U.S. Department
of Transportation

Federal Aviation
Administration

Advisory Circular

Subject: Performance Specification for Airport Vehicle Runway Incursion Warning Systems (RIWS)	**Date:** DRAFT **Initiated by:** AAS-100	**AC No:** 150/5210-XX **Change:**

1. What is the purpose of this advisory circular (AC)?

This advisory circular (AC) provides a performance specification for airport vehicle runway incursion warning system (RIWS) equipment.

2. What is the scope of this AC?

This AC contains minimum performance specifications for systems and equipment airports use to provide a warning to drivers on an airfield about a potential runway incursion. This AC discusses two types of detection systems: a preconfigured, commercial off the shelf (COTS) system; and a system with custom hardware and software.

3. To whom does this AC apply?

The Federal Aviation Administration (FAA) recommends the guidance and specifications in this AC for procuring airport runway incursion warning system equipment. In general, use of this AC is not mandatory. However, it is mandatory for all equipment acquired through the Airport Improvement Program (AIP) or the Passenger Facility Charge (PFC) Program. See Grant Assurance No. 34, Policies, Standards, and Specifications, and PFC Assurance No.9, Standards and Specifications. See http://www.faa.gov/airports/aip/grant_assurances/ for additional information about grant assurances.

4. Are there any related documents?

a. FAA ACs:

AC 150/5210-5	Painting, Marking, and Lighting of Vehicles Used on an Airport
AC 150/5210-19	Driver's Enhanced Vision System (DEVS)
AC 150/5210-20	Ground Vehicle Operations on Airports
AC 150/5220-23	Frangible Connections
AC 150/5220-26	Airport Ground Vehicle Automatic Dependent Surveillance-Broadcast (ADS-B) Out Squitter Equipment
AC 150/5300-13	Airport Design
AC 150/5340-1	Standards for Airport Markings
AC 150/5340-18	Standards for Airport Sign Systems
AC 150/5340-30	Design and Installation Details for Airport Visual Aids

AC 150/5345-26	FAA Specification For L-823 Plug And Receptacle, Cable Connectors
AC 150/5370-2	Operational Safety on Airports During Construction

b. Other FAA publications:

Aeronautical Information Manual

c. Federal regulations:

Title 47 CFR part 15, Radio Frequency Devices

d. Websites:

Call to Action for Runway Safety: www.faa.gov/airports/airports_safety/call_to_action/

Runway Safety: www.faa.gov/airports/runway_safety/

5. What are the principal changes in this AC?

This is a new AC.

6. How can I get this and other FAA publications?

You can view a list of all ACs at http://www.faa.gov/regulations_policies/advisory_circulars/.

You can view the Federal Aviation Regulations at http://www.faa.gov/regulations_policies/faa_regulations/.

7. How do I send comments and/or suggestions on this AC?

Send comments or suggestions to:

Manager, Airport Engineering Division (AAS-100)
Federal Aviation Administration
800 Independence Avenue SW
Washington DC 20591

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Director of Airport Safety and Standards

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Chapter 1. Terminology

101. Definitions.

a. Air Operations Area (AOA). For the purpose of this specification, AOA means any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area includes such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.

b. Alert area. Audible or visual alarm by RIWS to alert vehicle driver of proximity to a boundary.

c. Apron. That part of an airport, other than the movement area, intended to accommodate the loading and unloading of passengers and cargo, the refueling, servicing, maintenance and parking of aircraft, and any movement of aircraft, vehicles and pedestrians necessary for such purposes. Also called the "ramp."

d. Continuous surveillance. Uninterrupted surveillance by a sensor of a surface **w**ithin a specific scan area.

e. False alarm. An alert causing the driver to unnecessarily stop or maneuver the vehicle.

f. Missed alarm. An occasion when an alert is not presented when it should be.

g. Movement Area. The runways, taxiways, and other areas of an airport that are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading aprons and aircraft parking areas (reference Title 14 Code of Federal Regulations (CFR) Part 139).

h. Moving map. A map that shows the vehicle icon stationary, with the surroundings moving and rotating to maintain a heading-up orientation.

i. Protected area. An area normally required to be clear of ground vehicles while a runway is active.

j. Ramp. See apron.

