observer also assists the pilot in ensuring that all equipment aboard the search aircraft is properly stowed. An unsecured item can injure the crew or damage the aircraft in turbulence.

Once airborne, the observer provides navigation and communication assistance, allowing the pilot to precisely fly the aircraft with a greater degree of safety. The observer also assists in enforcing "sterile cockpit" rules when necessary. In flight, particularly the transit phase, the observer maintains situational awareness in order to help ensure crew safety.

The mission observer divides and assigns scanning responsibilities during the mission observer briefing, and ensures each scanner performs their assigned duty during flight. He/She monitors the duration of scanner activity, and enables the scanners to rest in order to minimize fatigue.

1.3 The Observer Log

The observer must become proficient in using an in-flight navigational log. A complete chronological log should be maintained from take-off until landing, and should include all events and sightings. Skill in maintaining the log requires training and experience. Remember, proficiency and confidence are gained through practice and application.

It is important to log the geographical location of the search aircraft at the time of all events and. This information is the basis of the mission debriefing, which is passed back to the incident commander and general staff after returning to base. It becomes a part of the total information that is the basis for his subsequent actions and reports. Good logs give the staff a better picture of how the mission is progressing.

If sketches or maps are made to compliment a sighting, note this and attach them to the log. The log and all maps and sketches will be attached to the ICS 220. A sample Observer Log (and instructions) is included in Attachment 2, Flight Guide.
1.4 **WSDOT - Aviation missions**

The Mission Aircrew course covers all aspects of the Emergency Services mission, including search and rescue (SAR), disaster relief (DR), life support, civil defense, and emergency communications.

### 1.4.1 The Wartime Mission

A national emergency may also invoke the *Emergency Security and Control of Air* (ESCAT) plan. The purpose of this plan is to provide security control of civil and military air traffic, navigational aids, and airspace use. It may involve the use of military interceptors, directed dispersal, landing, or grounding of aircraft, shutdown of navigational aids, or IFR-only operations.

### 1.4.2 Peacetime Disaster Relief

The WSDOT – Aviation Division, an integral part of the Washington State Organization for Emergency Management of Resources, is the responsible agency for the State and Regional Disaster Airlift plan (SARDA). The Aviation Division is tasked with providing direction and assistance in the managed movement of persons and goods and in the use of special purpose type aircraft in support of National, Regional, State and local essential operations. In addition, the Aviation Division is responsible for the management and control of civil aircraft, other than air-carrier aircraft, available to the state in an emergency.

The following are typical missions accomplished under SARDA operations:

- a. Aerial Surveillance of surface routes and traffic in times of disaster.
- b. Aerial Search and Rescue operations
- c. Aerial courier and messenger service.
- d. Transport of emergency personnel and supplies.
- e. Aerial reconnaissance for damage assessment.
- f. Provide communications facilities; either fixed, mobile, or airborne.

### 1.4.3 Search and Rescue (SAR)

RCW 47.68.380 states that the WSDOT Aviation Division is responsible for the conduct and management of all aerial search and rescue within the state. The division is also responsible for search and rescue activities involving electronic emergency signaling devices such as Emergency Locator Transmitters (ELT’s) and Emergency Position Indicating Radio Beacons (EPIRBS). Personal Locator Beacons (PLB’s) fall under the responsibility of the Washington State Emergency Management Division.
1.5 **Operational Agreements**

To facilitate mission execution, once notification is received by WSDOT - Aviation prearranged agreements are already in place to cover most contingencies. These exist at the national, regional and state/local levels so that we do not reinvent the wheel for each new tasking. These agreements are formalized through the respective agencies’ chains of command and signed off at all levels so that everyone understands their responsibilities and actual level of involvement for each contingency.

1.6 **Forms**

OPLANs, MOUs, regulations and agreements do not get the work done—people do. To ensure standardized training and mission accomplishment, a series of forms facilitate scanner and observer upgrade and mission execution. Some of these forms are the ICS 220A Mission Flight Plan, FAA Flight Plan 7233-1, and WSDOT 91T.

The Aviation Emergency Services Emergency Worker Card is used to identify mission-qualified personnel. WSDOT – Aviation issues this card. Each member is required to have a valid Air SAR card to participate in missions.

**ICS 220A is the Mission Flight Plan/Briefing Form**; the pilot usually fills out this form with the observer’s assistance. The mission usually begins with a general briefing, followed by an individual sortie briefing. The briefing section of the **ICS 220A** is used to ensure that critical aspects of the upcoming mission are covered. An accurate mission log, kept by the observer during the flight, allows the mission debriefing section to be filled out.

The WSDOT Flight Plan is also contained on the front of the **ICS 220A**, primarily on the top. It is prepared and filed by the mission pilot and must be closed out with the Flight Release Officer after landing. For cross-country flights greater than 50 nm, a FAA Flight Plan must be filed if an ICS 220A is not used. Both show the intended route of flight, details about aircraft markings and performance, anticipated flight time, available fuel, and souls on board to facilitate rescue efforts in case of an emergency.

The FAA Flight Plan and ICS 220A are covered in Chapter 13.

The AD-108 is used to claim reimbursement for missions IAW WAC 468-200.

1.6.1 **Entering Data into Forms**

The most basic rule for filling out forms is to enter data **accurately and legibly**. Remember that the customer can't read your mind and shouldn't have to resort to an ouija board to decipher your handwriting. So, if your handwriting is poor, print; if your printing is poor, have another crewmember fill out the form.

WSDOT – Aviation ICS forms are available in electronic format. [If feasible, make templates of the forms you use the most: filling in data that doesn't change (e.g., local and aircraft information) and then using the SAVE AS feature each time you use the form will save you lots of time.]
Some general rules to follow are:

- Avoid the use of "Liquid Paper" when making corrections to any forms.
- To correct mistakes draw a single line through the error and initial.
- Do not use signature labels or stamped signatures.
- Do not submit reimbursement forms that have things copied onto them, such as receipts or notes.
- Attach copies of all receipts that support expenses claimed on the reimbursement form.
- Attachments (e.g., expense receipts or maps) should have your name, the date, aircraft 'N' number, mission and sortie numbers, and Hobbs time on them so they can be tied to the form if they become separated.
- Always have another crewmember review the form before submittal. If there are any blanks or 'N/A' entries, make sure that is what you intended.
2. Aircraft Familiarization

OBJECTIVES:

1. State the basic function of the following aircraft components:
   a. Ailerons
   b. Elevator
   c. Rudder
   d. Trim tabs
   e. Fuel selector
2. Discuss the relationship between the magnetic compass and heading indicator.
3. State the basic function of the altimeter, airspeed indicator, attitude indicator, GPS, Nav/Comm radios, audio panel, and transponder.
4. Discuss the consequences of exceeding the gross weight limit.
5. Discuss the importance of maintaining proper balance (C.G.), and factors in computing weight & balance.
6. State the purpose of the preflight inspection, and discuss the items checked during the preflight inspection.
7. Discuss ground operations and safety, including:
   a. Ramp safety
   b. Moving and loading an aircraft
   c. Entry and egress
   d. Fuel management
   e. Taxiing, including airport signs and markings
   f. Flight line hand signals {Figure 2-9}
8. Discuss wake turbulence, including where it is most likely to be encountered.
2.1 Basic aircraft structure

An understanding of the basic elements that make up the structure of most general aviation aircraft will help you understand how the aircraft is controlled. When executing search patterns, the aircrew should know the aerodynamic parts that cause the aircraft to turn, climb, and roll.

The basic structure of a conventional airplane is the fuselage, and all other parts are attached to it. This is true for most single-engine aircraft. The primary source of lift is the wing while other parts provide stability and control. The tail, or empennage, consists of the horizontal stabilizer with its attached elevators and the vertical stabilizer with its attached rudder.

The basic aircraft control surfaces can be seen in Figure 2-1, along with a general aircraft design. The effects of aileron, elevator, and rudder movements can be seen in Figures 2-2 through 2-4.
2.1.1 Ailerons

Ailerons are movable surfaces attached to the trailing edge of the wing, toward the wing tip from the flaps. They control roll or movement around the longitudinal axis. When the aileron on one wing goes down, the aileron on the other wing automatically goes up. If the pilot wants to roll to the right, he turns the yoke to the right, and the right aileron goes up. This will create a loss of lift on the right wing and result in a roll to the right. At the same time the left aileron goes down and increases lift on the left side, assisting in the roll action to the right.
2.1.2 Elevator

An elevator is a control airfoil attached to the trailing edge of the tail's horizontal stabilizer. It controls pitch, or movement of the nose up or down. When the stick, or wheel, is moved back, the elevators are raised. The raised elevators and actions of relative winds cause a down force on the tail and raise the nose. The relative wind causes an opposite action when the pilot pushes the yoke forward.

2.1.3 Rudder

The rudder is an airfoil attached at the trailing edge of the tail's vertical fin. It is designed to control the yawing, or side-to-side action around the vertical axis of the aircraft. The action is controlled through right and left pedals at the pilot's feet. If she pushes the left pedal the rudder swings to the left, creating a force that pushes the tail to the right. The nose of the aircraft then moves, or yaws, to the left.

2.1.4 Trim tabs

A trim tab is used for fine control. It is an auxiliary surface attached to trailing edges of airfoils. When a continuous but slight pressure on the controls is required for straight and level flight, the pilot might adjust a trim tab to get the proper balance and be free from exercising continuous control on a long, tiring flight. Small knobs, or wheels, in the cockpit are provided to effect some of these adjustments in flight. Other tabs are adjustable only when the aircraft is on the ground. If the pilot lands and reports tail, nose, or wing heaviness, the remedy might be an adjustment of the tabs according to the need. Trim tabs are sometimes combined with balancing tabs and flying tabs.

![Diagram of airplane control surfaces](image_url)

This brief look at the basic structure of an airplane does not explain all there is to know about the control surfaces. With this familiarization you should be able to recognize these parts and understand in a general way how they function.
2.1.5 Fuel Selector

Although not part of the aircraft structure, the fuel selector is very important. The POH checklist details when the switch must be in BOTH (e.g., for takeoff and landing) but the PIC will often position the switch to RIGHT or LEFT to even out fuel consumption. The switch is also placed in RIGHT or LEFT prior to refueling.

2.2 Aircraft instruments

2.2.1 Magnetic compass

The magnetic compass shows the aircraft’s heading in relationship to the earth’s magnetic North Pole. This instrument requires no power or vacuum, so it can be used even in the event of complete electrical or vacuum system failure. However, it is not as stable as gyro-driven heading indicators, and does not show heading well during turns. It also is affected by the metal structure of the aircraft and by the magnetic fields produced by electronic equipment. It is primarily used to calibrate the other heading systems and as a backup in case they fail.
2.2.2 Heading Indicator

The heading indicator is easier to use than the magnetic compass. Because it is gyroscope-driven it provides a steady, reliable indication during turns. Since gyroscopes can develop errors over time, this instrument must be aligned periodically during a flight. It may be automatically updated through a "slave" connection to a magnetic compass, or the pilot may manually set it. The gyroscope that powers this instrument is normally driven by a vacuum pump but may be electrically powered.

2.2.3 Altimeter

The altimeter shows pressure altitude, and is usually set to show altitude above Mean Sea Level (MSL). If the local barometric pressure is not set in the instrument, the altitude reading will not be correct.

2.2.4 Turn Coordinator

The turn coordinator combines two instruments. The miniature aircraft indicates the direction and rate at which the aircraft is turning. The ball on the bottom is a slip indicator that indicates whether the aircraft is flying straight or is yawed to one side or another.
2.2.5 **Airspeed indicator**

The airspeed indicator shows the speed at which the aircraft is moving through the air. It is normally calibrated in nautical miles per hour (knots), although some indicate statute miles per hour. There are colored arcs around the outside of the dial indicating certain operating limits for the aircraft. These may include flap operating range, normal operating range, and maximum speed. Refer to the aircraft's operating manual for a complete description of the colored arcs and their meaning.

![Airspeed indicator](image)

2.2.6 **Vertical speed indicator**

The vertical speed indicator indicates the rate at which the aircraft is climbing or descending. It is usually calibrated in feet-per-minute. This instrument is most often used while flying in instrument conditions. Because of its design, it has a one or two second lag before an accurate indication is displayed.

