SECTION 27 21 33 WIRELESS COMMUNICATION SYSTEM - WiFi

PART 1 - GENERAL

1.01 SUMMARY

A. Section 27 21 33 includes the LAWA standards for WiFi communication systems to be installed by LAWA contractors, LAWA tenants and their contractors.

B. LAWA contractors, LAWA tenants and their contractors shall include in the construction submittal all necessary details about the proposed installation, including equipment, WiFi coverage projection, network connections, WiFi access point (AP) installation, IT rooms to be accessed/used, and estimated cost /installation duration.

C. LAWA contractors, LAWA tenants and their contractors are responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to airport/terminal operations in providing complete and operational WiFi systems.

D. LAWA contractors, LAWA tenants and/or their contractors shall coordinate with LAWA for provision of horizontal conduit and field boxes required to accommodate cabling of all WiFi access points and other system equipment.

E. LAWA contractors, LAWA tenants and/or their contractors shall inform and coordinate with LAWA if there are specialty electronic systems, information technology (IT) data networks and any other IT infrastructure systems that depend on or are transported by the WiFi communications.

F. Related documents within the LAWA Design and Construction Handbook:

Section 27 05 00 – Basic Telecommunication Requirements

1.02 REFERENCES

A. Glossary

1.	ANSI	American National Standards Institute
2.	AP	Access Point (wireless receive and transmit antenna)
3.	ASTM	American Society for Testing Materials
4.	BFU	Board of Fire Underwriters
5.	BICSI	Building Industry Consulting Services International
6.	CSA	Canadian Standards Association
7.	DEC	Department of Environmental Conservation
8.	EIA	Electronics Industry Association
9.	ER	Equipment Room

10.	FCC	Federal Communications Commission
11.	FM	Factory Mutual
12.	IEEE	Institute of Electrical and Electronics Engineers
13.	ISO	International Standards Organization
14.	NEC	National Electrical Code
15.	NEMA	National Electrical Manufacturers' Association
16.	NESC	National Electrical Safety Code
17.	NFPA	National Fire Protection Association
18.	OSHA	Occupational Safety and Health Administration
19.	TIA	Telecommunications Industry Association
20.	TR	Telecommunications Room
21.	TWC	Tenant Wiring Closet
22.	UFBC	Uniform Fire Prevention and Building Code
23.	UL	Underwriter's Laboratories, Inc.
24.	SSID	WiFi Service Set Identification, also known as a WiFi network name
25.	WPA2	WiFi Protected Access II protocol
26.	RSSI	Received Signal Strength Indication
27.	AEGIS	LAWA Airport Engineering Geographical Information System (also known as LUSAD – LAWA Utility Survey and Drawing System)
28.	DHCP	Dynamic Host Configuration Protocol, a standardized network protocol for computer servers or network controller to allocate IP addresses to computer network devices

B. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following References:

1. IEEE 802.11 (a, b/g, n, ac) - Information Technology - Telecommunications And Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications
2. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
3. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009
4. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08
5. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
6. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

7. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications
8. IEEE - National Electrical Safety Code (NESC); 2007
9. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises
10. LADBS - Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code
11. NEMA 250 - Enclosures for Electrical Equipment (1000 V Maximum)
12. NFPA-70 - National Electric Code; 2008
13. UL 1863 - Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

C. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.03 SUBMITTALS

A. General – Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Action Submittals

1. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities.
2. Submit all proposed labeling materials and nomenclature.
3. Coordination Drawings:
    a. Indicate locations where space is limited for installation and access.
    b. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
4. Submit details of proposed WiFi system, access point locations (refer to paragraph 3.4), bandwidth(s) and other details to LAWA for approval and coordination with other existing WiFi systems and applicable LAWA wireless usage agreements and procedures.
5. Submit floor plans with heat maps overlaid that show the results of contractor's WiFi vendor's predicative analysis modeling to indicate areas of coverage and extrapolated signal strength.
6. Submit all testing plans (acceptance and endurance) for review and approval prior to the performance of any testing.

