SD052

RETURN WITH BID

LETTING DATE July 30, 2010

ITEM NUMBER **1A**

Proposal Submitted By

Name

Address

City/State

9 Digit Zip Code - Telephone Number

FEIN Number FAX Number

E-Mail Address

BIDDERS NEED NOT RETURN THE ENTIRE PROPOSAL
(See instructions inside front cover)

NOTICE TO PROSPECTIVE BIDDERS

This proposal can be used for bidding purposes by only those companies that request and receive written AUTHORIZATION TO BID from IDOT's Central Bureau of Construction.
(SEE INSTRUCTIONS ON THE INSIDE OF COVER)

PROPOSAL COVER SHEET

Illinois Department of Transportation
DIVISION OF AERONAUTICS

AIRPORT **St. Louis Downtown**

MUNICIPAL DESIGNATION Sauget

COUNTY DESIGNATION St. Clair

ILLINOIS PROJECT NO. CPS-3906

FEDERAL PROJECT NO. 3-17-0039-B22

For engineering information, contact Rob Waller of Hanson Professional Services, Inc. at (217) 788-2450.

FAA rules prohibit the use of escalation clauses for materials. Therefore, the Division of Aeronautics cannot offer a bituminous material cost adjustment provision for projects utilizing federal funds.

PLEASE MARK THE APPROPRIATE BOX BELOW:

☐ A Bid Bond is included.

☐ A Cashier's Check or a Certified Check is included.

INSTRUCTIONS

ABOUT IDOT PROPOSALS: All proposals issued by IDOT are potential bidding proposals. Each proposal contains all Certifications and Affidavits, a Proposal Signature Sheet and a Proposal Bid Bond required for Prime Contractors to submit a bid after written **Authorization to Bid** has been issued by IDOT's Central Bureau of Construction. In addition, this proposal contains new statutory requirements applicable to the use of subcontractors and, in particular, includes the State Required Ethical Standards Governing Subcontractors to be signed and incorporated into all subcontracts.

WHO CAN BID?: Bids will be accepted from only those companies that request and receive written **Authorization to Bid** from IDOT's Central Bureau of Construction. To request authorization, a potential bidder must complete and submit Part B of the Request for Authorization to Bid/or Not For Bid Status form (BDE 124 INT) and submit an original Affidavit of Availability (BC 57).

WHAT CONSTITUTES WRITTEN AUTHORIZATION TO BID?: When a prospective prime bidder submits a "**Authorization to Bid or Not for Bid**" form, he/she must indicate at that time which items are being requested For Bidding purposes. Only those items requested For Bidding will be analyzed. After the request has been analyzed, the bidder will be issued a **Authorization to Bid or Not for Bid Report**, approved by the Central Bureau of Construction, that indicates which items have been approved For Bidding. If **Authorization to Bid** cannot be approved, the **Authorization to Bid or Not for Bid Report** will indicate the reason for denial. If a contractor has requested to bid but has not received a **Authorization to Bid or Not for Bid Report**, they should contact the Central Bureau of Construction in advance of the letting date.

WHAT MUST BE INCLUDED WHEN BIDS ARE SUBMITTED?: Bidders need not return the entire proposal when bids are submitted. That portion of the proposal that must be returned includes the following:

1. All documents from the Proposal Cover Sheet through the Proposal Bid Bond

2. Other special documentation and/or information that may be required by the contract special provisions

All proposal documents, including Proposal Guaranty Checks or Proposal Bid Bonds, should be stapled together to prevent loss when bids are processed by IDOT personnel.

ABOUT SUBMITTING BIDS: It is recommended that bidders deliver bids in person to insure they arrive at the proper location prior to the time specified for the receipt of bids. Any bid received at the place of letting after the time specified will not be accepted.

WHO SHOULD BE CALLED IF ASSISTANCE IS NEEDED?

Questions Regarding	**Call**
Prequalification and/or Authorization to Bid	(217)782-3413
Preparation and submittal of bids	(217/782-7806

RETURN WITH BID

Illinois Department of Transportation

PROPOSAL

TO THE DEPARTMENT OF TRANSPORTATION

1. Proposal of _____
   _____

   for the improvement officially known as:

   (a) St. Louis Downtown Airport

   (b) The proposed improvement shown in detail on the plans issued by the Department schedule and detail sheets included herein, includes, in general, the following described work:

   Widen Runway 12R/30L.

2. The plans for the proposed work are those issued by the Department of Transportation to cover the work described above.

   The specifications are those prepared by the Department of Transportation, Division of Aeronautics and designated as "Standard Specifications for Construction of Airports," the "Supplemental Specifications and Recurring Special Provisions," the "Interim Revisions to Supplemental Specifications and Recurring Special Provisions", latest editions located on the IDOT website at http://www.dot.il.gov/aero/airspecs.html, and the "Special Provisions" thereto, adopted and in effect on the date of invitation for bids.

3. **COMPLETION TIME/LIQUIDATED DAMAGES**. It being understood and agreed that the completion within the time limit is an essential part of the contract, the bidder agrees to complete the work within 130 calendar days, unless additional time is granted by the Engineer in accordance with the provisions of the specifications. In case of failure to complete the work on or before the time named herein, or within such extra time as may have been allowed by extensions, the bidder agrees that the Department of Transportation shall withhold from such sum as may be due him/her under the terms of this contract, the costs, as set forth below, which costs shall be considered and treated not as a penalty but as damages due to the State from the bidder by reason of the failure of the bidder to complete the work within the time specified in the contract. The following Schedule of Deductions supersedes the table given in Section 60-09 of the Division's Standard Specifications for Construction of Airports.

Schedule of Deductions for Each Day of Overrun in Contract Time			
Original Contract Amount		Daily Charges	
From More Than	To and Including	Calendar Day	Work Day
$ 0	$ 100,000	$ 375	$ 500
100,000	500,000	625	875
500,000	1,000,000	1,025	1,425
1,000,000	3,000,000	1,125	1,550
3,000,000	5,000,000	1,425	1,950
5,000,000	10,000,000	1,700	2,350
10,000,000	And over	3,325	4,650

A daily charge shall be made for every day shown on the calendar beyond the specified contract time in calendar days.

4. **ASSURANCE OF EXAMINATION AND INSPECTION/WAIVER.** The undersigned further declares that he/she has carefully examined the proposal, plans, specifications, supplemental and applicable recurring special provisions, addenda, form of contract and contract bonds, and special provisions, and that he/she has inspected in detail the site of the proposed work, and that he/she has familiarized themselves with all of the local conditions affecting the contract and the detailed requirements of construction, and understands that in making this proposal he/she waives all right to plead any misunderstanding regarding the same.

5. **EXECUTION OF CONTRACT AND CONTRACT BONDS.** The undersigned further agrees to execute a contract for this work and present the same to the department within fifteen (15) days after the contract has been mailed to him/her. The undersigned further agrees that he/she and his/her surety will execute and present within fifteen (15) days after the contract has been mailed to him/her contract bond satisfactory to and in the form prescribed by the Department of Transportation, in the penal sum of the full amount of the contract, guaranteeing the faithful performance of the work in accordance with the terms of the contract.

6. PROPOSAL GUARANTY. Accompanying this proposal is either a bid bond on the department form, executed by a corporate surety company satisfactory to the department, or a proposal guaranty check consisting of a bank cashier's check or a properly certified check for not less than 5 per cent of the amount bid or for the amount specified in the following schedule:

Amount of Bid			Proposal Guaranty	Amount of Bid			Proposal Guaranty
Up to		$5,000	$150	$2,000,000	to	$3,000,000	$100,000
$5,000	to	$10,000	$300	$3,000,000	to	$5,000,000	$150,000
$10,000	to	$50,000	$1,000	$5,000,000	to	$7,500,000	$250,000
$50,000	to	$100,000	$3,000	$7,500,000	to	$10,000,000	$400,000
$100,000	to	$150,000	$5,000	$10,000,000	to	$15,000,000	$500,000
$150,000	to	$250,000	$7,500	$15,000,000	to	$20,000,000	$600,000
$250,000	to	$500,000	$12,500	$20,000,000	to	$25,000,000	$700,000
$500,000	to	$1,000,000	$25,000	$25,000,000	to	$30,000,000	$800,000
$1,000,000	to	$1,500,000	$50,000	$30,000,000	to	$35,000,000	$900,000
$1,500,000	to	$2,000,000	$75,000	over		$35,000,000	$1,000,000

Bank cashier's checks or properly certified checks accompanying proposals shall be made payable to the Treasurer, State of Illinois, when the state is awarding authority; the county treasurer, when a county is the awarding authority; or the city, village, or town treasurer, when a city, village, or town is the awarding authority.

If a combination bid is submitted, the proposal guaranties which accompany the individual proposals making up the combination will be considered as also covering the combination bid.

The amount of the proposal guaranty check is _____ $( ). If this proposal is accepted and the undersigned shall fail to execute contract bonds as required herein, it is hereby agreed that the amount of the proposal guaranty shall become the property of the State of Illinois, and shall be considered as payment of damages due to delay and other causes suffered by the State because of the failure to execute said contract and contract bonds; otherwise, the bid bond shall become void or the proposal guaranty check shall be returned to the undersigned.

Attach Cashier's Check or Certified Check Here

In the event that one proposal guaranty check is intended to cover two or more proposals, the amount must be equal to the sum of the proposal guaranties which would be required for each individual proposal. If the guaranty check is placed in another proposal, state below where it may be found.

The proposal guaranty check will be found in the proposal for: Item _____

Airport _____

Mark the proposal cover sheet as to the type of proposal guaranty submitted.

7. COMBINATION BIDS. The undersigned further agrees that if awarded the contract for the sections contained in the following combination, he/she will perform the work in accordance with the requirements of each individual proposal comprising the combination bid specified in the schedule below, and that the combination bid shall be prorated against each section in proportion to the bid submitted for the same. If an error is found to exist in the gross sum bid for one or more of the individual sections included in a combination, the combination bid shall be corrected as provided below.

A combination bid is a total bid received on 2 or more proposals. No combination bids other than those specifically set up by the Department will be considered. Separate proposal forms will be issued for each project in the combination so bids may be submitted on the combination as well as on separate units of the combination. The Department reserves the right to make awards on combination bids or separate bids to the best advantage of the Department.

If a combination bid is submitted on 2 or more proposals, separate proposals on each individual contract shall also be submitted, and unless separate proposals are so submitted, the combination bid will not be considered. If the bidder desires to submit a combination bid, the bidder shall state, in the place provided in the proposal form, the amount of the combination bid for the entire combination.

If a combination bid is submitted on any stipulated combination, and errors are found to exist in computing the gross sum bid on any one or more of the individual proposals, corrections shall be made, by the Department and the amount of the combination bid shall be corrected so that it will be in the same proportion to the sum of the corrected gross sum bid as the combination bid submitted was to the sum of the gross sum bid submitted.

The following provisions shall govern combination bidding:

(a) A combination bid which is submitted for 2 or more proposals and awarded on that basis shall have the bid prorated against each proposal in proportion to the bid submitted for each proposal.

(b) Separate contracts shall be executed for each individual proposal included in the combination.

(c) The contract time for all contracts awarded on a combination bid shall be the sum of all calendar days contained within each contract included in the combination, unless otherwise provided in the contracts.

(d) In the event the Contractor fails to complete any or all of the contracts on the combination bid within the contract time, including any authorized extension, the liquidated damages shall be determined from the schedule of deductions shown above in paragraph 3 for each day of overrun in contract time, based on the combination bid total, and shall be computed on the combination and prorated against the 2 or more individual contracts based on the dollar value of each contract.

(e) The plans and Special Provisions for each separate contract shall be construed separately for all requirements, except as described in paragraphs (a) through (d) listed above.

RETURN WITH BID

When a combination bid is submitted, the schedule below must be completed in each proposal comprising the combination.

If alternate bids are submitted for one or more of the sections comprising the combination, a combination bid must be submitted for each alternate.

Schedule of Combination Bids

Combination No.	Sections Included in Combination	Combination Bid Dollars	Cents

8. **SCHEDULE OF PRICES.** The undersigned submits herewith, in accordance with the rules and instructions, a schedule of prices for the items of work for which bids are sought. The unit prices bid are in U.S. dollars and cents, and all extensions and summations have been made. The bidder understands that the quantities appearing in the bid schedule are approximate and are provided for the purpose of obtaining a gross sum for the comparison of bids. If there is an error in the extension of the unit prices, the unit prices shall govern. Payment to the contractor awarded the contract will be made only for actual quantities of work performed and accepted or materials furnished according to the contract. The scheduled quantities of work to be done and materials to be furnished may be increased, decreased or omitted as provided elsewhere in the contract.

9. **AUTHORITY TO DO BUSINESS IN ILLINOIS.** Section 20-43 of the Illinois Procurement Code (30 ILCS 500/20-43) provides that a person (other than an individual acting as a sole proprietor) must be a legal entity authorized to do business in the State of Illinois prior to submitting the bid.

COUNTY NAME	CODE	DIST	AIRPORT NAME	FED PROJECT	ILL PROJECT
ST CLAIR	163	08	ST. LOUIS DOWNTOWN	3-17-0039-B22	CP-S -3906

****** BASE ******

ITEM NUMBER	PAY ITEM DESCRIPTION	UNIT OF MEASURE	QUANTITY	UNIT PRICE DOLLARS	UNIT PRICE CENTS		TOTAL PRICE DOLLARS	TOTAL PRICE CTS
AR108082	1/C #2 XLP-USE	L.F.	1,200.000	X		=		
AR108086	1/C #6 XLP-USE	L.F.	3,906.000	X		=		
AR108108	1/C #8 5 KV UG CABLE	L.F.	29,923.000	X		=		
AR108258	2/C #8 5 KV UG CABLE IN UD	L.F.	717.000	X		=		
AR108656	3/C #6 600 V UG CABLE IN UD	L.F.	2,400.000	X		=		
AR108806	6 PAIR CONTROL CABLE	L.F.	400.000	X		=		
AR109200	INSTALL ELECTRICAL EQUIPMENT	L.S.	1.000	X		=		
AR109800	GENERATOR SYSTEM	L.S.	1.000	X		=		
AR109902	REMOVE ELECTRICAL EQUIPMENT	L.S.	1.000	X		=		
AR109924	REPLACE ELECTRIC SERVICES	L.S.	1.000	X		=		
AR110012	2" DIRECTIONAL BORE	L.F.	718.000	X		=		
AR110014	4" DIRECTIONAL BORE	L.F.	1,700.000	X		=		
AR110202	2" PVC DUCT, DIRECT BURY	L.F.	16,300.000	X		=		
AR110504	4-WAY CONCRETE ENCASED DUCT	L.F.	465.000	X		=		
AR110506	6-WAY CONCRETE ENCASED DUCT	L.F.	630.000	X		=		

ITEM NUMBER	PAY ITEM DESCRIPTION	UNIT OF MEASURE	QUANTITY		UNIT PRICE DOLLARS	UNIT PRICE CENTS		TOTAL PRICE DOLLARS	TOTAL PRICE CTS
AR110550	SPLIT DUCT	L.F.	240.000	X			=		
AR110610	ELECTRICAL HANDHOLE	EACH	10.000	X			=		
AR110710	ELECTRICAL MANHOLE	EACH	3.000	X			=		
AR110715	ELECTRICAL MANHOLE - SPECIAL	EACH	8.000	X			=		
AR125415	MITL-BASE MOUNTED	EACH	44.000	X			=		
AR125470	MODIFY EXISTING SIGN PANEL	EACH	2.000	X			=		
AR125515	HIRL, BASE MOUNTED	EACH	74.000	X			=		
AR125550	HI THRESHOLD LIGHT BASE MTD	EACH	16.000	X			=		
AR125565	SPLICE CAN	EACH	2.000	X			=		
AR125610	REILS	PAIR	1.000	X			=		
AR125615	PAPI (L-880 SYSTEM)	EACH	2.000	X			=		
AR125901	REMOVE STAKE MOUNTED LIGHT	EACH	143.000	X			=		
AR125902	REMOVE BASE MOUNTED LIGHT	EACH	9.000	X			=		
AR125904	REMOVE TAXI GUIDANCE SIGN	EACH	5.000	X			=		
AR125907	REMOVE REILS	PAIR	1.000	X			=		

ITEM NUMBER	PAY ITEM DESCRIPTION	UNIT OF MEASURE	QUANTITY		UNIT PRICE DOLLARS	UNIT PRICE CENTS		TOTAL PRICE DOLLARS	TOTAL PRICE CTS
AR125909	REMOVE VASI	EACH	1.000	X			=		
AR125964	RELOCATE TAXI GUIDANCE SIGN	EACH	8.000	X			=		
AR127985	RECONSTRUCT MALSR	L.S.	1.000	X			=		
AR150510	ENGINEER'S FIELD OFFICE	L.S.	1.000	X			=		
AR150530	TRAFFIC MAINTENANCE	L.S.	1.000	X			=		
AR150540	HAUL ROUTE	L.S.	1.000	X			=		
AR152410	UNCLASSIFIED EXCAVATION	C.Y.	29,712.000	X			=		
AR152442	OFFSITE BORROW EXCAVATION	C.Y.	9,641.000	X			=		
AR152540	SOIL STABILIZATION FABRIC	S.Y.	46,630.000	X			=		
AR156510	SILT FENCE	L.F.	14,641.000	X			=		
AR156521	HEADWALL PROTECTION	EACH	2.000	X			=		
AR156530	TEMPORARY SEEDING	ACRE	29.000	X			=		
AR209510	CRUSHED AGGREGATE BASE COURSE	TON	26,818.000	X			=		
AR209511	CRUSHED AGGREGATE BASE, (CA-1)	TON	19,688.000	X			=		
AR401614	BIT. SURF. CSE.-METHOD II, SUPERP	TON	5,154.000	X			=		

ITEM NUMBER	PAY ITEM DESCRIPTION	UNIT OF MEASURE	QUANTITY		UNIT PRICE DOLLARS	UNIT PRICE CENTS		TOTAL PRICE DOLLARS	TOTAL PRICE CTS
AR401630	BITUMINOUS SURFACE TEST SECTION	EACH	1.000	X			=		
AR401640	BITUMINOUS PAVEMENT GROOVING	S.Y.	38,783.000	X			=		
AR401650	BITUMINOUS PAVEMENT MILLING	S.Y.	910.000	X			=		
AR401900	REMOVE BITUMINOUS PAVEMENT	S.Y.	5,694.000	X			=		
AR403614	BIT. BASE CSE.-METHOD II, SUPERPA	TON	13,096.000	X			=		
AR403630	BITUMINOUS BASE TEST SECTION	EACH	1.000	X			=		
AR602510	BITUMINOUS PRIME COAT	GAL.	15,749.000	X			=		
AR603510	BITUMINOUS TACK COAT	GAL.	26,971.000	X			=		
AR620520	PAVEMENT MARKING-WATERBORNE	S.F.	86,065.000	X			=		
AR620525	PAVEMENT MARKING-BLACK BORDER	S.F.	5,077.000	X			=		
AR620900	PAVEMENT MARKING REMOVAL	S.F.	59,970.000	X			=		
AR760720	20" STEEL CASING	L.F.	50.000	X			=		
AR800405	INSTALL TEMPORARY LIGHTING	L.S.	1.000	X			=		
AR800500	REMOVE PAVEMENT	S.Y.	4,112.000	X			=		
AR800576	INSTALL GROUND ROD	EACH	4.000	X			=		

ITEM NUMBER	PAY ITEM DESCRIPTION	UNIT OF MEASURE	QUANTITY		UNIT PRICE DOLLARS	UNIT PRICE CENTS		TOTAL PRICE DOLLARS	TOTAL PRICE CTS
AR901510	SEEDING	ACRE	29.000	X			=		
AR908510	MULCHING	ACRE	29.000	X			=		

SUBTOTAL BASE $

***THE DEPARTMENT RESERVES THE RIGHT TO AWARD THIS CONTRACT ON THE
***BASIS OF ANY OF THE ALTERNATES OR COMBINATION THEREOF.

****** ALT 1 ******

ITEM NUMBER	PAY ITEM DESCRIPTION	UNIT OF MEASURE	QUANTITY		UNIT PRICE DOLLARS	UNIT PRICE CENTS		TOTAL PRICE DOLLARS	TOTAL PRICE CTS
AS701006	6" PVC STORM SEWER	L.F.	930.000	X			=		
AS705411	POROUS BACKFILL NO. 1	C.Y.	808.000	X			=		
AS705526	6" PERFORATED UNDERDRAIN W/SOCK	L.F.	12,865.000	X			=		
AS705546	6" NON PERFORATED UNDERDRAIN	L.F.	872.000	X			=		
AS705620	UNDERDRAIN END SECTION	EACH	6.000	X			=		
AS705630	UNDERDRAIN INSPECTION HOLE	EACH	10.000	X			=		
AS705640	UNDERDRAIN CLEANOUT	EACH	11.000	X			=		
AS751600	CATCH BASIN	EACH	12.000	X			=		

SUBTOTAL ALT 1 $

SUMMARY OF TOTAL ALTERNATES		DOLLARS	CTS
TOTAL BASE	$		
TOTAL ALT 1	$		

NOTE:

1. EACH PAY ITEM SHOULD HAVE A UNIT PRICE AND A TOTAL PRICE.

2. THE UNIT PRICE SHALL GOVERN IF NO TOTAL PRICE IS SHOWN OR IF THERE IS A DISCREPANCY BETWEEN THE PRODUCT OF THE UNIT PRICE MULTIPLIED BY THE QUANTITY.

3. IF A UNIT PRICE IS OMITTED, THE TOTAL PRICE WILL BE DIVIDED BY THE QUANTITY IN ORDER TO ESTABLISH A UNIT PRICE.

4. A BID MAY BE DECLARED UNACCEPTABLE IF NEITHER A UNIT PRICE NOR A TOTAL PRICE IS SHOWN.

RETURN WITH BID

THE PRECEDING SCHEDULE OF PRICES MUST BE

COMPLETED AND RETURNED.

RETURN WITH BID

STATE REQUIRED ETHICAL STANDARDS GOVERNING CONTRACT PROCUREMENT: ASSURANCES, CERTIFICATIONS AND DISCLOSURES

I. GENERAL

A. Article 50 of the Illinois Procurement Code establishes the duty of all State chief procurement officers, State purchasing officers, and their designees to maximize the value of the expenditure of public moneys in procuring goods, services, and contracts for the State of Illinois and to act in a manner that maintains the integrity and public trust of State government. In discharging this duty, they are charged by law to use all available information, reasonable efforts, and reasonable actions to protect, safeguard, and maintain the procurement process of the State of Illinois.

B. In order to comply with the provisions of Article 50 and to carry out the duty established therein, all bidders are to adhere to ethical standards established for the procurement process, and to make such assurances, disclosures and certifications required by law. Except as otherwise required in subsection III, paragraphs J-N, by execution of the Proposal Signature Sheet, the bidder indicates that each of the mandated assurances has been read and understood, that each certification is made and understood, and that each disclosure requirement has been understood and completed.

C. In addition to all other remedies provided by law, failure to comply with any assurance, failure to make any disclosure or the making of a false certification shall be grounds for the chief procurement officer to void the contract, or subcontract, and may result in the suspension or debarment of the bidder or subcontractor.

II. ASSURANCES

The assurances hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder.

A. Conflicts of Interest

1. The Illinois Procurement Code provides in pertinent part:

Section 50-13. Conflicts of Interest.

(a) Prohibition. It is unlawful for any person holding an elective office in this State, holding a seat in the General Assembly, or appointed to or employed in any of the offices or agencies of state government and who receives compensation for such employment in excess of 60% of the salary of the Governor of the State of Illinois, or who is an officer or employee of the Capital Development Board or the Illinois Toll Highway Authority, or who is the spouse or minor child of any such person to have or acquire any contract, or any direct pecuniary interest in any contract therein, whether for stationery, printing, paper, or any services, materials, or supplies, that will be wholly or partially satisfied by the payment of funds appropriated by the General Assembly of the State of Illinois or in any contract of the Capital Development Board or the Illinois Toll Highway authority.

(b) Interests. It is unlawful for any firm, partnership, association or corporation, in which any person listed in subsection (a) is entitled to receive (i) more than 7 1/2% of the total distributable income or (ii) an amount in excess of the salary of the Governor, to have or acquire any such contract or direct pecuniary interest therein.

(c) Combined interests. It is unlawful for any firm, partnership, association, or corporation, in which any person listed in subsection (a) together with his or her spouse or minor children is entitled to receive (i) more than 15%, in the aggregate, of the total distributable income or (ii) an amount in excess of 2 times the salary of the Governor, to have or acquire any such contract or direct pecuniary interest therein.

(d) Securities. Nothing in this Section invalidates the provisions of any bond or other security previously offered or to be offered for sale or sold by or for the State of Illinois.

(e) Prior interests. This Section does not affect the validity of any contract made between the State and an officer or employee of the State or member of the General Assembly, his or her spouse, minor child or any combination of those persons if that contract was in existence before his or her election or employment as an officer, member, or employee. The contract is voidable, however, if it cannot be completed within 365 days after the officer, member, or employee takes office or is employed.

The current salary of the Governor is $177,412.00. Sixty percent of the salary is $106,447.20.

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-13, or that an effective exemption has been issued by the Board of Ethics to any individual subject to the Section 50-13 prohibitions pursuant to the provisions of Section 50-20 of the Code and Executive Order Number 3 (1998). Information concerning the exemption process is available from the Department upon request.

B. Negotiations

1. The Illinois Procurement Code provides in pertinent part:

Section 50-15. Negotiations.

(a) It is unlawful for any person employed in or on a continual contractual relationship with any of the offices or agencies of State government to participate in contract negotiations on behalf of that office or agency with any firm, partnership, association, or corporation with whom that person has a contract for future employment or is negotiating concerning possible future employment.

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-15, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

C. Inducements

1. The Illinois Procurement Code provides:

Section 50-25. Inducement. Any person who offers or pays any money or other valuable thing to any person to induce him or her not to bid for a State contract or as recompense for not having bid on a State contract is guilty of a Class 4 felony. Any person who accepts any money or other valuable thing for not bidding for a State contract or who withholds a bid in consideration of the promise for the payment of money or other valuable thing is guilty of a Class 4 felony.

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-25, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

D. Revolving Door Prohibition

1. The Illinois Procurement Code provides:

Section 50-30. Revolving door prohibition. Chief procurement officers, State purchasing officers, procurement compliance monitors, their designees whose principal duties are directly related to State procurement, and executive officers confirmed by the Senate are expressly prohibited for a period of 2 years after terminating an affected position from engaging in any procurement activity relating to the State agency most recently employing them in an affected position for a period of at least 6 months. The prohibition includes, but is not limited to: lobbying the procurement process; specifying; bidding; proposing bid, proposal, or contract documents; on their own behalf or on behalf of any firm, partnership, association, or corporation. This Section applies only to persons who terminate an affected position on or after January 15, 1999.

2. The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-30, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

E. Reporting Anticompetitive Practices

1. The Illinois Procurement Code provides:

Section 50-40. Reporting anticompetitive practices. When, for any reason, any vendor, bidder, contractor, chief procurement officer, State purchasing officer, designee, elected official, or State employee suspects collusion or other anticompetitive practice among any bidders, offers, contractors, proposers, or employees of the State, a notice of the relevant facts shall be transmitted to the Attorney General and the chief procurement officer.

2. The bidder assures the Department that it has not failed to report any relevant facts concerning the practices addressed in Section 50-40 which may involve the contract for which the bid is submitted.

F. Confidentiality

1. The Illinois Procurement Code provides:

Section 50-45. Confidentiality. Any chief procurement officer, State purchasing officer, designee, or executive officer who willfully uses or allows the use of specifications, competitive bid documents, proprietary competitive information, proposals, contracts, or selection information to compromise the fairness or integrity of the procurement, bidding, or contract process shall be subject to immediate dismissal, regardless of the Personnel code, any contract, or any collective bargaining agreement, and may in addition be subject to criminal prosecution.

2. The bidder assures the Department that it has no knowledge of any fact relevant to the practices addressed in Section 50-45 which may involve the contract for which the bid is submitted.

I. Insider Information

1. The Illinois Procurement Act provides:

Section 50-50. Insider information. It is unlawful for any current or former elected or appointed State official or State employee to knowingly use confidential information available only by virtue of that office or employment for actual or anticipated gain for themselves or another person.

2. The bidder assures the Department that it has no knowledge of any facts relevant to the practices addressed in Section 50-50 which may involve the contract for which the bid is submitted.

III. CERTIFICATIONS

The certifications hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder. Section 50-2 of the Illinois Procurement Code provides that every person that has entered into a multi-year contract and every subcontractor with a multi-year subcontract shall certify, by July 1 of each fiscal year covered by the contract after the initial fiscal year, to the responsible chief procurement officer whether it continues to satisfy the requirements of Article 50 pertaining to the eligibility for a contract award. If a contractor or subcontractor is not able to truthfully certify that it continues to meet all requirements, it shall provide with its certification a detailed explanation of the circumstances leading to the change in certification status. A contractor or subcontractor that makes a false statement material to any given certification required under Article 50 is, in addition to any other penalties or consequences prescribed by law, subject to liability under the Whistleblower Reward and Protection Act for submission of a false claim.

A. Bribery

1. The Illinois Procurement Code provides:

Section 50-5. Bribery.

(a) Prohibition. No person or business shall be awarded a contract or subcontract under this Code who:

(1) has been convicted under the laws of Illinois or any other state of bribery or attempting to bribe an officer or employee of the State of Illinois or any other state in that officer's or employee's official capacity; or

(2) has made an admission of guilt of that conduct that is a matter of record but has not been prosecuted for that conduct.

(b) Businesses. No business shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of the business if the employee or agent is no longer employed by the business and:

(1) the business has been finally adjudicated not guilty; or

(2) the business demonstrates to the governmental entity with which it seeks to contract, and that entity finds that the commission of the offense was not authorized, requested, commanded, or performed by a director, officer, or high managerial agent on behalf of the business as provided in paragraph (2) of subsection (a) of Section 5-4 of the Criminal Code of 1961.

(c) Conduct on behalf of business. For purposes of this Section, when an official, agent, or employee of a business committed the bribery or attempted bribery on behalf of the business and in accordance with the direction or authorization of a responsible official of the business, the business shall be chargeable with the conduct.

(d) Certification. Every bid submitted to and contract executed by the State, and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the contractor or the subcontractor, respectively, that the contractor or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any certifications required by this Section are false. A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

2. The contractor or subcontractor certifies that it is not barred from being awarded a contract under Section 50.5.

B. Felons

1. The Illinois Procurement Code provides:

Section 50-10. Felons. Unless otherwise provided, no person or business convicted of a felony shall do business with the State of Illinois or any State agency, or enter into a subcontract, from the date of conviction until 5 years after the date of completion of the sentence for that felony, unless no person held responsible by a prosecutorial office for the facts upon which the conviction was based continues to have any involvement with the business.

2. Certification. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder or contractor or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any of the certifications required by this Section are false.

C. Debt Delinquency

1. The Illinois Procurement Code provides:

Section 50-11 and 50-12. Debt Delinquency. The contractor or bidder or subcontractor, respectively, certifies that it, or any affiliate, is not barred from being awarded a contract or subcontract under the Procurement Code. Section 50-11 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it knows or should know that it, or any affiliate, is delinquent in the payment of any debt to the State as defined by the Debt Collection Board. Section 50-12 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it, or any affiliate, has failed to collect and remit Illinois Use Tax on all sales of tangible personal property into the State of Illinois in accordance with the provisions of the Illinois Use Tax Act. The bidder or contractor or subcontractor, respectively, further acknowledges that the chief procurement officer may declare the related contract void if this certification is false or if the bidder, contractor, or subcontractor, or any affiliate, is determined to be delinquent in the payment of any debt to the State during the term of the contract.

D. Prohibited Bidders, Contractors and Subcontractors

1. The Illinois Procurement Code provides:

Section 50-10.5 and 50-60(c). Prohibited bidders, contractors and subcontractors.
The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-10.5 that no officer, director, partner or other managerial agent of the contracting business has been convicted of a felony under the Sarbanes-Oxley Act of 2002 or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953 or if in violation of Subsection (c) for a period of five years from the date of conviction. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder, contractor, or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer shall declare the related contract void if any of the certifications completed pursuant to this Section are false.

E. Section 42 of the Environmental Protection Act

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-12 that the bidder, contractor, or subcontractor, is not barred from being awarded a contract or entering into a subcontract under this Section which prohibits the bidding on or entering into contracts with the State of Illinois or a State agency, or entering into any subcontract, that is subject to the Procurement Code by a person or business found by a court or the Pollution Control Board to have committed a willful or knowing violation of Section 42 of the Environmental Protection Act for a period of five years from the date of the order. The bidder or contractor or subcontractor, respectively, acknowledges that the chief procurement officer may declare the contract void if this certification is false.

F. Educational Loan

1. Section 3 of the Educational Loan Default Act provides:

§ 3. No State agency shall contract with an individual for goods or services if that individual is in default, as defined in Section 2 of this Act, on an educational loan. Any contract used by any State agency shall include a statement certifying that the individual is not in default on an educational loan as provided in this Section.

2. The bidder, if an individual as opposed to a corporation, partnership or other form of business organization, certifies that the bidder is not in default on an educational loan as provided in Section 3 of the Act.

G. Bid-Rigging/Bid Rotating

1. Section 33E-11 of the Criminal Code of 1961 provides:

§ 33E-11. (a) Every bid submitted to and public contract executed pursuant to such bid by the State or a unit of local government shall contain a certification by the prime contractor that the prime contractor is not barred from contracting with any unit of State or local government as a result of a violation of either Section 33E-3 or 33E-4 of this Article. The State and units of local government shall provide the appropriate forms for such certification.

(b) A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

A violation of Section 33E-3 would be represented by a conviction of the crime of bid-rigging which, in addition to Class 3 felony sentencing, provides that any person convicted of this offense or any similar offense of any state or the United States which contains the same elements as this offense shall be barred for 5 years from the date of conviction from contracting with any unit of State or local government. No corporation shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation and: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract and that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent in behalf of the corporation.

A violation of Section 33E-4 would be represented by a conviction of the crime of bid-rotating which, in addition to Class 2 felony sentencing, provides that any person convicted of this offense or any similar offense of any state or the United States which contains the same elements as this offense shall be permanently barred from contracting with any unit of State or local government. No corporation shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation and: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract and that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent in behalf of the corporation.

2. The bidder certifies that it is not barred from contracting with the Department by reason of a violation of either Section 33E-3 or Section 33E-4.

H. International Anti-Boycott

1. Section 5 of the International Anti-Boycott Certification Act provides:

§ 5. State contracts. Every contract entered into by the State of Illinois for the manufacture, furnishing, or purchasing of supplies, material, or equipment or for the furnishing of work, labor, or services, in an amount exceeding the threshold for small purchases according to the purchasing laws of this State or $10,000.00, whichever is less, shall contain certification, as a material condition of the contract, by which the contractor agrees that neither the contractor nor any substantially-owned affiliated company is participating or shall participate in an international boycott in violation of the provisions of the U.S. Export Administration Act of 1979 or the regulations of the U.S. Department of Commerce promulgated under that Act.

2. The bidder makes the certification set forth in Section 5 of the Act.

I. Drug Free Workplace

1. The Illinois "Drug Free Workplace Act" applies to this contract and it is necessary to comply with the provisions of the "Act" if the contractor is a corporation, partnership, or other entity (including a sole proprietorship) which has 25 or more employees.

2. The bidder certifies that if awarded a contract in excess of $5,000 it will provide a drug free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensation, possession or use of a controlled substance, including cannabis, is prohibited in the contractor's workplace; specifying the actions that will be taken against employees for violations of such prohibition; and notifying the employee that, as a condition of employment on such contract, the employee shall abide by the terms of the statement, and notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction.

(b) Establishing a drug free awareness program to inform employees about the dangers of drug abuse in the workplace; the contractor's policy of maintaining a drug free workplace; any available drug counseling, rehabilitation, and employee assistance programs; and the penalties that may be imposed upon employees for drug violations.

(c) Providing a copy of the statement required by subparagraph (1) to each employee engaged in the performance of the contract and to post the statement in a prominent place in the workplace.

(d) Notifying the Department within ten (10) days after receiving notice from an employee or otherwise receiving actual notice of the conviction of an employee for a violation of any criminal drug statute occurring in the workplace.

(e) Imposing or requiring, within 30 days after receiving notice from an employee of a conviction or actual notice of such a conviction, an appropriate personnel action, up to and including termination, or the satisfactory participation in a drug abuse assistance or rehabilitation program approved by a federal, state or local health, law enforcement or other appropriate agency.

(f) Assisting employees in selecting a course of action in the event drug counseling, treatment, and rehabilitation is required and indicating that a trained referral team is in place.

(g) Making a good faith effort to continue to maintain a drug free workplace through implementation of the actions and efforts stated in this certification.

J. Disclosure of Business Operations in Iran

Section 50-36 of the Illinois Procurement Code, 30ILCS 500/50-36 provides that each bid, offer, or proposal submitted for a State contract shall include a disclosure of whether or not the Company acting as the bidder, offeror, or proposing entity, or any of its corporate parents or subsidiaries, within the 24 months before submission of the bid, offer, or proposal had business operations that involved contracts with or provision of supplies or services to the Government of Iran, companies in which the Government of Iran has any direct or indirect equity share, consortiums or projects commissioned by the Government of Iran, or companies involved in consortiums or projects commissioned by the Government of Iran and either of the following conditions apply:

(1) More than 10% of the Company's revenues produced in or assets located in Iran involve oil-related activities or mineral-extraction activities; less than 75% of the Company's revenues produced in or assets located in Iran involve contracts with or provision of oil-related or mineral-extraction products or services to the Government of Iran or a project or consortium created exclusively by that government; and the Company has failed to take substantial action.

(2) The Company has, on or after August 5, 1996, made an investment of $20 million or more, or any combination of investments of at least $10 million each that in the aggregate equals or exceeds $20 million in any 12-month period, which directly or significantly contributes to the enhancement of Iran's ability to develop petroleum resources of Iran.

The terms "Business operations", "Company", "Mineral-extraction activities", "Oil-related activities", "Petroleum resources", and "Substantial action" are all defined in the Code.

Failure to make the disclosure required by the Code shall cause the bid, offer or proposal to be considered not responsive. The disclosure will be considered when evaluating the bid, offer, or proposal or awarding the contract. The name of each Company disclosed as doing business or having done business in Iran will be provided to the State Comptroller.

Check the appropriate statement:

/____/ Company has no business operations in Iran to disclose.

/____/ Company has business operations in Iran as disclosed in the attached document.

K. Apprenticeship and Training Certification (Does not apply to federal aid projects)

In accordance with the provisions of Section 30-22 (6) of the Illinois Procurement Code, the bidder certifies that it is a participant, either as an individual or as part of a group program, in the approved apprenticeship and training programs applicable to each type of work or craft that the bidder will perform with its own forces. The bidder further certifies for work that will be performed by subcontract that each of its subcontractors submitted for approval either (a) is, at the time of such bid, participating in an approved, applicable apprenticeship and training program; or (b) will, prior to commencement of performance of work pursuant to this contract, begin participation in an approved apprenticeship and training program applicable to the work of the subcontract. The Department, at any time before or after award, may require the production of a copy of each applicable Certificate of Registration issued by the United States Department of Labor evidencing such participation by the contractor and any or all of its subcontractors. Applicable apprenticeship and training programs are those that have been approved and registered with the United States Department of Labor. The bidder shall list in the space below, the official name of the program sponsor holding the Certificate of Registration for all of the types of work or crafts in which the bidder is a participant and that will be performed with the bidder's forces. Types of work or craft work that will be subcontracted shall be included and listed as subcontracted work. The list shall also indicate any type of work or craft job category that does not have an applicable apprenticeship or training program. **The bidder is responsible for making a complete report and shall make certain that each type of work or craft job category that will be utilized on the project as reported on the Construction Employee Workforce Projection (Form BC-1256) and returned with the bid is accounted for and listed.**

N/A (Federal)

The requirements of this certification and disclosure are a material part of the contract, and the contractor shall require this certification provision to be included in all approved subcontracts. In order to fulfill this requirement, it shall not be necessary that an applicable program sponsor be currently taking or that it will take applications for apprenticeship, training or employment during the performance of the work of this contract.

L. Political Contributions and Registration with the State Board of Elections.

Sections 20-160 and 50-37 of the Illinois Procurement Code regulate political contributions from business entities and any affiliated entities or affiliated persons bidding on or contracting with the state. Generally under Section 50-37, any business entity , and any affiliated entity or affiliated person of the business entity, whose current year contracts with all state agencies exceed an awarded value of $50,000, are prohibited from making any contributions to any political committees established to promote the candidacy of the officeholder responsible for the awarding of the contracts or any other declared candidate for that office for the duration of the term of office of the incumbent officeholder or a period 2 years after the termination of the contract, whichever is longer. Any business entity and affiliated entities or affiliated persons whose state contracts in the current year do not exceed an awarded value of $50,000, either alone or in combination with contracts not exceeding $50,000, are prohibited from making any political contributions to any political committee established to promote the candidacy of the officeholder responsible for awarding the pending contract during the period beginning on the date the invitation for bids or request for proposals is issued and ending on the day after the date of award or selection if the entity was not awarded or selected. Section 20-160 requires certification of registration of affected business entities in accordance with procedures found in Section 9-35 of The Election Code

By submission of a bid, the contractor business entity acknowledges and agrees that it has read and understands Sections 20-160 and 50-37 of the Illinois Procurement Code, and that it makes the following certification:

The undersigned business entity certifies that it has registered as a business with the State Board of Elections and acknowledges a continuing duty to update the registration in accordance with the above referenced statutes. A copy of the certificate of registration shall be submitted with the bid. The bidder is cautioned that the Department will not award a contract without submission of the certificate of registration.

These requirements and compliance with the above referenced statutory sections are a material part of the contract, and any breach thereof shall be cause to void the contract under Section 50-06 of the Illinois Procurement Code. These provisions do not apply to federal-aid contracts.

M. Lobbyist Disclosure

Section 50-38 of the Illinois Procurement Code requires that any bidder or offeror on a State contract that hires a person required to register under the Lobbyist Registration Act to assist in obtaining a contract shall:

(i) Disclose all costs, fees, compensation, reimbursements, and other remunerations paid or to be paid to the lobbyist related to the contract,
(ii) Not bill or otherwise cause the State of Illinois to pay for any of the lobbyist's costs, fees, compensation, reimbursements, or other remuneration, and
(iii) Sign a verification certifying that none of the lobbyist's costs, fees, compensation, reimbursements, or other remuneration were billed to the State.

This information, along with all supporting documents, shall be filed with the agency awarding the contract and with the Secretary of State. The chief procurement officer shall post this information, together with the contract award notice, in the online Procurement Bulletin.

Pursuant to Subsection (c) of this Section, no person or entity shall retain a person or entity to attempt to influence the outcome of a procurement decision made under the Procurement Code for compensation contingent in whole or in part upon the decision or procurement. Any person who violates this subsection is guilty of a business offense and shall be fined not more than $10,000.

Bidder acknowledges that it is required to disclose the hiring of any person required to register pursuant to the Illinois Lobbyist Registration Act (25 ILCS 170) in connection with this contract.

☐ Bidder has not hired any person required to register pursuant to the Illinois Lobbyist Registration Act in connection with this contract.

Or

☐ Bidder has hired the following persons required to register pursuant to the Illinois Lobbyist Registration Act in connection with the contract:

Name and address of person: _____
All costs, fees, compensation, reimbursements and other remuneration paid to said person: _____
_____
_____
_____

IV. DISCLOSURES

A. The disclosures hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder. The bidder further certifies that the Department has received the disclosure forms for each bid.

The chief procurement officer may void the bid, contract, or subcontract, respectively, if it is later determined that the bidder or subcontractor rendered a false or erroneous disclosure. A contractor or subcontractor may be suspended or debarred for violations of the Procurement Code. Furthermore, the chief procurement officer may void the contract and the surety providing the performance bond shall be responsible for completion of the contract.

B. Financial Interests and Conflicts of Interest

1. Section 50-35 of the Illinois Procurement Code provides that all bids of more than $10,000 shall be accompanied by disclosure of the financial interests of the bidder. This disclosed information for the successful bidder, will be maintained as public information subject to release by request pursuant to the Freedom of Information Act, filed with the Procurement Policy Board, and shall be incorporated as a material term of the contract. Furthermore, pursuant to Section 5-5, the Procurement Policy Board may review a proposal, bid, or contract and issue a recommendation to void a contract or reject a proposal or bid based on any violation of the Procurement Code or the existence of a conflict of interest as provided in subsections (b) and (d) of Section 50-35.

The financial interests to be disclosed shall include ownership or distributive income share that is in excess of 5%, or an amount greater than 60% of the annual salary of the Governor, of the bidding entity or its parent entity, whichever is less, unless the contractor or bidder is a publicly traded entity subject to Federal 10K reporting, in which case it may submit its 10K disclosure in place of the prescribed disclosure. If a bidder is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. The disclosure shall include the names, addresses, and dollar or proportionate share of ownership of each person making the disclosure, their instrument of ownership or beneficial relationship, and notice of any potential conflict of interest resulting from the current ownership or beneficial interest of each person making the disclosure having any of the relationships identified in Section 50-35 and on the disclosure form.

In addition, all disclosures shall indicate any other current or pending contracts, proposals, leases, or other ongoing procurement relationships the bidding entity has with any other unit of state government and shall clearly identify the unit and the contract, proposal, lease, or other relationship.

2. Disclosure Forms. Disclosure Form A is attached for use concerning the individuals meeting the above ownership or distributive share requirements. Subject individuals should be covered each by one form. In addition, a second form (Disclosure Form B) provides for the disclosure of current or pending procurement relationships with other (non-IDOT) state agencies. **The forms must be included with each bid or incorporated by reference.**

C. Disclosure Form Instructions

Form A Instructions for Financial Information & Potential Conflicts of Interest

If the bidder is a publicly traded entity subject to Federal 10K reporting, the 10K Report may be submitted to meet the requirements of Form A. If a bidder is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. If a bidder is not subject to Federal 10K reporting, the bidder must determine if any individuals are required by law to complete a financial disclosure form. To do this, the bidder should answer each of the following questions. A "YES" answer indicates Form A must be completed. If the answer to each of the following questions is "NO", then the NOT APPLICABLE STATEMENT on Form A must be signed and dated by a person that is authorized to execute contracts for the bidding company. Note: These questions are for assistance only and are not required to be completed.

1. Does anyone in your organization have a direct or beneficial ownership share of greater than 5% of the bidding entity or parent entity? YES _____ NO _____

2. Does anyone in your organization have a direct or beneficial ownership share of less than 5%, but which has a value greater than $106,447.20? YES _____ NO _____

3. Does anyone in your organization receive more than $106,447.20 of the bidding entity's or parent entity's distributive income? (Note: Distributive income is, for these purposes, any type of distribution of profits. An annual salary is not distributive income.) YES_____ NO_____

4. Does anyone in your organization receive greater than 5% of the bidding entity's or parent entity's total distributive income, but which is less than $106,447.20? YES _____ NO _____

   (Note: Only one set of forms needs to be completed per person per bid even if a specific individual would require a yes answer to more than one question.)

A "YES" answer to any of these questions requires the completion of Form A. The bidder must determine each individual in the bidding entity or the bidding entity's parent company that would cause the questions to be answered "Yes". Each form must be signed and dated by a person that is authorized to execute contracts for your organization. **Photocopied or stamped signatures are not acceptable**. The person signing can be, but does not have to be, the person for which the form is being completed. The bidder is responsible for the accuracy of any information provided.

If the answer to each of the above questions is "NO", then the NOT APPLICABLE STATEMENT of Form A must be signed and dated by a person that is authorized to execute contracts for your company.

Form B: **Instructions for Identifying Other Contracts & Procurement Related Information**

Disclosure Form B must be completed for each bid submitted by the bidding entity. *Note: Checking the NOT APPLICABLE STATEMENT on Form A does not allow the bidder to ignore Form B. Form B must be completed, checked, and dated or the bidder may be considered nonresponsive and the bid will not be accepted.*

The Bidder shall identify, by checking Yes or No on Form B, whether it has any pending contracts (including leases), bids, proposals, or other ongoing procurement relationship with any other (non-IDOT) State of Illinois agency. If "No" is checked, the bidder only needs to complete the check box on the bottom of Form B. If "Yes" is checked, the bidder must do one of the following:

Option I: If the bidder did not submit an Affidavit of Availability to obtain authorization to bid, the bidder must list all non-IDOT State of Illinois agency pending contracts, leases, bids, proposals, and other ongoing procurement relationships. These items may be listed on Form B or on an attached sheet(s). Do not include IDOT contracts. Contracts with cities, counties, villages, etc. are not considered State of Illinois agency contracts and are not to be included. Contracts with other State of Illinois agencies such as the Department of Natural Resources or the Capital Development Board must be included. Bidders who submit Affidavits of Availability are suggested to use Option II.

Option II: If the bidder is required and has submitted an Affidavit of Availability in order to obtain authorization to bid, the bidder may write or type "See Affidavit of Availability" which indicates that the Affidavit of Availability is incorporated by reference and includes all non-IDOT State of Illinois agency pending contracts, leases, bids, proposals, and other ongoing procurement relationships. For any contracts that are not covered by the Affidavit of Availability, the bidder must identify them on Form B or on an attached sheet(s). These might be such things as leases.

ILLINOIS DEPARTMENT OF TRANSPORTATION

Form A
Financial Information & Potential Conflicts of Interest Disclosure

Contractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Code (30 ILCS 500). Vendors desiring to enter into a contract with the State of Illinois must disclose the financial information and potential conflict of interest information as specified in this Disclosure Form. This information shall become part of the publicly available contract file. This Form A must be completed for bids in excess of $10,000, and for all open-ended contracts. **A publicly traded company may submit a 10K disclosure (or equivalent if applicable) in satisfaction of the requirements set forth in Form A. See Disclosure Form Instructions.**

DISCLOSURE OF FINANCIAL INFORMATION

1. Disclosure of Financial Information. The individual named below has an interest in the BIDDER (or its parent) in terms of ownership or distributive income share in excess of 5%, or an interest which has a value of more than $106,447.20 (60% of the Governor's salary as of 7/1/2007). **(Make copies of this form as necessary and attach a separate Disclosure Form A for each individual meeting these requirements)**

FOR INDIVIDUAL (type or print information)

NAME: _____

ADDRESS _____

_____

Type of ownership/distributable income share:

stock _____ sole proprietorship _____ partnership _____ other: (explain on separate sheet)

% or $ value of ownership/distributable income share: _____

2. Disclosure of Potential Conflicts of Interest. Check "Yes" or "No" to indicate which, if any, of the following potential conflict of interest relationships apply. If the answer to any question is "Yes", please attach additional pages and describe.

(a) State employment, currently or in the previous 3 years, including contractual employment of services.
Yes____
No____If your answer is yes, please answer each of the following questions.

1. Are you currently an officer or employee of either the Capitol Development Board or the Illinois Toll Highway Authority? Yes____ No____

2. Are you currently appointed to or employed by any agency of the State of Illinois? If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) provide the name of the State agency for which you are employed and your annual salary.

_____

_____

3. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of the salary of the Governor? Yes ____ No____

4. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 2 times the salary of the Governor? Yes____ No____

(b) State employment of spouse, father, mother, son, or daughter, including contractual employment for services in the previous 2 years. Yes____ No____

If your answer is yes, please answer each of the following questions.

1. Is your spouse or any minor children currently an officer or employee of the Capital Development Board or the Illinois Toll Highway Authority? Yes____ No____

2. Is your spouse or any minor children is/are currently appointed to or employed by any agency of the State of Illinois? If your spouse or minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) provide the name of your spouse and/or minor children, the name of the State agency for which he/she is employed and his/her annual salary.

   _____

   _____

3. If your spouse or any minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) and amount in excess of the salary of the Governor? Yes____ No____

4. If your spouse or any minor children are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) are you and your spouse or minor children entitled to receive (i) more than 15% in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 2 times the salary of the Governor? Yes____ No____

(c) Elective status; the holding of elective office of the State of Illinois, the government of the United States, any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois currently or in the previous 3 years. Yes____ No____

(d) Relationship to anyone holding elective office currently or in the previous 2 years; spouse, father, mother, son, or daughter Yes____ No____

(e) Appointive office; the holding of any appointive government office of the State of Illinois, the United States of America, or any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois, which office entitles the holder to compensation in excess of the expenses incurred in the discharge of that office currently or in the previous 3 years. Yes____ No____

(f) Relationship to anyone holding appointive office currently or in the previous 2 years; spouse, father, mother, son, or daughter. Yes____ No____

(g) Employment, currently or in the previous 3 years, as or by any registered lobbyist of the State government. Yes____ No____

(h) Relationship to anyone who is or was a registered lobbyist in the previous 2 years; spouse, father, mother, son, or daughter. Yes____ No____

(i) Compensated employment, currently or in the previous 3 years, by any registered election or reelection committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections Yes____ No____

(j) Relationship to anyone; spouse, father, mother, son, or daughter; who was a compensated employee in the last 2 years by any registered election or re-election committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes____ No____

3. Communication Disclosure.

Disclose the name and address of each lobbyist and other agent of the bidder or offeror who is not identified in Section 2 of this form, who is has communicated, is communicating, or may communicate with any State officer or employee concerning the bid or offer. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the process and throughout the term of the contract. If no person is identified, enter "None" on the line below:

Name and address of person(s): _____

4. Debarment Disclosure. For each of the persons identified under Sections 2 and 3 of this form, disclose whether any of the following has occurred within the previous 10 years: debarment from contracting with any governmental entity; professional licensure discipline; bankruptcies; adverse civil judgments and administrative findings; and criminal felony convictions. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the procurement process and term of the contract. If no person is identified, enter "None" on the line below:

Name of person(s): _____

Nature of disclosure: _____

APPLICABLE STATEMENT

This Disclosure Form A is submitted on behalf of the INDIVIDUAL named on previous page. Under penalty of perjury, I certify the contents of this disclosure to be true and accurate to the best of my knowledge.

Completed by: ☐ _____ _____

Signature of Individual or Authorized Officer — Date

NOT APPLICABLE STATEMENT

Under penalty of perjury, I have determined that no individuals associated with this organization meet the criteria that would require the completion of this Form A.

This Disclosure Form A is submitted on behalf of the CONTRACTOR listed on the previous page.

☐ _____ _____

Signature of Authorized Officer — Date

The bidder has a continuing obligation to supplement these disclosures under Sec. 50-35 of the Procurement Code.

RETURN WITH BID

ILLINOIS DEPARTMENT OF TRANSPORTATION

Form B
Other Contracts & Procurement Related Information Disclosure

Contractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Act (30 ILCS 500). This information shall become part of the publicly available contract file. This Form B must be completed for bids in excess of $10,000, and for all open-ended contracts.

DISCLOSURE OF OTHER CONTRACTS AND PROCUREMENT RELATED INFORMATION

1. Identifying Other Contracts & Procurement Related Information. The BIDDER shall identify whether it has any pending contracts (including leases), bids, proposals, or other ongoing procurement relationship with any other State of Illinois agency:

Yes _____ No _____

If "No" is checked, the bidder only needs to complete the signature box on the bottom of this page.

2. If "Yes" is checked. Identify each such relationship by showing State of Illinois agency name and other descriptive information such as bid or project number (attach additional pages as necessary). SEE DISCLOSURE FORM INSTRUCTIONS:

THE FOLLOWING STATEMENT MUST BE CHECKED

☐ _____ _____

Signature of Authorized Representative Date

SPECIAL NOTICE TO CONTRACTORS

The following requirements of the Illinois Department of Human Rights' Rules and Regulations are applicable to bidders on all construction contracts advertised by the Illinois Department of Transportation:

CONSTRUCTION EMPLOYEE UTILIZATION PROJECTION

(a) All bidders on construction contracts shall complete and submit, along with and as part of their bids, a Bidder's Employee Utilization Form (Form BC-1256) setting forth a projection and breakdown of the total workforce intended to be hired and/or allocated to such contract work by the bidder including a projection of minority and female employee utilization in all job classifications on the contract project.

(b) The Department of Transportation shall review the Employee Utilization Form, and workforce projections contained therein, of the contract awardee to determine if such projections reflect an underutilization of minority persons and/or women in any job classification in accordance with the Equal Employment Opportunity Clause and Section 7.2 of the Illinois Department of Human Rights' Rules and Regulations for Public Contracts adopted as amended on September 17, 1980. If it is determined that the contract awardee's projections reflect an underutilization of minority persons and/or women in any job classification, it shall be advised in writing of the manner in which it is underutilizing and such awardee shall be considered to be in breach of the contract unless, prior to commencement of work on the contract project, it submits revised satisfactory projections or an acceptable written affirmative action plan to correct such underutilization including a specific timetable geared to the completion stages of the contract.

(c) The Department of Transportation shall provide to the Department of Human Rights a copy of the contract awardee's Employee Utilization Form, a copy of any required written affirmative action plan, and any written correspondence related thereto. The Department of Human Rights may review and revise any action taken by the Department of Transportation with respect to these requirements.

RETURN WITH BID

Illinois Department of Transportation

PART I. IDENTIFICATION

Dept. Human Rights #_____ Duration of Project: _____

Name of Bidder: _____

PART II. WORKFORCE PROJECTION

A. The undersigned bidder has analyzed minority group and female populations, unemployment rates and availability of workers for the location in which this contract work is to be performed, and for the locations from which the bidder recruits employees, and hereby submits the following workforce projection including a projection for minority and female employee utilization in all job categories in the workforce to be allocated to this contract:

TABLE A

TOTAL Workforce Projection for Contract													TABLE B: CURRENT EMPLOYEES TO BE ASSIGNED TO CONTRACT			
			MINORITY EMPLOYEES						TRAINEES							
JOB CATEGORIES	TOTAL EMPLOYEES		BLACK		HISPANIC		*OTHER MINOR.		APPREN-TICES		ON THE JOB TRAINEES		TOTAL EMPLOYEES		MINORITY EMPLOYEES	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
OFFICIALS (MANAGERS)																
SUPERVISORS																
FOREMEN																
CLERICAL																
EQUIPMENT OPERATORS																
MECHANICS																
TRUCK DRIVERS																
IRONWORKERS																
CARPENTERS																
CEMENT MASONS																
ELECTRICIANS																
PIPEFITTERS, PLUMBERS																
PAINTERS																
LABORERS, SEMI-SKILLED																
LABORERS, UNSKILLED																
TOTAL																

TABLE C

TOTAL Training Projection for Contract								
EMPLOYEES IN TRAINING	TOTAL EMPLOYEES		BLACK		HISPANIC		*OTHER MINOR.	
	M	F	M	F	M	F	M	F
APPRENTICES								
ON THE JOB TRAINEES								

FOR DEPARTMENT USE ONLY

* Other minorities are defined as Asians (A) or Native Americans (N).
Please specify race of each employee shown in Other Minorities column.

BC 1256 (Rev. 12/11/07)

Note: See instructions on page 2

PART II. WORKFORCE PROJECTION - continued

B. Included in "Total Employees" under Table A is the total number of **new hires** that would be employed in the event the undersigned bidder is awarded this contract.

The undersigned bidder projects that: (number) _____ new hires would be recruited from the area in which the contract project is located; and/or (number) _____ new hires would be recruited from the area in which the bidder's principal office or base of operation is located.

C. Included in "Total Employees" under Table A is a projection of numbers of persons to be employed directly by the undersigned bidder as well as a projection of numbers of persons to be employed by subcontractors.

The undersigned bidder estimates that (number) _____ persons will be directly employed by the prime contractor and that (number)_____ persons will be employed by subcontractors.

PART III. AFFIRMATIVE ACTION PLAN

A. The undersigned bidder understands and agrees that in the event the foregoing minority and female employee utilization projection included under **PART II** is determined to be an underutilization of minority persons or women in any job category, and in the event that the undersigned bidder is awarded this contract, he/she will, prior to commencement of work, develop and submit a written Affirmative Action Plan including a specific timetable (geared to the completion stages of the contract) whereby deficiencies in minority and/or female employee utilization are corrected. Such Affirmative Action Plan will be subject to approval by the contracting agency and the **Department of Human Rights**.

B. The undersigned bidder understands and agrees that the minority and female employee utilization projection submitted herein, and the goals and timetable included under an Affirmative Action Plan if required, are deemed to be part of the contract specifications.

Company _____ Telephone Number _____

_____

Address _____

NOTICE REGARDING SIGNATURE

The Bidder's signature on the Proposal Signature Sheet will constitute the signing of this form. The following signature block needs to be completed if revisions are required.

Signature: ☐ _____ Title: _____ Date: _____

Instructions: All tables must include subcontractor personnel in addition to prime contractor personnel.

Table A - Include both the number of employees that would be hired to perform the contract work and the total number currently employed (Table B) that will be allocated to contract work, and include all apprentices and on-the-job trainees. The "Total Employees" column should include all employees including all minorities, apprentices and on-the-job trainees to be employed on the contract work.

Table B - Include all employees currently employed that will be allocated to the contract work including any apprentices and on-the-job trainees currently employed.

Table C - Indicate the racial breakdown of the total apprentices and on-the-job trainees shown in Table A.

BC-1256 (Rev. 12/11/07)

RETURN WITH BID

CERTIFICATIONS REQUIRED BY STATE AND/OR FEDERAL LAW. The bidder is required by State and/or Federal law to make the below certifications and assurances as a part of the proposal and contract upon award. It is understood by the bidder that the certifications and assurances made herein are a part of the contract.

By signing the Proposal Signature Sheet, the bidder certifies that he/she has read and completed each of the following certifications and assurances, that required responses are true and correct and that the certified signature of the Proposal Signature Sheet constitutes an endorsement and execution of each certification and assurance as though each was individually signed:

A. By the execution of this proposal, the signing bidder certifies that the bidding entity has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action, in restraint of free competitive bidding in connection with the submitted bid. This statement made by the undersigned bidder is true and correct under penalty of perjury under the laws of the United States.

B. CERTIFICATION, EQUAL EMPLOYMENT OPPORTUNITY:

1. Have you participated in any previous contracts or subcontracts subject to the equal opportunity clause. YES____ NO____

2. If answer to #1 is yes, have you filed with the Joint Reporting Committee, the Director of OFCC, any Federal agency, or the former President's Committee on Equal Employment Opportunity, all reports due under the applicable filing requirements of those organizations? YES____ NO____

C. BUY AMERICAN - STEEL AND MANUFACTURED PRODUCTS FOR CONSTRUCTION CONTRACTS (JAN 1991)

(a) The Aviation Safety and Capacity Expansion Act of 1990 provides that preference be given to steel and manufactured products produced in the United States when funds are expended pursuant to a grant issued under the Airport Improvement Program. The following terms apply:

1. Steel and manufactured products. As used in this clause, steel and manufactured products include (1) steel produced in the United States or (2) a manufactured product produced in the United States, if the cost of its components mined, produced or manufactured in the United States exceeds 60 percent of the cost of all its components and final assembly has taken place in the United States. Components of foreign origin of the same class or kind as the products referred to in subparagraphs (b)(1) or (2) shall be treated as domestic.

2. Components. As used in this clause, components means those articles, materials, and supplies incorporated directly into steel and manufactured products.

3. Cost of Components. This means the costs for production of the components, exclusive of final assembly labor costs.

(b) The successful bidder will be required to assure that only domestic steel and manufactured products will be used by the Contractor, subcontractors, materialmen, and suppliers in the performance of this contract, except those-

(1) that the U.S. Department of Transportation has determined, under the Aviation Safety and Capacity Expansion Act of 1990, are not produced in the United States in sufficient and reasonably available quantities of a satisfactory quality;

(2) that the U.S. Department of Transportation has determined, under the Aviation Safety and Capacity Expansion Act of 1990, that domestic preference would be inconsistent with the public interest; or

(3) that inclusion of domestic material will increase the cost of the overall project contract by more than 25 percent.

(End of Clause)

D. BUY AMERICAN CERTIFICATE (JAN 1991)

By submitting a bid/proposal under this solicitation, except for those items listed by the offeror below or on a separate and clearly identified attachment to this bid/proposal, the offeror certifies that steel and each manufactured product, is produced in the United States (as defined in the clause Buy American - Steel and Manufactured Products or Buy American - Steel and Manufactured Products For Construction Contracts) and that components of unknown origin are considered to have been produced or manufactured outside the United States.

Offerors may obtain from (IDOT, Division of Aeronautics) lists of articles, materials, and supplies excepted from this provision.

PRODUCT	COUNTRY OF ORIGIN

E. NPDES CERTIFICATION

In accordance with the provisions of the Illinois Environmental Protection Act, the Illinois Pollution Control Board Rules and Regulations (35 Ill. Adm. Code, Subtitle C, Chapter I), and the Clean Water Act, and the regulations thereunder, this certification is required for all construction contracts that will result in the disturbance of one or more acres total land area.

The undersigned bidder certifies under penalty of law that he/she understands the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit (ILR100000) that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

The Airport Owner or its Agent will:

1) prepare, sign and submit the Notice of Intent (NOI)

2) conduct site inspections and complete and file the inspection reports

3) submit Incidence of Non-Compliance (ION) forms

4) submit Notice of Termination (NOT) form

Prior to the issuance of the Notice-to-Proceed, for each erosion control measure identified in the Storm Water Pollution Prevention Plan, the contractor or subcontractor responsible for the control measure(s) must sign the above certification (forms to be provided by the Department).

F. NON-APPROPRIATION CLAUSE

By submitting a bid/proposal under this solicitation the offeror certifies that he/she understands that obligations of the State will cease immediately without penalty or further payment being required in any fiscal year the Illinois General Assembly fails to appropriate or otherwise make available sufficient funds for this contract.

G. Contractor is not delinquent in the payment of any debt to the State (or if delinquent has entered into a deferred payment plan to pay the debt), and Contractor acknowledges the contracting state agency may declare the contract void if this certification is false (30 ILCS 500/50-11, effective July 1, 2002).

RETURN WITH BID

NOTICE TO BIDDERS

1. **TIME AND PLACE OF OPENING BIDS.** Sealed proposals for the improvement described herein will be received by the Department of Transportation at the Harry R. Hanley Building, 2300 South Dirksen Parkway in Springfield, Illinois until 10:00 o'clock a.m., July 30, 2010. All bids will be gathered, sorted, publicly opened and read in the auditorium at the Department of Transportation's Harry R. Hanley Building shortly after the 10:00 a.m. cut off time.

2. **DESCRIPTION OF WORK**. The proposed improvement, shown in detail on the plans issued by the Department includes, in general, the following described work:

   Widen Runway 12R/30L.

3. **INSTRUCTIONS TO BIDDERS**.

   (a) This Notice, the invitation for bids, proposal and award shall, together with all other documents in accordance with Article 10-15 of the Illinois Standard Specifications for Construction of Airports, become part of the contract. Bidders are cautioned to read and examine carefully all documents, to make all required inspections, and to inquire or seek explanation of the same prior to submission of a bid.