![Vertical speed indicator](image)

2.2.6A **Attitude Indicator**

The attitude indicator is highly reliable and the most realistic flight instrument on the panel. Its indications are very close approximations of the actual attitude of the airplane. It is normally powered by the vacuum system.

![Attitude indicator](image)
2.2.7 Engine instruments

Each aircraft has a different set of engine instruments. These may include a tachometer to show engine speed (rpm), oil pressure gauge, oil temperature gauge, and cylinder head temperature. Many engine instruments have colored arcs to show normal operating ranges.

2.2.8 Global Positioning System (GPS)

The GPS is a satellite-based system that provides highly accurate position and velocity information. GPS is unaffected by weather and provides a common grid reference based on latitude and longitude. GPS receivers (ARNAV Star 5000 and Apollo GX55 shown below) measure the distance from the satellites (usually the best four) using the travel time of radio signals. The receiver computes navigational values such as distance and bearing to a point, ground track and speed, and estimated time-in-route by using the airplane's known position and referencing this to its database. This database also contains much other useful information concerning airports and navigational aids.

A typical VFR-rated GPS will provide horizontal position accurate to within 30 meters and vertical position accurate to within 160 meters.
2.2.9 Navigation/Communications Radios

Most civil aircraft use VHF (AM) for short-range communications; military aircraft use UHF (AM) or VHF. Most SAR aircraft are equipped with dual navigation/communications transceivers (Nav/Comm). These allow the pilot to talk to ground agencies, other aircraft and navigate the aircraft. The figure below shows a typical Nav/Comm radio (KX 155); the one in your aircraft may be slightly different. The communication side allows the pilot to tune in a voice frequency and have another in "standby" mode. The navigation side works the same way, allowing the pilot to tune the specific frequency for an electronic navigation aid. Either frequency can easily be transferred into the active window by the push of a button (this function is often referred to as "flip-flop").

![Navigation/Communications Radios](image)

2.2.10 Audio Panel

The audio panel (KMA 24 and PMA7000MS shown below) serves two primary functions: it selects which radio(s) the crew will be transmitting on and listening to, and allows various communication and navigation instruments to be directed to the aircraft's overhead speaker or to the headphones. Because improper setup of the audio panel can lead to confusion and missed radio calls, do not reposition the switch or any of the pushbuttons without consulting with the Pilot-in-Command! Operation of the audio panel is covered in detail in Chapter 4.

![Audio Panel](image)

2.2.11 Transponder

The Mode C altitude-reporting transponder provides a strong signal to ground radar and provides air traffic controllers with information such as airplane identification, position and altitude.

The transponder is usually warmed up in the Standby position while taxiing; it is turned on (ALT) just before you take the active runway. Search aircraft transponders must be on during flight.

![Transponder](image)
Knobs allow you to select the desired (or assigned) code on the transponder. The normal code for VFR flight is 1200, although ATC will assign a different code when you are in a terminal radar service area or have requested flight following. Also, ATC may request that you "Ident"; pressing this switch (or button) will send a pulse that causes a special symbol to appear on the radar screen to allow positive identification by the controller.

There are some codes used only for special situations or emergencies, and you should avoid passing through these codes when you are setting or changing your assigned code. These codes are 7500 (for hijacking), 7600 (for lost communications), and 7700 (for emergency).

2.3 Weight and Balance

You will often hear the phrase “weight and balance” used in conjunction with preflight planning and preparation of the aircraft. Aircraft are designed to operate within specific design criteria, and exceeding these criteria can have devastating consequences. This section will discuss these issues in general terms. For information relating to weight and balance for a specific make and model of airplane, you should refer to the aircraft’s flight manual.

2.3.1 Weight

The force of gravity continually attempts to pull the aircraft toward the ground. The only force that counteracts weight is the lift generated by the wings. However, the amount of lift produced by an airfoil is limited by the airfoil design, angle of attack, airspeed, and air density. Therefore, you must avoid overloading the aircraft to ensure sufficient lift is generated to counteract the weight. If aircraft weight exceeds the manufacturer’s recommendations, the aircraft may not be able to take off, or may exhibit unexpected and potentially lethal flight characteristics.

Every item on the aircraft contributes to its weight. Each aircraft is weighed after production and the figures are recorded in the maintenance log. When extra equipment, such as radios or other instruments, is added to the aircraft, the aircraft’s weight is adjusted in the log. This figure is commonly referred to as “empty weight.” For each flight, the pilot computes further increases in the weight for items that are required for that flight. The first of these is oil and fuel for the engine. Fuel weighs approximately 6 pounds per gallon, so this is a very important consideration. If a large load is carried in the aircraft, the pilot may elect to only partially fill the fuel tanks. This, of course, limits range and must be done very carefully because the fuel gauges are not accurate enough to indicate small quantities of fuel.
2.3.2 Balance

Balance refers to the location of the center of gravity (C.G.) of an airplane and is critical to airplane stability and safety of flight. While gravity obviously affects the entire aircraft, for computations it can be assumed that the aircraft's weight is concentrated at the center of gravity. Figure 2-5 shows that gravity pulls down on the center of gravity, and the wings produce lift to counteract that force. The horizontal tail surface produces lift in a downward direction to balance weight and lift and keep the aircraft level. The pilot can change the force created by the horizontal tail by deflecting the elevator, and that causes the nose of the aircraft to go up and down. The purpose of planning aircraft balance before flight is to ensure the horizontal tail can generate enough lift to balance the aircraft and provide sufficient pitch control. The pilot controls the balance of the aircraft by calculating the center of gravity and loading the airplane to keep the C.G. within certain limits.

![Figure 2-5](image)

If the C.G. is not adjusted properly before flight, it can affect the stability of the aircraft. Modern civilian aircraft are designed to be stable in flight; this makes the aircraft safer and easier to operate. Positive pitch stability causes the aircraft to stay in a stable pitch attitude without constant manipulation of the controls, and pitch stability depends on the location of the C.G. in relationship to the center of lift. If the aircraft is loaded "tail heavy," the center of gravity will move aft toward the center of lift, and the aircraft will become less stable. In worse case conditions this can make stall recovery difficult or impossible.

Incorrect balance can also affect the control of the aircraft. The elevator on the horizontal stabilizer is used to vary the force on the tail and thereby change the pitch attitude of the aircraft. If the aircraft is loaded "nose heavy," it could result in a condition where the horizontal tail surface cannot generate enough force to raise the nose. This is especially noticeable at the slow airspeeds that are used during takeoff and landing, and that is the worse possible time to discover you have a balance problem.

The manufacturer establishes limits for the location of the airplane's center of gravity. There are fore and aft limits beyond which the C.G. should not be located for flight. For some airplanes, the C.G. limits, both fore and aft, may be specified to vary as gross weight changes. They may also be changed for certain operations such as acrobatic flight.

Every item in a balance problem has two components, a weight and a moment arm. Even the empty aircraft has both of these components. The moment arm is the item's distance from a specified point on the aircraft called the datum. In civilian aircraft the datum is often located at the aircraft's firewall, but
that is not always the case. Figure 2-6 shows the parts of a typical balance problem. The pilot begins with the weight and moment arm of the empty airplane, and then makes changes for the oil, fuel, passengers and baggage. The result must fall within the published limits for the aircraft, or something will have to be moved until the C.G. falls within those limits.

![Figure 2-6](image)

### 2.3.3 Computing weight and balance

Computing weight is very simple. The pilot starts with the documented empty weight of the aircraft and adds the weight of any items that are loaded for the flight. This figure should not exceed the published maximum gross weight for the aircraft.

Computing balance is a little more involved. Each item’s weight and moment arm must be used to determine whether the loaded aircraft falls within the manufacturer’s limits. Here’s an example problem:

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight</th>
<th>Moment / 1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty airplane</td>
<td>1340</td>
<td>51.6</td>
</tr>
<tr>
<td>Oil</td>
<td>15</td>
<td>-0.3</td>
</tr>
<tr>
<td>Pilot and front passenger</td>
<td>320</td>
<td>11.2</td>
</tr>
<tr>
<td>Fuel</td>
<td>240</td>
<td>11.6</td>
</tr>
<tr>
<td>Rear seat passenger</td>
<td>300</td>
<td>21.6</td>
</tr>
<tr>
<td>Baggage</td>
<td>60</td>
<td>5.5</td>
</tr>
<tr>
<td>Totals</td>
<td>2,275</td>
<td>101.2</td>
</tr>
</tbody>
</table>

The moment for each item is determined using another chart in the aircraft manual. Then, the total weight and moment are used to enter the chart shown below and determine whether the aircraft is properly loaded. In this case, the aircraft falls within the C.G. envelope for normal operations.
Notice the moment arm for the oil is a negative value. This happens because the datum for this aircraft is located at the firewall, and the oil is located in the engine, which is in front of the firewall. The moment for the oil is subtracted from the total moment, and all other calculations proceed as normal.

2.4 Preflight inspection

The act of preflighting an airplane is no more than a safety check and evaluation of the craft’s condition for the flight. This is the pilot’s responsibility, and exactly how it is done will depend on the pilot’s individual routine. Normally, the rest of the aircrew stands well clear as this preflighting process is carried out. If you are asked to help, you probably will call out each item on the checklist. When the pilot has examined the item called out, he or she will give a signal such as “check” or “OK.” This means the pilot is ready for the next item to be called out. This method of checklist accomplishment is called “challenge and response.” Figure 2-7 shows the major parts of the aircraft that are included in the preflight inspection.
The walk-around inspection is the major portion of preflighting (remember that looking for potential obstructions in the parking area is part of the preflight). A visual inspection will be made to ensure the aircraft is airworthy. Condensation can accumulate in the fuel tanks, and water in the aircraft's fuel can result in a reduction or complete loss of power. Aircraft fuel tanks have a drain at the bottom, and the pilot will use a "fuel sampler" to extract a small amount of fuel from each tank and inspect it for water contamination. Note: for environmental reasons, fuel that is 'sumped' in this manner should be placed in a designated container rather than being thrown out on the ramp.

Fuel gauges sometimes malfunction, so a visual check of the fuel quantity is accomplished. On high wing aircraft the pilot may have to use a stepladder to get to the fuel filler caps. Remove each cap and peer in the tank to make certain that it is filled. Normal procedure is to fill the tanks upon completion of each sortie, but larger aircraft may not fuel "to the top" after each flight: in this case, each aircraft should have a measuring device to accurately determine fuel levels. As the walk-around continues, every movable, attached part will be tested for freedom of movement. Also hinges will be scrutinized closely to see that they are fully in place and not worn thin.

The propeller and its attachment to the engine receive careful attention. A large nick or hairline crack in a propeller could cause it to fail in flight. There are many other items to check as the pilot continues the walk-around inspection. When it is completed you will be instructed to board the airplane. Remember to fasten your seat belts securely.

More preflight will take place after the crew is in the airplane. Other checklists are followed to start the engine, adjust radios and electronic navigation equipment, and check control surfaces. Pre takeoff is a short one and is used to see that the engine is working properly, the controls are free, and that the control surfaces (ailerons, elevator, and rudder) are moving in the right directions.
2.5 **Ground Operations and Safety**

Safety begins when you arrive at the airport. We will discuss operations and safety practices that apply from the time you arrive until takeoff.

**NOTE:** The most dangerous part of any mission is driving to and from the airport or mission base. Even though you should treat every callout as an emergency, you should always obey traffic signs and speed limits. An accident, even a minor fender bender, will delay you far longer than if you had stopped at all traffic lights and stayed within posted speed limits.

### 2.5.1 Ramp safety

Safe activity in the vicinity of aircraft depends on everyone knowing certain “do's and “don'ts.” Memorizing a list of what one should and should not do is desirable, but everything that could happen in a situation cannot be contained in a list. So, knowing certain basics are a beginning only; from this point on the person must be observant and think! Distraction and hurrying are part of a sure formula for mistakes.

In addition to remembering some very important do's and don'ts, and thinking, it is good practice to demonstrate courtesy. Individual aircraft owners who lend their craft to missions have a lot of money invested. Remember, aircraft and the equipment on them are fragile. Because of high investment and the fragility of the craft, owners are very protective of their property. Your demonstration of respect for their property will cause them to accept you quickly as one of the team.

