Chapter 8 - Airport Navigational Aids

Navigational Aids (NAVAIDS)

An airport's Visual and Navigational Aids (NAVAIDS) primary function is to assist pilots in the safe and efficient movement of aircraft during landing, takeoff, and taxiing maneuvers. It is therefore very important to have all visual and navigational aids working properly and maintained in good condition.

This chapter will briefly discuss various visual and navigational aids, provide general suggestions on inspection procedures of the more standard visual and navigational aids located on most general aviation facilities, and discuss safety procedures when maintaining such equipment.

The FAA recently revised their Advisory Circular 150/5340-26A dated 4/4/2005 titled "Maintenance of Airport Visual Aid Facilities" which is incorporated herein by reference. The AC provides system maintenance information for establishing at your airport a preventative maintenance program for airport visual aid facilities. The information in the AC covers the following systems:

Airport lighting vault and series lighting circuits
Constant Current Regulators (CCR)
Runway and taxiway elevated edge lighting systems
Runway and taxiway in-pavement lighting systems
Runway guard lights and stop bar lights
Illuminated runway and taxiway signs
Rotating beacons
Lighted wind cone assemblies
Precision Approach Path Indicator (PAPI) systems
Visual Approach Slope Indicator (VASI)
Runway End Identifier Lights (REIL) and Omni directional Approach Light System (ODALS)
Medium Intensity Approach Light System (MALS, MALS/F, MALS/R)
Hazard beacons and obstruction lights
Control systems
Standby engine generator systems

In addition to the visual aid facilities equipment topics, the circular also covers recommended safety practices and suggested troubleshooting procedures for airport series lighting circuits.

Other Types of Visual Aids

Retroreflective Markers

Retroreflective markers or reflectors are very useful to pilots on any airport. These reflectors are the same as those on roads. Taxiway centerlines are marked with green colored markers and edges are marked with blue markers. Reflectors are placed at least every 25 feet in straight ways and 12.5 feet in turns. Reflectors are also placed on runways along the extended exit taxiway centerline turnoffs.

In 1983 the FAA Technical Center conducted a study "Identification of Exit Taxiways (Retroreflective Markers Only)" and published their findings in DOT/FAA/CT-83-5, DOT/FAA/RD-82/91 dated April 1983. in summary "The results indicate that there was an improvement in the pilots ability to identify the exit taxiway associated with the exit-taxiway retroreflectors. The results also show that the retroreflectors should be placed on an arc from near the runway centerline to the taxiway centerline using a cord spacing of 12.5 feet". The LA DOTD Aviation Section has adopted this recommendation as a basic visual aid that should be installed at all runway exit taxiway intersections.

Segmented Circle

Segmented circles aid the pilot in locating obscure airports and provide a centralized location for such signal devices as may be required on a particular airport. Wind direction is indicated with a wind cone which should be lighted either internally or externally. Landing strip indicators are arranged outside the segmented circle indicating the orientation of the landing strip. Landing direction indicators are used to show pilots the direction in which landing and takeoffs are to be made. Traffic pattern indicators are arranged outside the segmented circle when there is any variation from the normal left-handed pattern. Several varieties of segmented circles are shown in **Figure 8.1**.

