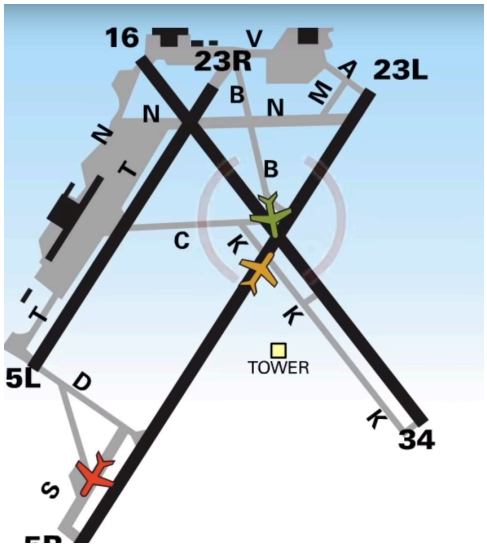
Runway Incursion Avoidance

Objective

To ensure the applicant learns the importance of runway incursion avoidance and the procedures that pilots can employ to prevent them from occurring.

Purpose

On December 6, 1999, two airliners in Providence, Rhode Island came close to a collision on the runway which would have claimed hundreds of lives. This near-collision was caused by a *runway incursion*, due to the pilots' uncertainty about their position on the airport. When pilots and air traffic controllers are unsure of, or are careless about their position on the airport, and especially on runways, disasters can happen. This lesson introduces pilots to the dangers of runway incursions, and gives them tools and techniques for avoiding them.



Schedule

- **Ground Lesson**: 25 minutes
- **Student Q&A**: 10 minutes

Equipment

- Airport Diagrams
- Whiteboard / Markers (optional)
- Model Airplane (optional)

Student Actions

- Ask any questions, receive study material for the next lesson.
- Watch linked videos.
- Review listed references.

Instructor Actions

- Deliver the ground lesson (below).
- Simulate taxi instructions for the student to read back and follow on an airport diagram.
- Answer student questions.

Completion Standards

- Student can explain the following concepts related to runway incursions:
  - Dangers of runway incursions, Importance of hold lines and hold signs, importance of sterile cockpit
  - Challenges of taxi operations, importance of situational awareness
  - Techniques to avoid runway incursions and maintain situational awareness during taxi operations
  - Non-towered taxi operations
  - Taxi safety techniques
  - Challenges of taxi during night/low-visibility conditions
  - Runway Status Lights

References

- MZeroA Flight Training - “Near Miss Runway Incursion”
  - YouTube - https://www.youtube.com/watch?v=hJszzAUCBFM
- Air Safety Institute - “Runway Safety: Providence, RI (2013)”
  - YouTube - https://www.youtube.com/watch?v=equVF3ULVw8
- FAA-H-8083-3C (Airplane Flying Handbook) - Chapter 2, Page 18-21 [Taxiing]
- AIM-2024-03-21 (Aeronautical Information Manual) - Chapter 2, Section 1-6 [Runway Status Lights], Chapter 2, Section 1-11 [Taxiway Lights], Chapter 2, Section 3 [Airport Marking Aids and Signs], Chapter 5, Section 2-4 [Taxi Clearance], Chapter 5, Section 5-2 [ATC Clearance/Readbacks]
- FAA AC 90-66C (Non-Towered Airport Flight Operations)
- FAA-S-ACS-25 (CFI ACS) - Area II Task C