**No smoking**

You will see “No smoking within 50 feet” signs at aviation gasoline pumps. This distance is stated because of the possibility of igniting gasoline fumes when any closer to the pumps. Such signs will not be displayed on SAR aircraft. Yet, the same rule applies. Why? All aircraft have fuel overflow vents through which gasoline may spill onto the ground when heat causes it to expand. As the gasoline evaporates its fumes may travel in any direction. Therefore, an open flame anywhere near the airplane could cause the airplane to catch fire.

The best or safest precaution is to forget about smoking when you are anywhere near aircraft or gasoline pumps or better yet - the flight line. There may be specially designated smoking areas at your mission headquarters. If so, use them. After all, they were designated for a special purpose - to avoid the loss of valuable property and, possibly, life.

**Keep clear**

You should always remember that an aircraft that is moving on the ground (taxiing) is a dangerous vehicle. You could be injured if struck by any part of the airplane, but the propeller is a real killer. The propeller spins so rapidly it is invisible most of the time, and this may be part of the explanation of why so many people have been killed by propellers. Still another part of the explanation must be that the victims were not paying attention to what they were doing - they were not thinking!

The airplane does not have to be moving for its propeller to be spinning. When a pilot starts the engine the propeller starts spinning. Before the airplane begins to taxi, the pilot lets the engine run while he makes adjustments to radios and other items in the cockpit. The reverse process takes place at the end of the flight. Engine shutdown is one of the last items on the pilot's checklist, so the engine may be kept running for several minutes after the airplane stops moving.

Because of the design of an aircraft electrical system, it may be possible for an engine to start by itself. Therefore, *never touch or even get close to a stopped*
propeller (resist the impulse to position the propeller so that it "looks nice"). Remember, keep well clear when the airplane is moving or when its engine is running, and always stay clear of the propeller even if it is stopped.

The trailing edges of the wings, flaps, and ailerons may be very sharp and are often right at head level. You should take extra care when moving around the aircraft and looking at some other item of detail.

**Fire on the ground**

As a general rule, the action to take in case of fire on the ground is to get away from the airplane. Whether you should run is a matter of judgment. After all, the fire may be a very small one that is confined to the engine compartment. If this is the case, the fire could be extinguished if action is taken quickly. Know where the nearest fire extinguisher is (each airplane has a small fire extinguisher on board, but it is of no use in this situation).

Remember, however, to use your head. If there is a small fire, but gasoline is pouring out of the fuel tanks, and if it isn't necessary to help other members of the aircrew get away, you should get away from the aircraft as fast as safely possible.

### 2.5.2 Moving and loading the aircraft

Aircraft, unlike automobiles and other vehicles, seem very flimsy to us. Actually, they are extremely strong, but only when the loads and forces acting on them are applied in the amounts and directions for which their designers intended. Other forces and loads can easily cause minor or major damage to the aircraft. Due to the complexity of their structure, even minor damage can be very expensive to repair.

When ground handling and pushing an airplane, never push or pull on the propeller. Also, don't rotate, hold, or stand near the propeller. Aircraft ignition systems are designed differently from those in cars, and even slight propeller movement, especially when the engine is still warm, can sometimes cause the engine to "fire" momentarily, hurting anyone in the propeller's path. Few individuals survive being struck by a propeller with anything less than major injuries. If you must push the aircraft, first check the aircraft operating manual or handbook to determine the proper locations for ground handling. Never push the aircraft at any point that has "No Push" painted on it.

When loading the aircraft, ensure all loose items are stowed or secured. In moderate to severe turbulence, loose objects in the airplane cabin can suddenly become projectiles that can hurt cabin occupants or damage the aircraft. If the aircraft is equipped with cargo nets or cargo straps, use them. Also, make sure that you do not overload the baggage compartments, as this will affect C.G.

### 2.5.3 Entry and Egress

Be very careful where you step when boarding or exiting the aircraft. Most aluminum wing skin will not support the weight of even a small adult without dimpling or distorting. On low-wing aircraft like the Cherokee, the portion of the wing that will support such weight is usually covered with black or gray nonskid material and is known as the wing walk. On high-wing aircraft like single-engine Cessna's, never step on the pod or "pant" that often covers each main wheel and tire assembly: wheel pants and mounting supports are not designed as steps, and will be bent or damaged if used as such. You may also see parts of the aircraft labeled "No Step" and "No Handhold." It is very important to follow the warnings given by these placards.

Entering or exiting an airplane while the engine is running is highly discouraged. Spinning propellers are nearly invisible and can easily injure or kill
an inattentive person. If you must board while the engine is running, make sure the aircraft is stopped and pilot has you in sight, and approach the airplane from behind the wing. Also remember that propellers can throw up dust and dirt even when spinning at idle power settings. As a habit, you should also depart an aircraft toward the rear.

Normally, the scanner(s) enter the aircraft's back seat first, followed by the observer in the right front seat. The first thing that one should do upon taking a seat in any aircraft is to fasten your seat belt and shoulder harness. It is good sense and good safety to keep them fastened at all times. In flight, especially low-level flight, there is almost always some degree of air turbulence. Even when taxiing, there is the possibility of a sudden stop. You normally exit the aircraft in the reverse order: the observer or pilot leaves the front seat forward while crewmembers in the back seat exit.

Always wear your seat belt and shoulder harness in the aircraft. WASAR regulations require all occupants to wear seat belts and shoulder harnesses anytime the aircraft is at or below 1000 feet AGL. Once above 1000’ AGL you may remove the shoulder harness, but it makes good sense to leave it fastened in case unexpected turbulence is encountered. Also, don’t touch anything in the aircraft, especially knobs and switches, unless you are familiar with its purpose and use.

Part of the preflight briefing by the pilot will concern emergency egress. Pay attention, because you don’t want any confusion when exiting an aircraft during an emergency. As a rule (Cessna’s), in an emergency all crewmembers will remove their headsets. The pilot will leave his/her seat full forward while the back-seat crew exit through the doors. The pilot and observer will follow (either may grab the fire extinguisher on the way out).

**Fuel management**

The pilot is responsible for ensuring there is enough fuel on board to complete the flight safely, while maintaining an adequate reserve. Sometimes, the weight of the passengers and equipment needed for a sortie will necessitate taking off with less than full tanks. The pilot should brief you on the fuel situation before leaving on a sortie, including his assumptions on how much fuel will be needed and where you will refuel, if necessary. Never be hesitant to ask questions about the fuel status. This topic will be covered in more detail in Chapter 13.

### 2.5.4 Taxiing

While taxiing the aircraft, all crewmembers should watch in all directions for any obstacles that might contact and damage the airplane, such as other airplanes, fuel trucks, signposts, linemen, or fence posts. Frequently, in crowded parking areas, it may be necessary for the pilot to taxi the airplane near an obstruction. Anytime the aircraft is within 10 feet of obstacles the pilot should stop, and then taxi at a speed not to exceed a slow walk.

If the obstacle is very close the crew should not attempt to taxi the aircraft; they should get out and push the aircraft clear of the obstacle. The crew can also obtain the assistance of a marshaled or "wing walker" to visually confirm the airplane will clear an obstruction. When in doubt, get out and push!

Ground crew use hand signals to help pilots during taxi operations. These signals can be found at the end of this chapter (Figure 2-9).

In addition to avoiding obstacles, aircrews must assist the pilot while taxiing around the airport in order to prevent collisions with other aircraft and vehicles. Additionally, all crewmembers should assist the pilot in finding and staying on a taxiway, especially during bad weather or at night on unlighted airports. In order to do this, you should have a basic knowledge of airport signs and markings.
**Airport signs and markings**

*Runway markings are white and taxiway markings are yellow.*

Taxiway *centerlines* are *solid yellow lines*, while taxiway edges are double yellow lines (if dashed, can cross).

May have blue taxiway edge lights or unlighted blue cones.

May have green lights imbedded in the centerline (as well as taxi paths) to assist taxiing aircraft in darkness and low visibility conditions.

May be enhanced on light-colored pavement with a black border.

*Mandatory signs* have a red background with a white inscription, and are used to denote an entrance to a runway or critical area where an aircraft is prohibited from entering without ATC permission.

**15-33**

Holding position for a runway. Located next to yellow holding position marking on taxiways and on runways that intersect other runways. *Do Not Cross without ATC permission!*

May have a row of red *stop bar lights*, embedded in the pavement and extending across the taxiway at the runway holding position. When illuminated they designate a runway hold position. NEVER cross a red illuminated stop bar, EVEN if ATC clearance has been given to proceed.

**15-APCH**
Holding position for approach area, located next to the yellow holding position markings. *Do Not Cross without ATC permission!*

**ILS**

Holding position for Instrument Landing System. *ATC may hold you at this sign* when the instrument landing system is being used.

**No Entry.** Typically located on a one-way taxiway or at the intersection of vehicle roadways with runways, taxiways or aprons where the roadway may be mistaken for a taxiway.

Remember, the aircrew must back up the pilot during heavy workload conditions. If you see the pilot about to cross a holding position without ATC permission, speak up!
Holding position *marking* for runway boundary.

Four yellow lines: two solid and two dashed. The aircraft stops behind the solid line (which ensures you are still on the taxiway). *Do Not Cross without ATC permission!* [Note: When exiting the runway, make sure you cross the solid lines before stopping; see the runway boundary sign below.]

May have yellow *clearance bar lights* embedded in the pavement. When installed with geographic position markings they indicated aircraft hold points. May have flashing yellow *runway guard lights* elevated or in-pavement, at runway holding positions.

*Location signs* are used to identify either a taxiway (letters) or runway (numbers) on which an aircraft is located, or to provide a visual clue to the aircrew when the aircraft has exited an area.

Shows which taxiway or runway you’re on. May be co-located with direction signs or runway holding position signs.
Runway boundary signs have a yellow background with a black inscription. Located adjacent to the holding position marking on the pavement and visible when exiting the runway, they provide a visual clue in determining when you are clear of the runway.

![Runway boundary sign](image)

ILS Critical Area boundary signs have a yellow background with a black inscription, and are visible when exiting the runway. Make sure you pass before stopping.

![ILS Critical Area boundary sign](image)

*Direction signs* indicate the direction of intersecting taxiways or runways, and are used in conjunction with location signs (like the black 'A' taxiway location sign shown below).

![Direction signs](image)

**Airport-related ATC clearances**

You also need to be familiar with certain ATC ground clearances that involve these airport signs and markings in order to back up the pilot when taxiing. Controllers are required to get an acknowledgement of "hold short" instructions, so a "hold short" clearance must be read back.
You should read back every clearance. For example, "cleared to taxi" or "taxi" (clearance implied), "cleared for takeoff, turn right on course," "enter a right downwind for 22" (clearance implied), or "cleared to land 22." Other examples:

"Taxi to.." Cleared to taxi to any point other than an assigned takeoff runway. Cleared to cross all runways that intersect the taxi route to that point. DOES NOT include authorization to taxi onto or cross the assigned runway.

"Taxi to.. hold short of .." Clearance to begin taxiing, but enroute to the taxi clearance limit you must hold short of another taxiway or a crossing runway as specified by the controller.

"Cross runway.." Cleared to taxi across the runway crossing your taxi route and continue to the taxi clearance limit.

"Hold short.." DO NOT enter or cross the taxiway or runway specified by the controller. If there is a painted hold line, do not cross it.

"Report location." Identify your location on the airport.

### 2.6 Wake turbulence

All crewmembers must be alert to prevent the aircraft from taxiing closely behind any large aircraft, either jet or prop, which has its engines running. Thrust produced by the operating engines, even at very low power settings, can blow the light airplane out of control. Rotor "down wash" from an operating helicopter can have a similar disastrous effect. Noise level from both the engines or props and air movement is one means you have of estimating the large aircraft's power setting and thus any danger from turbulence.

Wake turbulence is the disturbance of air caused by a large airplane's movement and is sometimes called "used air." This is a major cause for concern to all aircrew members. It develops when the motion of the aircraft structure, especially at the wing tips, disrupts normal air movement. Higher-pressure air beneath the wing continuously "spills" upward and around the tip to the lower pressure area above the wing. This creates a spiral vortex that, if visible, would resemble a horizontal tornado. Figure 2-8 depicts the generation of wing-tip vortices by an aircraft.

