Introduce speaker.
Objectives / Content

- For short- and soft-field takeoff and landing operations in CAP Cessna aircraft, review:
  - Standards (from ACS)
  - Procedures (from POH/AFM)
  - Techniques (from experience)
  - Risk management and decision-making for short- and soft-field operations

This presentation was developed with input from Region and Wing Standardization/Evaluation officers throughout Civil Air Patrol.

We'll discuss operations from soft or rough fields where the goal is to keep the airplane from becoming stuck and minimizing the risk of damage to airframe components. It must be stressed that some of the techniques described in this presentation are designed to reduce the risk of a mishap during training and evaluation flights. These techniques (practicing on a long, wide runway, brake release prior to full power application and simulating the use of maximum braking for short field operations) should not be used when operating from an actual short field.

Throughout this presentation, we'll focus on the use of sound Aeronautical Decision Making (ADM) and Risk Management (RM) techniques.
Since the procedures and techniques vary between airplane models, it is imperative to refer to the specific POH/checklist for the aircraft being flown.

Always refer to the POH for the specific airplane being flown for procedures and recommended techniques to be used.
Review ACS Short Field Takeoff standards.

Takeoffs and climbs from fields where the takeoff area is short or the available takeoff area is restricted by obstructions require that the pilot operate the airplane at the limit of its takeoff performance capabilities. To depart from such an area safely, the pilot must exercise positive and precise control of airplane attitude and airspeed so that takeoff and climb performance results in the shortest ground roll and the steepest angle of climb.

In order to accomplish a maximum performance takeoff safely, the pilot must have adequate knowledge in the use and effectiveness of the best angle-of-climb speed (VX) and the best rate-of-climb speed (VY) for the specific make and model of airplane being flown.

The speed for VX is that which will result in the greatest gain in altitude for a given distance over the ground. It is usually slightly less than VY which provides the greatest gain in altitude per unit of time. The specific speeds to be used for a given airplane are stated in the FAA-approved AFM/POH.

In some airplanes, a deviation of 5 knots from the recommended speed will result in a significant reduction in climb performance. Therefore, precise control of airspeed
has an important bearing on the successful execution as well as the safety of the maneuver.

For the Cessna 172/182, the POH describes accelerating to an Obstacle Clearance Speed (a speed below $V_X$ with flaps extended – $V_X$ and $V_Y$ are flaps UP airspeeds)

The Airman Certification Standards (ACS) lists the knowledge and risk management skills a pilot should possess for the safe completion of each task. Instructors and Check Pilots should use these as a guide towards successful completion of a CAP Form 5 evaluation.
Short-Field Procedures (POH/AFM)

For Your Specific Model Aircraft

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Insert the short field takeoff and landing checklist items for your specific aircraft model here.

(Refer to POH for specific airplane model being flow for short field takeoff and landing checklist items.)
Short Field Takeoff Techniques

• Use all available runway for takeoff
• Set flaps per the POH
• Use a Static Takeoff
• Hold the brakes while setting takeoff power with yoke slightly aft of neutral to keep weight off nose wheel
• After brake release, vary elevator control as necessary to maintain slightly nose high sight picture
• Approaching rotation speed, the airplane should be firmly and smoothly lifted off the surface to a pitch attitude that will result in reaching obstacle clearance speed at 50’ AGL
• The landing gear and flaps should remain in takeoff position until clear of obstacles (or as recommended by the manufacturer)

Review and discuss as appropriate each step in the short field takeoff checklist.

It is important to remember that good aeronautical decision making includes assessing available options if the takeoff or landing approach don’t go as desired.

After full power, check gauges and confirm proper take-off power prior to brake release.