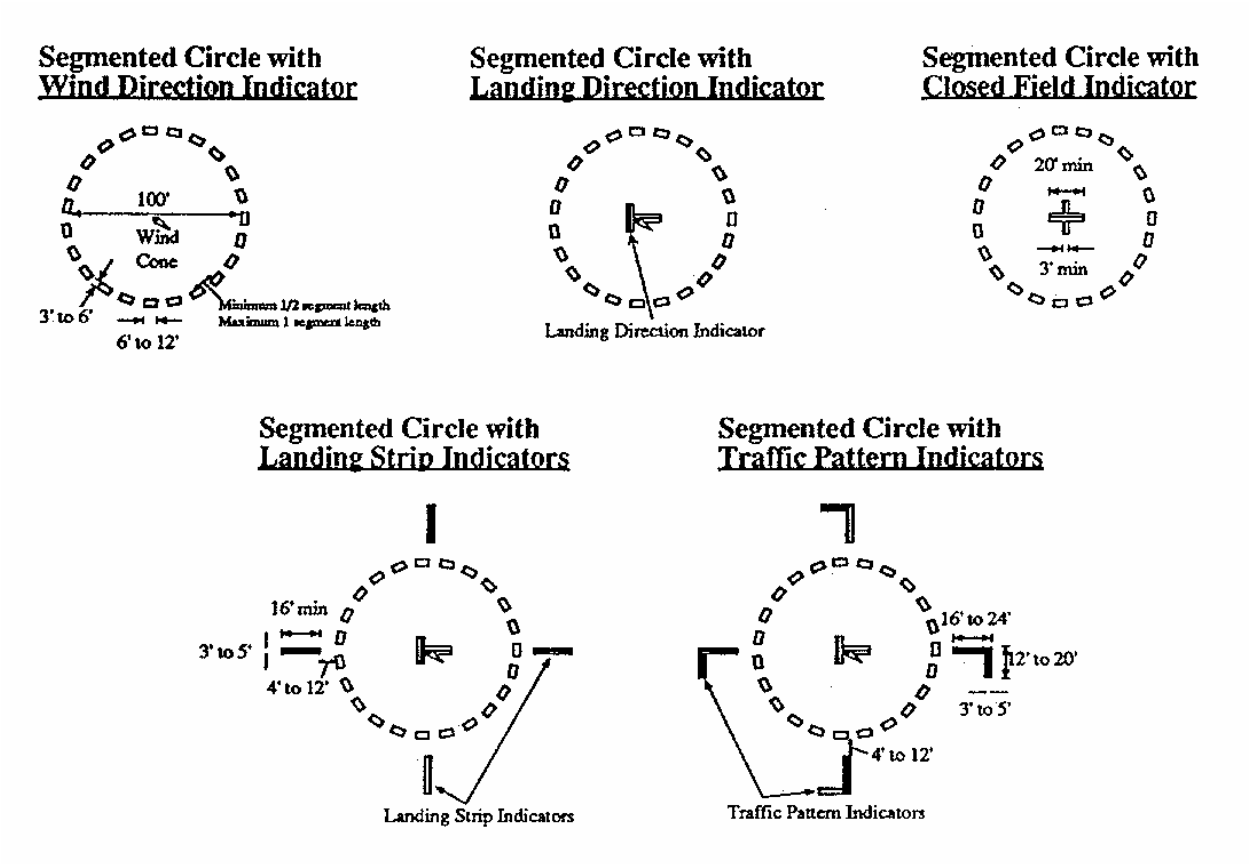

Figure 8.1: Segmented Circle Configurations

Electronic NAVAIDS

Nondirectional Beacon (NDB)

The nondirectional beacon (NDB) radiates a low or medium frequency signal which provides directional guidance to and from a transmitting antenna. A pilot whose aircraft is properly equipped can determine his bearing and "home" on the station. A NDB is normally mounted between two 55 foot poles forming a symmetrical "T" Antenna and may be located on or off the airport. It is preferable for the NDB to be located off the airport on the runway extended centerline between 4 to 6 nautical miles from the runway threshold. In 2002 and 2003 the LADOTD Aviation Division replaced all of the existing non-federal NDB systems statewide to increase reliability. The new NDB systems were manufactured by Nautel Limited, 201 Target Industrial Circle, Bangor, ME 04401, tel 207-947-8200, fax 207-947-3693. The system consists of a ND200S 50 watt transmitter, NX500TUB (FAA9782/1) Automatic Tuning Unit, Replacement T-20 "T" Antenna system, NRB4 Monitor Alarm Receiver with NLA/2 Active Ferrite Loop Antenna, and a NAB05A Battery Charger.

Localizer Antenna

The localizer (LOC) antenna emits a signal which is used to establish and maintain the aircraft's horizontal position until the pilot visually confirms the runway alignment and location. The LOC antenna is located on the extended runway centerline 1,000 to 2,000 feet beyond the stop end of the runway. In 1994 the LA DOTD Aviation Section replaced all of the existing non-federal LOC systems with the Mark 10 system.

To receive LOC funding from the LA DOTD Aviation Section, an airport must have a minimum runway 5000 foot in length with a minimum of 75 feet in width, (TORA 5000, TODA 5000, ASDA 5000 LDA 5000), Non-Precision Runway Markings, mandatory signage located 250 feet from all runway / taxiway and runway / runway intersections, an NDB installed as a compass locator on the runway extended centerline between 4 to 6 nautical miles from the runway threshold, a PAPI-2 or PAPI-4 with a 3° glidepath and 50 foot Threshold Crossing Height (TCH), a 34:1 or better approach obstruction clearance, a Runway Protection Zone with FAA standard dimensions for all aircraft approach categories with not lower than ¾ mile visibility. (length 1700 feet, inner width 1000 feet, outer width 1510 feet).