102. Acronyms.

ADS-B	Automatic Dependent Surveillance - Broadcast
AOA	Air Operations Area
ASDE-X	Airport Surface Detection Equipment – Model X
ASSC	Airport Surface Surveillance Capability

ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
DEVS	Driver's Enhanced Vision System
FAA	Federal Aviation Administration
FOD	Foreign Object Debris
GPS	Global Positioning System
ILS	Instrument Landing System
IP	Ingress Protection Rating
NOTAMS	Notices to Airmen
POFZ	precision obstacle free zone
RFID	radio frequency identification
RIWS	Runway Incursion Warning System
RSA	runway safety area

Chapter 2. Introduction

201. General.

The use of vehicle navigation devices is common by automobile drivers. Devices that use a GPS are accurate, and the technologies used to manufacture these devices are becoming less expensive. Such technology is used in aircraft, boats, automobiles, computers, cell phones, and other personal hand-held devices.

The FAA continues to assess ways to reduce the occurrence of runway incursions, especially by ground vehicles. The minimum operational performance specifications described in this AC identify a standalone incursion warning system for a ground vehicle driver. It is anticipated that GPS will be used to provide the vehicle location information for this warning system; however, airports can use other methods or technology such as radar, transponders, or RFID if these technologies achieve the required accuracy.

An airport ground vehicle RIWS provides alerts to vehicle drivers. The system does not give directions for navigating on an airport except for specific programmed routes as might be provided to operators of construction vehicles. It does not take the place of airport familiarization and air traffic control (ATC) instructions. The system should be used as a situational awareness tool to help reduce runway incursions.

202. Background.

a. Runway incursion definition. The FAA defines a runway incursion as any occurrence at an airport involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft. A runway incursion can happen when there is a breakdown in one or more of the following areas: complacency, poor communications, loss of situational awareness, and poor visibility.

b. Identifiable features to prevent runway incursions. Areas that could potentially result in an incursion or surface incident on an airport involve those normally required to be clear of ground vehicles while a runway is active. These areas are bounded by controlled points which a pilot or vehicle driver must get permission from ATC to cross at airports with an ATCT, or ensure there is no conflict with aircraft traffic before crossing at airports without an ATCT. These boundaries are typically supplemented with pavement markings, signs, and lighting so that pilots and vehicle drivers are aware of their locations. These boundary areas are:

- Holding position markings on taxiways and runways
- Non-movement area boundary markings or any markings bordering the AOA that may cause an incursion or surface incident
- RSAs

Detailed information on these boundaries is available in AC 150/5340-1, AC 150/5210-20, AC 150/5300-13, and in the Aeronautical Information Manual.

c. RSA. The RSA is a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway. A vehicle driver must be aware that he or she is approaching or is within the RSA. The RSA's width and length beyond the runway end can vary. The RSA width ranges from 120 to 500 ft (36 to 150 m). The RSA length beyond the runway ends ranges from 240 to 1000 ft (72 to 300 m). More information on the dimensions of the RSA is available in AC 150/5300-13.

Chapter 3. Vehicle RIWS Equipment

301. Purpose.

Airport personnel must be vigilant when driving on the airfield. The RIWS equipment specified in this AC provides airport ground vehicle drivers with a system to help them minimize the potential of runway incursions when operating in the AOA. By the use of both visual and audible proximity and alert area warnings when a vehicle is near holding position markings and/or runway safety areas, the system alerts the driver to the potential incursion. The equipment specified in this AC is intended to supplement, not replace, required airport familiarity, situational awareness, and ATCT instructions.

302. System Technology.

This AC does not limit the technology that airports may use for providing location information. Airports may use GPS, RADAR, transponders, RFID, or other technology to demonstrate the required function(s) and accuracy.

303. System Types.

a. Preconfigured. An RIWS may consist of a preconfigured system that functions for an airport without additional modifications. The system contains a preloaded aerial photograph/map of the user's airport with runway/taxiway labeling, hold position markings and proximity warning/alert areas identified.

b. Custom. An RIWS may consist of a custom system that may be configured by an airport operator to reflect changing needs, such as noting closed taxiways and runways, or construction areas and haul roads.

304. System Selection.

The airport user should consider the following factors when selecting the system type (preconfigured or custom) which best meets the airport's needs.