The Cessna POH Short Field Takeoff checklist states “Elevator Control - Slightly Tail Low. Keep in mind that when releasing the brakes under full power conditions the nose will tend to rise, especially in the 182. Be prepared for this so you don’t allow the nose wheel to come off the ground.
Short Field Takeoff Common Errors:

- Improper use of flaps
- Failure to use all available runway
- Lift-off or rotation premature
- Improper application of power
- Poor directional control on takeoff
- Brakes improperly used during takeoff
- Failure to firmly rotate at the specified rotation speed and achieve Obstacle Clearance Speed at 50’ AGL per the POH
- Failure to maintain appropriate climb speed

Short Field Takeoff Common Errors:

- Improper use of flaps – pilot used flap setting other than what is called for by the checklist.
- Following the taxiway line onto the runway centerline will shorten available takeoff distance by 100’ or more. Taxi towards the approach end of the runway pavement before turning to line up. Be careful not to put a wheel off the pavement!
- Lifting off too early will cause the airplane to settle back to the surface, extending the distance required to become airborne.
- Should not be a rolling takeoff – pilot may confuse short and soft field techniques. For training, with a suitably long runway, hold brakes until partial power (2000 RPM or 20” Hg. depending on aircraft flown) to reduce propeller erosion. Smooth application of maximum power after brake release.
- Maintaining directional control is essential. Drifting left or right of the center can result in striking runway edge lights. CAP pilots have scraped wingtips while performing short field takeoffs on Form 5 evaluation flights!
- Poor foot placement on the rudder pedals can result in application of brakes.
- Excessively high angle of attack can lead to a tail strike.
- Obstacle clearance airspeed should be used if obstacles are present, if no obstacles or after obstacles are cleared, accelerate to a safe flap retraction speed
before establishing $V_y$.

Refer to the airplane specific POH for recommended flap settings and speeds. The procedure that works for a Piper Cherokee doesn’t necessarily work for a Cessna 172!
Review ACS Short Field Landing standards.

Short-field approaches and landings require the use of procedures for approaches and landings at fields with a relatively short landing area or where an approach is made over obstacles that limit the available landing area. As in short-field takeoffs, it is one of the most critical of the maximum performance operations. It requires that the pilot fly the airplane at one of its crucial performance capabilities while close to the ground in order to safely land within confined areas. This low-speed type of power-on approach is closely related to the performance of flight at minimum controllable airspeeds.

To land within a short-field or a confined area, the pilot must have precise, positive control of the rate of descent and airspeed to produce an approach that will clear any obstacles, result in little or no floating during the roundout, and permit the airplane to be stopped in the shortest possible distance. The procedures for landing in a short-field or for landing approaches over obstacles, as recommended in the AFM/POH, should be used. A stabilized approach is essential. These procedures generally involve the use of full flaps, and the final approach started from an altitude of at least 500 feet higher than the touchdown area. A wider than normal pattern should be used so that the airplane can be properly configured and trimmed. In the absence of the manufacturer’s recommended approach speed, a speed of not more
than 1.3 VSO should be used. For example, in an airplane that stalls at 60 knots with power off, and flaps and landing gear extended, the approach speed should not be higher than 78 knots. In gusty air, no more than one-half the gust factor should be added. An excessive amount of airspeed could result in a touchdown too far from the runway threshold or an after-landing roll that exceeds the available landing area.

After the landing gear and full flaps have been extended, the pilot should simultaneously adjust the power and the pitch attitude to establish and maintain the proper descent angle and airspeed. A coordinated combination of both pitch and power adjustments is required. When this is done properly, very little change in the airplane’s pitch attitude and power setting is necessary to make corrections in the angle of descent and airspeed. The short-field approach and landing is in reality an accuracy approach to a spot landing. The procedures previously outlined in the section on the stabilized approach concept should be used. If it appears that the obstacle clearance is excessive and touchdown will occur well beyond the desired spot, leaving insufficient room to stop, power may be reduced while lowering the pitch attitude to steepen the descent path and increase the rate of descent. If it appears that the descent angle will not ensure safe clearance of obstacles, power should be increased while simultaneously raising the pitch attitude to shallow the descent path and decrease the rate of descent. Care must be taken to avoid an excessively low airspeed. If the speed is allowed to become too slow, an increase in pitch and application of full power may only result in a further rate of descent. This occurs when the angle of attack is so great and creating so much drag that the maximum available power is insufficient to overcome it. This is generally referred to as operating in the region of reversed command or operating on the back side of the power curve.