![Figure 2-8](image.png)

The amount of wake turbulence an aircraft produces is directly related to the amount of lift the aircraft's wings must produce. All aircraft wings, even the lightest ones, produce some amount of wake turbulence, but it is not normally a danger unless the aircraft creating it is large, or heavy, and its wing is creating lift.
Vortex strength varies with the size, speed, and shape of the wing. Large or "jumbo" jets create the most severe wing-tip vortices when they are taking off or landing. In a no-wind condition, the vortices spread outward and away from, and sink beneath the parent aircraft where normal atmospheric turbulence eventually disperses them. Vortices may remain active well after the aircraft that spawned them has passed. The duration of activity depends on the stability of the atmosphere at vortex level.

The FAA has studied wake turbulence and has published avoidance procedures for light-aircraft pilots. The agency recommends, when taking off behind a large jet, to wait several minutes for the vortices to disperse, and to make certain that the small plane lifts off the runway well before reaching the point where the jet's nose wheel lifted off. A large airplane does not create strong vortices until its wing makes lift, which generally begins at nose wheel lift off. When landing behind a large jet, the small plane should stay well above the jet's flight path and land beyond the jet's touchdown point. Once the jet's main and nose wheels are on the pavement, the wings produce only negligible lift and wing tip vortices. Turbulence can even be a problem when a large aircraft departs or lands on a runway that is parallel to or intersects the runway you are using.

Wake turbulence is a consideration to all aircrews when departing and arriving at low altitudes. Light aircraft must stay clear of the area behind and below the larger aircraft. The pilot of the smaller airplane should climb to an altitude above the large airplane's flight path. One thousand feet below the larger aircraft's flight path is also considered safe vertical separation for avoiding wake turbulence. The pilot might consider descending more to allow for misjudging the large aircraft's altitude, if uncertain. If it's not practical to climb or descend, the light aircraft pilot should slow or turn the aircraft as required to increase the distance between his aircraft and the larger airplane. Operations from parallel runways can also be dangerous. Wake turbulence can move laterally if a crosswind is present, and may drift across to affect an aircraft on another runway. Air traffic controllers normally allow two to three minutes for the vortices to disperse, but it is the pilot's final judgment to continue the takeoff or approach and landing.
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2.7 Flight Line Hand Signals

- **Outward motion with thumbs.** PULL CHOCKS
- **Circular motion of right hand at head level with left arm pointing to engine.** START ENGINE
- **Raise arm, with fist clenched, horizontally in front of body, and then extend fingers.** RELEASE BRAKE
- **Thumb Up.** OK or YES
- **Thumb Down.** NOT OK or NO.
- **Arms above head in vertical position with palms facing inward.** THIS MARSHALLER
- **Arms a little aside, palms facing backwards and repeatedly moved upward and backward from shoulder height.** MOVE AHEAD
- **Arms down with palms toward ground, then moved up and down several times.** SLOW DOWN
- **Arms extended with forearm perpendicular to ground. Palms facing body.** HOT BRAKES
Right or left arm down, other arm moved across the body and extended to indicate direction of next marshal. PROCEED TO NEXT MARSHALLER

Arms extended with forearm perpendicular to ground. Palms facing body. Gesture indicates right side. HOT BRAKES - RIGHT

Arms extended with forearm perpendicular to ground. Palms facing body. Gesture indicates left side. HOT BRAKES - LEFT

Waiving arms overhead. EMERGENCY STOP

Point right arm downward, left arm repeatedly moved upward-backward. Speed of arm movement indicating rate of turn. TURN TO THE LEFT

Point left arm downward, right arm repeatedly moved upward-backward. Speed of arm movement indicating rate of turn. TURN TO THE RIGHT

Arms crossed above the head, palms facing forward. STOP

Make a chopping motion with one hand slicing into the flat and open palm of the other hand. Number of fingers extended on left hand indicates affected engine. FEATHER / FUEL SHUT-OFF

Either arm and hand level with shoulder, hand moving across throat, palm downward. CUT ENGINES
Figure 2-9
Flight line (Marshalling) Hand Signals

Make rapid horizontal figure-of-eight motion at waist level with either arm, pointing at source of fire with the other. FIRE ONBOARD

Raise arm and hand, with fingers extended horizontally in front of the body, then clench fist. ENGAGE BRAKE

Inward motion with thumbs. INSERT CHOCKS

Right arm raised with elbow at shoulder height with palm facing forward. MARSHALLER FINISHED
3. Survival and Urgent Care

This chapter introduces the fundamentals of aircrew survival, and is not meant to make you a survival expert. *Your most important survival tool is your attitude* -- having a positive mental attitude is often the difference between life and death in a survival situation.

Fundamental knowledge varies from region to region, depending on terrain, weather or other unique circumstances. When flying, pack for the worst-case scenario. If you depart Houston (flat, hot, humid) for Alpine (mountainous, cool, dry), you must prepare for the entire flight and include the items that you may need should an incident occur.

Preparation is important, and something you control. The aircraft should have a survival kit -- how long has it been since you inspected its contents? Are the flashlight batteries dead or corroded? Are medicines past their expiration date? Is it still packed for summer, even though it's January?

Also, everyone on board should know the location of the ELT and know how to activate it manually. They should know how to fashion a basic antenna for the ELT.

Finally, take advantage of modern technology and carry a cell phone with fresh batteries. You may not get a signal in remote areas, but most accidents occur near civilization so the odds are with you.

**OBJECTIVES:**

1. Discuss basic post-crash actions.
2. Concerning survival equipment (aircraft & personal), discuss:
   a. The importance of water.
   b. Types of signaling devices (CLASS).
   c. Basic survival equipment.
3. Concerning urgent care, discuss:
   a. The four most important measures (moving the victim, airway, pulse and bleeding).
   b. Post-urgent care directions.
3.1 Post-crash Actions

In the event of an off field landing there are some basic actions you need to take. Before the off field landing, follow the aircraft checklist; it will have the crew prop open doors (headsets work nicely), tighten seatbelts and shoulder harnesses, secure loose items, and turn off electrical equipment and fuel. If the doors become jammed, kick them open or kick out the windows; it is also possible to exit through the baggage door.

Familiarize yourself with how the front seats move, paying particular attention to the left seat-rail latch. Neither front seat can be moved from the rear seat, so it is important to agree on the sequence of events for emergency egress (this should be briefed during preflight). Also discuss what to do if one or more of the crew is incapacitated.

After the controlled off field landing, get clear of the aircraft if there is any danger of fire or a chance that the aircraft may fall on you. Check everyone for injuries and apply first aid. As a precaution, treat yourself for shock by sipping water.

Once the immediate danger has passed, you need to consider rescue. Hopefully, you were able to communicate your position. In either case, don't get impatient and leave the site -- your best chance of discovery is to stay with the aircraft.

Try your cell phone. If that doesn't work, activate the ELT.

Finally, if rescue is not immediately expected, consider what you are going to do about water, shelter, and food (in that order). If you don't panic, you should survive. Remember that your will to survive is your greatest asset.

3.2 Survival equipment

Water is your most important survival resource. If you fly over regions where water is plentiful, have some means to purify water such as a filter or purification tablets or carry a metal cup for boiling water.

Signaling equipment is also a must. For daytime use, nothing beats a signal mirror (in a pinch, you can use a CD or a mirror). For nighttime, a beacon or strobe works well, but nearly anything that produces light will do. Personal Emergency Locator Beacons (PLB’s) are also becoming popular.

If you have no signaling device and you need to improvise one, use the CLASS acronym:

- **Color**: Make it an unnatural or highly contrasting one (not one your see in nature).
- **Location**: Put it where it can be seen most easily, usually high and open areas.
- **Angles**: These do not appear in nature, so it can be noticed.
- **Size**: Large enough to be seen from the air (at least twelve feet in height).
- **Shape**: Eye-catching.

Put ten people into a room and ask what should be in a survival kit. Come back a week later and they will still be fighting. There are many good articles (and even books) on the subject, so please study the topic and come to a consensus among your aircrew members.
Some areas, particularly mountainous, desert or coastal areas, have very special needs (and some requirements, like for the equipment required for over water flight beyond gliding distance of land). These are not discussed here.

That said, as a minimum an aircraft survival kit should contain:

- Water (or purification tablets or a filter).
- Signal mirror.
- Space blankets (one for each crewmember).
- Rations like MREs (Meal Ready to Eat).
- First aid kit and manual.
- Survival manual (written for your region).
- Matches.
- Compass.
- Knife.

It’s a very good idea to carry a personal survival kit. There is no official definition for the items in such a kit, but the following list contains important items:

- Multi-function tool (e.g., Leatherman) that includes knife blades and needle-nosed pliers with side cutters.
- Pocket compass.
- Match safe with matches.
- Plastic or metallic container.
- Sewing needles and thread.
- Chapstick and sun block lotion, SPF 30 or greater.
- Bar surgical soap or hand soap containing physohex.
- Small shelter.
- Personal medicines.
- Water purification tablets or water filter.

In addition, here are some good-to-have items:

- Pen-gun and flares.
- Colored cloth or scarf for signaling.
- Plastic water bottle.
- Flexible saw (wire saw).
- Travel razor.
- Small steel mirror.
- Aluminum foil.

Remember, survival items will do you no good if they are out of date, spoiled, or inoperable. Check the kits periodically and replace items as necessary.
4. Communications

Airmen use several means to communicate, whether they are flying, taxiing, or stranded after an accident. Aerial communication has grown from simple techniques of dropping messages from airplanes to the use of highly sophisticated transceivers. In order to fulfill communication responsibilities involving the aircraft radio, mission aircrew must study basic communication techniques that are applicable to general aviation. This chapter will discuss radio communication techniques, and examine other non-verbal communication methods that may be used when circumstances don't permit two-way radio use.

OBJECTIVES:

1. Describe how to use the aircraft radio:
   a. Frequency increments, and number of digits displayed.
   b. Importance of listening before transmitting.
   c. Basic message format (i.e., who, where, and what).
2. Describe how to use the audio panel and.
3. Describe how numbers are pronounced.
4. Describe how characters are pronounced (phonetic alphabet).
5. Discuss the use of Prowords, particularly: Affirmative and Negative; figures; out and over; read back and say again; and Roger versus Wilco.
6. Discuss the use of code words.
7. Describe how to recognize a stuck mike, and corrective actions.
8. Discuss radio reports, and list the minimum required reports.
9. Identify light gun, body, Paulin, emergency distress, and air-to-ground signals.
10. Discuss air-to-ground coordination techniques.
11. Discuss airdrop procedures and safety concerns.
12. Discuss in-flight services:
    a. Flight Service Station purpose and how to contact.
    b. ATIS information and how to obtain it.
    c. AWOS/ASOS information and how to obtain it.
    d. The importance of PIREP'S.
4.1 Electronic Communications

The aircraft radio is the primary means of communication in aviation. To effectively use the radio, mission pilots and observers must be knowledgeable not only of how to communicate, but when communication is required during WSDOT missions. Observers may operate the aircraft communications radios in order to reduce pilot workload, and they use the FM radio to communicate with ground units. The techniques covered in this section were developed to improve clarity, to help keep communications transmissions brief, and as a means of giving words standardized meanings. Necessary communication should never be delayed while mentally searching for the appropriate terminology or phrase. If in doubt, always use plain language. Keep your radio transmissions clear, simple, and accurate, and practice using the radio so that you will be ready to go into action when the situation arises.

Some aviation frequencies are designed for air-to-air communications and may be used by SAR aircraft (or any other general aviation aircraft). 123.1 is the official nationwide SAR frequency. 122.75 and 122.85 MHz are air-to-air communications frequencies (and for use by private airports not open to the general public). 122.90 MHz is the Multicom frequency; it can be used for search and rescue, but is also used for other activities of a temporary, seasonal or emergency nature (note, however, that it is also used by airports without a tower, FSS or UNICOM). Follow your communications plan, if applicable, and don't abuse these frequencies. Look at the sectional to see if 122.90 MHz is used by nearby airports, and always listen before you transmit.

4.1.1 Using the aircraft communications radio

To establish radio communications (a KX 155 is shown in Figure 4-1), first tune the communications radio to the frequency used by the clearance or ground station. Almost all general-aviation aircraft transmitters and receivers operate in the VHF frequency range 118.0 MHz to 136.975 MHz. Search aircraft normally have 720-channel radios, and the desired frequency is selected by rotating the frequency select knobs until that frequency appears in the light-emitting diode display, liquid crystal display, or other digital frequency readout or window.