   (b) State law, and, if the work is to be paid wholly or in part with Federal-aid funds, Federal law requires the bidder to make various certifications as a part of the proposal and contract. By execution and submission of the proposal, the bidder makes the certification contained therein. A false or fraudulent certification shall, in addition to all other remedies provided by law, be a breach of contract and may result in termination of the contract.

4. **AWARD CRITERIA AND REJECTION OF BIDS**. This contract will be awarded to the lowest responsive and responsible bidder considering conformity with the terms and conditions established by the Department in the proposal and contract documents. The issuance of plans and proposal forms for bidding based upon a prequalification rating shall not be the sole determinant of responsibility. The Department reserves the right to determine responsibility at the time of award, to reject any or all proposals, to readvertise the proposed improvement, and to waive technicalities.

5. **PRE-BID CONFERENCE.** There will be a pre-bid conference held at N/A at the St. Louis Downtown Airport administration building. For engineering information, contact Rob Waller of Hanson Professional Services, Inc. at (217) 788-2450.

6. **DISADVANTAGED BUSINESS POLICY.** The DBE goal for this contract is 10.0%.

7. **SPECIFICATIONS AND DRAWINGS.** The work shall be done in accordance with the Illinois Standard Specifications for Construction of Airports, the Illinois Division of Aeronautics Supplemental Specifications and Recurring Special Provisions, the Special Provisions dated April 16, 2010 and the Construction Plans dated April 16, 2010 as approved by the Department of Transportation, Division of Aeronautics.

8. **INSPECTION OF RECORDS.** The Contractor shall maintain an acceptable cost accounting system. The Sponsor, the FAA, and the Comptroller General of the United States shall have access to any books, documents, paper, and records of the Contractor which are directly pertinent to the specific contract for the purposes of making an audit, examination, excerpts, and transcriptions. The Contractor shall maintain all required records for three years after the Sponsor makes final payment and all other pending matters are closed.

9. **RIGHTS TO INVENTIONS.** All rights to inventions and materials generated under this contract are subject to Illinois law and to regulations issued by the FAA and the Sponsor of the Federal grant under which this contract is executed. Information regarding these rights is available from the FAA and the Sponsor.

10. TERMINATION OF CONTRACT.

1. The Sponsor may, by written notice, terminate this contract in whole or in part at any time, either for the Sponsor's convenience or because of failure to fulfill the contract obligations. Upon receipt of such notice services shall be immediately discontinued (unless the notice directs otherwise) and all materials as may have been accumulated in performing this contract, whether completed or in progress, delivered to the Sponsor.

2. If the termination is for the convenience of the Sponsor, an equitable adjustment in the contract price shall be made, but no amount shall be allowed for anticipated profit on unperformed services.

3. If the termination is due to failure to fulfill the Contractor's obligations, the Sponsor may take over the work and prosecute the same to completion by contract or otherwise. In such case, the Contractor shall be liable to the Sponsor for any additional cost occasioned to the Sponsor thereby.

4. If, after notice of termination for failure to fulfill contract obligations, it is determined that the Contractor had not so failed, the termination shall be deemed to have been effected for the convenience of the Sponsor. In such event, adjustment in the contract price shall be made as provided in paragraph 2 of this clause.

5. The rights and remedies of the sponsor provided in this clause are in addition to any other rights and remedies provided by law or under this contract.

11. BIDDING REQUIREMENTS AND BASIS OF AWARD. When alternates are included in the proposal, the following shall apply:

a. Additive Alternates

(1) Bidders must submit a bid for the Base Bid and for all Additive Alternates.

(2) Award of this contract will be made to the lowest responsible qualified bidder computed as follows:

The lowest aggregate amount of (i) the Base Bid plus (ii) any Additive Alternate(s) which the Department elects to award.

The Department may elect not to award any Additive Alternates. In that case, award will be to the lowest responsible qualified bidder of the Base Bid.

b. Optional Alternates

(1) Bidders must submit a bid for the Base Bid and for either Alternate A or Alternate B or for both Alternate A and Alternate B.

(2) Award of this contract will be made to the lowest responsible qualified bidder computed as follows:

The lower of the aggregate of either (i) the Base Bid plus Alternate A or (ii) the Base Bid plus Alternate B.

12. CONTRACT TIME. The Contractor shall complete all work within the specified contract time. Any calendar day extension beyond the specified contract time must be fully justified, requested by the Contractor in writing, and approved by the Engineer, or be subject to liquidated damages.

The contract time for this contract is 130 calendar days.

13. INDEPENDENT WEIGHT CHECKS. The Department reserves the right to conduct random unannounced independent weight checks on any delivery for bituminous, aggregate or other pay item for which the method of measurement for payment is based on weight. The weight checks will be accomplished by selecting, at random, a loaded truck and obtaining a loaded and empty weight on an independent scale. In addition, the department may perform random weight checks by obtaining loaded and empty truck weights on portable scales operated by department personnel.

14. GOOD FAITH COMPLIANCE. The Illinois Department of Transportation has made a good faith effort to include all statements, requirements, and other language required by federal and state law and by various offices within federal and state governments whether that language is required by law or not. If anything of this nature has been left out or if additional language etc. is later required, the bidder/contractor shall cooperate fully with the Department to modify the contract or bid documents to correct the deficiency. If the change results in increased operational costs, the Department shall reimburse the contractor for such costs as it may find to be reasonable.

15. ADDENDA AND REVISIONS: It is the contractor's responsibility to determine which, if any, addenda or revisions pertain to any project they may be bidding. Failure to incorporate all relevant addenda or revisions may cause the bid to be declared unacceptable.

Each addendum will be placed with the contract number. Addenda and revisions will also be placed on the Addendum/Revision Checklist and each subscription service subscriber will be notified by e-mail of each addendum and revision issued.

The Internet is the Department's primary way of doing business. The subscription server e-mails are an added courtesy the Department provides. It is suggested that the bidder check IDOT's website at http://www.dot.il.gov/desenv/delett.html before submitting final bid information.

IDOT IS NOT RESPONSIBLE FOR ANY E-MAIL RELATED FAILURES.

Technical Questions about downloading these files may be directed to Tim Garman (217)524-1624 or Timothy.Garman@illinois.gov.

RETURN WITH BID

PROPOSAL SIGNATURE SHEET

The undersigned bidder hereby makes and submits this bid on the subject Proposal, thereby assuring the Department that all requirements of the Invitation for Bids and rules of the Department have been met, that there is no misunderstanding of the requirements of paragraph 4 of this Proposal, and that the contract will be executed in accordance with the rules of the Department if an award is made on this bid.

(IF AN INDIVIDUAL)

Firm Name _____

Signature of Owner _____

Business Address _____

(IF A CO-PARTNERSHIP)

Firm Name _____

By _____

Business Address _____

Name and Address of All Members of the Firm:

_____ _____

_____ _____

(IF A CORPORATION)

Corporate Name _____

Corporate Seal

By _____

President

Attest _____

Corporate Secretary

Business Address _____

Name of Corporate Officers:

_____ _____ _____

President Corporate Secretary Treasurer

NOTARY CERTIFICATION

STATE OF ILLINOIS,

ALL SIGNATURES MUST BE NOTARIZED

COUNTY OF _____

I, _____, a Notary Public in and for said county, do hereby certify that _____

_____ AND _____

(Insert names of individual(s) signing on behalf of bidder)

who are each personally known to me to be the same persons whose names are subscribed to the foregoing instrument on behalf of the bidder, appeared before me this day in person and acknowledged that they signed, sealed, and delivered said instrument as their free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notarial seal this _____ day of _____ , A.D. _____

My commission expires _____ _____(Seal)

Notary Public

Illinois Department of Transportation

Return with Bid

Division of Aeronautics
Proposal Bid Bond

Sponsor _____ Item No. _____

IL Proj. No. _____ AIP Proj. No. _____ Letting Date _____

KNOW ALL MEN BY THESE PRESENTS, That We _____

_____

as PRINCIPAL, and _____

_____ as SURETY, are held jointly, severally and firmly bound unto the SPONSOR identified above, in the penal sum of 5 percent of the total bid price, or for the amount specified in Section 6, Proposal Guarantee of the Proposal Document, whichever is the lesser sum, well and truly to be paid unto said SPONSOR, for the payment of which we bind ourselves, our heirs, executors, administrators, successors and assigns.

THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH, that whereas, the PRINCIPAL has submitted a bid proposal to the SPONSOR through its AGENT, the State of Illinois, Department of Transportation, Division of Aeronautics, for the improvement designated by the Transportation Bulletin Item Number and Letting Date indicated above.

NOW, THEREFORE, if the SPONSOR through its AGENT shall accept the bid proposal of the PRINCIPAL; and if the PRINCIPAL shall, and as specified in the bidding and contract documents, submit a DBE Utilization Plan that is accepted and approved by the AGENT; and if, after the award by AGENT on behalf of SPONSOR, the PRINCIPAL shall enter into a contract in accordance with the terms of the bidding and contract documents, including evidence of the required insurance coverages and providing such bond as specified with good and sufficient surety for the faithful performance of such contract and for the prompt payment of labor and material furnished in the prosecution thereof; or if, in the event of the failure of the PRINCIPAL to make the required DBE submission or to enter into such contract and to give the specified bond, the PRINCIPAL pays to the SPONSOR the difference not to exceed the penalty hereof between the amount specified in the bid proposal and such larger amount for which the SPONSOR may contract with another party to perform the work covered by said bid proposal, then this obligation shall be null and void, otherwise, it shall remain in full force and effect.

IN THE EVENT the SPONSOR acting through its AGENT determines the PRINCIPAL has failed to comply with any requirement as set forth in the preceding paragraph, then SURETY shall pay the penal sum to the SPONSOR within fifteen (15) days of written demand therefor. If SURETY does not make full payment within such period of time, the AGENT may bring an action to collect the amount owed. SURETY is liable to the SPONSOR and to the AGENT for all its expenses, including attorney's fees, incurred in any litigation in which SPONSOR or AGENT prevail either in whole or in part.

In TESTIMONY WHEREOF, the said PRINCIPAL and the said SURETY have caused this instrument to be signed by their respective officers _____ day of _____ A.D., _____ .

PRINCIPAL

_____
(Company Name)

By _____
(Signature & Title)

SURETY

_____
(Company Name)

By: _____
(Signature of Attorney-in-Fact)

Notary Certification for Principal and Surety

STATE OF ILLINOIS,
County of _____

I, _____, a Notary Public in and for said County, do hereby certify that

_____ and _____
(Insert names of individuals signing on behalf of PRINCIPAL & SURETY)

who are each personally known to me to be the same persons whose names are subscribed to the foregoing instrument on behalf of PRINCIPAL and SURETY, appeared before me this day in person and acknowledged respectively, that they signed and delivered said instrument as their free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notarial seal this _____ day of _____ A.D. _____

My commission expires _____ _____
Notary Public

In lieu of completing the above section of the Proposal Bid Form, the Principal may file an Electronic Bid Bond. By signing the proposal and marking the check box next to the Signature and Title line below, the Principal is ensuring the identified electronic bid bond has been executed and the Principal and Surety are firmly bound unto the SPONSOR through its AGENT under the conditions of the bid bond as shown above.

Electronic Bid Bond ID#	Company / Bidder Name	Signature and Title
_____	_____	_____

AER 356B (Rev. 05/07/09)

Illinois Department of Transportation

PROPOSALS

for construction work advertised for bids by the
Illinois Department of Transportation

Item No.	Item No.	Item No.

Submitted By:

Name:
Address:
Phone No.

Bidders should affix this form to the front of a 10” x 13” envelope and use that envelope for the submittal of bids. If proposals are mailed, they should be enclosed in a second or outer envelope addressed to:

Engineer of Design and Environment - Room 326
Illinois Department of Transportation
2300 South Dirksen Parkway
Springfield, Illinois 62764

NOTICE

Individual bids, including Bid Bond and/or supplemental information if required, should be securely stapled.

CONTRACTOR OFFICE COPY OF CONTRACT SPECIFICATIONS

NOTICE

None of the following material needs to be returned with the bid package unless the special provisions require documentation and/or other information to be submitted.

Illinois Department of Transportation

SUBCONTRACTOR DOCUMENTATION

P.A. 96-0795, effective July 1, 2010, enacted substantial changes to the provisions of the Illinois Procurement Code (30 ILCS 500). Among the changes are provisions affecting subcontractors. The Contractor awarded this contract will be required as a material condition of the contract to implement and enforce the contract requirements applicable to subcontractors approved in accordance with article 108.01 of the Standard Specifications for Road and Bridge Construction.

If the Contractor seeks approval of subcontractors to perform a portion of the work, and approval is granted by the Department, the Contractor shall provide a copy of the subcontract to the Chief Procurement Officer within 20 calendar days after execution of the subcontract.

The subcontract shall contain the certifications required to be made by subcontractors pursuant to Article 50 of the Illinois Procurement Code. This Notice to Bidders includes a document incorporating all required subcontractor certifications and disclosures for use by the Contractor in compliance with this mandate. The document is entitled State Required Ethical Standards Governing Subcontractors.

RETURN WITH SUBCONTRACT

STATE ETHICAL STANDARDS GOVERNING SUBCONTRACTORS

Article 50 of the Illinois Procurement Code establishes the duty of all State chief procurement officers, State purchasing officers, and their designees to maximize the value of the expenditure of public moneys in procuring goods, services, and contracts for the State of Illinois and to act in a manner that maintains the integrity and public trust of State government. In discharging this duty, they are charged by law to use all available information, reasonable efforts, and reasonable actions to protect, safeguard, and maintain the procurement process of the State of Illinois.

The certifications hereinafter made by the subcontractor are each a material representation of fact upon which reliance is placed should the Department approve the subcontractor. The chief procurement officer may terminate or void the subcontract approval if it is later determined that the bidder or subcontractor rendered a false or erroneous certification.

Section 50-2 of the Illinois Procurement Code provides that every person that has entered into a multi-year contract and every subcontractor with a multi-year subcontract shall certify, by July 1 of each fiscal year covered by the contract after the initial fiscal year, to the responsible chief procurement officer whether it continues to satisfy the requirements of Article 50 pertaining to the eligibility for a contract award. If a contractor or subcontractor is not able to truthfully certify that it continues to meet all requirements, it shall provide with its certification a detailed explanation of the circumstances leading to the change in certification status. A contractor or subcontractor that makes a false statement material to any given certification required under Article 50 is, in addition to any other penalties or consequences prescribed by law, subject to liability under the Whistleblower Reward and Protection Act for submission of a false claim.

A. Bribery

1. The Illinois Procurement Code provides:

Section 50-5. Bribery.

(a) Prohibition. No person or business shall be awarded a contract or subcontract under this Code who:

(1) has been convicted under the laws of Illinois or any other state of bribery or attempting to bribe an officer or employee of the State of Illinois or any other state in that officer's or employee's official capacity; or

(2) has made an admission of guilt of that conduct that is a matter of record but has not been prosecuted for that conduct.

(b) Businesses. No business shall be barred from contracting with any unit of State or local government, or subcontracting under such a contract, as a result of a conviction under this Section of any employee or agent of the business if the employee or agent is no longer employed by the business and:

(1) the business has been finally adjudicated not guilty; or

(2) the business demonstrates to the governmental entity with which it seeks to contract, or which is signatory to the contract to which the subcontract relates, and that entity finds that the commission of the offense was not authorized, requested, commanded, or performed by a director, officer, or high managerial agent on behalf of the business as provided in paragraph (2) of subsection (a) of Section 5-4 of the Criminal Code of 1961.

(c) Conduct on behalf of business. For purposes of this Section, when an official, agent, or employee of a business committed the bribery or attempted bribery on behalf of the business and in accordance with the direction or authorization of a responsible official of the business, the business shall be chargeable with the conduct.

(d) Certification. Every bid submitted to and contract executed by the State, and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the contractor or the subcontractor, respectively, that the contractor or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any certifications required by this Section are false. A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

2. The contractor or subcontractor certifies that it is not barred from being awarded a contract under Section 50.5.

B. Felons

1. The Illinois Procurement Code provides:

Section 50-10. Felons. Unless otherwise provided, no person or business convicted of a felony shall do business with the State of Illinois or any State agency, or enter into a subcontract, from the date of conviction until 5 years after the date of completion of the sentence for that felony, unless no person held responsible by a prosecutorial office for the facts upon which the conviction was based continues to have any involvement with the business.

2. Certification. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder or contractor or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer may declare the related contract void if any of the certifications required by this Section are false.

C. Debt Delinquency

1. The Illinois Procurement Code provides:

Section 50-11 and 50-12. Debt Delinquency.

The contractor or bidder or subcontractor, respectively, certifies that it, or any affiliate, is not barred from being awarded a contract or subcontract under the Procurement Code. Section 50-11 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it knows or should know that it, or any affiliate, is delinquent in the payment of any debt to the State as defined by the Debt Collection Board. Section 50-12 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it, or any affiliate, has failed to collect and remit Illinois Use Tax on all sales of tangible personal property into the State of Illinois in accordance with the provisions of the Illinois Use Tax Act. The bidder or contractor or subcontractor, respectively, further acknowledges that the chief procurement officer may declare the related contract void if this certification is false or if the bidder, contractor, or subcontractor, or any affiliate, is determined to be delinquent in the payment of any debt to the State during the term of the contract.

D. Prohibited Bidders, Contractors and Subcontractors

1. The Illinois Procurement Code provides:

Section 50-10.5 and 50-60(c). Prohibited bidders, contractors and subcontractors.
The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-10.5 that no officer, director, partner or other managerial agent of the contracting business has been convicted of a felony under the Sarbanes-Oxley Act of 2002 or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953 or if in violation of Subsection (c) for a period of five years from the date of conviction.. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Procurement Code shall contain a certification by the bidder, contractor, or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the chief procurement officer shall declare the related contract void if any of the certifications completed pursuant to this Section are false.

E. Section 42 of the Environmental Protection Act

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-12 that the bidder, contractor, or subcontractor, is not barred from being awarded a contract or entering into a subcontract under this Section which prohibits the bidding on or entering into contracts with the State of Illinois or a State agency, or entering into any subcontract, that is subject to the Procurement Code by a person or business found by a court or the Pollution Control Board to have committed a willful or knowing violation of Section 42 of the Environmental Protection Act for a period of five years from the date of the order. The bidder or contractor or subcontractor, respectively, acknowledges that the chief procurement officer may declare the contract void if this certification is false.

The undersigned, on behalf of the subcontracting company, has read and understands the above certifications and makes the certifications as required by law.

_____
Name of Subcontracting Company

_____ _____
Authorized Officer Date

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SUBCONTRACTOR DISCLOSURES

I. DISCLOSURES

A. The disclosures hereinafter made by the subcontractor are each a material representation of fact upon which reliance is placed. The subcontractor further certifies that the Department has received the disclosure forms for each subcontract.

The chief procurement officer may void the bid, contract, or subcontract, respectively, if it is later determined that the bidder or subcontractor rendered a false or erroneous disclosure. A contractor or subcontractor may be suspended or debarred for violations of the Procurement Code. Furthermore, the chief procurement officer may void the contract or subcontract.

B. Financial Interests and Conflicts of Interest

1. Section 50-35 of the Illinois Procurement Code provides that all subcontracts of more than $10,000 shall be accompanied by disclosure of the financial interests of the subcontractor. This disclosed information for the subcontractor, will be maintained as public information subject to release by request pursuant to the Freedom of Information Act, filed with the Procurement Policy Board, and shall be incorporated as a material term of the Prime Contractor's contract. Furthermore, pursuant to this Section, the Procurement Policy Board may recommend to allow or void a contract or subcontract based on a potential conflict of interest.

The financial interests to be disclosed shall include ownership or distributive income share that is in excess of 5%, or an amount greater than 60% of the annual salary of the Governor, of the subcontracting entity or its parent entity, whichever is less, unless the subcontractor is a publicly traded entity subject to Federal 10K reporting, in which case it may submit its 10K disclosure in place of the prescribed disclosure. If a subcontractor is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. The disclosure shall include the names, addresses, and dollar or proportionate share of ownership of each person making the disclosure, their instrument of ownership or beneficial relationship, and notice of any potential conflict of interest resulting from the current ownership or beneficial interest of each person making the disclosure having any of the relationships identified in Section 50-35 and on the disclosure form.

In addition, all disclosures shall indicate any other current or pending contracts, subcontracts, proposals, leases, or other ongoing procurement relationships the subcontracting entity has with any other unit of state government and shall clearly identify the unit and the contract, subcontract, proposal, lease, or other relationship.

2. Disclosure Forms. Disclosure Form A is attached for use concerning the individuals meeting the above ownership or distributive share requirements. Subject individuals should be covered each by one form. In addition, a second form (Disclosure Form B) provides for the disclosure of current or pending procurement relationships with other (non-IDOT) state agencies. **The forms must be included with each bid or incorporated by reference.**

C. Disclosure Form Instructions

Form A Instructions for Financial Information & Potential Conflicts of Interest

If the subcontractor is a publicly traded entity subject to Federal 10K reporting, the 10K Report may be submitted to meet the requirements of Form A. If a subcontractor is a privately held entity that is exempt from Federal 10K reporting, but has more than 400 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. If a subcontractor is not subject to Federal 10K reporting, the subcontractor must determine if any individuals are required by law to complete a financial disclosure form. To do this, the subcontractor should answer each of the following questions. A "YES" answer indicates Form A must be completed. If the answer to each of the following questions is "NO", then the NOT APPLICABLE STATEMENT on the second page of Form A must be signed and dated by a person that is authorized to execute contracts for the subcontracting company. Note: These questions are for assistance only and are not required to be completed.

1. Does anyone in your organization have a direct or beneficial ownership share of greater than 5% of the bidding entity or parent entity? YES _____ NO _____

2. Does anyone in your organization have a direct or beneficial ownership share of less than 5%, but which has a value greater than $106,447.20? YES _____ NO_____

3. Does anyone in your organization receive more than $106,447.20 of the subcontracting entity's or parent entity's distributive income? (Note: Distributive income is, for these purposes, any type of distribution of profits. An annual salary is not distributive income.) YES _____ NO _____

4. Does anyone in your organization receive greater than 5% of the subcontracting entity's or parent entity's total distributive income, but which is less than $106,447.20? YES _____ NO _____

(Note: Only one set of forms needs to be completed per person per subcontract even if a specific individual would require a yes answer to more than one question.)

A "YES" answer to any of these questions requires the completion of Form A. The subcontractor must determine each individual in the subcontracting entity or the subcontracting entity's parent company that would cause the questions to be answered "Yes". Each form must be signed and dated by a person that is authorized to execute contracts for your organization. **Photocopied or stamped signatures are not acceptable**. The person signing can be, but does not have to be, the person for which the form is being completed. The subcontractor is responsible for the accuracy of any information provided.

If the answer to each of the above questions is "NO", then the NOT APPLICABLE STATEMENT on page 2 of Form A must be signed and dated by a person that is authorized to execute contracts for your company.

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Form B: **Instructions for Identifying Other Contracts & Procurement Related Information**

Disclosure Form B must be completed for each subcontract submitted by the subcontracting entity. *Note: Checking the NOT APPLICABLE STATEMENT on Form A does not allow the subcontractor to ignore Form B. Form B must be completed, checked, and dated or the subcontract will not be approved.*

The Subcontractor shall identify, by checking Yes or No on Form B, whether it has any pending contracts, subcontracts, leases, bids, proposals, or other ongoing procurement relationship with any other (non-IDOT) State of Illinois agency. If "No" is checked, the subcontractor only needs to complete the check box on the bottom of Form B. If "Yes" is checked, the subcontractor must list all non-IDOT State of Illinois agency pending contracts, subcontracts, leases, bids, proposals, and other ongoing procurement relationships. These items may be listed on Form B or on an attached sheet(s). Contracts with cities, counties, villages, etc. are not considered State of Illinois agency contracts and are not to be included. Contracts or subcontracts with other State of Illinois agencies such as the Department of Natural Resources or the Capital Development Board must be included.

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ILLINOIS DEPARTMENT OF TRANSPORTATION

Form A
Subcontractor: Financial Information & Potential Conflicts of Interest Disclosure

Subcontractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Code (30 ILCS 500). Subcontractors desiring to enter into a subcontract of a State of Illinois contract must disclose the financial information and potential conflict of interest information as specified in this Disclosure Form. This information shall become part of the publicly available contract file. This Form A must be completed for bids in excess of $10,000, and for all open-ended contracts. **A publicly traded company may submit a 10K disclosure (or equivalent if applicable) in satisfaction of the requirements set forth in Form A. See Disclosure Form Instructions.**

DISCLOSURE OF FINANCIAL INFORMATION

1. Disclosure of Financial Information. The individual named below has an interest in the SUBCONTRACTOR (or its parent) in terms of ownership or distributive income share in excess of 5%, or an interest which has a value of more than $106,447.20 (60% of the Governor's salary as of 7/1/07). **(Make copies of this form as necessary and attach a separate Disclosure Form A for each individual meeting these requirements)**

FOR INDIVIDUAL (type or print information)

NAME: _____

ADDRESS _____

_____

Type of ownership/distributable income share:

stock _____ sole proprietorship _____ Partnership _____ other: (explain on separate sheet):

% or $ value of ownership/distributable income share: _____

2. Disclosure of Potential Conflicts of Interest. Check "Yes" or "No" to indicate which, if any, of the following potential conflict of interest relationships apply. If the answer to any question is "Yes", please attach additional pages and describe.

(a) State employment, currently or in the previous 3 years, including contractual employment of services.
Yes _____ No _____

If your answer is yes, please answer each of the following questions.

1. Are you currently an officer or employee of either the Capitol Development Board or the Illinois Toll Highway Authority? Yes _____ No _____

2. Are you currently appointed to or employed by any agency of the State of Illinois? If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) provide the name the State agency for which you are employed and your annual salary _____
_____

3. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of the salary of the Governor? Yes _____ No _____

4. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 2 times the salary of the Governor? Yes _____ No _____

(b) State employment of spouse, father, mother, son, or daughter, including contractual employment services in the previous 2 years. Yes _____ No _____

If your answer is yes, please answer each of the following questions.

1. Is your spouse or any minor children currently an officer or employee of the Capitol Development Board or the Illinois Toll Highway Authority? Yes _____ No _____

2. Is your spouse or any minor children currently appointed to or employed by any agency of the State of Illinois? If your spouse or minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds $106,447.20, (60 % of the Governor's salary as of 7/1/07) provide the name of your spouse and/or minor children, the name of the State agency for which he/she is employed and his/her annual salary. _____
   _____

3. If your spouse or any minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds $106,447.20, (60% of the salary of the Governor as of 7/1/07) are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of the salary of the Governor? Yes _____ No _____

4. If your spouse or any minor children are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds $106,447.20, (60% of the Governor's salary as of 7/1/07) are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 2 times the salary of the Governor? Yes _____ No _____

(c) Elective status; the holding of elective office of the State of Illinois, the government of the United States, any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois currently or in the previous 3 years. Yes _____ No _____

(d) Relationship to anyone holding elective office currently or in the previous 2 years; spouse, father, mother, son, or daughter. Yes _____ No _____

(e) Appointive office; the holding of any appointive government office of the State of Illinois, the United States of America, or any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois, which office entitles the holder to compensation in excess of the expenses incurred in the discharge of that office currently or in the previous 3 years. Yes _____ No _____

(f) Relationship to anyone holding appointive office currently or in the previous 2 years; spouse, father, mother, son, or daughter. Yes _____ No _____

(g) Employment, currently or in the previous 3 years, as or by any registered lobbyist of the State government. Yes _____ No _____

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(h) Relationship to anyone who is or was a registered lobbyist in the previous 2 years; spouse, father, mother, son, or daughter. Yes _____ No _____

(i) Compensated employment, currently or in the previous 3 years, by any registered election or reelection committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes _____ No _____

(j) Relationship to anyone; spouse, father, mother, son, or daughter; who was a compensated employee in the last 2 years by any registered election or re-election committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes _____ No _____

APPLICABLE STATEMENT

This Disclosure Form A is submitted on behalf of the INDIVIDUAL named on previous page. Under penalty of perjury, I certify the contents of this disclosure to be true and accurate to the best of my knowledge.

Completed by: ☐ _____ _____
Signature of Individual or Authorized Officer Date

NOT APPLICABLE STATEMENT

Under penalty of perjury, I have determined that no individuals associated with this organization meet the criteria that would require the completion of this Form A.

This Disclosure Form A is submitted on behalf of the SUBCONTRACTOR listed on the previous page.

☐ _____ _____
Signature of Authorized Officer Date

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ILLINOIS DEPARTMENT OF TRANSPORTATION

Form B
Subcontractor: Other Contracts & Procurement Related Information Disclosure

Subcontractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Illinois Procurement Act (30 ILCS 500). This information shall become part of the publicly available contract file. This Form B must be completed for bids in excess of $10,000, and for all open-ended contracts.

DISCLOSURE OF OTHER CONTRACTS, SUBCONTRACTS, AND PROCUREMENT RELATED INFORMATION

1. Identifying Other Contracts & Procurement Related Information. The SUBCONTRACTOR shall identify whether it has any pending contracts, subcontracts, including leases, bids, proposals, or other ongoing procurement relationship with any other State of Illinois agency: Yes _____ No _____
If "No" is checked, the subcontractor only needs to complete the signature box on the bottom of this page.

2. If "Yes" is checked. Identify each such relationship by showing State of Illinois agency name and other descriptive information such as bid or project number (attach additional pages as necessary). SEE DISCLOSURE FORM INSTRUCTIONS:

THE FOLLOWING STATEMENT MUST BE CHECKED

☐ _____ _____
Signature of Authorized Officer Date

(1) Airport Improvement Program projects. The work in this contract is included in the federal Airport Improvement Program and is being undertaken and accomplished by the Illinois Department of Transportation, Division of Aeronautics and the Municipality, hereinafter called the Co-Sponsors, in accordance with the terms and conditions of a Grant Agreement between the Co-Sponsors and the United States, under the Airport and Airway Improvement Act of 1982 (Public Law 97-248; Title V, Section 501 et seq., September 3, 1982; 96 Stat. 671; codified at 49 U.S.C Section 2201 et seq.) and Part 152 of the Federal Aviation Regulations (14 CFR Part 152), pursuant to which the United States has agreed to pay a certain percentage of the costs of the Project that are determined to be allowable Project costs under the Act. The United States is not a party to this contract and no reference in this contract to FAA or representative thereof, or to any rights granted to the FAA or any representative thereof, or the United States, by the contract, makes the United States a party to this contract.

(2) Consent of Assignment. The Contractor shall obtain the prior written consent of the Co-Sponsors to any proposed assignment of any interest in or part of this contract.

(3) Convict Labor. No convict labor may be employed under this contract.

(4) Veterans Preference. In the employment of labor, except in executive, administrative, and supervisory positions, preference shall be given to veterans of the Vietnam era and disabled veterans as defined in Section 515(c) of the Airport and Airway Improvement Act of 1982. However, this preference shall apply only where the individuals are available and qualified to perform the work to which the employment relates.

(5) Withholding: Sponsor from Contractor. Whether or not payments or advances to the Co-Sponsors are withheld or suspended by the FAA, the Co-Sponsors may withhold or cause to be withheld from the Contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics employed by the Contractor or any subcontractor on the work the full amount of wages required by this contract.

(6) Nonpayment of Wages. If the Contractor or subcontractor fails to pay any laborer or mechanic employed or working on the site of the work any of the wages required by this contract the Co-Sponsors may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment or advance of funds until the violations cease.

(7) FAA Inspection and Review. The Contractor shall allow any authorized representative of the FAA to inspect and review any work or materials used in the performance of this contract.

(8) Subcontracts. The Contractor shall insert in each of his subcontracts the provisions contained in Paragraphs (1), (3), (4), (5), (6), and (7) above and also a clause requiring the subcontractors to include these provisions in any lower tier subcontracts which they may enter into, together with a clause requiring this insertion in any further subcontracts that may in turn be made.

(9) Contract Termination. A breach of Paragraph (6), (7), and (8) above may be grounds for termination of the contract.

PROVISIONS REQUIRED BY THE REGULATIONS
OF THE SECRETARY OF LABOR
29 CFR 5.5

(a) Contract Provisions and Related Matters.

(1) Minimum Wages.

Revised 1/92

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provision of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in paragraph 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefor only when the following criteria have been met:

(1)The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2)The classification is utilized in the area by the construction industry; and

(3)The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(ii)(B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB control number 1215-0140).

(ii)(C) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB control number 1215-0140).

(ii)(D) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(B) or (C) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided, that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB control number 1215-0140).

(2) Withholding. The Federal Aviation Administration shall upon its own action or written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such work, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs. (Approved by the Office Management and Budget under OMB control numbers 1215-0140 and 1215-0017).

(ii)(A) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the Federal Aviation Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph 5.5(a)(3)(i) of Regulations, 29 CFR Part 5. This information may be submitted in any form desired.

Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime Contractor is responsible for the submission of copies of payrolls by all subcontractors. (Approved by the Office of Management and Budget under OMB control number 1215-0149).

(ii)(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor, or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be maintained under paragraph 5.5(a)(3)(i) of Regulations, 29 CFR Part 5 and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed as specified in the applicable wage determination incorporated into the contract.

(ii)(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(ii)(D) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The Contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the (write the name of the agency) or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and Trainees

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as a apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a Contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage

determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ration permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contract will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(5) Compliance with Copeland Act requirements. The Contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The Contractor or subcontractor shall insert in any subcontracts the clauses contained in paragraph (a)(1) through (10) of this contract and such other clauses as the Federal Aviation Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for the compliance by an subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract determination: debarment. A breach of these contract clauses paragraphs (a)(1) through (10) and the 2nd clause (b)(1) through (5) below may be grounds for termination of the contract and for debarment as a Contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by referenced in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of Eligibility.

(i) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(b) Contract Work Hours and Safety Standards Act. The Agency Head shall cause or require the contracting officer to insert the following clauses set forth in paragraphs (b)(1), (2), (3), (4) and (5) of this section in full in AIP construction contracts in excess of $2,000. These clauses shall be inserted in addition to the clauses required by paragraph 5.5(a) or paragraph 4.6 of Part 4 of this title. As used in this paragraph, the terms "laborers" and "mechanics" include watchmen and guards.

(1) Overtime requirements: No Contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers, mechanics, watchmen or guards (including apprentices and trainees described in paragraphs 5 and 6 above) shall require or permit any laborer, mechanic, watchman or guard in any workweek in which he/she is employed on such work, to work in excess of 40 hours in such workweek unless such laborer, mechanic, watchman or guard receives compensation at a rate not less than one and one-half times his/her basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(2) Violations: Liability for Unpaid Wages; Liquidated Damages: In the event of any violation of the clause set forth in subparagraph (1) of this paragraph, the Contractor and any subcontractor responsible therefore shall be liable to any affected employee for his/her unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer, mechanic, watchman or guard employed in violation of the clause set forth in subparagraph (1) of this paragraph, in the sum of $10.00 for each calendar day on which such employee was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in subparagraph (1) of this paragraph.

(3) Withholding for unpaid wages and liquidated damages. The (write in the name of the Federal agency or the loan or grant recipient) shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor

under any such contract or any other Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in subparagraph (2) of this paragraph.

(4) Subcontracts. The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph (1) through (4) of this paragraph and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in subparagraphs (1) through (4) of this paragraph.

(5) Working Conditions. No Contractor or subcontractor may require any laborer or mechanic employed in the performance of any contract to work in surroundings or under working conditions that are unsanitary, hazardous, or dangerous to his health or safety as determined under construction safety and health standards (29 CFR 1926) issued by Department of Labor.

(c) In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in paragraph 5.1, the Agency Head shall cause or require the contracting officer to insert a clause requiring that the Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency Head shall cause or require the contracting officer to insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the Contractor or subcontractor will permit such representatives to interview employees during working hours on the job. (Approved by the Office of Management and Budget under OMB control numbers 1215-0140 and 1215-0017).

FEDERAL REGULATIONS VOL. 40, #74,
WEDNESDAY, APRIL 16, 1975, PAGE 17124,
ADMINISTRATION OF THE CLEAR AIR ACT
& WATER POLLUTION CONTROL ACT
(with respect to Federal Grants)

In connection with the administration of the Clean Air Act and the Water Pollution Control Act with respect to Federal Grants, specific requirements have been imposed of any contract which is not exempt under the provisions of 40 CFR 15.5.

(1) Any facility listed on the EPA List of Violating Facilities pursuant to Paragraph 15.20 of 40 CFR as of the date of the contract award will not be utilized in the performance of any non-exempt contract or subcontract.

(2) The Contractor shall comply with all the requirements of Section 114 of the Clean Air Act, as amended, 42 USC 1857 et seq. and Section 308 of the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq. relating to inspection, monitoring, entry, reports and information, as well as all other requirements specified in Section 114 and Section 308 of the Air Act and Water Act, respectively, and all regulations and guidelines issued thereunder after the award of the contract.

(3) Prompt notification shall be required prior to contract award to the awarding official by the Contractor who will receive the award of the receipt of any communication from the Director, Office of Federal Activities, U.S. Environmental Protection Agency, indicating that a facility to be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

(4) The Contractor shall include or cause to be included the criteria and requirements in paragraphs 1 through 4 in any non-exempt subcontract and will take such action as the Government may direct as a means of enforcing such provisions.

Attachment No. 1

During the performance of the contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on the behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

(3) The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or worker's representatives of the Contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(5) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of 24 September 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of 24 September 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.

(7) The Contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of 24 September 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event a Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

ATTACHMENT NO. 2

EACH PRIME CONTRACTOR SHALL INSERT IN EACH SUBCONTRACT THE CERTIFICATION IN APPENDIX B, AND FURTHER, SHALL REQUIRE ITS INCLUSION IN ANY LOWER TIER SUBCONTRACT, PURCHASE ORDER, OR TRANSACTION THAT MAY IN TURN BE MADE.

- Appendix B of 49 CFR Part 29 -

This certification applies to subcontractors, material suppliers, vendors and other lower tier participants.

Appendix B--Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Covered Transactions

Instructions for Certification

1. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.

2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

3. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

4. The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction, "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

5. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

6. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.

8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Covered Transactions

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

STATE REQUIRED CONTRACT PROVISIONS

ALL FEDERAL-AID CONSTRUCTION CONTRACTS

Effective February 1, 1969
Revised January 2, 1973

The following provisions are State of Illinois requirements and are in addition to the Federal requirements.

"EQUAL EMPLOYMENT OPPORTUNITY"

In the event of the Contractor's noncompliance with any provisions of this Equal Employment Opportunity Clause, the Illinois Fair Employment Practices Act or the Fair Employment Practices Commission's Rules and Regulations for Public Contracts, the Contractor may be declared nonresponsible and therefore ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and the contract may be canceled or avoided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute or regulation.

During the performance of this contract, the Contractor agrees as follows:

(1) That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin or ancestry; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization.

(2) That, if it hires additional employees in order to perform this contract or any portion hereof, it will determine the availability (in accordance with the Commission's Rules and Regulations for Public Contracts) of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.

(3) That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, national origin or ancestry.

(4) That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the Contractors obligations under the Illinois Fair Employment Practices Act and the Commission's Rules and Regulations for Public Contracts. If any such labor organization or representative fails or refuses to cooperate with the Contractor in its efforts to comply with such Act and Rules and Regulations, the Contractor will promptly so notify the Illinois Fair Employment Practices Commission and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations thereunder.

(5) That it will submit reports as required by the Illinois Fair Employment Practices Commission's Rules and Regulations for Public Contracts, furnish all relevant information as may from time to time be requested by the Commission or the contracting agency, and in all respects comply with the Illinois Fair Employment Practices Act and the Commission's Rules and Regulations for Public Contracts.

(6) That it will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency and the Illinois Fair Employment Practices Commission for purposes of investigation to ascertain compliance with the Illinois Fair Employment Practices Act and the Commission's Rules and Regulations for Public Contracts.

(7) That it will include verbatim or by reference the provisions of paragraphs 1 through 7 of this clause in every performance subcontract as defined in Section 2.10(b) of the Commission's Rules and Regulations for Public Contracts so that such provisions will be binding upon every subcontractor; and that it will also so include the provisions or paragraphs 1, 5, 6 and 7 in every supply subcontract as defined in Section 2.10(a) of the Commission's Rules and Regulations for Public Contracts so that such provisions will be binding upon every such subcontractor. In the same manner as with other provisions of this contract, the Contractor will be liable for compliance with applicable provisions of this clause by all its subcontractors; and further it will promptly notify the contracting agency and the Illinois Fair Employment Practices Commission in the event any subcontractor fails or refuses to comply therewith. In addition, no Contractor will utilize any subcontractor declared by the Commission to be nonresponsible and therefore ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.

CONSTRUCTION CONTRACT PROCUREMENT POLICIES

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SECTION 1

PROPOSAL REQUIREMENTS AND CONDITIONS

1-01 ADVERTISEMENT (Notice to Bidders). The State of Illinois shall publish the advertisement at such places and at such times as are required by local law or ordinances. The published advertisement shall state the time and place for submitting sealed proposals; a description of the proposed work; instructions to bidders as to obtaining proposal forms, plans, and specifications; proposal guaranty required; and the Owner's right to reject any and all bids.

For Federally assisted contracts the advertisement shall conform to the requirements of local laws and ordinances pertaining to letting of contracts and, in addition, shall conform to the requirements of the appropriate parts of the Federal Aviation Regulations applicable to the particular contract being advertised.

1-02 PREQUALIFICATION OF BIDDERS.

(a) When the awarding authority is the State of Illinois, each prospective bidder, prior to being considered for issuance of any proposal forms will be required to file, on forms furnished by the Department, an experience questionnaire and a confidential financial statement in accordance with the Department's Instructions for Prequalification of Contractors. The Statement shall include a complete report of the prospective bidder's financial resources and liabilities, equipment, past record and personnel, and must be submitted at least thirty (30) days prior to the scheduled opening of bids in which the Contractor is interested.

After the Department has analyzed the submitted "Contractor's Statement of Experience and Financial Condition" and related information and has determined appropriate ratings, the Department will issue to the Contractor a "Certificate of Eligibility". The Certificate will permit the Contractor to obtain proposal forms and plans for any Department of Transportation letting on work which is within the limits of the Contractor's potential as indicated on his "Certificate of Eligibility", subject to any limitations due to present work under contract or pending award as determined from the Contractor's submitted "Affidavit of Availability". Bidders intending to consistently submit proposals shall submit a "Contractor's Statement of Experience and Financial Condition" at least once a year. However, prequalification may be changed during that period upon the submission of additional favorable reports or upon reports of unsatisfactory performance.

Before a proposal is issued, the prospective bidder will be required to furnish an "Affidavit of Availability" indicating the location and amount of all uncompleted work under contract, or pending award, either as principal or subcontractor, as well as a listing of all subcontractors and value of work sublet to others. The prospective bidder may be requested to file a statement showing the amount and condition of equipment which will be available.

Before an award is made, the bidder may be required to furnish an outline of his plans for conducting the work.

(b) When the awarding authority for contract construction work is the County Board of a county; the Council, the City Council, or the President and Board of Trustees of a city, village or town, each prospective bidder, in evidence of his competence, shall furnish the awarding authority as a prerequisite to the release of proposal forms by the awarding authority, a certified or photostatic copy of a "Certificate of Eligibility" issued by the Department of Transportation, in accordance with Section 1-02(a).

The two low bidders must file within 24 hours after the letting a sworn affidavit, in triplicate, showing all uncompleted contracts awarded to them and all low bids pending award for Federal, State, County, Municipal and private work, using the blank form made available for this affidavit. One copy shall be filed with the awarding authority and two copies with the District Highway Office.

1-03 CONTENTS OF PROPOSAL FORMS. Upon request, the Department will furnish the prequalified bidders a proposal form. This form will state the location and description of the contemplated construction and will show the estimate of the various quantities and kinds of work to be performed or materials to be furnished, and will have a schedule of items for which unit bid prices are invited. The proposal form will state the time in which work must be completed, the amount of the proposal guaranty, labor requirements, and date, time and place of the opening of proposals. The form will also include any special provisions or requirements which vary from or are not contained in these specifications.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted. Any addenda officially issued by the Department, will be considered a part of the proposal whether attached or not.

For Federally assisted contracts, the proposal shall conform to the requirements of local laws and ordinances pertaining to letting of contracts and, in addition, shall conform to the requirements of the appropriate parts of the Federal Aviation Regulations pertaining to the particular contract being let.

1-04 ISSUANCE OF PROPOSAL FORMS. The Department shall refuse to issue a proposal form for any of the following reasons:

(a) Lack of competency and adequate machinery, plant and other equipment, as revealed by the financial statement and experience questionnaires required under Section 1-02(a).
(b) Uncompleted work which, in the judgment of the Department, might hinder or prevent the prompt completion of additional work if awarded.
(c) False information provided on a bidder's "Affidavit of Availability".
(d) Failure to pay, or satisfactorily settle, all bills due for labor and material on former contracts in force at the time of issuance of proposal forms.
(e) Failure to comply with any prequalification regulations of the Department.
(f) Default under previous contracts.
(g) Unsatisfactory performance record as shown by past work for the Department, judged from the standpoint of workmanship and progress.
(h) When the Contractor is suspended from eligibility to bid at a public letting where the contract is awarded by, or require approval of, the Department.
(i) When any agent, servant, or employee of the prospective bidder currently serves as a member, employee, or agent of a governmental body that is financially involved in the proposed work.
(j) When any agent, servant, or employee of the prospective bidder has participated in the preparation of plans or specifications for the proposed work.

1-05 INTERPRETATION OF QUANTITIES IN BID SCHEDULE. An estimate of quantities of work to be done and materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the contract. The Owner does not expressly or by implication agree that the actual quantities involved will correspond exactly therewith; nor shall the bidder plead misunderstanding or deception because of such estimates of quantities, or of the character, location, or other conditions pertaining to the work. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the plans and specifications. It is understood that the quantities may be increased or decreased as provided in the subsection titled ALTERATION OF WORK AND QUANTITIES of Section 20 of the Illinois Standard Specifications for Construction of Airports without in any way invalidating the unit bid prices.

1-06 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE. The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and contract forms. He shall satisfy himself as to the character, quality, and quantities of work to be performed, materials to be furnished, and as to the requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the proposed contract, plans, and specifications.

Boring logs, underground utilities and other records of subsurface investigations and tests are available for inspection of bidders. It is understood and agreed that such subsurface information, whether included in the plans, specifications, or otherwise made available to the bidder, was obtained and is intended for the Owner's design and estimating purposes only. Such information has been made available for the convenience of all bidders. It is further understood and agreed that each bidder is solely responsible for all assumptions, deductions, or conclusions which he may make or obtain from his examination of the boring logs and other records of subsurface investigations and tests that are furnished by the Owner.

1-07 PREPARATION OF THE PROPOSAL. The bidder shall submit his proposal on the form furnished by the Department. The proposal shall be executed property, and bids shall be made for all items indicated in the proposal form, except that when alternate bids are asked, a bid on more than one alternate for each item is not required, unless otherwise provided. The bidder shall indicate, in figures, a unit price for each of the separate items called for in the proposal; he shall show the products of the respective quantities and unit prices in the column provided for that purpose, and the gross sum shown in the place indicated in the proposal shall be the summation of said products. All writing shall be with ink or typewriter, except the signature of the bidder which shall be written with ink.

If the proposal is made by an individual, his name and business address shall be shown. If made by a firm or partnership, the name and business address of each member of the firm or partnership shall be shown. If made by a corporation, the proposal shall show the names, titles, and business address of the president, secretary, and treasurer, and the seal of the corporation shall be affixed and attested by the secretary.

The proposal shall be issued to a prequalified bidder in the same name and style as the financial statement used for prequalification and shall be submitted in like manner.

1-08 REJECTION OF PROPOSALS. The Department reserves the right to reject proposals for any of the conditions in Article 1-04 or for any of the following reasons:

(a) More than one proposal for the same work from an individual, firm, partnership, or corporation under the same or different names.
(b) Evidence of collusion among bidders.
(c) Unbalanced proposals in which the prices for some items are obviously out of proportion to the prices for other items.
(d) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items or lump sum pay items.
(e) If the proposal is other than that furnished by the Department; or if the form is altered or any part thereof is detached.
(f) If there are omissions, erasures, alterations, unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning.
(g) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.
(h) If the proposal is not accompanied by the proper proposal guaranty.
(i) If the proposal is prepared with other than ink or typewriter.
(j) If the proposal is submitted in any other name other than that to whom it was issued by the Department.

1-09 PROPOSAL GUARANTY. Each Proposal shall be accompanied by either a bid bond on the Department of Transportation, Division of Aeronautics form contained in the proposal, executed by a corporate surety company satisfactory to the Department or by a bank cashier's check or a properly certified check for not less than 5 percent of the amount bid.

Bank cashier's checks, or properly certified checks accompanying proposals shall be made payable to the Treasurer, State of Illinois.

1-10 DELIVERY OF PROPOSALS. Each proposal should be submitted in a special envelope furnished by the Department. The blank spaces on the envelope shall be filled in correctly to clearly indicate its contents. When an envelope other than the special one furnished by the Department is used, it shall be of the same general size and shape and be similarly marked to clearly indicate its contents. When sent by mail, the sealed proposal shall be addressed to the Department at the address and in care of the official in whose office the bids are to be received. All proposals shall be filed prior to the time and place specified in the Notice to Bidders. Proposals received after the time for opening of bids will be returned to the bidder unopened.

1-11 WITHDRAWAL OF PROPOSALS. Permission will be given a bidder to withdraw a proposal if he makes his request in writing or by telegram before the time for opening proposals. If a proposal is withdrawn, the bidder will not be permitted to resubmit this proposal at the same letting. With the approval of the Engineer, a bidder may withdraw a proposal and substitute a new proposal prior to the time of opening bids.

1-12 PUBLIC OPENING OF PROPOSALS. Proposals will be opened and read publicly at the time and place specified in the Notice to Bidders. Bidders, their authorized agents, and other interested parties are invited to be present.

1-13 DISQUALIFICATION OF BIDDERS. A bidder shall be considered disqualified for any of the following reasons:

(a) Submitting more than one proposal from the same partnership, firm, or corporation under the same or different name.

(b) Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the Owner.

(c) If the bidder is considered to be in "default" for any reason specified in the Subsection 1-04 titled ISSUANCE OF PROPOSAL FORMS of this section.

1-14 WORKER'S COMPENSATION INSURANCE. Prior to the approval of his contract by the Division, the Contractor shall furnish to the Division certificates of insurance covering Worker's Compensation, or satisfactory evidence that this liability is otherwise taken care of in accordance with Section 4.(a) of the "Worker's Compensation Act of the State of Illinois" as amended.

SECTION 2

AWARD AND EXECUTION OF CONTRACT

2-01 CONSIDERATION OF PROPOSALS. After the proposals are publicly opened and read, they will be compared on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the proposal by the unit bid prices. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern.

Until the award of a contract is made, the Owner reserves the right to reject a bidder's proposal for any of the following reasons:

(a) If the proposal is irregular as specified in the subsection titled REJECTION OF PROPOSALS of Section 1.

(b) If the bidder is disqualified for any of the reasons specified in the subsection titled DISQUALIFICATION OF BIDDERS of Section 1.

In addition, until the award of a contract is made, the Owner reserves the right to reject any or all proposals; waive technicalities, if such waiver is in the best interest of the Owner and is in conformance with applicable State and Local laws or regulations pertaining to the letting of construction contracts; advertise for new proposals; or proceed with the work otherwise.

2-02 AWARD OF CONTRACT. The award of contract will be made within 60 calendar days after the opening of proposals to the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed. The successful bidder will be notified by letter, that his bid has been accepted, and that he has been awarded the contract.

If a contract is not awarded within 60 days after the opening of proposals, a bidder may file a written request with the Division for the withdrawal of his bid and the Division will permit such withdrawal.

For Federally assisted contracts, unless otherwise specified in this subsection, no award shall be made until the Division has concurred in the Owner's recommendation to make such award and has approved the Owner's proposal contract to the extent that such concurrence and approval are required by Federal Regulations.

2-03 CANCELLATION OF AWARD. The Division reserves the right to cancel the award without liability to the bidder at any time before a contract has been fully executed by all parties and is approved by the Owner in accordance with the subsection titled APPROVAL OF CONTRACT of this section. The Division at the time of cancellation will return the proposal guaranty.

2-04 RETURN OF PROPOSAL GUARANTY. The proposal guaranties of all except the two lowest bidders will be returned promptly after the proposals have been checked, tabulated, and the relation of the proposals established. Proposal guaranties of the two lowest bidders will be returned as soon as the Construction Contract, Performance Bonds, and Payment Bonds of the successful bidder have been properly executed and approved.

If any other form of proposal guaranty is used, other than a bid bond, a bid bond may be substituted at the Contractor's option.

2-05 REQUIREMENT OF PERFORMANCE AND PAYMENT BONDS. The successful bidder for a contract, at the time of the execution of the contract, shall deposit with the Division separate performance and payment bonds each for the full amount of the contract. The form of the bonds shall be that furnished by the Division, and the sureties shall be acceptable to the Division.

2-06 EXECUTION OF CONTRACT. The successful bidder shall sign (execute) the Contract and shall return the signed Contract to the Owner (Sponsor) for signature (execution) and subsequently return all copies to the Division. The fully executed surety bonds specified in the subsection title REQUIREMENTS OF PERFORMANCE AND PAYMENT BONDS of this section will be forwarded to the Division within 15 days of the date mailed or otherwise delivered to the successful bidder. If the Contract and Bonds are mailed, special handling is recommended.

If the bidder to whom award is to be made is a corporation organized under the laws of a State other than Illinois, the bidder shall furnish the Division a copy of the corporation's certificate of authority to do business in the State of Illinois, or provide evidence of the same, with the return of the executed contract and bond. Failure to furnish such evidence of a certificate of authority within the time required will be considered as just cause for the annulment of the award and the forfeiture of the proposal guaranty to the State, not as a penalty, but in payment of liquidated damages sustained as a result of such failure.

2-07 APPROVAL OF CONTRACT. Upon receipt of the contract and bonds that have been executed by the successful bidder, the Owner shall complete the execution of the contract in accordance with local laws or ordinances, and return the contract to the Division for approval and execution by the Division. Delivery of the fully executed contract to the Contractor shall constitute the Department's approval to be bound by the successful bidder's proposal and the terms of the contract.

2-08 FAILURE TO EXECUTE CONTRACT. If the contract is not executed by the Division within 15 days following receipt from the bidder of the properly executed contracts and bonds, the bidder shall have the right to withdraw his bid without penalty.

Failure of the successful bidder to execute the contract and file acceptable bonds within 15 days after the contract has been mailed to him shall be just cause for the cancellation of the award and the forfeiture of the proposal guaranty which shall become the property of the State, not as a penalty, but as liquidation of damages sustained.

ILLINOIS DEPARTMENT OF TRANSPORTATION

DIVISION OF AERONAUTICS

The requirements of the following provisions written for Federally-assisted construction contracts, including all goals and timetables and affirmative action steps, shall also apply to all State-funded construction contracts awarded by the Illinois Department of Transportation.

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

APPENDIX A

The following goal for female utilization in each construction craft and trade shall apply to all Contractors holding Federal and federally assisted construction contracts and subcontracts in excess of $10,000. The goal is applicable to the Contractor's total on-site construction workforce, regardless of whether or not part of that workforce is performing work on a Federal, federally assisted or nonfederally related construction contact or subcontract.

AREA COVERED (STATEWIDE)

Goals for Women apply nationwide.

GOAL

	Goal (percent)
Female Utilization.....	6.9

APPENDIX B

Until further notice, the following goals for minority utilization in each construction craft and trade shall apply to all Contractors holding Federal and federally-assisted construction contracts and subcontracts in excess of $10,000. to be performed in the respective geographical areas. The goals are applicable to the Contractor's total on-site construction workforce, regardless of whether or not part of that workforce is performing work on a Federal, federally-assisted or nonfederally related construction contract or subcontract.

Economic Area	Goal (percent)
056 Paducah, KY: Non-SMSA Counties - IL - Hardin, Massac, Pope KY - Ballard, Caldwell, Calloway, Carlisle, Crittenden, Fulton, Graves, Hickman, Livingston, Lyon, McCracken, Marshall	5.2
080 Evansville, IN: Non-SMSA Counties - IL - Edwards, Gallatin, Hamilton, Lawrence, Saline, Wabash, White IN - Dubois, Knox, Perry, Pike, Spencer KY - Hancock, Hopkins, McLean, Mublenberg, Ohio, Union, Webster	3.5

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Economic Area	Goal (percent)
081 Terre Haute, IN:	
Non-SMSA Counties -	2.5
IL - Clark, Crawford	
IN - Parke	
083 Chicago, IL:	
SMSA Counties:	19.6
1600 Chicago, IL -	
IL - Cook, DuPage, Kane, Lake, McHenry, Will	
3740 Kankakee, IL -	9.1
IL - Kankakee	
Non-SMSA Counties	18.4
IL - Bureau, DeKalb, Grundy, Iroquois, Kendall, LaSalle, Livingston, Putnam	
IN - Jasper, Laporte, Newton, Pulaski, Starke	
084 Champaign - Urbana, IL:	
SMSA Counties:	
1400 Champaign - Urbana - Rantoul, IL -	7.8
IL - Champaign	
Non-SMSA Counties -	4.8
IL - Coles, Cumberland, Douglas, Edgar, Ford, Piatt, Vermilion	
085 Springfield - Decatur, IL:	
SMSA Counties:	
2040 Decatur, IL -	7.6
IL - Macon	
7880 Springfield, IL -	4.5
IL - Mendard, Sangamon	
Non-SMSA Counties	4.0
IL - Cass, Christian, Dewitt, Logan, Morgan, Moultrie, Scott, Shelby	
086 Quincy, IL:	
Non-SMSA Counties	3.1
IL - Adams, Brown, Pike	
MO - Lewis, Marion, Pike, Ralls	
087 Peoria, IL:	
SMSA Counties:	
1040 Bloomington - Normal, IL -	2.5
IL - McLean	
6120 Peoria, IL -	4.4
IL - Peoria, Tazewell, Woodford	
Non-SMSA Counties -	3.3
IL - Fulton, Knox, McDonough, Marshall, Mason, Schuyler, Stark, Warren	

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Economic Area	Goal (percent)
088 Rockford, IL:	
SMSA Counties:	
6880 Rockford, IL - IL - Boone, Winnebago	6.3
Non-SMSA Counties - IL - Lee, Ogle, Stephenson	4.6
098 Dubuque, IA:	
Non-SMSA Counties - IL - JoDaviess IA - Atlamakee, Clayton, Delaware, Jackson, Winnesheik WI - Crawford, Grant, Lafayette	0.5
099 Davenport, Rock Island, Moline, IA - IL:	
SMSA Counties:	
1960 Davenport, Rock Island, Moline, IA - IL - IL - Henry, Rock Island IA - Scott	4.6
Non-SMSA Counties - IL - Carroll, Hancock, Henderson, Mercer, Whiteside IA - Clinton, DesMoines, Henry, Lee, Louisa, Muscatine MO - Clark	3.4
107 St. Louis, MO:	
SMSA Counties:	
7040 St. Louis, MO - IL - IL - Clinton, Madison, Monroe, St. Clair MO - Franklin, Jefferson, St. Charles, St. Louis, St. Louis City	14.7
Non-SMSA Counties - IL - Alexander, Bond, Calhoun, Clay, Effingham, Fayette, Franklin, Greene, Jackson, Jasper, Jefferson, Jersey, Johnson, Macoupin, Marion, Montgomery, Perry, Pulaski, Randolph, Richland, Union, Washington, Wayne, Williamson MO - Bollinger, Butler, Cape Girardeau, Carter, Crawford, Dent, Gasconade, Iron, Lincoln, Madison, Maries, Mississippi, Montgomery, Perry, Phelps, Reynolds, Ripley, St. Francois, St. Genevieve, Scott, Stoddard, Warren, Washington, Wayne	11.4

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The Contractor's compliance with Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the provisions and specifications set forth in its federally assisted contracts, and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Illinois Division of Aeronautics will provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction contract and/or subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. This notification will list the name, address and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the contract is to be performed.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is the entire State of Illinois for the goal set forth in APPENDIX A and the county or counties in which the work is located for the goals set forth in APPENDIX B.

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STANDARD FEDERAL EQUAL EMPLOYMENT
OPPORTUNITY CONSTRUCTION CONTRACT
SPECIFICATIONS (EXECUTIVE ORDER 11246)

1. As used in these specifications:
   a) "Covered area" means the geographical area described in the solicitation from which this contract resulted;
   b) "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
   c) "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941;
   d) "Minority" includes:
      (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
      (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
      (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
      (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000. the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction Contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

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7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a) Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working as such sites or in such facilities.

b) Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c) Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractors may have taken.

d) Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e) Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f) Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreements; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g) Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foreman, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h) Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

i) Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship of other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

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j) Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's workforce.

k) Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m) Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o) Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction Contractors and suppliers, including circulation of solicitations to minority and female Contractor associations and other business associations.

p) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a Contractor association, joint Contractor-union, Contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specified minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

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14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy his requirement, Contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

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ANNUAL EEO-1 REPORT TO JOINT REPORTING COMMITTEE AS REQUIRED AT

41 CFR 60-1.7(a)

Any Contractor having a Federal contract of $50,000 or more and 50 or more employees is required to file annual compliance reports on Standard Form 100 (EEO-1) with the Joint Reporting Committee in accordance with the instructions provided with the form. The Contractor will provide a copy of such a report to the contracting agency within 30 days after the award of a contract.

The Contractor shall require its subcontractors to file an SF 100 within 30 days after award of the subcontract if (1) it is not exempt from the provisions of these regulations in accordance with 60-1.5, (2) has 50 or more employees, (3) first tier subcontractor, and (4) has a subcontract amounting to $50,000 or more.

Subcontractors below the first tier which perform construction work at the site of construction shall be required to file such a report if (1) it is not exempt from the provisions of these regulations in accordance with 60-1.5, (2) has 50 or more employees and has a subcontract amounting to $50,000 or more.

The SF 100 is available at the following address:

Joint Reports Committee
EEOC - Survey Division
1801 "L" Street N.W.
Washington, D.C. 20750

Phone (202) 663-4968

DISADVANTAGED BUSINESS POLICY

I. NOTICE

This proposal contains the special provision entitled “Required Disadvantaged Business Participation.” Inclusion of this Special Provision in this contract satisfies the obligations of the Department of Transportation under federal law as implemented by 49 CFR 23 and under the Illinois “Minority and Female Business Enterprise Act.”

II. POLICY

It is public policy that the businesses defined in 49 CFR Part 23 shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with State or Federal funds. Consequently, the requirements of 49 CFR Part 23 apply to this contract.

III. OBLIGATION

The Contractor agrees to ensure that the businesses defined in 49 CFR Part 23 have the maximum opportunity to participate in the performance of this contract. In this regard, the Contractor shall take all necessary and reasonable steps, in accordance with 49 CFR Part 23, to ensure that the said businesses have the maximum opportunity to compete for and perform portions of this contract. The Contractor shall not discriminate on the basis of race, color, national origin, or sex in the selection and retention of subcontractors, including procurement of materials and leases of equipment.

The Contractor shall include the above Policy and Obligation statements of this Special Provision in every subcontract, including procurement of materials and leases of equipment.

IV. DBE/WBE CONTRACTOR FINANCE PROGRAM

On contracts where a loan has been obtained through the DBE/WBE Contractor Finance Program, the Contractor shall cooperate with the Department by making all payments due to the DBE/WBE Contractor by means of a two-payee check payable to the Lender (Bank) and the Borrower (DBE/WBE Contractor).

V. BREACH OF CONTRACT

Failure to carry out the requirements set forth above and in the Special Provision shall constitute a breach of contract and may result in termination of the contract or liquidated damages as provided in the special provision.

(Rev. 9/21/92)

State of Illinois
Department of Transportation

SPECIAL PROVISION
FOR
DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
Effective: September 1, 2000
Revised: January 1, 2010

FEDERAL OBLIGATION: The Department of Transportation, as a recipient of federal financial assistance, is required to take all necessary and reasonable steps to ensure nondiscrimination in the award and administration of contracts. Consequently, the federal regulatory provisions of 49 CFR part 26 apply to this contract concerning the utilization of disadvantaged business enterprises. For the purposes of this Special Provision, a disadvantaged business enterprise (DBE) means a business certified by the Department in accordance with the requirements of 49 CFR part 26 and listed in the Illinois Unified Certification Program (IL UCP) DBE Directory

STATE OBLIGATION. This Special Provision will also be used by the Department to satisfy the requirements of the Business Enterprise for Minorities, Females, and Persons with Disabilities Act, 30 ILCS 575. When this Special Provision is used to satisfy state law requirements on 100 percent state-funded contracts, the federal government has no involvement in such contracts (not a federal-aid contract) and no responsibility to oversee the implementation of this Special Provision by the Department on those contracts. DBE participation on 100 percent state-funded contracts will not be credited toward fulfilling the Department's annual overall DBE goal required by the US Department of Transportation to comply with the federal DBE program requirements.

CONTRACTOR ASSURANCE: The Contractor makes the following assurance and agrees to include the assurance in each subcontract that the Contractor signs with a subcontractor:

The Contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of contracts funded in whole or in part with federal or state funds. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate.

OVERALL GOAL SET FOR THE DEPARTMENT: As a requirement of compliance with 49 CFR part 26, the Department has set an overall goal for DBE participation in its federally assisted contracts. That goal applies to all federal-aid funds the Department will expend in its federally assisted contracts for the subject reporting fiscal year. The Department is required to make a good faith effort to achieve the overall goal. The dollar amount paid to all approved DBE companies performing work called for in this contract is eligible to be credited toward fulfillment of the Department's overall goal.

CONTRACT GOAL TO BE ACHIEVED BY THE CONTRACTOR: This contract includes a specific DBE utilization goal established by the Department. The goal has been included because the Department has determined that the work of this contract has subcontracting opportunities that may be suitable for performance by DBE companies. This determination is based on an assessment of the type of work, the location of the work, and the availability of DBE companies to do a part of the work. The assessment indicates that, in the absence of unlawful discrimination, and in an arena of fair and open competition, DBE companies can be expected to perform **10.0%** of the work. This percentage is set as the DBE participation goal for this contract. Consequently, in addition to the other award criteria established for this contract, the Department will only award this contract to a bidder who makes a good faith effort to meet this goal of DBE participation in the performance of the work. A bidder makes a good faith effort for award consideration if either of the following is done in accordance with the procedures set forth in this Special Provision:

(a) The bidder documents that enough DBE participation has been obtained to meet the goal; or

(b) The bidder documents that a good faith effort has been made to meet the goal, even though the effort did not succeed in obtaining enough DBE participation to meet the goal.