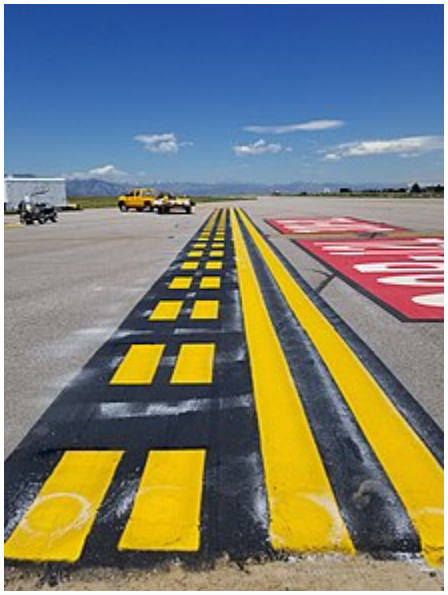
Ground Lesson Outline

- What are Runway Incursions? - Confusion, wrong turns, rolling out past hold lines, etc.
  - Dangers of Runway Incursions
  - Hold Lines
  - Causes of Runway Incursions - Pilots cause 65% (half by GA), Lack of familiarity, not following ATC instructions, not following standard procedures
- Importance of Sterile Cockpit
  - Procedures for ensuring - elimination of all distractive activities (i.e. cell phone, texting, conversations with passengers)
  - Taxi, Takeoff, Climb to Cruise
- Taxi Operations
  - Unique challenges
    - Steering/Maneuvering, Maintaining Taxiway/Runway Position
  - Situational Awareness
    - Other airplanes, vehicles
- Taxi Clearances and Taxi Route Planning
  - ATC Communication
    - Before Takeoff (Movement vs. Non-Movement Areas), Before Landing, After Landing
  - Techniques
    - Writing down Taxi Clearances, Airport Diagrams/Route Planning, Briefing Hot Spots, Minimizing Pilot Workload
    - Confirm/Always Be Sure - *Providence, RI Incident Case Study*
  - Taxiway/Runway Signage
  - Dangers of Confirmation and Expectation Bias
- Non-Towered Airport Taxi Operations
  - Planning and radio calls for Before Takeoff, Before Landing, After Landing
- Taxi Safety Techniques
  - Aircraft lighting, etc.
- After-Landing Taxi Operations
  - Briefing landing rollout to a taxiway exit
  - Proximity to other runways/hold lines
    - Parallel runways
  - LAHSO
- Challenges of Night and Low-Visibility Operations
  - Reduced visibility of hold lines, etc.
- Runway Status Lights

Ground Lesson Content

- **What are Runway Incursions?** - Simply put, a *runway incursion* occurs any time an airplane (or ground vehicle) enters a runway, or continues on a runway in a manner for which they were not cleared. Accidentally taxiing past a hold line into a runway area, or taxiing beyond a hold line on a runway into an intersecting runway, or making a wrong turn into a runway area are all runway incursions.
    - **Dangers of Runway Incursions** - Although it was not directly caused by a runway incursion in the traditional sense, the *Tenerife Airport Disaster* in 1977 demonstrates the sort of disaster that can occur when two airplanes are on the same runway during flight operations. Being the worst aviation accident in history, the Tenerife Disaster claimed the lives of 583 passengers and crew, and came about because of a **fundamental confusion about the position of other airplanes on the airport and runway environment**. Similar disasters are possible any time a runway incursion occurs.

    - **Hold Lines** - *Hold lines* are the primary marking that indicates the boundaries of runways or other protected areas. Often called *hold short lines*, they are depicted on the pavement as two solid and two dashed lines. Crossing from the dashed lines to the solid lines requires no clearance (as in, exiting a runway area), however, **crossing from the solid lines to the dashed lines always requires explicit ATC clearance!** (At towered airports)