- Size of the airport
- Future airport geometry as shown on the airport layout plan
- Volume of aircraft and vehicle traffic
- Complexity of airport geometry
- Equipment maintenance requirements
- Initial cost
- Frequency of changes to the airfield
- Future requirements
- Permanent vs short-term users

A small, simple airport with no plans for expansion or construction projects will likely find that the low cost, simplicity, and ease of operation of a preconfigured system best meets its needs. In contrast, a large, complex airport anticipating construction and/or desiring advanced features

such as vehicle tracking and integration with other airport systems may justify the additional cost of a custom system.

305. Performance Specifications.

a. Basic functions. Vehicle RIWS equipment must perform the following functions:

(1) Provide surveillance of vehicle locations in the AOA as specified by the airport.

(2) Provide a moving map indicating the position of the vehicle on the airport.

(3) Provide a warning/alert signal (audible and visual) to the vehicle driver as specified in this AC.

(4) The system must not interfere with current airport and aircraft communication, navigation, and surveillance systems.

(5) If specified by the airport operator, a system may be programmed manually with specific routes, and provide an alert if the vehicle deviates from that route.

b. Prohibited function. An airport ground vehicle RIWS must not give directions for navigating on an airport except for specific programmed routes as might be provided to operators of construction vehicles, and must not take the place of airport familiarization and air traffic control instructions. The system should only be used as a situational awareness tool. This prohibition does not apply to a DEVS that may fulfill the function of a Runway Incursion Warning System.

c. Performance.

(1) The required system performance for vehicle location: <10 feet (3 meters) 95% of the time.

(2) Vehicle position data update rate: once per second minimum.

(3) Vehicle warning time to possible incursion at holding positions or service road intersecting the runway: For a vehicle traveling 0-10 mph (0-16 km/hr), the system triggers a proximity warning of an alert area 20 ft (6 m) on either side of the vehicle's location receiver and at a minimum distance of 60 ft (18 m) in advance of the vehicle's direction of movement. The proximity warning increases 6 ft (2 m) in advance of the movement direction for every 1-mph (1.6 km/hr) increase in speed. Reference Table 3-1.

(4) System integrity monitoring. The system displays a warning if vehicle position information may be subject to errors due to lack of accuracy in input data. The system also exhibits an alarm if any malfunctions/failures preclude an accurate position display.

(5) System initialization: The system must be automatically initialized upon vehicle start-up and able to compute a vehicle position solution within 3 minutes (or an alternate time that may be separately specified by the airport user based on operational considerations).

(6) False alarms. One per 100 hours of use.

(7) Missed alarms. One per 100 alarm situations.

d. Ambient environmental specifications. The equipment furnished as part of the RIWS must be suitable for the environment that it will operated in. At a minimum, all equipment must be rated to operate under the following conditions:

Operating temperature range:	-4 °Fahrenheit (F) to 140 °F (-20 °Celsius (C) to 60 °C), except as specified by the airport operator for extreme conditions.
Storage Temperature range:	-40 °F to 167 °F (-40 °C to 75 °C)
Dust resistance:	Protected against the ingress of dust that could adversely affect keyboard, data communications ports, and mechanical functions. Compliant with IP31 standards.
Humidity:	Operating: 95% relative humidity at 140 °F (60 °C).
Water resistance:	Resistant to dripping water arising from condensation and spills.
Vibration resistance:	Resistant to damage cause by vehicle vibration while in operation over rough terrain and other activities (4.5g rms at 5 to 500 Hz sine).
Weather Conditions.	The airport user will specify if the device needs to operate in any unusual weather conditions.

e. Power requirements.

(1) The system power requirements must allow operation from the vehicle battery power bus for a minimum of 1 hour without adversely affecting other systems. Equipment installed on the vehicle battery power bus must be designed to withstand up to ±20 percent voltage variations from the nominal power bus voltage, alternator load dumps, voltage spikes/transients/noise and be protected from reverse polarity.