Glide Slope Antenna

The glide slope (GS) signal, which is the critical component of the Instrument Landing System (ILS), is used to establish and maintain the aircraft's descent rate until the aircraft's pilot visually confirms the runway alignment and location. A glide slope differentiates precision from nonprecision approaches. The GS may be located on either side of the runway but must be located on the opposite side of the parallel taxiway to prevent aircraft from causing GS signal interruption at non-towered airports.

In addition to the LOC requirements to receive GS funding from the LA DOTD Aviation Section an airport must have a minimum of a 100 foot in width runway with a full parallel taxiway, Precision Runway Markings, a 50:1 or better approach obstruction clearance, a Runway Protection Zone with FAA standard dimensions for all aircraft approach categories with lower than ¾ mile visibility. (length 2500 feet, inner width 1000 feet, outer width 1750 feet), an AWOS-3 P/T or ASOS, and either an RCO / GCO or dedicated 24 hour land-line for communications to ATC and / or FSS. In addition, the airport's runway lighting system must have a 24 hour emergency generator with an automatic transfer switch rated for continuous service.

Automatic Weather Observation Stations (AWOS)

Automatic recording instruments were developed to measure varying weather conditions such as cloud height, visibility, wind speed and direction in order to alert pilots of severe or dangerous weather. FAA Advisory Circular AC 150/5220-16, "Automated Weather Observing Systems (AWOS) for Non-Federal Applications" provides additional guidance. The AWOS-3 P/T system is the standard system configuration in Louisiana. Currently all of the AWOS systems installed in Louisiana are manufactured by Vaisala. See Chapter 15 "Local Altimeters" for further information.

Ground Communication Outlet (GCO)

The GCO is an unstaffed, remotely controlled, ground/ground communications facility. Pilots at uncontrolled airports may contact ATC and FSS via VHF to a telephone connection to obtain an instrument clearance or close a VFR or IFR flight plan. They may also get an updated weather briefing prior to takeoff. Pilots will use four "key clicks" on the VHF radio to contact the appropriate ATC facility or six "key clicks" to contact FSS. The GCO system is intended to be used only on the ground.

Once the GCO is activated by a pilot the VHF base station dials a preprogrammed ATC telephone number for direct communication with center or the toll free FSS number. The combination of VHF radio and dial-up telephone link is the most cost effective manner to enable a direct communication link between an aircraft and FAA ATC or FSS facilities. The GCO is designed to eliminate the mandatory pay phone requirements for airports with a published instrument approach.

Additionally, the GCO equipment has the capability of allowing the appropriate ATC facility or the FSS to initiate a call over the GCO facility, with an assigned programmable security code, to pilot using your airport. We anticipate that the airport's GCO would be assigned a frequency of 135.075MHz. The airport's GCO frequency would be published in the Airport/Facility Directory and the U.S. Terminal Procedures Publication for your airport under the topic "Communications".

If an airport would want to request a GCO facility, the LA DOTD Aviation Section requires a dedicated telephone line be permanently made available, at the airport's expense. The State would purchase and furnish the GCO equipment and reimburse the airport's initial telephone installation costs and GCO equipment installation costs performed by your non-federal technician.

There are no annual or monthly recurring equipment or service costs for the GCO other than telephone line expenses for the airport to participate in the program. The monthly recurring telephone expenses may be eligible for 50% reimbursement under the State's GA and Reliever Airport Maintenance Grant Program, based on funds availability from the legislature on an annual basis.

Currently, GCO equipment installed in Louisiana is the ARINC Model 92-SC/TDAT and the Avtech Ground Link Model LA-1000.

UNICOM Radio

The UNICOM radio is a non-government communications facility which may provide airport information at certain airports. Several frequencies for airports without an operating control tower are available for selection by the airport. These frequencies are 122.700, 122.725, 122.800, 122.975, 123.000, 123.050, and 123.075. LADOTD Aviation recommends that the UNICOM frequency selected should also be the same frequency for the Pilot Radio Controlled Airport Lighting System. Selection of the UNICOM frequency should take into consideration existing UNICOM frequencies used at nearby airports to avoid confusion during pilot broadcasts of location and intentions as they enter the airports airspace.

