

ITEM L-102 AIRPORT HAZARD BEACON

DESCRIPTION

L-102-1.1 This item shall consist of furnishing and installing an airport hazard beacon facility in accordance with these specifications and with the plans. This work shall include the clearing and grading of the site, construction of the foundation, erection of the pole or tower on the foundation, installation of an electrically operated fixture lowering device, installation of electric supply, installation of lightning protection, installation of the beacon and flashing unit on the lowering device, painting of the tower and beacon, testing of the beacon facilities, and all materials and incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

L-102-2.1 GENERAL.

- a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer, and replaced with materials which do comply with these specifications, at the sole cost of the Contractor.
- d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals. A total of six sets of submittals are required for each item.
- e. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.
- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

L-102-2.2 REINFORCED CONCRETE. Concrete for foundation shall conform to ODOT Class "C". Structural steel shall be Grade 60 meeting the requirements of ODOT Item 509 Reinforcing Steel, and shall be the sizes shown on the plans.

L-102-2.3 STEEL POLE. The steel pole for the beacon tower shall be a galvanized tubular steel sectional pole, 100

feet in height with maximum diameter of 18 inches at the bottom of the pole. The pole shall meet the requirements of ODOT Item 625 for light towers and those shown on the plans, and shall be similar to Union Metal Corporation model 77118-B238, or equal. The pole shall be designed in accordance with the AASHTO, 4th Edition, "Standard Specifications For Structural Supports For Highway Signs, Luminaires, And Traffic Signals" for 90 mph winds and 1.14 gust. The structure shall meet the following:

- a. 50 year design life
- b. Fatigue Category II
- c. Group I Deflection Limited To 2.5% pole height.
- d. Group II Deflection Limited To 15% pole height

The Contractor shall provide the Engineer with detailed plans for a pole which meets the above requirements. These plans shall be stamped by a registered professional engineer in the State of Ohio.

The bottom of the pole shall mount to a base plate that is bolted to the proposed foundation. The pole shall have a 30 inch by 10 inch hole with hinged cover near the bottom of the pole for access to the equipment installed inside the pole, and a tenon suitable capable of mounting the lowering device, attached to a plate at the top of the pole. The plate shall have a hole for the power cable to pass through to the head frame. A small hole or slot shall be provided near the top of the pole for running lightning ground cable into the interior of the pole. Grounding lugs shall be installed inside the pole, near the top and bottom for connection of the lightning grounding cables.

The contractor shall provide certification from the manufacturer of the lowering device that their equipment will function properly with the pole that they propose to utilize. The manufacturer of the lowering device may be able to provide all material and equipment for the pole, luminaire, and lowering device as a turn-key operation to make certain that everything works together.

L-102-2.4 BEACON. The beacon shall conform to the requirements of AC 150/5345-43, Specification for Obstruction Lighting Equipment. The beacon shall be a FAA L-864 flashing red obstruction light utilizing an array of light emitting diodes (LEDs) as the light source. Operating voltage shall be 120/240VAC.

L-102-2.5 PHOTOELECTRIC CONTROL. Photoelectric control shall be a standard commercially available unit that will energize when the northern sky illuminance falls below 60 footcandles but before reaching a level of 35 footcandles. The photoelectric switch should de-energize when the northern sky illuminance rises to a level of not more than 60 footcandles. The photocell shall be in an external weatherproof enclosure approved by the Engineer.

L-102-2.6 PANEL AND BREAKERS. The breaker panel and breakers shall conform to the requirements of Fed. Spec. W-P-115. A 20A single pole breaker shall be provided for operation of an attached 120v simplex three prong receptacle. The panel shall accept the No. 2 XLP copper cables supplying power to the facility.

L-102-2.7 WEATHERPROOF ENCLOSURES. Weatherproof enclosures shall conform to National Electrical Manufacturers Association Standards and shall be constructed of steel not less than No. 16 USS gauge. All enclosures exposed to weather shall be weatherproof.

L-102-2.8 WIRE. Existing electric supply cables are single conductor No. 2, XLP 600 volt copper cables. These cables shall be reused for power to the proposed hazard beacon facility. Temporary jumper cables to provide service to the existing hazard beacon facility shall be single conductor No. 2, XLP 600 volt copper cables. Power cables for operation of the lowering device and the flashing beacon shall be two conductor No. 12, SOOW, 600 volt copper cable. Both the hazard beacon cable and the motor cable shall end at the breaker panel in 3 prong plugs that plug into a new simplex socket at the breaker panel. Only one circuit at a time can be plugged into this socket.