(2) Vehicle-mounted equipment is powered by 12 VDC. The device or system in vehicles may be by direct hardwire power connections, 12V quick plug-ins, battery, battery

backup or a combination(s) of these methods. The airport user will specify the power source which meets their operational requirements. Equipment installed in buildings is powered by 120 VAC. Equipment installed on the airfield is powered as specified by the airport operator.

f. Vehicle location accuracy. Location accuracy is critical for operating and navigating on an airport. The standard for accuracy of the vehicle location is less than 10 feet (3 meters) 95% of the time. Systems must include self-initialization and an indication of system status.

g. Location receiver placement. Proximity warnings are triggered based on where the receiver is physically located on a vehicle. The receiver or separate antenna is centered on/in the vehicle as far forward as possible without obstructing the signal. The antenna must be weatherproof and mounted with a clear view of the sky.

h. Vehicle display/system control. Information presented must be readily visible and audible to a driver o**p**erating a typical vehicle such as a pickup/sedan or construction/airport maintenance equipment. At a minimum, the vehicle display requirements are:

- 5-inch diagonal touch screen
- display resolution of 480 × 272 pixels
- WQVGA color TFT with white backlight

i. Moving map. The moving map display provides situational awareness to the vehicle driver by confirming his or her location on the map and the direction of travel. The vehicle's location is centered on the map for complete 360 degree situational awareness around the vehicle with a minimum distance of 200 feet (60 m) visually shown around the vehicle for added situational awareness. The moving map display shows all an airport's AOA including the runways, taxiways, aircraft aprons, RSA, and other areas where a vehicle can travel within the AOA. The minimum size of the map display is 5 inches diagonal. The map must not be so complicated or crowded that its readability is compromised. The system software must allow for zooming, panning, and selecting a variable-sized area for full screen display.

j. Proximity warnings. Proximity warnings consist of an audible and visual signal to the vehicle driver, making he or she aware that the vehicle is approaching an alert area and there is a potential for an incursion. For a vehicle traveling 0-10 mph (0-16 km/hr), the system triggers a proximity warning of an alert area 20 ft (6 m) on either side of the vehicle's location receiver and at a minimum distance of 60 ft (18 m) in advance of the vehicle's direction of movement. The proximity warning increases 6 ft (2 m) in advance of the movement direction for every 1-mph (1.6 km/hr) increase in speed. The proximity warning decreases in the same manner to a minimum of 60 ft (18 m). Table 3-1 shows speed and proximity warning distances, using this criteria.

Table 3-1. Speed and Proximity Warning Distances

Speed – mph (km/hr)	Proximity Alert Distance – ft (m)
0-10 (0-16)	60 (18)
11 (18)	66 (20)
12 (19)	72 (22)
13 (21)	78 (24)
20 (32)	120 (37)
30 (48)	180 (55)
40 (64)	240 (73)
50 (80)	300 (91)
60 (97)	360 (110)

k. Alert areas.

(1) Runway holding position marking. A holding position marking alert area is the final indication to the vehicle driver that he or she is close to a holding position marking. The runway holding position marking alert area consists of an area extending from the holding position marking 30 feet (9 m) to each side and in the direction away from the runway. When a vehicle moving toward the runway enters this alert area, unique audible and visual signals are triggered. The audible signal is a voice message stating that the holding position marking is being crossed and the runway is being entered. For example, "runway hold line – entering runway." The visual signal is continuously active until the vehicle crosses a runway holding position marking traveling away from the runway or clears the runway safety area via other than a taxiway. When a vehicle moving away from the runway enters this alert area, a unique audible signal is triggered. The audible signal is a voice message stating that the holding position marking is being crossed and the runway is being cleared. For example, "runway hold line – clearing runway." The visual signal is discontinued when the vehicle enters this alert area moving away from the runway, or when the vehicle clears the runway safety area via other than a taxiway. Figure 3-1 shows an example of a runway holding position marking alert area.