Because the final approach over obstacles is made at a relatively steep approach angle and close to the airplane’s stalling speed, the initiation of the roundout or flare must be judged accurately to avoid flying into the ground, or stalling prematurely and sinking rapidly. A lack of floating during the flare, with sufficient control to touch down properly, is one verification that the approach speed was correct. Touchdown should occur at the minimum controllable airspeed with the airplane in approximately the pitch attitude that will result in a power-off stall when the throttle is closed. Care must be exercised to avoid closing the throttle too rapidly before the pilot is ready for touchdown, as closing the throttle may result in an immediate increase in the rate of descent and a hard landing. Upon touchdown, the airplane should be held in this positive pitch attitude as long as the elevators remain effective. This will provide aerodynamic braking to assist in deceleration. Immediately upon touchdown, and closing the throttle, appropriate braking should be applied to minimize the after-landing roll.

The airplane should be stopped within the shortest possible distance consistent with
safety and controllability. If the proper approach speed has been maintained, resulting in minimum float during the roundout, and the touchdown made at minimum control speed, minimum braking will be required.

The new Airman Certification Standards list the knowledge and risk management skills a pilot should possess for the safe completion of each task. Instructors and Check Pilots should use these as a guide towards successful completion of a CAP Form 5 evaluation.
Short Field Landing Techniques

- In smooth air, use the airspeed and flap setting recommended in the POH with enough power to control glide path
- In turbulent air, slightly higher airspeeds should be used
- Once clear of obstacles, smoothly reduce power and maintain airspeed by lowering the nose
- Touchdown should be made on the main wheels first.
- Immediately after touchdown, lower the nose and apply heavy braking as required (simulate heavy braking for training)
- For maximum brake effectiveness, retract flaps and apply maximum brake pressure without sliding the tires

(Recommend not reconfiguring flaps until clear of runway to reduce risk of loss of control)

Practice short field approaches should also be made to a full stop to standardize pilot actions (remember primacy of learning?) when landing on an actual short field.

Have you reviewed your performance charts? Cessna performance charts use pressure altitudes (PA). To determine PA, set altimeter to 29.92 on the ground and read the PA or compute using the actual altimeter setting from 29.92 to determine PA. The formula is (29.92-alt setting *1000 + field elevation = PA). Example: altimeter setting 30.10, field elevation 1,300’ (29.92-30.10*1000+1300 = PA 1,120)

According to Cessna, conservative distances can be established by reading the chart at the next higher values of weight, altitude and temperature. Don’t forget to include any corrections for headwinds/tailwinds or runway surface in computing distance required.

If you have to figure it that close and you’re still not sure if you can safely takeoff and land from a particular runway – don’t land there!
## Short Field Landing Common Errors

- Required landing distance exceeds available runway length
- Poor airspeed control
- Landing configuration established late
- Power control and monitoring inadequate
- Unstable approach
- Improper use of flaps
- Failure to trim properly
- Ignoring checklist
- Hard impact or bounce at touchdown
- Excessive brake application
- Go-around situation not recognized

### Short Field Landing Common Errors:

- Failure to calculate distance required to land.
- Excessive speed, too slow a speed or erratic speed control on approach
- Properly configure the airplane early enough to allow for a stabilized approach. Don’t rush the approach and landing.
- Using too high or too low a power setting for the desired approach airspeed. Suggest loosening the throttle friction on final to permit smooth throttle adjustments as appropriate. Don’t fight the friction!
- Unstable approach can be caused poor sight picture, bad aim point, improper power setting and approach airspeed, failure to compensate for wind drift.
- Use flaps appropriate for the wind and runway conditions. Don’t use full flaps with a 90 degree gusting crosswind on a narrow runway!
- Poor use of elevator and/or rudder trim increased the pilot work load.
- Failure to refer to the checklist can lead to use of improper flap settings and airspeeds.
- Short field landings should be *firm* to help dissipate energy, not spread the tires even with the cockpit windows. A bounced landing is a good reason to go around.
- Locking up the brakes will cause the airplane to stop faster when both main tires...
blow. Smooth, even application of the brakes without locking them is the proper technique. Pilots used to anti-skid brakes may need a reminder that they’re not in a 777. For training and evaluations, maximum braking should be simulated. Don’t ever threaten a pilot being trained or evaluation that they will “fail” if they don’t stop by a specific point on the runway. That sets the stage for a mishap and puts undue pressure on the trainee/evaluatee.