L-102-2.9 CONDUIT. Plastic conduit and fittings shall conform to the requirements of Fed. Spec. W-C-1094, Underwriters Laboratories Standards UL-651 and Article 347 of the current National Electrical Code and shall be Type II-Schedule 40 PVC suitable for either above ground or underground use. The conduit sizes shall be as shown on the plans.

L-102-2.10 LIGHTNING PROTECTION. Lightning protection shall comply with NFPA-780, Standard for the

Installation of Lightning Protection Systems. All materials shall comply with Class II requirements regardless of tower height.

Ground rods shall be solid copper. The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 8-feet long nor less than 5/8 inch in diameter. Ground plates for use where rock prevents a full length ground rod shall be 36" by 36" x 20 Ga. copper. Two ground rods or plates are required for the installation.

Conductor cable between the ground rod and the pole, and between the lightning rod and the pole, shall be No. 4 AWG. The grounding loop attached to the ground rods or plates around the tower shall be No. 0 AWG. Both cables shall be stranded wire conforming to ASTM B 3 and ASTM B 8, and shall be bare copper wire conforming to the requirements of ASTM D 33.

L-102-2.11 FLASHER. The beacon flasher shall be a standard commercially available unit designed for the service intended. The mechanism in the flasher shall be designed to flash not more than 40 and not less than 12 flashes per minute. The flashing switch shall be of the mercury contact-type encapsulated in nonbreakable plastic. The entire unit shall be housed in a weatherproof cabinet.

L-102-2.12 ELECTRONIC LOWERING DEVICE. The luminaire lowering device shall be similar to Holophane model LD25, or equal. It shall include a head frame assembly, 1/4 inch galvanized hoist cables, luminaire ring assembly, integral winch and motor assembly, power cables, and breaker panel. The head frame assembly shall mount on the tenon at the top of the pole with a slip-fit connection and contain pulleys and wheels for the power cable and hoist cables supporting the ring and other equipment. The hazard beacon shall mount to the ring assembly using a riser and plate assembly, as shown on the plans or approved by the Engineer. The ring assembly shall be counter balanced with weights so that the ring remains level during raising and lowering. The motor shall be capable of operating at 120 volt single phase power. The operating control shall be connected to the motor with a sufficient length of cable to permit the person operating the mechanism to do so from a distance of approximately 15-20 feet from the pole. A lightning arresting system shall be provided.

L-102-2.13 CABLE CONNECTIONS. No splices shall be permitted in the existing or proposed cables. Temporary splices to jumper cables shall meet the following requirements:

- a. **The Taped or Heat-Shrunked Splice.** Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape shall be used. The rubber tape shall meet the requirements of ASTM D 4388 and the plastic tape shall comply with Mil Spec. MIL-I-24391 or Fed. Spec. A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.
- b. In all the above cases, connections of cable conductors shall be made using crimp connectors utilizing a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made in accordance with the manufacturer's recommendations and listings.
- c. All connections of bare copper conductors to ground and lightning rods shall be made by the exothermic process or approved equivalent. All exothermic connections shall be made in accordance with the manufacturer's recommendations and listings.

L-102-2.14 CABLE IDENTIFICATION TAGS. Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

L-102-2.15 TAPE. Electrical tapes shall be Scotch Electrical Tapes – number Scotch 88 (1-1/2. wide) and Scotch 130C linerless rubber splicing tape (2. wide), as manufactured by the Minnesota Mining and Manufacturing

Company, or approved equivalent.

L-102-2.16 PAINT

- a. Priming paint for ungalvanized metal surfaces shall be a high solids alkyd primer conforming to TT-P-664D.
- b. Priming paint for galvanized steel towers and other metal surfaces shall be zinc dust-zinc oxide primer paint, conforming to MIL-DTL-24441/19B. If necessary, add not more than 1/2 pint of turpentine to each gallon.
- c. Orange paint for the body and the finish coats on metal surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Fed. Spec. TT-E-489. The color shall be in accordance with Federal Standards 595, Aviation Gloss Orange Number 12197.
- d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute, Reference #9, Exterior Alkyd, Gloss, VOC Range E2.