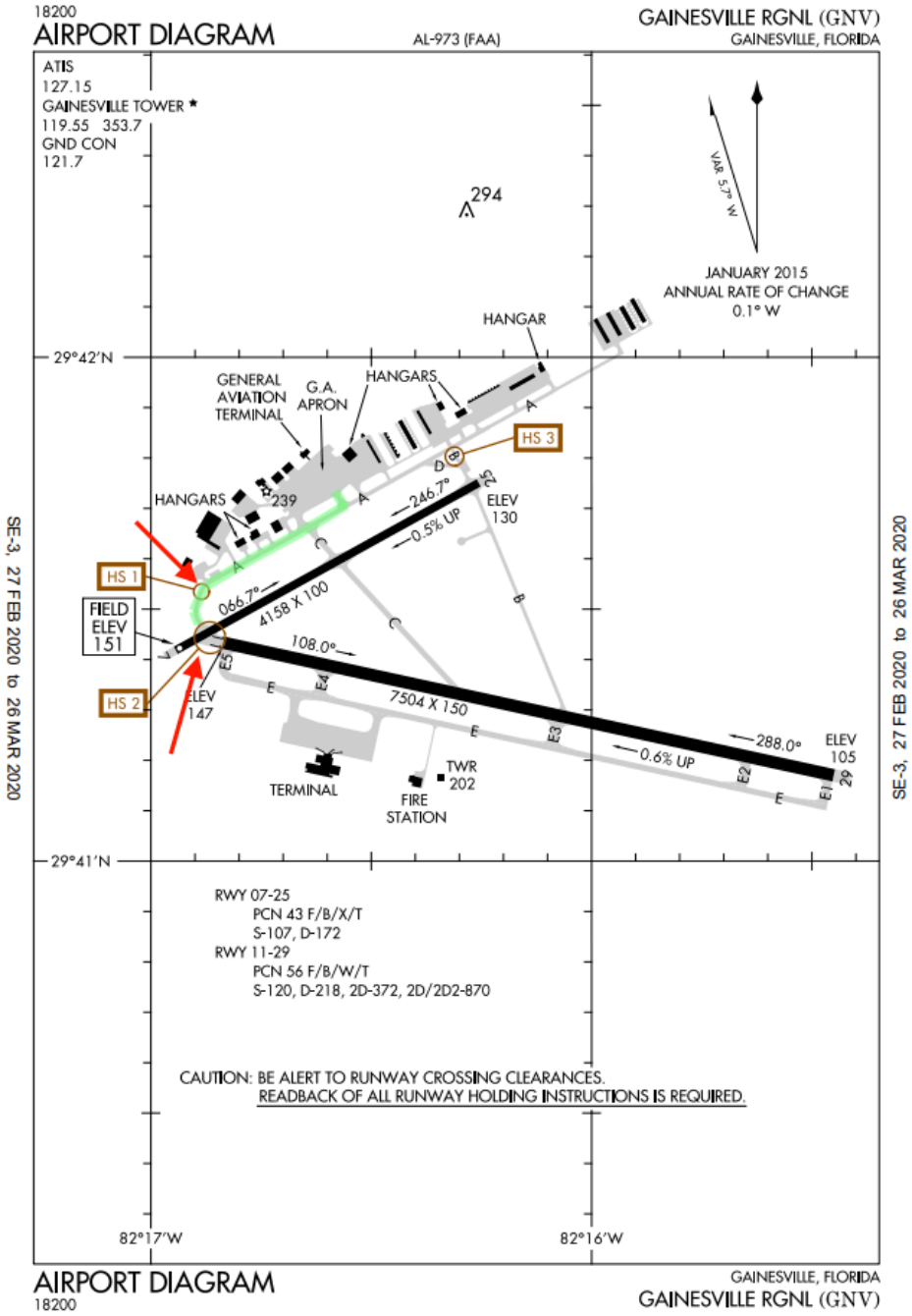
- **Causes of Runway Incursions -** Pilots cause 65% of runway incursions (half by GA pilots). Common

causes include lack of familiarity with the airport, not following ATC instructions, and not following standard procedures

- **Importance of Sterile Cockpit** - When taxiing anywhere on the airport, it is important to maintain a sterile cockpit, and minimize non-essential conversations.
    - **Procedures for Ensuring** - Turn off/silence cell phones, do not text, do not become distracted by Electronic Flight Bags (EFBs), ask passengers to refrain from talking.
    - **Taxi, Takeoff, Climb to Cruise** - When preparing to depart, the taxi, takeoff, and climb phases of the flight are critical and contain many hazards. Therefore, pilots should maintain a sterile cockpit until cruise flight in order to maintain focus and limit distractions.
- **Taxi Operations** - *Taxiing* is simply movement of aircraft on the airport environment, both on *taxiways* and on *runways*.
    - **Unique challenges** - Airplanes are designed to fly, with very little consideration given to ground handling. This presents unique challenges.
        - **Steering/Maneuvering** - Airplanes may be difficult to steer or maneuver. There is no ability to move in reverse, as a car might, and wide wingspans or long fuselage and tail sections can cause parts of the airplane to encroach on runway areas even if the rest of the airplane is not.
        - **Situational Awareness/Maintaining Taxiway/Runway Position** - Taxiways often have many intersecting taxiways, runways, aprons, etc. Pilots must maintain situational awareness of their position on the airport at all times. Airplanes may have poor outside ground visibility, making it difficult to see taxiway and runway signs and markings.
            - **Other airplanes, vehicles** - In addition to their own position, pilots should maintain a mental picture of where other airplanes and vehicles are moving on the airport environment.
- **Taxi Clearances and Taxi Route Planning** - When operating at towered airports, pilots must first obtain a taxi clearance from ATC. A taxi clearance will include a destination, and a route that the pilot should take to get there.
    - **ATC Communication During Phases**
        - **Before Takeoff/Taxi** - Before taxi for takeoff, contact the Ground controller and ask for clearance to taxi for departure before entering any *movement areas*. **Pilots are required to read back taxi or hold short clearances in full, including their callsign and any runways given by ATC.**
            - **Non-Movement Areas** - Aircraft may taxi freely on *non-movement areas*, which are airport areas that are not controlled by ATC. *Movement areas* are areas (taxiways, runways, generally) where aircraft movements are controlled by ATC. **While taxiing in non-movement areas requires no clearance, vigilance must be maintain by pilots since other vehicles or people may be present anywhere at any time!**
        - **Before Landing** - Before landing, pilots should brief the runway exit they intend to use, and note any nearby intersecting runways where they will need to hold short.
        - **After Landing** - After landing, pilots may taxi clear of the landing runway, **ensuring they fully cross the hold short line to exit the runway**, but may not continue taxiing without an ATC clearance! Pilots should be vigilant to not cross any other nearby hold lines without clearance.
    - **Techniques** - There are several techniques pilots can use to minimize confusion about taxi instructions
        - **Writing down Taxi Clearances** - Before reading back a taxi or hold short clearance, write it down on a kneeboard or scribble it on the airport diagram, to aid in memory.
        - **Airport Diagrams/Route Planning/Briefing Hot Spots** - It is best to actively look at the airport diagram as the taxi clearance is received, so that pilots can form a mental model