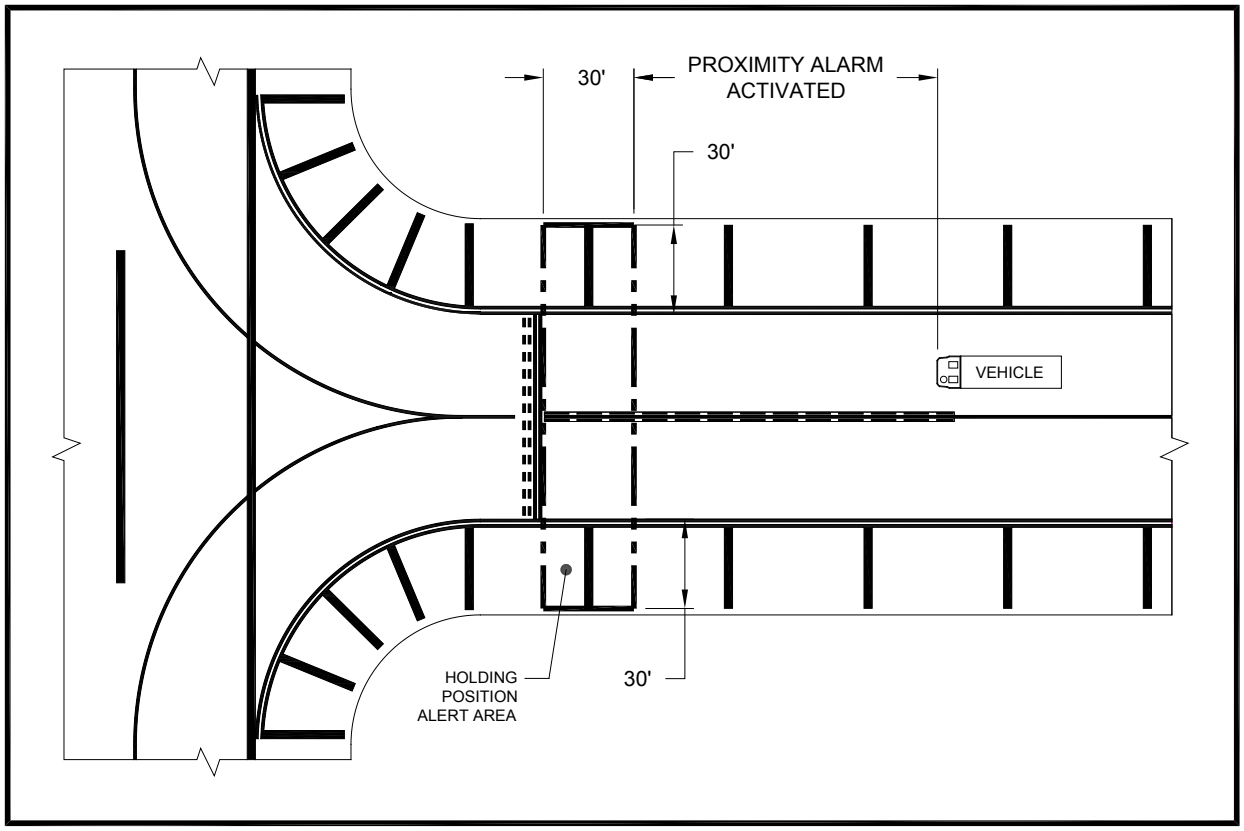

Figure 3-1. Example of a Holding Position Marking Alert Area

(2) ILS Critical Area/POFZ. Two special cases of a holding position marking are those bounding an ILS critical area and a POFZ. The holding position marking alert area consists of an area extending from the holding position marking 30 feet (9 m) to each side and in the direction away from the protected area. When a vehicle moving toward the protected area enters this alert area, unique audible and visual signals are triggered. The audible signal is a voice message stating which area is being entered. For example, "entering ILS critical area" or "entering POFZ." The visual signal is continuously active while the vehicle is in the protected area and discontinued when the vehicle leaves the protected area. When a vehicle moving away from the protected area enters this alert area, a unique audible signal is triggered. The audible signal is a voice message stating which area is being cleared. For example, "clearing ILS critical area" or "clearing POFZ." The visual signal is discontinued when the vehicle clears the protected area.

(3) RSA. The runway safety area alert area consists of an area extending from the edge of the runway safety area extending 30 feet (9 m) in the direction away from the runway. The size of the RSA is determined by the criteria in AC 150/5300-13. When a vehicle enters this alert area via other than a taxiway, unique audible and visual signals are triggered. The audible signal is a voice message stating "Entering runway safety area." The visual signal is continuously active while the vehicle is in the RSA. and discontinued when the vehicle moving away from the runway leaves the RSA alert area. When a vehicle clears the RSA via other than a

taxiway, a unique audible signal is triggered and the visual signal is discontinued. Figure 3-2 gives an example of an RSA Alert Area.