C. Closeout Submittals – If the construction of the proposed WiFi system is approved and the system is installed, tenants and their contractors must submit to LAWA as-built system drawings for record. The drawings shall be in current AutoCAD format (wherever applicable) and shall include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings
3. Newly prepared Drawings
4. Marked-up copies of Specifications, Addenda and Change Orders
5. Marked-up Project Data submittals
6. Record Samples
7. Field records for variable and concealed conditions
8. Record information on work that is recorded only schematically
9. As-built drawings
10. Record drawings
11. Operation and maintenance manuals
12. Electronic as-built – all electronic as-built drawings covering the above, wherever applicable, shall be submitted to LAWA at the conclusion of the construction to be included as a part of the AEGIS repository.

1.04 QUALITY ASSURANCE

A. The Contractor shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's permit and manufacturer's specifications. Records of the inspections signed and dated by the Contractor shall be included as a part of the Closeout Submittals to LAWA. LAWA may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.09).

1.05 APPROVED EQUIPMENT & SUBSTITUTION

A. Current LAWA approved WiFi equipment (as of February 28, 2014) is listed below. All WiFi equipment is standardized on Cisco devices.

Model Name / Number	Remarks
AIR-CAP1532E-A-K9	Outdoor Access Points
AIR-CAP1532EU-A-K9	Outdoor Access Points
AIR-CAP1552E-A-K9	Outdoor Access Points
AIR-CAP1552EU-A-K9	Outdoor Access Points
AIR-CAP3702E-A-K9	Indoor Access Points with External Antenna
AIR-CAP3702I-A-K9	Indoor Access Points with Built-In Antenna
WS-C3850-xxU-PoE	WiFi Controller/Switch
WLC-5760 or 8500	WiFi Controller with Code 7.6 or Later

Approval of alternate or substitute equipment or material in no way voids specification requirements.

B. LAWA Contractors, LAWA tenants, and tenant contractors who are performing the construction of WiFi system/equipment at LAWA airports must contact LAWA IT Infrastructure Division to verify the latest approved LAWA WiFi equipment list.

C. Any substitution from the approved WiFi equipment list must receive LAWA Infrastructure Division's approval. Approval of alternate or substitute equipment or material shall in no way void other Specification requirement set forth in this document.

D. Under no circumstances shall LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to LAWA all evidence to support the contention that the item proposed for substitution is equal to the specified item. LAWA's decision as to the equality of substitution shall be final and without further recourse.

1.06 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
2. Equipment shall meet all applicable FCC Regulations.
3. All equipment and systems must conform to the Specifications.
4. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment that serve the same function must be the same make and model.

D. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

E. Maximum standardization of components shall be provided to reduce spare part requirements.

1.07 FIELD/SITE CONDITIONS

A. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

B. The Contractor shall obtain the approval of LAWA for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

C. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

D. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

E. The Contractor shall not unreasonably encumber the site with any material or equipment. Construction, installation and operations shall be confined to areas permitted by law, permits, and contract documents.

F. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

G. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal and safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

H. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of LAWA so the area can be appropriately noted.

I. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

J. The Contractor shall notify LAWA or any existing facility shutdowns through LAWA's USR (Utility Shutdown Request) and ASR (Area Shutdown Request) process when working in the airport terminals.

PART 2 - WIFI SYSTEM AND INSTALLATION

2.01 TENANT WIFI SYSTEM GUIDELINES

Section 2.01 of this document applies to LAWA tenants and their contractors.

In order to mitigate potential interference between various WiFi systems in operation, the Tenant shall wire all its access points (APs) and/or Tenant's network switch to LAWA IT Infrastructure Division designated location to be connected to a LAWA network switch.