- Discuss the circumstances where a go around is warranted:
  - Unstable approach
  - Bounced or hard landing
  - Excessive float due to high airspeed
  - Poor directional control
Discuss these mishaps and actions that might have prevented them from occurring.

Upon touchdown with the nose still high during a full flap short field landing, the aircraft’s left main tire made contact with compacted snow at the edge of the 2550x30 runway, and the aircraft departed the asphalt and rolled to a stop on snow covered turf.

RM factors – narrow runway (30’ wide) with snow berms on either side. No weather available at the mishap airport. Closest weather 10 miles away – winds light/variable 5-10 kts, clear skies.
Discuss these mishaps and actions that might have prevented them from occurring.

During a C-172 initial form 5 checkout of multi-hundred hour pilot, the aircraft had a runway tail strike during a short field landing (second landing of the flight). While landing was hard, neither pilot nor check pilot realized it was a tail strike. Flight continued for two more landings and completion of checkout. Upon post flight inspection, it was discovered the rear tie down ring was sheared off.

RM factors – Pilot being evaluated had logged about 500+ PIC hours in a C-172M aircraft which he personally owns. Three of those hours have been logged in the past six months, two within the past three months. The pilot stated that while his personal aircraft and the CAP aircraft were very similar C-172s, except for CAP aircraft being fuel injected, he felt that his personal aircraft landing gear sits a little higher to the ground than the CAP 172 aircraft does. The pilot had not logged any CAP instruction time in a CAP 172 aircraft prior to the F5 checkride. Weather conditions at about the time of the mishap were: skies clear, wind from the south at 9-14kts, gusts to 19kts, 29.84 baro, visibility 10 miles, 79 F. degrees.
Discuss these mishaps and actions that might have prevented them from occurring.

Aircraft was disabled on the runway as a result of a flat tire.

RM factors – The pilot is a CAP mission pilot with 3,367 hours total time. During the last six months he has flown 19 hours, with two hours in the past three months. He has 300 hours in the make and model of the aircraft he was flying, with 6 landings and three flights in the past 90 days up to the time of the incident. The pilot was practicing short field landings causing the tire on the right main landing gear to blow upon landing. The pilot’s seat may have been positioned too far forward causing the pilot’s feet most likely to rest on the toe-brakes instead of the floor of the cabin, thereby causing premature braking causing the landing gear to lock. Weather at the airport was not a causal factor. The pilot was landing on runway 3R. The airport was VFR at the time of the incident with a NNE 6 knot wind.
Review ACS Soft Field Takeoff standards.

Takeoffs and climbs from soft fields require the use of operational techniques for getting the airplane airborne as quickly as possible to eliminate the drag caused by tall grass, soft sand, mud, and snow, and may or may not require climbing over an obstacle. The technique makes judicious use of ground effect and requires a feel for the airplane and fine control touch. These same techniques are also useful on a rough field where it is advisable to get the airplane off the ground as soon as possible to avoid damaging the landing gear. Soft surfaces or long, wet grass usually reduces the airplane’s acceleration during the takeoff roll so much that adequate takeoff speed might not be attained if normal takeoff techniques were employed.

It should be emphasized that the correct takeoff procedure for soft fields is quite different from that appropriate for short fields with firm, smooth surfaces.

To minimize the hazards associated with takeoffs from soft or rough fields, support of the airplane’s weight must be transferred as rapidly as possible from the wheels to the wings as the takeoff roll proceeds. Establishing and maintaining a relatively high angle of attack or nose-high pitch attitude as early as possible does this. Wing flaps may be lowered prior to starting the takeoff (if recommended by the manufacturer) to provide additional lift and to transfer the airplane’s weight from the
wheels to the wings as early as possible.