Development of Standards

The LA DOTD Aviation Section is in the process of developing statewide minimum standards for visual aids and NAVAIDS. These standards will be categorized according to the size of the airports. Although these standards have not yet been officially published, the LA DOTD

Aviation Section has prepared a statewide airport NAVAIDS inventory and management plan that suggests certain minimum standards.

The suggested minimum standards include a fully operational rotating beacon, lighted wind indicator (sock by FAA standard), runway lighting, REILS, and PAPI systems should be considered as minimum visual aid equipment at airports. Taxiway lights are also recommended at larger general aviation facilities.

A standard general aviation airfield should include the following visual NAVAIDS:

* 36” Rotating Beacon – L-802
* 36” Lighted Wind Indicator
* Runway Edge Lights - MIRL
* Taxiway Lights (Intersections*) - MITL
* Runway End Identifier Lights - (REILS)
* Precision Approach Path Indicators – (PAPI)

* Indicates “minimum standards

Replacement Parts

Replacement parts for airfield lighting and visual aids should be acquired from the original manufacturer, if possible. Otherwise, replacement parts should be acquired from manufacturers whose equipment is listed as approved in FAA Advisory Circular AC 150/5345-53C Appendix 3, or latest edition, entitled "Approved Airport Equipment". Also contact the LA DOTD Aviation Section at (225) 274-4125 for more information and assistance.

36” Airport Rotating Beacon, 1000 watt . . . . . Lamp P/N MH 1000 / U / BT 37

L-858 – Signs, Quartz 45 Watt . . . . . Lamp P/N EXM – mfg. by GE

L-861 T – Taxiway, Quartz 30 Watt . . . . . Lamp P/N EXL – mfg. by GE

L-861 T – Taxiway, Quartz 45 Watt . . . . . Lamp P/N EXM – mfg. by GE

L-861 – Runway, MIRL, Quartz 45 Watt . . . . . Lamp P/N EXM – mfg. by GE

L-861 – Runway Threshold, MIRL, Quartz 45 Watt . . . . . Lamp P/N EXM – mfg. by GE

L-861SE – Runway Threshold, MIRL, Quartz 120 Watt . . . . Lamp P/N EVV – mfg. by GE

L-862 – Runway Edge, HIRL, Quartz 120 Watt . . . . . Lamp P/N EVV – mfg. by GE

L-862 – Runway Threshold, HIRL, Quartz 200 Watt . . . . . Lamp P/N EZL – mfg. by GE

MFG. P/N or equal

EXL = 40737 Crouse-Hinds
EXL = 48A0006 Siemens Airfield Solutions, Inc.
EXL = 55041 6.6A/30T3.5Q EXL Sylvania
EXM = 40732 Crouse-Hinds
EXM = 48A0007 Siemens Airfield Solutions, Inc.
EXM = 55048 6.6A/45T3.5Q EXM Sylvania

Local Altimeters - AWOS

Altimeter setting source(s) at your airport may lower landing minimums. A sponsor may want to have a non-federal Automated Weather Observing System (AWOS) to be the primary altimeter source, but to receive LA DOTD Aviation Section funding assistance the AWOS observation data must be transmitted to the FAA's National Airspace Data Interchange Network (NADIN).

Altimeter Setting Source Procedures

The Federal Aviation Administration (FAA) Advisory Circular AC 91-14D "Altimeter Setting Sources" sets forth the proper procedures for altimeter setting sources.

System Approvals – Local Altimeter Sources

Altimeter setting sources are intended for use with approved instrument approach procedures will require initial approval and periodic inspection by the FAA. Initial approval and annual inspections should be accomplished by contacting the FAA Southwest Region Flight Standards District Office (FSDO) in Baton Rouge at (225) 932-5900. Reference AC 91-14D.

AWOS-3 P/T Systems

Automatic weather reporting systems are required to meet FAA and National Weather Service accuracy and reliability standards before they can used to support instrument flight rule operations. Reference AC 150/5220-16.

The Automated Weather Observing System (AWOS) provides continuous, real-time weather reports, without human involvement, for users of aviation facilities. Each AWOS installation is certified, inspected, and commissioned by the FAA. The non-federal AWOS systems funded by the LA DOTD Aviation Section are configured and designated AWOS-3 P/T systems.

The AWOS-3 P/T provides current altimeter setting, density altitude, temperature, dew point, wind speed and direction with gust indication, visibility, cloud height and sky conditions, precipitation identification and intensity, and thunderstorm reporting with local-area lightning tracking.