DBE LOCATOR REFERENCES: Bidders may consult the IL UCP DBE Directory as a reference source for DBE-certified companies. In addition, the Department maintains a letting and item specific DBE locator information system whereby DBE companies can register their interest in providing quotes on particular bid items advertised for letting. Information concerning DBE companies willing to quote work for particular contracts may be obtained by contacting the Department's Bureau of Small Business Enterprises at telephone number (217)785-4611, or by visiting the Department's web site at www.dot.il.gov.

BIDDING PROCEDURES. Compliance with this Special Provision is a material bidding requirement. The failure of the bidder to comply will render the bid not responsive.

(a) The bidder shall submit a Disadvantaged Business Utilization Plan on Department forms SBE 2025 and 2026 with the bid.

(b) The Utilization Plan shall indicate that the bidder either has obtained sufficient DBE participation commitments to meet the contract goal or has not obtained enough DBE participation commitments in spite of a good faith effort to meet the goal. The Utilization Plan shall further provide the name, telephone number and telefax number of a responsible official of the bidder designated for purposes of notification of plan approval or disapproval under the procedures of this Special Provision.

(c) The Utilization Plan shall include a DBE Participation Commitment Statement, Department form SBE 2025, for each DBE proposed for the performance of work to achieve the contract goal. For bidding purposes, submission of the completed SBE 2025 forms, signed by the DBEs and faxed to the bidder will be acceptable as long as the original is available and provided upon request. All elements of information indicated on the said form shall be provided, including but not limited to the following:

(1) The name and address of DBE firms that will participate in the contract;

(2) A description, including pay item numbers, of the work each DBE will perform;

(3) The dollar amount of the participation of each DBE firm participating. The dollar amount of participation for identified work shall specifically state the quantity, unit price and total subcontract price for the work to be completed by the DBE. If partial pay items are to be performed by the DBE, indicate the portion of each item, a unit price where appropriate and the subcontract price amount;

(4) DBE Participation Commitment Statements, form SBE 2025, signed by the bidder and each participating DBE firm documenting the commitment to use the DBE subcontractors whose participation is submitted to meet the contract goal;

(5) If the bidder is a joint venture comprised of DBE companies and non-DBE companies, the plan must also include a clear identification of the portion of the work to be performed by the DBE partner(s); and,

(6) If the contract goal is not met, evidence of good faith efforts.

GOOD FAITH EFFORT PROCEDURE. The contract will not be awarded until the Utilization Plan submitted by the apparent successful bidder is approved. All information submitted by the bidder must be complete, accurate and adequately document the good faith efforts of the bidder before the Department will commit to the performance of the contract by the bidder. The Utilization Plan will be approved by the Department if the Utilization Plan commits sufficient commercially useful DBE work performance to meet the contract goal or the bidder submits sufficient documentation of a good faith effort to meet the contract goal pursuant to 49 CFR part 26, Appendix A.

The Utilization Plan will not be approved by the Department if the Utilization Plan does not commit sufficient DBE participation to meet the contract goal unless the apparent successful bidder documented in the Utilization Plan that it made a good faith effort to meet the goal. This means that the bidder must show that all necessary and reasonable steps were taken to achieve the contract goal. Necessary and reasonable steps are those which, by their scope, intensity and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if they were not successful. The Department will consider the quality, quantity, and intensity of the kinds of efforts that the bidder has made. Mere *pro forma* efforts, in other words, efforts done as a matter of form, are not good faith efforts; rather, the bidder is expected to have taken genuine efforts that would be reasonably expected of a bidder actively and aggressively trying to obtain DBE participation sufficient to meet the contract goal.

(a) The following is a list of types of action that the Department will consider as part of the evaluation of the bidder's good faith efforts to obtain participation. These listed factors are not intended to be a mandatory checklist and are not intended to be exhaustive. Other factors or efforts brought to the attention of the Department may be relevant in appropriate cases, and will be considered by the Department.

(1) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBE companies that have the capability to perform the work of the contract. The bidder must solicit this interest within sufficient time to allow the DBE companies to respond to the solicitation. The bidder must determine with certainty if the DBE companies are interested by taking appropriate steps to follow up initial solicitations.

(2) Selecting portions of the work to be performed by DBE companies in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into

economically feasible units to facilitate DBE participation, even when the prime Contractor might otherwise prefer to perform these work items with its own forces.

(3) Providing interested DBE companies with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(4) a. Negotiating in good faith with interested DBE companies. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBE companies that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBE companies to perform the work.

b. A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBE companies is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable.

Also, the ability or desire of a bidder to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidders are not, however, required to accept higher quotes from DBE companies if the price difference is excessive or unreasonable.

(5) Not rejecting DBE companies as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

(6) Making efforts to assist interested DBE companies in obtaining bonding, lines of credit, or insurance as required by the recipient or Contractor.

(7) Making efforts to assist interested DBE companies in obtaining necessary equipment, supplies, materials, or related assistance or services.

(8) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBE companies.

(b) If the Department determines that the apparent successful bidder has made a good faith effort to secure the work commitment of DBE companies to meet the contract goal, the Department will award the contract provided that it is otherwise eligible for award. If the Department determines that the bidder has failed to meet the requirements of this Special Provision and that a good faith effort has not been made, the Department will notify the responsible company official designated in the Utilization Plan that the bid is not responsive. The notification shall include a statement of reasons why good faith efforts have not been found.

(c) The bidder may request administrative reconsideration of a determination adverse to the bidder within the five working days after receipt of the notification date of the determination by delivering the request to the Department of Transportation, Bureau of Small Business Enterprises, Contract Compliance Section, 2300 South Dirksen Parkway, Room 319, Springfield, Illinois 62764 (Telefax: (217)785-1524). Deposit of the request in the United States mail on or before the fifth business day shall not be deemed delivery. The determination shall become final if a request is not made and delivered. A request may provide additional written documentation and/or argument concerning the issue of whether an adequate good faith effort was made to meet the contract goal. The request will be forwarded to the Department's Reconsideration Officer. The Reconsideration Officer will extend an opportunity to the bidder to meet in person in order to consider all issues of whether the bidder made a good faith effort to meet the goal. After the review by the Reconsideration Officer, the bidder will be sent a written decision within ten working days after receipt of the request for reconsideration, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. A final decision by the Reconsideration Officer that a good faith effort was made shall approve the Utilization Plan submitted by the bidder and shall clear the contract for award. A final decision that a good faith effort was not made shall render the bid not responsive.

CALCULATING DBE PARTICIPATION. The Utilization Plan values represent work anticipated to be performed and paid for upon satisfactory completion. The Department is only able to count toward the achievement of the overall goal and the contract goal the value of payments made for the work actually performed by DBE companies. In addition, a DBE must perform a commercially useful function on the contract to be counted. A commercially useful function is generally performed when the DBE is responsible for the work and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. The Department and Contractor are governed by the provisions of 49 CFR part 26.55(c) on

questions of commercially useful functions as it affects the work. Specific counting guidelines are provided in 49 CFR part 26.55, the provisions of which govern over the summary contained herein.

(a) DBE as the Contractor: 100 percent goal credit for that portion of the work performed by the DBE's own forces, including the cost of materials and supplies. Work that a DBE subcontracts to a non-DBE does not count toward the DBE goals.

(b) DBE as a joint venture Contractor: 100 percent goal credit for that portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work performed by the DBE's own forces.

(c) DBE as a subcontractor: 100 percent goal credit for the work of the subcontract performed by the DBE's own forces, including the cost of materials and supplies, excluding the purchase of materials and supplies or the lease of equipment by the DBE subcontractor from the prime Contractor or its affiliates. Work that a DBE subcontractor in turn subcontracts to a non-DBE does not count toward the DBE goal.

(d) DBE as a trucker: 100 percent goal credit for trucking participation provided the DBE is responsible for the management and supervision of the entire trucking operation for which it is responsible. At least one truck owned, operated, licensed, and insured by the DBE must be used on the contact. Credit will be given for the following:

(1) The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.

(2) The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission it receives as a result of the lease arrangement.

(e) DBE as a material supplier:

(1) 60 percent goal credit for the cost of the materials or supplies purchased from a DBE regular dealer.

(2) 100 percent goal credit for the cost of materials or supplies obtained from a DBE manufacturer.

(3) 100 percent credit for the value of reasonable fees and commissions for the procurement of materials and supplies if not a regular dealer or manufacturer.

CONTRACT COMPLIANCE. Compliance with this Special Provision is an essential part of the contract. The Department is prohibited by federal regulations from crediting the participation of a DBE included in the Utilization Plan toward either the contract goal or the Department's overall goal until the amount to be applied toward the goals has been paid to the DBE. The following administrative procedures and remedies govern the compliance by the Contractor with the contractual obligations established by the Utilization Plan. After approval of the Utilization Plan and award of the contract, the Utilization Plan and individual DBE Participation Statements become part of the contract. If the Contractor did not succeed in obtaining enough DBE participation to achieve the advertised contract goal, and the Utilization Plan was approved and contract awarded based upon a determination of good faith, the total dollar value of DBE work calculated in the approved Utilization Plan as a percentage of the awarded contract value shall become the amended contract goal.

(a) No amendment to the Utilization Plan may be made without prior written approval from the Department's Bureau of Small Business Enterprises. All requests for amendment to the Utilization Plan shall be submitted to the Department of Transportation, Bureau of Small Business Enterprises, Contract Compliance Section, 2300 South Dirksen Parkway, Room 319, Springfield, Illinois 62764. Telephone number (217) 785-4611. Telefax number (217) 785-1524.

(b) The Contractor must notify and obtain written approval from the Department's Bureau of Small Business Enterprises prior to replacing a DBE or making any change in the participation of a DBE. Approval for replacement will be granted only if it is demonstrated that the DBE is unable or unwilling to perform. The Contractor must make every good faith effort to find another certified DBE subcontractor to substitute for the original DBE. The good faith efforts shall be directed at finding another DBE to perform at least the same amount of work under the contract as the original DBE, to the extent needed to meet the contract goal.

(c) Any deviation from the DBE condition-of-award or contract specifications must be approved, in writing, by the Department. The Contractor shall notify affected DBEs in writing of any changes in the scope of work which result in a reduction in the dollar amount condition-of-award to the contract.

(d) In addition to the above requirements for reductions in the condition of award, additional requirements apply to the two cases of Contractor-initiated work substitution proposals. Where the contract allows alternate work methods which serve to delete or create underruns in condition of award DBE work, and the Contractor selects that alternate

method or, where the Contractor proposes a substitute work method or material that serves to diminish or delete work committed to a DBE and replace it with other work, then the Contractor must demonstrate one of the following:

(1) That the replacement work will be performed by the same DBE (as long as the DBE is certified in the respective item of work) in a modification of the condition of award; or

(2) That the DBE is aware that its work will be deleted or will experience underruns and has agreed in writing to the change. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so; or

(3) That the DBE is not capable of performing the replacement work or has declined to perform the work at a reasonably competitive price. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so.

(e) Where the revision includes work committed to a new DBE subcontractor, not previously involved in the project, then a Request for Approval of Subcontractor, Department form BC 260A, must be signed and submitted.

(f) If the commitment of work is in the form of additional tasks assigned to an existing subcontract, than a new Request for Approval of Subcontractor shall not be required. However, the Contractor must document efforts to assure that the existing DBE subcontractor is capable of performing the additional work and has agreed in writing to the change.

(g) All work indicated for performance by an approved DBE shall be performed, managed, and supervised by the DBE executing the Participation Statement. The Contractor shall not terminate for convenience a DBE listed in the Utilization Plan and then perform the work of the terminated DBE with its own forces, those of an affiliate or those of another subcontractor, whether DBE or not, without first obtaining the written consent of the Bureau of Small Business Enterprises to amend the Utilization Plan. The Contractor shall notify the Bureau of Small Business Enterprises of any termination for reasons other than convenience, and shall obtain approval for inclusion of the substitute DBE in the Utilization Plan. If good faith efforts following a termination of a DBE for cause are not successful, the Contractor shall contact the Bureau of Small Business Enterprises and provide a full accounting of the efforts undertaken to obtain substitute DBE participation. The Bureau of Small Business Enterprises will evaluate the good faith efforts in light of all circumstances surrounding the performance status of the contract, and determine whether the contract goal should be amended.

(h) The Contractor shall maintain a record of payments for work performed to the DBE participants. The records shall be made available to the Department for inspection upon request. After the performance of the final item of work or delivery of material by a DBE and final payment therefore to the DBE by the Contractor, but not later than thirty calendar days after payment has been made by the Department to the Contractor for such work or material, the Contractor shall submit a DBE Payment Agreement on Department form SBE 2115 to the Regional Engineer. If full and final payment has not been made to the DBE, the DBE Payment Agreement shall indicate whether a disagreement as to the payment required exists between the Contractor and the DBE or if the Contractor believes that the work has not been satisfactorily completed. If the Contractor does not have the full amount of work indicated in the Utilization Plan performed by the DBE companies indicated in the Utilization Plan and after good faith efforts are reviewed, the Department may deduct from contract payments to the Contractor the amount of the goal not achieved as liquidated and ascertained damages. The Contractor may request an administrative reconsideration of any amount deducted as damages pursuant to subsection (j) of this part.

(i) The Department reserves the right to withhold payment to the Contractor to enforce the provisions of this Special Provision. Final payment shall not be made on the contract until such time as the Contractor submits sufficient documentation demonstrating achievement of the goal in accordance with this Special Provision or after liquidated damages have been determined and collected.

(j) Notwithstanding any other provision of the contract, including but not limited to Article 109.09 of the Standard Specifications, the Contractor may request administrative reconsideration of a decision to deduct the amount of the goal not achieved as liquidated damages. A request to reconsider shall be delivered to the Contract Compliance Section and shall be handled and considered in the same manner as set forth in paragraph (c) of “Good Faith Effort Procedures” of this Special Provision, except a final decision that a good faith effort was not made during contract performance to achieve the goal agreed to in the Utilization Plan shall be the final administrative decision of the Department.

Certification of Nonsegregated Facilities - as Required by 41 CFR 60-1.8

(Applicable to (1) contracts, (2) subcontracts, and (3) agreements with applicants who are themselves performing federally assisted construction contracts, exceeding $10,000.00 which are not exempt from the provisions of the Equal Opportunity clause).

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments and that that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of his certification is a violation of the Equal opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000.00 which are not exempt from the provisions of the Equal Opportunity clause; that he will retain such certifications in his files and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding $10,000.00 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C 1001.

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
Instructions for Certification

1. By signing and submitting this proposal, the prospective primary participant is providing the certification set out below.

2. The inability of a person to provide the certification required below will not necessarily result in denial of participation in this covered transaction. The prospective participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective primary participant to furnish a certification or an explanation shall disqualify such person from participation in this transaction.

3. The certification in this clause is a material representation of fact upon which reliance was placed when the department or agency determined to enter into this transaction. If it is later determined that the prospective primary participant knowingly rendered an erroneous certification in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause of default.

4. The prospective primary participant shall provide immediate written notice to the department or agency to whom this proposal is submitted if at any time the prospective primary participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

5. The terms "covered transaction" "debarred" "suspended" "ineligible" "lower tier covered transaction" "participant" "person" "primary covered transaction" "principal" "proposal" and "voluntarily excluded" as used in this clause have the meaning set out in the Definitions and Coverage sections of the rules implementing Executive Order 12540. You may contact the department or agency to which this proposal is being submitted for assistance in obtaining a copy of those regulations.

6. The prospective primary participant agrees by submitting this proposal that should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction unless authorized by the department or agency entering into this transaction.

7. The prospective primary participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Transaction", provided by the department or agency entering into this covered transaction without modification in all lower covered transactions and in all solicitations for lower covered transactions.

8. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to check the Nonprocurement List (Tel. #).

9. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

10. Except for transactions authorized under paragraph 8 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

Certification Regarding Debarment, Suspension, and
Other Responsibility Matters - Primary Covered Transactions

1. The prospective primary participant certifies to the best of its knowledge and belief that it and its principals:

   a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by an Federal department or agency;

   b. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain or performing a public (Federal, State or Local) transaction or contract under a public transaction: violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction or destruction of records, making false statements, or receiving stolen property;

   c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

   d. Have not within a three-period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

2. Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

CERTIFICATION REGARDING LOBBYING (Applicable to contracts in excess of $100,000):

Certification for Contracts, Grants, Loans and Cooperative Agreements.

The undersigned bidder certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have paid or will be paid, by or behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an Officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, “Disclosure Form to Report Lobbying”, in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

WORKERS' COMPENSATION INSURANCE

Prior to the execution of his construction contract by the Illinois Department of Transportation, Division of Aeronautics, hereinafter referred to as "Division", the Contractor shall furnish to the Division certificates of insurance covering Workers' Compensation, or satisfactory evidence that this liability is otherwise taken care of in accordance with Section 4.(a) of the "Workers' Compensation Act of the State of Illinois" as amended.

Such insurance, or other means of protection as herein provided, shall be kept in force until all work to be performed under the terms of the contract has been completed and accepted in accordance with the specifications, and it is hereby understood and agreed that the maintenance of such insurance or other protection, until acceptance of the work by the Division is a part of the contract. Failure to maintain such insurance, cancellation by the Industrial Commission of its approval of such other means of protection as might have been elected, or any other act which results in lack of protection under the said "Workers' Compensation Act" may be considered as a breach of the contract.

SPECIAL PROVISION FOR DOMESTIC SOURCE FOR STEEL

Control of Materials: All steel products, as defined by the Illinois Steel Products Procurement Act, incorporated into this project shall be manufactured or produced in the United States and, in addition, shall be domestically fabricated. The Contractor shall obtain from the steel producer and/or fabricator, in addition to the mill analysis, a certification that all steel products meet these domestic source requirements.

CLAUSE TO BE INCLUDED IN ALL SOLICITATIONS,
CONTRACTS, AND SUBCONTRACTS RESULTING FROM PROJECTS FUNDED UNDER THE AIP

The Contractor or subcontractor, by submission of an offer and/or execution of a contract, certifies that it:

a. is not owned or controlled by one or more citizens or nationals of a foreign country included in the list of countries that discriminate against U.S. firms published by the Office of the United States Trade Representative (USTR);

b. has not knowingly entered into any contract or subcontract for this project with a Contractor that is a citizen or national of a foreign country on said list, or is owned or controlled directly or indirectly by one or more citizens or nationals of a foreign country on said list.

c. has not procured any product nor subcontracted for the supply of any product for use on the project that is produced in a foreign country on said list.

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to a Contractor or subcontractor who is unable to certify to the above. If the Contractor knowingly procures or subcontracts for the supply of any product or service of a foreign country on the said list for use on the project, the Federal Aviation Administration may direct, through the sponsor, cancellation of the contract at no cost to the Government.

Further, the Contractor agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in each contract and in all lower tier subcontracts. The Contractor may rely upon the certification of a prospective subcontractor unless it has knowledge that the certification is erroneous.

The Contractor shall provide immediate written notice to the sponsor if the Contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The subcontractor agrees to provide immediate written notice to the Contractor, if at any time it learns that its certification was erroneous by reason of changed circumstances.

This certification is a material representation of fact upon which reliance was placed when making the award. If it is later determined that the Contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct, through this sponsor, cancellation of the contract or subcontract for default at no cost to the Government.

Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a Contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

MINIMUM WAGES FOR FEDERAL AND FEDERALLY ASSISTED CONSTRUCTION CONTRACTS

This project is funded, in part, with Federal-aid funds and, as such, is subject to the provisions of the Davis-Bacon Act of March 3, 1931, as amended (46 Sta. 1494, as amended, 40 U.S.C. 276a) and of other Federal statutes referred to in a 29 CFR Part 1, Appendix A, as well as such additional statutes as may from time to time be enacted containing provisions for the payment of wages determined to be prevailing by the Secretary of Labor in accordance with the Davis-Bacon Act and pursuant to the provisions of 29 CFR Part 1. The prevailing rates and fringe benefits shown in the General Wage Determination Decisions issued by the U.S. Department of Labor shall, in accordance with the provisions of the foregoing statutes, constitute the minimum wages payable on Federal and federally assisted construction projects to laborers and mechanics of the specified classes engaged on contract work of the character and in the localities described therein.

General Wage Determination Decisions, modifications and supersedes decisions thereto are to be used in accordance with the provisions of 29 CFR Parts 1 and 5. Accordingly, the applicable decision, together with any modifications issued, must be made a part of every contract for performance of the described work within the geographic area indicated as required by an applicable DBRA Federal prevailing wage law and 29 CFR Part 5. The wage rates and fringe benefits contained in the General Wage Determination Decision shall be the minimum paid by contractors and subcontractors to laborers and mechanics.

NOTICE

The most current **General Wage Determination Decisions** (wage rates) are available on the IDOT web site. They are located on the Letting and Bidding page at http://www.dot.state.il.us/desenv/delett.html.

In addition, ten (10) days prior to the letting, the applicable Federal wage rates will be e-mailed to subscribers. It is recommended that all contractors subscribe to the Federal Wage Rates List or the Contractor's Packet through IDOT's subscription service.

PLEASE NOTE: if you have already subscribed to the Contractor's Packet you will automatically receive the Federal Wage Rates.

The instructions for subscribing are at http://www.dot.state.il.us/desenv/subsc.html.

If you have any questions concerning the wage rates, please contact IDOT's Chief Contract Official at 217-782-7806.

1A

SECTION III

SAINT LOUIS DOWNTOWN AIRPORT

CAHOKIA, ST. CLAIR COUNTY, ILLINOIS

WIDEN RUNWAY 12R/30L

ILLINOIS PROJECT NO. CPS-3906

AIP PROJECT NO. 3-17-0039-B22

Prepared by

HANSON

Hanson Professional Services Inc.

APRIL 16, 2010

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APPENDIX D – FAA-E-982j, Dated May 6, 2003, U. S. DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION SPECIFICATION, PAR-56 LAMPHOLDER

FOREW0RD

These Special Provisions, together with applicable Standard Specifications for Construction of Airports, Rules and Regulations, Contract Requirements for Airport Improvement Projects, Payroll Requirements, and Minimum Wage Rates, which are hereto attached or which by reference are herein incorporated, cover the requirements of the State of Illinois, Department of Transportation (IDOT), Division of Aeronautics (Division) for the following improvement project at Saint Louis Downtown Airport, St. Clair County, Illinois including:

SCOPE OF WORK

The scope of work shall consist of widening Runway 12R/30L from 100' to 150' and the removal of Taxiway B2, including pavement removal, grading, paving, lighting, and marking. Associated work includes the installation of navigational aids (PAPI), adjustment of existing airport homerun cable, reconstruction of the MALSR threshold lights, and improvement to the electrical vault.

GOVERNING SPECIFICATIONS AND RULES AND REGULATIONS

The Standard Specifications for Construction of Airports, State of Illinois Department of Transportation, Division of Aeronautics, adopted November 02, 2009, shall govern the project, except as otherwise revised or noted in these Special Provisions. All references to IDOT Specifications refer to Standard Specifications for Road and Bridge Construction, Illinois Department of Transportation, adopted January 1, 2007, as revised. In the event of inconsistencies between the Standard Specifications and the Special Provisions, the Special Provisions shall govern.

DIVISION I

SECTION 50
LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

50-21 Environmental Protection. Add the following to this section:

> "The Contractor will be required to minimize air pollution from dust by watering disturbed areas at whatever frequency is necessary in order to control the creation of airborne dust. The furnishing and distribution of the water will be considered as an incidental item to the contract, and no additional compensation will be allowed."

SPECIAL CONSIDERATION SECTION
ADD THE FOLLOWING SPECIAL SECTIONS
HAUL ROUTE AND EQUIPMENT PARKING

The Contractor will use only the designated haul routes and equipment parking area shown on Sheet No. 5 of the Construction Plans. The Contractor's men and equipment shall not traverse outside the designated work areas to other locations on the Airport. The designated haul routes will be the only vehicular access to the construction site.

Because of the high requirements for airport security and safety, the following requirements must be adhered to:

All employees of the Contractor shall park their personal vehicles in the area as shown on Sheet No. 5 of the Construction Plans. The Contractor will transport the workers from the parking areas to the work area. Only Contractor vehicles will be allowed outside of the proposed parking and equipment storage while within the airport fence perimeter.

The Contractor will use the designated equipment parking and material storage area as shown on Sheet No. 5 of the Construction Plans. This area will be maintained throughout the duration of the construction project. At the conclusion of the project the Contractor will return this area to its original condition. The area will be seeded and mulched in accordance with items 901 and 908, where applicable. In agricultural areas the compacted soil from the construction and parking traffic will be loosed to a depth no less than 18 inches and lightly graded, and all debris removed. The restoration of this area will be considered as incidental to AR150540 Haul Route and no additional compensation will be allowed.

The Contractor will be required to be in two-way radio contact (121.8 MHz) with the Airport's Ground Control system. This will keep the Contractor in contact with Airport personnel and enable the Airport personnel to immediately contact the Contactor in case of an aeronautical emergency that would require action by the Contractor and/or his personnel.

The Contractor will restore the haul route and equipment parking area upon completion of the project, as defined in the Special Provision for AR150540.

Failure to use the prescribed haul route and equipment parking area or adhere to the safety requirements will result in the suspension of work.

SCHEDULING OF OPERATIONS

The Contractor shall coordinate all work on this project with the Resident Engineer, Project Engineer and the Airport Director to insure that the construction will cause the least amount of inconvenience possible to normal airport activity. A sequencing plan has been provided within the Plans, Sheet 6. The Resident Engineer shall coordinate all NOTAM's with the Airport

Director. Runway 12R/30L shall not be closed until all electrical material and equipment necessary to complete the proposed improvements is procured and stored on site.

The Contractor will be required to submit a project work schedule to the State of Illinois, Division, and to the Resident Engineer showing proposed sequences of work.

In the event that other construction projects are in progress at the Airport at the same time as this project, the Contractor will be required to cooperate with all other Contractors and the Airport Director in the coordination of the work.

The Airport Director will at all times have jurisdiction over the safety of air traffic during construction. Whenever the safety of air traffic during construction is concerned, his decision as to methods, procedures, and measures used shall be final, and any and all Contractors performing work must be governed by such decisions.

The Contractor shall not be entitled to any extra compensation due to delays or inconveniences caused by said necessary methods, procedures, and measures to protect air traffic.

CONTRACTOR IDENTIFICATION

The Contractor shall be responsible for providing the workers with some type of tag or garment to identify the person as being part of the construction crew.

SITE INSPECTION

The Contractor shall be responsible for an on-site inspection prior to submitting a bid on this project. **Upon receipt of a bid, it shall be assumed that the Contractor is familiar with the proposed construction site.**

ITEM AR108
INSTALLATION OF UNDERGROUND CABLE FOR AIRPORTS

DESCRIPTION

108-1.1. Add the following to this section:

"This Item of work shall consist of the installation (plowing, trenching, directional-boring, or installing in ducts or raceways) of cable for airfield lighting circuits and/or navaid circuits on the runways and taxiways and the associated homeruns at the locations shown on the Plans and in accordance with these Specifications. This Item shall include cable in unit duct where noted on the Plans and specified herein.

In areas where there is a congestion of buried cable or where the proposed cable crosses an existing cable, the Contractor will be required to trench the proposed cable into place. In all other areas, the Contractor has the option to either trench or plow the proposed cable in unit duct into place. The trenching or plowing of this cable will be considered incidental to the contract unit price of the proposed cable and no additional compensation will be allowed.

When crossing existing circuits, the Contractor will be required to hand dig the trenches for the proposed cable."

108-1.2 REFERENCES.

A. ASTM Specification B3 – Standard Specification for Soft or Annealed Copper Wire.

B. ASTM Specification B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. Federal Specification A-A-59544 Cable and Wire, Electrical (Power, Fixed Installation).

D. FAA-C-1391b U.S. Department of Transportation Federal Aviation Administration, Specification, INSTALLATION AND SPLICING OF UNDERGROUND CABLES.

E. FAA AC No. 150/5345-7E, (or latest edition) "SPECIFICATIONS FOR L-824 UNDERGROUND ELECTRICAL CABLE FOR AIRPORT LIGHTING CIRCUITS.

F. FAA AC No. 150/5345-53 "AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM" (most current issue) and AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum.

G. NFPA 70 – National Electrical Code (most current issue in force).

H. UL Standard 44 – Thermoset-Insulated Wires and Cables.

I. UL Standard 83 – Thermoplastic-Insulated Wires and Cables.

J. UL Standard 854 – Service Entrance Cables.

108-1.3 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for each wire, conductor, and/or cable type to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials, the Contractor shall furnish complete statements to the Project Engineer as to the origin, composition, and manufacturer of all material to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

C. Indicate the pay item number for each respective cable and/or cable in unit duct.

D. Shop drawings shall include wire/conductor/cable cut sheets with type, size, specifications, ETL or UL listing, manufacturer, and catalog or part number.

E. Shop drawings for cable in unit duct items shall include cut sheets with type, size, specifications, ETL or UL listing, manufacturer, and catalog or part number for the respective unit duct.

F. Where cable is required to have colored coded insulation, provide information on the color coding for the respective conductors.

EQUIPMENT AND MATERIALS

108-2.1 GENERAL. Add the following.

> "All cable shall be FAA-approved or UL-listed as suitable for installed application. Cable furnished on this project shall comply with the requirements of the "Buy American Act". All conductors shall be copper."

108-2.2 CABLE. Revise this section to read as follows:

> "L-824 Cable. L-824 cable shall be FAA L-824, Type C and shall conform to the requirements of FAA Advisory Circular 150/5345-7E, (or latest edition) "SPECIFICATIONS FOR L-824 UNDERGROUND ELECTRICAL CABLE FOR AIRPORT LIGHTING CIRCUITS". L-824 cable shall be FAA-approved and listed in

the current AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum. Circuits for use with constant current regulator outputs (runway or taxiway lighting circuits) shall use 5000-Volt rated cable. Circuits for voltage applications of 600-Volts or less shall use 600-Volt or 5000-Volt rated cable.

Cable for use with airfield lighting series circuits (including runway lighting, taxiway lighting and taxi guidance signs) shall be one conductor No. 8, 5,000-Volt, FAA L-824, Type C, stranded.

Power Cable (600V and Below). All power wiring, 600V and below, shall be the type, size, and number of conductors as noted on the Plans.

XLP-USE Wire. Cable shall comply with UL Standard 44, UL Standard 854, and Federal Specification A-A-59544. Conductor shall be concentric-strand, soft copper, conforming to ASTM B8 and Underwriters' Laboratories Standard UL44 for Rubber Insulated Wires. Insulation shall be rated for 600-Volt. Insulation shall be cross-linked polyethylene conforming to Underwriter's Laboratories Requirements for Type USE-2 insulation. Cable shall be UL-listed and marked USE-2. Cable shall be Service Wire Company Type USE-2, or approved equal.

Item AR108082 1/C #2 XLP-USE shall consist of 1/C #2 AWG, XLP-USE, 600-Volt cable installed in conduit, ducts, and manholes. **This cable shall be used with FAA Runway 12L-30R REIL cable adjustments to accommodate the Runway 12R-30L widening.** Conductor insulation for 120/240 VAC circuits shall be color-coded, Phase A-Black, Phase B-Red, and Neutral-White.

Item AR108086 1/C #6 XLP-USE shall consist of 1/C #6 AWG, XLP-USE, 600-Volt cable installed in conduit, ducts, handholes, and manholes from the Vault to the respective handhole/manhole, and between handholes/manholes that are connected through a duct bank. Conductor insulation for 240 VAC, single-phase, 2-wire with ground circuits shall be color-coded: Phase A – Black, Phase B – Red, and Ground – Green.

Item AR108108, 1/C #8 5KV UG Cable shall consist of one conductor No. 8, 5,000-Volt, FAA L-824, Type C cable installed in conduit, duct, manholes, handholes, and/or splice cans.

Item AR108258, 2/C #8 5KV UG Cable in UD shall be two No. 8 AWG, 5,000-Volt, FAA L-824, Type C, stranded conductors in unit duct (1-in. minimum).

Item AR108656, 3/C #6 600 V UG Cable In UD shall consist of 3-1/C #6 AWG, XLP-USE, 600-Volt cable in unit duct (1.25 in. or sized larger, as required per NEC). Conductor insulation for 240 VAC, single-phase, 2-wire with ground circuits shall be color-coded: Phase A – Black, Phase B – Red, and Ground – Green.

Item AR108806, 6 Pair Control Cable will need to be installed for the FAA Runway 12L-30R REIL cable adjustments to accommodate the Runway 12R-30L widening. Cable shall be compatible with the existing control cable used with the FAA REILS located on Runway 12L-30R. Cable shall comply with ANSI/ICEA S-84-608-2002 and RUS 7 CFR 1755.390 (PE-39). Cable shall be 6-pair, #19 AWG solid-annealed copper, shielded communications cable, gopher-resistant, jelly-filled to resist moisture entry and to inhibit corrosion, suitable for direct burial and for use in duct, Superior Essex CASPIC-F Series, Part Number 04-026-94, or approved equal.

Color-coding. Color-code phase and neutral conductor insulation for No. 6 AWG or smaller. Provide colored marking tape or colored insulation for phase and neutral conductors for No. 4 AWG and larger. **Insulated ground conductors shall have green colored insulation for all conductor sizes (AWG and/or KCMIL) to comply with NEC 250.119. Neutral conductors shall have white colored insulation for No. 6 AWG and smaller to meet the requirements of NEC 200.6.** Standard colors for power wiring and branch circuits for 120/240 VAC, 1-Phase, 3-Wire system shall be Phase A – Black, Phase B – Red, Neutral – White, and Ground – Green.

The wiring associated with the airport electrical vault work will be paid for under Item AR109200 Install Electrical Equipment - per lump sum.

Wiring associated with the removal and replacement of the MALS (Medium-intensity Approach Lighting System) threshold light bar will be paid for under Item AR127985 Reconstruct MALSR - per lump sum."

108-2.4 CABLE CONNECTIONS. Add the following to this section:

"The Contractor shall use a cable stripper/penciller whenever cable connections are made.

All breaks in the unit duct shall be sealed by shrink kits.

All below grade splices shall be installed in splice cans, handholes, or manholes. Splice cans shall be L-867, Class IA, Size B (12 in. diameter), 24 in. deep, with ½ in. thick, galvanized steel cover and stainless steel bolts. Larger size splice cans shall be provided, as applicable, for specific equipment applications or manufacturer's recommendations, and/or where detailed on the Plans. Splice cans located in areas subject to heavy aircraft or vehicle loading shall be L-868 type. The Engineer shall approve all splice locations before work commences. The furnishing and installing of splice cans for new homerun cables shall be incidental to the respective cable pay item, and no additional compensation will be allowed."

108-2.12 LINE MARKING TAPE. Delete this section.

108-2.13 UNIT DUCT. Add the following:

"Standard sizes of smooth wall polyethylene duct shall conform to the dimensional requirements specified below:

Nominal Duct Size	Nominal Inside Diameter	Nominal Standard Wall	Nominal Outside Diameter*
¾"	0.910"	0.070"	1.050"
1"	1.145"	0.085"	1.315"
1-1/4"	1.440"	0.110"	1.660"
1-1/2"	1.650"	0.125"	1.900"
1-1/2"	2.065"	0.155"	2.375"
2-1/2"	2.449"	0.213"	2.875"
3"	3.048"	0.226"	3.500"
4"	4.000"	0.250"	4.500"

* Dimensions include allowance for duct eccentricity."

CONSTRUCTION METHODS

108-3.1 GENERAL. Add the following to this section:

"If the Contractor wishes to lay cable on a line other than that shown on the Plans, he shall obtain approval of the Resident Engineer before doing so. Any additional cable needed because of such change will be at the Contractor's expense.

Only cable in unit duct may be plowed or directional-bored.

The Contractor shall identify all existing underground utilities located within the area where the proposed cables are being installed, and will take all precautions to protect these utilities from damage. Care shall be taken so as not to damage any existing circuits. Any existing circuits damaged shall be immediately repaired to the satisfaction of the Engineer and/or the respective utility or owner where applicable. Any underground utility damaged will be repaired or replaced at the Contractor's own expense. Any repairs of existing cables will be considered incidental to the contract, and no additional compensation will be allowed.

Contractor shall coordinate work and any power outages with the Airport Director or respective Airport personnel. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures, including, but not limited to, 29 CFR Section 1910.147 The Control of Hazardous Energy (lockout/tagout).

All cables installed by the Contractor shall be properly labeled and tagged at all points of access (handholes, manholes, and the respective wireway in the vault).

All changes to the airfield lighting system shall be documented by the Contractor and provided to the Airport Representative."

108-3.2 INSTALLATION IN DUCT OR CONDUIT. Add the following to this section:

"The unit duct will be run continuous through all ducts and conduits.

Homerun cables for a respective circuit that are installed in conduit or duct shall be run together in the same raceway or duct."

108-3.3 TRENCHING. Add the following to this section:

"F. Cable installed in cultivated fields shall be installed a minimum of 42 in. below grade.

G. Any and all trenches will be backfilled to a smooth grade to the satisfaction of the Resident Engineer. All trench settlement shall be corrected for a period of one year. Restoration, grading, and seeding of areas disturbed during the installation of the proposed cable will be incidental to the respective 108 Pay Item."

108-3.5 SPLICING. Add the following:

"In-line connections for existing cables cut during construction shall be repaired with the cast splice kit. The Contractor shall have a minimum of two splice kits on the job site at all times for emergency repairs. Cast splice kits shall be specified in paragraph (a) of Item 108-2.4. **Splice cans shall be provided for existing cables cut and repaired for each splice in cables not to be abandoned. Where a splice can is not readily available at the time of the cable damage, splice markers shall be temporarily installed over each splice in cables not to be abandoned, then these splices shall later be replaced with new splices in an L-867 splice can**.

There shall be no splices between series lighting circuit isolation transformers. In the event that a series lighting circuit cable is cut between isolation transformers, the entire length of cable between these isolation transformers shall be replaced."

108-3.8 TESTING. Add the following.

"K. Prior to beginning cable installation all existing series circuit cables shall be Megger tested and recorded at the vault. All existing series circuit cable loops shall have the resistance tested and recorded for each circuit at the vault."

108-3.12 LOCATING OF EXISTING UNDERGROUND UTILITIES AND CABLES. The location, size, and type of material of existing underground and/or aboveground utilities indicated on the Plans are not represented as being accurate, sufficient, or complete. Neither the Owner nor the Engineer assumes any responsibility whatever in respect to the accuracy, completeness, or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size, and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. It shall be the Contractor's responsibility to determine the actual location of all such facilities, including service connections to underground utilities. Prior to construction, the Contractor shall notify the utility companies of his operational plans, and shall obtain, from the respective utility companies, detailed information and assistance relative to the location of their facilities and the working schedule of the companies for removal or adjustment, where required. In the event an unexpected utility interference is encountered during construction, the Contractor shall immediately notify the utility company of jurisdiction. The Owner's Representative and/or the Resident Engineer shall also be immediately notified. Any damage to such mains and services shall be restored to service at once and paid for by the Contractor at no additional cost to the Contract.

All utility cables and lines shall be located by the respective utility. **Contact JULIE (Joint Utility Location Information for Excavators) for utility information, phone: 1-800-892-0123.** Contact the FAA (Federal Aviation Administration) for assistance in locating FAA cables and utilities. Location of FAA power, control, and communication cables shall be coordinated with and/or located by the FAA. Also contact Airport Director/Manager and Airport Personnel for assistance in locating underground Airport cables and/or utilities. Also coordinate work with all aboveground utilities.

Payment for locating and marking underground utilities and cables will not be paid for separately, but shall be considered incidental to the plowing/trenching/boring of cable and cable in unit duct.

108-3.13 SEPARATION OF HIGH-VOLTAGE AND LOW-VOLTAGE WIRING. Low-voltage wiring shall maintain separation from high-voltage wiring. Low-voltage wiring and high-voltage wiring shall not be installed in the same raceway, handhole, or junction box.

METHOD OF MEASUREMENT

108-4.1. Add the following:

> "The footage of cable or cable in unit duct installed in trench, duct or conduit to be paid for shall be the number of linear feet of cable installed in trench, duct, conduit, or raceway measured in place by direct measurement, completed, ready for operation and accepted as satisfactory with no allowance being made for overrun due to slack, turns, splices, waste, etc. Slack cable required to perform cable splices outside of the respective splice cans, handholes, or manholes, shall be incidental to the respective cable pay item and no additional measurement for payment will be made. The cable quantities as shown

on the Construction Plans are based on straight-line measurement and do not consider any vertical distances.

Cable will be measured for payment from the respective termination or splice point in the field up to the vault.

For Item AR108086, the footage of 1/C #6 XLP-USE installed in conduit, duct, and raceway, to be paid for shall be the number of linear feet installed in conduit or duct measured between each termination or splice point. Cable will be measured for payment up to the vault. Where multiple cables are installed each one conductor cable will be measured for payment. Slack cable located at a splice can, handhole or manhole will not be measured for payment.

For Item AR108108, the footage of 1/C #8 5KV UG Cable installed in conduit, duct, and raceway to be paid for shall be the number of linear feet installed in conduit, duct, and raceway measured between each termination and splice point. Cable will be measured for payment up to the respective termination in the vault. Where multiple cables are installed each one conductor cable will be measured for payment. Slack cable located at a splice can, handhole or manhole will not be measured for payment."

BASIS OF PAYMENT

108-5.1. Payment will be made at the contract unit price per lin. ft of cable completed and accepted by the Engineer. This price shall be full compensation for furnishing all materials, and for all preparation, assembly, and installation of these materials; for all plowing, trenching, directional-boring, coring of manholes or handholes, and for all excavation and backfilling; and for all labor, equipment, tools, and incidentals necessary to complete this Item.

Payment will be made under:

Item AR108082 1/C #2 XLP-USE - per lin. ft
Item AR108086 1/C #6 XLP-USE - per lin. ft
Item AR108108 1/C #8 5KV UG Cable - per lin. ft
Item AR108258 2/C #8 5KV UG Cable in UD - per lin. ft
Item AR108656 3/C #6 600 V UG Cable in UD - per lin. ft
Item AR108806 6 Pair Control Cable - per lin. ft

ITEM 109 INSTALLATION OF AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

DESCRIPTION

109-1.1. Revise this section to read as follows:

"Item AR109200, Install Electrical Equipment, shall consist of furnishing and installing all electrical equipment in the vault to perform the vault modifications, as detailed on the Plans and specified herein. This Item shall include all labor, materials, transportation, equipment, wiring, raceways, grounding, tools, utility coordination, relocations, operational instructions, labeling, testing, and all incidentals required to place the vault and associated equipment into proper working order as a completed unit to the satisfaction of the Owner and Engineer.

Included under this Item shall be the following:

A. Coordinating all work with the Airport Director and/or designated Airport maintenance staff, the respective FAA personnel, and the Resident Engineer.

B. Furnishing and installing all electrical equipment and support hardware in the vault, as detailed on the Plans and specified herein.

C. Furnishing and installing all pull boxes, junction boxes, wireways, raceways, conduits, conduit fittings, and ducts in, beneath, and adjacent to the vault. The galvanized rigid steel conduits and associated fittings from the vault to the respective high-voltage manhole located near the vault, as detailed on the Plans and specified herein, shall also be included under this Item.

D. Furnishing and installing all necessary cable and wiring within or at the vault, as detailed on the Plans and specified herein.

E. Furnishing and installing all necessary cable, wiring, connections, and work associated with the L-821 control panel at the Air Traffic Control Tower vault, as detailed on the Plans and specified herein.

F. Furnishing and installing all grounding, as detailed on the Plans and specified herein.

G. Testing, adjusting, and retesting (where applicable) all new equipment and modifications to existing systems for proper operation.

H. Labeling all electrical equipment and incidentals necessary to place all of the equipment in operation as a complete unit acceptable to the Owner and Engineer.

I. Furnishing operation, maintenance, and installation manuals for all new equipment."

109-1.2. Item AR109800 "Generator System" shall consist of furnishing and installing a portable generator quick connect and an automatic transfer switch at the vault as detailed on the Plans and specified herein. This item shall include all labor, equipment, wiring, raceways, grounding, materials, tools, utility coordination, operational instructions, labeling, startup and check out services, testing and all incidentals required to place the portable generator quick connect system, automatic transfer switch, and all associated accessories into proper working order as a completed unit to the satisfaction of the Owner and Engineer. Contractor shall also include 2 copies of instruction manuals, operation and maintenance manuals, and parts list bound in a durable plastic binder for the automatic transfer switch.

109-1.3. Item AR109902, Remove Electrical Equipment, shall include removal of the existing 2400 VAC electric service from the point of connection to the respective electric utility lines to the respective equipment in the vault. This shall include removal and disposal of the pothead and transformer or regulator located in the vault and all associated conduits, wiring, connection, fuses, fuse holders, supports, plywood, and materials. All items designated for disposal shall be disposed of in a legal manner off of the Airport Site. This item shall include all labor, tools, coordination, utility coordination, and incidentals required to remove the 2400 VAC service at the vault to the satisfaction of the Owner and Engineer.

109-1.4. Item AR109924, Replace Electric Services shall consist of removing and replacing the respective service disconnect for the Runway 30L VASI system. This service will be used to power the Runway 30L PAPI system that will replace the existing Runway 30L VASI System. This item shall include replacing the respective service conductors and conduit from the utility transformer to the meter base and new disconnect equipment, and replacing the existing grounding system as detailed on the Plans and specified herein. This item shall include all labor, equipment, wiring, raceways, grounding, materials, tools, utility coordination, labeling, testing and all incidentals required to remove and replace the respective electric service installation to the satisfaction of the serving electric utility, Owner and Engineer.

Included under this Item shall be the following:

A. Coordinating all work with the FAA Control Tower personnel, the Airport Director, the Airport maintenance staff, and the Resident Engineer.

B. Coordinating with the serving electric utility the replacement of the existing service disconnect with a new service disconnect.

C. Removing the existing service disconnect, conduit and cable and replacing them with a new service disconnect, conduit, and cable as detailed on the Plans and Specified herein. Service conductors shall be replaced between the existing meter base and the respective service disconnect.

D. Replacing the existing ground rod, grounding electrode conductor, and conduit with a new ground rod, grounding electrode conductor, and Schedule 40 PVC conduit as detailed on the Plans and Specified herein.

109-1.5 REFERENCES.

A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.4 – Fittings Rigid Metal Conduit and EMT.

C. ANSI Z535.4-2002 - American National Standard for Product Safety Signs and Labels.

D. ASTM Specification B3 – Standard Specification for Soft or Annealed Copper Wire.

E. ASTM Specification B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

F. Federal Specification A-A-59544 Cable and Wire, Electrical (Power, Fixed Installation).

G. FAA AC No. 150/5340-30D “DESIGN AND INSTALLATION DETAILS FOR AIRPORT VISUAL AIDS”.

H. FAA AC No. 150/5345-7E, (or latest edition) "SPECIFICATIONS FOR L-824 UNDERGROUND ELECTRICAL CABLE FOR AIRPORT LIGHTING CIRCUITS.

I. FAA AC No. 150/5345-10F “SPECIFICATION FOR CONSTANT CURRENT REGULATORS AND REGULATOR MONITORS”.

J. FAA AC No. 150/5345-53 “AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM” (most current issue) and AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum.

K. FAA-STD-019d dated August 9, 2002, “LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING, AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT”.

L. NEMA ICS 1 – General Standards for Industrial Control Devices, Controllers, and Assemblies.

M. NEMA ICS 2 – Standards for Industrial Control Devices, Controllers, and Assemblies.

N. NEMA ICS 6 – Enclosures for Industrial Controls and Systems.

O. NFPA 70 – National Electrical Code (most current issue in force).

P. NFPA 110 – Emergency and Standby Power Systems.

Q. UL Standard 6 – Rigid Metal Conduit.

R. UL Standard 44 – Thermoset-Insulated Wires and Cables.

S. UL Standard 83 – Thermoplastic-Insulated Wires and Cables.

T. UL Standard 467 – Grounding and Bonding Equipment.

U. UL Standard 486A-486B Wire Connectors.

V. UL Standard 514B – Conduit, Tubing and Cable Fittings.

W. UL Standard 854 – Service Entrance Cables.

X. UL 1008 – Standard for Safety Transfer Switch Equipment.

109-1.6 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for vault equipment and materials to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Cut sheets with part number and specifications for the service breaker. Coordinate selection of the service breaker with the automatic transfer switch to maintain the withstand and closing ratings of the transfer switch.

D. Automatic transfer switch. Provide catalog sheets, manufacturer, model number, voltage, switch size, Amperage rating, number of poles, operating logic, withstand and closing ratings, dimensions, and enclosure details. Coordinate auto transfer switch withstand and closing ratings with the service entrance breaker/disconnect to maintain the withstand and closing ratings of the switch.

E. Submittals for panelboards shall include manufacturer, catalog numbers, panel schedule, voltage and amperage ratings, bus material, integrated short circuit ampere rating, circuit breaker arrangement and sizes and respective enclosure.

F. Cut sheets with part numbers and specifications for each double throw (fusible or not fusible) safety switch.

G. Cut sheets with part number and specifications for the constant current regulators. Include list of spare parts.

H. Cut sheets with part number and specifications for the S-1 cutouts and enclosures.

I. Provide cut sheets for all types of conduit and raceway used in the vault (for example galvanized rigid steel conduit, UL-listed, liquid-tight, flexible metal conduit, wireway, and pull boxes). Include certification that steel conduits are made with 100 percent domestic steel.

J. Provide cut sheets for the power and control circuit conductors.

EQUIPMENT AND MATERIALS

109-2.1 GENERAL. Add the following to this section:

"C. FAA approval of Airport lighting equipment and subsequent inclusion in Advisory Circular 150/5345-1, "Approved Airport Equipment", and/or Advisory Circular 150/5345-53, "Airport Lighting Equipment Certification Program", only means that the test data satisfied the applicable Specification requirements. This does not insure that the approved equipment will satisfactorily operate when connected power-wise and/or control-wise to other approved airport lighting equipment or "off the shelf" equipment not requiring FAA approval.

D. The Contractor shall ascertain that all lighting system components furnished by him (including FAA-approved equipment) are compatible in all respects with each other and the remainder of the new system. Any non-compatible components furnished by the Contractor shall be replaced by him, at no additional cost to the Airport Sponsor, with a similar unit approved by the Engineer (different model or different manufacturer) that is compatible with the remainder of the Airport lighting system.

E. Except as specified otherwise, all new equipment shall be provided by the Contractor and shall be tested for Specification conformance as part of the Aviation Lighting Equipment Certification Program. Certification of conformance, as tested by the testing laboratory, shall be provided by the manufacturer for all items submitted for approval."

109-2.4 BRICK. Delete this section.

109-2.5 RIGID STEEL CONDUIT. Add the following:

"Rigid Steel Conduit and fittings shall be hot-dipped, galvanized, UL-listed, and produced in accordance with UL Standard 6 – Rigid Metal Conduit and ANSI C80.1 – Rigid Steel Conduit, Zinc Coated. Couplings, connectors, and fittings for rigid steel conduit shall be threaded, galvanized steel or galvanized, malleable iron, specifically

designed and manufactured for the purpose. Fittings shall conform to ANSI C80.4 – Fittings Rigid Metal Conduit and EMT and UL 514B – Conduit, Tubing, and Cable Fittings. Set screw type fittings are not acceptable. Galvanized rigid steel conduit shall be produced from 100 percent domestic steel. Contractor shall provide certification that the respective steel conduits used on this project are manufactured from 100 percent domestic steel."

109-2.6 LIGHTING. Delete this section.

109-2.10 HIGH-VOLTAGE BUS. Delete this section.

109-2.11 BUS CONNECTORS. Delete this section.

109-2.12 BUS SUPPORTS. Delete this section.

109-2.13 GROUND BUS. Delete this section.

109-2.14 SQUARE DUCT. Revise the last sentence to read:

"Square duct shall be sized, as detailed on the Plans."

Add the following:

"Wireway shall be installed, as indicated on the Plans, including, but not limited to, straight lengths, elbows, tees, offsets, panel adaptors, closing plates, wire retainers, and supports, as required for a complete installation. Wireways shall be constructed of 16-gauge steel before finishes are applied. All straight lengths of wireway shall have hinged or bolt-on covers. Lengths shall be provided with cover latches, a minimum of every 3 ft, which shall hold the cover securely in-place when closed. Sealing ears shall be provided on both the wireway lengths and connector covers so that the entire run can be sealed.

Wireways shall be 6 in. by 6 in., as detailed on the Plans. Wireways shall be furnished without knockouts. Connectors shall be slip-in type with self-retained mounting screws. They shall also have the feature to allow "lay-in" of all conductors. Wireways shall be provided with a gray, epoxy-painted finish applied over a corrosion-resistant, phosphate primer. All wireway lengths and accessories shall be UL-listed and labeled in conformance with UL 870 Standards for Wireways, Auxiliary Gutters, and Associated Fittings and conform to NEMA 1 enclosure rating."

109-2.16 POTHEADS. Delete this section.

109-2.17 PREFABRICATED METAL HOUSING. Delete this section.

109-2.18 FAA-APPROVED EQUIPMENT. Add the following:

"A. Constant Current Regulator for Runway 12R-30L. Constant current regulator for Runway 12R-30LR shall be a 20 KW, L-828 constant current regulator, 240 VAC, single-phase, 60 Hertz input, Class 1 - 6.6-Amps output, Style 2 with five output brightness steps (2.8, 3.4, 4.1, 5.2, and 6.6-Amps). Constant current regulator shall comply with FAA AC 150/5345-10 (latest issue in force) for Type L-828 regulator. Constant current regulator shall be dry-type, ferro-resonant or saturable-reactor type regulator. Constant current regulator shall not have solid state controls in the series circuit and shall be designed for no radio communication interference. Solid state electronic designs are not acceptable. Constant current regulator shall include open circuit protection, over current protection, output current ammeter, elapsed time meter (for total time on), output voltmeter, and lightning and transient protection on input and output lines. Constant current regulators shall also include a remote/local control feature with selections for "Remote, Off, B1-0.15% Brightness, B2-1.2% Brightness, B3-5% Brightness, B4-25% Brightness, and B5-100% Brightness". Control voltage shall be 120 VAC (internal). Constant current regulators shall be manufactured by ADB/Siemens Airfield Solutions, Manairco, Inc. or Flight Light Inc./Hevi-Duty. Include the following spare components:

1. One spare control circuit board for each type in the constant current regulator.
2. Primary switch contactor.
3. Lightning arresters (input and output).
4. Control circuit fuses or breaker.

B. Backup Constant Current Regulator for Runway 12R-30L. Backup Constant current regulator for Runway 12R-30LR shall be a 20 KW, L-828 constant current regulator, 240 VAC, single-phase, 60 Hertz input, Class 1 - 6.6-Amps output, Style 2 with five output brightness steps (2.8, 3.4, 4.1, 5.2, and 6.6-Amps). Constant current regulator shall comply with FAA AC 150/5345-10 (latest issue in force) for Type L-828 regulator. Constant current regulator shall be dry-type, ferro-resonant or saturable-reactor type regulator. Constant current regulator shall not have solid state controls in the series circuit and shall be designed for no radio communication interference. Solid state electronic designs are not acceptable. Constant current regulator shall include open circuit protection, over current protection, output current ammeter, elapsed time meter (for total time on), output voltmeter, and lightning and transient protection on input and output lines. Constant current regulators shall also include a remote/local control feature with selections for "Remote, Off, B1-0.15% Brightness, B2-1.2% Brightness, B3-5% Brightness, B4-25% Brightness, and B5-100% Brightness". Control voltage shall be 120 VAC (internal). Constant current regulators shall be manufactured by ADB/Siemens Airfield Solutions, Manairco, Inc. or Flight Light Inc./Hevi-Duty. Include the following spare components:

1. One spare control circuit board for each type in the constant current regulator.
2. Primary switch contactor.

3. Lightning arresters (input and output).
4. Control circuit fuses or breaker.

109-2.19 OTHER ELECTRICAL EQUIPMENT. Add the following:

"Contractor shall confirm quantity for all electrical equipment with the Plans. Proposed electrical equipment for the vault shall be as follows:

A. Service Breaker. Service breaker for the vault shall be a 240 VAC, 800 Amp, 2-pole circuit breaker with 65,000 AIC (minimum) rating at 240 VAC in a NEMA 1 enclosure UL-listed suitable for service entrance. Circuit breaker shall be rated as Service Entrance Equipment, Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents. **Coordinate selection of this breaker with the Automatic Transfer Switch (ATS) to maintain the withstand and closing ratings rating of the ATS.** Include solid neutral and separate equipment ground bar. Circuit Breaker enclosure shall be pad lockable in the "OFF" position. Also identify the main service breaker per the requirements of NEC 230.70 (B). Circuit breaker shall be manufactured by Square D Company; a brand of Schneider Electric, Eaton Electrical Inc.; Cutler-Hammer Business Unit, or General Electric Company; GE Consumer & Industrial - Electrical Distribution. Circuit breaker shall be manufactured in the United States to comply with the "Buy American Act".

B. Portable Generator Quick Connect. Provide a portable generator docking station/system rated for 800 amps at 120/240 VAC, single-phase, 3-wire with ground. Portable generator quick connect system shall be an 800 Amp, 120/240 VAC single-phase, Camlok Docking Station with Male Camlok input, in a NEMA 3R stainless steel enclosure. Bus shall be Copper. Provide 2-Camlok interfaces for each phase and neutral and 1-Camlock interface for ground. Each Camlok interface shall be color coded Phase A-Black, Phase B-Red, Neutral-White, and Ground-Green. Camlok Docking Station shall be UL-listed. Include 7 portable generator power cable coils (2 sets for each phase and neutral, and 1 set for ground) of #4/0 AWG Copper UL Type PPE 2000 Volt, 75 Degree C wet, Portable Generator Cables manufactured to UL Standard 1581, each 50 feet minimum in length. Cables shall be fitted with Male to Female Crouse-Hinds Camlok connectors that are compatible with the generator docking station. Cable insulation shall be color coded Black for Phase A, Red for Phase B. White for Neutral, and Green for Ground. Portable generator cables shall be manufactured by Trystar Bridgewater Tech Inc. Part number TSPPC, or approved equal. Include 7 pigtails (same size as portable generator cables) 3 feet minimum in length with Female Crouse-Hinds Camlok to bare end for interface to a portable generator. Pigtails shall be rated 400 Amps each. Pigtail colors shall be Black for Phase A, Red for Phase B. White for Neutral, and Green for Ground. Pigtails shall be manufactured by Trystar Bridgewater Tech Inc. Part Number TSPPC, or approved equal. Portable generator quick connect/Camlok docking station shall be manufactured by Trystar Bridgewater Tech Inc. Part Number TSDOCKHD, or approved equal. Trystar Bridgewater Tech Inc. can be contacted with the

following information: Address: 2917 Industrial Drive, Faribault, Minnesota 55021, Phone: 507-333-3990, Fax: 507-333-3991.

C. Main Distribution Panelboard "A". Main distribution panel shall be 800 Amp, 120/240 VAC, 1-phase, 3-wire with solid neutral with 800 Amp, 2-pole main breaker, copper bus braced for 42,000 Amperes symmetrical (minimum) at 240 VAC, 45 in. of breaker mounting space, suitable for 800 Amp frame max branch breakers, in a NEMA 1 enclosure UL-listed, sized in accordance with UL 67, Square D, I-line, Type HCP Series, or approved equal. All bussing shall be copper. Neutral bus shall be copper. Include separate copper equipment ground bars adequately sized for all ground wires and grounding electrode conductors to and from the panel. Main breaker and all branch and feeder breakers shall have an interrupting rating of 25,000 Amps minimum at 240 VAC and shall be constructed in accordance with NEMA AB1 and UL 489. Circuit breakers shall be equipped with individually insulated braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position (or equip each breaker with a circuit card holder and neatly printed card identifying the circuit). Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. See Plans for details on size and quantity of branch and feeder breakers. Panel shall be UL-listed and bear the UL label. Provide legend plates as detailed on the Plans. Coordinate selection of two pole breakers with the manufacturer to confirm proper bus connections.

D. Transient Voltage Surge Suppressor (TVSS) for Main Distribution Panel. AC power surge arrester/TVSS shall be UL-listed per UL 1449, Second Edition, and shall conform to the applicable requirements of FAA-STD-019d dated August 9, 2002, "LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING, AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT". AC power surge arrester/TVSS for the main distribution panel shall be suitable for a 120/240 VAC, 1-phase, 3-wire, plus ground system with a surge current rating of 240,000-Amps, 8 x 20 microsecond wave per mode (L-L, L-N, L-G, N-G), and status indication lights in a NEMA 12-rated enclosure, Lightning Protection Corporation Model LPC 2020-8U-G, or approved equal. Include six spare indicator lamps with each AC power surge arrester/TVSS.

E. Circuit Breaker Panelboard "B". Circuit breaker panelboard shall be rated 120/240 VAC, 1-phase, 3-wire and shall have copper bus structure braced for 22,000 RMS Amperes fault current minimum at 120/240 VAC. All copper parts shall be plated to prevent corrosion. Panelboards shall bear the UL label. Panelboards for service entrance applications shall be UL-listed suitable for service entrance. All panelboards shall be dead-front safety-type, equipped with thermal magnetic-molded case breakers and solid neutral bus. Bus bar connections to the branch circuit breakers shall be the "Distributed Phase" or "Phase Sequence" type. Bussing shall be such that adjacent single-pole breakers will be on different phases or polarities, and that two pole breakers can be installed at any location. Panelboard numbering shall be such that starting at the top, odd numbers shall be used in sequence down the left hand side, and even numbers shall be used in sequence down the right hand side. Cabinets

shall be fabricated of code-gauge, galvanized steel with gutters per the NEC. Fronts shall have doors with matching one-piece trim, be code-gauge, and be finished with rust-inhibiting primer and baked enamel. Fronts shall have adjustable indicating trim clamps completely concealed when door is closed. Provide a circuit directory frame and card with a clear plastic covering on the inside of the doors. Fronts shall have flush locks, and be furnished with two keys per lock. Provide circuit breakers, quick-make, quick-break, thermal-magnetic, trip indicating, and common trip on all multi-pole breakers. Handles shall have "ON", "OFF", and "TRIPPED" positions. Circuit breakers shall be UL-listed in accordance with UL Standard 489. Breakers shall have bolt-on connections to the bus. Amperage trip ratings, voltage ratings, interrupting current ratings, and number of poles shall be as shown on the panelboard schedules. Contractor shall confirm and adjust circuit breaker sizes, as required for the respective equipment or device being fed, in accordance with the respective equipment manufacturer's recommendation and the NEC. Panelboards shall be furnished with copper-ground bus and separate insulated copper neutral bus.

F. Double Throw Not Fusible Safety Switch. Double throw not fusible safety switch for use as a manual transfer switch shall be UL-listed, heavy-duty, 200 Amp, 240 VAC, 2-pole with equipment ground kit in a NEMA 1 enclosure, Cutler-Hammer Catalog Number DT224UGK with ground kit, or approved equal. Switch must be suitable to connect a single power source to either of two different loads. The switch will be used to connect power to either of two different constant current regulators. Switches that void the UL listing for this application are not acceptable.

G. Double Throw Fusible Safety Switches. Double throw fusible safety switches for use as a manual transfer switch shall be UL-listed, heavy-duty, 240 VAC, 2-pole with Amperage ratings as detailed on the Plans and equipment ground kit in a NEMA 1 enclosure as manufactured by Cutler-Hammer, or approved equal. Switch must be suitable to connect a single power source to either of two different loads. The switch will be used to connect power to either of two different constant current regulators. Switches that are not rated for this application or that void the UL listing for this application are not acceptable.

H. Fuses. Fuses shall be the size and type as shown on the Plans. Fuses shall be manufactured by Bussmann or Littlefuse. Furnish two additional fuses of each size and type used on the project, for use as spares.

I. Type S-1 Series Plug Cutouts. Provide series plug cutouts for each constant current regulator as detailed on the Plans. Series plug cutouts shall be Type S-1, rated 5KV, 20-Amp, and shall comply with FAA AC 150/5340-4C. Cutouts shall be certified by the manufacturer as suitable for the respective application. Cutouts for the runway series circuits will be wired for manual transfer operation (one series circuit loop with the capability of being powered from either of two constant current regulator power sources). Series plug cutouts shall be Crouse-Hinds, Type S-1, Model 2, Catalog Number 30775, or an approved equal. Note Crouse-Hinds Type S-1, Model 3, Catalog Number 30771 series plug cutouts are not acceptable because the handle is

not removable. Siemens SCO Series cutouts are not acceptable because they do not function the same as the Crouse-Hinds, Type S-1, Model 2, Catalog Number 30775 cutout. Airport Lighting Company S-1 Series cutouts are not acceptable because the manufacturer has noted their cutouts are not recommended to operate with the handle pulled/removed. Other cutouts, that do not function the same as the Crouse-Hinds, Type S-1, Model 2, Catalog Number 30775 units, are not acceptable. Install the series plug cutouts in a NEMA 1 or NEMA 12 painted steel enclosure adequately sized to house the cutout(s), with a hinged cover and back panel to mount the cutouts. All enclosures shall be pad lockable.

J. Lighting Contactor Panel for Airfield NAVAIDS. The lighting contactor panel for use with the REILS for Runway 12R is an existing panel. It has two spare lighting contactors available for use with the Runway 12R REILS. Provide legend plates to identify the respective lighting contactors and "Hand-Off-Auto" selector switches.

K. High-Voltage Pull Box. Junction and pull boxes shall be sized, as required for conductors and splices, and per 2008 NEC Article 314. Boxes shall be UL-listed. Special boxes made to suit conditions shall be used to accommodate the respective application, or where required by the NEC, even though they might not be indicated on the Drawings. The high-voltage pull box to be installed inside the vault for transitioning from the high-voltage handhole/manhole shall be a NEMA 12 enclosure with hinged cover sized, as detailed on the Plans, and manufactured by Hoffman, or approved equal.

L. Liquid-Tight, Flexible Metal Conduit. Liquid-tight, flexible metal conduit shall consist of polyvinyl jacket over flexible, hot-dip, galvanized steel tubing. The flexible conduit shall be completely sealed from liquids, dust, dirt, and fumes and be resistant to oil, gasoline, grease, and abrasion. Jacket shall also be sunlight-resistant. Liquid-tight, flexible metal conduit shall be UL-listed, suitable for use as a grounding conductor, and comply with Article 350 of the NEC. **Liquid-tight, flexible metal conduit and associated fittings shall be UL-listed to meet the requirements of NEC 350.6.** Liquid-tight, flexible metal conduit shall be Anaconda Sealtite Type UA, as manufactured by Anamet Electrical Inc., 1000 Broadway Avenue East, Mattoon, Illinois 61938-0039, Phone: 217-234-8844, Liquatite Type LA, as manufactured by Electri-Flex Company, 222 W. Central Ave., Roselle, Illinois 60172, Phone: 630-529-2920 or 1-800-323-6174, or approved equal. Do not install liquid-tight, flexible metal conduit that is not UL-listed. Confirm liquid-tight, flexible metal conduit bears the UL label prior to installation."