Stopping on a soft surface, such as mud or snow, might bog the airplane down; therefore, it should be kept in continuous motion with sufficient power while lining up for the takeoff roll.
### Soft-Field Procedures (POH/AFM)

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Insert the soft field takeoff and landing checklist items for your specific aircraft model here. If there is not a specific soft field checklist, refer to the Amplified Normal Procedures section of the POH for guidance.
**Soft Field Takeoff Techniques**

- Taxi on soft surfaces with full aft yoke
- Set flaps per the POH
- Use a rolling takeoff (do not stop while setting takeoff power) with yoke slightly aft of neutral to keep weight off nose wheel
- Smoothly increase power to maximum as airspeed increases
- Vary elevator control as airspeed increases to maintain slightly nose high sight picture
- Lift off at lowest possible airspeed and lower nose to accelerate in ground effect until a safe flap retraction speed is reached per the POH
- If obstacles are present, accelerate in ground effect until reaching the obstacle clearance speed per the POH
- Once obstacles are cleared, increase to a safe flap retraction speed per the POH

As with the short field takeoff and landing, it’s important to remember that good aeronautical decision making includes assessing available options if the takeoff or landing approach don’t go as desired.

As the airplane is aligned with the takeoff path, takeoff power is applied smoothly and as rapidly as the power plant will accept it without faltering. As the airplane accelerates, enough back-elevator pressure should be applied to establish a positive angle of attack and to reduce the weight supported by the nose wheel. When the airplane is held at a nose-high attitude throughout the takeoff run, the wings will, as speed increases and lift develops, progressively relieve the wheels of more and more of the airplane’s weight, thereby minimizing the drag caused by surface irregularities or adhesion. If this attitude is accurately maintained, the airplane will virtually fly itself off the ground, becoming airborne at airspeed slower than a safe climb speed because of ground effect.

After becoming airborne, the nose should be lowered very gently with the wheels clear of the surface to allow the airplane to accelerate to a safe flap retraction speed and then climb at $V_Y$. If obstacles must be cleared, accelerate to the obstacle clearance speed listed in the POH. When the obstacles are cleared, accelerate to a safe flap retraction speed before establishing $V_X$ or $V_Y$. Extreme care must be exercised immediately after the airplane becomes airborne and while it accelerates,
to avoid settling back onto the surface. An attempt to climb prematurely or too steeply may cause the airplane to settle back to the surface as a result of losing the benefit of ground effect. An attempt to climb out of ground effect before sufficient climb airspeed is attained may result in the airplane being unable to climb further as the ground effect area is transited, even with full power. Therefore, it is essential that the airplane remain in ground effect until at least obstacle clearance speed is reached. This requires feel for the airplane, and a very fine control touch, in order to avoid over-controlling the elevator as required control pressures change with airplane acceleration.

It is important to remember that good aeronautical decision making includes assessing available options if the takeoff or landing approach don’t go as desired.

It’s a rolling takeoff but still verify proper engine instrument readings to confirm full power is being developed.

The Cessna POH does not have a Soft Field Takeoff checklist or landing. There is a discussion about operating from soft/rough fields in the Amplified Normal Procedures section. It says “…lifting the airplane off the ground as soon as practical in a slightly tail low attitude.”
Illustrations of proper and improper airplane attitude for takeoff.
Illustrations of proper and improper airplane attitude for takeoff.
Soft Field Takeoff Common Errors:

- Improper use of flaps – too much or not enough.
- Airplane stopped on runway prior to takeoff – should be a rolling takeoff.
- Improper application of power – using partial power, or jamming power in risking loss of control.
- Poor directional control on takeoff – maintain the runway centerline.
- Brakes improperly used during takeoff – poor foot placement resulting in inadvertent brake application.
- Excessive pitch attitude – dragging the tail.
- Drifting uncontrolled during initial climb – maintain position over the runway.
- Touchdown inadvertently after lift-off – from trying to pull the airplane into the air too soon.
Discuss these mishaps and actions that might have prevented them from occurring.

While performing soft field takeoff procedure for Form 5 annual evaluation, during throttle up the nose of the aircraft rose rapidly, causing the tow hook release to strike the runway and bend the release bracket.
Discuss these mishaps and actions that might have prevented them from occurring.