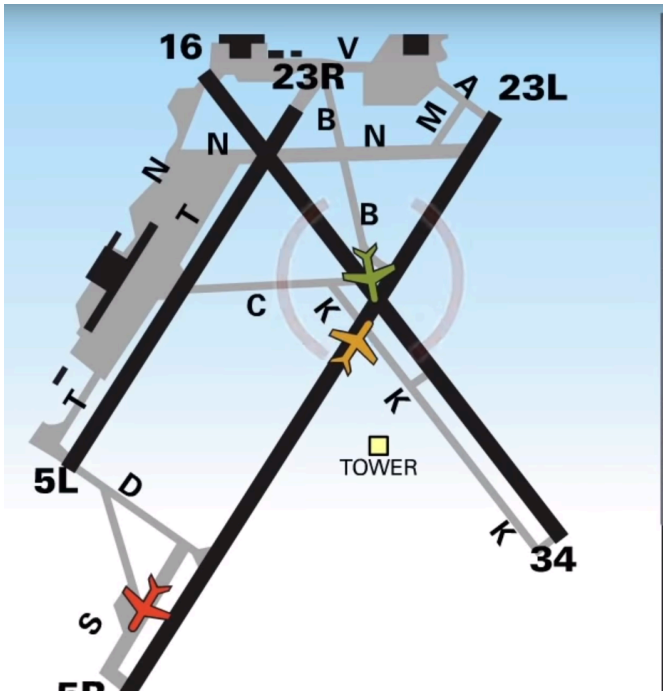
of the taxi route. Pilots should ideally highlight the received taxi route on their airport diagram, and especially brief any hot spots that will be encountered on the route.

- **Hot Spots** - Airport *hot spots* are areas where other pilots (or vehicles) have commonly made mistakes leading to runway incursions. They are often confusing or irregularly shaped hold lines or intersections, and **pilots should be extra vigilant for the presence of hold lines or runway identifier signs in these locations.**