![Figure 4-1](image)

The 720-channel radios are normally tuned in increments of 50 kilocycles (e.g., 119.75 or 120.00). They can be tuned in increments of 25 kilocycles (e.g., 119.775) pulling out on the tuning knob, but the last digit of the frequency will not be shown in the display (e.g., 119.775 will be displayed as 119.77). Before
transmitting, first listen to the selected frequency. An untimely transmission can "step on" another transmission from either another airplane or ground facility, so that all the transmissions are garbled. Many pilots have been violated for not complying with instructions that, it was later determined, had been blocked or "stepped on" by another transmission. Next, mentally prepare your message so that the transmission flows naturally without unnecessary pauses and breaks (remember "Who, Where and What"). You may even find it helpful to jot down what you want to say before beginning the transmission. When you first begin using the radio, you may find abbreviated notes to be a convenient means of collecting thoughts with the proper terminology. As your experience level grows, you may find it no longer necessary to prepare using written notes.

Some radios have a design limitation that causes a slight delay from the instant the microphone is "keyed" until the radio actually starts transmitting. If you begin to speak before the radio has actually started to transmit, the first few syllables of the transmission will be lost. Until you become familiar with the characteristics of the individual radio, you may find it desirable to make a slight pause between keying the microphone and beginning to speak. When you are prepared to transmit, place the microphone close to your mouth and speak in a normal voice.

**Call signs**

The initial transmission to a station starts with the name of the station you’re calling (e.g., Amarillo Ground), followed by your aircraft call sign. You almost always identify yourself using your aircraft's tail number. Once you’ve identified the facility and yourself, state your position (e.g., "at the ramp") and then make your request.

WASAR aircraft should use the word "Rescue" in their call sign when priority handling is critical. From the example above, this would be "Cessna One-One-Nine-Rescue." DO NOT abuse the use of this code; it should only be used when you are on a critical mission and you need priority handling. NEVER use the word "rescue" during training or drills.

### 4.1.2 Using the aircraft audio panel

The audio panel serves as the "hub" for the aircraft's communication and NavAid equipment. Whatever type of audio panel is installed in the aircraft, it serves two basic functions:

- Selecting the 'active' radio (COM 1, COM 2, etc.). This is the radio over which you will transmit when you use the push-to-talk switch or the hand mike.
- Allows communication and navigational instruments to be directed to the aircraft's overhead speaker or to the headphones.

The position of the switch and the pushbuttons on the audio panel should be checked as part of each preflight. There is no set rules on how they should be set, and settings may vary according to the mission and the airspace you will be flying in. The important thing is to realize how the panel is set up so that your equipment will function as you need and expect them to function.

There are several types of audio panels installed in aircraft: the older type is the King KMA 24 (Figure 4-2) and the newest type is the PMA7000MS (Figure 4-3). [Note: Both have controls and indicators on the left-hand side (MKR or Marker) that are associated with instrument approaches, and will not be covered here.]
KMA 24

One of the most common older audio panels, the KMA 24 is still found in many aircraft. The switch on the right-hand portion of the panel determines which radio you will transmit on; also, if none of the pushbuttons are depressed, the switch setting (e.g., COM 1) determines which radio you are listening to. The pushbuttons are arranged in two rows: the upper row is associated with the aircraft’s overhead speaker, and depressing these pushbuttons will direct their associated equipment to the speaker (e.g., press the ADF pushbutton and the ADF will be heard on the speaker); the bottom row is associated with the headphones and serves the same function.

Depressing a pushbutton routes the signal from the associated instrument (e.g., a com radio or the ADF) to the speaker or your headphones, regardless of the setting on the COM switch. This comes in handy when you want to monitor two frequencies at the same time. For example, you have Center on the #1 radio and the COM switch in the COM 1 position. You will be flying near a local airport and want to listen to its CTAF. Set the CTAF in the #2 radio and depress the COM 2 PHONE pushbutton. You will now be able to hear both frequencies, but still will only be able to transmit on Center frequency.

The two most common mistakes made with this type of audio panel include: transmitting on the wrong frequency because you set the desired frequency in one radio but failed to select the corresponding COM channel; and failing to hear a message over the FM radio because you failed to depress the appropriate pushbutton (usually the TEL pushbutton) to direct the call to the overhead speaker or headphones.

PMA7000MS

This audio panel was custom-designed to meet SAR operational requirements. In addition to normal audio panel functions, this unit contains an automatic voice-activated (VOX) stereo intercom system with automatic squelch control.

Refer to Figure 4-4. Unit power is turned on and off by pushing the Volume knob. In the Off (or Fail-Safe) position the pilot is connected directly to Com 1 to
allow communication capability regardless of unit condition (any time power is
removed or turned off the audio selector will be placed in the fail-safe mode). The
power switch also controls the audio selector panel functions, intercom, and
marker beacon receiver. Unless the Mic Selector is in Com 3 mode, at least one
of the selected audio LEDs will be on (Com 1 or Com 2).

The Volume control knob adjusts the loudness of the intercom for the pilot
and copilot only; it has no effect on selected radio levels, music input levels or
passengers' volume level. Adjust the radios and intercom volume for a
comfortable listening level for the pilot. [Most general aviation headsets today
have built-in volume controls; therefore, passenger volume can be adjusted on the
headset.] For best performance your headset microphone must be placed within
¼ inch of your lips, preferably against them. It is also a good idea to keep the
microphone out of a direct wind path.

The Operation Manual may be obtained at www.ps-engineering.com.

**Figure 4-4**

**Mic Selector switch and receiver switches.** Receiver audio is selected
through two momentary and six latched, push-button, backlit switches. Because
the rotary Mic (microphone) Selector switch controls what transceiver is being
heard, the Com 1 and Com 2 push-buttons are of the momentary type and do not
remain in when selected. Because of this, you will always hear the audio from the
transceiver that is selected for transmit by the rotary Mic Selector switch (in other
words, you can't transmit without listening to the receiver). You can identify which
receivers are selected by noting which of the switch LEDs are illuminated. Push
buttons labeled Nav 1, Nav 2, COM 3, DME, MKR (Marker), ADF and SPR
(Speaker) are "latched" type switches. When one of these buttons is pressed, it
will stay in the "in" position; press the switch again and it will be in the "out"
position and remove that receiver from the audio. When selected, the SPR button
will place all selected audio on the aircraft's overhead speaker (Note: the speaker
amplifier is not active in the split mode).

When the Mic Selector switch is in the Com 1 position, both pilot and copilot
will be connected to the Com 1 transceiver. Only the person that presses their
Push-to-Talk (PTT) will be heard over the aircraft radio. Turning the rotary switch
to the Com 2 position will place pilot and copilot on the Com 2 transceiver. The
PMA7000MS gives priority to the pilot's PTT; if the copilot it transmitting and the
pilot presses her PTT, the pilot’s microphone will be heard over the selected transmitter.

**Split Mode.** Turning the rotary switch to Com 1/2 places the PMA7000MS into “Split Mode.” This places the pilot on Com 1 and the copilot on the Com 2 transceiver. An example of this useful feature is when the pilot may want to talk to Air Traffic Control while the copilot/observer is checking weather with Flight Watch. Switching to Com 1/3, the pilot will be on Com 1 and the copilot will be on Com 3 (the FM radio). In Com 2/3, the pilot is on Com 2 and the copilot on Com 3. [Note: In split mode the pilot and copilot are usually isolated from each other on the intercom, simultaneously using their respective radios. Depressing the ICS button in split mode will activate VOX intercom between the pilot and copilot positions; this permits intercommunication when desired between the crew. Pressing the ICS button again disables this crew intercom function.]

The COMM antennas are normally mounted on top of the aircraft in close proximity to one another. As a result, if the pilot and copilot are transmitting simultaneously (e.g., Com 1/2) and the frequencies are close together, there may be some "bleed over.” This is usually not a problem when one of the persons is using the FM radio (e.g., Com 1/3 or 2/3)

**Swap Mode.** With an optional yoke-mounted switch, the pilot can change from the current Com transceiver to the other. This “Swap Mode” can be used to reverse transceiver selection in the split mode. For example, if the Mic Selector is in the Com 1/2 mode, pressing the swap button will place the pilot on Com 2 and the copilot on Com 1. When the swap mode is active, the swap indicator light (lower right corner of the unit) will illuminate, indicating that the Mic Selector switch position is no longer current. To cancel swap mode, the pilot may either press the yoke mounted switch again or turn the Mic Selector switch to the Com that is active.

The table below summarizes the transmitter combinations:

<table>
<thead>
<tr>
<th>Mic Selector</th>
<th>Normal</th>
<th>Swap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pilot</td>
<td>Copilot</td>
</tr>
<tr>
<td>Com 1</td>
<td>Com 1</td>
<td>Com 1</td>
</tr>
<tr>
<td>Com 2</td>
<td>Com 2</td>
<td>Com 2</td>
</tr>
<tr>
<td>Com 3</td>
<td>Com 3</td>
<td>Com 3</td>
</tr>
<tr>
<td>Com 1/2</td>
<td>Com 1</td>
<td>Com 2</td>
</tr>
<tr>
<td>Com 1/3</td>
<td>Com 1</td>
<td>Com 3</td>
</tr>
<tr>
<td>Com 2/3</td>
<td>Com 2</td>
<td>Com 3</td>
</tr>
</tbody>
</table>

**Intercom Mode.** A 3-position toggle switch (“Intercom Mode Sel.” in Figure 4-3) allows the pilot to tailor the intercom function to best meet the current cockpit situation. The following description of the intercom mode function is valid only when the unit is not in the “Split” mode (as mentioned before, the pilot and copilot intercom is controlled with the ICS button when in the split mode).

- **ISO** (up position): The pilot is isolated from the intercom and is connected only to the aircraft radio system. She will hear the aircraft radio reception (and side tone during radio transmissions). The copilot/observer will hear the passengers’ intercom and the back seat scanners will hear the copilot's intercom; neither will hear aircraft radio receptions or pilot transmissions.
- **ALL** (middle position): All parties will hear the aircraft radio and intercom.
CREW (down position): The pilot and copilot/observer are connected on one intercom channel and have exclusive access to the aircraft radios. Back seat scanners can continue to communicate with themselves without interrupting the pilot or copilot.

The following table summarizes the intercom modes:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Pilot Hears</th>
<th>Copilot Hears</th>
<th>Passengers Hears</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolate</td>
<td>A/C Radios, Pilot Side tone (during radio transmission), Entertainment 1 is Muted</td>
<td>Copilot and passenger intercom, Entertainment #1</td>
<td>Passenger and Copilot intercom, Entertainment #2</td>
<td>This mode allows the pilot to communicate without the others bothered by the conversations. Copilot and passengers can continue to communicate and listen to music.</td>
</tr>
<tr>
<td>All</td>
<td>Pilot, Copilot, A/C Radio, Passengers, Entertainment #1</td>
<td>Pilot, Copilot, A/C Radio, Passengers, Entertainment #1</td>
<td>Passengers, Pilot, Copilot, A/C Radio, Passengers, Entertainment #1</td>
<td>This mode allows all on board to hear radio reception as well as communicate on the intercom. Music and Intercom is muted during intercom and radio communications.</td>
</tr>
<tr>
<td>Crew</td>
<td>Pilot, Copilot, A/C Radio, Entertainment #1</td>
<td>Copilot, Pilot, A/C Radio, Entertainment #1</td>
<td>Passengers, Pilot, Copilot, A/C Radio, Entertainment #2</td>
<td>This mode allows the pilot and copilot to concentrate on flying, while the passengers can communicate amongst themselves.</td>
</tr>
</tbody>
</table>

Because improper setup of the audio panel can lead to confusion and missed radio calls, do not reposition the switch or any of the pushbuttons without consulting with the Pilot-in-Command!

4.1.3 Using the VHF FM radio

The TDFM-136 is a P25-compliant airborne transceiver capable of operating in the 136 MHz to 174 MHz range (digital or analog) in 2.5 KHz increments. It can have up to 200 operator-accessible memory positions, each capable of storing a receive frequency, a transmit frequency, a separate tone for each receive and transmit frequency, an alphanumeric identifier for each channel, and coded squelch information for each channel.
Data can be entered via the 12-button keypad but is normally downloaded from a PC. Operating frequencies, alphanumeric identifiers and other related data are presented on a 96-character, four-line LED matrix display. It is capable of feedback encryption.