This incident occurred during demonstration of soft field takeoff for Form 5 evaluation. Excessive nose high and light crosswind resulted in loss of directional control, causing aircraft to drift to left side of runway on lift off and strike runway light on Becker can. Taking corrective action to lower the wing caused the left wing tip to contact grass and rebound right wing tip to pavement, correcting back onto runway.
Review ACS Soft Field Landing standards.

Landing on fields that are rough or have soft surfaces, such as snow, sand, mud, or tall grass requires unique procedures. When landing on such surfaces, the objective is to touch down as smoothly as possible, and at the slowest possible landing speed. The pilot must control the airplane in a manner that the wings support the weight of the airplane as long as practical, to minimize drag and stresses imposed on the landing gear by the rough or soft surface. The approach for the soft-field landing is similar to the normal approach used for operating into long, firm landing areas. The major difference between the two is that, during the soft-field landing, the airplane is held 1 to 2 feet off the surface in ground effect as long as possible. This permits a more gradual dissipation of forward speed to allow the wheels to touch down gently at minimum speed. This technique minimizes the nose-over forces that suddenly affect the airplane at the moment of touchdown. Power can be used throughout the level-off and touchdown to ensure touchdown at the slowest possible airspeed, and the airplane should be flown onto the ground with the weight fully supported by the wings.

The use of flaps during soft-field landings will aid in touching down at minimum speed and is recommended whenever practical. In low-wing airplanes, the flaps may suffer damage from mud, stones, or slush thrown up by the wheels. If flaps are
used, it is generally inadvisable to retract them during the after-landing roll because
the need for flap retraction is usually less important than the need for total
concentration on maintaining full control of the airplane.

The final approach airspeed used for short-field landings is equally appropriate to
soft-field landings. The use of higher approach speeds may result in excessive float in
ground effect, and floating makes a smooth, controlled touchdown even more difficult.
There is, however, no reason for a steep angle of descent unless obstacles are
present in the approach path.
Soft Field Landing Techniques

- Use a normal landing technique (i.e. flap setting appropriate for runway and wind conditions)
- Hold the airplane 1-2’ off the surface as long as possible while dissipating airspeed. Add power to control descent rate.
  - Power controls rate of descent
  - Retarding power abruptly will result in a hard landing
- Touch down at or near stall speed, under power with minimum sink, slightly tail low to prevent nosing over
- Hold the nose wheel off the surface as long as possible
- Taxi on soft surfaces with full aft yoke

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When in doubt - go around!

Depending on how close the obstacle is to the runway, aim for a point before the touchdown point to allow for flare distance. On final, use pitch for airspeed and power for rate of decent.
Soft Field Landing Common Errors:

Many of the errors are the same as those made on short field landings. The main differences are firmer landing than desired and allowing the nosewheel to touch the surface prematurely.
Discuss these mishaps and actions that might have prevented them from occurring.

Finally a nice day after all that rain, let's land on the grass runway over there.... Not the best idea!

This and the next two slides show the damage.
Soft Field Landing Errors
Soft Field Landing Errors
Discuss these mishaps and actions that might have prevented them from occurring.

Pilot was making a soft field approach to landing. Aircraft ballooned during flare and in attempt to correct, excessive nose up pitch occurred. The aircraft settled onto the runway while in nose high position, and the tail skid and tie-down struck the runway. The tail skid and tie-down ring sheared or ground off. The bottom of the rudder shows abrasion.
Risk Management Reminders

• Threshold Questions:
  – Do I really need to operate from a short or soft field?
  – If so, am I current, capable, and proficient in these operations?
  – Are there crosswind or gusty wind conditions?
  – Consider doing practice short/soft takeoffs and landings on a long, wide runway to have more options available in case things go sour

• Reminders:
  – Establish & maintain a stabilized approach
  – Keep sight picture on end of the runway
  – Never attempt to save a landing
  – Make the go-around decision early
  – Instructor/Check Pilot must always guard the controls!

Review the Risk Management questions and reminders.

Many times we fly with a person in the right seat. That person is not always a pilot, but there must be a discussion between the PIC and the rest of the crew/passengers on responsibilities. For example, when to call for a go around or question an unstable approach to the pilot. TRUE Crew Resource Management need to be put to use.