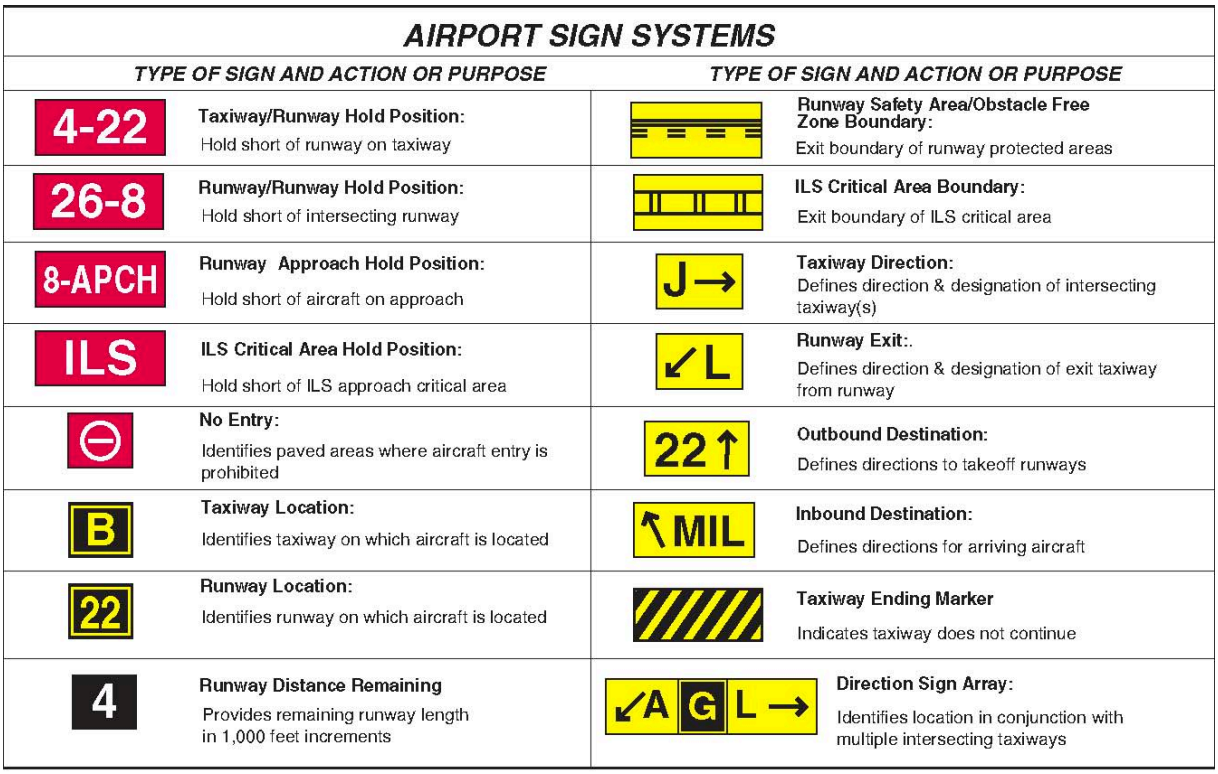
- **Minimizing Pilot Workload** - During taxi operations, in addition to maintaining a sterile cockpit, pilots should avoid unnecessary tasks (e.g. programming the GPS, working on EFB, etc.) so that their full attention can be devoted to taxiing and maintaining situational awareness.

- **Confirm/Always Be Sure** - Most importantly, **if any uncertainty exists about the taxi clearance or the airplane's position on the runway or airport, the pilot *must* clarify the instructions with ATC.** Uncertainty about taxi instructions or the position of airplanes in relation to runways and taxiways is extremely dangerous and can lead to disastrous results. **If in doubt, ask again!** Pilots can also ask for *progressive* taxi instructions, where ATC will provide turn-by-turn guidance.
    - **Verbalize** - When approaching a runway hold line, pilots should refer to their taxi clearance and confirm to themselves that they are in fact cleared to cross.
        - Example: (approaching Runway 31 hold) "I am cleared to cross Runway 31".
    - **Case Study** - *December 6, 1999 Providence, RI Incident*
        - This incident had many contributing factors, including:
            - Pilot uncertainty about position
            - Vague descriptions of signage "we are by the runways", not "we are by Runway 23L"
            - Not cross-referencing outside sight picture with airport diagram
        - https://www.youtube.com/watch?v=equVF3ULVw8



Transcript:
United: And, uh, United 1448, we're approaching Kilo here, uh, um, somebody just took off!

- **Taxiway/Runway Signage** - One of the most important airport signs that pilots should keep watch for is the *runway hold position* sign. The **red** color of the sign is used only for important hold signs on airports, and should always be a clue that there is a hold line nearby.