109-2.20 WIRE. Add the following to Section A. Control Circuits:

"Control wiring that is used to interface the lighting contactor panel in the vault to the respective 48 VDC pilot relay panels shall be #12 AWG copper-type THWN.

THWN Wire. Cable shall comply with Underwriters' Laboratories Standard UL-83 and Federal Specification A-A-59544. Conductor shall be soft-annealed, uncoated copper,

and shall comply with ASTM B3 and B8. Insulation shall be rated for 600-Volt. Insulation shall be PVC conforming to Underwriters' Laboratories requirements for Type THW. The outer covering shall be nylon-conforming to Underwriters' Laboratories for type THHN or THWN. Cable shall be UL-listed and marked THWN. Power and control wiring shall be Encore, Superior Essex, Southwire Company Type THWN, or approved equal."

Delete paragraphs 1, 2, and 3 under Section B, Power Circuits.

Add the following:

"Power Cable (600-Volt and Below). All power wiring, 600-Volt and below, shall be the type, size, and number of conductors, as noted on the Plans.

THWN Wire. Cable shall comply with Underwriters' Laboratories Standard UL-83 and Federal Specification A-A-59544. Conductor shall be soft-annealed, uncoated copper and shall comply with ASTM B3 and B8. Insulation shall be rated for 600-Volt. Insulation shall be PVC conforming to Underwriters' Laboratories requirements for Type THW. The outer covering shall be nylon-conforming to Underwriters' Laboratories for type THHN or THWN. Cable shall be UL-listed and marked THWN-2. Power and control wiring shall be Encore, Superior Essex, Southwire Company Type THWN-2, or approved equal. **Note: Where THWN wiring is referenced on the Plans, it shall be THWN-2.**

XHHW Wire. Cable shall be UL-listed as Type XHHW-2 per UL Standard 44 for Rubber-Insulated Wires and Cables. Cable shall also conform to ICEA S-95-658/NEMA WC70 and Federal Specification J-C-30B. Conductors shall be Class B stranded, annealed, uncoated copper per UL Standard 44. Insulation shall be rated for 600-Volt. Insulation shall be cross-linked polyethylene complying with the physical and electrical requirements of UL Standard 44 for Type XHHW-2. XHHW wire may be used in place of THWN wire for all applications and shall be Southwire Type XHHW-2, or approved equal.

XLP-USE Wire. Cable shall comply with UL Standard 44, UL Standard 854, and Federal Specification A-A-59544. Conductor shall be concentric-strand, soft copper, conforming to ASTM B8 and Underwriters' Laboratories Standard UL44 for Rubber Insulated Wires. Insulation shall be rated for 600-Volt. Insulation shall be cross-linked polyethylene conforming to Underwriter's Laboratories Requirements for Type USE-2 insulation. Cable shall be UL-listed and marked USE-2. Cable shall be Service Wire Company Type USE-2, or approved equal.

Grounding electrode conductors and/or bonding jumpers shall be the size and type, as detailed on the Plans."

109-2.21 FLOOR DRAINS. Delete this section.

109-2.22 AUTO TRANSFER SWITCH**.** Automatic transfer switch shall be an electrically operated, mechanically held type, rated for continuous load, 800 Amp, 2-pole with solid neutral, 120/240 VAC 1-phase, 3-wire, 60 Hz, with a separate equipment ground bar adequately sized for all ground wires to and from the switch, in a NEMA 12 enclosure. Automatic transfer switch shall conform to the requirements of NEMA Standard ICS2 and Underwriters' Laboratories UL-1008 and shall be rated in Amperes for total system transfer including control of motors, electric-discharge lamps, electric-heating and tungsten-filament lamp loads. Automatic transfer switch shall be rated for all classes of load and suitable for the respective airfield lighting and vault equipment loads. Voltage and current ratings shall be as shown on the drawings. Transfer switches shall have withstand and closing rating of 65,000 RMS Sym. Amps., minimum per UL Standard 1008. Coordinate selection of the service entrance breaker/disconnect to maintain the withstand and closing ratings of the switch. **Automatic transfer switch and associated controls shall be suitable for use with a portable engine generator set and suitable to accommodate a future standby engine generator set.**

A. AUTOMATIC TRANSFER SWITCH SHALL INCLUDE THE FOLLOWING OPTIONS AND FEATURES:

1. Voltage sensing for each phase of normal source. Pick-up voltage is adjustable from 85 percent to 100 percent nominal, and drop-out voltage is adjustable form 75 percent to 98 percent pick-up value. Factory set for pick-up at 90 percent and drop-out at 85 percent.
2. Emergency/Standby Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent (adjustable from 90% to 100%) from rated nominal value.
3. Time delay to override momentary normal source outages to delay all transfer switch and engine stating signals. Adjustable from 0.5 to 6 seconds.
4. Voltage/Frequency Lockout Relay: Prevent premature transfer. Voltage pick-up is adjustable from 85 percent to 100 percent nominal. Factory set to pick-up at 90 percent. Pick-up frequency is adjustable from 90 percent to 100 percent nominal. Factory set to pick-up at 95 percent.
5. Retransfer to normal time delay, adjustable from 0 to 30 minutes. Bypass time delay in event of emergency/standby source failure.
6. Unloaded running time delay for emergency/standby engine generator cool down period adjustable from 0 to 30 minutes.
7. Transfer to emergency/standby time delay, adjustable for 0 to 5 minutes for controlled timing of load transfer to emergency/standby power source.
8. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
9. Transfer Override Switch: Overrides automatic retransfer control so the ATS will remain connected to the emergency power source regardless of the condition of the normal source. A pilot light indicates the override status.
10. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from emergency/standby to normal source.
11. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, STANDBY SOURCE AVAILABLE, NORMAL SWITCH POSITION, and STANDBY SWITCH POSITION.

12. Transfer Switch Auxiliary Contacts: Two normally open on normal switch position, closed on emergency/standby switch position. Two normally closed on normal switch position, open on emergency/standby switch position.
13. Engine generator start and stop control contacts.
14. Engine generator exercise timer (2 weeks), with toggle switch to select load or no load operation.
15. Equipment ground bar adequately sized for all ground wires to and from the transfer switch. Install one ground wire per ground lug terminal unless the lug is rated and listed for multiple conductors.

B. AUTOMATIC SEQUENCE OF OPERATION

1. When normal (commercial) service drops below preset percentage of rated voltage and remains for specified time delay, contact closure in the transfer switch will signal the engine generator to start. When engine generator output reaches proper voltage and frequency, the transfer switch will transfer load to the generator. Time delay before transfer to alternate power source shall be 0 to 60 seconds, adjustable.
2. When normal (commercial) source returns to preset percentage of rated voltage and frequency, and after specified time delay, load retransfers to normal source, through the in phase monitor.
3. Engine generator start control to remain closed to allow engine generator to run (unloaded) for preset time after retransfer before shutdown. Cool down period for engine generator shall be as recommended by the engine generator manufacturer.
4. Control relays, etc. to reset instantaneously, ready for next automatic operation.

C. ENCLOSURE

1. Enclosure shall be NEMA Type 12, painted steel, free standing type unit with hinged door.
2. Finish shall be manufacturer's standard gray enamel or green enamel.

D. ACCEPTABLE PRODUCTS

1. Automatic Switch Company 7000 Series.
2. Onan/Cummins Model OHPC Series Power Command.

CONSTRUCTION METHODS

109-3.10 GENERAL. Add the following to this section:

"The Contractor shall furnish and install all materials necessary for complete and operational installation of the vault equipment, as specified herein, and as shown on the Plans. The complete installation and wiring shall be done in a neat, workmanlike manner. All electrical work shall comply with the requirements of the NFPA 70 – National Electrical Code (NEC), most current issue in force, and all other applicable local

codes, laws, ordinances, and requirements in force. Electrical equipment shall be installed in conformance with the respective manufacturer's directions and recommendations for the respective application. Any installations which void the UL listing, ETL listing (or other third party listing), and/or the manufacturer's warranty of a device will not be permitted.

A. Contractor shall keep a copy of the latest National Electrical Code in force on site at all times during construction for use as a reference.

B. Contractor shall keep a copy of the Plans, Special Provision Specifications including any addenda, and copies of any change orders on site at all times during construction.

C. Contractor shall coordinate work and any power outages with the Airport Director **(Robert McDaniel, St. Louis Downtown Airport, 1680 Sauget Industrial Parkway, Sauget, Illinois 62206-1449, Phone: 618-337-6060, Fax: 618-337-1597)** and/or the Airport Maintenance Manager **(Bobby Toenjes, Phone: 618-337-6060, Cell Phone: 314-486-5639),** and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures including, but not limited to, 29 CFR section 1910.147 The Control of Hazardous Energy (lockout/tagout).

D. All electrical equipment installed by the Contractor shall be properly labeled, and all cables must be tagged.

E. All changes to the airfield lighting system control wiring will be documented by the Contractor and provided to the Resident Engineer.

F. All power and control cables shall be installed in conduit, wireways, pull boxes, junction boxes, or raceways. No exposed power or control wiring will be permitted.

G. Locate Existing Underground Utilities and Cables. The location, size, and type of material of existing underground and/or aboveground utilities indicated on the Plans are not represented as being accurate, sufficient, or complete. Neither the Owner nor the Engineer assumes any responsibility whatever in respect to the accuracy, completeness, or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size, and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. It shall be the Contractor's responsibility to determine the actual location of all such facilities, including service connections to underground utilities. Prior to construction, the Contractor shall notify the utility companies of his operational plans, and shall obtain, from the respective utility companies, detailed information and assistance relative to the location of their facilities and the working

schedule of the companies for removal or adjustment, where required. In the event an unexpected utility interference is encountered during construction, the Contractor shall immediately notify the utility company of jurisdiction. The Owner's Representative and/or the Resident Engineer shall also be immediately notified. Any damage to such mains and services shall be restored to service at once and paid for by the Contractor at no additional cost to the Contract. All utility cables and lines shall be located by the respective utility. **Contact JULIE (Joint Utility Location Information for Excavators) for utility information, phone: 1-800-892-0123.** Contact the FAA (Federal Aviation Administration) for assistance in locating FAA cables and utilities. Location of FAA power, control, and communication cables shall be coordinated with and/or located by the FAA. Also contact Airport Director/Manager and Airport Personnel for assistance in locating underground Airport cables and/or utilities. Also coordinate work with all aboveground utilities."

109-3.11 POWER SUPPLY EQUIPMENT. Add the following to this section:

"Constant Current Regulators. Install constant current regulators in conformance with the manufacturer's recommendations, as detailed on the Plans and as specified herein. Maintain working clearances in front of constant current regulators per the requirements of NEC 110.26 and 110.34. Maintain clearance around constant current regulators for air flow and cooling per the respective manufacturer's recommendations. Confirm circuit breaker sizes for constant current regulators are sized in conformance with the respective manufacturer's recommendations and/or requirements and NEC. Where necessary to accommodate the respective constant current regulator input amperage requirements, circuit breakers, conductors, and conduits shall be adjusted (increased in size) to meet the manufacturer's recommendations and/or requirements and the NEC. Conduit connections to constant current regulators shall be with UL-listed, liquid-tight, flexible metal conduit. Include an external bonding jumper or internal equipment ground wire with each piece of liquid-tight, flexible metal conduit that is connected to a constant current regulator to comply with NEC 350.60. High-voltage wiring shall enter each respective regulator at the high-voltage/series circuit output section of the regulator. 240 VAC input power wiring shall enter each respective regulator at the low-voltage/input power section of the regulator. Furnish and install control wiring, as detailed on the Plans. Control wiring shall enter each respective regulator at the control section of the regulator. Bond each constant current regulator enclosure frame, to the vault ground bus with a #6 AWG (minimum), bare-stranded, copper-bonding jumper."

109-3.12 SWITCHGEAR AND PANELS. Add the following to this section:

"A. Installation of Safety Switches and Enclosed Circuit Breakers. All safety switches and enclosed circuit breakers shall be provided with appropriate mounting hardware and strut support. Strut support shall be hot-dipped, galvanized steel strut support; Unistrut P-1000-HG, stainless steel strut support; Unistrut P-1000-SS, or approved equal. Provide zinc rich paint applied to field cuts of galvanized steel strut support to minimum the potential for corrosion per the respective strut support manufacturer's recommendation. All hardware shall be corrosion-resistant. Mount

safety switches and circuit breakers securely in accordance with the manufacturer's recommendations/instructions for the respective application. Inspect all safety switches and circuit breakers for proper operation, tight and secure connections, and correctness. All safety switch and circuit breaker enclosures shall be bonded to ground with a ground lug or bar and ground wire. Field cut holes in safety switch enclosures to accommodate conduit entrances. Where safety switches and/or circuit breaker enclosures are provided with concentric knockouts, and the respective conduit does not use the largest knockout, install a grounding bushing with ground wire connections between the bushing and the ground bus. Do not use safety switch or circuit breaker enclosures for a splice box or for a pull box. Do not route control wires or other circuit wiring through a safety switch or circuit breaker enclosure. Provide weather-proof, abrasion-resistant, engraved legend plates for each safety switch and enclosed circuit breaker noting the device served, the power source, and the voltage system.

B. Installation of Automatic Transfer Switch. Install transfer switches in accordance with manufacturer's instructions and as detailed on the Plans. Provide engraved plastic legend plates identifying the transfer switch and the voltage system. Include additional legend plates noting the respective power sources (for both feeds) and their respective locations.

1. Examination. Inspect transfer switch for damage, rust or corrosion, broken or loose wiring, secure connections, etc. Verify proper installation and proper operation of transfer switch. Verify that mounting surface location is suitable for transfer switch installation. Coordinate inspection of the automatic transfer switch with the serving electric utility to verify it conforms to their requirements.
2. Manufacturer's Field Services. Provide checkout, inspection, start-up, adjustments, and any other required services in order to provide a complete and operational system. Provide label on inner and outer door with name, address, phone number and emergency phone number of the service representative for the transfer switch. Program engine generator exercise timer and coordinate time of operation with the Airport Manager. Provide three copies of operation and maintenance manuals for the automatic transfer switch.
3. Demonstration. Provide systems demonstration. Demonstrate operation of transfer switch in normal, and emergency modes, instruct use personnel on the operation of the transfer switch. Note to user personnel items requiring adjustments for operation where applicable. Verify all equipment operates properly on each power source.

C. Installation of Panelboards. Panelboards shall be thoroughly inspected for physical damage, proper alignment, anchorage, and grounding. The exterior finish shall be inspected for blemishes, nicks, and bare spots and touched up, as required, using matching touch-up paint. Inspections shall be made for proper installation and tightness of connections for circuit breakers. Install panelboards, as shown on the Plans and in accordance with NEMA PB1.1. Maximum distance from floor to highest breaker shall not exceed 6 ft-6 in. Install panelboards plumb. Install circuit

breakers in panelboards in conformance with the respective manufacturer's directions. Connect only one wire/cable to each breaker terminal. Provide filler plates for unused spaces in panelboards. Provide typed circuit directory for each branch circuit panelboard to identify the respective device fed by each circuit breaker. Revise directory to reflect circuiting changes, as required. Provide legend plates for all panelboards to identify the panelboard designation, the power source, and the voltage system. Legend plates shall be weather-proof and abrasion-resistant, phenolic material. Lettering shall be black on white background. Panelboards shall be thoroughly tested after installation and connection to respective loads.

D. Surge Protector Device Installation. Install Surge Protector Devices (SPD)/TVSS devices in conformance with of FAA-STD-019d, dated August 9, 2002, "LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT" and the respective manufacturer's directions and recommendations. Contractor shall confirm all connections to the surge arrester (phases, neutral, and ground) are completed and secure. Connection leads to the surge arrester shall be sized per the respective manufacturer's recommendation and as detailed herein, and shall be maintained as short as possible, maximum 2 ft in length, and laced together for mutual coupling. The conduit or conduit nipple connecting the SPD/TVSS device enclosure to the panel enclosure shall be sealed with duct seal or other nonflammable medium to prevent soot from entering the enclosure in the event of a SPD/TVSS device failure.

E. Installation of Control Panels. Install control panels, as detailed on the Plans and in conformance with the respective panel manufacturer's requirements and/or recommendations.

F. Installation of S-1-Type Cutouts. Install plug cutouts in conformance with the manufacturer's recommendations, as detailed on the Plans and as specified herein. Provide NEMA 1 or NEMA 12 painted steel enclosures adequately sized for the cutouts and cables with hinged cover and back panel to mount the plug cutouts."

109-3.13 DUCT AND CONDUIT. Add the following to this section:

"A. Conduit shall be installed in accordance with the following:

1. All service, feeder, branch circuit, and control circuit conduits shall be galvanized rigid steel conduit.
2. Schedule 40 PVC conduits shall be used for individual grounding electrode conductors and/or or bonding jumpers.
3. Liquid-tight, flexible metal conduit shall be used as specified herein.

B. Conduit Runs:

1. All conduits shall be sized, as indicated on the Drawings, or if conduit sizes are not shown, shall be in accordance with the NEC. All conduit systems shall be mechanically and electrically continuous from source of current to all outlets and grounded in accordance with the NEC.
2. Run all exposed conduit parallel to building walls using right-angle bends. Exposed diagonal runs of conduit will not be permitted. Do not install conduit on roof surfaces, unless specifically indicated on the Drawings.
3. Ream conduit after threads are cut. Cut ends square, and butt solidly into couplings.
4. Prevent the accumulation of water, foreign matter, or concrete in the conduits during the execution of the work. Temporarily plug conduit, blowout, and swab before wires are pulled.
5. Fasten conduits to all sheet metal boxes and cabinets with two locknuts, in accord with NEC, where insulated bushings are used and where bushings cannot be brought into firm contact with the metal enclosures; otherwise, use at least a single locknut and bushing.
6. Provide conduit expansion joints at building expansion joints for conduit runs 1½ in. and larger. Provide conduit expansion joints or flexible conduit connection at building expansion joints for conduits less than 1½ in.
7. Seal each underground joint and make water-tight.
8. Where building construction or other conditions make it impossible to use standard threaded couplings, install water-tight, threaded unions.
9. Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with conduit bending machine to avoid changing the internal diameter of the conduit and not damage it's protective coating, either inside or outside. Individual bends shall not exceed 90 degrees, and not more than 270 degrees total bends will be allowed in any one conduit run. Where more bends are necessary, and conduit runs exceed 150 lin. ft, install a suitable pull box or junction box.
10. Provide empty conduits installed with a pull wire. Pull wire shall be No. 14 AWG zinc-coated steel or of plastic having not less than 200-lb. tensile strength. Leave not less than 12 in. of slack at each end of the pull wire.
11. Use liquid-tight, flexible metal conduit for final connection to motors, constant current regulators, transformers, portable equipment, and for equipment subject to vibration and noise transmission. For each conduit sizes up to 1-in. trade size, flexible conduit shall be minimum length of 12 in., and a maximum length of 36 in. For conduit sizes above 1-in. trade size, flexible conduit shall be minimum length of 20 in., and maximum length of 48 in. Liquid-tight, flexible metal conduit shall be UL-listed and suitable for grounding. Liquid-tight, flexible metal conduit that is used for flexibility, including connections to motors, constant current regulators, and transformers, shall require an external bonding jumper or internal equipment grounding conductor per NEC 350.60. Do not install liquid-tight, flexible metal conduit that is not UL-listed.

C. Raceway Support and Hangers:

1. Securely fasten raceways in-place and support from ceiling or walls at spacing not exceeding:

	Material	Maximum Spacing of Supports
a.	½-in. thru 1-in. trade size conduit	6 ft
b.	1¼-in. thru 1½-in. trade size conduit	8 ft
c.	2-in. to 4-in. trade size conduit	10 ft
d.	Liquid-tight, flexible metal conduit	4½ ft
e.	Metal wireway	10 ft

2. Support rigid conduits within 3 ft of every outlet box, junction box, pull box, cabinet, or termination. Support flexible conduit within 12 in. on each side of every outlet box or fitting.
3. Support conduits by pipe straps, wall brackets, hangers, or ceiling trapeze. The use of perforated iron or wire for supporting conduits is prohibited. Fasten with wood screws or screw nails to wood; by toggle bolts on hollow masonry units, by concrete inserts, or expansion bolts on concrete or spring-tension, or threaded C-clamps for rigid steel conduits on steel. Do not weld conduits or pipe straps to steel structures, unless specifically indicated.
4. The load applied to fasteners shall not exceed one-third the proof test load of the fasteners.
5. Fasteners attached to concrete shall be vibration-resistant and shock-resistant.
6. Where two or more conduits 1-in. trade size or larger run parallel, trapeze hangers may be used consisting of threaded solid rods, washers, nuts, and galvanized "L" angle or channel iron. Individually fasten conduits to the cross member of every other trapeze hanger, with one-hole straps or clamp backs with proper size bolts, washers, and nuts. When adjustable trapeze hangers are used, use U-bolt type clamps at end of conduit runs, at each elbow, and at each third intermediate hanger to fasten each conduit.
7. Make hangers of durable materials suitable for the application involved. Applied loads shall not exceed one-third of their loading capacity.
8. All screws, bolts, washers, and miscellaneous hardware used for conduit supports shall be fabricated from rust-resisting metal. Trapeze hangers shall have hanger assemblies protected with galvanized finish."

109-3.15 WIRING AND CONNECTIONS. Add the following to this section.

"Low-voltage wiring shall maintain separation from high-voltage wiring. Low-voltage and high-voltage wiring shall not be installed in the same raceway. Low-voltage and high-voltage wiring shall not be installed in the same handhole or junction box."

109-3.16 MARKING AND LABELING. Add the following to this section:

"C. Legend plates shall be provided for all equipment. Legend plates shall be provided to identify the equipment controlled, the power source, and the function of each device. Legend plates shall be weather-proof, abrasion-resistant, phenolic/plastic, engraved material and fastened with contact-type permanent adhesive, screws, or rivets. Installation shall not break, crack, or deform the legend plate. Lettering shall be ¼ in. high, black on a white background, unless noted otherwise.

D. Identify control wiring at each termination point and in junction/terminal boxes with wire number corresponding to the respective control wiring diagram or respective terminal numbering arrangement. Each individual control wire shall have unique identification, and shall maintain that same identification from its point of origin to its final termination point. Wire markers shall be permanent pressure-sensitive label, with suitable numbers or letters for easy recognition. Where new control wiring is interfaced to existing control wiring, it shall also match the color-coding of the existing control wiring.

E. Color-code phase and neutral conductor insulation for No. 6 AWG or smaller. Provide colored marking tape for phase and neutral conductors for No. 4 AWG and larger. **Insulated ground conductors shall have green colored insulation for all conductor sizes (AWG and/or KCMIL) to comply with NEC 250.119. Neutral conductors shall have white colored insulation for No. 6 AWG and smaller to meet the requirements of NEC 200.6.** Standard colors for power wiring and branch circuits for 120/240 VAC, 1-Phase, 3-Wire system shall be Phase A – Black, Phase B – Red, Neutral – White, and Ground – Green.

F. Furnish and install weather-proof warning label for each meter socket, enclosed circuit breaker, disconnect switch, switchboard, panelboard, load center, motor control center, and control panel to warn persons of potential electric arc flash hazards, per the requirements of NEC 110.16 "Flash Protection". Labels shall also conform to ANSI Z535.4-2002 "American National Standard for Product Safety Signs and Labels". NEC 110.16 requires that switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked to warn qualified persons of potential arc flash hazards. The markings shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. This new requirement is intended to help reduce the occurrence of serious injury or death due to arcing faults to those working on or near energized electrical equipment. The warning labels are to indicate to a qualified worker who intends to open the equipment for analysis of work that a serious hazard exists and that the worker should follow appropriate work practices and wear appropriate personal protective equipment (PPE) for the specific hazard. Labels shall be as detailed on the Plans or shall include at least the following information: "Warning - Potential Arc-Flash Hazards exist while working on this energized equipment. Appropriate PPE Required."

109-3.17 EXISTING EQUIPMENT RELOCATIONS AND REMOVALS. Add the following:

"The Contractor shall relocate existing equipment where detailed on the Plans and/or where necessary to accommodate new work and installations. The Contractor shall be held responsible for any damage to existing equipment cause by the relocation and shall repair such damage immediately to the satisfaction of the Engineer at no cost to the Contract. The Contractor shall disconnect and remove the existing 120/240 VAC electric service equipment upon completion and activation of the new electric service to the Airport Electrical Vault. The Contractor shall provide temporary power and connections to maintain the operation of the lighting systems for the active runways and taxiways. Closure of a runway or taxiway must be coordinated with and approved by the Airport Director prior to proceeding with the respective closure."

109-3.18 TESTING. The installation shall be tested in operation and as a completed unit prior to acceptance. Contractor shall furnish all equipment, meters, instruments, cable connections, tools, manpower, and labor to perform the respective tests. Test all new equipment and all existing equipment where modifications take place and confirm proper operation. Coordinate tests with the respective Airport personnel and the Resident Engineer. Tests shall include resistance, voltage, and current reading, as applicable, for the respective equipment. When tests disclose any unsatisfactory workmanship or equipment furnished under this Contract, correct defects and retest. Repeat tests until satisfactory results are obtained. When any wiring or equipment is damaged by tests, the wiring or equipment shall be repaired or replaced at no additional cost to the Contract. Test repaired or replaced items to ensure satisfactory operation. Submit three copies of all test reports to the Resident Engineer. All test reports shall be assembled and bound in a folder or binder. Each test report shall include the following information:

- Project number,
- Project title and location,
- Device or system tested,
- Test performed,
- Date performed,
- Test equipment used,
- Respective Contractor's name, address, and telephone number,
- Testing firm's name, address, and telephone number, if other than the Contractor,
- Names of individuals performing tests,
- Names of individuals observing tests,
- Statement verifying each test,
- Name plate data from respective equipment tested,
- Test results, and
- Retest results after correction of defective components or systems, where applicable.

109-3.19 GROUNDING REQUIREMENTS. Grounding shall conform to the following: The Contractor shall furnish and install all grounding shown on the Plans, as specified herein, and in conformance with latest NFPA 70 – National Electrical Code (NEC) in force in order to make a complete grounding system. The reliability of the grounding system is dependent on careful, proper installation, and choice of materials. Improper preparation of surfaces to be joined to make an electrical path, loose joints, or corrosion can introduce impedance that will seriously impair the ability of the ground path to protect personnel and equipment and to absorb transients that can cause noise in communications circuits. The following functions are particularly important to ensure a reliable ground system:

A. All products associated with the grounding system shall be UL-listed and labeled.

B. All bolted or mechanical connections shall be coated with a corrosion-preventative compound before joining, Sanchem Inc. "NO-OX-ID "A-Special" compound, Burndy Penetrox E, or equal.

C. Metallic surfaces to be joined shall be prepared by the removal of all non-conductive material, per 2008 NEC, Article 250-12. All copper bus bars must be cleaned prior to making connections to remove surface oxidation.

D. Metallic raceway fittings shall be made up tight to provide a permanent low impedance path for all circuits. Metal conduit terminations in enclosures shall be bonded to the enclosure with UL-listed fittings suitable for grounding. Provide grounding bushings with bonding jumpers (from bushing to the respective ground connection/enclosure frame) for all metal conduits entering service equipment (meter bases, CT cabinet, service disconnects, service panelboards, main service breaker enclosure, etc.). Provide grounding bushings with bonding jumpers for all metal conduits entering an enclosure through concentric or eccentric knockouts that are punched or otherwise formed so as to impair the electrical connection to ground. Standard locknuts or bushings shall not be the sole means for bonding where a conduit enters an enclosure through a concentric or eccentric knockout.

E. Furnish and install ground rings, ground fields, and/or ground rods at all locations, where shown on the Plans or specified herein. Ground rods shall be ¾ in. diameter, 10 ft long, UL-listed, copper-clad with 10-mil. minimum copper coating. Top of ground rods shall be a minimum of 30 in. below finish grade, unless otherwise noted on the Plans. Ground rods shall be spaced, as detailed on the Plans, and in no case spaced less than one-rod length apart. All connections to ground rods and/or ground rings shall be made with exothermic-weld type connectors, Cadweld by Erico Products, Inc., Solon, Ohio, Phone: 800-248-9353, Thermoweld by Continental Industries, Inc., Tulsa, Oklahoma, Phone: 918-663-1440, or Ultraweld by Harger Lightning Protection Grounding Equipment, Grayslake, Illinois, Phone: 800-842-7437. Exothermic-weld connections shall be installed in conformance with the respective manufacturer's directions using molds, as required, for each respective application. Bolted connections will not be permitted at ground rods or at buried grounding electrode conductors. Grounding electrode conductors shall be bare-stranded copper sized, as detailed on the Plans. In addition to the grounding work described herein and shown on the Plans, the Contractor shall test the made electrode ground field/ground ring with an

instrument specifically designed for testing ground field systems. If ground resistance exceeds **10 Ohms**, contact the Resident Engineer for further direction. Copies of ground field test results shall be furnished to the Resident Engineer, upon request, for review and record purposes.

F. Buried or concealed ground systems shall be observed by the Resident Engineer before backfilling or covering.

G. All connections located above grade between the different types of grounding conductors shall be made using UL-listed, double-compression, crimp-type connectors or UL-listed, bolted ground connectors. For ground connections to enclosures, cases, and frames of electrical equipment not supplied with ground lugs, the Contractor shall drill required holes for mounting a bolted ground connector. All bolted ground connectors shall be Burndy, Thomas and Betts, or equal. Tighten connections to comply with tightening torques in UL Standard 486A to assure permanent and effective grounding.

H. All metal equipment enclosures, conduits, cabinets, boxes, receptacles, etc. shall be bonded to the respective grounding system.

I. Each feeder circuit and/or branch circuit shall include an equipment ground wire. Metal raceway or conduit shall not meet this requirement. The equipment ground wire from equipment shall not be smaller than allowed by 2008 NEC Table 250-122 "Minimum Size Conductors or Grounding Raceway and Equipment." When conductors are adjusted in size to compensate for voltage drop, equipment-grounding conductors shall be adjusted proportionately according to circular mil area. All equipment ground wires shall be copper, either bare or insulated, and green in color. Where the equipment grounding conductors are insulated, they shall be identified by the color green, and shall be the same insulation type as the phase conductors.

J. All utility transformer bank grounds shall be installed in accordance with the serving utility company's requirements and recommendations and in accordance with NEC.

K. Bond the main electrical service neutral to ground at the main service disconnect. Bond the service neutral to ground at one location only per the NEC. A grounding connection shall not be made to any neutral circuit conductor on the load side of the service disconnecting means, except as permitted by the 2008 NEC, Article 250-24. Where the Contractor is unable to distinguish the difference between a neutral conductor and equipment grounding conductor, or other ground conductor, contact the Resident Engineer for assistance from the Project Engineer.

L. The secondary neutral of all transformers (separately derived system transformers) shall be grounded in accordance with the NEC. The respective grounding electrode conductor shall be connected to the neutral point of the transformer between the transformer and the output disconnect means. Size of the grounding electrode conductor shall be in accordance with the 2008 NEC, Article 250-66 and Table 250-66, unless shown larger on the Drawings. A bond shall be provided between the neutral and transformer case, or other metal that is part of the

AC equipment grounding system, so as to complete a circuit for fault current to the transformer winding from the AC equipment grounding system. Size of the neutral bonding conductor shall be in accordance with the 2008 NEC, Article 250-102.

M. All exterior metal conduits, where not electrically continuous because of manholes, handholes, non-metallic junction boxes, etc., shall be bonded to all other metal conduit in the respective duct run and at each end with a copper-bonding jumper sized in conformance with the 2008 NEC, Article 250-102. Where metal conduits terminate in an enclosure (such as a motor control center, switchboard, etc) where there is not electrical continuity with the conduit and the respective enclosure, provide a bonding jumper from the respective enclosure ground bus to the conduit sized per the 2008 NEC, Article 250-102.

N. Install grounding electrode conductors and/or individual ground conductors in Schedule 40 or Schedule 80 PVC conduit. Where grounding electrode conductors or individual ground conductors are run in PVC conduit, do not completely encircle conduit with ferrous and/or magnetic materials. Use non-metallic, reinforced, fiberglass strut support. Where metal conduit clamps are installed, use nylon bolts, nuts, washers, and spacers to interrupt a complete metallic path from encircling the conduit.

O. Individual ground conductors and/or grounding electrode conductors shall not be run in metallic conduit and shall not be encircled by metallic clamps. If local codes dictate that grounding conductors must be run in metal conduit or raceway, then the conduit or raceway must be bonded to the grounding conductor at both ends with a bonding jumper sized in accordance with the NEC 250.64(E). All such installations requiring individual grounding conduits to be run in metal conduit or raceway shall be verified and reviewed with the Resident Engineer. This does not apply to AC equipment ground wires run with AC circuits.

METHOD OF MEASUREMENT

109-4.3. Add the following to this section:

> "The quantity of vault equipment to be paid for under Item AR109200, Install Electrical Equipment, shall consist of furnishing and installing all electrical equipment at the vault, as detailed on the Plans and specified herein. This Item shall include all labor, equipment, materials, conductors, connectors, conduits, wireways, terminal panels, core drilling, tools, operational instructions, coordination, labeling, and testing required to place the vault and associated electrical equipment into proper working order. Conduits between the vault and handholes located near the vault shall be considered incidental to this Item, and no additional compensation will be allowed."

109-4.4. The quantity of the Generator System to be paid for under Item AR109800 "Generator System" shall consist of the portable generator quick connect, the automatic transfer switch, and the feeder conductors and conduits between the portable generator quick connect and the automatic transfer switch, installed, connected, tested, and accepted as a complete unit ready for operation.

109-4.5. The quantity of Remove Electrical Equipment to be paid for under Item AR109902, Remove Electrical Equipment, shall consist of the removal of the existing 2400 VAC electric service from the point of connection to the respective electric utility lines to the respective equipment in the vault. This shall include removal and disposal of the pothead and transformer or regulator located in the vault and all associated conduits, wiring, connection, fuses, fuse holders, supports, plywood, and materials. This item shall include all labor, tools, coordination, utility coordination, and incidentals required to remove the 2400 VAC service at the vault to the satisfaction of the Owner and Engineer.

109-4.6. The quantity of the electric service replacement for the Runway 30L VASI/ PAPI system to be paid for under Item AR109924, Replace Electric Services shall consist of removing and replacing the respective service disconnect for the Runway 30L VASI system. This service will be used to power the Runway 30L PAPI system that will replace the existing Runway 30L VASI System. This item shall include replacing the respective service conductors and conduit from the utility transformer to the meter base and new disconnect equipment, and replacing the existing grounding system as detailed on the Plans and specified herein. This item shall include all labor, equipment, wiring, raceways, grounding, materials, tools, utility coordination, labeling, testing and all incidentals required to remove and replace the respective electric service installation to the satisfaction of the serving electric utility, Owner and Engineer.

BASIS OF PAYMENT

Payment will be made under:

Item AR109200 Install Electrical Equipment - per lump sum
Item AR109800 Generator System - per lump sum
Item AR109902 Remove Electrical Equipment - per lump sum
Item AR109924 Replace Electric Services - per lump sum

ITEM 110 INSTALLATION OF AIRPORT UNDERGROUND ELECTRICAL DUCT

DESCRIPTION

110-1.1. Add the following:

"This item of work shall consist of the installation of all proposed conduits and ducts as shown on the Construction Plans."

110-1.2 REFERENCES.

A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.4 – Fittings Rigid Metal Conduit and EMT.

C. ASTM D3350 – Specification of Polyethylene Plastics Pipe and Fittings Materials.

D. ASTM F2160 – Standard Specification for Solid Wall, High-Density Polyethylene Conduit Based on Controlled Outside Diameter.

E. NEMA TC-2 – Electrical Plastic Tubing and Conduit.

F. NEMA TC-3 – Fittings Rigid PVC Conduit and Tubing.

G. NEMA Specification TC-7 – Smooth-Wall Coilable Polyethylene Electrical Plastic Conduit.

H. NFPA 70 – National Electrical Code (NEC), most current issue in force.

I. UL Standard 6 – Rigid Metal Conduit.

J. UL Standard 514B – Conduit, Tubing and Cable Fittings.

K. UL Standard 651 – Schedule 40 and 80 Rigid PVC Conduit.

L. UL Standard 651B – Standard for Continuous Length High-Density Polyethylene (HDPE) Conduit.

110-1.3 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for each type of conduit or duct to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Indicate the pay item number for each respective conduit or duct.

D. Shop drawings shall include conduit and/or duct cut sheets with type, size, specifications, UL listing, manufacturer, and catalog or part number.

E. Provide certification that the respective steel conduits used on this project are manufactured from 100 percent domestic steel.

EQUIPMENT AND MATERIALS

110-2.1 GENERAL. Add the following:

"Duct for constructing 2-way, 4-way, or 6-way duct (concrete-encased) shall be 4-inch Schedule 40 PVC Conduit. The duct to be directional-bored shall be Galvanized Rigid Steel Conduit (GRSC) duct, Schedule 40 PVC Conduit, or High-Density Polyethylene (HDPE) duct, sized as detailed on the Plans and as specified herein.

Item AR110202 2" PVC Duct Direct Bury shall be 2-inch High-Density Polyethylene (HDPE) duct."

All materials for these Items shall be in accordance with the FAA Standard Specification 110, Equipment and Materials and as specified herein.

110-2.2 STEEL CONDUIT. Replace this section with the following:

"Rigid Steel Conduit and fittings shall be hot-dipped, galvanized, UL-listed, and produced in accordance with UL Standard 6 – Rigid Metal Conduit and ANSI C80.1 – Rigid Steel Conduit, Zinc Coated. Couplings, connectors, and fittings for rigid steel conduit shall be threaded, galvanized steel or galvanized, malleable iron, specifically designed and manufactured for the purpose. Fittings shall conform to ANSI C80.4 – Fittings Rigid Metal Conduit and EMT and UL 514B – Conduit, Tubing, and Cable Fittings. Set screw type fittings are not acceptable. Steel used to manufacture conduits shall be 100 percent domestic steel. Contractor shall provide certification that the respective steel conduits used on this project are manufactured from 100 percent domestic steel.

Miscellaneous Fittings. Fittings shall be suitable for use with conduits and ducts supplied. All fittings for use with rigid metal conduit shall be threaded. Set screw-type fittings are not acceptable. All conduit bodies, fittings, and boxes installed in classified

hazardous locations (Class I, Division 1 or 2, Group D) shall be suitable for use in Class I, Division 1, and Group D locations. Fittings shall be as manufactured by Appleton, Crouse-Hinds, Hubbel-Killark, O-Z/Gedney, or approved equal."

110-2.3 PLASTIC CONDUIT. Add to this section:

"Conduits for concrete encasement shall be Schedule 40 PVC, UL-listed, rated for 90°C cable-conforming to NEMA Standard TC-2 and UL 651, listed suitable for concrete encasement. Conduits for directional boring shall be Schedule 40 PVC or Schedule 80 PVC conduit, UL-listed, rated for 90°C cable-conforming to NEMA Standard TC-2 and UL 651 and suitable for directional boring installation, Schedule 80 HDPE conduit, UL-listed, conforming to NEMA Standard TC-7 and UL 651B and suitable for directional boring installation, or Wall Type SDR 9 or SDR 11 HDPE conduit manufactured in accordance with ASTM D-3350 (Specification of Polyethylene Plastics Pipe and Fittings Materials) and ASTM F2160 (Standard Specification for Solid Wall, High-Density Polyethylene Conduit Based on Controlled Outside Diameter), and suitable for directional boring installation. **Per NEC 300.5 (K), raceways installed using directional boring equipment shall be approved for the purpose. Provide manufacturer's literature confirming the respective duct is suitable for directional boring with the respective Shop Drawing submittal.** Conduits shall be suitable for underground applications encased in concrete or direct burial, and suitable for exposed applications aboveground."

110-2.8 NON-METALLIC SPLIT DUCT. Non-metallic spilt duct shall be used to extend existing duct that contains cables and/or for protection of existing cables as detailed on the Plans. Non-metallic split duct shall be Schedule 40 PVC designed for use with power and control cable applications. Non-metallic split shall be suitable for direct burial in earth and concrete encasement and exhibit superior impact strength. Joints shall be sealed with corrosion-resistant tape and heavy-duty plastic straps as recommended by the split duct manufacturer for the application. Split duct sleeve couplings, duct sweeps, fittings, and accessories shall be by the same manufacturer to assure system integrity. Non-metallic split duct shall be manufactured by Carlon Electrical Products, or approved equal. 4-in. Schedule 40 split ducts shall be Carlon Part Number 49015SD or approved equal. Install split duct as detailed on the Plans and in conformance with manufacturer's recommendations for the respective application. Where split duct is to be concrete-encased, confirm it is suitable for the respective application with the manufacturer.

110-2.9 DUCT SPACERS. Provide duct spacers to provide proper separation of conduits installed in concrete encased duct. Duct spacers shall be designed to provide 3" separation of conduits. Duct spacers shall be Underground Devices Incorporated Wunpeece Series suitable for the respective size and quantity of ducts, approved equal. Contact information for Underground Devices Incorporated is address: 3304 Commercial Avenue, Northbrook, Illinois 60062, Phone: (847) 205-9000, Fax: (847) 205-9004. Confirm catalog numbers with the manufacturer for the respective application.

110-2.10 2" HDPE UNIT DUCT. Item AR110202 2" PVC Duct Direct Bury shall be 2-inch HDPE (High-Density PolyEthylene) duct. HDPE Unit Duct shall be suitable for underground applications direct burial in earth or concrete, Schedule 40 minimum wall thickness, UL-listed, conforming to NEMA Standard TC-7 and UL 651B. Conduit shall be manufactured in accordance with ASTM D-3350 (Specification of Polyethylene Plastics Pipe and Fittings Materials) and ASTM F2160 (Standard Specification for Solid Wall, High-Density Polyethylene Conduit Based on Controlled Outside Diameter). Where the 2-inch HDPE duct is also used for boring applications it shall be suitable for directional boring installation and the respective shop drawing shall include manufacturer's literature confirming the respective duct is suitable for directional boring installation. Sizes of smooth wall high-density polyethylene duct shall conform to the minimum dimensional requirements specified below (Schedule 40 shown below):

Nominal Duct Size	Nominal Inside Diameter	Minimum Wall	Nominal Outside Diameter*
2"	2.047"	0.154"	2.375"

* Dimensions include allowance for duct eccentricity.

CONSTRUCTION METHODS

110-3.1 GENERAL. Add to this section:

"The proposed concrete-encased ducts shall be constructed at the locations and in accordance with the details shown on the Construction Plans. Ducts shall be installed 18 in. minimum below grade. Ducts located in area subject to farming shall be 42 in minimum below grade. Where detailed on the Plans or where required to avoid obstructions, ducts shall be buried deeper. Where concrete-encased duct interfaces to directional-bored duct at a pavement crossing, the concrete encasement shall be installed up to the respective pavement edge. Where concrete-encased duct interfaces to an electrical handhole or manhole, the concrete encasement shall be installed up to the respective handhole or manhole. Provide bushings or bells at conduit terminations in electrical handholes or manholes.

Underground ducts installed by directional-boring method shall be installed in a manner that will not damage any existing underground utilities, and shall not disturb or damage the respective pavement or roadway surface. Ducts shall be directional-bored at the locations shown on the Construction Plans. The ducts will be bored at a minimum depth of 24 in. below the bottom of the pavement it is being bored under. Ducts installed under paved areas and roadways shall extend a minimum of 10 ft beyond the respective pavement or roadway surface. A pull wire will be left in the conduit if it is to be left vacant. The ends of the conduit will be sealed with approved plugs.

High-Density Polyethylene Unit Duct may be installed in trench, by boring method, or plowed in conformance with the respective manufacturer's recommendations and

instructions. Where High-Density Polyethylene Unit Duct is installed by plowing method conform to the requirements of Item 108 regarding installation of unit duct.

The Contractor shall determine if there is a conflict between the installation of the proposed electrical ducts and any existing utilities. He will make all necessary adjustments in depth of installation to avoid any and all proposed underground improvements."

110-3.7 RESTORATION. Add to this section:

"Any and all trenches and disturbed areas will be backfilled and restored to a smooth grade and seeded to the satisfaction of the Engineer. All trench settlement shall be corrected for a period of one year. Restoration, grading, and seeding of areas disturbed during the installation of the proposed ducts will be incidental to the respective pay item for which the duct is installed. The fertilizing and seeding will be completed in accordance with Items 901 and 908, but will be incidental to the respective pay item for which the duct is installed."

110-3.8 LOCATING OF EXISTING UNDERGROUND UTILITIES AND CABLES. The location, size, and type of material of existing underground and/or aboveground utilities indicated on the Plans are not represented as being accurate, sufficient, or complete. Neither the Owner nor the Engineer assumes any responsibility whatever in respect to the accuracy, completeness, or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size, and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. It shall be the Contractor's responsibility to determine the actual location of all such facilities, including service connections to underground utilities. Prior to construction, the Contractor shall notify the utility companies of his operational plans, and shall obtain from the respective utility companies detailed information and assistance relative to the location of their facilities and the working schedule of the companies for removal or adjustment, where required. In the event an unexpected utility interference is encountered during construction, the Contractor shall immediately notify the utility company of jurisdiction. The Owner's Representative and/or the Resident Engineer shall also be immediately notified. Any damage to such mains and services shall be restored to service at once and paid for by the Contractor at no additional cost to the Contract.

All utility cables and lines shall be located by the respective utility. **Contact JULIE (Joint Utility Location Information for Excavators) for utility information, phone: 1-800-892-0123.** Contact the FAA (Federal Aviation Administration) for assistance in locating FAA cables and utilities. Location of FAA power, control, and communication cables shall be coordinated with and/or located by the FAA. Also contact Airport Director/Manager and Airport Personnel for assistance in locating underground Airport cables and/or utilities. Also coordinate work with all aboveground utilities.

Contractor shall locate and mark all existing cables within ten (10) feet of proposed excavating/trenching area. Any cables found interfering with proposed excavation or cable/trenching shall be hand dug and exposed. Any damaged cables shall be immediately

repaired to the satisfaction of the Resident Engineer at the Contractor's expense. The Resident Engineer and Owner shall be notified immediately if any cables are damaged.

Payment for locating and marking underground utilities and cables will not be paid for separately, but shall be considered incidental to the respective duct installation.

METHOD OF MEASUREMENT

110-4.1. The quantity of conduit to be paid for shall be the number of lin. ft of ducts of the particular type installed and measured in-place, complete, and accepted by the Resident Engineer.

BASIS OF PAYMENT

110-5.1. Payment will be made at the contract unit price per each type and size of duct completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials; for all sawing and pavement removal; for all duct interface work to handholes/manholes including coring of handholes/manholes; for all excavation and backfilling with aggregate backfill, earth backfill, and concrete; and for all labor, coordination, equipment, tools, and incidentals necessary to complete this Item.

Payment will be made under:

Item AR110012 2" Directional Bore - per lin. ft
Item AR110014 4" Directional Bore - per lin. ft
Item AR110202 2" PVC Duct Direct Bury - per lin. ft
Item AR110504 4-Way Concrete-Encased Duct - per lin. ft
Item AR110506 6-Way Concrete-Encased Duct - per lin. ft
Item AR110550 Split Duct - per lin. ft

ITEM AR110610
ELECTRICAL HANDHOLE

DESCRIPTION

110610-1.1. This item of work shall consist of the construction of electrical handholes with lids complete, in accordance with this Specification and as detailed on the Construction Plans.

110610-1.2 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for handholes to be used on the project. Shop drawings shall be clear and legible. Copies that are illegible will be rejected. Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Concrete mix design for handholes to be cast in place.

D. Precast concrete handholes and manholes must be on IDOT (Illinois Department of Transportation) List of Certified Precast Concrete Producers. Provide information on respective precast concrete producer for precast handholes and drawings for respective handholes.

E. Provide cut sheets with part number and specification for handhole frame and lid.

MATERIALS

110610-2.1. Concrete shall conform to Item 610. The handholes shall be provided with extra heavy-duty square slab type manhole frames and spring assist hatch series hinged solid lids capable of withstanding minimum 100,000-pound loads as called for in FAA Advisory Circular AC 150/5320-6D Appendix 3, NEENAH R-3498-K2S frame and lid, or an approved equal. Lids for the handholes containing high-voltage cables shall include lettering labeled “HIGH-VOLTAGE”. Lids for the handholes containing low-voltage cables shall include lettering labeled “LOW-VOLTAGE”.

CONSTRUCTION METHODS

110610-3.1. The electrical handholes shall be constructed in accordance with the details as shown on the Construction Plans.

METHOD OF MEASUREMENT

110610-4.1. The number of electrical handholes to be paid for shall be the number of structures constructed in place and accepted by the Resident Engineer.

BASIS OF PAYMENT

110610-5.1. Payment will be made at the contract unit price bid for each electrical handhole completed and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling, and placing of the materials; for all coring and labor associated with conduit, duct, cable in unit duct, and/or cable entries; and for all labor, equipment, tools, and incidentals necessary to complete the structure.

Payment will be made under:

Item AR110610 Electrical Handhole - per each

ITEM AR110710
ELECTRICAL MANHOLE

DESCRIPTION

110710-1.1. This item of work shall consist of the construction of an electrical manhole with lids complete, in accordance with this Specification and as detailed on the Construction Plans.

110710-1.2 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for each type of electrical manhole to be used on the project. Shop drawings shall be clear and legible. Copies that are illegible will be rejected. Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, subcontractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Precast concrete handholes and manholes must be on IDOT (Illinois Department of Transportation) List of Certified Precast Concrete Producers. Provide information on respective precast concrete producer for precast manholes and drawings for respective manholes.

D. Provide cut sheets with part number and specification for manhole frame and lid.

MATERIALS

110710-2.1. Electrical manholes shall be constructed in accordance with the details as shown on the Construction Plans. The manhole shall be provided with heavy-duty manhole frame and lid capable of withstanding minimum 50,000-pound load, NEENAH Foundry Company R-1640-C frame and lid, or an approved equal.

A. Lids for the high-voltage manholes shall include lettering labeled **"HIGH-VOLTAGE"**.

B. Lids for the low-voltage manholes shall include lettering labeled **"LOW-VOLTAGE**" or **"0V - 600V ELECTRIC"**.

CONSTRUCTION METHODS

110710-3.1. Electrical manholes shall be constructed in accordance with the details as shown on the Construction Plans.

METHOD OF MEASUREMENT

110710-4.1. The number of electrical manholes to be paid for shall be the number of structures constructed in place and accepted by the Resident Engineer.

BASIS OF PAYMENT

110710-5.1. Payment will be made at the contract unit price bid for each electrical manhole completed and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling, and placing of the materials; for all coring, coordination, and labor associated with conduit, duct, cable in unit duct, and/or cable entries; and for all labor, equipment, tools, and incidentals necessary to complete the structure.

Payment will be made under:

Item AR110710 Electrical Manhole - per each

ITEM AR110715
ELECTRICAL MANHOLE SPECIAL

DESCRIPTION

110715-1.1. This item of work shall consist of the construction of an airport rated electrical manhole with lids complete, in accordance with this Specification and as detailed on the Construction Plans.

110715-1.2 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for each type of electrical manhole to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Precast concrete handholes and manholes must be on IDOT (Illinois Department of Transportation) List of Certified Precast Concrete Producers. Provide information on respective precast concrete producer for precast manholes and drawings for respective manholes.

D. Provide cut sheets with part number and specification for manhole frame and lid.

MATERIALS

110715-2.1. Airport electrical manholes shall be constructed in accordance with the details as shown on the Construction Plans. The manhole shall be provided with extra heavy-duty airport manhole frame and lid capable of withstanding minimum 100,000-pound loads as called for in FAA Advisory Circular AC 150/5320-6D Appendix 3, NEENAH Foundry Company R-3492-A frame and lid, or an approved equal.

A. Lids for the high-voltage manholes shall include lettering labeled "**HIGH-VOLTAGE**".

B. Lids for the low-voltage manholes shall include lettering labeled "**LOW-VOLTAGE**" or "**0V - 600V ELECTRIC**".

C. Lids for the manholes containing FAA REIL circuits shall include lettering labeled **"FAA-REILS**".

D. Lids for the manholes containing MALSR power wiring shall include lettering labeled **"FAA-MALSR**", or **"FAA-POWER"**.

CONSTRUCTION METHODS

110715-3.1. Airport electrical manholes shall be constructed in accordance with the details as shown on the Construction Plans.

METHOD OF MEASUREMENT

110715-4.1. The number of airport electrical manholes to be paid for shall be the number of structures constructed in place and accepted by the Resident Engineer.

BASIS OF PAYMENT

110715-5.1. Payment will be made at the contract unit price bid for each airport electrical manhole completed and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling, and placing of the materials; for all coring, coordination, and labor associated with conduit, duct, cable in unit duct, and/or cable entries; and for all labor, equipment, tools, and incidentals necessary to complete the structure.

Payment will be made under:

Item AR110715 Electrical Manhole Special - per each

ITEM AR125 INSTALLATION OF AIRPORT LIGHTING SYSTEMS

DESCRIPTION

125-1.1. Revise this paragraph to read as follows:

"This Item of work shall consist of furnishing and installing runway lights, threshold lights, taxiway lights, and taxi guidance signs at the locations shown on the Construction Plans and in accordance with the details shown on the Plans. This Item of work shall also include the removal of base-and stake-mounted runway and taxiway lights. Also included in this Item will be the testing of the installation and all incidentals necessary to place the lighting systems into operation, completed, and to the satisfaction of the Resident Engineer."

125-1.9 REFERENCES.

A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.4 – Fittings Rigid Metal Conduit and EMT.

C. FAA AC No. 150/5340-30D "DESIGN AND INSTALLATION DETAILS FOR AIRPORT VISUAL AIDS".

D. FAA AC No. 150/5345-42F "SPECIFICATION FOR AIRPORT LIGHT BASES, TRANSFORMER HOUSINGS, JUNCTION BOXES, AND ACCESSORIES".

E. FAA AC No. 150/5345-44H "SPECIFICATION FOR RUNWAY AND TAXIWAY SIGNS".

F. FAA AC No. 150/5345-46C "SPECIFICATION FOR RUNWAY AND TAXIWAY LIGHT FIXTURES".

G. FAA AC No. 150/5345-47B "ISOLATION TRANSFORMERS FOR AIRPORT LIGHTING SYSTEMS".

H. FAA AC No. 150/5345-53 "AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM" (most current issue) and AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum.

I. UL Standard 6 – Rigid Metal Conduit.

J. UL Standard 514B – Conduit, Tubing and Cable Fittings.

125-1.10 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for airfield lighting equipment and materials to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Cut sheets with part number and specifications for each airfield light fixture. Include cut sheets with part numbers and dimensions for mounting stakes, base cans, cover plates, transformers, and associated components for each light airfield fixture.

D. Concrete mix design.

E. Provide cut sheets with manufacturer's name, catalog number, dimensions, material and UL listing for each type and size ground rod. Include certification of 100% domestic steel for ground rods. Include cut sheets for exothermic-weld connections, ground lugs, and ground wire.

F. Provide cut sheets for all types of conduit used with the airfield light fixtures (for example galvanized rigid steel conduit). Include certification that steel conduits are made with 100 percent domestic steel.

EQUIPMENT AND MATERIALS

125-2.1 GENERAL. Add the following to this section:

"D. Non-metallic light fixtures or plastic couplings will not be acceptable under this Contract. Proposed runway lights shall be Type L-862, with 120-Watt quartz lamps. Lens colors for runway lights shall be as detailed on the Plans. Threshold lights shall be Type L-862, with 200-Watt quartz lamps. Lens colors for threshold lights shall be bi-color Red/Green. All proposed taxiway lights shall be Type L-861-T, with 30-Watt quartz lamps and blue lenses. All lights shall have an overall height of 24 in. All of the above lights shall be manufactured in accordance to FAA Specification AC No. 150/5345-46C, or latest edition in force.

The concrete used in the construction of these Items shall be in accordance with Item 610."

125-2.4 CONDUIT. Add the following to this section:

"Rigid Steel Conduit and fittings shall be hot-dipped, galvanized, UL-listed, produced in accordance with UL Standard 6 – Rigid Metal Conduit and ANSI C80.1 – Rigid Steel Conduit, Zinc Coated. Couplings, connectors, and fittings for rigid steel conduit shall be threaded galvanized steel or galvanized malleable iron specifically designed and manufactured for the purpose. Fittings shall conform to ANSI C80.4 – Fittings Rigid Metal Conduit and EMT. Set screw type fittings are not acceptable. Galvanized rigid steel conduit shall be produced from 100 percent domestic steel."

125-2.8 LIGHT CANS. Add the following to this section:

"Each light base can and/or splice can shall include internal and external ground lugs. Cans shall be the size and depth as detailed on the Plans. L-867 splice cans shall have galvanized steel covers, 3/8 in. thick, with stainless steel bolts."

125-2.11 AIRFIELD SIGNS. Add the following to this section:

"The proposed taxi guidance signs and/or replacement sign panels shall conform to Advisory Circular 150/5345-44G and be FAA-approved. The signs shall be Size 1, 18-in. sign face with a 12-in. legend; Style 2, powered from a 4.8 to 6.6 amp series lighting circuit (for use on the taxiway circuits); Class 2, for operation down to -55ºC; medium-intensity, Mode 2, to withstand wind loads of 200 M.P.H., base-mounted, double-sided, as specified on the Plans.

Lighted taxi guidance signs on the Airport are Lumacurve signs. For this reason, all modifications to the existing signs will be Lumacurve products. Lumacurve is a brand of Standard Sign, Inc.

The signs shall read as described on the Construction Plans. The proposed taxi guidance signs will be Type L-858-Y direction, destination, and boundary signs (black legend on yellow background); Type L-858-R mandatory instruction sign (black outline on outside edge of white legend on red background); and Type L-858-L location sign (yellow legend and border on black background). Where noted on the Plans blank black replacement panels shall be provided.

The concrete used in the construction of these Items shall be in accordance with Item 610."

125-2.14 IDENTIFICATION TAGS. Identification tags shall be attached to each new fixture and sign. The tag shall be of the type and with the lettering shown on the Plans. The cost of furnishing and installing these tags shall be included in the unit price for the fixtures or signs and no additional compensation will be allowed.

125-2.15 ANTI-SEIZE COMPOUND. Prior to installing the proposed taxi guidance signs, the Contractor will apply an oxide-inhibiting, anti-seizing compound to all screws, nuts, breakable

coupling, and all places where metal comes into contact with metal. The anti-seize compound will be as manufactured by I.T.T. brand name "Contax", or approved equal.

125-2.16 STAINLESS STEEL BOLTS. All base plate-mounting bolts and stake-mounting bolts shall be stainless steel.

125-2.17 GROUND RODS. Furnish and install 5/8-in. diameter by 8-ft long (minimum), UL-listed, copper-clad, ground rod at each L-867 transformer base/light can and at each stake-mounted light fixture. Steel used to manufacture ground rods shall be 100 percent domestic steel.

CONSTRUCTION METHODS

125-3.1 GENERAL. Add the following to this section:

"The proposed taxi guidance signs, taxiway, runway, and threshold lights shall be installed in accordance with the details shown on the Construction Plans. The taxi guidance signs shall be relocated, adjusted, and/or installed in accordance with the details shown on the Construction Plans.

The existing airfield lights and taxi guidance signs designated for removal will be removed in their entirety. The Contractor will remove the existing lights and existing taxi guidance signs, including mounting stakes, bases, foundations, and transformers. The electrical wire will be disconnected from each light and placed underground at a minimum depth of 18-in. If the Contractor elects to salvage the cable within the circuit of the lights to be removed, shown in the Construction Plans as cable to be abandoned, any cost associated with removal of the cable shall be considered incidental to the Contract and no additional compensation will be allowed. The existing lights, taxi guidance signs, transformers, and mounting stakes shall be turned over to the Airport Director. Any materials not salvaged by the Airport, shall be disposed of off the airport site, in a legal manner, at the Contractor's own expense. The concrete sign bases and base mounted lights shall be removed and earth material will be placed in the hole made from the sign base removal. The disturbed area will be seeded and mulched in accordance with Item 901 and 908. The seeding and mulching will be considered as an incidental item to the sign removal and/or light removal and no additional compensation will be allowed.

Obtaining the required borrow material from an offsite borrow, placing the borrow material, grading, seeding, and mulching the disturbed areas will be considered as an Incidental Item to the proposed taxi guidance signs and lights, and no additional compensation will be allowed.

Contractor shall coordinate work and any power outages with the Airport Director and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall

be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures including, but not limited to, 29 CFR section 1910.147 The Control of Hazardous Energy (lockout/tagout).

The Contractor shall furnish and install all electrical materials necessary for complete and operational installation of the airfield lighting systems as shown on the Plans and detailed herein. The complete installation and wiring shall be done in a neat, workmanlike manner. All electrical work shall comply with the requirements of the NFPA 70 - National Electrical Code (NEC) most current issue in force and the applicable Federal Aviation Administration standards, orders, and advisory circulars. Equipment shall be installed in conformance with the respective manufacturer's directions and recommendations for the respective application. Any installations which void the UL listing, ETL/Intertek listing, (or other third party listing), and/or the manufacturer's warranty of a device will not be permitted."

125-3.4 IDENTIFICATION NUMBERS. The Contractor will place light identification number tags on ALL of the proposed runway lights, threshold lights, taxiway lights, and taxi guidance signs as detailed on the Plans. The correct light identification numbers are shown on the Construction Plans.

125-3.5 GROUNDING FOR AIRFIELD LIGHTS AND TAXI GUIDANCE SIGNS. Grounding for Runway Lights, Taxiway Lights, and Lighted Taxi Guidance Signs shall be as detailed on the Plans and as specified herein. Per FAA AC 150/5340-30D DESIGN AND INSTALLTION DETAILS FOR AIRPORT VISUAL AIDS, Chapter 12, Part 12.6; a safety ground must be installed at each light fixture. The purpose of the safety ground is to protect personnel from possible contact with an energized light base or mounting stake as the result of a shorted cable or isolation transformer. A safety ground shall be installed at each transformer base/light can associated with runway lights, taxiway lights, and lighted taxi guidance signs. A safety ground shall also be installed at each stake-mounted light fixture. The safety ground shall be a #6 AWG bare copper conductor connected to the ground lug on the respective L-867 transformer base/light can or mounting stake and a 5/8-in. diameter by 8-ft long (minimum), UL-listed, copper-clad ground rod. Connections to ground lugs on the L-867 transformer base/light can or mounting stake shall be with a UL-listed grounding connector. Connections to ground rods shall be made with exothermic-weld type connectors, Cadweld by Erico Products, Inc., Solon, Ohio (Phone: 800-248-9353), Thermoweld by Continental Industries, Inc., Tulsa, Oklahoma (Phone: 918-663-1440), or Ultraweld by Harger, Grayslake, Illinois (Phone: 800-842-7437). Exothermic-weld connections shall be installed in conformance with the respective manufacturer's directions using molds, as required for each respective application. Bolted connections will not be permitted at ground rods. Top of ground rods shall be buried 24 in. minimum below grade.

METHOD OF MEASUREMENT

Add the following:

"Removal and disposal of existing sign foundations associated with the relocation of a taxi guidance sign will be considered incidental to the relocation of the respective taxi guidance sign and no additional compensation will be allowed."

BASIS OF PAYMENT

Add the following:

"If upon delivery and incorporation of any materials, the Contractor has failed to provide the necessary submittals as required by Sections 30-18, 40-01, and 40-03, of the Standard Specifications the pay item will not be included on the Contractor Progress Payment report until such submittals have been furnished."

Payment will be made under:

Item AR125415 MITL – Base Mounted – per each
Item AR125470 Modify Existing Sign Panel – per each"
Item AR125515 HIRL – Base Mounted – per each
Item AR125550 HI Threshold Light Base Mtd – per each
Item AR125565 Splice Can – per each
Item AR125964 Relocate Taxi Guidance Sign – per each
Item AR125901 Remove Stake Mounted Light – per each
Item AR125902 Remove Base Mounted Light – per each
Item AR125904 Remove Taxi Guidance Sign – per each"

ITEM AR125610
REILS

DESCRIPTION

125610-1.1. This item of work shall consist of furnishing and installing Runway End Identification Lights (REILS) at the locations shown on the Construction Plans. Each installation will be in accordance with the details on the Plans and these Special Provisions. Also included in this item will be the testing of the installation and all incidentals necessary to complete and place the lighting system into proper operation to the satisfaction of the Resident Engineer.

125610-1.2 REFERENCES.

A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.4 – Fittings Rigid Metal Conduit and EMT.

C. FAA AC 150/5345-42F "SPECIFICATION FOR AIRPORT LIGHT BASES, TRANSFORMER HOUSINGS, JUNCTION BOXES, AND ACCESSORIES".

D. FAA AC No. 150/5345-51A "SPECIFICTION FOR DISCHARGE TYPE FLASHING LIGHT EQUIPMENT"

E. FAA AC No. 150/5345-53 "AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM" (most current issue) and AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum.

F. NFPA 70 – National Electrical Code (most current issue in force).

G. UL Standard 6 – Rigid Metal Conduit.

H. UL Standard 467 – Grounding and Bonding Equipment.

I. UL Standard 486A-486B Wire Connectors.

J. UL Standard 514B – Conduit, Tubing and Cable Fittings.

125620-1.3 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for REIL units and materials to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Cut sheets with part number and specifications for REIL system.

D. Concrete mix design.

E. Provide cut sheets for L-867 light bases.

F. Provide cut sheets with manufacturer's name, catalog number, dimensions, material and UL listing for each type and size ground rod. Include certification of 100% domestic steel for ground rods. Include cut sheets for exothermic-weld connections, ground lugs, and ground wire.

G. Provide cut sheets for all types of conduit used with the PAPI installation (for example galvanized rigid steel conduit). Include certification that steel conduits are made with 100 percent domestic steel.

EQUIPMENT AND MATERIALS

125610-2.1 REILS. The proposed REILS shall be Type L-849V, Style A (unidirectional, high intensity, one brightness step), base mounted, consisting of two lighting units (a master unit with controller and a slave unit) with 240 VAC ± 10%, 60 Hz input power requirement, transient suppression, and all accessories as per FAA AC 150/5345-51A and approved by the FAA AC 150/5345-53B, or latest revision. The controller shall include a main breaker or disconnect switch to provide overcurrent protection and to serve as a maintenance safety switch to disconnect all power to the REILS when in the "off" or "tripped" position. Also include an elapsed time meter to indicate the number of hours of operation. REILS shall be Flash Technology Corporation 812 Series, or approved equal.