CONSTRUCTION METHODS

L-102-3.1 CLEARING AND GRADING. The site on which the beacon tower is to be erected shall be cleared. All trees and brush shall be removed from the area within a distance of 100 feet from the tower, or as called for in the plans. Stumps shall be removed to a depth of 18 inches below finished grade and the excavation filled with earth from other grading or excavation operations on the site, and shall be tamped. All debris removed from the tower site shall be disposed of by the Contractor off of the site to the satisfaction of the Engineer and in accordance with Federal, state, or local regulations.

L-102-3.2 INSTALLATION OF TEMPORARY JUMPER CABLES. Power to the existing hazard beacon shall be turned off with the disconnect switch at the existing electric service pole. The location of the existing cables shall then be determined and marked. The cables shall be carefully exposed and cut at the location shown on the plans. These cut cables shall then be carefully excavated (by hand, if necessary) and removed from the existing trench up to the location shown on the plans, where they shall be coiled and stored. The Contractor shall then temporarily splice new jumper cables to both ends of the cut cables, temporarily providing service to the existing hazard beacon facility. Locate the jumper cables so that they are outside of the proposed work area. The existing coiled cables shall be protected from damage until needed for the new beacon tower. Once the jumper cables are in place, the disconnect switch on the power pole shall be restored to the 'on' position.

L-102-3.3 EXCAVATION. All excavation shall be considered as "Unclassified Excavation" regardless of the nature of the material. The contractor shall locate and mark the position of the proposed foundation and set stakes for grading, for approval by the Engineer prior to installation.

The Contractor shall strip the proposed work area of all grass and weeds, then scalp the area of topsoil. The topsoil shall be stockpiled at the site for later respreading. The Contractor shall then grade the site so that, once 4 inches of topsoil has been respread over the work area, the grades conform with the plans.

The Contractor shall do all excavation for structures and structure footings to the lines and grades or elevations, shown on the plans. The excavation shall be of sufficient size to permit the placing of the full width and length of the foundations shown. The elevations of the bottoms of foundations, as shown on the plans, shall be considered as approximate only; and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner which will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

If the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. At the direction of the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

If the Contractor's excavating operations encounter abnormal material such as, but not limited to tanks, drums, stained earth, or any unusual odors during construction operations, the contractor shall temporarily discontinue the work in that area, leave the equipment in place, cordon off the area, and notify the Engineer. The area might contain hazardous waste or material and must be evaluated.

All excess excavation, including topsoil after respreading, shall be removed from the site.

L-102-3.4 REINFORCED CONCRETE FOUNDATION. The proposed foundation design is based on assumptions regarding the soil properties at the proposed site. The Contractor shall retain an ODOT approved soils laboratory to obtain a soil sample from the site of the proposed foundation and test the soil to determine actual soil properties, as shown on the plans. If the actual soil properties vary from the assumptions, then the foundation design may need to be revised.

After excavation has been completed, the Contractor shall notify the Engineer to that effect. The Contractor shall then place the reinforcement and form the top of the proposed foundation.

All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concreting. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs.

Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as designed on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The Contractor shall bear responsibility for their adequacy. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. Concrete shall not be placed until all the forms and reinforcement have been checked by the Engineer. The forms shall not be removed before the expiration of at least 30 hours.

Before placing concrete, any items that are to be embedded shall be firmly and securely fastened in place as indicated. All such items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The embedding of wood shall be avoided. No items may be embedded in the concrete without prior approval of the Engineer, except those shown on the plans.

All concrete shall be placed during daylight, unless otherwise approved. The concrete shall not be placed until the depth and character of foundation, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved. Concrete shall be placed as soon as practical after mixing and in no case later than 1 hour after water has been added to the mix. The method and manner of placing shall be such to avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. Dropping the concrete a distance of more than 5 feet, or depositing a large quantity at one point, will not be permitted. Concrete shall be placed upon clean, damp surfaces, free from running water, or upon properly consolidated soil.

The concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When necessary, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction. The

concrete shall be spaded and consolidated around and against embedded items. Vibrators shall be manipulated so as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any joint shall be of sufficient duration to accomplish compaction but shall not be prolonged to the point where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket, or other approved method and shall not be disturbed after being deposited.