The Tenant who plans to install WiFi system and equipment in its leased areas must adhere to the following LAWA guidelines:

A. The Tenant shall plan and design their WiFi access point (AP) distribution within the confine of the Tenant's lease area.

B. The Tenant, as a part of the construction request, shall submit the WiFi system and AP distribution design to LAWA IT Infrastructure Division for approval. In the interest of mitigating wireless interference between various WiFi systems, LAWA IT Infrastructure Division reserves the right to work with the Tenant and its Contractor in modifying the design.

C. The Tenant shall submit the plan and design with installation details, including proposed physical locations of all devices, in AutoCAD (.dwg) format. The submitted plan and design shall also include parts list.

D. LAWA's WiFi system and equipment standard is currently set to Cisco systems and equipment. The Tenant and its Contractor shall plan, design, purchase and install only Cisco WiFi systems and equipment. During the planning stage, the Tenant and its Contractors are encouraged to contact LAWA IT Infrastructure Division to receive the current approved WiFi equipment list.

E. LAWA's communications network cabling standard is currently set to single mode fiber optic and CAT 6a copper communications cables. The Tenant and its Contractor shall plan, design, purchase and install its wiring part of the system with single mode fiber optic and CAT 6a copper communications cables, wherever applicable.

F. The Tenant shall be responsible for the purchase/installation of all the APs and the Layer 2 switches that interface directly with LAWA network. The mentioned shall be managed by LAWA IT Infrastructure Division. The Tenant can choose from one of the following two options to connect its APs to LAWA's infrastructure:

   1. Wire all APs to LAWA telecommunications room or closet as designated by LAWA IT Infrastructure Division.

   2. Wire all APs to the Tenant's own telecommunications room or closet, terminate them on a Tenant's purchased (but LAWA managed) Layer 2 switch, and install an uplink cable to LAWA telecommunications room or closet. The Tenant shall provide LAWA Infrastructure Division with the Layer 2 switch for configuration. After LAWA configures the switch, the Tenant shall physically install the switch in the tenant telecom room or closet.

G. These APs shall be registered with LAWA WiFi controller(s). LAWA IT Infrastructure Division can configure up to 2 SSID's for each Tenant's WiFi system.

H. The tenant is responsible for installing network cables for the network devices mentioned in Section 2.01F above.

I. Tenant equipment that is connected to LAWA network shall become LAWA owned when the tenant terminate its lease with LAWA unless the tenant notifies LAWA of its intention to remove the equipment. In the latter case, the tenant shall be responsible for all cost associated with removing the WiFi equipment and associated cabling, and the tenant must coordinate the removal with LAWA IT Infrastructure Division to mitigate any disruption to LAWA WiFi systems.

J. The tenant WiFi system traffic will be transported to the Tenant's router (within the Tenant's leased space) through LAWA MPLS network infrastructure.

K. The Tenant is responsible to provision its own Internet service, which typically connects to a Tenant network router, for routing all Tenant Internet traffic from its WiFi equipment. The tenant shall coordinate with LAWA IT Infrastructure Division to extend its Internet service provider's demarcation from the main telecommunications room (commonly known as MPOE – minimum point of entry) to the tenant's leased area where the network router is located.

L. All wiring for the WiFi system must be installed in conduit. The Tenant and its Contractor shall provide electrical conduit and cables for the necessary work.

M. The tenant may choose one of the following options to connect to LAWA network for its wireless traffic. Option 1 and 2 may require the tenant to have a Layer 3 connection to LAWA network. Option 3 requires prior approval from LAWA IT Infrastructure Division.

1. **Tunnel Handoff** – The tenant must have a WiFi controller (refer to the Section 1.05 A for the acceptable controller) in the tenant's space. The tenant shall provide DHCP service and authentication to its wireless clients.
2. **Layer 3 Handoff** – The tenant does not have a WiFi controller within its space. LAWA shall assign IP address to the tenant's wireless clients.
3. **Layer 2 Handoff** – LAWA IT Infrastructure Division approval for this option is required. The tenant may or may not have a WiFi controller within its space. The tenant shall provide DHCP and authentication services to its wireless clients.