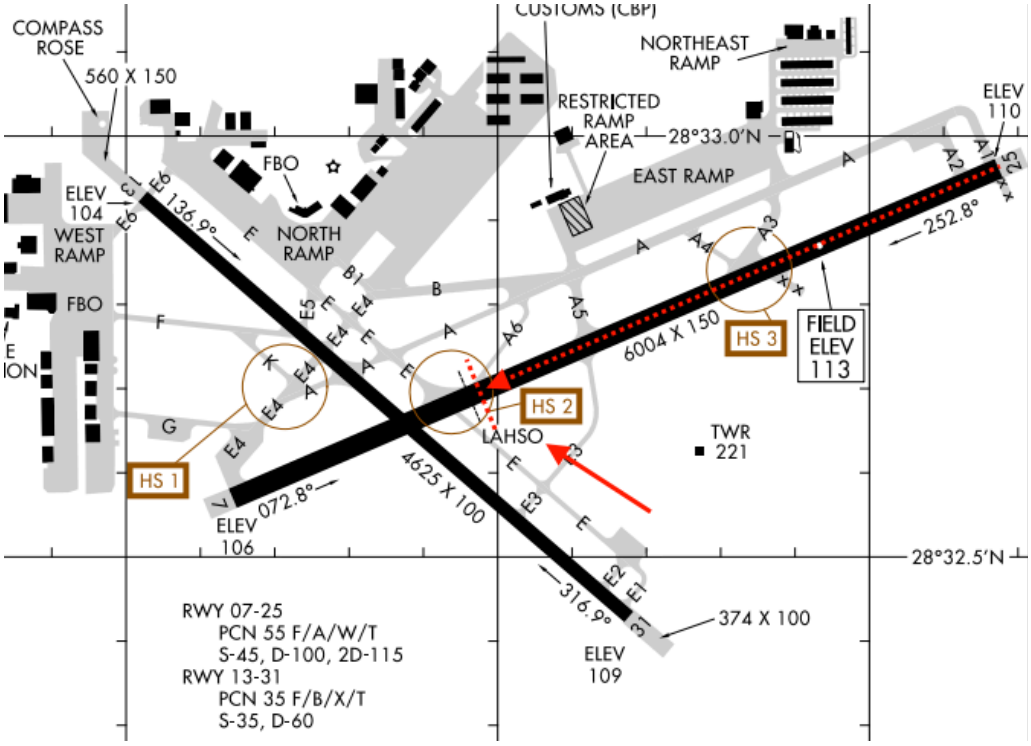


  - **Dangers of Confirmation and Expectation Bias** - It is critical that pilots actively *listen* to their taxi instructions and not fall prey to confirmation or expectation bias. These biases can lead pilots to hear what they are expecting to hear, rather than what was actually said.
    - **Example** - A pilot is *always* cleared to taxi to Runway 25 “via Alpha, Bravo”, but this time they are cleared “via Alpha, hold short of taxiway Bravo”. This difference can easily be missed.
- **Non-Towered Airport Taxi Operations** - Although there is no ATC at non-towered airports to manage taxi operations, pilots should nonetheless remain vigilant for runway incursions. Pilots should maintain situational awareness about the position of other airplanes and vehicles on runways and taxiways, and **always self-announce taxi intentions and the intention to enter a runway**.
  - **Planning and radio calls for Before Takeoff, Before Landing, After Landing** - Just as with a towered airport, pilots should consult the airport diagram before taxi, takeoff, and landing to be sure that they know the route they will use to enter and exit the runway.
    - Because no explicit takeoff or landing clearances are available at non-towered airports, pilots must also **visually confirm** that the runway *and final approach* are clear before entering any runways.
- **Taxi Safety Techniques** - Pilots can enhance safety by always **visually confirming** that a runway (and final approaches) are clear before crossing or entering any runway surface, *whether cleared or not*. Other techniques include:
  - Turning on airplane strobes, taxi, and landing lights to enhance visibility.
  - Maintaining eyes outside the cockpit when in any runway area.
  - Taxiing clear of runways quickly and without delay.
- **After-Landing Taxi Operations** - Many runway incursions actually occur after landing, when pilots let their guard down and may taxi into other nearby runway areas.
  - **Briefing landing rollout to a taxiway exit** - Pilots should always brief the expected runway exit before landing, especially if there are nearby runways.
  - **Proximity to other runways/hold lines** - When two runways are nearby, or exiting the runway will put the airplane near another runway, pilots should be especially vigilant that they cross only