Any defective work disclosed after the forms have been removed shall be immediately removed and replaced. If any dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows honeycomb, which in the opinion of the Engineer cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

All exposed concrete surfaces shall be true, smooth, free from open or rough spaces, depressions, or projections. The concrete in horizontal plane surfaces shall be brought flush with the finished top surface at the proper elevation and shall be struck-off with a straightedge and floated. Mortar finishing shall not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

When directed, the surface finish of exposed concrete shall be a rubbed finish. If forms can be removed while the concrete is still green, the surface shall be pointed and wetted and then rubbed with a wooden float until all irregularities are removed. If the concrete has hardened before being rubbed, a carborundum stone shall be used to finish the surface. When approved, the finishing can be done with a rubbing machine.

All concrete shall be properly cured for 14 days, and shall be protected by the Contractor. The work shall be protected from the elements, flowing water, and from defacement of any nature during the building operations. The concrete shall be cured as soon as it has sufficiently hardened by covering with an approved material.

Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for a period of at least 3 days. All curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to currents of air. Where wooden forms are used, they shall be kept wet at all times until removed to prevent the opening of joints and drying out of the concrete.

When concrete is placed at temperatures below 40 F, the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. No calcium chloride may be incorporated in the mix.

After the concrete foundation has cured sufficiently, the contractor shall backfill the areas around the outsides of the foundation to a point 4 inches below adjacent ground in maximum 8 inch loose lifts of material removed from the excavation. Each lift shall be compacted to at least the density of the adjacent undisturbed soil using hand tampers, mechanical equipment, or other methods approved by the Engineer. The final 4 inches of material shall consist of topsoil removed from the site.

L-102-3.5 INSTALLATION OF UNDERGROUND CONDUIT. The Contractor shall install underground conduits for access to the interior of the proposed pole through the foundation at the approximate locations indicated on the plans. The Engineer shall indicate specific locations as the work progresses, if required to differ from the plans. All conduit lines shall be laid so as to grade towards conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches per 100 feet. No underground conduit shall be less than 18 inches below finished grade. Conduits shall extend at least 24 inches beyond the sides of the concrete foundation and 12 inches above the foundation, unless otherwise shown on the plans.

Trenches for conduits may be excavated manually or with mechanical trenching equipment. Walls of conduit trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches below the required conduit depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch sieve. Flowable backfill may alternatively be used. The Contractor shall ascertain the type of soil or rock to be excavated before bidding.

Joints in plastic conduit shall be prepared in accordance with the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly.

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

All excavation required for installation of the conduit shall be considered incidental to this item of work.

The Contractor shall mandrel each individual conduit. An iron-shod mandrel, not more than 1/4-inch smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean interiors of pull boxes, raceways, enclosures, etc. IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the all accessible points of entry to the conduit system shall be kept closed except when installing cables. All ends left open, after initial cleaning, for any reason, shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable.

A total of 8 inches of sand, soft earth, or other fine fill (loose measurement) shall be placed above the conduits and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted to the satisfaction of the Engineer. Material used for this back fill shall be select material not larger than 4 inches in diameter. Flowable backfill may alternatively be used. Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface.

For pulling the permanent wiring, each individual conduit shall be provided with a 200 pound test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminate from entering the conduits. Any conduit section having a defective joint shall not be installed.

L-102-3.6 INSTALLATION OF CABLES. Once the proposed hazard beacon facility has been completed and is ready for connection of power, the Contractor shall remove the temporary splices to the jumper cables and remove the jumper cables. The existing cables to the old hazard beacon tower shall be abandoned in place and buried. The existing coiled cables shall then be uncoiled and installed in new trench and conduit to the inside of the pole, where they shall be cut and connected to the breaker panel. The Contractor shall install the specified cable at the approximate locations indicated on the plans, and shall provide not less than 3 feet of cable slack on each side of all connections to equipment.

a. Cable Installed in Trench. Contractor shall not use a cable plow for installing the cable. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed. Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches below finished grade and to a width not less than 6 inches for a single cable. The width of the trench shall be increased by 3 inches for each additional cable to be installed in the trench to permit separation between cables of not less than 3 inches. Unless otherwise specified on the plans, all cables in the same location and running in the same general direction shall be installed in the same trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch sieve. Flowable backfill material may alternatively be used. The Contractor shall ascertain the type of soil or rock to be excavated before bidding.

The existing power cables that have been removed from trench and stored shall be carefully placed in the center of the trench. Sharp bends or kinks in the cable shall not be permitted. In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair

or replacement.