Pilots and airport personnel make critical decisions based on the weather. Automated Weather Observing Systems (AWOS) are pilot's reliable guide through ever-changing weather conditions, so informed decisions can be made with confidence.

Lightning-sensitive airport operations rely on the lightning detection sensor to provide critical lightning threat information on the Graphics Weather Display along with VHF tramsmitter

broadcasts of advance precaution information which allows pilots to initiate avoidance procedures.

The AWOS-3 P/T system includes the following systems to form an operational unit:

Wind measurement, both speed and direction comprising wind vanes, anemometers, combined wind sensors and ultrasonic wind sensors.

Ceilometers which measure cloud heights at 25,000 feet or up to 40,000 feet.

Present Weather sensors combining visibility and present weather sensors that carry out tasks normally requiring a human observer and multiple instruments.

Visibility meters

Dual barometric pressure sensors which is used to determine the altimeter setting for the airport

Relative humidity and air temperature sensors

Additional AWOS peripherals include:

- VHF Ground-to-Air Transmitter broadcasts weather reports, 24 hours a day
- Operator Terminal - GWD Graphic Weather Display and a printer.
- NOTAM Capability - Record and transmit Notices to Airmen (NOTAMs).
- Telephone Access - phone line to access current weather or perform Remote Maintenance Monitoring (RMM) functions.
- Uninterruptible Power Supply
- UHF Data Link

National Airspace Data Interchange Network (NADIN) Connection - Connects the AWOS to the national weather network so that the facility's weather observations are available for flight planning and forecasting to both the FAA and NWS.

AWOS-3 P/T Data Link to NADIN

Pilots choose to prepare for their flights with weather briefings from the Federal Aviation Administration (FAA) Flight Services, Air Traffic Control (ATC), DUATS as well as commercial weather providers, Internet sites, pilot briefing systems and private forecasting companies.

Currently, Louisiana AWOS-3 P/T systems are manufactured by Vaisala. Further, Vaisala recently purchased CLH, Inc. which installed and managed the Z-Link non-federal interface portal system to the FAA NADIN. The Vaisala AviMet™ Data Link system replaces the Z-Link system. Louisiana weather observations is incorporated into FAA or NWS weather maps and

briefings using this single source of data distribution to the FAA's Weather Message Switching Center (WMSCR) through the National Airspace Data Interchange Network (NADIN).

NADIN

NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN)

The National Airspace Data Interchange Network (NADIN) Message Processing Service (NADIN I) is a store-in-forward message-switched data network. NADIN I is also known as NADIN MSN (Message Switched Service). The initial network will replace and combine the U.S. operated portion of the Aeronautical Fixed Telecommunications Network (AFTN) and Automatic Data Interchange System B (ABDIS). Both of these networks switch Service B information (flight plan data) among FSSs, Air Route Traffic Control Center (ARTCCs), Base Operations (BASOPs), and intentional points. NADIN I will also handle Service B traffic for Flight Service Automation System (FSAS) Model 1, intentional Notice to Airman System (NOTAMs) for selected users, and Service A weather data for ARTCCs.

The majority of users will interface with the network at a NADIN concentrator, located at each ARTCC, where protocol, speed, and Code conversion functions are performed. In a few special cases, users will connect directly to a switch Front-End Processor (FEP). Any NADIN I user will be able to transmit authorized messages to and receive authorized messages from any other NADIN I User.

Each of the two operational NADIN I Switches at Atlanta and Salt Lake City controls its own "star" network of concentrators. Generally, concentrators east of the Mississippi River are assigned to the Atlanta switch, while concentrators west of the Mississippi are assigned to the Salt Lake City switch. Each SWITCH is connected to its assigned SWITCH, and the two Switches are connected to one another by two 9.6 kbps circuits. Under normal conditions, messages are transmitted between their respective assigned switch (es), as follows:

- Traffic between two concentrators connected to the same switch is transmitted via that switch.
- Traffic between concentrators connected to separate switches is transmitted from the originating concentrator to its assigned switch, then to the other switch and then to the receiving concentrator.

Switches are located in separate NADIN buildings at the Atlanta and Salt Lake City ARTCC locations. The switch message traffic bound from one SWITCH to another.

Switches provide users in en route areas with an interface to the NADIN I system. Switches pass all messages from users to a switch for further routing/distribution. The 23 operational Switches are 20 in the Continental United States (CONUS) ARTCCs, and one each at Anchorage, and Honolulu.