IT Infrastructure Division can provide details of implementing each of the above three options upon request.

2.02 WiFi EQUIPMENT GENERAL SPECIFICATIONS

A. WiFi Access Points and Other Network Equipment

1. All APs shall be current approved Cisco equipment per LAWA list (See Section 1.05 A).
2. All network switch shall be Cisco equipment such as Cisco Catalyst 3850-XXU-PoE or later.
3. All network routers shall be Cisco equipment.

B. This section (Section 2.02B) applies to LAWA Contractors only.

Provide a minimum of -50 dBm RSSI at the following locations:

1. Curbside areas
2. Ticketing check-in and ATO office spaces
3. Tenant and concessions areas
4. Concourses and holdrooms
5. Ramp areas
6. Inbound and outbound baggage makeup areas

Provide a minimum of -70 dBm RSSI at the following locations:

1. Paging rooms
2. Mechanical rooms
3. Air conditioning (HVAC) rooms
4. IT communications rooms
5. Electrical rooms
6. LAWA shops
7. All basement area (where cell phone signal cannot be accessed due to thick walls)

2.03 LABELS

A. Labels shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Labels shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable manufacturers for labels:
   1. **W.H. Brady**
   2. **Ideal**
   3. **Panduit**
   4. **Other equal**

F. Each AP shall be labeled with a name that contains the last six hex number (with no dot or dash) of the AP MAC address. The label shall be placed on the top surface of the AP.

G. This section (Section 2.03G) applies to LAWA Contractors only.

WiFi Controller Naming: Each AP shall be named in the WiFi controller as shown below:

TB-Lx-Rxxx-Cyy-Bww-zzzzzz, where

TB: short for TBIT (Tom Bradley International Terminal. In similar fashion, T1 would be for Terminal 1 and so on)

Lx: floor level where x indicates the level number (L2 is Level 2)

Rxxx: R is for room and xxx for room number. This is the IT room where the WiFi network switch is located and where the AP is connected to

Cyy: C is for Cisco, and yy is for the first two numbers of the Cisco AP series being used

Bww: B is for Baggage Claim Carousel (in similar fashion, T is for Ticketing Counter, C is for Concourse Level, and M is for Mezzanine Level), followed by xx for AP sequence number or other unique identifier of the AP location

zzzzzz: this is the last six digits of the AP's MAC address

Examples

(1) TB-L2-R202-C36-B01-ela9
This AP is located in TBIT, Level 2, connected to IT Room #202, Cisco AP3602, near Baggage Claim Carousel 1, AP MAC address is ela9.

(2) BW-L1-R120-C36-Elevator121-e158
This AP is located in Bradley West, Level 1, connected to IT Room #120, Cisco AP3602, next to Elevator #121, AP MAC address is e158.

H. This section (Section 2.02H) applies to LAWA Contractors only.

Network Switch Port Naming: Each AP shall be named on the switch as shown below:

C3602-Bww-zzzzzz

C3602: Sample of Cisco access point model number.

Bww: B is for Baggage Claim Carousel (in similar fashion, T is for Ticketing Counter, C is for Concourse Level, and M is for Mezzanine Level), followed by AP sequence number or other unique identifier of the AP location

zzzzzz: last six digits of the AP's MAC address

2.04 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

C. The Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with LAWA the exact location and mounting height of all equipment in finished areas.

E. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, LAWA shall be notified before starting that part of the work. In areas with no ceilings, install only after LAWA reviews and comments on arrangement and appearance.

F. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

G. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of LAWA.

H. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.
2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.
3. Bundles shall be secured with hook-and-loop cable strap material.

a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.

b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.