After the cable has been installed, the trench shall be backfilled. The first layer of backfill in the trench shall be 3 inches deep, loose measurement, and shall be either earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch sieve. This layer shall not be compacted. The second layer shall be 5 inches deep, loose measurement, and shall contain no particles that would be retained on a 1-inch sieve. The remaining 3rd and subsequent layers of backfill shall not exceed 8 inches of loose measurement and be excavated or imported material and shall not contain stone or aggregate larger than 4 inches maximum diameter.

The second and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent undisturbed soil, and to the satisfaction of the Engineer. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.

Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when turf is to be established over the trench, the backfilling shall be stopped at a depth of 4 inches below the adjacent ground for installation of respread topsoil. Any excess excavated material shall be removed and disposed of in accordance with the plans and specifications.

- b. Cable Installed in Conduit.** The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be in accordance with the latest National Electric Code, or the code of the local agency or authority having jurisdiction. Low voltage and high voltage cables shall be installed in separate ducts.

The Contractor shall make no connections or splices of any kind in cables installed in conduits. Check conduit routes prior to construction to obtain assurance that the shortest routes are selected and interferences are avoided. Where required, splices shall be made in junction boxes using terminal boards. All splices shall be weatherproof. The contractor shall identify all conductors by circuit number and phase at each terminal or splice location.

The cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through conduits may be accomplished by handwinch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall be governed by cable manufacturer's recommendations. A non-hardening lubricant recommended for the type of cable being installed shall be used where pulling lubricant is required.

Contractor shall submit pulling tension values to the Engineer prior to any cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or the NEC requirements whichever is more restrictive shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Install pull boxes in conduit runs containing more than three 90 degree bends, runs exceeding 200 feet, where indicated on the drawings, and where required to conform with the National Electrical Code. Size junction and pull boxes in accordance with the requirements of the National Electrical Code. Provide terminal blocks in

junction boxes where cable terminations or splices are required.

Cable shall not be dragged across boxes, manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or utilize other appropriate means to prevent abrasion to the cable jacket.

L-102-3.7 ERECTION OF STEEL POLE. Detail erection drawings furnished by the manufacturer shall be strictly followed during construction. All towers shall be erected in sections from the ground up unless otherwise specified. In final assembly, all welded connections shall be made properly, all bolts and fastenings shall be installed, and the structure shall be plumb, true, square, and level. Nuts shall be taken up to a firm bearing after which the bolts shall, if necessary, be cut to proper length to protrude three full threads. Approved locknuts shall be placed on each bolt over the regular nut. Surfaces bared of protective coatings shall be painted with the proper priming paint, as specified in these specifications.

L-102-3.8 LIGHTNING PROTECTION. The Contractor shall furnish and install an air terminal, down conductors, two ground plates or rods, and a ground loop, as indicated in the plans. The air terminal shall be installed at the top of the tower with the tip of the rod extending not less than 6 inches above the top of the beacon.

Bare cables shall be securely fastened to lugs on the inside of the pole near the top and bottom.

All connections of bare cable to air terminals, ground rods, or ground plates shall be made by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections. Contractor shall demonstrate to the satisfaction of the Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations. All slag shall be removed from welds.

All buried copper cable and weld material at weld connections shall be thoroughly coated with 6 mil of 3M - Scotchkote, or approved equivalent, or coated with coal-tar bitumastic material to prevent surface exposure to corrosive soil or moisture.

The complete lightning protection installation shall be accomplished to the satisfaction of the Engineer. The resistance to ground of any part of the lightning protection system shall not exceed 25 ohms.

L-102-3.9 PLACING THE BEACON. The beacon shall be securely mounted to a steel plate and riser apparatus, which shall be attached to the lowering platform, as shown in the plans. The support to which the beacon is fastened shall be accurately leveled before mounting the beacon.

L-102-3.10 FLASHER. A separate flashing mechanism for the beacon shall be installed in an enclosure on the lowering ring, near the beacon. This equipment shall be wired to the power cable and to the beacon as required by the manufacturer. Power to the flasher must come from the photocell.

L-102-3.11 WIRING. The Contractor shall furnish all necessary labor and materials and shall make complete aboveground electrical connections in accordance with the wiring diagram furnished with the project plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electric Code.

L-102-3.12 SPLICING. Temporary splices shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape

will be applied (plus 3 inches on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately 1 inch over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminants prior to application.

L-102-3.13 PHOTOELECTRIC CONTROL. The photoelectric control shall be installed in an enclosure on the lowering ring, near the beacon, and it shall be connected and adjusted in accordance with the manufacturer's instructions. The photocell may be installed on the enclosure for the flasher equipment.