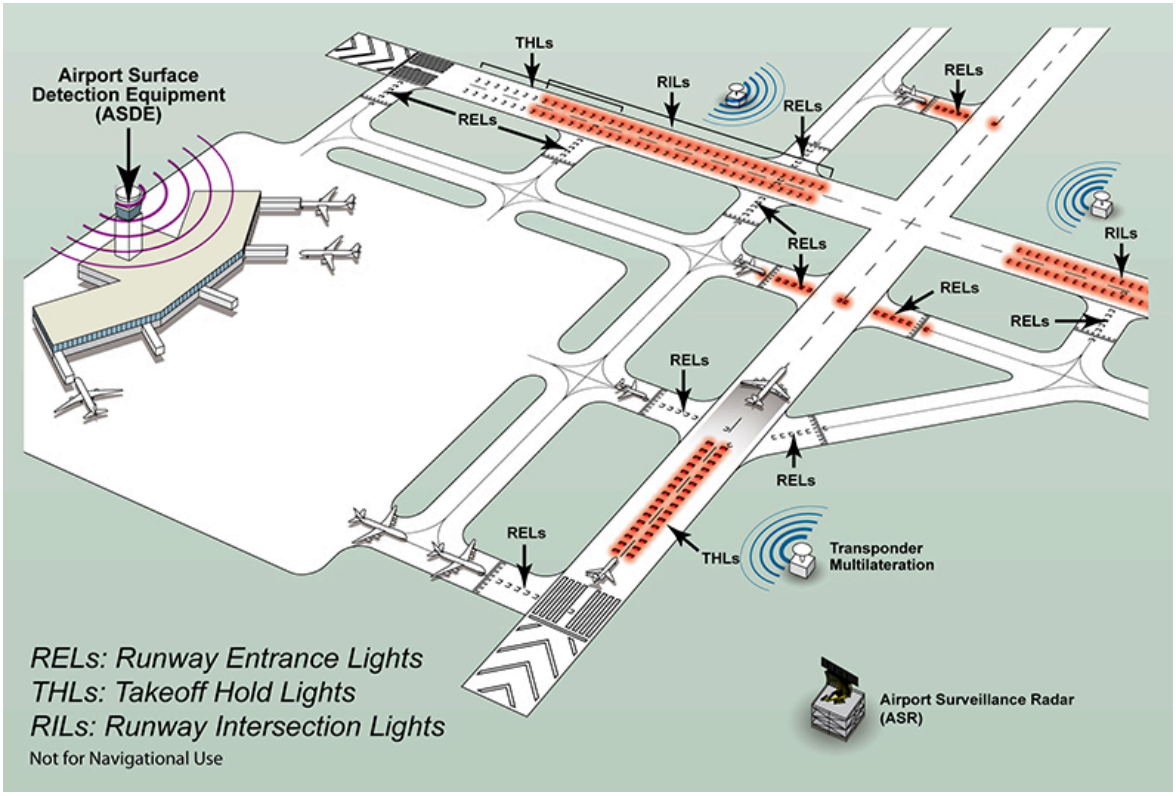
the *correct* hold line when exiting the runway.

- **Parallel runways** - In the case of exiting between parallel runways, the available taxi area for runway exit may be quite small, and the danger of a runway incursion is higher. Always brief this potential hazard before landing!

- **LAHSO** - ATC at some airports may offer so-called "LAHSO" (Land And Hold Short Operations) operations. **Pilots must explicitly accept (and may reject) a LAHSO clearance**, however if a LAHSO clearance is accepted, pilots should explicitly brief the landing and be vigilant that they do not rollout past the LAHSO line during landing.



- **Challenges of Night and Low-Visibility Operations** - When operating at night, or in low visibility conditions, it is more difficult to distinguish taxiway markings, signs, and identify other aircraft. Therefore, the potential for ATC to mis-identify aircraft (issue the right instructions to the wrong aircraft) is higher, and pilots must be extra vigilant about maintaining situational awareness of their own position, as well as that of other airplanes and vehicles. **If an instruction does not make sense, and goes against what was planned or briefed, ask for clarification from ATC!** (See Providence, RI Case Study)
- **Runway Status Lights** - Runway Status Lights are a fully automated system that provides runway status information to pilots and surface vehicle operators to clearly indicate when it is unsafe to enter, cross, takeoff from, or land on a runway. The RWSL system processes information from surveillance systems and activates Runway Entrance Lights (REL) and Takeoff Hold Lights (THL), in accordance with the position and velocity of the detected surface traffic and approach traffic. This provides an additional layer of safety that does not depend on human Air Traffic Controllers to prevent runway incursions.


Airport Surface Detection Equipment (ASDE)
THLs
RILs
RELs
RELs
RELs
RELs
RILs
RELs
RELs
RELs
RELs
RELs
RELs
THLs
Transponder Multilateration
Airport Surveillance Radar (ASR)
RELs: Runway Entrance Lights
THLs: Takeoff Hold Lights
RILs: Runway Intersection Lights
Not for Navigational Use