4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.02 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.03 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.04 AP SITE SURVEY

A. A full site survey of the Terminal(s) shall be conducted in order to determine and document the exact number, placement, and coverage of access point devices and the type of antenna required by each to provide full wireless network coverage. The contractor shall carry out and document the survey at its cost, working closely with Design Consultant and stakeholders.

B. Upon concurrence and approval of AP design and layout, provide installation, programming and commissioning of all AP and wireless network components.

3.05 INSTALLATION

A. APs shall be mounted horizontally with facing down toward the floor. The Contractor shall notify LAWA prior to any AP installation where the AP faces a large metal object or the AP can only be mounted in vertical orientation.

B. APs shall be mounted at temper-safe places and be at least eight feet above, but not higher than fifteen feet, above ground. AP's in public areas shall have a security device installed to

prevent removal of the AP by an unauthorized person. The Contractor shall confer with LAWA IT Infrastructure Division on acceptable security device.

C. The Ethernet network patch cable to the APs shall be yellow in color. This jumper cable shall be labeled with the AP's MAC address at each end.

D. APs must be installed with adequate clearance to allow a technician to perform periodical maintenance safely on a ladder.

E. APs shall be provisioned and tested before mounting. For example, the AP shall be physically connected to a switch port. The AP's working condition shall be verified by examining its LEDs according to the guidelines published in the AP's installation manual.

F. Each cable between the AP and the demarcation point must be tested end-to-end and certified with a cable tester. The report of the test results for each cable must be individually identified and submitted to LAWA IT Infrastructure Division.

G. At the end of the project, the Contractor shall configure the network switch port where the Aps are connected to as part of the switch port requirement. Contract shall contact LAWA IT Infrastructure Division for the latest switch port configuration guidelines.

3.06 QUALITY CONTROL

A. Phases of Testing

1. On-Site Performance Verification Testing
2. On-Site Endurance Testing

B. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of LAWA. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment.
2. Test equipment is to be identified by manufacturer and model. The Contractor shall provide current calibration certificates for all test equipment as well as technician training certificates.
3. Interconnection of test equipment and steps of operation shall be defined.
4. Expected results required to comply with specifications.
5. Record of test results with witness initials or signature and date performed.
6. Pass or fail evaluation with comments.
7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.
9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to witness any or all of the tests.
10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:
    a. Summary and commentary on test results.
    b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.
    c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.
    d. Signatures of persons who performed and witnessed the test.
    e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant/LAWA, before any subsequent testing phase is performed.

C. Performance Verification Testing:
1. AP Testing
    a. Verify Ethernet Link light of the AP when the other end of the cable is connected to a network switch.
    b. Verify that the AP had successfully joined a WiFi controller by examining the solid ring light on the front cover of the AP.
    c. Verify the RF coverage with AirMagnet or similar WiFi test equipment and provide a report to LAWA IT Infrastructure Division.
2. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.
3. Schedule test with LAWA. Do not begin testing until:
    a. All systems have been installed and individually and jointly tested to ensure they are operating properly.
    b. Written permission from LAWA has been received.
4. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.
5. Verification: Verify correct operation of the required system functionality as defined in these specifications.

6. Adjustment, Correction, and Completion:
    a. Correct deficiencies and retest affected components.
    b. Make necessary adjustments and modification to system after obtaining approval of LAWA.
    c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by LAWA.
7. Recording:
    a. Describe actual operational tests performed and equipment used and list personnel performing tests.
    b. Record in tabular form all test results, deficiencies, and corrective measures.
8. Termination
    a. Performance verification test shall be terminated by LAWA when:
        1) Individual components, subsystems, or the integrated system fail to perform as specified.
        2) It is determined that system is missing components or installation is not complete.
    b. Upon termination, corrective work shall be performed and performance verification test rescheduled with LAWA.
    c. Retesting shall be performed by Contractor at no additional expense.
    d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of LAWA.