L-102-3.14 PAINTING. The Contractor shall furnish all materials and labor for painting the beacon tower and other equipment. The color scheme for the steel tower and attached equipment shall be seven equal segments of alternating colors of white and orange, from the bottom of the pole to the top, with the top and bottom segments being aviation orange.

Galvanized steel pole and galvanized conduits, enclosures, and other equipment exposed to weather shall be given one priming coat of corrosion-inhibiting primer before erection. Non-Galvanized steel conduits, enclosures, and other metal equipment exposed to weather shall be given one priming coat of corrosion inhibiting primer before erection. All equipment under this contract exposed to the weather shall be given one body and one finish coat of aviation-orange or white paint as required by the color scheme after erection. This shall include beacon (except glass surfaces). It shall not include air terminals. The paint shall be applied uniformly in the proper consistency by skilled painters.

The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of 4 days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, dusty, or frosty atmospheres, or when air temperature is below 40° F (4° C), nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied.

The ready-mixed paint shall be thinned for the body coats in accordance with the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

- a. Body coats for steel surfaces - add 1/2 pint of turpentine to each gallon of ready-mixed paint for body coats.
- b. Finish coats for steel surfaces - the ready-mixed paint shall be used as it comes from the container for finish coats.

L-102-3.15 TESTING. Testing equipment shall be furnished by the Contractor. Whenever the scope of work requires connection to an existing circuit, the circuit's insulation resistance shall be tested, in the presence of the Engineer. The test shall be performed in accordance with this item and prior to any activity affecting the respective circuit. The Contractor shall record the results on forms acceptable to the engineer. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Engineer. The Contractor shall record the results on forms acceptable to the engineer. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs shall be borne by the Contractor.

The complete installation shall be tested in operation as a completed unit prior to acceptance. Tests shall include the following:

- a. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.
- b. That all affected circuits (existing and new) are free from unspecified grounds.
- c. That the insulation resistance to ground of all new portions of non-grounded conductors of new multiple circuits or circuit segments is not less than 50 megohms.
- d. That the insulation resistance to ground of all non-grounded conductors of multiple circuits, including existing cables, is not less than the original measurement prior to construction.
- e. That all affected circuits (existing and new) are properly connected in accordance with applicable wiring diagrams.
- f. That all affected circuits and equipment are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.
- g. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be utilized, as described by ANSI/IEEE Standard 81, to verify this requirement.

Two copies of tabulated results of all tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

~~**METHOD OF MEASUREMENT**~~

~~L-102-4.1 All work under this item shall be measured for payment as a complete system, installed in accordance with the plans and specifications to the satisfaction of the Engineer, in place, accepted, and ready for operation.~~

~~**BASIS OF PAYMENT**~~

~~L-102-5.1 Payment will be made at the contract lump sum price for the completed and accepted Airport hazard Beacon Facility. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.~~

~~Payment will be made under:~~

~~Item L-102 Airport Hazard Beacon Facility, in place — per lump sum~~

MATERIAL REQUIREMENTS

- AC 150/5345-7 Specification For L-824 for Underground Electrical Cable for Airport Lighting Circuits
- AC 150/5345-43 Specification for Obstruction Lighting Equipment
- FED SPEC J-C-30 Cable and Wire, Electrical (Power, Fixed Installation) (cancelled; replaced by AA-59544 Cable and Wire, Electrical (Power, Fixed Installation))
- FED SPEC

| | |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------|
| TT-E-489 | Enamel, Alkyd, Gloss, Low VOC Content |
| FED SPEC TT-P-664D | Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant |
| MIL-DTL 24441/19B | Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III |
| FED SPEC W-P-115 | Panel, Power Distribution |
| FED STD 595 | Colors Used in Government Procurement |
| Underwriters Laboratories Standard 6 | Rigid Metal Conduit |
| Underwriters Laboratories Standard 514 | Fittings for Conduit and Outlet Boxes |
| Underwriters Laboratories Standard 1242 | Intermediate Metal Conduit |
| NFPA-70 | National Electric Code |
| NFPA-780 | Standard for the Installation of Lightning Protection Systems |
| FED SPEC A-A-55809 | Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic |
| ASTM B 3 | Soft or Annealed Copper Wire |
| ASTM D 4388 | Rubber tapes, Nonmetallic Semiconducting and Electrically Insulating Master Painter's Institute |
| ANSI/IEEE Std 81 IEEE | Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System |