125610-2.2 POWER AND CONTROL CABLE. Feeder cables from the respective power source to the respective master REIL installation will be paid for under Item 108. Power cables between the REIL master unit and the REIL slave unit shall be as detailed on the Plans and in accordance with the respective REIL manufacturer's recommendations. Control cable shall be as detailed on the Plans, as recommended by the respective REIL manufacturer and per FAA AC 150/5345-51A.

125610-2.3 CONDUIT AND DUCTS. Conduit and ducts for the REIL systems shall conform to Item 110, per manufacturer's recommendations, as detailed on the Plans, and as specified herein. Conduit for power and control cables from the REIL Master Control Unit to the REIL

Slave unit shall be 2-inch Galvanized Rigid Steel Conduit, or larger where required by NEC and/or manufacturer's recommendations for the respective cables. GRSC shall be heavy wall, hot-dipped, galvanized steel pipe bearing the UL label and conforming to UL-6 and ANSI Specification C80.1. Couplings, connectors, and fittings for rigid steel conduit shall be threaded galvanized steel or galvanized malleable iron specifically designed and manufactured for the purpose. Fittings shall conform to ANSI C80.4 and UL-514B. Galvanized rigid steel conduit shall be produced from 100 percent domestic steel.

125610-2.4 REIL BASE/SPLICE CANS. REIL Base/Splice cans shall conform to the requirements of FAA AC 150/5345-42F for Type L-867, Class IA, Size D (16-inch nominal diameter), 24-inch deep, and/or as detailed on the Plans. Base cans shall include internal and external ground lugs. Base cans shall have 3/8" minimum thick galvanized steel covers, or aviation yellow powder coat painted steel covers with 2" NPT holes compatible with the respective REIL units and stainless steel bolts. Include breakable couplings for mounting REILS to the respective base.

125610-2.5 ANTI-SEIZE COMPOUND. Prior to installing the proposed REIL units, the Contractor will apply an oxide-inhibiting, anti-seizing compound to all screws, nuts, breakable coupling, and all places where metal comes into contact with metal. The anti-seize compound will be as manufactured by I.T.T. brand name "Contax", or an approved equal.

125610-2.6 STAINLESS STEEL BOLTS. All base plate mounting bolts shall be stainless steel.

125610-2.7 GROUND RODS. Ground rods shall be 3/4-inch diameter by 10-foot long UL-listed, copper-clad, with 10-mil minimum copper coating.

125610-2.8 CONCRETE. Concrete associated with the each REIL foundation pads and/or splice cans shall conform to Item 610 Portland Cement Concrete of the Standard Specifications for Construction of Airports.

125610-2.9 LEGEND PLATES. Legend plates shall be required for all REIL units, safety switches, circuit breakers, disconnects, etc. Legend plates shall be provided to identify the equipment controlled, the power source and voltage, and the function of each device. Legend plates shall be weather-proof and abrasion-resistant phenolic material. Lettering shall be black letters on a white background, unless otherwise noted.

CONSTRUCTION METHODS

125610-3.1 INSTALLATION OF REILS. The REILS shall be installed at the locations shown on the Plans. Installation of REILS systems shall conform to FAA AC No. 150/5345-51A titled "SPECIFICATION FOR DISCHARGE-TYPE FLASHING LIGHT EQUIPMENT", the respective manufacturer's instructions, as detailed on the Plans, and as specified herein. The Contractor shall install L-867 base/splice cans and construct concrete bases for the REIL units in accordance with the respective REIL manufacturer's recommendation. Because of the difference in manufacturers' installations, all required trenching, cable, and ducts between the master and

slave units, associated hardware, mounting requirements, etc. shall be installed per the respective REIL manufacturer's recommendation, and shall be considered part of the installation with no additional compensation.

Contractor shall coordinate work and any power outages with the Airport Director, the respective Airport personnel, and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures, including, but not limited to, 29 CFR Section 1910.147 The Control of Hazardous Energy (lockout/tagout).

125610-3.2 ELECTRICAL. The Contractor shall furnish and install all electrical materials necessary for complete and operational installation of the REIL systems as shown on the Plans and detailed herein. The complete installation and wiring shall be done in a neat, workmanlike manner. All electrical work shall comply with the requirements of the NFPA 70 - National Electrical Code (NEC) most current issue in force. Electrical equipment shall be installed in conformance with the respective manufacturer's directions and recommendations for the respective application. Any installations which void the UL listing, ETL listing, (or other third party listing), and/or the manufacturer's warranty of a device will not be permitted.

125610-3.3 CABLE INSTALLATION FOR REILS. Installation of cables shall conform to Item 108, the applicable sections of FAA AC 150/5345-51A, per the respective equipment manufacturer's recommendations, as detailed on the Plans, and as specified herein. Where cable splices are required they shall conform to Item 108 and the details on the Plans. Power and control cables in conduit or duct between the REIL Master unit and the REIL Slave unit shall be installed as detailed on the Plans and in conformance with the respective REIL manufacturer's recommendations and instructions. Cables and conduits between the REIL units will be considered incidental to the REIL installation and no additional compensation will be allowed.

125610-3.4 CONDUIT INSTALLATION FOR REILS. Installation of conduit shall conform to Item 110, the respective REIL manufacturer's installation instructions and/or recommendations, as detailed on the Plans and as specified herein. Control cables between REIL units shall be installed in a separate dedicated conduit. Power cables between the REIL units shall be installed in a separate dedicated conduit.

125610-3.5 GROUNDING FOR REILS. Grounding for REILS shall conform to the respective REIL manufacturer's installation instructions, as detailed on the Plans, and as specified herein. The power circuit to Master REIL unit, and each slave unit, shall include an equipment ground wire of the same size and type as the phase conductors. Furnish and install a 3/4-inch diameter by 10-foot long copper-clad ground rod at each REIL unit. Bond each REIL unit housing and the REIL base can to the respective ground rod in accordance with the manufacturer's instructions with a #6 AWG bare solid or stranded (per REIL manufacturer requirements) copper grounding electrode conductor. Top of ground rods shall be buried 30 inches below grade. All connections to ground rods shall be exothermic-weld, as manufactured by Cadweld,

Thermoweld, or Ultraweld. Connections to REIL unit frames shall be as recommended by the manufacturer or with a UL-listed grounding connector. Provide multi-terminal ground bar or individual ground lugs to terminate each ground wire in each REIL unit.

125610-3.6 REIL OPERATION.

A. In the automatic mode of operation the REILS shall be activated by a toggle switch on the L-821 control panel located at the Air Traffic Control Tower.

B. In the manual mode of operation the REILS shall be activated by the respective "Hand-Off-Auto" selector switch on the lighting contactor panel located in the vault. In the "Hand" position the REILS will be on.

METHOD OF MEASUREMENT

125610-4.1. The REIL systems to be furnished and installed shall be measured for payment as a unit price per pair (master and slave unit) and shall include all concrete and materials as required for foundations, all cable and conduit between the master and slave units, base/splice cans, equipment, grounding, excavating, restoration, labor, tools, testing, and incidentals necessary to furnish a complete and operational REIL system as approved by the Resident Engineer.

BASIS OF PAYMENT

125610-5.1. Payment shall be made at the contract unit price per pair. This price and payment shall be full compensation for installation of the REIL units and bases; for furnishing and installing all equipment and materials; for all grounding, coordination, excavating, labor, tools, testing, restoration, and incidentals necessary to complete this item of work.

Payment will be made under:

Item AR125610 REILS - per pair

ITEM AR125615
PAPI (L-880 SYSTEM)

DESCRIPTION

125615-1.1. This item of work shall consist of furnishing and installing Precision Approach Path Indicators (PAPI's) at the locations shown on the Construction Plans. Each installation will be in accordance with the details on the Plans and these Special Provisions. Also included in this item will be the testing of the installation and all incidentals necessary to place the respective PAPI system into proper operation and to the satisfaction of the Engineer.

125615-1.2 REFERENCES.

A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.4 – Fittings Rigid Metal Conduit and EMT.

C. FAA AC No. 150/5345-28F "PRECISION APPROACH PATH INDICATOR (PAPI) SYSTEMS"

D. FAA AC 150/5345-42F "SPECIFICATION FOR AIRPORT LIGHT BASES, TRANSFORMER HOUSINGS, JUNCTION BOXES, AND ACCESSORIES".

E. FAA AC No. 150/5345-53 "AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM" (most current issue) and AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum.

F. NFPA 70 – National Electrical Code (most current issue in force).

G. UL Standard 6 – Rigid Metal Conduit.

H. UL Standard 467 – Grounding and Bonding Equipment.

I. UL Standard 486A-486B Wire Connectors.

J. UL Standard 514B – Conduit, Tubing and Cable Fittings.

125615-1.3 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for PAPI units and associated equipment and materials to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Cut sheets with part number and specifications for PAPI System.

D. Include cut sheets with part numbers and dimensions for base cans, cover plates, and associated components.

E. Concrete mix design.

F. Provide cut sheets with manufacturer's name, catalog number, dimensions, material and UL listing for each type and size ground rod. Include certification of 100% domestic steel for ground rods. Include cut sheets for exothermic weld connections, ground lugs, and ground wire.

G. Provide cut sheets for all types of conduit used with the PAPI system (for example galvanized rigid steel conduit). Include certification that steel conduits are made with 100 percent domestic steel.

MATERIALS

125615-2.1 PAPI UNITS. The proposed PAPI units shall be a Type L-880 system consisting of four dust-tight light units (each containing three light channels and three lamps), Style "A" (240 VAC ± 10%, 60 Hz input power), Class I qualified to -35º C, a power and control unit (PCU), and all accessories as per FAA AC 150/5345-28F and approved by the FAA AC 150/5345-53B, or latest revision. The PCU shall include a main breaker to provide overcurrent protection and to serve as a maintenance safety switch to disconnect all power to the PAPI installation when in the "off" or "tripped" position. PAPI systems shall be Crouse-Hinds Catalog Number 880A3A-1, or approved equal. All PAPI units furnished on this project shall be from the same manufacturer. Note where the respective PAPI system requires a voltage system other than 240 VAC, single phase, 2-wire with ground, the Contractor shall be responsible to furnish and install the respective transformers and/or additional feeder cable conductors to accommodate the required voltage system.

125615-2.2 AIMING AND CALIBRATION EQUIPMENT. Furnish one clinometer (aiming and calibration device) with the PAPI units for each respective runway. Aiming and calibration equipment will be incidental to the PAPI units.

125615-2.3 POWER AND CONTROL CABLE. Power cables from the respective power source to the respective PAPI installation shall be sized as detailed on the Plans and in

conformance with Item 108. Control cable shall be as recommended by the respective PAPI manufacturer and per FAA AC 150/5345-28F. Power feeds from the PAPI Power and Control Unit to the PAPI lighting units shall be per manufacturer's recommendations and/or instructions.

125615-2.4 CONDUIT AND DUCTS. Conduit and ducts for the PAPI systems shall conform to Item 110, per manufacturer's recommendations, as detailed on the Plans, and as specified herein. Conduit for power and control cables from the PAPI Power and Control Unit to the PAPI lighting units and between the PAPI lighting units shall be 2-inch Galvanized Rigid Steel Conduit, or larger where required by NEC and/or manufacturer's recommendations for the respective cables. GRSC shall be heavy wall, hot-dipped, galvanized steel pipe bearing the UL label and conforming to UL-6 and ANSI Specification C80.1. Couplings, connectors, and fittings for rigid steel conduit shall be threaded galvanized steel or galvanized malleable iron specifically designed and manufactured for the purpose. Fittings shall conform to ANSI C80.4 and UL-514B. Galvanized rigid steel conduit shall be produced from 100 percent domestic steel.

125615-2.5 SPLICE CANS. Splice cans shall conform to the requirements of FAA AC 150/5345-42F for Type L-867, Class IA, Size B (12-inch nominal diameter), 24-inch deep. Splice cans shall have galvanized steel or aviation yellow powder coat painted steel covers, 3/8 in. thick, or as recommended by the respective PAPI manufacturer where the splice can is installed at the PAPI installation. **Include internal and external ground lugs on each L-867 splice can.**

125615-2.6 ANTI-SEIZE COMPOUND. The Contractor will apply an oxide-inhibiting, anti-seizing compound to all screws, nuts, breakable coupling, and all places where metal comes into contact with metal. The anti-seize compound will be as manufactured by I.T.T. brand name "Contax", or an approved equal.

125615-2.7 STAINLESS STEEL BOLTS. All base plate-mounting bolts shall be stainless steel.

125615-2.8 GROUND RODS. Ground rods shall be 3/4-inch diameter by 10-foot long UL listed copper clad, with 10-mil minimum copper coating. Steel used to manufacture ground rods shall be 100 percent domestic steel.

125615-2.9 CONCRETE. Concrete associated with the each PAPI foundation piers/pad and/or splice can shall conform to Item 610 Portland Cement Concrete of the Standard Specifications for Construction of Airports.

125615-2.10 BOOST TRANSFORMERS. Provide a boost transformer at the vault where the voltage drop from the vault to the respective PAPI Power and Control Unit exceeds 5% (12 Volts for a 240 VAC nominal supply). Boost transformer is not required where the PAPI Power and Control Unit has input power transformer tap adjustments suitable for the respective input voltage and cable losses. Boost transformers shall be rated to handle the respective equipment loads, suitable for connection as 240 VAC, 60 Hz, 1 phase, 2-wire input and provide the proper output voltage at the respective PAPI Power and Control Unit with the PAPI system in operation. Boost transformer shall be UL listed and designed, manufactured, and tested in accordance with ANSI Standard Z535.3 and NEMA ST20 where applicable. Transformer shall be suitable for

indoor/outdoor installation with a NEMA 3R weatherproof enclosure. Boost transformers for PAPI circuits shall be manufactured in the United States to comply with the "Buy American Act". Confirm proper output voltage for the respective application.

125615-2.11 LEGEND PLATES. Legend plates shall be required for all PAPI power control units, safety switches, circuit breakers, disconnects, etc. Legend plates shall be provided to identify the equipment controlled, the power source and voltage, and the function of each device. Legend plates shall be weatherproof and abrasion resistant phenolic material. Lettering shall be black letters on a white background, unless otherwise noted.

CONSTRUCTION METHODS

125615-3.1 INSTALLATION OF PAPI SYSTEMS. Installation of PAPI systems shall conform to FAA AC No. 150/5345-28F titled "PRECISION APPROACH PATH INDICATOR (PAPI) SYSTEMS" and the respective manufacturer's instructions, as detailed on the Plans, and as specified herein. The Contractor shall construct concrete bases for the PAPI system units per manufacturer's instructions and recommendations and/or as shown on the Construction Plans. All bolt placements will be as per manufacturer's recommendations. The structural legs shall have breakable couplings not more than 2 in. from the top of the respective base/foundation. Coordinate conduit installations into the bases as applicable for power, control, and/or grounding cable conduits. The power control unit shall be installed in the location shown on the Plans. The poles/support posts installed to support the unit will be anchored in concrete typical to the PAPI base, and each pole/support post shall have a breakable coupling not more than 2 in. from the top of the concrete base/foundation.

The PAPI units shall be installed and aimed in accordance with manufacturer's specifications and instructions. The aiming angles shall comply with those shown on the Plans.

Contractor shall coordinate work and any power outages with the Airport Director, the respective Airport personnel, and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures, including, but not limited to, 29 CFR Section 1910.147 The Control of Hazardous Energy (lockout/tagout).

125615-3.2 ELECTRICAL. The Contractor shall furnish and install all electrical materials necessary for complete and operational installation of the PAPI systems as shown on the plans and detailed herein. The complete installation and wiring shall be done in a neat, workmanlike manner. All electrical work shall comply with the requirements of the NFPA 70 - National Electrical Code (NEC) most current issue in force. Electrical equipment shall be installed in conformance with the respective manufacturer's directions and recommendations for the respective application. Any installations which void the UL listing, ETL listing, (or other third party listing), and/or the manufacturer's warranty of a device will not be permitted.

125615-3.3 CABLE INSTALLATION FOR PAPI'S. Installation of cables shall conform to Item 108, the applicable sections of FAA AC 150/5345-28F, per the respective equipment manufacturer's recommendations, and as detailed on the Plans. Power and control cables from the PAPI Power and Control Unit to the PAPI lighting units and between the PAPI lighting units shall be installed in 2-inch galvanized rigid steel conduit, or larger where required by NEC and/or manufacturer's recommendations for the respective cables.

125615-3.4 CONDUIT INSTALLATION FOR PAPI'S. Installation of conduit shall conform to Item 110, the respective PAPI manufacturer's installation instructions and/or recommendations, as detailed on the Plans and as specified herein. Coordinate conduit installations into the PAPI foundations and/or L-867 splice cans. Provide duct seal at conduit terminations inside the PAPI Power and Control Unit enclosure.

125615-3.5 GROUNDING FOR PAPI'S. Grounding for PAPI's shall conform to the respective PAPI manufacturer's installation instructions, as detailed on the Plans, and as specified herein. The power circuit to each PAPI unit, including the PAPI PCU (Power and Control Unit), shall include an equipment ground wire of the same size and type as the phase conductors. Furnish and install a 3/4-inch diameter by 10-foot long copper clad ground rod at the PAPI PCU and at each PAPI lighting unit. Bond each PAPI unit (PCU and lighting units) and the respective L-867 splice can to the respective ground rod with a #6 AWG stranded copper grounding electrode conductor. Top of ground rods shall be buried approximately 24 inches below grade. All connections to ground rods shall be made with exothermic, weld-type connectors, Cadweld by Erico Products, Inc., Solon, Ohio, (Phone: 800-248-9353), Thermoweld by Continental Industries, Inc., Tulsa, Oklahoma (Phone: 918-663-1440), or Ultraweld by Harger Lightning Protection Grounding Equipment, Grayslake, Illinois (Phone: 800-842-7437). Connections to L-867 splice cans shall be with UL listed grounding connectors suitable for use in direct burial or concrete encasement applications. Connections to PAPI unit frame shall be as recommended by the manufacturer or with a UL listed grounding connector. All ground rods associated with the complete PAPI installation shall be bonded to together with a #6 AWG solid copper counterpoise conductor. This counterpoise conductor shall be installed in the same trench located 10 inches above the power and control conductors, between each respective PAPI unit (PCU and/or lighting unit).

125615-3.6 GROUNDING REQUIREMENTS. Grounding shall conform to the following as applicable: The Contractor shall furnish and install all grounding shown on the Plans and/or as may be necessary or required to make a complete grounding system, as required by the latest NFPA 70 – National Electrical Code in force. The reliability of the grounding system is dependent on careful, proper installation, and choice of materials. Improper preparation of surfaces to be joined to make an electrical path, loose joints, or corrosion can introduce impedance that will seriously impair the ability of the ground path to protect personnel and equipment and to absorb transients that can cause noise in communications circuits. The following functions are particularly important to ensure a reliable ground system:

A. All products associated with the grounding system shall be UL-listed and labeled.

B. All bolted or mechanical connections shall be coated with a corrosion-preventative compound before joining, Sanchem Inc. "NO-OX-ID "A-Special" compound, Burndy Penetrox E, or equal.

C. Metallic surfaces to be joined shall be prepared by the removal of all non-conductive material, per 2008 NEC Article 250-12. All copper bus bars must be cleaned prior to making connections to remove surface oxidation.

D. Metallic raceway fittings shall be made up tight to provide a permanent low impedance path for all circuits. Metal conduit terminations in enclosures shall be bonded to the enclosure with UL-listed fittings suitable for grounding. Provide grounding bushings with bonding jumpers for all metal conduits entering service equipment (meter base, CT cabinet, main service breaker enclosure, etc.), generator breaker enclosures, and automatic transfer switch enclosures. Provide grounding bushings with bonding jumpers for all metal conduits entering an enclosure through concentric or eccentric knockouts that are punched or otherwise formed so as to impair the electrical connection to ground. Standard locknuts or bushings shall not be the sole means for bonding where a conduit enters an enclosure through a concentric or eccentric knockout.

E. Furnish and install ground rods at all locations where shown on the Plans or specified herein. Ground rods shall be spaced, as detailed on the Plans, and in no case spaced less than one rod length apart. All connections to ground rods and/or buried grounding electrode conductors shall be made with exothermic, weld-type connectors, Cadweld by Erico Products, Inc., Solon, Ohio, (Phone: 1-800-248-9353), Thermoweld by Continental Industries, Inc., Tulsa, Oklahoma (Phone: 918-663-1440), or approved equal. Exothermic-weld connections shall be installed in conformance with the respective manufacturer's directions using molds, as required for each respective application. Bolted connections will not be permitted at ground rods or at buried grounding electrode conductors.

F. All connections, located above grade, between the different types of grounding conductors shall be made using UL-listed, double-compression, crimp-type connectors or UL-listed, bolted ground connectors. For ground connections to enclosures, cases, and frames of electrical equipment not supplied with ground lugs, the Contractor shall drill required holes for mounting a bolted, ground connector. All bolted, ground connectors shall be Burndy, Thomas and Betts, or equal. Tighten connections to comply with tightening torques in UL Standard 486A to assure permanent and effective grounding.

G. All metal equipment enclosures, conduits, cabinets, boxes, receptacles, etc. shall be bonded to the respective grounding system.

H. Each new feeder circuit and/or branch circuit shall include an equipment ground wire. Metal raceway or conduit shall not meet this requirement. The equipment ground wire from equipment shall not be smaller than allowed by 2008 NEC Table 250-122 "Minimum Size Conductors or Grounding Raceway and Equipment." When conductors are adjusted in size to compensate for voltage drop, equipment-grounding conductors shall be adjusted proportionately according to circular mil. area. All equipment ground wires shall be copper,

either bare or insulated, green in color. Where the equipment grounding conductors are insulated, they shall be identified by the color green, and shall be the same insulation type as the phase conductors.

I. Install grounding electrode conductors and/or individual ground conductors in Schedule 40 or Schedule 80 PVC conduit. Coordinate the installation of PVC conduit sleeves into the PAPI foundations to accommodate grounding electrode conductor installations from the respective PAPI unit to the respective ground rod.

125615-3.7 PAPI OPERATION. For the PAPI units installed on Runway 12R-30L they shall be on 24 hours per day, seven days a week. No control wiring interface between the Air Traffic Control Tower and the Airport Electrical Vault or other respective power source is required for the PAPI units on Runway 12R-30L.

125615-3.8 RESTORATION. All turf areas disturbed by the installation of the PAPI system and associated work shall be restored, graded, and seeded to establish a stand of grass to the satisfaction of the Engineer and will be considered as incidental to the installation of the PAPI.

125615-3.9 INSTRUCTION OF AIRPORT STAFF. Contractor shall provide instruction to airport staff in regard to the operation and maintenance of the PAPI system. Contractor shall demonstrate operating procedures, lamp changing procedures, and items requiring maintenance. Contractor shall furnish operation and maintenance manuals for PAPI and associated equipment.

125615-3.10 FLIGHT CHECK. Prior to final acceptance and activation, the completed PAPI unit will be flight checked by Illinois Division of Aeronautics, and it shall be the Contractor's responsibility to have a representative present to make any necessary adjustments in the aiming of the PAPI units.

METHOD OF MEASUREMENT

125615-4.1 The PAPI systems to be furnished and installed shall be measured for payment as a unit price per each and shall include a Type L-880 system consisting of four light units, a power and control unit (PCU), all concrete and materials as required for foundations, all cable and conduit between and/or at the PAPI lighting units and PCU, grounding, splice cans, equipment, excavating, labor, tools, aiming and calibration equipment, testing, and incidentals necessary to furnish a complete and operational PAPI system as approved by the Resident Engineer.

BASIS OF PAYMENT

125615-5.1. Payment shall be made at the contract unit price per each. This price and payment shall be full compensation for furnishing and installing all materials, for all excavating, labor, tools, equipment, and incidentals necessary to complete this item of work. Cable in unit duct from the respective power source to the respective PAPI installation shall be paid for under item 108.

Payment will be made under:

Item AR125615 PAPI (L-880 System) - per each

ITEM AR125907
REMOVE REILS

DESCRIPTION

This item of work shall consist of the removal of the existing Runway End Identification Lights (REIL) units from the existing threshold of runway end 12R.

CONSTRUCTION

Power for each respective REIL system shall be disconnected at the respective power source prior to removing the respective REIL system. Power for the existing REIL system located on Runway End 12R is understood to be powered from a Power Adapter (a device that provides 120 VAC or 120/240 VAC when connected on a 6.6 Amp series circuit) connected to the Runway 12R-30L series circuit that is powered by a constant current regulator located in the Airport Electrical Vault. Contractor shall field verify to confirm the respective power source for each REIL system.

Contractor shall coordinate work and any power outages with the Airport Director, the respective Airport personnel, and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures, including, but not limited to, 29 CFR Section 1910.147 The Control of Hazardous Energy (lockout/tagout).

The Contractor shall remove the REIL units when the runway is closed. The Contractor shall turn the REIL units over to the Airport Director. The Contractor shall coordinate the removal of the existing REIL units with the Airport Manger. The Contractor shall remove the existing REIL bases and dispose of them off the airport site in a legal manner. The existing electrical cables shall be disconnected and abandoned in place or removed to accommodate new construction. The holes left from the removal of the concrete bases will be filled with earth material. The earth material will be compacted to prevent any future settlement. The earth material will be obtained from off the Airport site. The disturbed area will be restored, graded, and seeded to the satisfaction of the Engineer, and will be considered as an incidental item to the removal of the REIL units.

BASIS OF PAYMENT

This work will be paid for at the contract unit bid price per lump sum for REIL Removal. Said price and payment shall constitute full compensation for removing the existing REIL units; for

all excavating and backfilling, for furnishing all earth material, materials, labor, tools, equipment, and incidentals necessary to complete this item of work.

Payment will be made under:

Item AR125907 Remove REILS - per pair

ITEM AR125909
REMOVE VASI

DESCRIPTION

This item shall consist of the removal of the Visual Approach Slope Indicator (VASI) units in accordance with the details in the Construction Plans and in accordance with these Special Provisions. A VASI unit shall consist of the Downwind Light Boxes, Upwind Light Boxes, Power and Control Unit and associated concrete bases/foundations.

CONSTRUCTION METHODS

Power for each respective VASI system shall be disconnected at the respective power source prior to removing the respective VASI systems. Power for the existing VASI system located on Runway 30L is understood to be powered from the 120/240 VAC single phase service located at the area of the Runway 30L Glide Slope facility. Contractor shall field verify to confirm the respective power sources for each VASI system.

Contractor shall coordinate work and any power outages with the Airport Director, the respective Airport personnel, and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures, including, but not limited to, 29 CFR Section 1910.147 The Control of Hazardous Energy (lockout/tagout).

The Contractor shall remove the existing VASI units on runway 12R/30L and turn them over to the Airport Director. The Contractor shall also coordinate with and notify the Airport Director and the Resident Engineer and provide a schedule for the VASI removals and the new PAPI installations. VASI removals on Runway 30L shall be coordinated with the PAPI installation on the same runway approach to minimize the time that this runway is without a visual approach descent indicator. The Contractor will remove the existing VASI concrete bases and dispose of them off the airport site in a legal manner. The existing electrical cables will be placed in the bottom of the hole and will be abandoned. The holes left from the removal of the concrete bases will be filled with earth material. The earth material will be compacted to prevent any future settlement. The earth material will be obtained from off the Airport site. The disturbed area will be restored, graded, and seeded to the satisfaction of the Engineer, and will be considered as an incidental item to the removal of the VASI.

BASIS OF PAYMENT

This item of work will be paid for at the contract unit price bid per each for Remove VASI. This price and payment shall constitute full compensation for removing the VASI units (light boxes, power and control units, and associated bases/foundations); for all excavating and backfilling; for furnishing all earth material; and for furnishing all labor, tools, equipment, and incidentals necessary to complete this item of work.

Payment will be made under:

Item AR125909 Remove VASI - per each

ITEM AR127985
RECONSTRUCT MALSR

DESCRIPTION

127985-1.1 GENERAL. This item shall consist of removal and replacement of the MALS (Medium-intensity Approach Lighting System) threshold light bar furnished and installed at the location and in accordance with the dimensions, design and details shown on the Plans and as Specified herein. This item shall consist of removing the existing threshold light bar, furnishing and installing a new threshold light bar, and the furnishing of all labor, tools, preparation, coordination, equipment, materials, foundations, concrete, base cans, junction boxes, cables, ducts, splice cans, grounding, and all miscellaneous items and incidentals necessary to place the MALS threshold light bar in operation as a completed system to the satisfaction of the Engineer and FAA (Federal Aviation Administration). MALS threshold lights shall be FAA-approved and FAA supported system components. This item shall include but not be limited to, the following major items of work by the Contractor:

- Threshold Light Bar,
- Concrete Foundations,
- L-867 Base Cans,
- Power Wiring,
- Conduit, Ducts, and Manholes,
- Grounding,
- Alignment, Calibration, Testing, and Demonstration coordinated with FAA,
- Coordination with the Airport and the FAA, and
- All other incidental items necessary to complete the MALS threshold light bar and interface to the existing MALSR (Medium-intensity Approach Lighting System with Runway Alignment Indicator Lighting).

127985-1.2 APPLICABLE DOCUMENTS. The following publications and regulations, in effect on date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein. FAA-GL-918C Specification for Construction of Terminal Navigational Aid Facilities, Specifications Supplemental to Specification FAA-GL-840b and FAA-GL-918C, FAA-STD-019e, and Specification FAA-E-982j are included in the Appendix of this Document. In the event of conflicts between this Special Provision and the FAA Specifications and Standards contact the Resident Engineer and/or the Project Engineer for further direction and clarification.

A. NFPA Number 70 – National Electrical Code (most current issued in force).

B. Local governing body rules and regulations.

C. FAA-GL-918C DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION, GREAT LAKES REGION, CHICAGO, ILLINOIS, SPECIFICATION FOR CONSTRUCTION OF TERMINAL NAVIGATIONAL AID FACILITIES.

D. FAA-C-1391b U.S. Department of Transportation Federal Aviation Administration, Specification, INSTALLATION AND SPLICING OF UNDERGROUND CABLES.

E. FAA-STD-019e, December 22, 2005, Department of Transportation, Federal Aviation Administration Standard, LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT.

F. FAA-E-982j, Dated May 6, 2003, U. S. Department of Transportation Federal Aviation Administration Specification PAR-56 LAMPHOLDER.

G. Illinois Standard Specifications for Construction of Airports, Illinois Department of Transportation Division of Aeronautics, Adopted November 2, 2009.

127985-1.3 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for MALS components and associated equipment and materials to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Cut sheets with part number and specifications for MALS threshold light fixtures and components.

D. Include cut sheets with part numbers and dimensions for base cans, cover plates, and associated components for each light fixture.

E. Concrete mix design.

F. Certifications for reinforcement steel. Include certification that rebar is produced from 100% domestic steel.

G. Shop drawings shall include wire/conductor/cable cut sheets with type, size, specifications, ETL or UL listing, manufacturer, and catalog or part number.

H. Shop drawings for cable in unit duct items shall include cut sheets with type, size, specifications, ETL or UL listing, manufacturer, and catalog or part number for the respective unit duct.

I. Provide cut sheets with manufacturer's name, catalog number, dimensions, material and UL listing for each type and size ground rod. Include certification of 100% domestic steel for ground rods.

J. Provide cut sheets for all types of conduit used with the MALS installation (for example galvanized rigid steel conduit, schedule 40 PVC). Include certification that conduits are manufactured in the United States. Include certification that steel conduits are made with 100 percent domestic steel.

EQUIPMENT AND MATERIALS

127985-2.1 GENERAL.

A. The Contractor shall provide all components in order to construct a complete and operational MALS Threshold light bar as detailed on the Plans and as specified herein. Materials and equipment, to be acceptable, must comply with all Contract requirements. Materials to be furnished by the Contractor under this specification shall be new and, unless specified otherwise, the standard products of a manufacturer's latest designs. All equipment shall meet all requirements for acceptance and takeover by the FAA for maintenance and operation. Where a conflict is determined between the Plans, Special Provision Specifications, and the FAA Specifications contact the Resident Engineer or Project Engineer for clarification and/or further direction.

B. Airport lighting equipment and applicable materials covered by these specifications and/or as detailed on the Plans shall have the prior approval of the Federal Aviation Administration and shall be listed in Advisory Circular 150/5345-1 "Approved Airport Equipment", and/or Advisory Circular 150/5345-53 "Airport Lighting Equipment Certification Program" (latest revision). All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification on compliance with the applicable specification when requested by the Engineer. Wherever standards have been established by Underwriter's Laboratories, Inc., the materials shall bear the UL label.

C. FAA approval of airport lighting equipment and subsequent inclusion in Advisory Circular 150/5345-1 "Approved Airport Equipment", and/or Advisory Circular 150/5345-53 "Airport Lighting Equipment Certification Program" only means that the test data satisfied the applicable Specification requirements. This does not insure that the approved equipment will satisfactorily operate when connected power-wise and/or control-wise to other approved airport lighting equipment or "off the shelf" equipment not requiring FAA approval.

D. The Contractor shall ascertain that all lighting system components furnished by him (including FAA-approved equipment) are compatible in all respects with each other and the

E. remainder of the respective system. Any non-compatible components furnished by the Contractor shall be replaced by him, at no additional cost to the Airport Sponsor, with a similar unit approved by the Engineer (different model or different manufacturer) that is compatible with the remainder of the respective airport lighting system.

F. Except as specified otherwise, all new equipment shall be provided by the Contractor and shall be tested for Specification conformance as part of the Aviation Lighting Equipment Certification Program. Certification of conformance, as tested by the respective testing laboratory, shall be provided by the manufacturer for all items submitted for approval.

127985-2.2 MALS THRESHOLD LIGHT FIXTURES. The replacement PAR-56 lampholders shall conform to U. S. Department of Transportation Federal Aviation Administration Specification FAA-E-982j, PAR-56 Lampholder. A copy of Specification FAA-E-982j is included in the Appendix. Note; based on information from the FAA, Specification FAA-E-982j applies to both the ALSF (high-intensity Approach Light system with Sequenced Flashers) lampholder and the MALS (Medium-intensity Approach Light System) lampholder. The PAR 56 lampholder shall conform to the following requirements:

A. The PAR 56 lampholder shall include a turnbuckle to hold the lamp aiming angle.

B. Involve no exposed cables outside the lampholder, its slipfitter base, or its conduit mounting.

C. Be a component of an FAA Type-numbered MALSR equipment, not a commercial derivative.

D. Be equipped by the lampholder manufacturer with filter clips to hold the green glass filters for the threshold light.

E. Required with each PAR-56 lampholder is a 300-watt, 120-volt PAR-56 lamp, Lamp Industry P/N 300PAR56/NSP-120V. The National Stock Number (NSN) of this lamp is 6240-00-569-1902.

F. Also required with each PAR-56 lampholder is a green glass filter, generically described as follows: Filter, marker light P/N A4885-1 green; V/C 81341; MS 24489-2, V/C 96906, FAA P/N A4885-1green, Military Standards P/N MS24489-2. The NSN of this filter is 6210-00-633-6887-1. Multi Electric P/N 894-3G meets requirements. This filter is also manufactured by Gillinder Glass, Port Jervis, NJ. The green glass filter must be compatible with the respective lamp holder.

DME Corporation FA-11508 Elevated Threshold PAR-56 lampholder meets the above specification requirements. Contact information for DME is DME Corporation, 6830 N. W. 16 Terrace, ft. Lauderdale, Florida 33309, Attn. Mr. Gary Shapiro, Phone: 954-975-2222, Cell Phone: 954-658-2659, Fax: 954-979-3313. 18 MALS threshold lampholders are required for a

runway threshold 150 feet in width. Two full spare light assemblies are required by the FAA and shall be provided to the respective FAA MALSR maintenance staff.

MALS Threshold Lampholder Equipment List		
MFR Part Number	**Description**	**Quantity**
(Confirm Part No. with respective Manufacturer)	Elevated threshold light fixture (with PAR-56 lamp holder with lamp retaining hardware)	20
(Confirm Part No. with respective Manufacturer)	PAR-56, 300 Watt lamps for threshold fixtures	20
(Confirm Part No. with respective Manufacturer)	Green filter for threshold light fixtures	20

127985-2.3 LIGHT BASE CANS AND SPLICE CANS. Light base cans and splice cans shall conform to the requirements of FAA AC 150/5345-42D (or most current issue in force) for Type L-867, Class I, with size (diameter), depth, number of hubs, locations of hubs, sizes of hubs, and gaskets as detailed on the Plans for the respective MALS components. Cans for use with MALS components shall be minimum Size D (16-inch diameter). Base cans and splice cans shall include internal and external ground lugs. Contractor shall coordinate selection of L-867 bases to be compatible with the respective MALS system components. Base plates for light fixtures shall be approved to support the respective light fixtures. **Contractor shall confirm part numbers of L-867 bases detailed on the Plans with the respective manufacturer**.

127985-2.4 CONCRETE. Concrete for foundations shall conform to Item 610 Structural Portland Cement Concrete, per the respective equipment manufacturer's recommendation for the respective application, and as detailed on the Plans.

127985-2.5 CONDUITS.

A. Galvanized Rigid Steel Conduit (GRSC): Rigid Steel Conduit and fittings shall be hot-dipped, galvanized, UL-listed, and produced in accordance with UL Standard 6 – Rigid Metal Conduit and ANSI C80.1 – Rigid Steel Conduit, Zinc Coated. Couplings, connectors, and fittings for rigid steel conduit shall be threaded, galvanized steel or galvanized, malleable iron, specifically designed and manufactured for the purpose. Fittings shall conform to ANSI C80.4 – Fittings Rigid Metal Conduit and EMT and UL 514B – Conduit, Tubing, and Cable Fittings. Set screw type fittings are not acceptable. Steel used to manufacture conduits shall be 100 percent domestic steel. Contractor shall provide certification that the respective steel conduits used on this project are manufactured from 100 percent domestic steel.

B. Schedule 40 PVC Conduit: Schedule 40 PVC conduit shall comply with Item 110, NEMA Specification TC-2 (Conduit), TC-3 (Fittings), and UL 651 (Standard for rigid nonmetallic conduit).

C. Liquid-Tight, Flexible Metal Conduit. Liquid-tight, flexible metal conduit shall consist of polyvinyl jacket over flexible, hot-dip, galvanized steel tubing. The flexible conduit shall be completely sealed from liquids, dust, dirt, and fumes and be resistant to oil, gasoline, grease, and abrasion. Jacket shall also be sunlight-resistant. Liquid-tight, flexible metal conduit

shall be UL-listed, suitable for use as a grounding conductor, and comply with Article 350 of the NEC. **Liquid-tight, flexible metal conduit and associated fittings shall be UL-listed to meet the requirements of NEC 350.6.** Liquid-tight, flexible metal conduit shall be Anaconda Sealtite Type UA as manufactured by Anamet Electrical Inc., 1000 Broadway Avenue East, Mattoon, Illinois 61938-0039, (Phone: 217-234-8844), Liquatite Type LA as manufactured by Electri-Flex Company, 222 W. Central Ave., Roselle, Illinois 60172, (Phone: 630-529-2920 or 1-800-323-6174), or approved equal. Do not furnish liquid-tight, flexible metal conduit that is not UL-listed.

D. Electrical Metallic Tubing (EMT): Electrical Metallic Tubing shall be galvanized steel tubing conforming to ANSI C80.3 and U.L. 797. All EMT and mounting hardware shall be constructed of corrosion-resistant materials and be listed for use in wet locations. EMT fittings shall conform to ANSI C80.4. Steel used to manufacture conduits shall be 100 percent domestic steel. Contractor shall provide certification that the respective steel conduits used on this project are manufactured from 100 percent domestic steel.

127985-2.6 CABLES. Power Cables: 600 Volt power cable shall conform to Item 108 and as detailed on the Plans. All cable shall be copper. Cables from the MALS Distribution Panelboard (or respective splice point near the MALS Distribution Panelboard) to the MALS threshold light bar shall consist of 4-1/C #2/0 AWG, XLP-USE, 600-Volt cable in unit duct (2.5 in. or sized larger, as required per NEC). Conductor insulation for 120/240 VAC, single-phase, 3-wire with ground circuits shall be color-coded: Phase A – Black, Phase B – Red, Neutral-White, and Ground – Green.

127985-2.7 GROUNDING EQUIPMENT AND MATERIALS.

A. Ground Rods. Ground rods shall be UL-listed, copper-clad steel, 3/4-inch by 10 feet long with 10 mil minimum copper coating, except where otherwise specified. Steel used to manufacture ground rods shall be 100 percent domestic steel.

B. Grounding Conductor. All grounding conductors shall be copper. All grounding conductors, which are totally above grade, shall be green-insulated conductors. All grounding electrode conductors, which are either entirely or partially direct-earth buried, shall be bare stranded copper conductors, unless noted otherwise on the drawings. Conductor sizes (AWG) shall be as detailed on the Plans.

C. Buried Guard Wire. Underground cables, which are not completely enclosed in ferrous metal conduit, shall be protected by a #1/0 AWG bare copper guard wire. The guard wire shall be embedded in the soil a minimum of 10 inches directly above, and parallel to, the lines or cables being protected. The guard wire shall be bonded to the grounding electrode system at each end of the cable run, and to ground rods (UL-listed, copper-clad steel, 3/4-inch by 10 feet long) at approximately 90 ft intervals using exothermic welds. The spacing of ground rods must vary by 10% to 20% to prevent resonance. Install ground rods at approximately 6 feet on either side of the cable trench.

D. Exothermic-Weld Process for Connecting Grounding Conductors to Metal Objects. Where the drawings and/or Specifications require connection of a grounding conductor to a metal object by exothermic-weld process, the contractor shall supply the correct exothermic-welding kit for the application. The mold and cartridge used shall be selected on the basis of size, number and type of conductors to be connected, composition and surface shape of object, and position in which the weld will be made. Three sources of exothermic-welding kits are Cadweld (Erico Products, Inc.), Thermoweld (Continental Industries) and Ultraweld (Harger Lightning Protection and Grounding Equipment). The contractor shall confirm the appropriate kits for each respective application with the respective exothermic-weld manufacturer. Regardless of the source of the kits he selects, the Contractor shall submit catalog cuts or other manufacturer information, demonstrating that the kits fit their intended applications on the above-described basis. The Contractor shall provide and use the proper preparation tools in applying the exothermic-weld process to insure an adequate weld. Torch welds and/or brazing will not be permitted.

E. Underground Conduit Ground Connectors. Grounding connections to underground metallic conduit shall be with UL-listed ground connectors that are corrosion-resistant and suitable for direct burial in earth applications, sized for the respective conduit and ground wire, Burndy Type GAR-BU Series, or approved equal.

CONSTRUCTION

127985-3.1 GENERAL.

A. The MALS equipment and components shall be installed in conformance with the respective manufacturer's instructions, as detailed on the Plans and as specified herein. Contractor personnel installing the MALS equipment shall be experienced with the requirements and techniques involved with the respective installation. Installation personnel shall be thoroughly familiar with the National Electrical Code and airport rules and regulations, and applicable safety requirements. All work shall be scheduled and coordinated with the Airport Director and the Resident Engineer.

B. Concrete Work. Construction of concrete foundations for the MALS equipment and other associated equipment shall be in accordance with Item 610 Structural Portland Cement Concrete, per the respective equipment manufacturer's recommendation for the respective application, and as detailed on the Plans.

C. Electrical. The Contractor shall furnish and install all electrical materials necessary for complete and operational installation of the MALSR as detailed herein and as shown on the Plans. The complete installation and wiring shall be done in a neat, workmanlike manner. All electrical work shall comply with the requirements of the National Electrical Code (most current issue in force). Electrical equipment shall be installed in conformance with the respective manufacturer's directions and recommendations for the respective application. Any installations which void the UL listing, ETL listing, (or other third party listing), and/or the manufacturer's warranty of a device will not be permitted. Contractor shall keep a copy

of the latest National Electrical Code in force on site at all times during construction for use as a reference.

D. Coordination. Contractor shall coordinate the removal and replacement of the MALS threshold light bar with the Airport Director **(Robert McDaniel, St. Louis Downtown Airport, 1680 Sauget Industrial Parkway, Sauget, Illinois 62206-1449, Phone: 618-337-6060, Fax: 618-337-1597)** and/or the Airport Maintenance Manager **(Bobby Toenjes, Phone: 618-337-6060, Cell Phone: 314-486-5639),** the respective FAA Maintenance Personnel, and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures including, but not limited to, 29 CFR section 1910.147 The Control of Hazardous Energy (lockout/tagout).

E. Locate Existing Underground Utilities and Cables. The location, size, and type of material of existing underground and/or aboveground utilities indicated on the Plans are not represented as being accurate, sufficient, or complete. Neither the Owner nor the Engineer assumes any responsibility whatever in respect to the accuracy, completeness, or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size, and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. It shall be the Contractor's responsibility to determine the actual location of all such facilities, including service connections to underground utilities. Prior to construction, the Contractor shall notify the utility companies of his operational plans, and shall obtain from the respective utility companies detailed information and assistance relative to the location of their facilities and the working schedule of the companies for removal or adjustment, where required. In the event an unexpected utility interference is encountered during construction, the Contractor shall immediately notify the utility company of jurisdiction. The Owner's Representative and/or the Resident Engineer shall also be immediately notified. Any damage to such mains and services shall be restored to service at once and paid for by the Contractor at no additional cost to the Contract. All utility cables and lines shall be located by the respective utility. **Contact JULIE (Joint Utility Location Information for Excavators) for utility information, phone: 1-800-892-0123.** Contact the FAA (Federal Aviation Administration) for assistance in locating FAA cables and utilities. Location of FAA power, control, and communication cables shall be coordinated with and/or located by the FAA. Also contact Airport Director/Manager and Airport Personnel for assistance in locating underground Airport cables and/or utilities. Also coordinate work with all aboveground utilities.

F. Contractor shall locate and mark all existing cables within ten (10) feet of proposed excavating/trenching area. Any cables found interfering with proposed excavation or cable/trenching shall be hand dug and exposed. Any damaged cables shall be immediately repaired to the satisfaction of the Resident Engineer at the Contractor's expense. The Resident Engineer and Owner shall be notified immediately if any cables are damaged.

G. Warranty. All work included under this item is to be served by a one-year warranty (including periodic required maintenance) from the time of final acceptance of the project by the Division of Aeronautics. The warranty will make the Contractor responsible for the cost of furnishing the necessary service, including travel expenses, and materials to keep the complete system operational provided that the malfunction is caused by defective materials, equipment, or installation workmanship. Upon failure of any part of the system under the warranty, the Contractor will be notified by the respective Airport Authority, and the Contractor will repair or replace that part of the system. The repair or replacement by the Contractor will be in a reasonable period of time, and if it is not completed in a reasonable period of time, the respective Airport Authority will have the option of contracting the necessary repairs and the Contractor will be liable for the cost of repairs. (Arbitration and final decision will be made by the Chief Engineer of the Division of Aeronautics).

127450-3.2 INSTALLATION OF CONDUITS AND DUCTS. Installation of conduit and ducts shall conform to Item 110, FAA Specifications FAA-GL-918C Division 16, and as detailed on the Plans.

127450-3.3 INSTALLATION OF CABLES. Installation of cables shall conform to Item 108, FAA Specifications FAA-GL-918C Division 16, per the respective equipment manufacturer's recommendations, and as detailed on the Plans. Color-code phase and neutral conductor insulation for No. 6 AWG or smaller. Provide colored marking tape or colored insulation for phase and neutral conductors for No. 4 AWG and larger. **Insulated ground conductors shall have green colored insulation for all conductor sizes (AWG and/or KCMIL) to comply with NEC 250.119. Neutral conductors shall have white colored insulation for No. 6 AWG and smaller to meet the requirements of NEC 200.6.** Standard colors for power wiring and branch circuits for 120/240 VAC, 1-Phase, 3-Wire system shall be Phase A – Black, Phase B – Red, Neutral – White, and Ground – Green.

127450-3.4 INSTALLATION OF GUARD WIRES. Underground cables, which are not completely enclosed in ferrous metal conduit, shall be protected by a #1/0 AWG bare copper guard wire. The guard wire shall be embedded in the soil a minimum of 10 inches directly above, and parallel to, the lines or cables being protected. The guard wire shall be bonded to the grounding electrode system at each end of the cable run, and to ground rods at approximately 90 ft intervals using exothermic welds. The spacing of ground rods must vary by 10% to 20% to prevent resonance. Install ground rods at approximately 6 feet on either side of the trench. Ground rods shall be UL-listed, copper-clad steel, 3/4-inch by 10 feet long. Connections to guard wire and ground rods shall be with exothermic-weld type connectors.

127450-3.5 SEPARATION OF HIGH-VOLTAGE AND LOW-VOLTAGE WIRING. Low-voltage wiring shall maintain separation from high-voltage wiring. Low-voltage wiring and high-voltage wiring shall not be installed in the same raceway, handhole, or junction box.

127450-3.6 GROUNDING. The Contractor shall furnish and install all grounding shown on the Plans as required/recommended by the respective MASLR Manufacturer, as required by FAA-STD-019e and/or as may be necessary or required to make a complete grounding system as required by the latest National Electrical Code (NFPA 70) in force. The reliability of the

grounding system is dependent on careful, proper installation and choice of materials. Improper preparation of surfaces to be joined to make an electrical path, loose joints or corrosion can introduce impedance that will seriously impair the ability of the ground path to protect personnel and equipment and to absorb transients that can cause noise in communications circuits. The following functions are particularly important to ensure a reliable ground system:

A. All products associated with the grounding system shall be UL-listed and labeled.

B. All bolted or mechanical connections shall be coated with a corrosion preventative compound before joining, Sanchem Inc. NO-OX-ID "A-Special" compound or equal

C. All grounding conductors shall be properly sized as specified herein, as detailed on the Plans and/or per the NATIONAL ELECTRICAL CODE.

D. Metallic surfaces to be joined shall be prepared by the removal of all non-conductive material, per **2008 National Electrical Code Article 250-12**. All copper bus bars must be cleaned prior to making connections to remove surface oxidation.

E. Raceway fittings shall be made up tight to provide a permanent low impedance path for all circuits.

F. Furnish and install ground rings, ground fields, guard wires, and/or ground rods at all locations where shown on the Plans. Ground rods shall be 3/4" diameter, 10 foot long, UL-listed, copper-clad with 10-mil minimum copper coating. Top of ground rods shall be a minimum of 12 inches below finish grade unless otherwise noted on the Plans. Grounding electrode conductors used in ground rings shall be installed a minimum of 30 inches below finished grade or below the frost line whichever is deeper as detailed on the Plans. Ground rods shall be spaced as detailed on the Plans and in no case spaced less than one rod length apart. All connections to ground rods and/or ground rings shall be made with one shot, exothermic-weld type connectors, Cadweld by Erico Products, Inc., Solon, Ohio, (Phone: 1-800-248-9353), Thermoweld by Continental Industries, Inc., Tulsa, Oklahoma, (Phone: 918-663-1440), or Ultraweld by Harger, Grayslake, Illinois (Phone 1-800-842-7437). Exothermic-weld connections shall be installed in conformance with the respective manufacturer's directions using molds as required for each respective application. Bolted connections will not be permitted at ground rods or at buried grounding electrode conductors. In addition to the grounding work described herein and shown on the Plans, the Contractor shall test the made electrode ground field/ground ring with an instrument specifically designed for testing ground field systems. If ground resistance exceeds 10 ohms, contact Resident Engineer for further direction. Copies of ground field test results shall be furnished to the Resident Engineer, upon request, for review and record purposes.

G. All connections, located above grade, between the different types of grounding conductors shall be made using UL-listed, double compression, crimp-type connectors or UL-listed, bolted ground connectors. For ground connections to enclosures, cases and frames of electrical equipment not supplied with ground lugs the Contractor shall drill required holes for mounting a bolted ground connector. All bolted ground connectors shall be Burndy, Thomas and Betts, or

equal. Tighten connections to comply with tightening torques in UL Standard 486A to assure permanent and effective grounding.

H. All metallic non-current carrying parts of electrical equipment (including enclosures) and supporting structures installed under this Contract, whether used either for power or control, shall be grounded with an equipment-grounding conductor, whether or not shown on the drawings. The grounding conductor shall be sized in accordance with the National Electrical Code, but shall be of larger gauge if so shown on the drawings. In no case shall the equipment grounding conductor be smaller than #12 AWG, unless shown otherwise on the drawings.

I. A metallic service entrance conduit and any other power feeder conduit emerging from below grade and supplying power to another facility or system component shall terminate with grounding bushings at both ends. These requirements apply unless shown otherwise on the drawings.

J. All connections to the equipment to be grounded shall be made with a grounding connector specifically intended for that purpose. Connecting screws or mounting bolts and screws are not suitable for use as grounding connections. All ground lugs shall be of a non-corroding material suitable for use as a grounding connection, and must be compatible wit the type of metal being grounded. Remove paint and other non-conducting materials from surfaces of grounding connections.

K. Provide grounding bushings at all conduits entering service entrance equipment (meter bases, service disconnects, service panelboards, etc.) and ground wire from bushing to ground bus in the respective service entrance equipment.

L. The equipment ground wire from motors and equipment shall not be smaller than allowed by 2008 NEC Table 250-122 “Minimum Size Conductors or Grounding Raceway and Equipment”. In no case shall ground wire be smaller than #12 AWG stranded copper. All equipment ground wires shall be copper either bare or insulated green in color. Where the equipment grounding conductors are insulated shall be identified by the color green and shall be the same insulation type as the phase conductors. Equipment ground wires shall be adequately protected from damage and shall have continuity with the service ground bus.

M. It is the intent of this specification that all equipment frames, metal enclosures housing electrical equipment, etc. have a continuous copper wire ground connection. Conduit and connectors <u>will not</u> be considered as adequate grounding.

N. Provide a positive ground bond for all outlet boxes, electrical equipment enclosures, grounding receptacles, etc. Install a grounding conductor in all wire and cable raceways. Ground conductor to have 600-volt insulation and be identified by a continuous green color coating. They shall be used solely for grounding purposes and be entirely separate from white grounded neutral conductor, except at the supply side of service disconnecting means, where the grounding and neutral systems are to be connected to the service ground. The equipment-

grounding conductor shall be installed in the same conduit as its related branch and/or feeder conductors, and shall be connected to the ground bus in the respective panelboard.

O. Provide all boxes for proposed outlets, switches, circuit breakers, etc. with grounding screws. Provide all panelboard, load center, etc., enclosures with grounding bars with individual screws, lugs, clamps, etc. for each of the grounding conductors that enter their respective enclosures.

P. All utility transformer bank grounds shall be installed in accordance with the utility company's recommendations and in accordance with the NEC.

Q. Each and all grounded cases and metal parts associated with electrical equipment shall be tested for continuity of connection with the ground bus system by the Contractor in the presence of the Engineer or his representatives.

R. All exterior exposed metal conduit, where not electrically continuous because of manholes, handholes, splice cans, etc., shall be bonded to all other conduit in the respective duct run, and at each end, with a bare copper conductor as sized in conformance with **2008 NEC 250-102**. Where metal conduits terminate in an enclosure (such as a motor control center, switchboard, etc.) where there is not electrical continuity with the conduit and the respective enclosure, provide a bonding jumper from the respective enclosure ground bus to the conduit sized per **2008 NEC 250-102.** (Size to be based on the largest conductor entering the duct).

S. Install lightning protection down conductors and separate ground conductors in Schedule 40 or Schedule 80 PVC conduit or exposed where acceptable to local codes. Where lightning protection down conductors or individual ground conductors are run in PVC conduit, Do Not completely encircle conduit with ferrous and/or magnetic materials. Use non-metallic reinforced fiberglass strut support. Where metal conduit clamps are installed, use nylon bolts, nuts, washers and spacers to interrupt a complete metallic path from encircling the conduit. This is required to avoid girdling of ground conductors. Girdling of a ground conductor is the result of placing the conductor in a ring of magnetic material. This ring could be a metallic conduit, u-bolt or strut support pipe clamp, or other support hardware. The result of girdling ground conductors significantly increases the inductive impedance of the ground conductor. Inductive and capacitive impedance is a type of resistance that opposes the flow of alternating current. Any increase in the impedance of a ground conductor reduces its ability to effectively mitigate radio frequency noise in the ground system. The condition where a ground conductor is girdled during a lightning strike results in phenomena known as Surge Impedance Loading. Surge impedance loading is a result of voltage and current reaching 500,000 volts and 10,000 amps for a short duration. Girdling further increases the impedance at lightning frequencies of 100 kilohertz to 100 megahertz. At these power and frequency levels any increase in the impedance of the ground conductor must be controlled. During lightning discharge conditions a low inductive impedance path is more important than a low DC resistance path.

T. **If local codes dictate that individual grounding conductors must be run in metal conduit or raceway, then the conduit or raceway must be bonded at each end of the run**

with a bonding jumper sized equal to the individual grounding conductor or as required by 2008 NEC 250-102. ***(Note the use of metallic conduit for an individual grounding conductor must be approved by the Engineer).*** **Note this does not apply to AC equipment grounding conductors run with AC circuits.**

U. All grounding system conductors shall turn toward the ground source when attaching to a home run. Minimum bending radius of ground conductors shall be 8". Sharp bends will not be allowed.

V. Bond the main electrical service neutral to ground at the main service disconnect. Bond the service neutral to ground at one location only per the National Electrical Code. A grounding connection shall not be made to any neutral circuit conductor on the load side of the service disconnecting means, except as permitted by 2008 NEC 250-24.

METHOD OF MEASUREMENT

127450-4.1. The quantity of the MALS threshold light bar paid for under Item AR127985 Reconstruct MALSR Installation shall be measured per lump sum furnished and installed as a completed system in place, ready for operation and accepted by the Engineer and Federal Aviation Administration.

Airport Electrical Manholes associated with the MALS threshold light bar will be paid for under Item AR110715 Electrical Manhole Special - per each

BASIS OF PAYMENT

127450-5.1. Payment will be made at the lump sum Contract unit price for the complete, operational, and accepted MALS Threshold Light Bar system. This price shall be full compensation for furnishing and installing all equipment and materials; for all labor, preparation, tools, coordination, foundations, concrete, base cans, splice cans, supports, spare parts, accessories and hardware; for furnishing and installing all conduits, cables, cables in unit duct, guard wires, ground rods, and grounding; for providing manufacturer's support and services where applicable; for all duct interface work to handholes/manholes including coring of handholes/manholes; for all excavation, backfilling, and restoration; for all required testing; for furnishing and installing all miscellaneous items, materials and incidentals in order to provide a completed system as detailed on the Plans and specified herein.

Payment will be made under:

Item AR127985 Reconstruct MALSR - per lump sum

ITEM AR150510
ENGINEER'S FIELD OFFICE

DESCRIPTION

150-1.1. Add the following to this section:

"A cellular telephone will be required for exclusive use by the Resident Engineer for the duration of this project. The cellular telephone shall be hand-held and portable, and shall be approved by the Resident Engineer. The Resident Engineer will use this cellular telephone for project related phone calls only. The Contractor will be responsible for all charges associated with this cellular telephone. Upon completion of the project the cellular telephone will be returned to the Contractor."

ENGINEER'S FIELD OFFICE

150-2.1. Revise the first sentence as follows:

"Type A field offices shall have a ceiling height of not less than seven (7') ft and a floor space of not less than three hundred and eighty (380) sq. ft."

Add the following to the list of equipment and furniture required in the office:

"N. One (1) lockable cabinet or closet that is large enough in which a nuclear density machine may be stored."

BASIS OF PAYMENT

150-3.1. Add the following to this section:

"The cellular telephone and associated charges will be included at the contract unit price per lump sum for Engineer's Field Office. This price shall include all utility costs and shall reflect the salvage value of the building, equipment, and furniture which becomes the property of the Contractor after release by the Resident Engineer, except the Engineering firm will make payment for all long distance telephone calls in excess of one hundred dollars ($100.00) per month for the land line."

Payment will be made under:

Item AR150510 Engineer's Field Office - per lump sum

AR150530

TRAFFIC MAINTENANCE

DESCRIPTION

This item of work shall consist of providing barricades and traffic cones at the construction site to protect aircraft from entering into the work area. Barricades will be used in areas outside of the runway, and traffic cones will be used on the runway. The barricades will be lighted, marked, and flagged so that they are plainly visible, night or day, to the pilots operating the aircraft. The barricades will be standard highway barricades with a steady-burn, red light, unless otherwise noted. On taxiways where jumpers are placed as part of the temporary lighting, low profile barricades will be utilized. The barricades will require weighting down with sand bags or other methods approved by the Airport and/or their representative. The placement locations for the barricades and traffic cones are detailed on the Plans. Barricades will not be used on any runway surface. The Contractor shall also provide traffic cones to demark the path of travel on the airfield pavements used for all hauling operations to minimize the amount of tracking that occurs on the existing pavement marking, where applicable.

This item of work shall also consist of providing runway closure markers, both lighted and non-lit. One pair of runway closure markers will be required for each runway closed. The runway closure markers will be placed, as shown on the Proposed Safety Plan. The Airport will provide a single set of lighted runway closure markers for use on Runway 12R-30L, which will be maintained by the Contractor, including any fuel, fluids, etc. necessary for the unit to function.

This item of work shall also consist of the Contractor monitoring the entrance gate to the work site, on the haul route. The gate shall be locked at all times continuous hauling operations are not in progress. When continuous hauling operations are in progress the Contractor will station a worker at the gate to monitor the traffic coming into the site, allowing only personnel and equipment affiliated with the project, the Airport staff, and the Consultants working on the job to enter.

CONSTRUCTION METHODS

At commencement of the work, the Contractor shall place barricades to block access to the construction area. Barricades and traffic cones will be placed as shown on the Safety Plan in the Construction Plans. Providing that work areas are temporarily opened and closed, the Contractor will be required to take up and reset the barricades.

Prior to the closing of a Runway, non-lit runway closure markers or lit markers will be placed at the locations shown on the Proposed Safety Plan. The non-lit crosses will be yellow in color, and shall be made of a suitable material, as approved by the Airport Director. The crosses will be placed over the numerals or off the runway end, as depicted on the Plans, and secured in a manner approved by the Airport Director. The proposed crosses will be placed each day the runway is closed, and removed when the runway is reopened. The Contractor will be

responsible for the placement and removal of the crosses. A pair of lit markers will be supplied by the Airport for the Contractor to use. The Contractor will be responsible for the markers, once provided. The lit markers shall be used on Runway Ends 12R and 30L.

The proposed markers will be placed each day the runway is closed and removed when the runway is reopened. The Contractor will be responsible for the placement and removal of the crosses. Upon completion of the project, the lighted runway closure markers will be returned to the Airport in the same condition they were received. Any cost to repair will be the responsibility of the Contractor, including all maintenance of fuel and/or fluids.

BASIS OF PAYMENT

Payment will be made at the contract unit price per lump sum for providing, maintaining, and removing barricades for purposes of delineating the work site, and prevent aircraft from entering the work area; providing and placing runway closure markers, both lighted and non-lit; and opening and closure of the runways and taxiways, as described in this Specification and on the Plans. The price shall be full compensation for furnishing and installation of all personnel, equipment, and materials; maintenance; for all labor and incidentals, including fuel and other mechanical fluids, necessary to operate the units and complete this item of work.

Payment will be made under:

Item AR150530 Traffic Maintenance - per lump sum

AR150540
HAUL ROUTE

DESCRIPTION

This item of work shall consist of construction, maintenance and removal of the haul route and vehicle parking and material storage area at the location shown on the Construction Plans.

CONSTRUCTION METHODS

A portion of the primary haul route, vehicle parking, and material storage area is already improved, currently serving as a maintenance access road. This portion, which includes a crossing of Goose Lake Creek, shall be used to access the work site. As shown on the Plans the alignment of the remainder of the proposed haul route will divert from the existing alignment and require improvement with a minimum of 6-inches of oversize aggregate (CA-1). This portion of the proposed haul route will remain in place at the conclusion of the haul route and serve as the new alignment of the Glide Slope maintenance access road. The Contractor will maintain the haul route for hauling material to the construction work area and the vehicle parking and material storage area for parking of vehicles and equipment. At the completion of the project, the materials that comprise the Haul Route will be reshaped and left in place, except for the areas added east of Goose Lake Ditch that form the radius prior to the crossing, and the area shown as the "Truck Staging Area". This area of the Haul Route will be removed entirely and the original alignment restored. The material to be removed that can be relocated without adversely affecting the usefulness of the maintenance access road to remain may be reused or relocated to this area. However all material containing soil that would otherwise result in mud shall be hauled off site and disposed of at the Contractor's expense. All millings generated on the project shall be placed on the existing alignments of maintenance access roads, supplementing the existing aggregate.

The turf material that comprises the areas to be removed in the turf areas of the Haul Route to be improved will be excavated and hauled off site for disposal. Clean earth fill material, where required, will be obtained to fill the excavated area and paid for as part of Item AR15244 Offsite Borrow Excavation. The grades of the fill material combined with that of the proposed oversize aggregate shall be coordinated to provide the increase in elevation at the site of the Haul Route. The areas disturbed but not improved shall smooth graded and prepared for seeding and fertilizing, at the grades shown in the Plans. The site preparation, seeding, fertilizing, and mulching shall comply with Item 901 and 908 respectively.

The Haul Route will be maintained as not to cause delay to the proposed construction. The Contractor will be required to employ methods to control dust and tracking of mud on the grade of the construction site and paved areas.

The Haul Route begins at the easternmost edge of airport property, at a gate entrance off of Goose Lake Road. The Contractor is required to review and comply with paragraph 50-04 Permits, Licenses and Fees, Section 50 in the Standard Specifications.

The Contractor will use the existing gate at the entrance to the Haul Route and the gate will be locked during non-construction hours.

Safety. **All traffic control, safety, and permitting requirements associated with the construction and use of the haul route, vehicle parking and material storage area are the responsibility of the Contractor.**

BASIS OF PAYMENT

Payment will be made at the contract unit price per lump sum for maintaining the haul route, vehicle parking and material storage area, and for restoring the area as described. This price shall be full compensation for furnishing and installation of all materials; restoration and turfing; for all labor, equipment, and incidentals necessary to complete this item of work.

Payment will be made under:

Item AR150540 Haul Route - per lump sum

ITEM AR152
EXCAVATION AND EMBANKMENT

DESCRIPTION

152-1.1. Add the following to this section:

"Item AR152410 shall include all excavation associated with the coring of the shoulders and beneath existing pavements to be reconstructed; the excavations associated with the floodplain mitigation area; the formation of embankments within the project area; and the formation of the proposed stockpile adjacent to the floodplain mitigation area.

Item AR152442 Offsite Borrow Excavation shall consist of hauling and formation of embankments within the project area using the material currently available in an existing stockpile adjacent to the floodplain mitigation area as well as the additional material produced from the excavation of the proposed floodplain mitigation area as shown in the Construction Plans."