The National Airspace Data Interchange Network (NADIN) Packet Switched Network (PSN), commonly known as NADIN II, is part of the data switching sub-element of the NAS communications element and it currently provides, or will provide, high-speed, data communications between other sub-systems in the NAS. The NADIN II, which was

commissioned on March 31, 1995, employs the international Telecommunications Union-Telecommunications Standards Section (ITU-TSS) X.25 (1984 version) protocol and operates 24 hours a day, seven days a week.

NADIN II is an independent X.25 Packet Switched Network (PSN) that augments and functions in parallel with the NADIN I (sometimes incorrectly referred to as NADIN IA) store-and-forward Message Switching Network (MSN). Collectively, both networks are known as NADIN. The NADIN II is a highly robust data communications network composed of packet switching nodes connected by high-speed digital backbone trunks and controlled from a central facility, the Network Control center (NCC). The major functions to be performed by the NCCs are network management and control. However, normal day-to day operation of NADIN II requires no manual (operator) intervention by the NCCs or others; it is fully automatic.

The PSN provides end-to-end connectivity between users and host computers nationwide. NADIN II uses commercially leased circuits, currently LINCS, and the T-carrier portion of the Radio Communications Link (RCL) as the transmission medium to connect the 24 operational NADIN II packet switching nodes. Network services include interactive host-to-host, host-to-terminal, terminal-to-host, and terminal-to-terminal data transfer. The packet switching nodes are multi-processor devices with automatic redundancy. Alternate routing is provided to all node sites, with each node having a minimum of two backbone trunks. NADIN II is an FAA-owned system. Hughes Corporation is the contractor. NADIN II is fully operational.

References

www.faa.gov/programs/fti/telesum.htm “Telecommunications Systems Summaries-NADIN”

Federal Aviation Administration Advisory Circular 91-14D, “Altimeter Setting Sources”

Federal Aviation Administration Advisory Circular 150/5070-6B, “Airport Master Plans”

Federal Aviation Administration Advisory Circular 150/5190-4A, “A Model Zoning Ordinance to Limit Height of Objects Around Airports”

Federal Aviation Administration Advisory Circular 150/5220-16C, “Automated Weather Observing Systems (AWOS) for Non-federal Applications”

Federal Aviation Administration Advisory Circular 150/5230-4A, “Aircraft Fuel Storage, Handling, and Dispensing on Airports”

Federal Aviation Administration Advisory Circular 150/5300-13, “Airport Design”

Federal Aviation Administration Advisory Circular 150/5340-5B, “Segmented Circle Airport marker System”

Federal Aviation Administration Advisory Circular 150/5340-18D, “Standards for Airport Sign Systems”

Federal Aviation Administration Advisory Circular 150/5340-26A, “Maintenance of Airport Visual Aid Facilities”

Federal Aviation Administration Advisory Circular 150/5340-30B, “Design and Installation Details for Airport Visual Aids”

Federal Aviation Administration Advisory Circular 150/5345-1V, “Approved Airport Equipment”

Federal Aviation Administration Advisory Circular 150/5345-12E, “Specification for Airport and Heliport Beacon”

Federal Aviation Administration Advisory Circular 150/5345-27D, “Specification for Wind Cone Assemblies”

Federal Aviation Administration Advisory Circular 150/5345-28F, “Precision Approach Path Indicator (PAPI) Systems”

Federal Aviation Administration Advisory Circular 150/5345-39C, “Specification for L-853, Runway and Taxiway Retroreflective Markers”

Federal Aviation Administration Advisory Circular 150/5345-43F, “Specification for Obstruction Lighting Equipment”

Federal Aviation Administration Advisory Circular 150/5345-44G, “Specification for Taxiway and runway Signs”

Federal Aviation Administration Advisory Circular 150/5345-46C, “Specification for Runway and Taxiway Light Fixtures”

Federal Aviation Administration Advisory Circular 150/5345-47B, “Specification for Series to Series Isolation Transformers for Airport Lighting Systems ”

Federal Aviation Administration Advisory Circular 150/5345-49B, “Specification L-854 Radio Control Equipment”

Federal Aviation Administration Advisory Circular 150/5345-51A, “Specification for Discharge-Type Flashing Light Equipment”

Federal Aviation Administration Advisory Circular 150/5345-53C, “Airport Lighting Equipment Certification Program”

Federal Aviation Administration Advisory Circular 150/5370-2E, “Operational Safety on Airports During Construction”

Federal Aviation Administration Advisory Circular 150/5370-10B, “Standards for Specifying Construction of Airports”