D. Endurance Testing
1. The Contractor shall provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.
2. Start test after:
    a. Successful completion of performance verification testing.
    b. Training as specified has been completed.
    c. Correction of deficiencies has been completed.
    d. Receipt of written start notification from LAWA.
3. Monitor all systems during endurance testing. Coordinate monitoring with LAWA.
4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:
    a. Date and time for all entries.
    b. Name of individual making entry.

c. Environmental conditions.

d. Authority activities in process.

e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

f. Description of all equipment failures, including software errors.

g. Description of all maintenance and adjustment operations performed on system.

h. Daily and weekly tabulations.

i. Daily entries of performance data shall be reviewed by LAWA's representative designated to observe monitoring of system.

5. LAWA may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

   a. Phase I - Initial Testing:

      1) Time: 24 hours per day for 15 consecutive calendar days.

      2) Make no repairs during this phase unless authorized in writing by LAWA.

      3) If system experiences no failures, proceed to Phase III - Final Testing.

   b. Phase II - Initial Assessment:

      1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

      2) After submission of report, schedule review meeting at job site. Schedule date and time with LAWA.

      3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

      4) Based on report and review meeting, LAWA will direct the Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

   c. Phase III - Final Testing:

      1) Time: 24 hours per day for 15 consecutive calendar days.

      2) Make no repairs during this phase unless authorized in writing by LAWA.

7. Phase IV - Final Assessment:

   a. After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

   b. After submission of report schedule review meeting at job site. Schedule date and time with LAWA.

c. At review meeting, demonstrate that all failures have been corrected by performing verification tests.

d. Based on report and review meeting, LAWA will approve endurance test or direct the Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance:

a. During endurance testing make adjustments and corrections to system only after obtaining written approval of LAWA.

b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

E. Commissioning Testing

1. The Contractor shall develop a commissioning test plan that includes the following components, as a minimum:

a. LAWA readiness

b. Operational procedures verification

c. Disaster recovery procedures

d. Computerized Maintenance Management System data verification

e. Change management procedures

2. The commissioning test plan/procedures shall be submitted to LAWA for review and approval.

F. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with LAWA.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to the Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to the Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by LAWA, extend monitoring period for a time as designated by LAWA.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

3.07 STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
3. System wiring has been tested and verified as correctly connected as indicated.
4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.08 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with LAWA prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. All WiFi devices shall have a LAWA asset tag affixed. The Contractor shall obtain the asset tags from LAWA.

3.09 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM (CMMS)

A. LAWA CMMS: Information regarding all equipment including model, nomenclature, serial number, function, location, MAC address, IP address, switch/port information, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.10 CLOSEOUT ACTIVITIES – ACCEPTANCE, MAINTENANCE, TRAINING

A. Acceptance - Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the system for a 90-day period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

B. Training:

1 By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA's designated staff and Airline personnel in the operation, adjustment and maintenance of all products, equipment and systems.

2 The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

3 The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with the Design Consultant/LAWA.

4 All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to the Design Consultant/LAWA's approval.

5 Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum:

a. Functional flow-charts, overall block diagrams, and descriptive material for all software

b. Schematic drawings for each of the hardware components

c. All procedure manuals, specification manuals, and operating manuals

d. As-built drawings

6. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

C. Types of Training

1. User Training: System users shall be instructed in all aspects of operations of the system. Four (4) hours of basic user training shall be provided. Additionally, four (4) hours of advanced user training shall be provided.

2. Technician Training: Two days or two 8-hours of maintenance training shall be provided. Training for maintenance technicians shall be provided on site, and shall include, but not be limited to, installation, operation, renovation, alteration, inspection, maintenance and service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level.

3. System Administrator Training: System Administrator Training shall be provided. System Administrator Training shall include both classroom work and on the job training and shall be provided on-site at LAX or at a location within 50 miles of LAX.
4. Classroom Training: Three days or three 8-hours of software training shall be provided for each system. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete software system. The course material must be presented in depth with the instructor covering detailed design, structure, and algorithms.

END OF SECTION