ITEM AR156521
HEADWALL PROTECTION

DESCRIPTION

This Item of work shall consist of placing and maintaining straw bales and silt fence to protect the existing end sections within near proximity of the grading limits from silt in accordance with the details shown on the Construction Drawings as a partial implementation of a SWPPP. The measures of the Plan and the locations of the headwall protection are shown in the Construction Plans, and shall be constructed in accordance with IEPA Standards and Specifications for soil erosion and sediment control and these Special Provisions.

MATERIALS

Erosion Control Fence. The proposed silt fence fabric shall conform to the Standard Specifications listed in Item AR156000 – Erosion Control.

CONSTRUCTION METHODS

The Contractor shall furnish, install, and maintain the straw bales and silt fence required for the headwall protection at the locations shown on the Construction Drawings. The headwall protection shall be inspected frequently and straw bales replaced or repaired, as needed, to the satisfaction of the Resident Engineer throughout the duration of the project. Replacement of straw bales or silt fence is considered incidental to the headwall protection, and no additional compensation will be allowed. Once a stand of grass is established and accepted by the Engineer, the Contractor shall remove the straw bales and silt fence and remove them from the Airport property.

METHOD OF MEASUREMENT

The quantity of headwall protection to be paid for shall be the number of headwall protection constructed as detailed and specified and accepted by the Resident Engineer.

BASIS OF PAYMENT

Payment will be made at the contract unit bid price for Headwall Protection. This price shall be full compensation for furnishing the required materials and constructing the Headwall Protection to the details shown and the Specifications herein for maintaining and replacing the straw bales and silt fence, as needed, for the duration of the project, and their removal, once an acceptable stand of grass has been established on the site.

Payment will be made under:

Item AR156521 Headwall Protection – per each

ITEM AR209511
CRUSHED AGGREGATE BASE, (CA-1)

DESCRIPTION

This Item of work shall consist of placing oversized crushed aggregate to establish a stable subbase under the proposed pavement. The subbase will have a depth of 8-inches. under the proposed pavement and will be placed to the grades and locations, as shown on the Construction Plans and cross-sections. The oversize aggregate shall be installed in accordance to the Standard Specifications for Construction of Airports, Item 208 procedures, with the following exceptions, as outlined below.

MATERIALS

The oversize aggregate material shall be a CA-1 course aggregate meeting the gradations specified under Article 1004.01 in the Standard Specifications for Road and Bridge Construction adopted January 1, 2007. A 3-in. top size will be allowed for the aggregate material.

CONSTRUCTION METHODS

The oversize crushed aggregate shall be constructed on top of the soil stabilization fabric, and shall be constructed to the line and elevations, as shown on the Construction Plans. The subbase course shall be consolidated to the satisfaction of the Resident Engineer, with a minimum of three passes with a steel wheeled roller.

BASIS OF PAYMENT

Payment will be made at the contract unit bid price per ton of oversize aggregate, which price and payment will constitute full compensation for preparing subgrade, furnishing, hauling, and placing the materials; for spreading, compacting, and rolling; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Item AR209511 Crushed Aggregate Base, (CA-1) - per ton

ITEM AR620
PAVEMENT MARKING

This Special Provision modifies Item 620 Pavement Marking as follows:

620-2.2 Paint.

C.19. Epoxy. Delete this entire section and all references to epoxy paint throughout this Specification.

AR760720
20" STEEL CASING

DESCRIPTION

This Item of work shall consist of furnishing and placing an extension to an existing steel casing pipe for the existing water main at the locations and to the elevations shown on the Plans.

MATERIALS

The waterline casing will be 20-in. steel, casing pipe. The pipe shall meet or exceed the requirements of ASTM A-139, Grade B, with minimum wall thickness of ¼ in.

Water main installed at all locations shall be PVC pipe conforming to AWWA Standard C-900, with a pressure rating of 150 p.s.i. (DR 18), with push-on joints, where necessary.

CA-6 course aggregate material placed in accordance with the backfill requirements of Item 705 for the backfill material.

CONSTRUCTION METHODS

This work Item shall consist of excavating down to the depth of the existing steel casing pipe at the locations shown on the Plans, severing the existing PVC water main at or near the termination of the existing steel casing, removing the appropriate quantity of sections of water main to facilitate placing the steel casing extension, and placing the length of steel casing shown in the Plans to extend the casing beyond the limits of the proposed pavement. The operation shall be conducted in accordance to the Standard Specifications for Water and Sewer Main Construction in Illinois.

The carrier pipe shall be center restrained by the use of casing spacers. The casing spacers shall be constructed of non-reactive material designed specifically for that purpose. The spacers shall be positioned within 6 in. from the end of the casing on each side of joint in the carrier pipe and at the midpoint of each pipe length. Spacers constructed of wood and steel banding are not acceptable.

The casing ends shall be sealed to the carrier pipe by the use of an APS Standard Model AC pull on casing end seal, or equivalent.

The casing spacers and casing end seals shall be considered incidental to the installation of the 20-in. Steel Casing.

The carrier pipe (existing, 10" PVC) to be contained inside the casing pipe will be replaced back to the nearest complete section of pipe. Any backfilling necessary to complete the installation of the casing pipe will be completed in accordance with Item AR701830, Trench Backfill. The ends of the

casing pipes are to be sealed and water-tight. The PVC pipe shall be considered incidental to the extension of the 20-inch steel casing.

Trenching and Pipe Installation. Trench for pipe will be excavated to the depths and widths necessary to complete the installation.

The trench shall be constructed in accordance with all local, State, and Federal regulations, specifically OSHA Standards 1926.650, 1926.651, and 1926.652.

Placement of the pipe will be in accordance with the Standard Specifications for Water and Sewer Main Construction in Illinois.

Backfilling will be in accordance with the backfill requirements of Item 705.

Testing. Pressure testing of water mains shall conform to the Standard Specifications. A minimum hydrostatic pressure of 100 p.s.i. shall be used if the hydrostatic pressure equal to 50 percent more than the operating pressure at the lowest elevation of the pipe section is less than 100 p.s.i.

The pressure test period shall be 1 hour.

The leakage test period shall be 1 hour, and shall directly follow the pressure test. The allowable leakage rate shall be computed per Section 41-2.13C of the Standard Specifications.

Pressure testing and leakage testing of the water mains shall be incidental to the installation of the water main.

Disinfection. Disinfection shall be in conformance with the Standard Specifications. Satisfactory disinfection is demonstrated when two (2) consecutive samples, collected at least 24 hours apart, indicate no bacteriological contamination.

Disinfection of the water mains shall be incidental to the installation of the water main.

METHOD OF MEASUREMENT

The quantity of steel casing to be paid for shall be the number of lineal feet of steel casing extended, accepted, and measured in place by the Resident Engineer.

BASIS OF PAYMENT

This Item of work will be paid for at the contract unit bid price per lin. ft to extend the steel casing, which price shall be full compensation for excavation, placing of the casing; replacement of the water main sections; for backfilling the trench; for furnishing all materials, labor, equipment, and incidentals necessary to complete this Item of work.

Payment will be made under:

Item AR760720 20” Steel Casing - per lin. ft

ITEM AR800405
INSTALL TEMPORARY LIGHTING

DESCRIPTION

AR800405-1.1. This item of work shall consist of installing cable as jumpers for airfield lighting series circuits to temporarily activate runway and taxiway lighting circuits during this project.

AR800405-1.2 REFERENCES.

A. FAA AC No. 150/5345-7E, (or latest edition) SPECIFICATIONS FOR L-824 UNDERGROUND ELECTRICAL CABLE FOR AIRPORT LIGHTING CIRCUITS.

B. FAA AC No. 150/5345-53 AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM" (most current issue) and AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum.

C. FAA AC No. 150/5370-2E OPERATION SAFETY ON AIRPORTS DURING CONSTRUCTION.

D. NFPA 70 – National Electrical Code (most current issue in force).

MATERIALS

AR800405-2.1. Jumpers shall be constructed using the following material:

A. 1/C #8 5KV UG Cable shall be one conductor No. 8, 5000-Volt, FAA L-824, Type C, stranded. L-824 cable shall be FAA-approved and listed in the current AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum, and shall be in compliance with the Buy American Act.

B. Splices shall be as detailed on the Plans and in accordance with Item 108.

C. Ducts used for temporary lighting circuits shall be in accordance with Items 108 and 110.

CONSTRUCTION METHODS

AR800405-3.1. The Contractor shall furnish and install all materials necessary for complete and operational installation of the temporary lighting, as specified herein and as shown on the Plans. The complete installation and wiring shall be done in a neat, workmanlike manner. All electrical work shall comply with the requirements of the NFPA 70 – National Electrical Code (NEC) most current issue in force, and all other applicable local codes, laws, ordinances, and requirements in force. Electrical equipment shall be installed in conformance with the respective

manufacturer's directions and recommendations for the respective application. Any installations which void the UL listing, ETL listing (or other third party listing), and/or the manufacturer's warranty of a device will not be permitted. All temporary installations shall comply with National Electrical Code Article 590 – "Temporary Installations". The contractor shall secure, identify, and place temporary exposed wiring in conduit, duct, or unit duct to prevent electrocution and fire ignition in conformance with the requirements of FAA AC 150/5370-2E, Part 3-6, c.

A. There are seven existing runway and taxiway lighting circuits (high-voltage circuits) powered by Constant Current Regulators (CCR's) out of the vault. Contractor shall field verify all circuits to confirm the respective power sources. Based on field data and record drawings the existing runway and taxiway circuits are as follows:

1. Taxiway A powered by 30 KW CCR.
2. Taxiway B Circuit #1 powered by a 30 KW CCR; Note the L-821 control panel at the Air Traffic Control Tower has one set of controls for Taxiway B lighting system which controls both Taxiway B circuit #1 and Taxiway B circuit #2 simultaneously.
3. Taxiway B Circuit #2 powered by a 15 KW CCR.
4. Taxiway C powered by a 15 KW CCR.
5. Runway 5-23 powered by a 4 KW CCR.
6. Runway 12R-30L powered by a 10 KW CCR. Note Runway 12R-30L appears to have some taxi guidance signs included on this circuit. The Runway 12R REILS are powered by this circuit through a power adapter device. This power adapter provides 120 VAC or 120/240 VAC when connected on the 6.6 Amp series circuit. The supplemental wind cone located on Runway 30L is also powered by this circuit.
7. Runway 12L-30R powered by a 7.5 KW CCR. Runway 12L-30R also has (or will have installed under a separate Contract) a backup constant current regulator. There are two cutouts with one handle wired as a transfer switch. Either constant current regulator is capable of powering the Runway 12L-30R lighting circuit. The supplemental wind cones located on Runway 12L-30R are also powered by this circuit.

B. The existing low-voltage circuits powered out of the vault are as follows:

1. Airport Rotating Beacon cables.
2. Wind Tee and Wind Cone homerun cables.
3. Gate operator for access gate located west of the vault.
4. Control cables from the vault to the L-821 Control panel located in the Air Traffic Control Tower.

C. The Contractor will be required to provide temporary wiring to maintain operation of runway and taxiway lighting circuits as detailed on the Plans and as specified herein. All of the runway and taxiway lighting circuits shall be identified and labeled by the Contractor. Airfield lighting circuits may only be disabled during day light hours unless the respective runway or taxiway is scheduled to be closed. All runway and taxiways that are not closed shall have their respective airfield lighting circuits operational by nightfall.

D. All of the low-voltage circuits fed out of the vault shall remain in place and in operation for the duration of this project.

E. All temporary wiring shall be installed in conduit, duct, or unit duct and shall be protected and guarded by suitable fencing, barriers, or other effective means to limit access only to authorized and qualified personnel to comply with NEC 590.7. Temporary cables in conduit are permitted to be run across the ground provided they are adequately protected from damage and access is limited to only authorized and qualified personnel. Any damage shall be immediately repaired at the Contractor's own expense. Contractor shall provide lighted barricades for all taxiway and runway pavement closures. All taxiway, runway, and other pavement closures shall be coordinated with the Airport Director and the Resident Engineer. Lighted barricades shall comply with the requirements of the Airport Safety Plan. Contractor shall provide temporary fencing and/or barricades for areas of excavation, open manholes, etc. and to protect the temporary cable installation, and to keep unauthorized personnel from entering the construction area.

F. Contractor shall coordinate work and any power outages with the Airport Director and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures including, but not limited to, 29 CFR section 1910.147 The Control of Hazardous Energy (lockout/tagout).

G. At the end of the construction day, prior to leaving the construction site, the Contractor shall activate the respective runway and taxiway lighting circuits to insure they are functioning properly. If a jumper cable has been damaged, it will be replaced at no additional cost to the project. The Contractor shall repair any lighting circuit that is not functioning. The maintenance of these lighting circuits, and jumper cables will be considered as part of this item of work, and no additional compensation will be allowed. The Contractor will furnish a contact person who will be responsible to provide 24-hour repair service in the case a circuit should deactivate after the Contractor has left the job site for the day.

H. Temporary jumpers shall be removed when the respective replacement circuit installations are complete and operational.

I. Cable used for Item AR800405 Install Temporary Lighting will not be permitted for reuse for Items AR108108 1/C #8 5KV UG Cable or AR108258 2/C #8 5 KV UG Cable in UD. This cable will be turned over to the Airport when the temporary jumpers are removed, coiled and bound. If the Airport elects not to accept the conduit the Contractor will dispose of it off the airport site at his cost.

METHOD OF MEASUREMENT

AR800405-4.1. The quantity of this item to be paid for under Item AR800405 Installing Temporary Lighting shall be for furnishing all materials; and for furnishing all labor, tools, equipment, coordination, barricades, temporary fencing, and incidentals necessary to complete this item of work.

BASIS OF PAYMENT

AR800405-5.1. This work will be paid for at the contract unit price bid per lump sum for Installing Temporary Lighting. Said price and payment shall constitute full compensation for furnishing all materials; and for furnishing all labor, tools, equipment, coordination, barricades, temporary fencing, and incidentals necessary to complete this item of work.

Payment will be made under:

Item AR800405 Install Temporary Lighting – per lump sum

ITEM AR800500
REMOVE PAVEMENT

DESCRIPTION

This item of work shall consist of full depth bituminous pavement removal and underlying Portland Cement Concrete (PCC) pavement removal on Taxiway B2, as designated on the Construction Plans. All pavement removal areas will be marked in the field by the Resident Engineer. The bituminous pavement will be removed through use of bituminous pavement milling. The millings will remain on site and be evenly dispersed on constructed haul route alignments to remain at the project conclusion. The PCC material will be disposed of off the airport site. Areas of removal outside of Taxiway B2 to be removed shall be paid for under Item AR401900 Bituminous Pavement Removal, not this Item. This Item is intended for use on Taxiway B2 only.

CONSTRUCTION METHODS

All pavement removal areas within this Item shall have a full depth saw cut (8 in. depth, approximate) made at the right edge of pavement of Taxiway B. The bituminous pavement will then be removed full depth by rotary milling. All milling material produced shall remain on the Airport and be evenly distributed on constructed haul route alignments to remain, and lightly graded. The PCC pavement will then be rubblized or demolished and all debris removed. All removed PCC pavement material including the concrete as well as the reinforcing steel will be disposed of by the Contractor off the airport site, at his expense. The sawing will be considered as an incidental item to the pavement removal on Taxiway B2, and no additional compensation will be allowed.

METHOD OF MEASUREMENT

The quantity of pavement removal to be paid for shall be the number of sq. yds. removed, completed, and accepted by the Resident Engineer.

BASIS OF PAYMENT

This work will be paid for at the contract unit price bid per sq. yd. for pavement removal, which price and payment shall constitute full compensation for sawing, milling, and removal, disposal of waste material; distribution of millings to the haul route and the associated light grading; and for furnishing all material, labor, equipment, and incidentals necessary to complete this item of work.

Payment will be made under:

Item AR800500 Remove Pavement - per sq. yd.

ITEM AR800576
INSTALL GROUND ROD

DESCRIPTION

AR800576-1.1. This item of work consists of the installation of ground rods, grounding electrode conductors, and grounding connectors for the existing counterpoise/guard wires for the FAA REIL power and control cables that run to the REILS on Runway 12L-30R at the locations and details shown on the Construction Plans.

AR800576-1.2 REFERENCES.

A. ASTM Specification B3 – Standard Specification for Soft or Annealed Copper Wire.

B. FAA-C-1391b U.S. Department of Transportation Federal Aviation Administration, Specification, INSTALLATION AND SPLICING OF UNDERGROUND CABLES.

C. FAA-GL-918C DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION, GREAT LAKES REGION, CHICAGO, ILLINOIS, SPECIFICATION FOR CONSTRUCTION OF TERMINAL NAVIGATIONAL AID FACILITIES.

D. NFPA 70 – National Electrical Code (most current issue in force).

E. UL 467 – Grounding and Bonding Equipment.

AR800576-1.3 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for MALS components and associated equipment and materials to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Provide cut sheets with manufacturer's name, catalog number, dimensions, material and UL listing for each type and size ground rod. Include certification of 100% domestic steel for ground rods.

EQUIPMENT AND MATERIALS

AR800576-2.1 GROUND RODS. Ground rods shall be 3/4-inch diameter by 10-feet long UL-listed, copper-clad with 10-mil minimum copper coating. Steel used to manufacture ground rods shall be 100 percent domestic steel.

AR800576-2.2 GUARD WIRE FOR EXISTING REIL CABLES. Guard wire for the existing FAA REIL cables shall match the existing guard wires. Based on FAA record drawings existing guard wires for the existing FAA REIL cables are No. 6 AWG bare solid copper conductor. Guard wire for the existing FAA REIL circuits shall be No. 6 AWG bare solid copper conductor conforming to ASTM Specification B3.

AR800576-2.3 EXOTHERMIC-WELD TYPE CONNECTORS. Connections to ground rods shall be made with exothermic-weld type connectors, Cadweld by Erico Products, Inc., Solon, Ohio (Phone: 800-248-9353), Thermoweld by Continental Industries, Inc., Tulsa, Oklahoma (Phone: 918-663-1440), or Ultraweld by Harger, Grayslake, Illinois (Phone: 800-842-7437). Exothermic-weld connections shall be installed in conformance with the respective manufacturer's directions using molds, as required for each respective application. Bolted connections will not be permitted at ground rods.

CONSTRUCTION METHODS

AR800576-3.1. The Contractor shall furnish and install ground rods, guard wire, and exothermic-weld connections to interface to the existing guard wires for the FAA REIL cables as detailed on the Plans and specified herein. Guard wire will need to be installed with the power and control cables associated with the FAA REIL cable adjustments for the REILS on Runway 12L-30R. Guard wire shall be #6 AWG bare solid copper conductor. Contractor shall locate the existing guard wires, interface to them and terminate them at a ground rod located just outside of each respective manhole where the FAA REIL are spliced and cross under the runway. Ground rods shall be 3/4-in. diameter, 10 ft long, UL-listed, copper-clad with 10-mil minimum copper coating. Ground rods shall be driven into the ground adjacent to the respective manholes so that the top of the rod is at least 12 inches below grade. Guard wires shall be attached to the ground rod by exothermic-weld connection. See FAA-C-1391b U.S. Department of Transportation Federal Aviation Administration, Specification, INSTALLATION AND SPLICING OF UNDERGROUND CABLES, Part 3.4.6 Cable guard wires for additional information regarding installation of ground rods for guard wires.

METHOD OF MEASUREMENT

AR800576-4.1. The quantity of ground rods to be paid for shall be the number of ground rods installed with connections and interface to guard wires constructed in place and accepted by the Resident Engineer.

BASIS OF PAYMENT

AR800576-5.1. Payment shall be made at the contract unit price for each ground rod installed, as per this Specification and accepted by the Resident Engineer, which shall be full compensation for all labor, materials, tools, equipment, and incidentals necessary to complete these items.

Payment will be made under:

Item AR800576 Install Ground Rod - per each

ITEM AR908
MULCHING

This Special Provision modifies Item 908 Mulching as follows:

908-2.1 Mulch Material. Add the following:

"Hydraulic mulch will be used exclusively in all areas within the project limits."

ITEM AS701006
6" PVC STORM SEWER
(ADDITIVE ALTERNATE NO. 1)

DESCRIPTION

This work shall consist of directionally boring a 6" pipe beneath the existing and proposed runway pavement for the purpose of conveying underdrain discharge from the south side of the runway to the north.

REFERENCES

A. ASTM D1784-08 Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

B. ASTM D1785-99 Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

SHOP DRAWINGS

The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for each type of pipe and/or fitting to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

A. Certification of compliance with the Buy American Act for all materials and equipment.

B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.

C. Indicate the pay item number for each respective pipe or fitting.

D. Shop drawings shall include pipe and fitting cut sheets with type, size, specifications, manufacturer, and catalog or part number.

EQUIPMENT AND MATERIALS

The 6" pipe to be directional-bored shall be Schedule 40 PVC or Schedule 80 PVC, or High-Density Polyethylene (HDPE) pipe, sized as detailed on the Plans and as specified herein.

All PVC Schedule 40 pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785 and D2665 (where applicable), consistently meeting and/or exceeding the Quality Assurance test requirements of these standards with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be manufactured in the USA, using domestic materials, by an ISO 9001 certified manufacturer. Standard lengths of pipe sizes 6" and larger shall be beveled each end by the pipe manufacturer. All pipe shall be stored indoors after production at the manufacturing site until shipped from factory.

The pipe shall be suitable for directional boring, and for use as drainage pipe. Pipes shall be suitable for underground applications encased in concrete or direct burial. Pipe manufacturer shall provide literature and/or certification that the pipe is rated suitable for installation by boring method.

CONSTRUCTION METHODS

Drainage pipes installed by directional-boring shall be installed in a manner that will not damage any existing underground utilities, and shall not disturb or damage the respective pavement or roadway surface. The pipes shall be directional-bored at the locations shown on the Construction Plans. The pipes will be bored at the depth and slopes shown on the Plans, at elevations below the bottom of the pavement, base, and subbase it is being bored under. Pipes shall extend a minimum of 2 ft beyond the respective subbase it is being bored under to facilitate placement of the respective catch basin from which it will drain from and to. The ends of the pipe will be sealed with grout at each catch basin. Once the catch basin is placed and the pipe end grouted in place, the excess pipe within the catch basin will be trimmed to the wall of the basin, or the extent of the grout material. All pipes will be placed to allow positive drainage out of the respective catch basin.

The Contractor shall determine if there is a conflict between the installation of the proposed pipes and any existing utilities. He will make all necessary adjustments in depth of installation to avoid any and all proposed underground improvements.

RESTORATION

Any and all trenches and disturbed areas will be backfilled and restored to a smooth grade and seeded and mulched to the satisfaction of the Engineer in accordance with Items 901 and 908, respectively. All trench settlement shall be corrected for a period of one year. Restoration, grading shall be incidental to Item AR152410 Unclassified Excavation. Seeding and mulching

of areas disturbed during the installation of the proposed ducts will be included in Items AR901510 and AR908510, respectively.

LOCATING OF EXISTING UNDERGROUND UTILITIES AND CABLES

The location, size, and type of material of existing underground and/or aboveground utilities indicated on the Plans are not represented as being accurate, sufficient, or complete. Neither the Owner nor the Engineer assumes any responsibility whatever in respect to the accuracy, completeness, or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size, and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. It shall be the Contractor's responsibility to determine the actual location of all such facilities, including service connections to underground utilities. Prior to construction, the Contractor shall notify the utility companies of his operational plans, and shall obtain from the respective utility companies detailed information and assistance relative to the location of their facilities and the working schedule of the companies for removal or adjustment, where required. In the event an unexpected utility interference is encountered during construction, the Contractor shall immediately notify the utility company of jurisdiction. The Owner's Representative and/or the Resident Engineer shall also be immediately notified. Any damage to such mains and services shall be restored to service at once and paid for by the Contractor at no additional cost to the Contract.

All utility cables and lines shall be located by the respective utility. **Contact JULIE (Joint Utility Location Information for Excavators) for utility information, phone: 1-800-892-0123.** Contact the FAA (Federal Aviation Administration) for assistance in locating FAA cables and utilities. Location of FAA power, control, and communication cables shall be coordinated with and/or located by the FAA. Also contact Airport Director/Manager and Airport Personnel for assistance in locating underground Airport cables and/or utilities. Also coordinate work with all aboveground utilities.

Contractor shall locate and mark all existing cables within ten (10) feet of proposed excavating/trenching area. Any cables found interfering with proposed excavation or cable/trenching shall be hand dug and exposed. Any damaged cables shall be immediately repaired to the satisfaction of the Resident Engineer at the Contractor's expense. The Resident Engineer and Owner shall be notified immediately if any cables are damaged.

Payment for locating and marking underground utilities and cables will not be paid for separately, but shall be considered incidental to the respective pipe installation.

METHOD OF MEASUREMENT

The quantity of pipe to be paid for shall be the number of lin. ft of pipe of installed and measured in-place, complete, and accepted by the Resident Engineer.

BASIS OF PAYMENT

Payment will be made at the contract unit price of pipe completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials; for all pipe interface work to catch basins including coring of catch basins; for all excavation and backfilling with aggregate backfill, earth backfill, and concrete (grout); and for all labor, coordination, equipment, tools, and incidentals necessary to complete this Item.

Payment will be made under:

Item AR701006 6” PVC Storm Sewer - per lin. ft

APPENDIX A

FAA-GL-918C DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION, GREAT LAKES REGION, CHICAGO, ILLINOIS, SPECIFICATION FOR CONSTRUCTION OF TERMINAL NAVIGATIONAL AID FACILITIES

PLEASE RECYCLE.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
GREAT LAKES REGION
CHICAGO, ILLINOIS

FAA-GL-918C
November 30, 1994

SPECIFICATION FOR CONSTRUCTION OF TERMINAL NAVIGATIONAL AID FACILITIES

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DIVISION 1 - GENERAL REQUIREMENTS
SECTION 1A
SPECIAL CONDITIONS

1A.1 SCOPE.

a. This specification covers general requirements for construction of an Instrument Landing System (ILS) and Visual Guidance Lighting Systems. The complete ILS consists of several component facilities. The term visual guidance lighting systems covers lighting facilities. Refer to the solicitation package for types of facilities to be constructed. This specification includes requirements common to all facilities and requirements specific to individual facility types. In general, all parts of this specification covering construction required on project drawings and in other contract documents, are applicable to this contract.

b. The contractor shall furnish all plant, labor, materials (except Government-furnished property), equipment, energy, transportation, and other services necessary to construct all elements of the systems required in the specifications, drawings, and other contract documents. Construction shall include all miscellaneous and incidental work necessary for a complete and operational system, whether or not such work is specifically shown or specified.

1A.2 GOVERNMENT-FURNISHED PROPERTY. Government-furnished property (GFP) is also known as Government-furnished material (GFM). Government-furnished property for this contract is shown on the Government-Furnished Property List. The Government-Furnished Property List is the sole contract document which validly identifies Government-furnished property under this contract. The contract drawings give little or no indication of which items are Government-furnished. To determine whether an item of equipment or other material is Government-furnished, see the Government-Furnished Property List. For Government-furnished property, the contractor shall provide for and pay for loading of this property at the storage location (location indicated on the Government-Furnished Property List) and transportation to, and unloading at, the job site.

1A.3 CONTRACTOR-FURNISHED MATERIAL. The contractor shall furnish all material under this contract per Paragraph 1A.1b, except the Government-furnished property identified on the Government-Furnished Property List. The instruction install on the drawings means furnish and install unless the item(s) to which the instruction applies is Government-furnished property included in the Government-Furnished Property List. The contractor shall be aware that certain materials to be furnished by the contractor, may be long-lead-time items. Therefore, the successful bidder should determine the availability of all material immediately after contract award, and initiate procurement action on long-lead-time items at the earliest possible date. To facilitate the use of this specification in procuring material and equipment, see the Material and Equipment Specification Index at the end of this section. Where the specifications mention material or equipment by brand, it is regarded as a known acceptable source, as it meets specifications.

1A.4 SUBMITTALS AND BRAND NAME USAGE.

a. Introduction. Each product required for use in the contract drawings and specifications must meet the actual minimum needs of the Government as demonstrated in the salient (prominent, important) characteristics for that product. If a brand name product is used in the drawings or specifications, it should be regarded as a "known acceptable source" (i.e., a product that meets the actual minimum needs, and demonstrates the appropriate salient characteristics). The product used can be identical or equal to the brand name product or known acceptable source in meeting the salient characteristics, but it need not exceed the actual minimum requirements. Any brand name product or known acceptable source mentioned will, however, not be required for use in order to comply with the specification or drawing unless those documents make it clear that the brand name product is required, and substitution is prohibited. The following submittal procedure shall be followed in order to:

(1) Insure adherence to functional and quality standards in substitute contractor-furnished material.

(2) Inform the FAA of the contractor's plans to use certain material and equipment, e.g., splicing materials and tools, even if they are a known acceptable source.

b. Definition. A submittal is a collection of information required by specifications, or by the Contracting Officer, presenting detailed information on:

(1) Material or equipment items the contractor proposes to use.

(2) Methods or plans of action which the contractor intends to employ in specific situations.

c. Requirements. Submittal requirements are formally defined in a paragraph of the contract Special Specifications. Submittal guidance of varying extent is presented in this specification (FAA-GL-918C), as indicated in the Material and Equipment Specification Index at the end of this section. Each product that a contractor wishes to use that is not a known acceptable source, must be approved before use, by the Contracting Officer or the Contracting Officer's designee. To gain approval, the contractor must submit documents and/or samples that will demonstrate that that product clearly will meet the Government's minimum needs, and demonstrates appropriate salient characteri-stics. All submittals must be in writing. The Contracting Officer shall have the right to require submittals from the contractor where the contractor makes an unsolicited change proposal. The information presented in a submittal shall be sufficient to demonstrate that all specification requirements for the subject material, equipment, methods,

or plans, are met by the contractor's proposal. The informational materials may include documents such as shop drawings, sketches, calculations, data sheets, written plans of action, manufacturers' catalog cuts, brochures, and/or specification sheets. If the specifications or Contracting Officer requires actual samples of material or equipment, the contractor shall provide them. For any documentary submittal, the contractor shall submit four identical sets of documents.

d. Submittal Review. When submitting before the Notice to Proceed date, the contractor shall send the submittal package(s) directly to the Contracting Officer. When submitting after contract work has begun, the contractor shall give submittal packages to the Resident Engineer, who will forward them promptly to the Contracting Officer. The Contracting Officer may personally evaluate the submittal, or request FAA engineers to evaluate it. In either case, the submittal will return directly from the Contracting Officer to the contractor, with the Contracting Officer's approval, approval with comments, or disapproval.

e. Submittal Time Frame. To provide adequate time for document transmission and submittal review, the FAA reserves the right to take two weeks to complete a review, transmission date to transmission date. Terminal navi-gational aid contracts are brief contracts. The review process can therefore span a substantial portion of the contract period. For this reason:

(1) The contractor is urged to initiate submittals as soon as feasible after contract award, and to expedite document transmission.

(2) The Contracting Officer and other reviewers (if any) will expedite reviews and document transmission insofar as feasible.

Maximum use of fast document transmission modes (e.g., fax, couriers, and overnight freight forwarders) is encouraged.

f. Procurement Before Approval. The contractor is advised not to procure any item for which submittal approval is required but not yet granted. If approval is denied, the contractor will be prevented from installing the disapproved item(s). The contractor must transmit a new submittal package for the new items replacing the disapproved items, and must procure only approved items. The contractor shall take responsibility for the delivery and installation of any items installed before submittal approval is granted. The FAA reserves the right to discontinue field work on any item furnished without submittal approval. Procuring and/or installing material which is later disapproved could result in substantial losses of money and time for the contractor.

1A.5 PRE-CONSTRUCTION CONFERENCE. The contractor shall attend a pre-construction conference when required by the contracting officer or airport management. The contractor shall abide by all agreements reached at the conference regarding safety practices, ingress and egress routes to the site, maintenance of airport security (locking gates, etc.), deference to air traffic, and other operational procedures.

1A.6 COORDINATION. All coordination between the contractor and the airport management and local FAA personnel, shall be accomplished through the Resident Engineer.

1A.7 PROJECT DRAWINGS.

a. Conflict Between Site Drawings and Standard Drawings. If any conflict should exist between site drawings (location-specific drawings) and standard drawings (drawings not referring to a particular location), the site drawings shall govern.

b. Drawings Referenced But Not Provided. Unless otherwise specified, drawings which are referenced on contract drawings, but which are not listed in the list of specifications and drawings, do not apply to the contract.

1A.8 TEMPORARY ELECTRICAL POWER. Unless otherwise specified, the contractor shall make all arrangements and pay all costs for temporary electrical power needed for construction of the facility.

1A.9 COMPLIANCE WITH LOCAL AND OTHER CODES. The contractor shall comply with standards (e.g., National Electrical Code) adopted by the contract documents, and with local and other codes. Where the requirements of the specifications and drawings exceed those of the adopted and local codes, the contractor shall comply with the requirements of the specifications and drawings.

1A.10 SANITARY FACILITIES. Sanitary facilities are not available at the work sites. The contractor shall provide temporary toilet facilities as required for his employees. The locations of the toilet facilities shall be where directed by the Resident Engineer.

MATERIAL AND EQUIPMENT SPECIFICATION INDEX

Material or Equipment Specified	Relevant Paragraph(s)	Does the paragraph include: Product(s) listed?	Submittal guidance?
air conditioner	16A.17e	N	N
anti-seize compound	13A.2d(1)	Y	N
	13C.2b	Y	N
cable			
600V power cable, DEB	Section 16B	N	N
600V armored power cable, DEB	Section 16C	N	Y
5,000V power cable, DEB	Section 16D	N	Y
clamp	13A.2d(2)	Y	N
control cable	Section 16E	N	Y
connector protection	16A.24	Y	N
end caps	16A.8	Y	N
splicing connectors			
power	13A.6c	Y	Y
power and control	16F.6	Y	Y
splicing kits			
MALS power	13A.6b	Y	Y
power and control	16F.6	Y	Y
circuit breakers	16A.14b&e	Y	N
conduit	16A.1	N	N
	16A.3	N	N
door hardware for shelters	13E.4	Y	N
electrical coating	16A.25	Y	N
electrical enclosures and wireways	16A.15	N	N
electrical tape	16A.21	Y	N

MATERIAL AND EQUIPMENT SPECIFICATION INDEX (CONTINUED)

Material or Equipment Specified	Relevant Paragraph(s)	Does the paragraph include: Product(s) listed?	Does the paragraph include: Submittal guidance?
environmental equipment for shelters	16A.17	Y	N
exothermic welding kits	16A.4f	Y	Y
expansion couplings	16A.27	Y	N
fiber forms for concrete piers	3B.7b	Y	N
fire and arc proofing	16A.23	Y	N
framing, commercial metal	16A.26	Y	N
frangible couplings	16A.20	Y	N
fuses for switches	16A.13f	Y	N
geotextile	2B.3a	Y	Y
grounding electrode material	16A.4c	N	N
crimped connectors for	16A.4g	Y	Y
grounding conductor	16A.4d	N	N
heater	16A.17c	Y	N
heater timer unit (components)	16A.17d	Y	N
landscape fabric	2B.3b	Y	Y
lamp, MALS 120-watt	13A.5	Y	Y
lighting equipment for shelters	16A.17f	Y	N
	16A.17g	Y	N
lightning protection equipment	16A.18	Y	N
paint	9A	N	N
	13E.7	Y	N
panelboard	16A.14	Y	N
pre-stretched rubber tubing	16A.22	Y	N

MATERIAL AND EQUIPMENT SPECIFICATION INDEX (CONTINUED)

Material or Equipment Specified	Relevant Paragraph(s)	Does the paragraph include: Product(s) listed?	Submittal guidance?
safety disconnect switches	16A.13	Y	N
screw anchor foundations	Section 13D	Y	Y
shelter steel siding	13E.8	Y	N
splicing connectors and kits	see under cable		
surge arrester	13F.7	Y	N
	16A.16	Y	Y
switches, safety	16A.13	Y	N
fuses for	16A.13	Y	N
tape	see electrical tape		
terminal strips for control cable	16A.19	Y	N
vent fan	16A.17a	Y	N
thermostat for	16A.17b	Y	N

DIVISION 2 - SITE WORK
SECTION 2A
EARTHWORK AND SITE IMPROVEMENTS

2A.1 DESCRIPTION OF WORK. The extent of earthwork is indicated on the drawings and by the provisions of this section. Require-ments for access road and site surfacing and paving are covered in Sections 2B and 2C.

2A.2 QUALITY ASSURANCE.

a. Codes and Standards. Perform all earthwork in compliance with applicable requirements of governing authorities having jurisdiction.

b. Testing and Inspection.

(1) Soil materials and degree of compaction shall conform to ASTM specifications referenced herein. Professional soil testing methods associated with this specification will generally not be required, but the FAA reserves the right to engage a state-licensed soil testing service to resolve disputes regarding adequacy of all earthwork performed.

(2) Visual inspection and qualitative testing shall be performed by the contractor in the presence of, and wherever directed by, the Resident Engineer.

2A.3 SAFETY REQUIREMENTS.

a. Refer to Division 1 for construction within classified and unclassified areas.

b. To protect life, property, and work, all earthwork operations shall be performed in compliance with local and OSHA (Occupational Safety and Health Administration) requirements. The contractor shall provide all sheeting, shoring, and other bracing as necessary.

c. All trenches in classified areas, excavated in one day, shall be backfilled during the same day. An effort shall be made to backfill other excavations in classified areas, during the same day.

2A.4 JOB CONDITIONS.

a. Existing Utilities.

(1) Locate all underground cables, utility lines, and other underground construction before beginning excavation work. Any damage to such lines or construction belonging to the FAA, utility companies, or others, shall be promptly repaired, at contractor's expense, to the complete satisfaction of the owner.

(2) Project drawings generally indicate locations of cables maintained by the Federal Aviation Administration only. The FAA will field establish approximate locations of its own cables.

b. Weather Conditions.

(1) Excavating and backfilling for foundations, trenches, and jacking or boring pits, shall not proceed when excessively wet or freezing weather conditions could adversely affect the load-bearing characteristics of the soil, or prevent proper compaction.

(2) When freezing weather is expected, excavations shall not be made to full depth unless concrete or conduits can be placed immediately. If an excavation is already at full depth, the excavation shall be protected from frost.

c. Drainage.

(1) All excavations shall be continually drained by natural means or pumping to prevent any decrease in soil bearing capacity or damage to poured foundations or to trenches.

(2) Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

(3) Establish and maintain temporary drainage ditches and other diversions outside excavations limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

2A.5 MATERIALS.

a. Structure and Foundation Materials. In-place undisturbed inorganic soils will be adequate to support all project structures, unless otherwise indicated. Highly organic soils (topsoil, peat, and swamp location soils) shall be removed entirely from areas to be occupied by structures.

2A.5b

b. Backfill and Fill. Material shall be inorganic soil excavated from site, or borrow comprised of inorganic soil approved by the Resident Engineer. All such soils shall be free of rock, gravel, and cohesive lumps greater than two inches in any direction, and debris, waste, vegetation, frozen material, and other deleterious materials.

c. Base Course for Concrete Slabs. Material shall be a graded mixture of washed crushed stone or crushed or uncrushed gravel with 100% passing a 1 1/2 inch sieve, and not more than 5% passing a number 4 sieve.

2A.6 SITE PREPARATION.

a. Clearing and Grubbing. The contractor shall scalp areas where excavation or embankment will be made. Scalping shall include the removal of materials such as trees, brush, roots, sod, grass, residue of agriculture crops, sawdust, and decayed vegetable matter, from the surface of the ground. These materials shall be removed from the site and disposed of off airport property.

b. Topsoil Removal.

(1) Topsoil shall be considered soil containing visible vegetable matter and black loam that will not compact with the usual compacting methods.

(2) Unless otherwise specified, topsoil shall be removed from all areas to receive fill, granular surfacing, pavement, and structures, and from all areas where subsoil excavating is required, such as for roadway cuts and ditches. Dispose of excess topsoil on or off airport property, as directed by the Resident Engineer, at no additional cost to the Government.

2A.7 EXCAVATION.

a. Excavation Classification. Excavation is unclassified and includes excavation to subgrade elevation indicated, regardless of character of materials and obstructions encountered excepting as qualified herein.

b. Rock Excavation. If rock is encountered above the design footing elevations of any facility structure, such foundation shall bear entirely on clean solid rock or on soil, but not on both. If the soil-and-rock bearing condition is encountered, the Resident Engineer will determine which material shall support the structure. If rock surface is used, it shall be reasonably level or shall be stepped to make level segments.

c. Unauthorized Excavation. Removal of materials beyond design subgrade elevations or dimensions without specific direction from the Resident Engineer constitutes unauthorized excavation. Remedial work for such excess excavation shall be as directed by the Resident Engineer at the contractor's expense.

d. Additional Excavation. When any excavation has reached required subgrade elevation, notify the Resident Engineer, who will inspect soil conditions. If the Resident Engineer determines that the soil possesses inadequate bearing capacity, carry such excavation deeper as directed by the Resident Engineer.

e. Excavation for Structures.

(1) Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services and other construction, and for inspection.

(2) In excavating for footings and foundations, take care not to disturb the bottom of the excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave a solid base.

f. Excavation for Cable and Conduit Trenches.

(1) Excavate in compliance with lines and depths shown on drawings. Minimum trench depth shall be 24 inches and 30 inches, on and off airport lands, respectively, unless otherwise specified. Slope trenches to same elevations as conduits where cables will be routed to a building interior. Minimum trench width shall be that required to accept power-operated mechanical tampers.

(2) Grade bottom surfaces of trenches to provide uniform bearing and continuous support for cable and conduit.

(3) Material excavated in excess by error, or due to unsuitable bearing, shall be replaced with mechanically compacted inorganic soil.

(4) If solid rock is encountered, the Resident Engineer will decide if such rock need be removed or if an alternate trench route or lesser depth conduit installation will be acceptable.

(5) If a trench must cross a concrete or asphalt paved surface, all cuts shall be saw cuts, unless otherwise specified.

2A.8 COMPACTION.

a. General.

(1) All compaction shall be accomplished by using power-operated mechanical equipment except for limited use of manual tampers in constricted areas. Operate all power equipment as herein specified to achieve the minimum degree of compaction subject to acceptance by testing.

(2) Cohesive soils are defined herein as those containing less than 60 percent sand, gravel, or stone. Percentages greater than 60 percent are herein termed non-cohesive soils.

b. Cohesive Soil Compaction.

(1) Use sheepsfoot roller of such minimum weight that at least 200 psi will be transmitted to surface area of studs or feet. Operate at speeds not exceeding 4 mph on each layer of fill until roller walks itself to top of grade.

(2) Use motor-operated soil tamper (stomper) in confined areas, including trenches, on each layer of fill until no further visible consolidation is evident.

(3) Use a heavy blunt tamping rod on each layer of fill in the most constricted locations where power equipment cannot be used.

c. Non-Cohesive Soil Compaction.

(1) Use pneumatic tire roller fully loaded and weighing not less than 275 pounds per inch of tire tread width. Operate at speeds not exceeding 4 mph. A minimum of ten passes of the roller is required on each layer of fill.

(2) Use motor-operated vibratory tamper in confined areas, including trenches, on each layer of fill until no further visible consolidation is evident.

(3) Use heavy blunt tamping rods on each fill layer in constricted locations where power equipment cannot be used.

d. Moisture Control.

(1) Where soil material must be moisture-conditioned before compaction, uniformly apply water to a layer of soil material in such quantity that free water will not appear on the surface during or subsequent to compaction operations.

(2) Scarify and air-dry soil material that is too wet to permit compaction to specified density.

e. Percentage of Maximum Density Requirements.

(1) General Requirements. The required densities for cohesive and non-cohesive soils are determined by quantitative testing procedures defined by ASTM Standards D 1557 and D 4253/4254, respectively. To assure compliance, the contractor may arrange for such professional soil testing services, at no additional cost to the Government. The FAA, at its expense, may also make such arrangements if qualitative testing procedures appear inadequate.

(2) Structures, Slabs, and Access Roads/Parking Areas. Compact top surfaces of subgrade and each layer of backfill or fill material to 90% of maximum density for cohesive soils, or to 95% relative density for non-cohesive material.

(3) Turf and Non-Vehicular Surfaced Areas. Compact top surfaces of subgrade and each layer of backfill or fill material to 90 percent of maximum density for cohesive soils, or to 90 percent relative density for non-cohesive material.

f. Qualitative Testing and Inspection Procedures.

(1) General. The contractor shall perform qualitative soil compaction testing and inspection procedures for each type of backfill or fill material used wherever directed by, and in the presence of, the Resident Engineer. Special attention shall be given to the backfilling of structures and trenches.

(2) Qualitative Testing.

(a) Qualitative soil testing will consist of comparing the resistance to penetration of undisturbed soil to that of compacted backfill of the same composition. For borrow material the penetration comparison shall be made between maximum test sample density and in-place fill density.

(b) A soil penetration device (penetrometer) indicating depth and force exerted shall be utilized. Compaction will be adequate if backfill or fill possesses at least 95% of the resistance to penetration of undisturbed soil or test sample, respectively.

(c) Borrow test sample shall be a four inch deep (compacted measurement) layer of soil, aerated or moistened as directed by the Resident engineer, and compacted by power equipment until no further consolidation occurs, as approved by the Resident Engineer.

(3) Concrete Slab Base Course. Compact with vibratory tamper until no further visible consolidation is evident.

2A.9 BACKFILL AND FILL.

a. Structure Foundations. Backfill or fill as promptly as work permits, but not until completion of the following:

(1) Acceptance of construction below grade.

(2) Recording locations of underground conduit.

(3) Removal of concrete formwork, bracing, trash, and debris.

b. Ground Surface Preparation. Remove vegetation, debris, topsoil, and unsatisfactory subsoil from ground surface, and compact the subgrade, prior to placement of fill layers.

c. Placement and Compaction.

(1) Place acceptable backfill and fill materials in layers not more than eight inches in loose depth for material to be compacted by heavy equipment, and not more than four inches in loose depth for material to be compacted by hand-operated tampers.

(2) Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Do not place backfill or fill on water, ice, snow, frozen soil, or excessively wet soil.

d. Cable Trench Backfill.

(1) Before laying cables, inspect the bottom of the cable trench. If it is not smooth, or if any rock or stone that would be retained on a 1/4-inch sieve is present, place a two-inch layer of bedding material, according to Paragraph (2) below, in the trench. Do not compact this layer. Lay cables on top of this layer.

(2) The first layer of backfill material over cables shall be three inches deep, loose measurement, and shall be sand or other homogeneous inorganic soil containing no mineral aggregate particles that would be retained on a 1/4-inch sieve. This layer shall not be mechanically compacted.

(3) The second layer, in turf and crushed rock surface areas, shall be four inches deep, loose measurement, and shall contain no mineral aggregate particles that would be retained on a one-inch sieve. Subsequent layers shall be clean soil containing no rock particles larger than two inches in their largest dimension.

(4) Except for surfacing material, all layers of trench backfill, for areas to be paved or surfaced with crushed rock, shall be sand, placed and compacted as required for access roads.

(a) If a trench crosses an area surfaced with crushed rock, the top 12 inches of trench backfill shall be crushed rock, placed and compacted as required for access roads. The finished grade elevation of the crushed rock backfill shall equal the grade elevation of existing adjacent crushed rock.

2A.9d(4)(b)

(b) If a trench crosses an area surfaced with concrete or asphalt pavement, the pavement shall be replaced with materials of the same composition, thickness, and degree of compaction as the adjacent pavement structure, except that the crushed rock base shall be a minimum of 12 inches deep. Replacement concrete shall have a 28-day compressive strength of 3,000 psi. Finished grade of the pavement patch shall be flush with the adjacent pavement surfaces.

e. Backfill and Fill Surface Elevations. Finished grade, shown on the drawings, is the top surface of turf and crushed rock or crushed stone surfaced areas. Therefore, make allowances for six inches of topsoil and depths as detailed or specified for surfaced areas when establishing top surface of fill or backfill.

2A.10 GRADING.

a. General. Uniformly grade areas within limits of grading, including adjacent transition area. Smooth the finished surfaces within specified tolerances, and compact with uniform slopes between points where elevations are indicated, or between such points and existing grades.

b. Grading Outside Building Lines. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish areas to receive topsoil and surfacing within 0.10 feet above or below required subgrade elevations.

c. Grading Surface of Fill Under Building Slabs. Grade smooth and level and to proper elevation to within a tolerance of 1/2 inch when tested with a 10-foot straightedge.

2A.11 MAINTENANCE.

a. Protection of Graded Areas. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

b. Reconditioning. Where compacted areas are disturbed by construction operations, adverse weather, or where any settlement has occurred, scarify surface, add acceptable fill, reshape, grade, and compact as necessary.

2A.12 DISPOSAL OF EXCESS AND WASTE MATERIALS. Remove and dispose of all excess soil and waste material from the project site and adjacent lands. All costs associated with disposal shall be at contractor's expense.

DIVISION 3 - CONCRETE
SECTION 3A
CONCRETE FORMWORK AND REINFORCEMENT

3A.1 DESCRIPTION OF WORK. Extent of work is indicated on the drawings and by the requirements of this section.

3A.2 CONCRETE FORMWORK.

a. Design of Forms. Forms shall conform to shapes, lines, and dimensions of the members shown on the plans, and shall be sufficiently tight to prevent leakage of mortar. They shall be properly tied together so as to maintain position and shape.

b. Form Removal. Forms shall not be loosened or removed until the concrete members have acquired strength sufficient to support their own weight. No additional loads shall be placed on the concrete for at least 48 hours after placing.

c. Form Ties. Form ties for concrete shall be of a type that will break back 1 1/2 inches from the concrete surface. Ties shall be removed to a minimum depth of 1 1/2 inches, and the surface patched.

3A.3 CONCRETE REINFORCEMENT.

a. Materials. Reinforcement bars shall conform to "Specifications for Billet - Steel Bars for Concrete Reinforcement", ASTM A-615. All bars shall be intermediate grade deformed bars.

b. Cleaning and Bending Reinforcement. At the time concrete is placed, metal reinforcement shall be free from rust scale or other coatings that will destroy or reduce the bond. All bent bars shall be bent cold. No bars partially embedded in concrete shall be field bent except as shown on plans.

c. Placing Reinforcement. Metal reinforcement shall be accurately placed according to the plans, and adequately secured in position by concrete, metal, or other approved chairs, spacers, or ties.

d. Splices in Reinforcement. No splices or reinforcement shall be made except as shown on the plans or as authorized by the Resident Engineer. All welding shall conform to the American Welding Society's recommended practices for welding reinforcing steel, metal inserts and connections in reinforced concrete construction (AWSD12.1).

e. Concrete Protection for Reinforcement. The reinforcement shall be protected by the thickness of concrete shown on the drawings. Where not shown, the thickness of concrete over the reinforcement shall be as follows:

(1) Where concrete is deposited against the ground without the use of forms, not less than 3 inches.

(2) Where concrete is exposed to the weather or to the ground but placed in forms, not less than 2 inches for bars larger than number 5, and 1 1/2 inches for number 5 bars or smaller.

DIVISION 3 - CONCRETE
SECTION 3B
CAST-IN-PLACE CONCRETE

3B.1 DESCRIPTION OF WORK. The extent of work is indicated on the drawings and by the provisions of this section.

3B.2 MATERIALS. Cement shall conform to Specification for Portland Cement ASTM C-150, Type I, or Specification for Air-Entraining Portland Cement ASTM C-175, Type 1A, unless otherwise specified. The concrete shall have a minimum 28-day compressive strength of 3,000 PSI, a maximum slump of 4 inches, and a maximum aggregate size of 1-inch. The concrete mix shall contain an air-entraining admixture. Air content shall be 5 to 7 percent. The contractor shall give the Resident Engineer a certificate from the concrete supplier, bearing the intended job mix and certifying that the concrete delivered will meet the above requirements. The contractor shall obtain approval of the job mix from the Resident Engineer prior to placing concrete.

3B.3 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT.

a. Before placement, all equipment for mixing and transporting the concrete shall be cleaned. All debris and ice shall be removed from the places to be occupied by the concrete. Forms shall be thoroughly wetted (except in freezing weather) and oiled prior to placing reinforcing steel. The reinforcement shall be thoroughly cleaned of ice, dirt, rust scale, or other coatings.

b. Water shall be removed from place of deposit before concrete is placed. All laitance and other unsound material shall be removed from hardened concrete before additional concrete is added.

3B.4 CONVEYANCE. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent segregation or loss of materials. Equipment for chuting concrete shall be of such size and design so as to ensure a continuous flow of concrete at the delivery end without segregation of materials.

3B.5 PLACEMENT.

a. Concrete shall be placed within 1 1/2 hours after mixing begins. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The placing of concrete shall be carried on at such rate that concrete is at all times plastic, and flows readily into the spaces between the bars. No concrete that has been contaminated by foreign material shall be used, nor shall retempered concrete be used.

b. When placing is started, it shall be carried on as a continuous operation until placement is completed.

3B.5c

c. Concrete shall be placed in layers not exceeding 18 inches deep, and vibrated in place. During and immediately after depositing, the concrete shall be consolidated by vibrators. The concrete shall be thoroughly worked around reinforcement, around embedded fixtures, and into corners. Accumulations of water on the surface of the concrete due to water gain, segregation, or other causes, shall be prevented as much as possible by employing proper placement, consolidation, and finishing practices. Provisions shall be made to remove such water as may accumulate, so that under no conditions will concrete be placed in such accumulations.

d. Vibrators shall be the internal immersion type, operating at speeds of not less than 7,000 RPM. Vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly spaced not further apart than the radius over which the vibrator is visibly effective. The entire depth of a new layer of concrete shall be vibrated. The vibrators shall penetrate several inches into the layer below to insure thorough union of the layers. The vibrator shall not be held in one location long enough to draw a pool of grout from the surrounding concrete. Vibration shall be such that the concrete becomes uniformly plastic.

3B.6 FOOTINGS. All footings and foundations without footings shall bear on firm, undisturbed soil.

3B.7 CYLINDRICAL CONCRETE PIERS.

a. All cylindrical concrete piers if required, shall be formed to full depth in fiber forms. Tops of piers shall be finished flat within the confines of the fiber forms. No spillage (mushrooming) over the tops of forms will be permitted. Where conduit emerges from vertical surfaces of concrete piers, no appreciable amount of concrete shall be permitted to spill through forms adjacent to such conduit.

b. Fiber forms for cylindrical concrete piers shall be spirally constructed of laminated plies of fiber. The total wall thickness shall be as published by the manufacturer. The width of each ply shall not be less than 6 inches. Plies shall be laminated with an adhesive of a non-water-sensitive type, with a proven record of satisfactory service in concrete forms. The exterior surface shall be uniformly wax impregnated for weather and moisture protection. The interior surface shall be coated with pure polyethylene uncontaminated by paraffin or other additives. A-Coated Sonotube forms by Sonoco Products Company of Hartsville, South Carolina, are among the products that meet these specifications.

3B.7c

c. Remove all loose soil from bore holes so that concrete will bear on undisturbed soil. Support forms rigidly and in proper horizontal and vertical alignment. After pouring, remove only that part of each form that will be exposed above grade. Backfill excess space between bore holes and forms with thoroughly compacted inorganic soil. Do not use sand backfill unless adjacent undisturbed soil is sand.

3B.8 ANCHOR BOLT INSERTS. No drilling for or placing of anchor bolt inserts or anchors will be permitted in concrete for a period of three days after placement, unless noted otherwise on the drawings.

3B.9 CURING.

a. Provision shall be made for maintaining concrete in a moist condition for a period of at least 5 days after placement.

b. In lieu of wet curing, one coat of a concrete coring sealer which forms a film over the concrete surface, may be used for curing the concrete. The sealer shall meet the ASTM C-309 and AASHTO M-14 specification for moisture retention as tested per ASTM C-156 and AASHTO M-155. The compound shall not be a type that permanently discolors the concrete. Symons Cure and Seal is one of the products which meet this specification. On exposed surfaces, application shall be made immediately after the concrete has been finished. If there is any delay, the concrete shall be kept moist until the application is made. After the forms are removed, the concrete shall be sprayed lightly with water, and then the coat of curing compound applied. If the forms (wood only) cannot be removed within 48 hours, they shall be wetted down and kept wet until their removal, and then the compound applied as above.

3B.10 COLD-WEATHER REQUIREMENTS.

a. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. No frozen materials or materials containing snow or ice shall be used. Concrete shall not be placed on frozen soil.

b. All reinforcement, forms, fillers, and ground which will make contact with concrete shall be free from snow and ice. Whenever the temperature of the surrounding air is below $40^{O}F$, all concrete placed in forms shall have a temperature of $45^{O}F$ or higher, after placement. Adequate means shall be provided for maintaining this temperature for 4 days. Any additional time necessary to ensure proper curing of the concrete shall be provided as directed by the Resident Engineer. The housing, covering, or other protection used in connection with curing, shall remain in place and intact at least 24 hours after the artificial heating is disconnected. Do not use salt or other chemicals to prevent freezing.

3B.11 HOT-WEATHER REQUIREMENTS.

a. In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided as directed by the Resident Engineer.

b. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperature shall be less than $90^{O}F$.

3B.12 SLUMP. Concrete shall be tested for consistency at the mixer or at the place of deposit if delivered ready-mixed. The sample shall be taken immediately from the batch and tested by the contractor in the presence of the Resident Engineer in accordance with ASTM standard C143. Concrete with slump in excess of four inches shall be rejected.

3B.13 DELIVERY TICKETS. At the time of concrete delivery, the contractor shall give the Resident Engineer a copy of the delivery ticket bearing the quantity, strength, and air entrainment of the concrete delivered.

3B.14 CONCRETE TESTS. If the Resident Engineer determines that concrete strength and air entrainment tests are needed, the Federal Aviation Administration will make arrangements for and bear costs of such tests.

DIVISION 16 - ELECTRICAL
SECTION 16B
600-VOLT POWER CABLE FOR UNDERGROUND INSTALLATION

16B.1 SCOPE. This section covers the material requirements for all contractor-furnished single-conductor 600-volt power cable required for direct earth burial installation. Installation of power cable is covered in Section 16F.

16B.2 GENERAL REQUIREMENTS. Cable construction shall include copper single conductor and XLP (thermosetting crosslinked polyethylene) insulation. Cable shall be UL listed as Type USE or RHW or RHH for use in circuits not exceeding 600 volts at conductor temperatures of 90^{O}C for continuous normal operation, 130^{O}C for emergency overload conditions, and 250^{O}C for short circuit conditions. Cables shall be suitable for direct burial and above-grade installation in wet or dry locations.

16B.3 APPLICABLE SPECIFICATIONS.

a. Underwriters Laboratories Standard 854 for Service Entrance Cables.

b. Underwriters Laboratories Standard 44 for Rubber-Insulated Wires and Cables.

c. ICEA Publication Number S-66-524, NEMA Publication Number WC7 for Crosslinked Polyethylene-Insulated Wire and Cable.

d. Federal Specification J-C-30A.

16B.4 CABLE CONSTRUCTION. Cable characteristics shall include the following materials and construction:

a. Conductors. Conductors shall be solid or Class B stranded annealed uncoated copper, per UL Standards 854 and 44.

b. Separator. A suitable separator over the conductor may be used at the option of the manufacturer.

c. Insulation. Each conductor shall be insulated with XLP (crosslinked polyethylene) complying with the physical and electrical requirements of UL Standard 854 for Type USE and UL Standard 44 for Types RHW and RHH and Paragraph 3-6 of ICEA Publication Number S-66-524. The insulation shall be applied lightly to the conductor and shall be free-stripping.

16B.5 IDENTIFICATION. The cable shall be identified by surface marking indicating manufacturer's conductor size and metal, voltage rating, UL Symbol and type designation, and year of manufacture.

16B.6 TESTS. Cable shall be tested in accordance with requirements of UL Standard 854 for Type USE, UL Standard 44 for Types RHW and RHH, and ICEA Publication Number S-66-524, Paragraph 3.6.

16B.7 DATE OF MANUFACTURE. Year of manufacture of all cable shall be no earlier than one calendar year immediately preceding contract award date.

16B.8 PACKAGING. All cable shall be provided on wooden or steel reels, and ends of all cable shall be sealed to prevent entry of moisture. All reels shall identify type, length, and year of manufacture of cable packaged on such reels. All such identification shall be clearly provided by the manufacturer.

DIVISION 16 - ELECTRICAL
SECTION 16E
CONTROL CABLE

16E.1 SCOPE. This section covers the material requirements for all contractor-furnished exterior standard and gopher-resistant filled control (telephone) cable to be installed as shown on the drawings. Installation of control cables is covered in Section 16F.

16E.2 APPLICABLE SPECIFICATIONS.

a. United States Department of Agriculture, Rural Electrification Administration (REA), Specification PE-39 for "Filled Telephone Cable" (Bulletin 345-67) latest edition, including all addendums and attachments thereto, forms a part of these specifications and is applicable in its entirety.

b. Certain requirements, specified herein, supplement the requirements of Specification PE-39, and shall receive special attention by the cable manufacturer and contractor.

16E.3 GENERAL REQUIREMENTS.

a. Definition. The term "control cable" used throughout these specifications and on the project drawings is a general FAA term for cable used to transmit voice and control functions. The required cable is termed "telephone" or "telephone exchange" cable by the cable manufacturing industry.

b. Quality. All control (telephone) cables shall be the standard products of a single major cable manufacturer and shall be designed and manufactured according to the highest industry standards. All cables shall be free of any imperfection which could affect serviceability and design life.

16E.4 STANDARD CABLE CONSTRUCTION. Cable requirements, complying with these specifications and Specification PE-39, include the following materials and construction.

a. Conductors. #19 AWG solid annealed copper.

b. Conductor Insulation. Solid polypropylene or polyethylene color coded in accordance with telephone industry "standard" coding.

c. Twisted Pairs. Individual conductors twisted into pairs with varying lays to minimize crosstalk.

d. Forming of Cable Core. Cables having 25 pairs or less are assembled into a single cylindrical group. Cables having more than 25 pairs are assembled in units, each individually identified by color coded unit binders.

16E.4e

e. Filling Compound. Water resistant non-hardening compound to fill and seal all interstices between the conductor pairs.

f. Core Covering. Non-hygroscopic dielectric tape.

g. Flooding Compound. Water resistant and bonding compound to fill all voids between the core wrap and shield and between the shield and jacket.

h. Shield. Corrugated electrically continuous and longitudinally applied 0.008 inch coated aluminum or 0.005 inch copper.

i. Jacket. High molecular weight polyethylene or high-molecular weight ethylene copolymer.

16E.5 GOPHER-RESISTANT CABLE CONSTRUCTION.

a. General. If gopher-resistant cable is required by drawings or special specifications, cable construction shall comply with all construction requirements for standard cable in Subsection 16E.4 above (including conformance with REA Specification PE-39) excepting for item h, "Shield", which shall comply with the following:

b. Gopher-Resistant Shield. Corrugated electrically continuous and longitudinally applied overlapping metal shield consisting of one of the following materials:

(1) 0.010 inch copper.

(2) 0.006 inch copper/stainless steel/copper bimetallic alloy.

(3) 0.007 inch Alloy 194 for 6 pr #19 cable.

(4) 0.006 inch Alloy 194 for cables larger than 6 pr #19.

(5) 0.008 inch coated aluminum with 0.006 inch coated steel.

16E.6 CABLE IDENTIFICATION. In accordance with Specification PE-39, all cable shall have jacket printed at periodic intervals with the name of the manufacturer, manufacturer's standard designation, year of manufacture, number of pairs, conductor gauge, sequential length marks, and notation signifying compliance with Specification PE-39 (if not clearly referenced in the manufacturer's submittals). In addition, the gopher-resistant shield shall be clearly identified.

16E.7 DATE OF MANUFACTURE. Year of manufacture of all cable shall be no earlier than one calendar year immediately preceding contract award date.

16E.8 PACKAGING. In accordance with Specification PE-39, all cable shall be stored and shipped on reels affording the required protection. Thermal wrapping shall be provided and ends of all cables shall be capped against exposure to moisture. All reels shall be labeled by the manufacturer and shall bear the manufacturer's name, year of manufacture, REA cable designation, description of cable, actual shipping length, and identification referenced to tests of record as required herein.

16E.9 TESTS.

a. All project cable furnished shall satisfy all test requirements of Specification PE-39. Records of all such tests shall be retained by the manufacturer, according to Paragraph 29 of Specification PE-39, and shall be promptly made available to the Federal Aviation Administration upon request. All tests shall be specifically and clearly referenced to all reels of cable furnished.

b. Basic cable design, for all project cable furnished, shall have proven acceptable to REA through "qualification testing" according to Paragraph 27 of Specification PE-39.

c. Electrical tests, according to paragraph 28.1 of Specification PE-39, shall be performed on 100 percent of all project cable furnished.

d. Quality assurance (capability) tests, according to Paragraph 28.2 of Specification PE-39, shall be performed on such periodic production basis so as to represent quality of all project cable furnished.

16E.10 SUBMITTALS. Prior to procuring any cable specified herein, the contractor shall submit the following documents for the specific cable that the contractor proposes to use, to the Contracting Officer, and receive written approval therefrom (see Paragraph 1A.4 above):

a. Manufacturer's complete cable specifications, including manufacturer's statement of compliance with REA Specification PE-39.

b. Drawing showing cable construction details.

DIVISION 16 - ELECTRICAL
SECTION 16F
CABLE INSTALLATION

16F.1 DESCRIPTION OF WORK. The extent of work is indicated on the drawings and by the provisions of this section. Included in this section are installation, splicing, and testing of power and control cables.

16F.2 GENERAL REQUIREMENTS.

a. Service Interruptions. Existing sources of power and control are indicated on the drawings. For circuits actively in use, the contractor shall coordinate temporary interruptions of service with users and suppliers, the Resident Engineer, and the airport management.

b. Cable Protection.

(1) All cable ends which will be exposed to weather, water, ground, or corrosive environment prior to termination, shall be sealed against these elements while awaiting termination or splicing. This requirement also applies to all cable ends in manholes or handholes. The sealing material shall be properly sized, easily removable heat shrinkable end caps (3M ICEC are acceptable), or electrical tape (see Paragraph 16A.19 above), with an application of brushed-on electrical coating.

(2) Cables shall not be bent at radii less than radii recommended by the manufacturer, or 10 times cable diameter (12 times diameter for armored cable), whichever is greater. Any cables damaged in any way by sharp bending shall be replaced.

(3) Special care should be taken when working with filled cables, especially when the temperature is below 35^{O}F. This type of cable becomes more difficult to bend and work as the temperature decreases, and there is a possibility of cable damage at temperatures near 0^{O}F.

c. 600-Volt Wire and Cable Color Coding.

(1) All single conductor 600 volt wire and cable for 120/240 volt power circuits shall be color coded black for line 1, red for line 2, and white for the neutral.

(2) For conductor sizes smaller than #8 AWG, conductor insulation shall be color coded. For sizes #8 AWG and larger, and for armored power cable, colored tape shall be used to identify the conductors if insulation is not color identified.