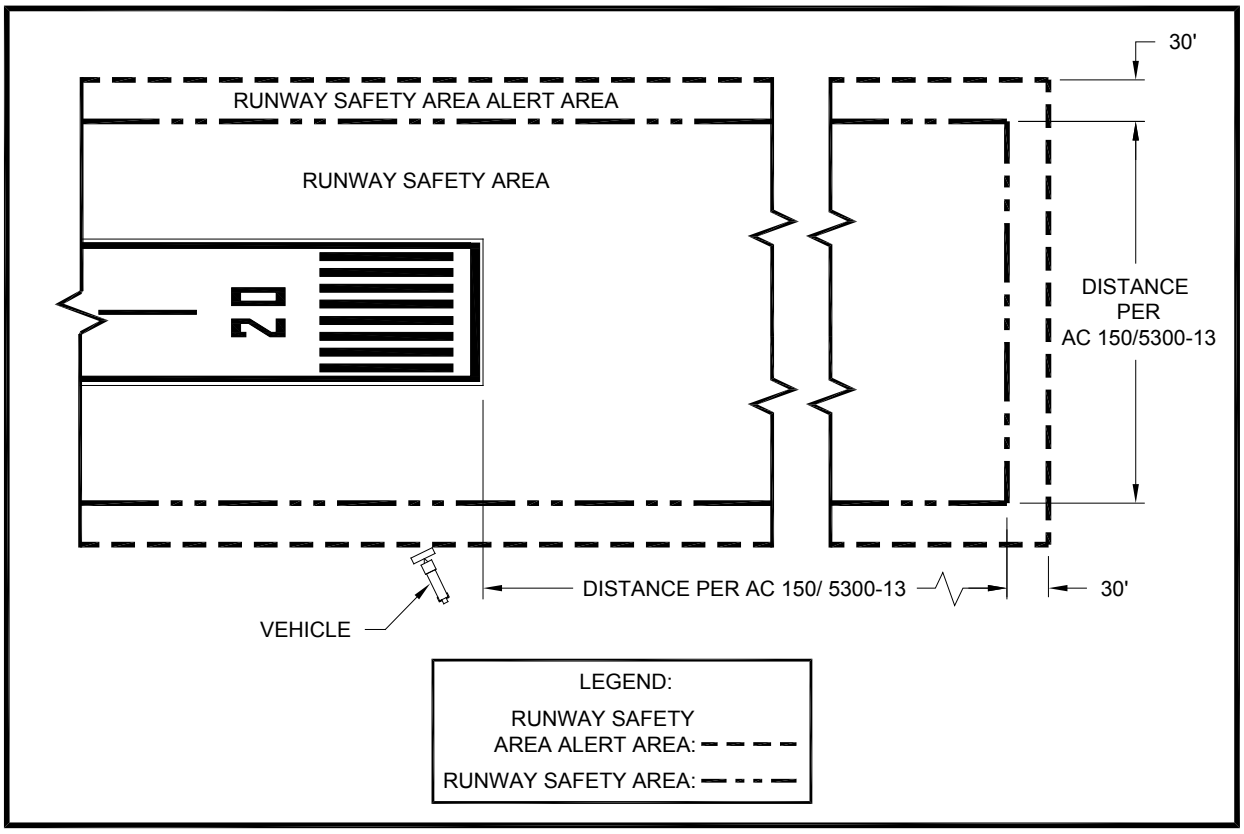

Figure 3-2. Example of an RSA Alert Area

(4) Custom areas. If specified by the airport operator, a custom system is capable of providing unique audible and visual signals alerting a vehicle driver that he or she is entering or leaving an area (e.g. a construction area or haul route configured by the airport operator; approach hold and runway hold position for runway to runway intersections without position markings).

l. Alert signals.

(1) Audible. An audible signal consists of beeps, tones, melodies, or voice messages. Both preconfigured and custom airport ground vehicle runway incursion warning systems provide options from which the airport operator can select the audible signals that meet its operational requirements. A custom system has the ability to add additional or custom audible signals as the airport operator requires. Unique voice message signals are triggered when a vehicle enters different areas, as specified in this AC and by the airport operator. Signals that are not specified are selected by the manufacturer.