The radio also has a scan function that can scan any or all of the main channels stored in the preset scan lists; scan lists, if enabled, are set by the wing communications officer.

As shown in Figure 4-5, the radio simultaneously displays two frequencies. The upper line is the Main (MN) frequency and the lower is the Guard (GD) frequency. Normally, you will be set up to transmit and receive on the Main and be able to receive the Guard frequency. This feature allows mission base to contact you at any time (via Guard), no matter what frequency you are using (Main).

Controls and normal settings:

- The knob above the MN/GD switch is the power switch and controls volume for Main. The knob above the G1/G2 switch is the volume control for Guard.
- The "Squelch" pushbutton is not used (automatic squelch). Don't push it.
- The MN/GD toggle switch selects the frequency on which you will transmit and receive. It is normally set to MN.
- The G1/G2 toggle switch selects the Guard frequency you are monitoring (G1 = Air-to-Ground and G2 = Primary). It is normally set to G1.
- The HI/LO toggle switch selects transmitter power (10 watts or 1 watt). It is normally set to HI.

Keypad operation:

- Pressing and holding "4" (Scroll Memory Down) will let you scroll down through the programmed memories (it wraps around). Upon reaching the desired entry, release the button. "6" (Scroll Memory Up) lets you scroll up. [Note: scroll speed increases the longer you hold the buttons.]
- Pressing "5" (Scan) lets you select a scan list to scan, and to start or stop the scan. Once the scan list you want is displayed press # ENTER to start the scan or press * ESC to stop the scan. [Note: this function must be enabled by the wing communications officer for it to work.]
- Pressing and holding "2" (Display - Brighter) will increase display brightness; "8" (Display - Dimmer) decreases brightness.

When you get in the aircraft and power up the radio it should be set to MN, G1 and HI. Use pushbutton 4 or 6 to select the assigned Main frequency (normally Air-to-Ground), and "004 Air/Grd 149.5375" will be displayed on the upper line. The second line should display the Guard 1 frequency (in this case, the same as Main).

As another example, lets say you are working with the U.S. Forest Service and have their frequency on Main. Mission base, noting that you have not called in your "Operations Normal" report, calls you using the G1 frequency. You will hear mission base over Guard (its set to G1), regardless of what is coming over the Main frequency. You simply take the MN/GD switch to GD and answer "Ops Normal," and then return the switch to MN and carry on with the mission.
4.1.4 Pronunciation

Radios do not always provide crystal clear sound. For example, 5 and 9, or B, D, T, and V may sound the same on a static-filled radio speaker. To minimize confusion, and to increase clarity, pronunciations of certain numbers and alphabetical characters used in radio transmissions have been accentuated.

Numbers are usually transmitted digit-by-digit, but there are some exceptions to that rule. For example, 10,000 is often transmitted as TEN THOUSAND, instead of ONE ZERO THOUSAND and radio frequencies are usually expressed like ONE TWENTY-EIGHT POINT ONE, instead of ONE TWO EIGHT POINT ONE.

Table 4-1 provides a sample of how numbers are pronounced when using either the aircraft or FM radio.

<table>
<thead>
<tr>
<th>Number</th>
<th>Spoken As:</th>
<th>Number</th>
<th>Spoken As:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ZERO</td>
<td>9</td>
<td>NINE ER</td>
</tr>
<tr>
<td>1</td>
<td>WUN</td>
<td>10</td>
<td>WUN ZERO</td>
</tr>
<tr>
<td>2</td>
<td>TOO</td>
<td>11</td>
<td>WUN WUN</td>
</tr>
<tr>
<td>3</td>
<td>TREE</td>
<td>33</td>
<td>TREE TREE</td>
</tr>
<tr>
<td>4</td>
<td>FO WER</td>
<td>136</td>
<td>WUN TREE SIX</td>
</tr>
<tr>
<td>5</td>
<td>FI YIV</td>
<td>500</td>
<td>FI YIV HUN DRED</td>
</tr>
<tr>
<td>6</td>
<td>SIX</td>
<td>1478</td>
<td>WUN FO WER SEVEN ATE</td>
</tr>
<tr>
<td>7</td>
<td>SEVEN</td>
<td>2100</td>
<td>TOO WUN ZERO ZERO</td>
</tr>
<tr>
<td>8</td>
<td>ATE</td>
<td>128.1</td>
<td>WUN TOO EIGHT POINT ONE</td>
</tr>
</tbody>
</table>

Table 4-1

Like numbers, the letters of the alphabet carry distinctive traits of pronunciation. When it becomes necessary to spell difficult words, groups of words, or to identify any letter of the alphabet, the standard phonetic alphabet is used. The word to be spelled will be preceded by the words “I spell.” If the operator can pronounce the word to be spelled, do so before and after spelling the word.

You should express your call sign phonetically when calling, entering, reentering, joining, or rejoining a net, and when difficult operating conditions may result in confusion or mistaken identity. At all other times, phonetic expression of call signs is not required. Table 4-2 shows the phonetic alphabet pronunciation for each letter.
**Letter Word Pronunciation**

<table>
<thead>
<tr>
<th>Letter</th>
<th>Word</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Alpha</td>
<td>AL FAH</td>
</tr>
<tr>
<td>B</td>
<td>Bravo</td>
<td>BRAH VOH</td>
</tr>
<tr>
<td>C</td>
<td>Charlie</td>
<td>CHAR LEE</td>
</tr>
<tr>
<td>D</td>
<td>Delta</td>
<td>DELL TAH</td>
</tr>
<tr>
<td>E</td>
<td>Echo</td>
<td>ECK OH</td>
</tr>
<tr>
<td>F</td>
<td>Foxtrot</td>
<td>FOKS TROT</td>
</tr>
<tr>
<td>G</td>
<td>Golf</td>
<td>GOLF</td>
</tr>
<tr>
<td>H</td>
<td>Hotel</td>
<td>HOH TELL</td>
</tr>
<tr>
<td>I</td>
<td>India</td>
<td>IN DEE AH</td>
</tr>
<tr>
<td>J</td>
<td>Juliet</td>
<td>JEW LEE ETT</td>
</tr>
<tr>
<td>K</td>
<td>Kilo</td>
<td>KEY LO</td>
</tr>
<tr>
<td>L</td>
<td>Lima</td>
<td>LEE MAH</td>
</tr>
<tr>
<td>M</td>
<td>Mike</td>
<td>MIKE</td>
</tr>
<tr>
<td>N</td>
<td>November</td>
<td>NOE VEM BER</td>
</tr>
<tr>
<td>O</td>
<td>Oscar</td>
<td>OSS CAH</td>
</tr>
<tr>
<td>P</td>
<td>Papa</td>
<td>PAH PAH</td>
</tr>
<tr>
<td>Q</td>
<td>Quebec</td>
<td>KEH BEK</td>
</tr>
<tr>
<td>R</td>
<td>Romeo</td>
<td>ROW ME OH</td>
</tr>
<tr>
<td>S</td>
<td>Sierra</td>
<td>SEE AIR AH</td>
</tr>
<tr>
<td>T</td>
<td>Tango</td>
<td>TANG GO</td>
</tr>
<tr>
<td>U</td>
<td>Uniform</td>
<td>YOU NEE FORM</td>
</tr>
<tr>
<td>V</td>
<td>Victor</td>
<td>VIK TAH</td>
</tr>
<tr>
<td>W</td>
<td>Whisky</td>
<td>WISS KEY</td>
</tr>
<tr>
<td>X</td>
<td>X-Ray</td>
<td>EKS RAY</td>
</tr>
<tr>
<td>Y</td>
<td>Yankee</td>
<td>YANG KEE</td>
</tr>
<tr>
<td>Z</td>
<td>Zulu</td>
<td>ZOO LOO</td>
</tr>
</tbody>
</table>

**Table 4-2**

### 4.1.5 Prowers

Prowers are pronounceable words and phrases that have been assigned a meaning for the purpose of expediting communications on radiotelephone circuits. Despite their economical uses, a Prowords, or combination of Prowords should not be used to substitute in the text of the message if they will distort, change, or cause the actual meaning of the message to become unintelligible. Table 4-3 contains a sample of Prowords commonly used in radio communication.

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION or MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFFIRMATIVE</td>
<td>Yes.</td>
</tr>
<tr>
<td>ALL AFTER</td>
<td>The portion of the message that follows (word).</td>
</tr>
<tr>
<td>ALL BEFORE</td>
<td>The portion of the message that precedes (word).</td>
</tr>
<tr>
<td>BREAK</td>
<td>I hereby indicate the separation of the text from other portions of the message.</td>
</tr>
<tr>
<td>COPY</td>
<td>I understand.</td>
</tr>
<tr>
<td>CORRECT</td>
<td>You are correct, or what you have transmitted is correct</td>
</tr>
<tr>
<td>CORRECTION</td>
<td>An error has been made in this transmission. Transmission will continue with the last word correctly transmitted.</td>
</tr>
<tr>
<td>DISREGARD</td>
<td>The last transmission was in error. Disregard it.</td>
</tr>
<tr>
<td>DISREGARD THIS TRANSMISSION</td>
<td>This transmission is in error. Disregard it. This proword should not be used to cancel any message that has been completely transmitted and for which receipt or acknowledgment has been received.</td>
</tr>
<tr>
<td>EXEMPT</td>
<td>The addresses immediately following are exempted from the collective call.</td>
</tr>
<tr>
<td>FIGURE(s)</td>
<td>Numerals or numbers follow.</td>
</tr>
<tr>
<td>FROM</td>
<td>The originator of this message is the address designator that follows.</td>
</tr>
<tr>
<td>I READ BACK</td>
<td>The following is my response to your instructions to read back.</td>
</tr>
<tr>
<td>I SAY AGAIN</td>
<td>I am repeating transmission or portion indicated.</td>
</tr>
<tr>
<td>I SPELL</td>
<td>I shall spell the next word phonetically.</td>
</tr>
<tr>
<td>TERM</td>
<td>DEFINITION or MEANING</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>I VERIFY</td>
<td>That which follows has been verified at your request and is repeated. To be used only as a reply to VERIFY.</td>
</tr>
<tr>
<td>INFO</td>
<td>The addressees immediately following are addresses for information.</td>
</tr>
<tr>
<td>INITIALS</td>
<td>Personal initials shall be spoken phonetically prefixed by the word “INITIALS.”</td>
</tr>
<tr>
<td>MESSAGE FOLLOWS</td>
<td>A message that requires recording is about to follow. Transmitted immediately after the call. (This proword is not used on nets primarily employed for conveying messages. It is intended for use when messages are passed on tactical or reporting nets.)</td>
</tr>
<tr>
<td>MORE TO FOLLOW</td>
<td>Transmitting station has additional traffic for the receiving station.</td>
</tr>
<tr>
<td>NEGATIVE</td>
<td>No or “permission not granted” or “that is not correct.”</td>
</tr>
<tr>
<td>OUT</td>
<td>This is the end of my transmission to you and no answer is required or expected.</td>
</tr>
<tr>
<td>OVER</td>
<td>This is the end of my transmission to you and a response is necessary. Go ahead; transmit.</td>
</tr>
<tr>
<td>PRIORITY</td>
<td>Precedence PRIORITY.</td>
</tr>
<tr>
<td>READ BACK</td>
<td>Repeat my message back to me. A request to repeat instructions back to the sender, for the purpose of confirmation. Also, the receiver's reply, repeating the instructions, as in: &quot;Read back is as follows...&quot;</td>
</tr>
<tr>
<td>RED CAP</td>
<td>Precedence RED CAP.</td>
</tr>
<tr>
<td>RELAY (TO)</td>
<td>Re-transmit this message to...</td>
</tr>
<tr>
<td>ROGER</td>
<td>I have received and understand all of your last transmission. This should not be used to answer a question requiring a yes or no answer.</td>
</tr>
<tr>
<td>ROUTINE</td>
<td>Precedence ROUTINE.</td>
</tr>
<tr>
<td>SAY AGAIN</td>
<td>Repeat all of your last transmission. Followed by identification data means &quot;Repeat __________ (portion indicated).&quot;</td>
</tr>
<tr>
<td>SPEAK SLOWER</td>
<td>Your transmission is at too fast a speed. Reduce speed of transmission.</td>
</tr>
<tr>
<td>SPELL, or I SPELL</td>
<td>Please spell, or &quot;I shall spell the next word phonetically.&quot;</td>
</tr>
<tr>
<td>STANDBY</td>
<td>I must pause for a few seconds.</td>
</tr>
<tr>
<td>THIS IS</td>
<td>This transmission is from the station whose designator immediately follows.</td>
</tr>
<tr>
<td>TIME</td>
<td>That which immediately follows is the time or date-time group of the message.</td>
</tr>
<tr>
<td>TO</td>
<td>The addressees immediately following are addressed for action.</td>
</tr>
<tr>
<td>VERIFY</td>
<td>Verify entire message (or portion indicated) with the originator and send correct version. To be used only at the discretion of or by the addressee to which the questioned message was directed.</td>
</tr>
<tr>
<td>WAIT</td>
<td>I must pause for a few seconds.</td>
</tr>
<tr>
<td>WAIT OUT</td>
<td>I must pause longer than a few seconds.</td>
</tr>
<tr>
<td>WILCO</td>
<td>I have received your signal, understand it, and will comply. To be used only by the addressee. Since the meaning of ROGER is included in that of WILCO, these two prowords are never used together.</td>
</tr>
<tr>
<td>WORD AFTER</td>
<td>The word of the message to which I have reference is that which follows _______.</td>
</tr>
</tbody>
</table>
As an example of using phonetic letters and numbers, consider the following hypothetical example:

You want to fly an aircraft, Cessna N9324, through Restricted Area R-2403B, just north of Little Rock, Arkansas. You must verify the status of that area before proceeding and can do so with a transmission such as this:

"Memphis Center, CESSNA NINER THREE TWO FOUR requests flight through Restricted Area TWO FOUR ZERO THREE BRAVO to Fort Smith at NINER THOUSAND, FIVE HUNDRED if that airspace is not presently active."

If the area is not active, you might receive a reply like this from Memphis Center:

"NINER THREE TWO FOUR, Memphis Center. Restricted Area TWO FOUR ZERO THREE BRAVO is not currently active. Proceed own navigation to Fort Smith."

Now that the controller has answered the request, you must make one final transmission so that the controller knows you have received and understood his instruction:

"Roger Memphis. CESSNA THREE TWO FOUR proceeding direct Fort Smith at NINER THOUSAND, FIVE HUNDRED."

In this communication exchange, both observer and controller were consistent in their messages. On the initial call-up, the observer first identified the station being called, then identified his aircraft fully before transmitting the request. [NOTE: Sometimes a controller will ask you for the type of aircraft, especially where speed and timing is a factor.]

The controller did the same, enabling both parties to know with certainty to whom each was speaking. Only when that positive identification has been established may the parties abbreviate the call sign, as in the observer’s later transmissions of "Cessna Three Two Four."

### 4.1.6 Code words

Because the frequencies WASAR & CAP normally use are not secure, code words and phrases are sometimes used to prevent unauthorized parties from obtaining the information and possibly compromising mission integrity. The incident commander may assign code words and phrases for mission members to use when transmitting important mission information, such as the sighting of the target aircraft, its location, and whether there are survivors.

ICs and communications leaders ensure the codes provided to mission members are exact and complete enough to relay vital information. However, the observer must be sure all the following information is relayed, even when code words are being used:

- The fact that a sighting has been made.
• Location or position of the target in accordance with the grid, map, or chart that is standard to the mission.
• Any survivor information that is available.

In most cases code words are not necessary.

4.1.7 Stuck mike

Occasionally, the transmit button on aircraft radio microphones gets stuck in the transmit position, resulting in a condition commonly referred to as a “stuck mike.” This allows comments and conversation to be unintentionally broadcast. Worse yet, it also has the effect of blocking all other transmissions on that frequency, effectively making the frequency useless for communication by anyone within range of the offending radio. You may suspect a stuck mike when, for no apparent reason, you do not receive replies to your transmissions, especially when more than one frequency has been involved. You may notice that the 'T' (transmit symbol) is constantly displayed on your communications radio and, in the case of the PMA7000MS audio panel, the transmit (TX) light in the lower right-hand corner is on continuously. You may notice a different sound quality to the background silence of the intercom versus the noise heard when the microphone is keyed but no one is talking. Often the problem can be corrected by momentarily re-keying the microphone. If receiver operation is restored, a sticking microphone button is quite likely the problem.

4.1.8 Mission radio reports

As a minimum, the aircrew must report the following to mission base:
• Radio check (initial flight of the day).
• Take off time ("wheels up").
• Time entering a search area.
• Time exiting a search area.
• Landing time ("wheels down").
• Operations normal ("Ops Normal"), at intervals briefed by mission staff.

4.2 Non-verbal communication

While you are on a mission, nonverbal signals may be the only available method of communication with a crash survivor or with ground teams. Mission aircrews may have to interpret these nonverbal messages and must be able to do so accurately regardless of the method used.

4.2.1 Light gun signals

If the radio in your aircraft fails, it is still very important for you to follow instructions from the tower at a controlled airport. In this case, you may have to rely on light gun signals from the control tower in order to receive the necessary landing and taxi clearances previously described. These clearance requirements still apply despite an inoperative radio. Table 4-4 shows each light gun signal, followed by its meaning.
<table>
<thead>
<tr>
<th>Color and Type of Signal</th>
<th>On the Ground</th>
<th>In Flight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady Green</td>
<td>Cleared for takeoff</td>
<td>Cleared to land</td>
</tr>
<tr>
<td>Flashing Green</td>
<td>Cleared to taxi</td>
<td>Return for landing</td>
</tr>
<tr>
<td>Steady Red</td>
<td>Stop</td>
<td>Give way to other aircraft and continue circling</td>
</tr>
<tr>
<td>Flashing Red</td>
<td>Taxi clear of runway area</td>
<td>Airport unsafe—Do not land</td>
</tr>
<tr>
<td>Flashing White</td>
<td>Return to starting place on airport</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Alternating Red and Green</td>
<td>General warning — exercise extreme caution</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-4

4.2.2 Body signals

Use of the body is one of the most common means of sending messages. These signals are called "body signals" since they involve the whole body, not just arm movements. They are easy to use because no special materials are needed. Body signals are shown on the last page of this chapter.

4.2.3 Paulin signals

"Paulin" is a short form of tarpaulin, which means waterproof canvas. If the victims of an accident are fortunate enough to have some Paulin material, they may be able to aid the rescuers greatly by sending signals with it (Figure 4-6). It would be better if it were large and brightly colored. If the paulins are laid in clear areas wherein their colors cause high contrasts, they can be seen from substantial distances.

![Figure 4-6](image-url)
4.2.4 Emergency distress signals

The standard emergency distress signals shown below are another form of ground-to-air communication. These signals may be constructed using strips of fabric, pieces of wood, stones, wreckage parts, or any other available material. Each letter is two to three feet wide and six to twelve feet long, with colors that contrast with the background, if possible. Another use for these signals is to inform aerial searchers of ground team findings and intentions, in the absence of radio contact.

4.2.5 Air-to-ground signals

Communicating by radio is the basic air-to-ground communication method. If this isn’t possible for any reason, the pilot has a limited number of signals that can be given using the aircraft itself, as illustrated in Figure 4-7. These signals serve as a standard means to acknowledge receiving and understanding signals from the ground. An “affirmative, I understand” response to a survivor’s signal can often be a morale booster, and renew hope for imminent rescue.

In addition to the four signals shown in Figure 4-7, there are two more that aircrews use to communicate with ground rescue teams. First, if the crew believes a ground team should investigate an area, the pilot may fly over the team, “race” the engine or engines, and then fly in the direction the team should go. The pilot may repeat this maneuver until the ground team responds or until another means of communication is established.

Second, you may pinpoint an area for investigation by circling above the area, continuing to do so until the ground team reaches the area and begins the search. The better the communication from ground-to-air and air-to-ground, the more coordinated the search will be and the greater the chances for success.
Figure 4-7

4.2.6 Air-to-ground team coordination

The basic plan for a combined air and ground team search is that the aircrew locates the objective and then guides the ground team to the objective. It sounds simple, but there are several factors to consider.

As an aircrew member, it is important to understand that you have the advantage of perspective; the long-range visibility that is inherent to flying is absent from the ground. You can see over the hills, trees, and other obstacles that are blocking the ground team member's sight, so you may have to explain the situation to the ground team in painstaking detail.

Another perspective problem is time: time seems to pass very slowly while waiting for a ground team, and it is easy to get impatient and leave station prematurely.

Naturally, the best means of working with a ground team is to use the radio. However, communications difficulties are par for the course. This gives you additional incentive to practice directing and working with ground teams.

Sometimes the ground team member may not understand radio jargon, so use plain English. For example, if you wanted a ground team to take a left at the next intersection, what would you say? How about “Ground Team 1, turn left at the next intersection, over.” Most often the plain English answer is the correct way to say it in radioese, anyway.

Someone in the aircrew (often the back seat scanner) should continuously have his or her eyes on the ground team; this frees the pilot to fly the aircraft and allows the observer to work the radio to execute the coordination. The observer will likely also have to be the one who keeps track of where you “left” your target.

After these tasks are delegated, the observer simply talks the ground team to the target. What could be easier? Well, of course there are additional factors to consider.
First of all, how do we get the aircrew and the ground team together in the first place? You will often find that a poorly conducted rendezvous with the ground team will result in a frustrating "search for the searchers." It is important to brief the mission with the ground team, if possible, and at least agree on communications frequencies and lost Comm procedures, maps/charts to be used by both teams, determine what vehicle the ground team is driving (e.g., type, color, and any markings), determine what the ground team members are wearing (highly visible vests are preferred), and a rendezvous point and time window for rendezvous (+/- 15 minutes).

One tried-and-true method is to rendezvous at a landmark that both the aircrew and the ground team can easily identify. A common rendezvous point is an intersection of prominent roads; these are easily identifiable by both the aircrew and ground team. The rendezvous location should be set up before you leave mission base.

Also, ground teams that have a hand-held GPS can radio their latitude and longitude coordinates to you and say, “Come and get me!” If you are unable to loiter over the target and bring the ground team to it, you can simply radio the coordinates to the ground team and let them navigate to it on their own. This is not nearly as efficient, however, as when you lead them to it. Note that two pieces of technology have to be working properly to make this work: 1) both air and ground operators need to be proficient with their GPS units and 2) two-way radio communication must be established and maintained.

After visual contact with the ground team, the pilot may use flaps to reduce groundspeed. If you lose radio communication, you can use the signals as listed below. However, these signals may be used as a standard to be followed in addition to two-way radio communication for additional clarity and practice. Allow plenty of room for your maneuvers or you may confuse the ground team and do not rush your signals.

Note: It is important to plan for a loss of communications during the briefing. The teams should agree on pre-arranged signals such as: stopping the vehicle means lost Comm; blinking headlights indicate the message has been received; and operating the flashers means the message hasn't been received.
Keeping contact with the ground team.

- Aircraft action: Aircraft approaches the vehicle from the rear and turns in a normal manner right (or left) to re-approach the vehicle from the rear. Circle back as necessary using oval patterns and flying over the team from behind, indicating that they should continue. This process may be referred to as a “Daisy Chain.” Daisy Chain over the ground team as long as necessary.
- Desired team action: Continue driving in indicated direction along this road.

Turning the ground team around.

- Aircraft action: Aircraft approaches the vehicle from the rear and then turns sharply right (or left) in front of the vehicle while in motion. Circle back as necessary, flying against the team’s direction of travel, and then take up the ‘keeping up’ procedure outlined above.
- Desired team action: Turn vehicle around.
Directing a Turn.

- Aircraft action: Aircraft approaches the vehicle from the rear and then turns sharply right (or left) in front of the vehicle while in motion. Circle back as necessary using oval patterns and flying over the team from behind, indicating that they should continue.
- Desired team action: Turn vehicle to right (or left) at the same spot the aircraft did and then continue in that direction until further signals are received.

Stop or Dismount.