16F.2c(3)

(3) Conductors shall be color-coded in junction boxes, square duct, terminal boxes, or any other place accessible to view. In no case shall green be used for other than grounding, nor white for other than the system grounded (neutral) conductor.

d. Designation of Armored Cable. On drawings and other contract documents, the letter A immediately following the AWG number of a cable, indicates that the cable is armored (e.g., 3/C #8A, 600V).

16F.3 DIRECT-EARTH BURIAL CABLE INSTALLATION.

a. Installation Method. Unless otherwise specified, outdoor cables running from one structure or item of equipment to another, shall be direct earth buried. Direct-earth burial cables shall be installed either by the trench and backfill method or by the cable plowing method in accordance with all the requirements specified herein.

b. General Requirements.

(1) Underground cables shall be installed in straight lines between terminating locations or points of directional change.

(2) Unless otherwise specified, cables shall be installed a minimum of 24 inches and 30 inches below finished grade on airport property and off airport lands, respectively.

(3) Wherever possible, cable shall be installed in one continuous length without splices from connection to connection. The number of splices shall be kept to a minimum. Cable ends shall be effectively sealed against moisture immediately after cutting any type of cable. See the MALSR splice restrictions of Paragraph 13A.6.

(4) The contractor shall prepare a schedule for installing each reel of underground cable and shall submit it to the Resident Engineer for approval before installing any cable. The plan shall be predicated on use of the longest practical lengths of cable, in order to minimize splicing.

(5) A cable loop of at least three feet shall be left on each end of every cable run, on at least one side of every splice, and at all points where cable is brought above ground. A 3-foot minimum surplus cable length shall be left on both sides of splices in handholes and light bases. The slack loop shall be installed with the same minimum depth requirements as the cable run. Where cable is brought above ground, enough additional slack cable shall be left to make the required connections.

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c. Trench and Backfill Installation Method.

(1) Comply with all trenching, backfilling, compaction, and restoration requirements in Division 2.

(2) The contractor shall unreel the cable adjacent to or over the trench and manually place it in the trench. Do not pull the cable into the trench or drag it along the trench.

(3) Where more than one cable is installed in the same trench, maintain separation as hereinafter specified. Multiple cables shall be installed in the same relative positions throughout the cable trench. Cables shall not be stacked, crossed or intertwined in any manner.

d. Cable Plowing Method.

(1) Vibratory cable plowing equipment, adequate for installation of the types of cables to be installed and for the depth required, may be used, provided that soil conditions are suitable, equipment is in good working order, and proper installation procedures are utilized.

(2) While cable is being plowed into place, one person in addition to the operator of the plowing vehicle shall be present to assure that the cables do not kink or bind tightly while entering the plow.

(3) If, during plowing operations, it appears that the soil contains sharp objects, rocks over 2 inches in diameter, or any other hazard to the cable, plowing shall be discontinued, and the Resident Engineer notified. The Resident Engineer shall determine whether plowing will be allowed to continue, or whether another cable placement method shall be used.

(4) The slice left by the plow shall be closed by tamping or other approved method, after cable placement, to minimize the disturbance of the surface by the slice.

e. Cable Separation - Direct Burial.

(1) Where new buried power cables cross over or under control or telephone cables, power cables shall be installed in a length of PVC duct extending two feet each side of the crossing. Minimum separation shall be twelve inches.

(2) Power cables of the same circuit may be laid together in the trench without separation, except as noted below. Series lighting cables may be considered being of the same circuit.

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(3) Power cables, of the same or different circuits of less than 600 volts, may be laid together in the same trench without separation.

(4) All power cables, 5,000 volts and below, shall be separated from all control, telephone and coaxial type cables by a minimum of 6 inches.

(5) Power cable, of more than 5,000 volts, shall be separated from all other cables by a minimum of 12 inches.

(6) Control, telephone, and coaxial cables may be laid in the trench without separation from each other.

f. Buried Ground Wire (Counterpoise). Unless specified otherwise, all direct-earth burial power, control and coaxial cables shall include the installation of #6 bare copper ground wire (counterpoise) per Paragraph 16A.4e above.

g. Cable Markers.

(1) Cable runs shall be marked by concrete cable markers according to project drawings. Cable markers for underground cable shall be installed at all changes of direction in cable runs, at 300 feet intervals in straight-line cable run segments, and at all splice locations.

(2) Markers shall not be poured in place. The markers shall be installed flat in the ground immediately above the cable and with approximately one inch projecting above the surface. Impress additional circuit identification symbols on markers if so directed by the Resident Engineer. Existing cable markers removed or displaced shall be replaced after installation of new cable.

16F.4 CABLE INSTALLATION IN UNDERGROUND DUCTS AND CONDUIT.

a. Precautions.

(1) Because almost all cable failures are caused by mechanical damage occurring during installation, the contractor should employ workmen experienced in underground cable installation, and utilize all the proper and unique equipment necessary for successful cable installation. Excessive direct tension, excessive sidewall pressure, sidewall impact, abrasion, sharp bending, and moisture intrusion will either destroy or shorten the useful life of cables installed.

(2) The following conditions and installation procedures, capable of damaging cable, shall be avoided:

(a) Sediment in ducts.

(b) Scoring of duct bends by pulling ropes.

(c) Inadequate support of guiding pulleys and pull tubes, resulting in binding of mechanisms and misalignment.

(d) Inadequate cable and duct lubrication, especially at bends.

(e) Dragging cables over manhole frame edges, duct entrances, and ground or pavement surfaces.

(f) Exposure to pedestrian or vehicular traffic.

(g) Looping in and out of manholes to avoid splicing.

(h) Power pulling at locations other than at ends of cable.

(i) "Jerking" of cables caused by too weak rope that elongates under tension, exerts momentary sharp pull on cable, recovers, and elongates for another like cycle.

(j) Sheaves and pulleys that stop rolling during pull, due to inadequate support or lubrication.

(k) Inadequate sealing and mechanical protection of cable ends.

(l) Reel surface and edge damage from poor hoisting techniques.

(m) Pulling distances too great.

b. Installation Equipment. Major equipment items, required for installing cable in underground ducts, shall include the following:

(1) Power winch.

(2) Cable feed-in tubing guide capable of producing a uniform and rigid 3 and 4-foot and greater radius bend, and having a nominal diameter equal to that of the ducts.

(3) Single pulleys or sheaves providing a minimum cable bending radius (not overall sheave radius) of 10 times the largest cable diameter. Such sheaves shall be

used for minor cable bends within "through cable" manholes and at feed-in manhole rims (if necessary). Sheaves shall have ball or roller bearings.

(4) Adjustable gang pulleys with three or more pulleys capable of producing up to a 4-foot smooth cable bending radius. Each pulley shall have minimum cable bending radius of 10 times the largest cable diameter.

(5) Lubrication equipment to pre-lubricate ducts, cables at guide-in tubing, and cables at intermediate pull-through manholes.

(6) Cable reel support equipment including stands, arbor, and braking mechanism.

(7) Dynamometer for measuring pulling tensions.

(8) Communications equipment.

(9) Pulling ropes or cords having the following characteristics:

(a) A working strength at least equal to the maximum allowable cable tensions as specified herein. "Working strength" is normally 10 to 14 percent of published rope "breaking strength".

(b) Rope or cord shall be a twisted or braided synthetic fiber unaffected by water and having a low level of elongation under load. Material shall have a texture non-injurious to plastic duct when pulled against bends. Wire rope, if proposed, shall have a smooth and rigidly adhering synthetic material covering.

(c) All pulling ropes or cords shall have swivel devices at cable attachment ends.

(10) Cable lubricant specifically manufactured for electrical and control (telephone) cables. Do not use soap lubricants or those containing soap which are harmful to polyethylene- sheathed cables.

(11) Cable pulling devices (secured to ends of cable as specified below).

c. Cable Pulling Devices.

(1) Pulling devices for securing cable to pulling rope shall be factory-installed pulling eyes, field-installed pulling eyes, or basket weave cable grips. All shall be provided with integral or separate swivels.

(2) Factory-installed pulling eyes necessitate that each cable pulling segment be cut to length by the cable manufacturer. Greater tensions and longer pulling lengths can be used with factory pulling eyes for straight duct bank segments.

(3) Field-installed pulling eyes for control cable shall be a 4-crimp series, sized to the cable. Power cable pulling eyes shall be a type secured to conductors and approved by the Resident Engineer.

(4) Basket weave cable pulling grips shall be carefully sized to the specific diameters of the cables to be installed. Use grips with a rotating eye feature for power and control (telephone) cables.

d. Duct Cleanout and Pre-Lubrication.

(1) If any new or existing underground duct or conduit displays any evidence of contamination by soil or other foreign matter, such ducts or conduit shall be cleaned with a stiff bristle brush, swabbed, and flushed clean with water under pressure, before proceeding with cable pulling operations. Even a minor amount of soil or sediment in the bottom area of a duct will greatly increase the coefficient of friction and pulling tension required. With soil contamination, cable lubricant is of little value. Therefore, it is of utmost importance that conduit be cleaned prior to installation of cable.

(2) It is the contractor's responsibility to determine whether ducts designated for occupancy should be cleaned. The contractor shall assume complete responsibility for any difficulties or damage to the cable in placing cable in ducts.

(3) In addition to cable lubrication as specified elsewhere, all ducts to receive cables under this contract, shall be pre-lubricated using the same lubricant as for cables. Lubrication shall be thoroughly applied with applicators designed for this purpose. Lubrication on cable only, will rub off to a large degree, especially at duct bank offsets at manholes.

e. Setting Up Cable Reels and Apparatus.

(1) The contractor shall inspect cable reels for flange protrusions which could damage the cable sheath. Also, the contractor shall inspect for any obstructions that could interfere with proper unwinding of the cable.

(2) Careful control shall be exercised in the movement of cable reels. Where it is necessary to roll a reel to a desired location, it shall be rolled in the direction indicated by the arrows painted on the reel flanges. The reel shall not be allowed to tilt. A substantial runway of heavy planks should be employed where uneven ground conditions exist that may cause the reel to tilt. Where it is necessary to move a reel of cable with heavy equipment, a cable reel sling or equivalent should be used.

(3) In conduit sections containing curves, the cable reel shall be set up at the manhole near the curve unless other conditions do not permit.

(4) Cable reels shall be set up on the same side of the manhole as the conduit section in which the cable is to be placed. The reel shall be made level and brought into proper alignment with the conduit section so that the cable may be passed from the top of the reel in a long smooth bend at maximum radius into the duct without twisting and making more than a 90-degree bend. This is of utmost importance in handling filled type cable in temperature ranges of 35^{O}F and lower. Under no circumstances shall the cable be pulled from the bottom of a reel.

(5) It is essential that the cable reel be in proper alignment and level during the placing operation. Incorrect location of the reel will cause unnecessary binding which will result in uneven cable feed.

(6) Do not permit adjacent turns of cable on the reel to stick together and cause binding as the cable is payed off the reel. Feed the cable by rotating the reel manually.

(7) Other cable support equipment, such as pulleys, sheaves, and gang-pulley equipment shall be set up rigidly within intermediate manholes to smoothly guide cables to exiting ducts.

f. Attaching Pulling Grips. All pulling grips shall be stretched onto the cables such that the entire lengths of the grip woven material will exert tension on the cable, thereby distributing stress. If the end of any cable grip

(furthest from the cable end) does not grip as tightly as the lead end, secure same to cable with a steel banding. Inspect cable grips frequently, and the first pull of control (telephone) cable in particular (in the first intermediate manhole), to ascertain that this requirement is fulfilled. If any uneven gripping is evident, banding will be required for all remaining cable installation of the applicable cable type and size.

g. Feeding and Pulling Cable.

(1) All cable shall be installed using methods that will prevent excessive and harmful stretching, twisting, and flexing of the cable. Such damaging treatment will mechanically weaken the cable and destroy the electrical properties immediately or in a short time.

(2) Cable may be pulled by hand or power winch. Pull rope shall be attached to cables with pulling eye or basket weave pulling grips (all equipped with swivels) for each cable pulled. Do not exceed maximum allowable pulling tension as hereinafter specified. Do not use cable manufacturer's maximum pulling tensions except for cable factory-installed pulling eyes.

(3) All splices shall occur in manholes only. Splices shall not be pulled into ducts or manholes.

(4) Cable feed-in tubing guide, same size as conduit, of suitable length shall be secured in the manhole between the cable reel and the face of the duct to protect the cable and guide it at the maximum possible smooth radius into the duct as it is payed off the reel.

(5) A cable lubricator (funnel) shall be placed around the cable just ahead of the cable feed-in guide to facilitate lubrication of the cable. The quantity of lubricant shall conform to the lubricant manufacturer's recommendations.

(6) Before starting to pull, check the equipment carefully to make sure that it is properly set up in order to minimize the chance of interruption once pulling has started. Tension shall be kept on both the cable reel and the pulling line at the start of the pull. Excessive slack and the twist of the pulling line may cause the connecting links to turn and catch in the duct. As far as possible, the cable shall be pulled in without stopping. A pulling speed of 80 to 100 feet per minute is recommended to minimize friction forces.

(7) A person experienced with cable handling shall be posted continuously at the cable reel while pulling cable. In addition to braking the reels and observing cable lubrication, he shall carefully inspect cable paying off the reel for cable sheath and other defects. If defects are noticed, the pulling operation shall be stopped immediately and the Resident Engineer promptly notified of the defect. Kinks and/or irregularities in the cable sheath shall be removed or corrected as directed by the Resident Engineer.

(8) Careful attention shall be paid to signals from the installation crew as the cable is being pulled so that pulling may be stopped instantly whenever necessary to avoid damage to the cable.

(9) If for any reason the pulling operation is halted between manholes, the winch operator shall not release the tension on the winch unless directed to do so. In restarting the pulling operation, the inertia of the cable shall be overcome by gradually increasing the tension in steps a few seconds apart until the cable once again is in motion.

(10) The leading end of the cable at intermediate manholes shall be guided into the duct and a feeder tube nozzle placed around the cable to prevent the cable from rubbing on the edge of the duct.

(11) All pulled ends shall be examined for evidence of damage due to the pulling operation. The cable sheath shall not be pulled beyond the cable core. Notify the Resident Engineer for inspection, and for repair or replacement action that must be taken where cracks or openings are found in the cable sheath following the pulling operations.

(12) Cable ends shall be kept sealed at all times using REA-approved cable end caps and electrical tape. After the cable has been placed, the exposed cable in the manholes should be wiped clean of cable lubricant with a cloth before leaving the manhole.

(13) All individual cable segments shall be pulled in one direction only. Both ends of a cut cable segment shall not be introduced into an intermediate manhole and pulled in two different directions. Also, no cable segments shall be pulled out of any manhole and introduced into the same manhole for a continuation of a cable segment pull. These unacceptable pulling practices, used to avoid splicing, result in abrasion from dragging over ground surfaces and manhole frame, exposure to pedestrian and vehicular traffic,

damage to cable layers from twisting and small bending radii when pulling cable loops through manhole frame. Shields of cables so pulled are almost always damaged.

(14) Sidewall cable pressure from duct bends, feed-in tubes, and pulleys, frequently govern the length of cable that can be pulled. The greater the radii, the less the sidewall pressure. Therefore, the contractor shall use the maximum radius at every manhole where a 90-degree pull is permitted. Adjustable gang pulleys with three or more pulleys shall be used for horizontal bends in manholes. Individual pulleys within the gang pulley device shall have a cable bending radius of minimum 10 times outside diameter of largest cable to be pulled. Width of pulleys shall be adequate to support the cable group to be pulled. Adjust gang pulleys to produce a smooth 90 degree curvature bend where such changes in direction occur.

(15) If cables will be spliced in a manhole where duct banks enter and leave 90 degrees apart, separate cable segments shall be introduced into the manhole and pulled in different directions unless pulling is permitted around a horizontal gang pulley within the manhole.

(16) Where more than one cable will be installed in a single duct, all shall be pulled into the duct concurrently.

h. Cable Spoil. All cable pulling ends shall be trimmed back to remove cable material always damaged by pulling eyes or basket weave pulling grips. To remove such spoil, cut each cable off a distance from the end equal to three times the length of pulling eye or twice the length of the basket weave pulling grip as a minimum. These amounts shall be cut off for all cables including those to be spliced or terminated by others.

i. Use of Dynamometer.

(1) The dynamometer shall be accurately calibrated and secured to properly indicate tension exerted on the cable. The dynamo-meter reading will usually give the resultant force exerted on the anchoring device, which shall be converted to the horizontal component to give correct value of pulling tension.

(2) Dynamometer readings shall be made only in the presence of the Resident Engineer. If any pulling tension is approaching the maximum allowable, and if in the judgment of the Resident Engineer, the allowable will be appreciably exceeded for the proposed run, pulling

operations shall be immediately stopped, and the cable run spliced in the preceding manhole.

j. Maximum Cable Pulling Tensions. Maximum allowable cable pulling tensions, as measured by dynamometer, shall not exceed the following values for single cables. For multiple cables, add the tension values for the number of cables being pulled. Use a pulling rope having a working strength [not breaking strength -- reference subsection 16F.4b(9)] at least equal to the "maximum allowable pulling tension" values below.

Cable	Maximum Allowable Pulling Tension (lbs)
1-1/C #8	125
1-1/C #6	200
1-1/C #4	325
1/1-C #2	500
1-6 PR #19	125
1-12 PR #19	250
1-25 PR #19	500

k. Separation of Cables Installed in Conduit or Duct.

(1) Power cables of the same voltage may be installed in the same duct.

(2) Power cables of less than 600 volts may be installed in the same duct.

(3) Power cables of less than 600 volts shall not be installed in the same duct with control, telephone, or coaxial type cables.

(4) Power cables of more than 600 volts shall not be installed in the same duct with control, telephone, coaxial, or power cables of less than 600 volts.

(5) Control, telephone, and coaxial cables may be installed in the same duct.

l. Cable Installation in Manholes or Handholes.

(1) Power and control cables shall be installed in separate manholes or handholes unless otherwise specified. If installed in same manhole, install power and control cables on opposite sides. At splice locations, use cable racks at different elevations to separate power and control cables.

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(2) Cable racking surplus shall be pulled back by hand into intermediate manholes. Pull surplus one manhole at a time beginning near both ends of cable segment. Do not use power winch unless permitted by the Resident Engineer.

(3) Cables shall be carefully routed around manhole interiors, taking all necessary precautions to prevent sharp bending. Cable racks shall be plastic or galvanized steel with properly sized porcelain insulators for the latter. Fasten all cables to plastic racks with nylon ties and to steel racks by means of the insulators.

(4) Where a splice occurs, cable shall make one loop around the manhole, and the splice located near the center of the loop.

(5) Where power and control cables are installed in the same manhole, the entire exposed length of all power and control (telephone) cables shall be fireproofed by applying fire and arc proofing tape per Paragraph 16A.23 above.

16F.5 CABLE TAGGING.

a. All cables shall be tagged in each manhole and in each terminal cabinet with not less than two tags per cable, one near each duct entrance hole. Tags shall be attached to cables immediately after installation of each cable.

b. Tags shall be circular in shape and 2 inches in diameter. Material shall be minimum 0.020-inch thick copper or brass or 0.0625-inch thick lead. 1/4-inch high steel lettering dies or equivalent size engraving equipment shall be used to make the tags. Tags shall be secured firmly to cables with Number 14 AWG copper wire.

c. Tag markings shall consist of an abbreviation of the facility served by the cable and the letter "P" or "C" denoting power or control. The facility shall include the applicable runway. Where like multiple control cables are routed between the same facilities, further identify such cables throughout the run with a single-digit number following the letter "C". All individual-conductor power circuits shall be bundled under the same tag as opposed to separate tags for each conductor.

16F.6 SPLICING.

a. General Requirements.

(1) Splices shall be performed only by experienced and qualified cable splicers regularly engaged in this type of work.

(2) Cable armor and/or shielding shall be bonded together across splices to provide continuous electrical paths.

(3) Where a cable is cut preparatory to splicing, the work shall proceed without delay. When an unavoidable delay is encountered in completing a splice, the opened cable shall be protected to prevent the entrance of moisture and foreign matter.

(4) Any splicing material (such as resin) older than the do-not-use-after date on the package, shall be replaced with new material at the contractor's expense.

(5) Unless otherwise specified, where multiple runs of single-conductor underground power cables are spliced, each single-conductor cable shall be spliced in a separate envelope.

(6) Approved stress reduction methods shall be used in splicing all shielded high voltage power cables (5KV and higher voltage).

b. Underground Power Cable Splices (600 Volts or Less). All low voltage splices shall be encapsulated in pressure resin in clear plastic envelopes, except as otherwise specified in Paragraph 13A.6 above, on drawings, or in special specifications. All low voltage splices shall be made with compression connectors specified in Paragraph 13A.6 above, except as otherwise specified on drawings and in special specifications.

c. Underground Control (Telephone Cable) Splices.

(1) Kit and Resin. The splices shall consist of a rigid polypropylene mold body with a built-in spacer web to provide cable centering and proper compound coverage. The mold body shall be filled with a flexible polyurethane electrical compound capable of continuous operation at 90°C, with an emergency overload temperature rating of 130°C. Splices must have provisions for inline splicing of shielded or non-shielded plastic or rubber-jacketed control (telephone) cables. The splices shall be rated for direct burial applications. For control cables with outside diameters between 0.25 inches and 3.25 inches, 3M Scotchcast Signal and Control Cable Inline Splicing kits of the 72N series are approved, as they are among kits which meet specifications.

(2) Connectors. Control cable splice connectors shall be in-line type, in which two conductors are spliced by laying one conductor in each end of the connector, and crimping the connector with a special tool selected to match the connector type and size. Before crimping,

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the connector is open on one side of its length. After crimping, the connector is closed all around its length. The connector bodies shall be made with a tin-plated phosphor bronze piece on the inside, to contact the cable conductors, and bonded polyester insulation on the outside, to insulate the connection. The insulation shall be color coded to denote wire size range. The cable splice connectors and tools shall incorporate the insulation displacement termination technique which uses a slotted, tin-plated contact to displace the conductor insulation, thus providing four redundant electrical contact points. Connectors which require prestripping the conductor shall not be used. AMP, Inc. (Harrisburg, PA) Picabond connectors sized for conductor size, and matching AMP tooling, are among products meeting the above specifications, and are approved.

d. Submittals. See Paragraph 1A.4 above. If the contractor --

(1) Intends to splice using materials different from those specified in Paragraphs b and c above, or

(2) Intends to splice a 5KV or higher voltage power cable,

then the contractor shall submit to the Contracting Officer, shop drawings or catalog cuts for all splicing materials, tools, and dies. The contractor shall splice no cables before he has received the Contracting Officer's approval of these items.

16F.7 CONTROL (TELEPHONE) CABLE TERMINATIONS.

a. Cable Routing and Support.

(1) Cable jackets shall be removed within terminating enclosures such that no more than 2 inches of jacket material is visible within the enclosures. Ground shielding and armor as specified below.

(2) Exposed cable conductor bundles shall be lock-stitched laced together with nylon lacing twine spaced at approximate 5/8- inch intervals. Each bundle shall contain maximum 25 pairs of conductors which shall be neatly routed and secured to backing panels with nylon clamps.

b. Cable Pair Terminations.

(1) Terminated pairs shall have the same sequence on each terminal strip. (For terminal block specifications, see Paragraph 16A.19, above.) The color code termination sequence on the terminal strips shall be in accordance with the following schedule. The white

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mates shall start at the top or left-hand side of the terminal block with color continuing down or across the block according to the following schedule:

MATE COLORS	PRIMARY WIRE COLORS
WHITE	BLUE
"	ORANGE
"	GREEN
"	BROWN
"	SLATE
RED	BLUE
"	ORANGE
"	GREEN
"	BROWN
"	SLATE
BLACK	BLUE
"	ORANGE
"	GREEN
"	BROWN
"	SLATE
YELLOW	BLUE
"	ORANGE
"	GREEN
"	BROWN
"	SLATE
VIOLET	BLUE
"	ORANGE
"	GREEN
"	BROWN
"	SLATE

(2) When cables do not have the preceding color code, like pairs shall be terminated in the same sequence at both ends of the cable.

16F.8 CABLE ARMOR AND SHIELD GROUNDING.

a. Grounding Locations.

(1) Control cable armor and/or shielding shall be grounded at one end of each cable run only.

(2) Power cable armor shall be grounded at both ends of each cable run.

(3) Shielding and armor of control and power cables shall not be grounded at splice locations.

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b. Grounding Procedures.

(1) Use #14 AWG stranded copper grounding conductors for grounding shielding and armor. Secure grounding conductors to shielding and armor by using UL-approved grounding connectors specifically designed for this purpose. Neatly tape ends of butted cable to conceal the connections.

(2) Attach crimp-type lugs of proper size to free ends of grounding conductors, and secure lugs to enclosure interior wall with a machine screw and nut.

16F.9 CABLE TESTING.

a. General Requirements.

(1) Both before and after installation, all contractor-furnished and Government-furnished power and control (telephone) cables shall be tested as required herein. Testing after installation shall be accomplished across splices.

(2) All testing shall be accomplished in the presence of the Resident Engineer. Furnish two signed and dated copies of all test results, clearly tabulated for all segments of cable tested, to the Resident Engineer.

(3) The contractor shall use his own test equipment, which shall bear current calibration certification from a certified instrument calibration laboratory.

(4) Any measured values not conforming to specified values shall be cause for rejection of the defective cable installation. After repair or replacement, if so required by the Resident Engineer, cable shall be retested and additional remedial work performed until satisfactory test results are obtained. All repair and replacement work shall be accomplished at no additional cost to the Government.

b. 600-Volt Power Cable Testing.

(1) Conductor continuity shall test positive.

(2) Armor continuity shall test positive.

(3) Dielectric strength/insulation resistance shall test 50 megohms minimum at 500 volts D.C. between the following:

(a) Conductor and ground for single-conductor cable.

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(b) Individual conductors for multi-conductor armored cable.

(c) Individual conductors and grounded armor.

c. Control (Telephone) Cable Testing.

(1) Conductor continuity shall test positive.

(2) Shield continuity shall test positive.

(3) Armor continuity shall test positive.

(4) Dielectric strength/insulation resistance shall test 50 megohms minimum at 500 volts D.C. between paired conductors and between individual conductors and grounded shield.

(5) After installing control cable, the minimum number of acceptable paired conductors shall comply with the following:

(a) For 11 pair or less cable, all pairs shall test acceptable.

(b) For 12 to 25 pair cable, all pairs except one shall test acceptable.

APPENDIX B

FAA-C-139LB U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION, SPECIFICATION, INSTALLATION AND SPLICING OF UNDERGROUND CABLES

FAA-C-1391b
January 25, 1991
SUPERSEDING
FAA-C-1391a, 12/04/73

U. S. Department of Transportation

Federal Aviation Administration

Specification

INSTALLATION AND SPLICING OF UNDERGROUND CABLES

CONTENTS

CONTENTS (continued)

TABLES

ILLUSTRATIONS

1. SCOPE.- This specification covers minimum requirements for installation of electrical cables buried directly in the earth or installed in underground duct or conduit. It includes trenching, installation, splicing or other joining of cables, and testing of cables for acceptability.

2. APPLICABLE DOCUMENTS.- Current issues of the following documents in effect on the date of the invitation-for-bids or request-for-proposals form a part of this specification, and are applicable to the extent specified herein.

2.1 Federal specification

WW-C-581 Galvanized Steel Conduit

(To obtain copies of federal specifications, contact General Services Administration offices in Washington DC, Atlanta, Boston, Chicago, Dallas, Denver, Kansas City MO, Los Angeles, New York, San Francisco, and Seattle.)

2.1.2 Military specifications

MIL-I-3825 Insulating Tape, Self-Fusing

MIL-C-38359 Cable, Power, Electrical, Airport Lighting

(Single copies of military specifications, standards, and handbooks may be requested by mail or telephone from Naval Forms and Publications Center, 5801 Tabor Ave., Philadelphia PA 19120. Not more than five items may be ordered on a single request; the invitation-for-bid or contract number should be cited where applicable. Only latest revisions [complete with latest amendments] are available; slash sheets must be individually requested. Request all items by document number. For information on subscription service, direct inquiries to the above address with additional marking, "ATTN: CODE 56.")

2.1.3 Federal Aviation Administration specifications

L-823 Plug and Receptacles, Cable Connectors

L-824 Underground Electrical Cables for Airport Lightning Circuits

FAA-E-2793 Cable, Electrical Power, 500 to 25,000 Volts

FAA-E-2013 Cable, Electrical Power, 600 to 15,000 Volts

FAA-E-2042 Cable, Electrical Control, Exterior

FAA-E-2072 Cable, Telephone, Exterior

FAA-E-2171 Cable, Coaxial, Armored, M17/6-RG11

FAA-E-2271 Cable, Coaxial, 50-Ohm, Foam Dielectric, 1/2 and 7/8 Inch

3.1.1 Government-furnished cable.- Government-furnished cable will be delivered to the contractor in accordance with the provisions of the contract. The contractor shall test the cable in accordance with paragraph 4.1 and report electrical or physical cable defects within two weeks of cable receipt. If adequate cable lengths are unavailable for testing on the reel, a visual inspection shall be made and any damage reported. The required tests shall then be made immediately after unreeling. Hidden defects discovered when installing the cable shall be reported to the Contracting Officer in accordance with the contract provisions.

3.1.2 Contractor-furnished cable.- Single and multi-conductor power, control and signal cables furnished by the contractor shall conform to the following FAA specifications where appropriate:

FAA-E-2013	for single- and multi-conductor power cables used in 600 to 5,000 volt applications;
FAA-E-2042	for use in electrical control applications;
FAA-E-2072	for use in telephone communications;
FAA-E-2171, -2271, -2524, -2619	as appropriate for coaxial communications cables.
FAA-E-2793	for single- and multi-conductor power cables used in 5,000 to 25,000 volt applications;
L-824	Class C, 5 KV for airport single-conductor series lighting cable. Cable conforming to MIL-C-38359, Class II is an acceptable alternative.

For applications where no FAA specification is appropriate, the cable shall meet the following minimum requirements:

(a) Copper conductors.

(b) Thermoplastic, thermosetting, or silicon rubber insulation.

(c) Neoprene, polyethylene, or vinyl jacket for normal areas and PTFE (teflon) jacket in areas exposed to fuel, oil, solvent or chemical leakage, excessive ground water or extremely acidic soil.

(d) For rated voltages to 8 KV, insulation shall have a minimum continuous voltage withstanding capability of 4 times rated voltage (but not less that 150 volts). For rated voltages above 8 KV, insulation shall have a minimum continuous voltage withstanding capability of 3 times rated voltage. Cable voltage surge capabilities shall be 15 times rated voltage for voltages to 8 KV, 9 times rated voltage for voltages above 8 KV through 15 KV, and 7 times rated voltage for voltages above 15 KV through 25 KV.

(e) The pull strength of the completed cable(s) shall exceed the expected installation forces by a minimum of 50 percent.

FAA-E-2524 Cable, Radio Frequency, Foam Dielectric, 1/2 and 7/8 Inch, Corrugated Type

FAA-E-2619 Cable, Coaxial, RG-35/U, Armored

(Copies of FAA specifications may be obtained from the Contracting Officer in the office issuing the invitation-for-bids or request-for-proposals. Requests should fully identify material desired, i.e., specification, standard, amendment, drawing numbers, and dates. Requests should cite the invitation-for-bids, request-for-proposals, contract involved, or other use to be made of the requested material.)

2.1.4 National Electrical Manufacturers Association (NEMA) standards

TC 6 Plastic Utilities Duct for Underground Installation.

(For copies of NEMA Standards, contact the National Electrical Manufacturers Association, 155 East 44th Street, New York, NY 10017.)

2.1.5 Underwriters' Laboratories (UL), Inc. standards

UL 651 Rigid Non-metallic Conduit

(For copies of UL standards contact Underwriters' Laboratories Inc., Publications Department, 207 E. Ohio Street, Chicago, IL 60611.)

2.1.6 Institute of Electrical and Electronics Engineers (IEEE) Standards

IEEE-404-1977 Standard for Power Cable Joints

IEEE-48-1975 Standard for Cable Terminations

(For copies of IEEE standards, contact IEEE Standards Office, 345 East 47th St., New York, NY 10017-2394.)

2.1.7 American National Standards Institute (ANSI) Standards

ANSI C119.2-1974 Water Immersion Test

ANSI C119.1-1974 Sealed Insulated Underground Connector System Rated 600 Volts

(For copies of ANSI standards, contact the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

3. REQUIREMENTS

3.1 Materials and workmanship.- The requirements of this specification shall be considered as minimum requirements and shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship than specified herein when so required by the contract drawings and specifications.

3.1.3 Workmanship.- All work shall be done by experienced personnel regularly engaged in this type of work. All cable splices shall be performed only by experienced and qualified cable splicers. Before any cable splices are made, the Contracting Officer may request a sample splice be made for his approval. When required by the local government, the workers shall be properly licensed.

3.2 Trenching

3.2.1 Precautions.- The contractor shall take all reasonable precautions to protect existing underground equipment and utilities such as fuel tanks, water lines, and buried control and power cables. All known FAA power and control cables leading to and from any operating facility will be marked in the field by the Contracting Officer for the information of the contractor before starting work in the general vicinity. The contractor shall contact utility companies and the airport sponsor for the location of existing utility lines and airport sponsor cables. Thereafter, through the entire construction period, buried equipment and utilities shall be protected from damage. The contractor shall immediately repair, with equal material by skilled workmen, any underground cables damaged by contract workers, equipment or work. Prior approval from the Contracting Officer shall be obtained for the materials, workers, time of day or night, method of repairs, and for any temporary or permanent repairs the contractor proposes to make. Upon completion, any repair work shall be inspected and approved by the Contracting Officer with the concurrence of the affected utility company or airport sponsor.

3.2.2 Excavations.- Where turf is well established and sod can be removed, it shall be carefully stripped and properly stored. The contractor shall excavate all trenches for direct-earth burial cable as follows:

(a) At the depth specified in paragraph 3.2.2.2 .

(b) To a width of not less than six inches for single or multiple runs of power, or control and signal cable.

(c) To a width and depth which will provide horizontal or vertical separation of power cables as specified in paragraph 3.4.1.1 from other power cables of different voltage ratings, or from any power cable and any control or signal cable.

(d) Backfill shall be firmly tamped in the separation area.

NOTE: Control and signal cables may be installed without separation from each other.

Unless otherwise specified, all cables in the same location and running in the same general direction shall be installed in the same trench. Trenches for cables may be excavated manually or with powered trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, trenches shall be opened only for the time required to install and inspect cables. The trench shall be closed in the same working day.

3.2.2.1 Rock.- Where rock is encountered, it shall be removed to a depth of 3 inches below the required cable depth, and shall be replaced with a bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch sieve. When ledge is encountered, the Contracting Officer shall be consulted regarding alternatives such as re-routing, transition to overhead lines, or installation in rigid steel conduit.

3.2.2.2 Cable location and depth requirements.- Unless otherwise specified all cables, ducts, and conduits shall be installed as follows:

(a) Direct-earth-burial cables shall be a minimum of 24 inches below finished grade when on airport or government controlled property, and 36 inches below finished grade when off airport or government controlled property. Cables shall not be direct buried under paved areas, roadways, railroad tracks, or ditches.

(b) Underground ducts shall be installed so that the tops of all such ducts are at least 18 inches below finished grade. Underground ducts, except rigid steel conduit, shall not be installed under paved areas, roadways, railroad tracks, or ditches.

(c) Concrete-encased duct or rigid steel conduit shall be installed so that the top of the concrete envelope or conduit is not less than 18 inches below the bottom of paving when installed under runways, taxiways, and other paved areas; and not less than 18 inches below finished grade when installed in unpaved areas.

(d) When cable is routed under railroad tracks, it shall be in rigid-steel conduit or concrete-encased duct with the top of the duct not less than 42 inches below the base of the rail.

3.2.3 Backfilling.- Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations. Trenches shall be completely backfilled and tamped level with the adjacent surface. If necessary to obtain the desired compaction, backfill material shall be moistened or aerated. When sod is to be placed over a trench, backfill shall be stopped at a depth equal to the thickness of the sod to be used. Any excess excavated material shall be removed in accordance with instructions of the Contracting Officer.

3.2.3.1 Underground Cable.- After underground cable has been installed the trench shall be backfilled. The first layer of backfill shall be 3 inches deep, loose measurement, and shall be either earth or natural sand containing no material aggregate particles that would be retained on a 1/4-inch sieve. This layer shall not be compacted, except as noted in paragraph 3.4.1.1. The second layer shall be 9 inches deep, loose measurement, and shall contain no particles that would remain on a 1-inch sieve, the remainder of the backfill shall be excavated or imported material and shall not contain stone 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 Contracting Officer.

3.2.4 Restoration.- Where sod has been removed it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction, and other work shall be restored to the original condition. Restoration shall include any necessary grading, fertilizing, liming, seeding, sodding, sprigging or mulching as required to restore the disturbed area to match the adjacent area. Where trenching cuts through paved areas, the surface shall be properly backfilled and resurfaced with paving similar to the original paving. Resurfaced areas shall be level with original paving, free from cracks and capable of withstanding full traffic loads without settling or cracking. The contractor shall be held responsible for maintaining all disturbed and restored surfaces until final acceptance.

3.3 Installation of underground ducts

3.3.1 General.- All underground ducts shall be: (a) Rigid-steel conduit (heavy wall) conforming to Federal Specification WW-C-581, or (b) Rigid non-metallic conduit (duct) conforming to UL 651 or NEMA TC 6.

3.3.1.1 Conduit burial.- Rigid-steel conduits may be direct earth buried. Rigid non-metallic conduits shall be concrete encased.

3.3.1.2 Duct size, material, and installation.- Ducts shall be of the size, material, and type indicated on the drawings or specifications. Standard precast spacers shall be used for duct support and alignment. Where no size is indicated on the drawings or specifications, the ducts shall not be less than 4 inches inside diameter. All duct lines shall be laid to slope toward handholes, manholes, and duct ends for drainage. Grades shall be at least 3 inches per 100 feet. On runs where it is not practicable to maintain the slope all one way, the duct line shall be sloped from the center in both directions toward manholes, handholes or duct ends. Pockets or traps where moisture may accumulate shall be avoided.

3.3.1.3 Access penetrations.- Where a steel conduit penetrates a wall of a manhole or handhole, a grounding bushing shall be provided. These grounding bushings shall be connected to each other and to the earth ground system with No. 6 AWG bare copper conductors.

3.3.1.4 Mandrel requirements.- The contractor shall mandrel each duct he installs and each existing duct in which he installs or replaces cable. An iron-shod mandrel, not more than 1/4-inch smaller than the bore of the duct, shall be pushed through each duct with jointed conduit rods. The mandrel shall have a leather or rubber gasket slightly larger than the duct hole.

3.3.1.5 Spare ducts.- All spare ducts installed by the contractor shall be provided with No. 10 AWG copper-clad steel pull wires or polyolefin pull lines with a minimum tensile strength of 200 pounds. The open ends of the spare ducts shall be sealed with removable tapered plugs, of a type recommended by the duct manufacturers. The plug shall be adapted to firmly secure the pull wire.

3.3.1.6 Duct protection.- All ducts shall be securely fastened in place during construction and progress of the work, and shall be plugged to prevent seepage of grout, water, or dirt. Any duct section having a defective joint shall not be installed. Trenching for ducts shall be in accordance with paragraph 3.2 of this specification.

3.3.2 Ducts encased in concrete.- All concrete encasement ducts shall be placed on a layer of concrete not less than 3 inches thick prior to its initial set. Where two or more ducts are encased in concrete the contractor shall space them not less than 1-1/2 inches apart (measured from outside wall to outside wall) using spacers applicable to the type of duct. As the duct laying progresses concrete not less than 3 inches thick shall be placed around the sides and top of the duct bank. End bells or couplings shall be installed flush with the concrete encasement where required. Interlock spacers shall be used every 5 feet to insure a uniform spacing between ducts. All bottom spacers shall be secured to 1-inch by 3-inch boards to prevent sinking and overturning. All joints in adjacent ducts shall be staggered a minimum of 24 inches apart and shall be made completely waterproof prior to concreting.

3.3.3 Ducts without concrete encasement.- Trenches for single-duct lines shall be not less than 6 inches nor more than 12 inches wide, and the trench for two or more ducts installed at the same level shall be proportionally wider. Trench bottoms for ducts without concrete encasement shall be made to conform accurately to grade to provide uniform support for the duct along its entire length. A 3-inch layer of bedding material shall be placed around the ducts. The bedding material shall contain no particles that would be retained on a 1-inch sieve. The bedding material shall be tamped until firm. When two or more ducts are installed in the same trench without concrete encasement, they shall be spaced not less than 2 inches apart (outside wall to outside wall) in a horizontal direction or not less than six inches apart (outside wall to outside wall) in a vertical direction.

3.4 Installation of cables.- Wherever possible, cable shall be run in one piece, without splices, from connection to connection. The number of splices shall be minimized. If the job plans do not include a schedule for laying each reel of cable, the contractor shall provide such a plan for approval of the Contracting Officer prior to installing any of the cable. The plan shall be predicated on the use of the longest practicable lengths of cable to minimize splicing requirements.

(a) When cable cutting is required, cable ends shall be effectively sealed against moisture immediately after cutting. The method of sealing shall be approved by the Contracting Officer. Bends of a radius less than eight times the diameter for rubber-covered or plastic-covered cable, or twelve times the diameter for metallic armored cable shall not be made. Cable that has been kinked shall not be installed.

(b) When unreeling, an observer shall be stationed at the reel to report any cable irregularities. Unless specifically stated in the plans, non-armored cable shall be used in duct and armored cable used for direct earth burial. Non-armored coaxial and series lighting cable may be direct

earth buried when not otherwise specified. Grounding conductors, where required, shall be No. 6 AWG bare copper wire, minimum.

3.4.1 Direct earth burial.- Direct earth burial cable shall be unreeled in place in the open trench or adjacent to the trench, and carefully placed in the trench bottom. Pulling the cable into the trench, or dragging it over the ground will not be permitted.

3.4.1.1 Separation between direct earth burial cables.

(a) Power cables of the same circuit may be laid together in the trench without separation.

(b) Power cables of different circuits of less than 600 volts may be laid in the same trench without separation.

(c) Power cables rated 5,000 volts shall be separated a minimum of 6 inches from all other power cables rated 600 volts and below, and from all control and signal cables.

(d) Power cable of more than 5,000 volts shall be separated a minimum of 12 inches from power cables rated 5,000 volts and below, and from all control and signal cables.

(e) Control and signal cables may be in the same trench without separation from each other.

(f) Backfill separating cables shall be firmly tamped.

(g) Where cables of different types (i.e., power and control or signal) or different voltages are jointly installed as stated in (a) through (e) above, the individual cables or groups of cables shall be clearly and unambiguously identified by voltage and type.

3.4.1.2 Cable slack loop, direct earth burial.- A cable slack loop of 3 feet plus or minus 6 inches shall be left on each end of cable runs, and all points where cable connections are brought above ground. The slack loop shall be installed at the same minimum depth as the cable run. Loops shall have no bends with an inner radius less than twelve times the outside diameter of the cable. Where cable is brought above ground, additional slack left above ground shall be as shown by the drawings or as directed by the Contracting Officer. Cable loops shall not be installed on coaxial cable. Joints in coaxial cables shall be made in accordance with the contract specification.

3.4.2 Cable installation in duct.- The contractor shall verify that the duct is open, continuous, and clear of debris before installing cable. 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. All cable ends shall be sealed with moisture-sealing tape before pulling, and shall be left sealed until connections are made. Where more than one cable is to be installed in one duct, all cables shall be pulled at the same time. In no case shall a splice be pulled into a duct.

3.4.2.1 Cable pulling.- The apparatus used to pull cable at the entrance to the manhole shall be a pulling tube or shall consist of a framework and two sheaves, the diameter of the sheaves being at least ten times that of the diameter of the largest cable. Cable installed in the duct may be pulled by a power winch or by hand. Adequate cable pulling compound shall be used. The type of pulling compound shall be approved by the Contracting Officer. Petroleum grease shall not be used. The surface of any cable sheath or jacket shall not be damaged to a depth greater than 1/10th the original thickness or be flattened out-of-round more than 1/10th the outside diameter.

(a) Table I lists maximum pulling tensions for commonly installed cables. Maximum pulling tensions for cables not listed in this table shall be obtained from the cable manufacturer.

(b) The limitations in Table I do not preclude the use of steel or wire rope for cable pulling. A dynamometer graduated to indicate the tension on the cable being pulled can be used, or the contractor shall adapt a rope harness properly sized to limit pull tension to the value indicated. Any combination of a group of cables to be pulled into a duct shall not exceed the sum of individual allowable tension of each cable plus 15 percent.

(c) To minimize splicing, the longest practicable lengths of cable shall be pulled into the ducts at one time. Unless otherwise specified, manholes and handholes should be as far apart as practicable for the type of cable installed. Under no condition should the distance between handholes or manholes exceed 600 feet. If possible, the maximum cable length to be pulled shall be obtained from the cable manufacturer. An estimate of the absolute maximum length of pull in a straight duct may be calculated as follows:

$$L = T \times KW$$

Where: L = length of cable pull in feet,
T = total tension in pounds,
K = coefficient of friction, 0.3 for single cables, 0.4 for multiple cables, and
W = weight of all cables being pulled in pounds per foot.

This formula is based on new, level, straight plastic duct and the use of adequate cable pulling compound.

3.4.2.2 Separation of cables installed in conduit or duct.

(a) Power cables of the same circuit shall be installed in the same duct.

(b) Power cables of less than 600 volts for different circuit may be installed in the same duct.

(c) Power cables shall not be installed in the same duct with control and signal cables.

Table I. Maximum Allowable Non-Armored Cable Pull Using Dynamometer or Rope.

CABLE	TENSION (Pounds)	ROPE DIAMETER (INCHES)			
		Cotton	Manila	Dacron	Nylon
2 - 1c #8 Solid	275	3/16			
3 - 1c #8 Solid	367	1/4	3/16		
4 - 1c #8 Solid	550		1/4		
2 - 1c #6 Stranded	420	1/4	3/16		
3 - 1c #6 Stranded	630	5/16	1/4		
4 - 1c #6 Stranded	840	3/8		3/16	
1 - 2c #8 Stranded	305	1/4			
1 - 3c #8 Stranded	395	1/4			
1 - 4c #8 Stranded	585		1/4		
1 - 2c #6 Stranded	455	1/4	3/16		
1 - 3c #6 Stranded	685	5/16			
1 - 4c #6 Stranded	880	3/8	5/16	3/16	
1 - 6c #12 Stranded	315	1/4			
1 - 12c #12 Stranded	630	5/16	1/4		
1 - 12PR #19 Solid	230	3/16			
1 - 25PR #19 Solid	541		1/4		
1 - 50PR #19 Solid	1061	7/16			3/16
1 - 100PR #19 Solid	2000		15/32	5/16	
RG-11/U	85	3/16			
RG-213/U (RG-8/U)	125	3/16			
RG-214/U (RG-9/U)	145	3/16			
RG-216/U (RG-13/U)	135	3/16			
RG-217/U (RG-14/U)	250		1/4		
RG-218/U (RG-17/U)	800	7/16			

(d) Power cables shall not be installed in the same duct with power cables of a lower voltage rating.

(e) Control and signal cables may be installed in the same duct.

(f) Power cables may be installed in the same duct system as control and signal cables, but power cable shall be installed in a different duct separated a minimum of 3 inches (outside wall to outside wall) from ducts that encase control and signal cables. Power cables rated more than 600 volts shall be separated from control and signal cables to the maximum extent possible in the duct system.

3.4.3 Cable installation in manholes.- Power and control cables shall be installed in separate manholes unless otherwise specified on the job plans. If space is available, cable slack sufficient for one splice for each cable shall be left in each manhole.

3.4.3.1 Separation of cables in manholes.- When it is not possible to install power and other cable types in separate manholes, they shall be installed on opposite sides. In addition, the entire exposed length of all control and signal cables shall be fireproofed by applying a 1/4 inch minimum thickness of arc-proofing 3M No. 7700 or equal, in accordance with the manufacturer's instructions.

(a) Where cables of different types (i.e., power and control or signal) or different voltages are jointly installed as stated in (a) through (e) of paragraph 3.4.2.2, the individual cables or groups of cables shall be clearly and unambiguously identified by voltage and/or type.

(b) Where it is suspected that interference on signal or control lines is caused by their proximity to power cables, the control or signal cables and/or the power cables shall be shielded. These shields shall be grounded.

3.4.3.2 Cable racking.- Cable racks in manholes and handholes are furnished under manhole/handhole specifications. These racks shall be either made of plastic or galvanized steel provided with porcelain insulators. Cables shall be carefully formed on the racks around the interior of manholes or handholes, avoiding sharp bends or kinks. All splices and cables shall be tied to cable racks using 1/8-inch nylon line. Where possible, splices shall be a minimum of 2 feet from the mouth of the duct opening into the manhole or handhole. Where this is not possible, splices shall be located as advised in the manhole/handhole specification or drawing. Where feasible, splices in different cables shall be staggered.

3.4.4 Cable terminations.- All control and signal cables shall be terminated as specified. All power cable terminations rated above 5,000 volts shall be made with a stress-relief devices. Where potheads are used, the contractor shall strictly conform with the manufacturer's installation recommendations. Where terminations are made at transformer bushings, both high and low voltage exposed conducting surfaces shall be taped for full rated voltage, e.g., for full primary voltage on the primary side and for full secondary voltage on the secondary side, and coated with Glyptal red enamel or equal.

3.4.5 Cable grounding.

(a) Shields on shielded power cables shall be grounded at each end. The grounding conductor shall be No. 2 AWG bare copper and connected to a ground rod by exothermic welding, hydraulic crimping, or explosive crimping using a tap connector. Exothermic weld connections and hydraulic crimping connections may be direct buried. Explosive crimped connections shall be located in access wells. The shields or armor on direct earth buried power cables shall be grounded on each end, but not at each splice.

(b) Control cable shields shall be grounded at each end. Intermediate splices in control cables shall be insulated from ground to values equal to that of the original cable.

(c) Telephone cable shields shall be grounded at one end only. The shield shall be insulated from ground equal to that of the original cable at each splice.

(d) Coaxial cable shields shall be insulated from ground throughout the length of the cable run, or as shown on the drawings. These cable shields shall terminate at connectors mounted on metal bulkhead connector plates. These connector plates shall be a minimum of 1/4 inch thick and shall be constructed of tinned copper or other material compatible with the cable line connectors. The connectors shall provide a path to ground for cable shields except when the shield must be isolated for proper equipment operation. If external and internal cables are of a different size, the connector size change may be accomplished by the feed-through connectors at the plate. The bulkhead connector plate shall be bonded to the earth electrode system with a No. 2/0 AWG insulated copper cable, colored green with a red tracer. The bulkhead connector plate shall also be bonded to building steel, where building steel is properly bonded to the earth electrode system. Exothermic welds or FAA approved pressure connectors shall be used for these connections.

3.4.6 Cable guard wires.- Where indicated on the drawings, the contractor shall install cable guard wires to protect underground conductors from the effects of lightning discharges. Guard wires may be direct earth buried or installed in nonmetallic ducts. Each guard wire shall be a bare solid No. 6 AWG copper conductor installed not less than 10 inches above the buried conductors or ducts. One guard wire shall be installed above the centerline of conductor or duct runs of 3 feet or less in width. Two guard wires shall be installed for conductor or duct runs greater than 3 feet in width with each guard wire not greater than 12 inches from the outside edges of the conductor or duct runs. Guard wires shall be grounded at each end of the cable run to a 3/4 inch by 10-foot long copper-clad ground rod driven not less than 12 inches below grade. Ground rods shall be installed 6 feet from the cable or duct installation and shall be connected to the guard wires with No. 2 AWG bare copper conductors. All connections to the ground rods and guard wires shall be exothermic welds.

3.5 Cable marking.

3.5.1 Cable tagging.- All cables shall be tagged in each manhole or handhole with not less than two tags per cable, one near each duct entrance hole. Tags shall be attached to cable immediately after installation. Cable terminations and potheads shall be tagged as to function, i.e., facility which it serves or other pertinent data. Tags shall be circular in shape, 2-inch minimum diameter and of not less than 0.020-inch thick copper or 0.0625-inch thick lead. Steel lettering dies, 1/4-inch minimum size or the equivalent engraving process, shall be used to mark the tags. Each tag shall be securely attached to the cable using 1/8-inch nylon cord. Tags shall be marked with an abbreviation of the name of the facility or facilities served by the cable plus an appropriate letter: "P", "T", "C", or "R" (Power, Telephone, Control, or Radio Frequency respectively). Where telephone type cable is used for control functions it shall be marked "T" instead of "C." Where more than one identical cable is used to serve the same facility, they may be bundled under one tag unless job plans state otherwise. Figure 1, Typical Cable Tag, indicates the type of cable tag required.

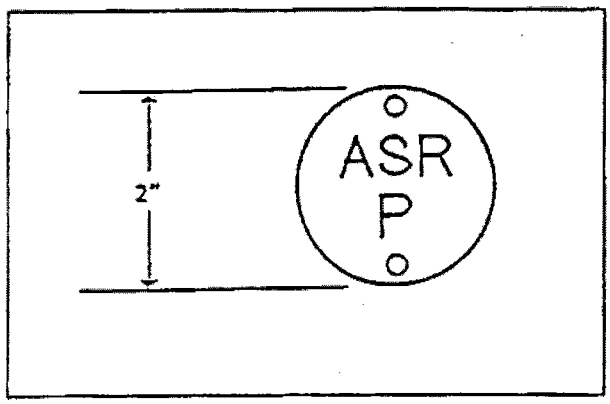

Figure 1. Typical Cable Tag.

3.5.2 Cable markers.- The location of direct earth burial cables shall be marked at grade surface with concrete slabs, 2-feet square by 6-inch thick. These markers shall be placed every 200 feet along a cable run, at each change of direction of the cable, and at each cable splice. These markers shall be installed within 24 hours of the final backfill of the cable trench. Markers shall be installed flat in the ground with the top approximately 1 inch above the finished grade. After the concrete marker has set a minimum of 24 hours, the top surface shall be painted with bright orange paint manufactured specifically for uncured exterior concrete. Markers shall not be installed in concrete or asphalt surfaces. Each cable marker shall have the following information impressed upon its top surface:

(a) The word "CABLE."

(b) Name of facility served, e.g., "ASR," "VORTAC," "ALS."

(c) Abbreviations for all the types of cables installed, e.g., "P" for Power, "C" for Control, "T" for Telephone, and "R" for Radio Frequency (coaxial).

(d) An arrow to indicate the direction or change of direction of the cable run.

(e) Any additional information, as directed by the Contracting Officer.

Manholes and handholes shall be identified by "FAA-POWER" or "FAA-CONTROL" markings on the covers. These markings shall be cast into steel covers, or die stamped into a nominal 1/16 inch minimum thickness copper plate brazed or fastened to the cover with a minimum of two 10-32 brass screws.

The contractor shall obtain approval from the Contracting Officer for the information to be impressed on the cable markers and the method used to make the impressions. Letters shall be 4 inches high, 3 inches wide and 1/2 inch deep. An example is shown in Figure 2, Typical Cable Run Marker.

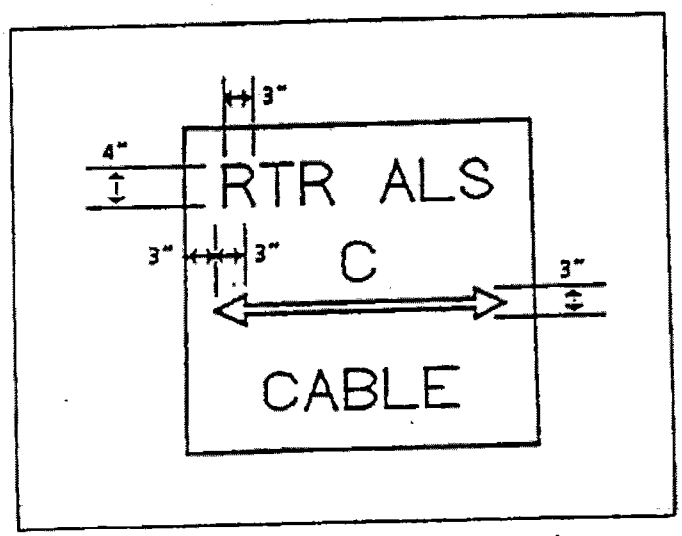

Figure 2. Typical Cable Run Marker.

3.6 Cable Splicing.- The use of underground splices shall be minimized. Where underground splices are required, they shall be installed in handholes or manholes. Direct-earth burial of splices shall only be allowed where indicated on the drawings or as approved by the Contracting Officer. Each cable splicer shall be qualified in making cable splices and in the use of the specified cable splicing kits. The Contracting Officer may request a test splice of each type and voltage rating from each cable splicer. The contractor shall obtain approval of the splice and cable splicer from the Contracting Officer prior to making any field splices. All cable splicing methods and materials shall be of a type recommended by the splicing materials manufacturer for the cable to be spliced. All splices shall be as

manufactured by Raychem Corporation, 300 Constitution Drive, Menlo Park CA 94025; Sigmaform Corporation, 2401 Walsh Avenue, Santa Clara CA 95051; 3M Corporation, 3M Center, St. Paul MN 55101; or approved equal as follows:

(a) Power cables above 5,000 volts. Use standard splicing kits as manufactured by Raychem Corporation, Energy Division, HVS-1520 and HVS-2520, or approved equal.

(b) Power cables 601 to 5,000 volts. Use standard splicing kits as manufactured by Raychem Corporation, Energy Division, HVS-800, or Sigmaform Corporation, APL-L823-14C-54-1, 2, or 3, as appropriate, or approved equal. For unshielded series lighting power cables a field installed plug-in splice in accordance with FAA specification L-823, "Plug and Receptacle Cable Connectors," shall be used. When plug and receptacle are subject to water submersion, such as in threshold fixture cans, an "APC" Raychem, "APL" Sigmaform, or approved equal splice cover shall be added.

(c) Power cables 600 volts and below. Use heavy-wall self-sealing heat-shrinkable tubing manufactured by Raychem Corporation, Energy Division, Part No. "WCSM," Sigmaform Corporation, Part No. "SST," or approved equal.

(d) Control and telephone cables. Use standard splicing kits as manufactured by Raychem Corporation, Telecommunications Division, "XAGA 1600," Sigmaform Corporation, "STEB," or approved equal. Type "D" polyurethane re-enterable encapsulant shall be used for encapsulation of the wire bundle and cable core moisture blockage. An approved encapsulant is available from Texocom, Garland TX; or 195RE encapsulant from Hexcel Corporation, Dallas TX. Cable preparation shall include, and particular attention shall be given to cleaning the grease filling from the splice area. Use a non-reacting, non-residue type solvent.

(e) Coaxial cable (nonpressurized). Appendix A, "Underground Splicing of RG-164 Armored Coaxial Cable" presents a procedure for splicing coaxial cables. This procedure shall be adapted by the contractor for all cable to be installed and shall be submitted to the Contracting Officer for approval prior to any cable splicing.

(f) Connectors, power cable. Stranded cable conductor connections shall be made using crimp connectors utilizing a crimping tool designed to make a complete crimp before the tool can be removed.

(g) Connectors, control and telephone cable. Amp Picabond type connectors #61292-2 are preferred for splicing telephone pair conductors, because of their small size. Other connectors may be used with prior approval. Control cable connectors shall be crimp or solder type. If crimp connectors are used, they must be installed with a ratchet type tool which requires full compression before it releases. Insulation for connectors may be either factory applied or field taped.

(h) Cable armor and shields. Armor and shield shall be made continuous through a splice. Armor and shield shall be folded back prior to splicing, then reinstalled across the splice and bonded with approved bonding clips, or

soldering when copper material is used. If the armor is galvanized, it shall be bolted. Excess threads should be cut from bolts and wrapped with butyl tape so there are no sharp projections prior to using heat-shrink tubing.

(i) Evaluation of "or equal products." Deviation from the requirements of paragraph 3.6 may be allowed with prior Contracting Officer approval. To obtain product approval, the contractor shall submit samples of the product proposed, drawings showing splicing method details, and a statement of his experience making splices with the product. In addition, products shall meet the standards in Table II, "Cable Slicing Specification Equivalents."

Table II. Cable Splicing Specification Equivalents.

PRODUCT IDENTIFIED IN PARAGRAPH	APPLICATION STANDARD	LEVEL OF ACCEPTANCE
3.6 (a)	1. IEEE-404-1977, Standard for Power Cable Joints.	Meet or exceed.
	2. IEEE-48-1975, Standard for Cable Terminations.	Meet or exceed.
	3. ANSI C119.2-1974 Water Immersion Test.	Meet or exceed.
3.6 (b)	Same as 3.6 (a).	Meet or exceed.
3.6 (c) and (e)	ANSI C119.1-1974 Sealed Insulated Underground Connector System Rated 600 Volts.	Meet or exceed.

4. QUALITY ASSURANCE PROVISIONS

4.1 Cable testing.- All cable testing shall be performed by the contractor in the presence of the Contracting Officer. The contractor shall furnish all necessary test instruments, except where otherwise indicated. All instruments shall have been calibrated within a two year period preceding cable testing by a laboratory approved by the measurement instrument manufacturer. All cables shall be tested before installation, after each splice, and again upon completion of the installation. All testing shall be completed on contractor-installed cable before connection is made to any existing cables. The FAA will test existing cables prior to connecting to contractor-installed cables.

4.2 Power cables, 5,000 volts.- Conductors, splices, and other contractor performed connections shall be tested at 10,000 volts. Tests shall be made between conductors and from each conductor to ground with the cable shield and armor grounded. To assure that the cable is completely charged, each test shall continue for a period of not less than 1 minute after instrument readings stabilize. Minimum acceptable insulation resistance value of the cable is 50 megohms. Unless cable length exceeds 10,000 feet, no reduction in the specified insulation resistance should be allowed. In cases where cable length exceeds 10,000 feet, the minimum allowable insulation resistance may be corrected downward based on the total number of 10,000-foot cable segments (i.e.; up to 10,000 feet, 50 megohms; 10,000 to 20,000 feet, 50 x 2 megohms; 20,000 to 30,000 feet, 50 x 3 megohms, etc.).

Tests shall be made for continuity of cable shield armor. An ohmmeter-type instrument may be used. The contractor shall demonstrate that circuits are properly connected, including operation of each lighting and power circuit for not less than one-half hour.

4.2.1 Power cables, above 5,000 volts.- Power cables rated above 5,000 volts shall be tested as in paragraph 4.2, except that the test voltage shall be twice the cable voltage rating plus 1,000 volts.

4.3 Cables, 5,000 volts, series lighting.- After completing installation, each series loop with its connectors and lighting transformers shall be tested for insulation resistance. Test shall be conducted in accordance with paragraph 4.2 with both ends of each loop disconnected from the series cutouts at the substation, except for the following:

(a) If the transformers cannot withstand a DC voltage of 10,000 volts, the test shall be performed at the highest allowable transformer voltage.

(b) Depending upon the number of lighting transformers in the loop and their individual insulation resistances, the allowable loop insulation resistance may be reduced, based on the parallel summation of the cable and transformer insulation resistances. However, the cable insulation resistance shall never be less than the minimum value allowed in paragraph 4.2.

With both ends of each loop disconnected from the series cutouts at the substation, each loop will also be tested for loop resistance with the

lighting transformers installed. The DC circuit resistance of each series loop shall be calculated using of the following formula:

$$R_{loop} = (R_c \times L_l) + (R_t \times T_s)$$

Where: R_{loop} - Loop resistance

R_c - Resistance of the cable conductor per 1,000 feet (0.64 ohms @ 68 degrees Fahrenheit)

L_l - Length of loop in thousands of feet.

R_t - Resistance of the transformer primary as measured with a Wheatstone bridge.

T_s - Number of series transformers in loop.

The loop resistance shall be measured with a Wheatstone bridge or equivalent instrument and recorded. The measured resistance value shall not exceed the calculated resistance by more than 20 percent.

4.4 Power cables, 600 volts and below.- All power cables shall measure not less than 50 megohms resistance between conductors, and between conductors and ground. Measurements shall be taken at not less than 500 volts DC.

4.5 Control and telephone cables.- After installation these cables shall comply with the requirements of Table III.

Table III. Control and Telephone Cable Conductors.

CABLE SIZE	MINIMUM NUMBER OF ACCEPTABLE CONDUCTORS
12 pair or less	All
13 through 25 pair	All, except 1 pair
Over 25 pair	All, except 2 pairs

4.5.1 Acceptable conductors satisfactorily pass tests for (a) continuity, (b) freedom from short circuits, and (c) a minimum of 50 megohms resistance between conductors and from each conductor to grounded shield when tested at not less than 500 volts DC.

4.5.2 Cable testing.- The contractor shall test the cable prior to installation and tag any defective conductor pairs that are found. The contractor shall notify the Contracting Officer of any unusable conductors found. These may be subtracted from the allowable number of excepted

conductors specified in Table III, if the cable is government furnished. Tests between unpaired conductors showing an insulation resistance below infinity on a 500-volt, 100-megohm, or equivalent insulation-measuring instrument shall be tabulated by the contractor and furnished to the Contracting Officer. This report shall indicate measured resistance values.

NOTE: Some telephone cables may include an extra conductor pair, and if so, may have one pair tagged as defective by the manufacturer. This extra conductor pair shall not be included in the minimum number of acceptable pairs listed in Table III.

4.6 Coaxial cables.- The insulation and loop resistance of radio frequency cables shall be measured prior to installation. The results shall be recorded and furnished to the Contracting Officer. The insulation test shall be made between the center conductor and shield with a 500-volt DC instrument. The loop resistance test shall also be made in the same way, but with the center conductors shorted to the shield at the far end of the cable. This test shall be made with a bridge, ohmmeter, or other suitable instrument.

4.6.1 Testing after installation.- After installation, the conductor-to-shield and conductor-to-ground resistance shall exceed 50 megohms when measured at 500 volts DC. Loop resistance shall be within 10 percent of the measured values prior to installation, e.g., measured resistance per 1,000 feet of cable on a reel, multiplied by each 1,000 feet and fraction thereof of installed cable. Shield-to-ground insulation shall be measured and the results furnished to the Contracting Officer.

4.6.2 Pulse reflection test.- The FAA will conduct pulse reflection tests on coaxial cables which carry trigger or video information. These tests will be conducted prior to and after cable installation to determine if discontinuities were introduced in the cable during installation. Discontinuities can be caused by improper connector installation or mechanical damage to the cable. Test results will be recorded and furnished to the contractor.

4.6.3 Electrical test.- A hipot tester with microammeter current leakage meter, or equivalent, will be used to apply 3,000 volts DC between the inner and outer conductors for a minimum period of 3 minutes. While this voltage is applied, no noticeable current shall flow between the inner and outer conductors after the charging current has stabilized.