(2) Visual. A visual signal consists of different styles of lights, flashing screens, colors, textual messages, graphics, or any combination thereof. Both preconfigured and custom

airport ground vehicle runway incursion warning systems provide several options from which the airport operator can select the visual signals that meet its operational requirements. A custom system has the ability to add additional or custom visual signals as the airport operator requires. Unique visual signals are used for proximity warnings, holding position marking alert areas, and RSA alert areas. The visual signal is continuously active as specified in this AC.

m. Airport information updates. Periodic airport updates and changes provide assurance that the information in the RIWS is current**.** The RIWS must provide the capability for updating of the airport diagrams/maps, alert/proximity warning areas, etc. as conditions change on an airport. The RIWS manufacturer must provide update capability for the useful life of the RIWS. Updates to the airport maps/diagrams, alert/proximity warning areas, etc. must be provided by the RIWS manufacturer within 5 business days of the request from the airport operator or provide the capability for the airport operator to make the required updates.

n. Standard features. The following features are provided by a preconfigured system.

(1) Automatic or Manual Display Dimming. The brightness of the display is adjusted for ambient light automatically or manually.

(2) Vehicle speed indicator / warning. The system provides an indication of the vehicle speed and a warning if a speed set by the airport operator is exceeded.

o. Optional features. The following additional features are provided as specified by the airport operator with a justification for their operational requirements, requiring a custom system.

(1) Historical tracking and vehicle trails. A vehicle's historical track information of where the vehicle has been is stored within the device, and the vehicle's trail is shown graphically on a display. System must retain tracking information for a minimum of 48 hours with download capability.

(2) System integration. Device integration is considered with other airport systems already in use and approved by the FAA, such as FOD detection equipment, ADS-B, ASDE-X, DEVS, multilateration and ASSC,and airfield maintenance and inspection programs.

(3) Zone creation. Zones may be created as "do not enter" or "do not exit." The system provides an alert if the zone is entered or exited, as programmed. The airport user can create other type of zones to provide additional warning, information, and tracking, such as construction zones, speed zones, traffic zones, and temporary zones.

p. Network Capability. Network capable devices are operated and monitored over a wireless communication network. Each individual device functions as one integrated system providing airport operations monitoring, shows the location of other devices on the map display, allow the exchange of information without interfering with radio communications, allow changes to the software program instantly and collectively, display real-time weather information and current airport operating information. All radio frequency (RF) broadcast at an airport is subject to the approval of FAA Spectrum Management.

(4) Multiple-vehicle tracking. The system is capable of operating on a network which provides multi-vehicle tracking allowing the airport user to monitor the location of all vehicles on the AOA.

(5) Document display. The system stores documents, such as airport operating procedures; regulations; guidelines; NOTAMS, etc. which can be retrieved by the vehicle driver.

q. Useful life. The useful life for which the equipment is designed, assuming it is used and maintained in accordance with the manufacturer's recommendations, is a minimum of 5 years.

r. Construction standards.

(1) General requirements. All equipment and material is new, undamaged, and of the best grade. Decisions concerning quality, fitness of materials, or workmanship are determined by the airport operator.

(2) Workmanship. The manufacturer installs all equipment, materials, specialties, etc., in accordance with industry standards.

(3) Materials.

(a) Equipment exposed to outside weather is moisture resistant to IP 62 per International Electrotechnical Commission (IEC) 60529, Degrees of Protection Provided by Enclosures.

(b) All external components are constructed and finished in a manner to inhibit corrosion.

(c) All machined surfaces are corrosion resistant.

(4) Parts.

(a) Insofar as practicable, parts complying with commercial standards are used throughout.

(b) Interchangeability and replaceability.

(i) All parts having the same manufacturer's part number are directly and completely interchangeable with each other with respect to installation and performance.

(ii) All components and assemblies incorporated in the equipment are designed and manufactured to dimensional tolerances which permit future interchangeability and facilitate the replacement of parts.

(c) The manufacturer must develop and provide a parts list. The manufacturer must maintain an inventory of spare components with an availability of 10 business days.

(5) Codes and Standards. The manufacturer recognizes and complies with all codes and standards applicable to the design and construction of this type of equipment generally accepted and used as best practices in the industry

s. Installation and acceptance standards.

(1) Installation.

(a) Access to the airfield is as directed by the airport operator.

(b) Systems must conform to applicable airport obstruction criteria, marking and lighting, and equipment installation standards.

(c) For components located within the runway safety area:

- Fixed by function. Sensors may only be located within the runway safety area if they will not perform their function if located outside the RSA.