- Aircraft action: Aircraft approaches the vehicle low and head-on while the vehicle is moving.
- Desired team action: Stop the vehicle and await further instructions.
- Aircraft action: Aircraft makes two (or more) passes in same direction over a stopped ground team.
- Desired team action: Get out of the vehicle, then follow the aircraft and obey further signals (proceed on foot).
Objective is here.

- Aircraft action: Aircraft circles one geographic place.
- Desired team action: Proceed to the location where the low wing of the aircraft is pointing; that is the location of the target.

Remember: Air-to-ground coordination is an art that should be regularly practiced, both during daylight and at night.

4.2.7 Airdrops

Airdrops are an uncommon event. As such, they should be trained and practiced before attempting. Follow FAA rules when training for airdrops.

The ability to drop a message or emergency equipment such as a radio or medicine is a valuable skill. An airdrop is not inherently dangerous. Being familiar with this procedure will allow an aircrew to conduct an airdrop safely.

An airdrop offers an alternative way of communicating with someone (e.g., a survivor or a trapped fire crew) on the ground. Your message needs to be clear and concise, and you should always spell out what kind of response you expect so that you will know your message was received and understood. For example, "if you need medical assistance, lay flat on the ground," or "help is on the way and will arrive in three hours; wave your arms if you understand."

The message airdrop should be a light object that is safe to drop, and an equipment airdrop should be a small, padded bag. You should attach a roll of brightly colored tape (e.g., a roll of florescent surveyor's tape) to the airdrop; the tape will unroll and provide a trail to the airdrop in case it lands in a tree, brush or snow.

Some safety concerns for the pilot are:
- Fly the aircraft and don't worry about what the observer is doing.
- Do not pull back hard on the yoke or go negative 'G' after the release, because this could cause the airdrop to hit the tail.
- Don't look back after the drop to see where the airdrop landed. Looking over your shoulder could cause you to pitch up. This could lead to a roll and then to a stall/spin.
Configure the aircraft with 10º flaps and a speed of 80 knots. Fly a right-turn pattern (assuming the airdrop will be through the right window) at 800 AGL and aligned so that final will be into the wind. Make the base turn so that you will have a two-mile final to the drop point. Descend to approximately 500 AGL and open the window (preferably, the observer’s window).

While on the drop run, the observer can assist in directing the pilot, particularly during the turns. If any crewmember sees an unsafe condition, call "No drop, No drop, No drop" and the pilot will level out and begin climbing to a safe altitude.

When the drop point is under the wheel, release the tape. Pause momentarily and then release the airdrop (delay one or two seconds if it’s an equipment drop). This ensures that the forward motion will carry the airdrop past the survivor and not hit them.

After the drop, climb to a safe altitude and continue to circle until you confirm receipt of the message or equipment.

4.3 In-flight services

Whether you are participating in a training exercise or an actual mission, the aircraft radio is an invaluable piece of equipment. Therefore, an understanding of the basic types of services that are provided through the radio is essential for mission observers.

4.3.1 Flight service stations

The FAA maintains a number of Flight Service Stations (FSS’s) that can provide assistance both before and after takeoff. Assistance includes preflight and in-flight briefings, scheduled and unscheduled weather broadcasts, and weather advisories. Selected FSS’s provide transcribed weather briefings.

Enroute weather information can be obtained from the Enroute Flight Advisory Service ("Flight Watch") by tuning 122.0 into the radio and calling "Flight Watch." It mainly provides actual weather and thunderstorms along your route. Additionally, Flight Watch is the focal point for rapid receipt and dissemination of pilot reports (PIREP’S). Other flight service frequencies are indicated on the sectional charts.

Flight service station personnel are also familiar with the general operating areas surrounding their respective facilities, and can be helpful in determining a pilot’s position, should he become lost or disoriented. FSS personnel are also trained to help lost pilots establish their positions by VOR triangulation, and direction finding. These “lost pilot” services are to be used by pilots or crews who are genuinely lost, not those who are momentarily uncertain of their positions.

4.3.2 Transcribed Weather Broadcasts (TWEB’s)

The TWEB is a continuous broadcast on low/medium frequencies (200-415 kHz) and selected VORs. Broadcasts are made from a series of tape recordings and are updated as changes occur. The information varies from one station to the next, but usually includes at least the following:

- Synopsis.
• Flight precautions.
• Route forecasts.
• Outlook (optional).
• Winds aloft forecast.

TWEB’s generally are route oriented and give area surface weather reports, radar and pilot reports, and Notices to Airmen (NOTAMs). In most cases, you must listen to TWEB’s on the VOR or ADF receiver.

4.3.3 Scheduled Weather Broadcasts

All flight service stations having voice facilities on radio ranges (VOR) or radio beacons (NDB) broadcast weather reports and Notice to Airmen information at 15 minutes past each hour from reporting points within approximately 150 miles of the broadcast station.

At each station, the material is scheduled for broadcast as available in this order:
• Alert notice announcement.
• Hourly weather reports.
• Weather advisory.
• Pilot reports.
• Radar reports.
• Notice to Airmen (NOTAMS).
• Alert notice.

Special weather reports and some notices to airmen data are broadcast off-schedule, immediately upon receipt. If you need special forecast service en route, you may obtain it from any flight service station. The time of observation of weather reports included in scheduled broadcasts is understood to be 58 minutes past the hour preceding the broadcast. When the time of observation is otherwise, the observation time is given.

Scheduled weather broadcasts (15 minutes past each hour) begin with the announcement “Aviation broadcast, weather.” For example:

“Aviation broadcast, Weather, Oklahoma City. Oklahoma City Wiley Post measured ceiling one thousand broken, visibility two, fog, temperature four three, dew point four one, wind one niner zero degrees at four. Altimeter two niner eight seven.” The completed broadcast is ended with “The time is one eight and one quarter.”

Reports for approximately 10 additional stations may follow. The local report is repeated as the last station report. Temperature is not broadcast, for other than the local report, when it is 40 degrees or less, or 85 degrees or higher.

When the temperature/dew point spread is five degrees or less, both the temperature and dew point are given. Surface wind direction and speed is given when it is ten knots or more (sustained). For this station, wind directions are magnetic, that is, measured from magnetic north rather than true north. The altimeter setting is given for the broadcast stations local report only. Special weather reports and advisories are broadcast when warranted by significant changes in the weather at a particular station or in a given area.
4.3.4 Automatic Terminal Information Service (ATIS)

At many airports, the FAA dedicates one or more transmitters and frequencies to continuous taped broadcasts of weather observations, special instructions, and NOTAMS that relate to the airport or nearby navigational facilities. ATIS tapes are intended to relieve air traffic controllers of repetitively transmitting the same data to every arriving and departing aircraft. Broadcast weather information is about *actual* observations for the smaller, terminal area, not forecasts. ATIS information is also digitized and may be received in a printed format if your aircraft is equipped with a special receiver and printer.

ATIS information is updated *hourly*, but may be updated sooner if the weather, special instructions or NOTAMS change significantly. Usually, you must listen to ATIS recordings on the communication radio. The frequency for the ATIS transmission is found on the sectional chart near the airport’s name, or in a table on the reverse side of the sectional title panel. A typical ATIS transmission may sound like this:

"Atlanta Hartsfield Airport, arrival information 'November'. 2350 Zulu weather -- measured ceiling 800 overcast, 1 1/2 miles in fog and haze. Temperature 61 degrees, dew point 60 degrees, wind calm, altimeter 29.80. ILS approaches in progress to Runways 8 Left and 9 Right. Landing runways 8 Left and 9 Right. Atlanta VOR out of service. Taxiway Mike closed between taxiways Delta and Sierra. Read back all 'hold short' instructions. Advise controller on initial contact you have information 'November'."

Even though you may not intend to stop at Hartsfield, this transmission contains bits of information that may have a significant bearing on your flight. The last weather observation, including the wind, and the fact that the VOR is out of service could be very important to you. If you had any intention of using the Atlanta VOR for navigation assistance on your mission, you now know to make a different plan.

If you are conducting a search under visual flight rules that will take you in the vicinity of Hartsfield, you know to consider a new plan because the reported weather will not allow VFR flight. When cloud bases are more than 5,000 feet above the terrain and visibility is better than five miles, those portions of the weather observation may often be deleted from the broadcast.

4.3.5 In-Flight Weather Broadcasts

When Flight Service receives severe weather forecast alerts from the National Weather Service, specialists transmit the alerts immediately and then again at each hour, half-hour, and quarter-hour for the first hour after the alert was first issued. The air traffic control centers also transmit the alert, but only once. Subsequent broadcasts may advise pilots to contact Flight Service to receive the alert text.

Alerts include SIGMETs (conditions that could be dangerous to all aircraft), Convective SIGMETs (conditions associated with thunderstorms, such as tornadoes or large hail, that could be dangerous to all aircraft), and AIRMETs (hazards primarily dangerous to small aircraft).

4.3.6 Hazardous In-Flight Weather Advisory Service (HIWAS)

You can also receive advisories of hazardous weather on many VORs. As the HIWAS name implies, this information relates only to hazardous weather,
such as tornadoes, thunderstorms, or high winds. If no hazardous weather is reported, the crewmember will only hear the facility’s identifier. NAVAID’s having HIWAS broadcast capability are annotated on the sectional chart.

When receiving a hazardous weather report, ATC or FSS facilities initiate the taped HIWAS transmissions, and ATC then directs all aircraft to monitor HIWAS.

4.3.7 Automated Weather Observation System (AWOS)

At many airports, the FAA has installed Automated Weather Observation Systems. Each system consists of sensors, a computer-generated voice capability, and a transmitter. Information provided by AWOS varies depending upon the complexity of the sensors installed. Airports having AWOS are indicated on sectional charts by the letters AWOS adjacent to the airport name, and the level of information is indicated by a single digit suffix, as shown below.

<table>
<thead>
<tr>
<th>AWOS-A</th>
<th>Altimeter setting only</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWOS-1</td>
<td>Altimeter, surface wind, temperature, dew point, density altitude</td>
</tr>
<tr>
<td>AWOS-2</td>
<td>Altimeter, surface wind, temperature, dew point, density altitude, visibility</td>
</tr>
<tr>
<td>AWOS-3</td>
<td>Altimeter, surface wind, temperature, dew point, density altitude, visibility, clouds/ceiling data</td>
</tr>
</tbody>
</table>

4.3.8 Automated Surface Observing System (ASOS)

The primary surface weather observing system in the U.S., the FAA has installed hundreds of ASOS. Each system consists of sensors, a computer-generated voice capability, and a transmitter. Information provided by ASOS varies depending upon the complexity of the sensors installed. ASOS can be heard by telephone, and so is very useful in flight planning. Information includes: wind speed, direction and gusts; visibility and cloud height; temperature and dew point; altimeter setting and density altitude.

4.3.9 Pilot Weather Report (PIREP)

Federal Aviation Administration stations are required to solicit and collect pilot reports (PIREP) whenever ceilings are at or below 5,000 feet above the terrain, visibility is at or less than 5 miles, or thunderstorms, icing, wind shear, or turbulence is either reported or forecast. These are extremely useful reports, and all pilots are encouraged to volunteer reports of cloud tops, upper cloud layers, thunderstorms, ice, turbulence, strong winds, and other significant flight condition information.

PIREP’s are normally given to Flight Watch. They are then included at the beginning of scheduled weather broadcasts by FAA stations within 150 nautical miles of the area affected by potentially hazardous weather. Pilots are advised of these reports during preflight briefings by FAA and national weather service stations, and by air/ground contacts with FAA stations. PIREP’s can help you avoid bad weather and warn you to be ready for potential hazards. SAR pilots are strongly encouraged to regularly give PIREP’s.
Wave Both arms across face
DO NOT ATTEMPT TO LAND

Both arms held overhead
PICK UP - PLANE IS ABANDONED

Cup hands over ears
OUR RECEIVER IS WORKING

Lie flat on back with hands above head
NEED MEDICAL ASSISTANCE

Both arms horizontal
NEED MECHANIC HELP or PARTS - LONG DELAY

Wave one arm over head
ALL OK - DO NOT WAIT

Wave cloth horizontally
NEGATIVE – NO

One arm horizontal
CAN PROCEED SHORTLY WAIT IF PRACTICAL

Both arms pointing in the direction of landing while squatting
LAND IN THIS DIRECTION

Wave cloth vertically
AFFIRMATIVE – YES