- Frangibility. Any sensors must be frangibly mounted (reference AC 150/5220-23, Frangible Connections).

- Height. The height of the sensors must be no more than 30 in (0.76 m), or the height of existing edge lights for the runway, whichever is less (reference AC 150/5340-30, Design and Installation Details for Airport Visual Aids).

- Connector. The sensor is connected through a breakaway connector that will disconnect upon impact. (Reference AC 150/5345-26, FAA Specification For L-823 Plug And Receptacle, Cable Connectors)

- Temporary sensors. Sensors may be established during a construction project to enhance the RIWS. It is intended that these sensors conform to all installation standards and are removed after the project is completed.

(d) Wind. The sensor unit(s) must withstand a wind loading of 300 mph (483 km/h). Prior to installation, the manufacturer obtains all site construction, environmental, and coordination requirements for installation of the detection system at the airport.

(e) Unless otherwise specified by the airport operator, installers of mechanical and electrical work participate in any pre-installation meetings at the project site to review conditions of other related project work.

(f) The manufacturer provides trained personnel at the time of delivery to place the device into operation.

(g) Equipment located outside of paved surfaces is designed and built with ease of maintenance in mind.

(h) The mobile system is installed on existing vehicle infrastructure, tested and ready for use within a time mutually agreed upon by the installing activity and airport.

(2) Quality assurance. The manufacturer tests all equipment installed under this specification and demonstrates its proper operation to the airport operator. The manufacturer furnishes all required labor, testing, instruments and devices required for the conduct of such tests.

(a) The manufacturer installs all electrical, instrumentation, and mechanical parts necessary for operation of the system.

(b) The manufacturer notifies the airport operator in writing of any instances in the specifications that are in conflict with applicable national and local codes. The manufacturer performs all work per applicable laws, rules, or regulations.

(c) Deviations from the specifications required for conformance with the applicable codes and/or laws are corrected immediately, but not until such deviations have been brought to the attention of the airport operator.

(d) Where this AC calls for materials or design details in excess of the applicable codes requirements and laws, the AC takes precedence.

(3) Inspection. The manufacturer will establish a formal final inspection procedure to ensure that each system is adjusted as designed, and that all systems are operating properly. The airport operator may choose to participate in the final inspection of designated systems.

(4) Testing. After the equipment has been installed and the various units have been inspected, adjusted/calibrated, and placed in correct operating condition, the equipment is field tested per the airport operator's testing procedures and requirements. The field tests demonstrate that the equipment functions are in compliance with the specifications over the entire range of operation. The manufacturer reports any unusual conditions and correct deficiencies of any of the units.

(a) The airport operator may specify preliminary qualification tests.

(b) The airport operator may specify formal qualification tests.

(5) Manuals and publications. The following operation and maintenance manuals accompany the delivered equipment. The quantity of items is specified by the airport operator. No special format is required.

(a) Operator's handbook.

(b) Illustrated parts breakdown and list.

(c) Preventive maintenance schedule.

(d) Sensor Failure Detection

t. Equipment training and maintenance standards.

(1) Training.

(a) The manufacturer provides trained personnel at the time of delivery to adequately train airport/airline staff in the operation and maintenance of the equipment.

(b) Training includes written operating instructions that depict the step by step operational use of the system. Written instructions include, or are supplemented by, materials which can be used to train subsequent new operators.

(c) Training topics include trouble shooting and problem solving, in the form of theory and hands-on training, for personnel designated by the airport operator.

(d) At least four hours of training for airport/airline personnel is provided by the manufacturer. Training selected personnel as part of a "Train the Trainer" program will also satisfy this requirement.

(e) Upon the completion of training, the manufacturer issues a certificate of competency to each participant.

(2) Maintenance.

(a) Preventive. The manufacturer develops and provides the airport operator with written documentation for recommended preventive maintenance actions.

(b) Cleaning. The manufacturer develops and provides written documentation on recommended cleaning procedures to the airport operator.

(c) Inspection. The manufacturer develops and provides written documentation on regularly scheduled maintenance procedures to the airport operator. A focus on sensitive equipment and schedule timelines is included in the documentation.

(d) Recalibration. The manufacturer develops and provides any recalibration requirements to the airport operator. Recalibration ensures that performance specifications are maintained for the life of the equipment.