4.7 Failure of cable under test.- If the contractor-furnished cable fails to meet test requirements after installation, the contractor shall repair or replace, at his expense, the sections of cable proven defective. If the cable is government furnished and the failure results from a manufacturer's defect not detectable prior to installation, the government will repair or replace the cable. If the government-furnished cable fails to meet test requirements after installation, due to faulty installation practices, the contractor shall repair or replace the sections of cable proven defective.

5. PREPARATION FOR DELIVERY.- Not applicable.

6. NOTES

6.1 General.- This specification is to be used as part of the contract documentation for construction and facility modification projects that do not require major design efforts. No waivers to contractors, other than those indicated as alternatives, are allowed. This specification is not to be used as a design guide. For design information, consult FAA-STD-019, "Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities"; FAA-STD-020, "Transient Protection, Grounding, Bonding and Shielding Requirements for Equipment"; Order 6950.19, "Practices and Procedures for Lightning Protection, Grounding, Bonding, and Shielding Implementation"; Order 6950.20, Considerations for Lightning Protection, Grounding, Bonding and Shielding" and other documentation as applicable.

6.2 Conflicts between documents.- In all but the smallest of modification or construction contracts, conflicts are unavoidable between the various documents cited in the contract or referenced in an included specification. Any proposal request using this document should contain the following provisions: "Prospective contractors shall, as part of their proposals, enumerate, identify, and list conflicts that exist within the contract documents, and between those documents and the rules, regulations, and codes of the local utility company and local, county or state governing bodies."

APPENDIX A. SPLICING ARMORED COAXIAL CABLE

Use the following procedure to splice RG-164 armored coaxial cable for underground installation:

1. Strip 6 inches of outer cable jacket from each end to be spliced.

2. Install a 12-inch length of Raychem WCSM 51/16 mm, or equal, over one end of the cable and a 6-inch length of Raychem WCSM 38/12 mm, or equal, over the other end of the cable to be spliced. Slide both sleeves back out of the way.

3. Loosen the armor, unwrap and fold it back to expose the inner jacket. Cut the inner jacket 4 inches from the cable end. Cut the outer jacket 2 inches from the cable end.

4. Fold back and temporarily tape the braided shield with Scotch 88. Cut the dielectric 1-inch from inner jacket cut, and approximately 3 inches from the end of cable. This will provide overlap for braid and armor. CAUTION: Do not nick the center conductor. Cut approximately 3/4 through the dielectric then bend to break the dielectric loose.

5. Slide a 4-inch long Raychem WCSM 28/9 mm, or equal, on same cable end as the 12-inch length.

6. Trim center conductor to a length of 1-inch, crimp and solder using a Burndy "YSV," or equal, butt connector. Fill the cavity over the connector and between dielectric, with Scotch #23 tape. Dimension of fill shall be the same as dielectric diameter. Center 4-inch sleeve and heat-shrink.

7. Remove the temporary tape (step 4) and return the braided shield over the splice. The shield will overlap. Tape the ends to hold the shield tight against the previous splice sleeve, solder the overlapping shield halves all around to form a good electrical connection. Center and heat-shrink a 6-inch sleeve over the spliced braid.

8. Spiral rewrap the armored shield across the splice and bolt the overlapping ends. Use a No. 12 bolt and nut. Cut excess threads and tape over bolt and nut so there are no sharp projections.

9. Center and heat-shrink a 12-inch sleeve over the splice.

Procedures for other coaxial cables (RG-11A, etc.) shall be similar to that described for RG-164 except that sizes of tubing and butt connectors shall be appropriate for the cable to be spliced. To size tubing, select a size so the cable is between 20-80% of the expanded-to-contracted range of the tubing.

Approved splicing materials are Raychem Corporation's "WCSM, Sigmaform Corporation's "SST", or approved equal. Dimensions (ID expanded/ID recovered) are for Raychem materials. If materials are supplied by others or different size coaxial cables are used, size tubing accordingly.

APPENDIX C

DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION, LIGHTING AND SURGE PROTECTION, GROUNDING, BONDING AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT

FAA-STD-019e
December 22, 2005

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION STANDARD

LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT

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FOREWORD

All construction of Federal Aviation Administration (FAA) operational facilities and the electronic equipment installed therein shall conform to this standard. This document defines minimum requirements for all FAA facilities. When the specific needs of a facility exceed these minimum requirements, the facility shall be designed and installed to meet these specific needs. These needs are influenced by the equipment to be installed at the site, the configuration of the structures and location of the equipment, and by the physical environment present at the location.

The requirements contained in this document reflect investigation and resolution of malfunctions and failures experienced at field locations. The requirements thus are considered the minimum necessary to harden sites sufficiently for the FAA missions – to prevent delay or loss of service, to minimize or preclude outages, and to enhance personnel safety. Further, the requirements in the document have been coordinated with industry standards, and in some cases exceed industry standards where necessary to meet the FAA missions.

In this document the use of "shall" or verbs such as "construct", "weld", "connect", etc indicates a requirement necessitating mandatory compliance. In cases when implementation of certain requirements is not technically feasible, a National Airspace System (NAS) Change Proposal (NCP) must be submitted with adequate justification and technical documentation and approved by the NAS Configuration Control Board (CCB) before a deviation is permitted.

This document is organized in accordance with MIL-STD-962D.

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1 SCOPE

1.1 Scope

This document mandates standard lightning protection, transient protection, grounding, bonding and shielding configurations and procedures and control of electrostatic discharge (ESD) for new facilities, modifications and upgrades to existing facilities, new equipment installations, and new electronic equipment used in the National Airspace Systems (NAS). It provides requirements for the design, construction, modification or evaluation of facilities and equipment. (It is recommended that the OPR of this document be contacted to obtain technical guidance on the applicability of the requirements to modifications, upgrades and new equipment installations in existing facilities.)

This document is not mandatory for programs that have been funded prior to the issue date of this document, nor is it mandatory for construction contracts associated with programs funded prior to the issue of the document. Application of this document is at the discretion of the user for programs that have been funded prior to the issue of the document. The Office of Primary Responsibility (OPR) can mandate the use of this document for programs started before the issue date of this document, if funding is provided.

The interface between contractor owned equipment or electronic equipment not used for operational purposes (administrative local area network (LAN), administrative telephone, etc.) and the operational facility shall be in accordance with this document.

1.2 Purpose

The requirements of this standard provide a systematic approach to minimize electrical hazards to personnel, electromagnetic interference and damage to facilities and electronic equipment from lightning, transients, ESD, and power faults.

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2 APPLICABLE DOCUMENTS

2.1 Government Documents

Due to the continuous updating of Government documents, the Contracting Officer and/or the Implementation Engineer must specify the version current at contract award or project design. These documents form a part of this standard and are applicable to the extent specified elsewhere in this document. If conflicts occur between these documents and the contents of this standard, the contents of this standard provide the superseding requirements.

FAA Specifications

FAA-C-1217	Electrical Work, Interior
FAA-G-2100	Electronic Equipment, General Requirements
NAS-SS-1000	Functional and Performance Requirements for the National Airspace Air Traffic Control Element

FAA Orders

Order 6950.19	Practices and Procedures for Lightning Protection, Grounding, Bonding and Shielding Implementation
Order 6950.20	Fundamental Considerations of Lightning Protection, Grounding, Bonding and Shielding

(Copies of these specifications, standards, orders, and other applicable FAA documents may be obtained from the Contracting Officer issuing the invitation-for-bids or request-for-proposals. Requests should fully identify material desired, i.e. specification, standard, amendment, drawing numbers and dates. Requests should cite the invitation-for-bids, request-for-proposals, the contract involved, or other use to be made of the requested material.)

Military Documents

MIL-HDBK-232	Revision A Red/Black Engineering-Installation Guidelines
MIL-HDBK-237	Electromagnetic Compatibility Management Guide for Platforms, Systems and Equipment
MIL-HDBK-253	Guidance for the Design and Test of Systems Protected Against the Effects of Electromagnetic Energy
DOD/MIL-HDBK-263	Electrostatic Discharge Control Handbook
DOD-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
MIL-HDBK-419	Grounding, Bonding, and Shielding for Electronic Equipment and Facilities
MIL-PRF-87893	Performance Specification, Workstations, Electrostatic Discharge Control

MIL-W-87893	Military Specification, Workstations, Electrostatic Discharge (ESD) Control
MIL-STD-461	The Control of Electromagnetic Interference Emissions and Susceptibility
MIL-STD-889	Dissimilar Metals
MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)
NACSIM 5203	Guidelines for Facility Design and Red/Black Installation (Confidential Document)

Single copies of Military specifications, standards, and handbooks may be requested by mail or telephone from Document Automation and Production Service Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D Philadelphia, PA 19111-5094 or via dodssp.daps.dla.mil. Not more than five items may be ordered on a single request; the Invitation for Bid or Contract Number should be cited where applicable. Only latest revisions (complete with latest amendments) are available; slash sheets must be individually requested. Request all items by document number.

2.2 Non-Government Documents

Due to the continuous updating of Non-Government documents, the Contracting Officer and/or the Implementation Engineer must specify the version current at contract award or project design unless a specific version is called out in the requirements of this standard. These documents form a part of this standard and are applicable to the extent specified herein. While this standard may exceed the requirements of the following documents, Nationally required practices shall always be performed as a minimum.

Electronic Industries Alliance (EIA)

EIA Standard EIA-625	Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices

Requests for copies of EIA Standards should be addressed to Electronic Industries Alliance, Corporate Engineering Department, 2500 Wilson Boulevard, Arlington, VA 22201 or telephone 703 907-7500. www.eia.org

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code (NEC)
NFPA 77	Static Electricity
NFPA 780	Standard for the Installation of Lightning Protection Systems

Requests for copies of NFPA documents should be addressed to the National Fire Protection Association, One Batterymarch Park, Quincy MA 02269. www.nfpa.org

Underwriters Laboratories, Inc. (UL)

UL 96	Lightning Protection Components
UL 96A	Installation Requirements for Lightning Protection Systems
UL 779 (ANSI-A148.1)	Electrically Conductive Floorings
UL 1449	Transient Voltage Surge Suppressors

Requests for copies of UL documents should be addressed to Global Engineering Documents, 1500 Inverness Way, East Englewood, CO 80112. Telephone 303 397-7945, 800 854-7179. www.ul.com

Institute of Electrical and Electronic Engineers (IEEE)

ANSI/IEEE C62.41	Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
ANSI/IEEE C62.45	IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits
ANSI/IEEE 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book)

Requests for copies of IEEE documents should be addressed to Institute of Electrical and Electronic Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-9916. www.ieee.org

Electrostatic Discharge (ESD) Association Documents

ESD ADV53.1	ESD Protective Workstations
ANSI/ESD S4.1	Worksurfaces – Resistance Measurements
ANSI/ESD S7.1	Floor Materials, Characterization of Materials
ANSI/ESD S8.1	Symbols – ESD Awareness
ANSI/ESD S11.11	Surface Resistance Measurement of Static Dissipative Planar Materials
ANSI/ESD S20.20	Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment
ANSI/ESD STM5.1	Sensitivity Testing, Human Body Model (HBM), Component Level
ANSI/ESD STM12.1	Seating - Resistive Measurement
ESD TR20.20	Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment – Handbook

Requests for copies of ESD Association documents should be addressed to the ESD Association, 7900 Turin Road, Bldg 3, Suite 2, Rome, NY 13440-2069. Telephone 315 339-6937. www.esda.org

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3 DEFINITIONS

3.1 Access Well
A covered opening in the earth using concrete, clay pipe or other wall material to provide access to an EES connection.

3.2 Air Terminal
That component of a lightning protection system specifically designed to accept lightning strikes.

3.3 Armored Cable
Power, signal, control or data cable having an overall armor or covering constructed of ferrous (steel) material that provides both structural protection and electromagnetic shielding for direct buried cables.

3.4 Arrester
Components, devices or circuits used to attenuate, suppress, limit, and/or divert adverse electrical (surge and transient) energy. The terms arrester, suppressor and protector are used interchangeably except that the term arrester is used herein for components, devices and circuits at the service disconnecting means.

3.5 Bond
The electrical connection between two metallic surfaces used to provide a low resistance path between them.

3.6 Bond, Direct
An electrical connection utilizing continuous metal-to-metal contact between the members being joined.

3.7 Bond, Indirect
An electrical connection employing an intermediate electrical conductor between the bonded members.

3.8 Bonding
The joining of metallic parts to form an electrically conductive path to assure electrical continuity and the capacity to conduct current imposed between the metallic parts.

3.9 Bonding Jumper
A conductor installed to assure electrical conductivity between metal parts required to be electrically connected.

3.10 Branch Circuit
The circuit conductors between the final overcurrent device protecting the circuit and the load served.

3.11 Building
The fixed or transportable structure which provides environmental protection.

3.12 Bulkhead Plate
A metallic plate located where conduits, conductor, waveguides etc first enter the facility. The bulkhead plate provides a central point for the grounding of conduits, conductors and waveguides entering the facility or structure.

3.13 Cabinet
An enclosure designed either for surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.

3.14 Cable
A fabricated assembly of one or more conductors in a single outer insulation. Types include axial, armored and shielded.

3.14.1 Cable, AC (not the same as armored (DEB) cable)
Type AC cable is a fabricated assembly of insulated conductors in a flexible metallic enclosure.

3.14.2 Cable, Armored Direct Earth Burial (DEB)
Cable with a ferrous shield designed to provide both physical and electromagnetic protection to the conductors.

3.14.3 Cable, Axial
Cable where all conductors are oriented on a single axis. Examples include coaxial, biaxial, and triaxial cables

3.14.4 Cable, Shielded
Cable with a metalized or braid shield to improve resistance to electromagnetic interference (EMI).

3.15 Case
A protective housing for a unit or piece of electrical or electronic equipment.

3.16 Catenary Wire
A catenary lightning protection system consisting of one or more overhead ground wires and supporting masts.

3.17 Chassis
The metal structure that supports the electrical or electronic components which make up the unit or system.

3.18 Clamp Voltage
Clamp voltage is the voltage that appears across the SPD terminals when the suppressor is conducting a surge or transient current.

3.19 Conductor, Bare
An electrical conductor that has no covering or electrical insulation.

3.20 Conductor, Insulated
An electrical conductor encased within material of composition and thickness recognized by the NEC as electrical insulation.

3.21 Conductor, Lightning Bonding (Secondary)
An electrical conductor used to bond a metal object, within the zone of protection and subject to currents induced by lightning strikes, to the lightning protection system.

3.22 Conductor, Lightning Down
The down conductor serves as the path to the earth grounding system from the roof system of air terminals and roof conductors or from an overhead ground wire.

3.23 Conductor, Lightning Main
The main conductors are the conductors intended to carry lightning currents between air terminals and ground terminations. These can be the roof conductors interconnecting the air terminals on the roof, the conductor to connect a metal object on or above roof level that is subject to a direct lightning strike to the lightning protection system, or the down conductor.

3.24 Conductor, Lightning Roof
Roof conductors interconnecting all air terminals to form a two-way path to ground from the base of each air terminal.

3.25 Crowbar
The term "crowbar" refers to a method of shorting a surge, voltage, or current using surge protective devices.

3.26 Earth Electrode System (EES)
A network of electrically interconnected rods, plates, mats, piping, incidental electrodes (metallic tanks, etc.) or grids installed below grade to establish a low resistance contact with earth.

3.27 Electromagnetic Interference (EMI)
Any emitted, radiated, conducted or induced voltage which degrades, obstructs, or interrupts the desired performance of electronic equipment.

3.28 Electronic Multipoint Ground System
An electrically continuous network consisting of interconnected ground plates, equipment racks, cabinets, conduit junction boxes, raceways, duct work, pipes, copper grid system, building steel, and other non-current-carrying metal elements. It includes conductors, jumpers and straps that connect individual items of electronic equipment to the SRP or MPG system.

3.29 Electronic Single Point Ground (SPG) System
An SPG signal reference network provides a single point reference in the facility for equipment that requires single point grounding. It consists of conductors, plates and equipment terminals, all of which are isolated from any other grounding system except at the main ground plate.

3.30 Enclosed Ferrous Cable Tray
A cable tray with steel sides and bottom with a steel cover or lid. This tray may have small holes and gaps.

3.31 Equipment Areas
Areas that contain electronic equipment used to support NAS operation. These include electronic equipment rooms, TELCO rooms, VORs, Radars etc.

3.32 Equipment Grounding Conductor
The conductor with the phase and neutral conductors used to connect non-current-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor and/or to the grounding electrode conductors at the main service disconnecting means or at the point of origin (X_o bond) of a separately derived system.

3.33 Equipment
A general term including materials, fittings, devices, appliances, fixtures, apparatus, machines, etc, used as a part of, or in connection with, an electrical installation.

3.34 Facility Ground System
Consists of the complete ground system at a facility including the EES , SRP or MPG system, electronic single point ground system (SPG), equipment grounding conductors, grounding electrode conductor(s), and lightning protection system.

3.35 Faraday Cage
A closed conducting surface, such as wire mesh, completely surrounding an object or person so as to protect from impinging electromagnetic waves.

3.36 Feeder
All circuit conductors between the service equipment or the source of a separately derived system and the final branch circuit overcurrent device.

3.37 Ferrous Conduit
Material composed of and/or containing iron. Rigid Galvanized Steel Conduit (RGS) thick walled threaded conduit (NEC Rigid Metal Conduit (RMC)). For the purpose of this document, conduits not adequate for magnetic shielding include Electrical Metallic Tubing (EMT), Intermediate Metal Conduit (IMC) and conduits made from silicon bronze and stainless steel.

3.38 Fitting, High Compression
See "Pressure Connector".

3.39 Ground
A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

3.40 Grounded Conductor
A system or circuit conductor that is intentionally grounded at the service disconnecting means

or at the source of a separately derived system. This grounded conductor is the neutral conductor for the power system.

3.41 Grounded
Connected to earth through a connection of sufficiently low impedance and having sufficient current carrying capacity so that fault current which occurs cannot build up to voltages dangerous to personnel.

3.42 Grounding Conductor
A conductor used to connect equipment or the grounded circuit of a wiring system to the grounding electrode system. (In this standard, grounding conductors not related to or not used as part of NEC required electrical system grounding, are used for the electronic equipment grounding system).

3.43 Grounding Electrode
Copper rod, plate or wire embedded in the ground for the specific purpose of dissipating electric energy to the earth.

3.44 Grounding Electrode Conductor
The conductor used to connect the grounding electrode to the equipment grounding conductor and/or to the grounded (neutral) conductor of the facility at the service disconnecting means or at the source of a separately derived system.

3.45 High frequency
All electrical signals at frequencies greater than 100 kilohertz (kHz), and pulse and digital signals with rise and fall times of less than 10 μs are classified as high frequency signals.

3.46 Horizontal Transitions
Architectural term used to describe horizontal elements in a vertical structure (floors stair landings, etc.).

3.47 Jordan Dissipation Plate Design
Based on original design from W. Jordan FAA OKC.

3.48 Landline
Any conductor, line or cable installed externally above or below grade to interconnect electronic equipment in different facility structures or to interconnect externally mounted electronic equipment.

3.49 Line Replaceable Unit
Hardware elements whose design enables removal, replacement and checkout by organizational maintenance.

3.50 Low Frequency
Includes all voltages and currents, whether signal, control, or power, up to and including 100 kHz. Pulse and digital signals with rise and fall times of 10 μs or greater are considered to be low frequency signals.

3.51 Main Service Disconnect
Main Service Disconnect is a switch, fused switch or circuit breaker that disconnects main service AC power (generally utility power) from a facility. Also referred to as Service Disconnecting Means (SDM).

3.52 National Electrical Code
A standard containing provisions that govern the use of electrical wire, cable, equipment and fixtures installed in buildings.

3.53 Operational Areas
Areas used to provide NAS support such as IFR rooms, ARTCC control rooms, ATCT tower cabs and operations control centers.

3.54 OPR
OPR is an acronym for Office of Primary Responsibility. The OPR is assigned to maintain and interpret this standard.

3.55 Overshoot Voltage
The fast rising voltage that appears across transient suppressor terminals before the suppressor turns on (conducts current) and clamps the input voltage to a specified level.

3.56 Pressure Connector
For purpose of this document, "FAA approved pressure connectors" shall be those that use hydraulically crimped terminations to effect closure.

3.57 Rack
A frame in which one or more equipment units are mounted.

3.58 Reference Plane or Point, Electronic Signal (Signal Ground)
The conductive terminal, wire, bus, plane, or network which serves as the relative zero potential for all associated electronic signals.

3.59 Rigid Metal Conduit (RMC)
A threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings.

3.60 RGS
See Ferrous Conduit.

3.61 Shield
A housing, shield, or cover which substantially reduces the coupling of electric and magnetic fields into or out of circuits or prevents accidental contact of objects or persons with parts or components operating at hazardous voltage levels.

3.62 Signal
Any electromagnetic transmission of information or control function. A signal can be analog, digital data or a control function such as a relay closure.

3.63 Standard Version
The applicable version of the standard is that issue in effect on the date of a contract signing.

3.64 Structure
Any fixed or transportable building, shelter, tower, or mast that is intended to house electrical or electronic equipment or otherwise support or function as an integral element of the air traffic control system.

3.65 Surge
An overvoltage or overcurrent of short duration occurring on a power line.

3.66 Susceptibility Level
The electronic equipment susceptibility level is the least of the damage, degradation, or upset levels considering all electronic components potentially affected by conducted or radiated transients.

3.67 Transient
An overvoltage or overcurrent pulse on a power, signal, control, or data line.

3.68 Transient Suppressor
Components, devices or circuits designed for the purpose of attenuating, absorbing and suppressing conducted transient and surge energy to protect facility equipment.

3.69 Turn-on Voltage
The voltage required across transient suppressor terminals to cause the suppressor to conduct current.

3.70 Zone of Protection
The zone of protection is that space adjacent to a lightning protection system that has a reduced probability of receiving a direct lightning strike.

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4 GENERAL REQUIREMENTS

4.1 Requirements Common to Both Facilities and Equipment

This section provides requirements that are established to ensure the proper operation of FAA facilities and equipment. The use of the term "facilities" in this document can differ from the manner in which it is frequently used in other FAA documents. In this document, physical proximity of equipment(s) defines a single facility, while physical separation would define separate facilities. For example, the cab and electronic/electrical equipment located on the junction and subjunction levels of an Airport Traffic Control Tower (ATCT) are a single facility. An ATCT with a base building containing electronic equipment is an example of two facilities located at the same site. Other examples of two or more facilities include the ARSR-4 (the tower and base building are separate facilities) and Air Route Traffic Control Centers (ARTCC) with multiple buildings that must be treated as separate facilities. An example of a single facility (for purposes of this document) is a Remote Controlled Air to Ground Site (RCAG) collocated in a VHF Omni-directional Range (VOR) building. Contact the Office of Primary Responsibility (OPR) of this document for specific guidance on new facilities/systems.

4.1.1 Bonding Requirements

4.1.1.1 Resistance of Bonds

Unless otherwise specified in this standard, all bonds shall have a maximum DC resistance of 1 milliohm when measured between the bonded components with a 4-terminal milliohmmeter.

4.1.1.2 Methods of Bonding

Bonding for electrical purposes shall be accomplished by a method that provides the required degree of mechanical strength, achieves the value of low and high frequency impedance required for proper functioning of the equipment. Soft soldered or brazed connections shall not be used for any part of the power grounding system, EES or the lightning protection system (air terminals, roof conductors, down conductors, fasteners, and conduit). Soft solder shall only be used to improve conductivity at joints already secured with mechanical fasteners. Soft solder shall not be used to provide mechanical restraint.

4.1.1.2.1 Exothermic Welds

Exothermic welds shall be allowed for any type of bond connection specified herein. Exothermic welds shall be used for all buried or subject to submersion connections. Where exothermic welds are not be possible between certain materials, shapes, or in hazardous locations, i.e., near fuel tanks, where nearby objects are subject to damage, etc., connections using UL listed connectors shall be permitted. Exothermic welding shall be used for the permanent bonding of copper conductors to steel. Where the combustion products of a standard exothermic weld present problems, a smokeless exothermic process is commercially available and shall be used. All residual fluxes shall be removed or neutralized to prevent corrosion.

4.1.1.2.2 Welded Assemblies

Individual components of a welded assembly shall not require additional bonds between components if the DC resistance between individual components is less than 1 milliohm.

4.1.1.2.3 Dissimilar Metals

Mechanical bonds shall comply with Table I unless specifically approved by the OPR.

The legend shown below is for Table I and represents the four basic categories of possible metal interfaces.

no	Not suitable. This interface is highly likely to result in significant corrosion.
•	Suitable for indoor environments where temperature and humidity are controlled (non-condensing environment).
••	Suitable for all indoor environment.
•••	Suitable for all environments.

Table I. Mechanical Bonds Between Dissimilar Metals

METAL	Copper, solid or plate	Brass and bronze	Stainless Steel	Tin-plate; tin-lead solder	Aluminum, wrought alloys of the 2000 Series	Iron, wrought, gray or malleable, plain carbon and low alloy steels	Aluminum, wrought alloys other than 2000 Series aluminum, cast alloys of the silicon type	Aluminum, cast alloys other than silicon type, plated and chromate	Galvanized steel	Zinc, wrought; zinc-base die-casting alloys; zinc plated
Copper, solid or plate	●●●	●●●	●●	●	●	●	no	no	no	no
Brass and bronze	●●●	●●●	●●	●●	●	●	●	no	no	no
Stainless Steel	●●	●●	●●●	●●●	●●●	●●	●	●	no	no
Tin-plate; tin-lead solder	●	●●	●●●	●●●	●●●	●●	●●	●	no	no
Aluminum, wrought alloys of the 2000 Series	●	●	●●●	●●●	●●●	●●●	●●●	●●	●	●
Iron, wrought, gray or malleable, plain carbon and low alloy steels	●	●	●●	●●	●●●	●●●	●●●	●●●	●	●
Aluminum, wrought alloys other than 2000 Series aluminum, cast alloys of the silicon type	no	●	●	●●	●●●	●●●	●●●	●●●	●	●
Aluminum, cast alloys other than silicon type, plated and chromate	no	no	●	●	●●	●●●	●●●	●●●	●●	●
Galvanized steel	no	no	no	no	●	●	●	●●	●●●	●●●
Zinc, wrought; zinc-based die-casting alloys; zinc plated	no	no	no	no	●	●	●	●	●●●	●●●

4.1.1.2.4 Mechanical Connections

4.1.1.2.4.1 Coupling of Dissimilar Metals

Compression bonding with bolts and clamps should be used between metals having acceptable couples depending on the location as shown in
Table I. When the base metals form couples that are not allowed, the metals shall be coated, plated, or otherwise protected with a conductive finish. MIL-STD-889 provides specific information in this area.

4.1.1.2.4.2 Bolted Connections for Electrical Bonding

Bolts shall be used primarily as mechanical fasteners for holding the component members of the bond in place. Bolts shall be tightened sufficiently to maintain the contact pressures required for effective bonding but shall not be over-tightened to the extent that deformation of bond members occurs. Disc springs (Belleville spring washers) shall be installed on all bolted connections ¼ inches diameter and greater to prevent loosening. Bolted joints other than those intentionally used to attach bonding straps or conductors, shall not be used in lieu of dedicated bonding jumpers.

a) All bolted connections ¼ inches diameter and greater shall conform to the torque requirements in Table II.
b) All bolted connections in corrosive, damp, or wet locations, ¼ inches diameter and greater shall utilize stainless steel bolts, nuts, and load distribution washers to meet the strength requirements of same size SAE Standard J429 Grade 5. All other locations shall use corrosion inhibited SAE Standard J429 Grade 5 nuts and bolts. Load distribution washers shall comply with ANSI B18.22.1 for stainless steel washers, Wide Series, Type B.
c) Bolted connections ¼ inches diameter and greater shall be assembled in the order shown in Figure I. Additional load distribution washers, if used, shall be positioned directly underneath the bolt head. Disc springs shall be between the nut and the load distribution washer. Washers shall not be placed between bonded members. Load distribution washers be wide Series, Type B.

Table II. Torque Requirements for Bolted Bonds

Bolt Size	Torque (ft-lbs)	Bolt Load (lbs)	Washers Required	Solon Part Number*
1/4 in.	10	2500	3	4-EH-70-301
5/16 in.	21	4000	3	5-EH-80-301
3/8 in.	34	5500	3	6-EH-89-301
7/16 in.	55	7500	6	7-L-70-301
1/2 in.	83	10,000	2	8-18-125-301
9/16 in.	117	12,500	N/A	N/A
5/8 in.	167	16,000	3	10-EH-150-177
3/4 in.	288	23,000	3	12-EH-168-177
7/8 in.	452	31,000	3	14-EH-168-177
1 in.	567	40,000	3	15-H-187-177

*Other manufacturers of disc spring washers are equally suitable

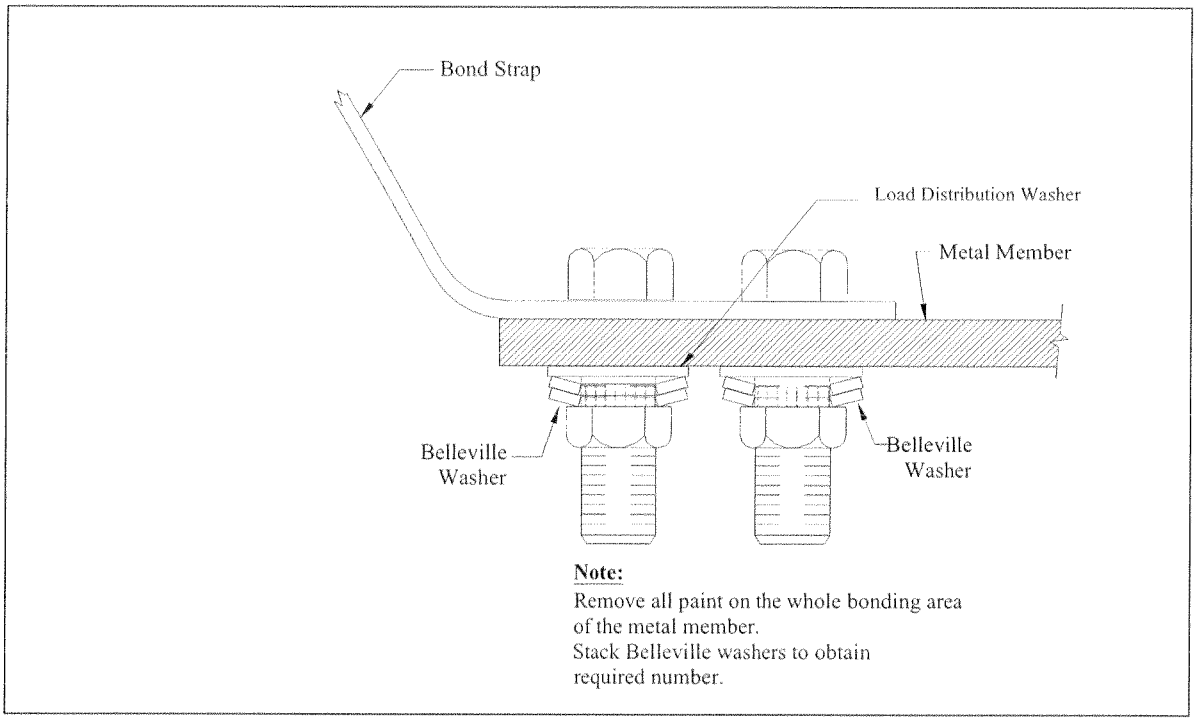


Figure I. Order of Assembly for Bolted Connections

4.1.1.2.4.3 Sheet Metal Screws

Sheet metal screws shall not be used to provide an electrical bond.

4.1.1.2.4.4 Hydraulically Crimped Terminations

Where crimped connectors are used for conductors 6 AWG or larger, the connectors shall be accomplished hydraulically using a minimum force of 12 tons concentrically applied.

4.1.1.2.4.5 Soldering

The use of silver solder to improve mechanical bonds by excluding contaminants from the mating surfaces shall be allowed. Mechanical bonds shall be mechanically secured prior to applying solder to prevent cold solder joints. Soldered mechanical connections shall not be used for any part of the power grounding system or the lightning protection system. See FAA Order 6950.20, Chapter 5, paragraph 99 for additional information.

4.1.1.2.4.6 Riveting

Rivets shall be employed solely as mechanical fasteners to hold multiple smooth, clean metal surfaces together or to provide a mechanical load bearing capability to a soldered bond.

4.1.1.3 Bonding Straps and Jumpers

Bonding straps, including jumpers, shall conform to the following:

(a) Bonding jumpers shall be insulated except those used under a raised floor which shall be bare. Bonding jumpers for structural steel, rebar, connected to the EES, the lightning protection system, and any plenum or environmental airspace shall be bare also. Short bonding straps may be bare. (This requirement is to maintain compliance with the requirements of the NEC)
(b) Bonding straps shall be attached to the basic component rather than through any adjacent parts.
(c) Bonding straps shall be installed so that the electrical bond is not affected by motion or vibration.
(d) Braided bonding straps shall not be used for bonding transmitters or other sources of radio frequency (RF) fields.
(e) Bonding straps shall be installed whenever possible in areas accessible for maintenance and inspection.
(f) Bonding straps shall be installed so they will not restrict movement of the components being bonded or other components nearby which must be able to move as part of normal functional operation.
(g) Two or more bonding straps shall not be connected in series to provide a single bonding path.
(h) The method of installation and point of attachment of bonding straps shall not weaken the components to which they are attached.
(i) Bonding straps shall not be compression-fastened through non-metallic material.
(j) Bonding straps shall be designed not to have resonant impedances at equipment operating frequencies. Two short, low-impedance grounding straps between the signal reference structure and two corners of the equipment should be used. These straps shall be connected as far apart as possible on the equipment (ideally on opposite corners) in order to reduce mutual inductance and they shall have few bends or sags. Two straps with a 20% to 30% difference in length should be used so that if one strap experiences resonance, limiting current flow, the other strap will not.
(k) The length of the equipment bonding conductor connections shall be as short as possible and ideally be limited to 1/20th of a wavelength of the signal frequency, e.g., about six inches at 100 MHz.
(l) Broad flat conductors, with a large surface area (at least one inch wide) shall be used for bonding straps since they have a lower inductance than round conductors. All bonding straps shall be fabricated with integral terminations that approximate the width of the strap, permitting proper terminations. Lower impedance can be achieved by multiple bonds.

4.1.1.4 Fasteners

Fastener materials for bonding aluminum and copper jumpers to structures shall conform to the materials listed in
Table I.

4.1.1.5 Temporary Bonds

Alligator clips and other spring loaded clamps shall be employed only as temporary bonds while performing repair work on equipment or facility wiring.

4.1.1.6 Inaccessible Locations

All bonds in permanently concealed or inaccessible locations shall be exothermically welded.

4.1.1.7 Surface Preparation

All surfaces to be bonded shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other coatings shall be removed to expose the base metal.

4.1.1.7.1 Area to Be Cleaned

Clean all surfaces at least $^{1}/_{4}$ inches (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces.

4.1.1.7.2 Final Cleaning

Clean surfaces with a solvent suitable for electrical work immediately prior to assembly.

4.1.1.7.2.1 Clad Metals

Clean clad metal to a bright, shiny, smooth surface without penetrating the cladding. Wipe the cleaned area with solvent and allow to air dry before completing the bond.

4.1.1.7.2.2 Aluminum Alloys

A conductive finish shall be applied to aluminum mating surfaces after cleaning to a bright finish.

4.1.1.7.3 Completion of the Bond

Mating surfaces shall be joined within 2 hours after cleaning if an intentional protective coating has been removed from the metal surface. If delays beyond two hours are necessary in corrosive environments, the cleaned surfaces must be protected with an appropriate coating that must be removed before completion of the bond.

4.1.1.7.4 Refinishing of Bond

Where practicable restore areas around bonds so as to match the original finish.

4.1.1.7.5 Surface Plating or Treatments

Surface treatments that include plating provided for added abrasion resistance or corrosion protection shall offer high conductivity. Unless suitably protected from the atmosphere, silver and other easily tarnished metals shall not be used to plate bond surfaces, except where an increase in surface contact resistance cannot be tolerated.

4.1.1.8 Bond Protection

All bonds shall be protected against weather, corrosive atmospheres, vibration, and mechanical damage. Under dry conditions, apply a compatible corrosion preventive or sealant, within 24 hours of assembly of the bond materials. Under conditions exceeding 60% humidity, seal the bond with a compatible corrosion preventive or sealant within 1 hour of joining.

4.1.1.8.1 Paint

If a paint finish is required on the final assembly, the bond shall be sealed with the recommended finish. Care shall be taken to assure that all means by which moisture or other contaminants

enter the bond are sealed. A waterproof type of paint or primer shall be used if the recommended finish is not waterproof.

4.1.1.8.2 Compression Bonds in Protected Areas

Sealing is not required for compression bonds between copper conductors or between compatible aluminum alloys located in readily accessible areas that are not exposed to moisture, corrosive fumes, or excessive dust.

4.1.1.8.3 Corrosion Protection

All exterior and interior bonds exposed to moisture or high humidity shall be protected against corrosion. All interior bonds made between dissimilar metals shall be protected against corrosion in accordance with paragraph 4.1.1.2.3 and paragraph 4.1.1.2.4.1. All exothermic welds shall be cleaned of all residual slag. Protection shall be provided by a moisture proof paint conforming to the requirements of FAA-STD-012 or shall be sealed with a silicone or petroleum-based sealant to prevent moisture from reaching the bond area. Bonds protected by conductive finishes (alodine, iridite, et. al.) shall not require painting to meet the requirements of this standard.

4.1.1.9 Bonding across Shock Mounts

Bonding straps installed across shock mounts or other suspension or support devices shall not impede the performance of the mounting device. They shall be capable of withstanding the anticipated motion and vibration requirements without suffering metal fatigue or other failures.

4.1.1.10 Enclosure Bonding

Directly bond subassemblies and equipment at the areas of physical contact with the mounting surface.

4.1.1.11 Subassemblies

Utilize the maximum possible contact area when bonding subassemblies to the chassis. All feed throughs, filters, and connectors shall be bonded around the periphery to the subassembly enclosure to maintain shield effectiveness. Covers shall exhibit intimate contact around their periphery, and contact shall be achieved and maintained through the use of closely spaced screws or bolts, or the use of resilient conductive gaskets, or both. Note: COTS equipment should be treated as a sealed unit for the purposes of this requirement.

4.1.1.12 Equipment

The chassis or case of equipment shall be directly bonded to the rack, frame, or cabinet in which it is mounted. Clean all flange surfaces and the contact surface on the supporting element of all paint or other insulating substances in accordance with the requirements of paragraph 4.1.1.7. Fasteners shall maintain sufficient pressure to assure adequate surface contact to meet the bond resistance requirements in paragraph 4.1.1.1. Captive nuts and sheet metal screws shall not be used for fasteners. If equipment must remain operational when partially or completely withdrawn from its mounted position, the bond shall be maintained by a moving area of contact or by the use of a flexible bonding strap. Mechanical designs shall employ direct bonding, without straps, whenever feasible.

4.1.1.13 Connector Mounting

All metal or metallized connectors shall be mounted so that electrical contact is maintained between the connector body and the panel to which it is mounted. Bonding shall be accomplished completely around the periphery of the flange of the connector. Both the flange surface and the mating area on the panel shall be cleaned in accordance with paragraph 4.1.1.7. All nonconductive material shall be removed from the panel as illustrated in Figure II. After mounting of the connector, the exposed area of the panel shall be repainted or otherwise protected from corrosion in accordance with paragraph 4.1.1.8.

4.1.1.14 Shield Terminations

Cable shields shall be terminated in the manner specified by paragraphs 4.1.2.3.2 and 4.1.2.3.3. Shields of axial cables shall be fastened tightly to the cable connector shell with a compression fitting or soldered connection. The cable shall be able to withstand the anticipated use without becoming noisy or suffering a degradation in shielding efficiency. Axial connectors shall be of a material that is corrosion resistant in keeping with requirements of FAA-G-2100. Low frequency shields shall be soldered in place or, if solderless terminals are used, the compressed fitting shall afford maximum contact between the shield and the terminal sleeve. Shield pigtails shall extend less than 1 inch from the point of breakaway from the center conductors of the cable.

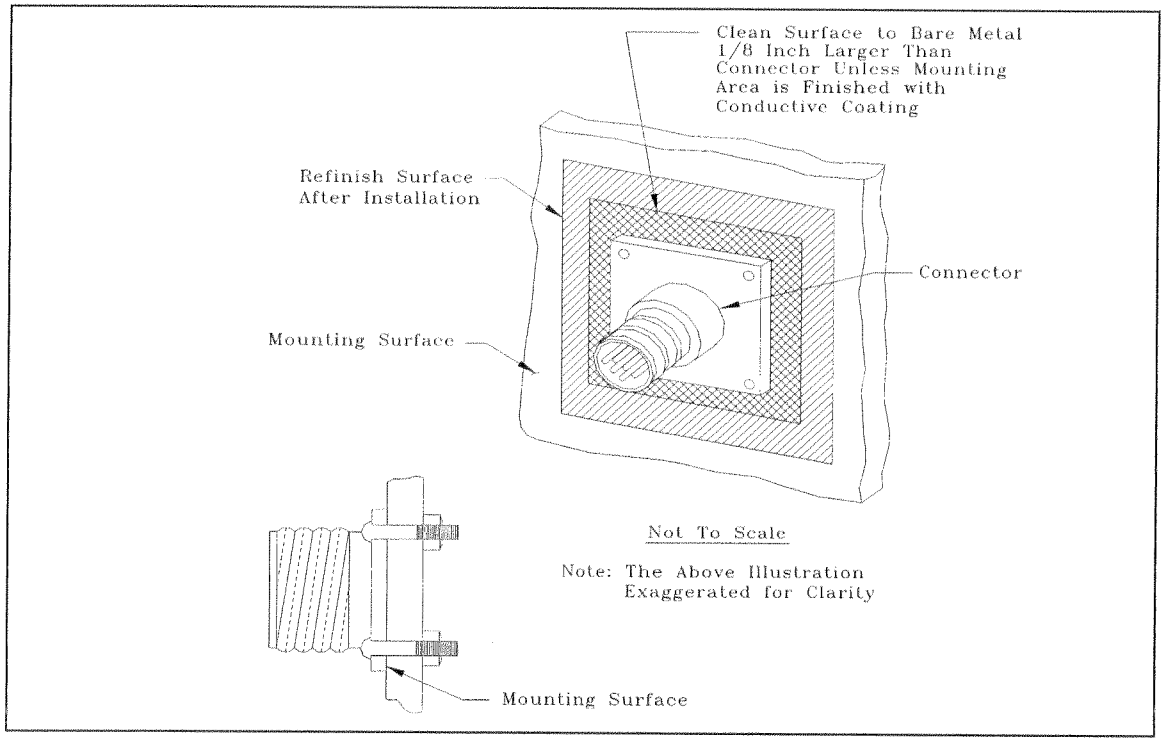


Figure II. Bonding of Connectors to Mounting Surface

4.1.1.15 RF Gaskets

Conductive gaskets shall be made of corrosion resistant material, shall offer sufficient conductivity to meet the resistance requirements of paragraph 4.1.1.1, and shall possess adequate

strength, resiliency, and hardness to maintain the shielding effectiveness of the bond. The surfaces of contact with the gasket shall be smooth and free of insulating films, corrosion, moisture, and paint. The gasket shall be firmly affixed to one of the bond surfaces by screws, conductive cement, or other means that do not interfere with the effectiveness of the gasket; or a milled slot shall be provided that prevents lateral movement or dislodging of the gasket when the bond is disassembled. Gaskets shall be a minimum of $^1/_8$ inch wide. The gasket as well as the contact surfaces shall be protected from corrosion.

4.1.2 Shielding Requirements

4.1.2.1 Design

The facility design and construction shall incorporate both protective shields to attenuate radiated signals, and separation of equipment and conductors to minimize the coupling of interference. The equipment design shall incorporate component compartments and overall shields as necessary to meet the electromagnetic susceptibility and emission requirements of MIL-STD-461 as required by NAS-SS-1000 and FAA-G-2100. In addition, the design shall provide the shields necessary to protect personnel.

4.1.2.2 Facility Shielding

Shielding of facility buildings, shelters or equipment spaces shall be provided when other facility or environmental sources of radiation are of sufficient magnitude to degrade the operation and performance of electronic equipment or system. Where rebar or a rudimentary Faraday cage exists, it shall be connected to the EES with a minimum 2 AWG copper conductor that is applied via an exothermic weld or a hydraulically crimped termination.

4.1.2.3 Conductor and Cable Shielding

Conductor and cable shielding shall comply with the following sub-paragraphs:

4.1.2.3.1 Signal Lines and Cables

Cables consisting of multiple twisted pairs shall have individual shields for each twisted pair.. The shields shall be isolated from each other. Cables with an overall shield shall have the shield insulated and isolated from the individual shields..

4.1.2.3.2 Termination of Individual Shields

Shields of pairs of conductors, line shields, and the shield of cables containing unshielded conductors shall be terminated in accordance with the following:

(a) Shields shall be terminated to ensure correct equipment operation.
(b) Shield terminations shall employ minimum length pigtails between the shield and the connection to the bonding halo or ferrule ring and between the halo or ferrule ring and the shield pin on the connector. The unshielded length of a signal line shall not exceed 1 inch (25 mm) with not more than $^1/_2$ inch (13 mm) of exposed length as the desired goal.
(c) Shields, individually and collectively, shall be isolated from overall shields of cable bundles and from electronic equipment cases, racks, cabinets, junction boxes, conduit, cable trays, and elements of the electronic multipoint ground system. Except for one interconnection, individual shields shall be isolated from each other. This isolation shall be maintained in

junction boxes, patch panels and distribution boxes throughout the cable run. When a signal line is interrupted such as in a junction box, the shield shall be carried through. The length of unshielded conductors shall not exceed 1 inch (25 mm). To meet this requirement, the length of shield pigtail longer than 1 inch shall be allowed but shall be the minimum required.

(d) Circuits and chassis shall be designed to minimize the distance from the connector or terminal strip to the point of attachment of the shield grounding conductor to the electronic signal reference. The size of the wire used to extend the shield to the circuit reference shall be as large as practical but shall not be less than 16 AWG or the maximum wire size that will fit the connector pin. A common shield ground wire for input and output signals, for both high level and low level signals, for signal lines and power conductors, or for electronic signal lines and control lines shall not be used.

(e) Nothing in this requirement shall preclude the extension of the shields through the connector or past the terminal strip to individual circuits or chassis if required to minimize unwanted coupling inside the electronic equipment. Where extensions of this type are necessary, overall cable or bundle shields grounded in accordance with paragraph 4.1.2.3.3 shall be provided.

4.1.2.3.3 Termination of Overall Shields

Cables that have an overall shield over individually shielded pairs shall have the overall shield grounded at each end unless otherwise required by the equipment. Grounding through an SPD is permissible if grounding both ends of the conductors degrades system performance. The drain wire if present shall be grounded the same as the shield.

(a) Cable shields terminated to connectors shall be bonded to the connector shell as shown in Figure IIIa or Figure IIIb. The shield shall be carefully cleaned to remove dirt, moisture, and corrosion products. The connector securing clamp shall be carefully tightened to assure that a low resistance bond to the connector shell is achieved completely around the circumference of the cable shield. The bond shall be protected against corrosion in accordance with paragraph 4.1.1.8. The panel-mounted part of the connector shall be bonded to the mounting surface in accordance with paragraph 4.1.1.13.

(b) Where the cable continuity is interrupted, such as in a junction box, the shield shall be carried through and grounded at the box. The length of unshielded conductors shall not exceed 1 inch (25 mm). If necessary, the shield pigtail shall be allowed longer than 1 inch to reach ground but shall be as short as possible.

(c) Cables which penetrate walls or panels of cases or enclosures without the use of connectors shall have their shields bonded to the penetrated surface in the manner shown in Figure IIIc. Overall shields shall be terminated to the outer surface of cases to the maximum extent possible.

(d) Grounding of overall shields to terminal strips shall be as shown in Figure IV.

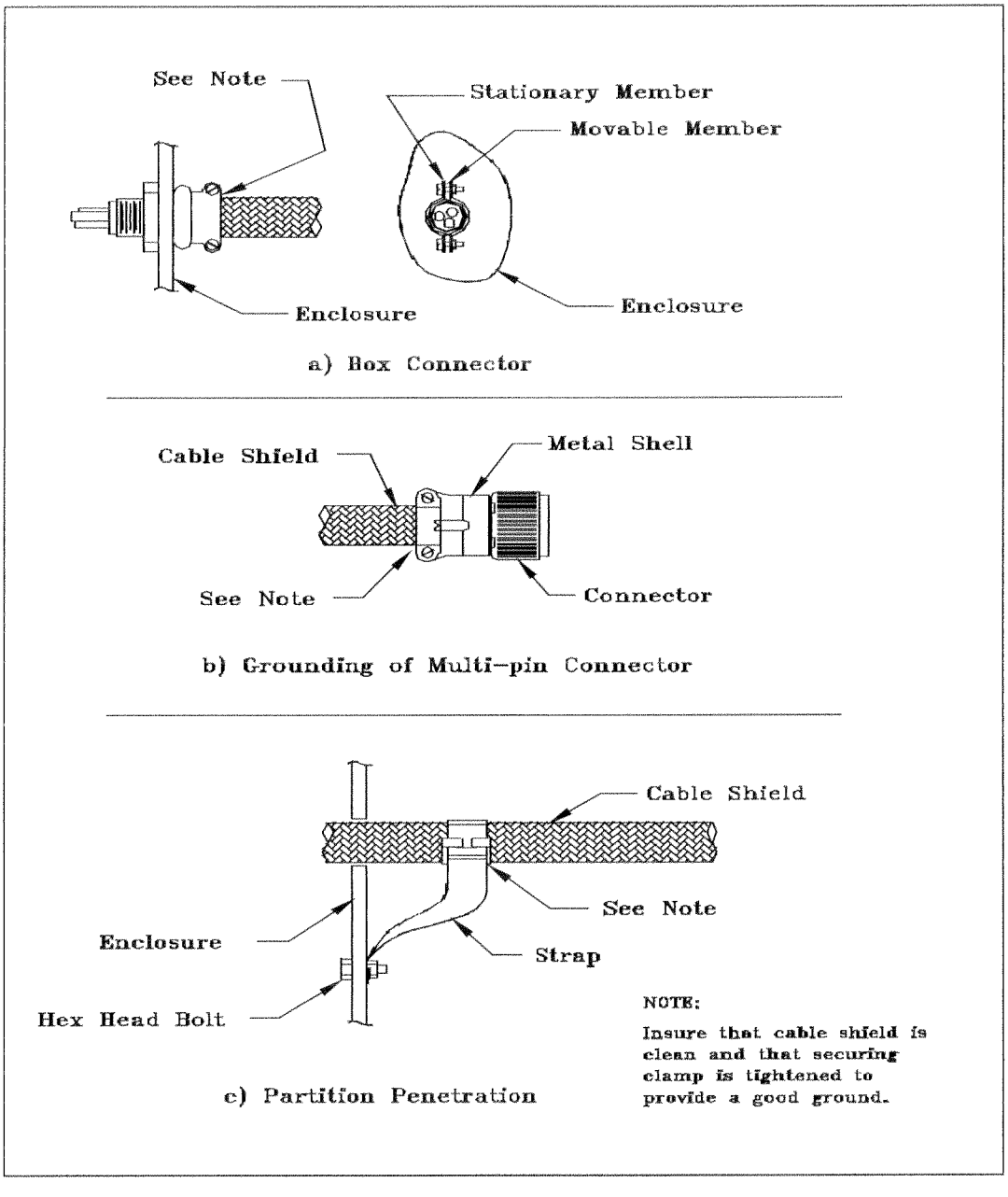


Figure III. Grounding of Overall Cable Shields to Connectors and Penetrating Walls

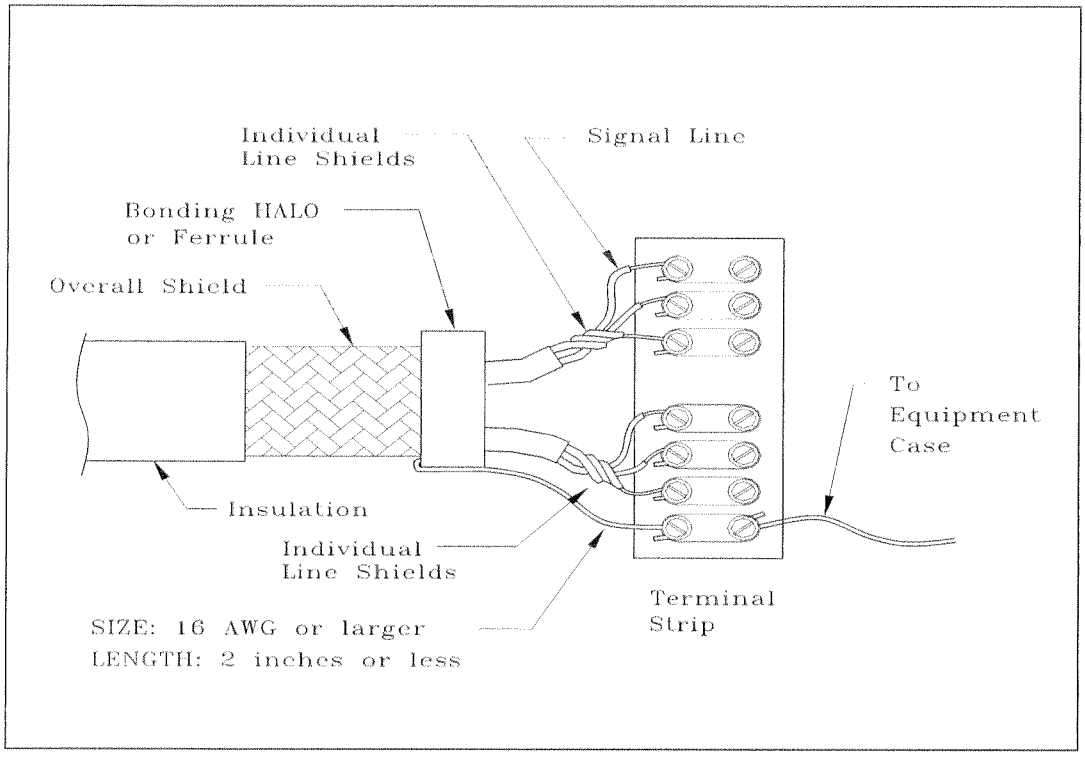


Figure IV. Grounding of Overall Cable Shield to Terminal Strip

4.1.2.4 Electromagnetic Environment Control

Shielding shall be integrated with other basic interference control measures such as filtering, wire routing, cable and circuit layout, signal processing, spectrum control, and frequency assignment to achieve the highest operational reliability of the equipment. Implementation procedures necessary to achieve the required filtering and shielding shall be detailed in the control plan described in paragraph 4.1.4.2 to include material requirements, shield configurations, placement and installation limitations, gasket utilization, filter integration, aperture control, bonding and grounding requirements, and wire routing and circuit layout constraints.

4.1.2.4.1 Space Separation

The design and layout of facilities shall physically separate electronic equipment and conductors that produce interference from equipment and conductors that are susceptible to interference. The minimum separation distance between power and signal cables shall be in accordance with Table III.

4.1.2.4.2 Wire and Cable Routing

The routing and layout of wires, conductors and cables shall be performed in a manner that does not jeopardize the integrity of the equipment shield. Signals with power level differences of greater than 20dB shall be routed as far apart as feasible. AC power conductors and control lines shall be routed away from sensitive digital or other susceptible circuits. Shielded cables shall be

used where needed to prevent emissions and/or to provide shielding. Cable shields shall be grounded in accordance with the requirements of paragraphs 4.1.2.3.2 and 4.1.2.3.3

Table III. Minimum Separation Distance Between Signal and Power Conductors.

Condition	Circuit Power Level		
	< 2 kVA	2-5 kVA	> 5 kVA
Unshielded power lines or electrical equipment in proximity to signal conductors in open cable tray or nonmetal raceway.	5 in. (127 mm)	12 in. (305 mm)	24 in. (610 mm)
Unshielded power lines or electrical equipment in proximity to signal conductors in a grounded metal raceway.	2.5 in. (64 mm)	6 in. (152 mm)	12 in. (305 mm)
Power lines enclosed in a metal raceway (or equivalent shielding) in proximity to signal conductors in a metal raceway.	-	3 in. (76 mm)	6 in. (152 mm)

4.1.2.4.3 Gaskets

Conductive gaskets conforming to paragraph 4.1.1.15 shall be utilized at joints, seams, access covers, removable partitions, and other shield discontinuities to the extent necessary to provide interference-free operation of the equipment under normal use and environmental conditions. Finger stock used on doors, covers, or other closures subject to frequent openings shall be installed in a manner that permits easy cleaning and repair.

4.1.2.4.4 Filter Integration

Filters on power, control, and signal lines shall be installed in a manner that maintains the integrity of the shield. AC power filters shall be completely shielded with the filter case grounded in accordance with paragraph 4.3.4.4. Filters for control and signal lines shall be placed as close as possible to the point of penetration of the case to avoid long, unprotected paths inside the equipment.

4.1.2.4.5 Bonding and Grounding of Compartment Shields

All shields shall be grounded. Bonding shall be accomplished in accordance with paragraph 4.1.1.

4.1.3 Electrostatic Discharge (ESD) Requirements

Modern electronic and electronically controlled electrical equipment is susceptible to damage from Electrostatic Discharge (ESD). The requirements of this section are designed to reduce the frequency and minimize the effects of ESD events. All electronic circuitry that contains miniaturized or solid-state components shall be considered ESD susceptible.

4.1.3.1 ESD Sensitivity Classification

Classification of items as ESD sensitive shall be in accordance with the Human Body Model testing procedures and requirements of ANSI/ESD STM5.1. Electronic parts, components, and assemblies shall be classified as either sensitive or supersensitive. Items that will fail from ESD at 1000 to 16000 Volts shall be classified as ESD sensitive. Those items that will fail below 1000 Volts shall be classified as supersensitive. Any exceptions to this guidance shall be through the OPR of this document. Devices with a sensitivity of less than +/- 200 Volts require additional ESD protection measures than those specified in this standard. ESD susceptible items shall not be exposed to an electrostatic field (E-field) greater than 100 Volts/meter or brought closer than 24" to known static generators or non-essential insulative materials.

4.1.3.2 ESD Protection Requirements

All NAS electrical and electronic equipment, subassemblies, and components subject to damage from exposure to electrostatic fields or electrostatic discharge (ESD) shall be protected in accordance with the protection requirements herein. ESD controlled areas shall be provided for all operations, storage, repair, and maintenance spaces used for electrical and electronic equipment or subassemblies that are subject to damage from static electricity or ESD.

4.1.3.3 Classification of Materials

4.1.3.3.1 General

Most materials and products that are used to control and prevent ESD are classified by their resistive properties as conductive or static dissipative. Antistatic materials are an exception to this and are classified by their propensity to not generate static electricity from triboelectric charging. Any material used for construction of ESD protected areas (with the exception of antistatic materials) shall meet the resistive properties specified for type and use of the material. Materials that will tribocharge to greater than +/- 200 Volts (EIA-625), if the material were to contact and separate from itself or from other materials, shall not be used in ESD controlled areas.

4.1.3.3.2 Static Conductive Materials

Those materials with a surface resistivity less than 1.0×10^5 ohms/square when tested per ANSI/ ESD S11.11 shall be considered conductive. Conductive ESD control materials shall not be used for ESD control work surfaces, tabletop mats, floor mats, flooring, or carpeting where the threat of personnel contact with energized electrical or electronic equipment exists. Conductive ESD control materials are not to be used in any other application where their use could result in electromagnetic interference (EMI) or radio frequency interference (RFI) that would be created by rapid, high voltage ESD spark discharges. Any exceptions to this guidance shall be through the OPR of this document.

4.1.3.3.3 Electrostatic Shielding Materials

Electrostatic shielding materials are a subset of conductive materials with a surface resistance equal to or less than 1.0×10^3 ohms when tested per ANSI/ESD S11.11. Electrostatic shielding materials shall be allowed as barriers for protection of ESD sensitive items from electrostatic fields where required.

4.1.3.3.4 Electromagnetic Shielding Materials

Electromagnetic shielding materials with highly conductive surfaces (< 10 ohms) or specifically designed composite materials that absorb and reflect electromagnetic radiation over a broad range of frequencies shall also be allowed as barriers where required to protect ESD sensitive items from electromagnetic fields.

4.1.3.3.5 Static Dissipative Materials

Those materials with a surface resistivity greater than 1.0×10^5 ohms/square but less than or equal to 1.0×10^{12} ohms/square when tested per ANSI/ESD S11.11 are classified as static dissipative materials. Static dissipative materials with a surface resistance less than or equal to 1.0×10^9 ohms shall be used to provide controlled bleed-off of accumulated static charges in ESD controlled areas. Static dissipative materials with a surface resistance of greater than 1.0×10^9 ohms shall not be used for applications where controlled bleed-off of accumulated static charges is essential. Any exception to this guidance shall be through the OPR of this document.

4.1.3.3.6 Antistatic Materials

Any material that inhibits or has a low propensity to generate static electricity from triboelectric charging shall be considered antistatic. Antistatic ESD control items and materials used for construction of ESD controlled areas in new or renovated facilities shall not tribocharge to greater than +/- 200 Volts when being used for their intended application. Antistatic materials with a surface resistance greater than 1×10^9 ohms shall not be used for ESD protective work surfaces, tabletop mats, floor mats, flooring, and carpeting when charge dissipation is the primary consideration. If the surface resistance (R_{tt}) of an antistatic material is greater than 10^{12} ohms it shall normally be considered to be too resistive for use in ESD controlled areas. Use of antistatic items and materials that utilize hygroscopic surfactants that depend on ambient humidity to promote absorption of water shall be limited. Only antistatic materials that are intrinsically antistatic and will retain their antistatic properties shall be used in ESD controlled areas. Exceptions to this guidance shall be through the OPR of this document.

4.1.3.3.7 Static-Generative Materials, Non-Conductors, and Insulators

Materials having a surface resistance greater than 1.0×10^{12} ohms (ANSI/ESD S11.11) shall be considered to be insulators and a possible source of triboelectric charging. These include common plastics, Plexiglas, Styrofoam, Teflon, nylon, rubber, untreated polyethylene, and polyurethane. Their use shall be minimized where ESD sensitive items are located.

4.1.3.4 Protection of ESD Susceptible and Sensitive Items

4.1.3.4.1 Static Protected Zone

A static protected zone shall be a volume or area where unprotected ESD sensitive items will be safe from direct contact with electrostatic potentials greater than +/- 200 volts, electrostatic fields greater than 100 volts/meter, or radiated electromagnetic interference and radio frequency interference produced by rapid, high voltage ESD spark discharges. Static protected zones shall be incorporated into the construction of ESD special protection areas, ESD protected workstations, and ESD protected storage areas.

4.1.3.4.2 ESD Special Protection Areas

Special protection areas shall be designated areas that require extraordinary ESD control measures to accomplish the following:

(a) Minimize triboelectric charging.
(b) Control bleed-off and dissipation of accumulated static charges.
(c) Neutralize charges.
(d) Minimize the effects of E-Fields, H-Fields, and EMI and RFI from ESD spark discharges.

Areas within a facility that shall be designated as ESD special protection areas are:

(a) Air traffic operations areas (e.g., tower cab, TRACON, ARTCC control rooms, AFSS, etc.).
(b) Electronic equipment rooms.
(c) Storage areas for ESD susceptible components, subassemblies, circuit cards, etc.
(d) Areas that contain personal computers and Local Area Networks (LANs) that are connected to or interface directly with NAS electronic equipment.
(e) All other locations where jacks, plug in connectors or interfaces of ESD sensitive electronic equipment are exposed and vulnerable to damage from ESD by direct human contact shall also be designated as ESD special protection areas.

4.1.3.4.3 ESD Controls Required for ESD Special Protection Areas

The following minimum ESD control measures shall be implemented in all areas designated as ESD special protection areas:

4.1.3.4.3.1 ESD Groundable Point (GP)

Each ESD control material, surface, or item used in an ESD controlled area shall have a designated groundable point (GP) to provide ease of connection to the nearest Signal Reference Structure (SRS).

4.1.3.4.3.2 Grounded Static Dissipative Surfaces

All work surfaces which include work surface laminates, paints and sealers, writing surfaces, table tops, consoles, workbenches, and table top mats shall be static dissipative and connected to any SRS in the area served – except to a single point ground system. The point-to-point resistance and surface to ground resistance of static dissipative work surfaces shall be greater than 1.0×10^6 ohms and less than 1.0×10^9 ohms (ANSI/ESD S4.1).

4.1.3.4.3.3 Limiting the Use of Non-ESD Control Materials

Materials that will tribocharge (e.g., generate electrostatic potentials by contact and separation with themselves or other materials) shall not be used for construction in ESD special protection areas. Insulative materials and any other non-essential triboelectric charge generators that generate potentials in excess of +/- 200 Volts shall not be permitted within 24 inches of ESD special protection areas.

4.1.3.4.3.4 Static Dissipative Chairs

Chairs (e.g., seating) provided for ESD special protection areas shall incorporate a continuous path between all chair elements (e.g., cushion and arm rests) to the ground points of greater than

1.0×10^5 ohms to less than 1.0×10^9 ohms. The ground points for ESD chairs are static dissipative or conductive casters that provide electrical continuity from all elements of the chair to ESD control carpeting, tile, or floor mats that are properly bonded to any SRS – except to a single point ground system . ESD control chairs must be tested and meet the requirements of ANSI/ESD STM12.1.

4.1.3.4.3.5 Static Dissipative ESD Control Floor Coverings

Static dissipative ESD control floor coverings shall include static dissipative tile, carpeting, static limiting floor finishes, and floor mats. Floor coverings in ESD special protection areas shall have a point-to-point resistance and surface-to-ground resistance of greater than 1.0×10^6 ohms and less than 1.0×10^9 ohms (ANSI/ESD S7.1). These floor coverings shall be bonded to any SRS in the area served in accordance with paragraphs 4.1.3.4.3.1 and 4.1.3.4.8 – except to a single point ground system. In circumstances involving extremely static sensitive equipment a static conductive floor covering with a lower resistance limit of 2.5×10^4 ohms (UL779) shall be implemented when it is part of a designed approach for ESD control for the equipment approved by the OPR of this document. This designed approach shall include all steps required to produce an electrically safe working environment.

4.1.3.4.3.6 Relative Humidity Control

Relative humidity in ESD special protection areas shall be maintained within the range of 40 to 60%.

4.1.3.4.4 ESD Signs, Labels, Cautions, and Warnings

ESD warning signs that include ESD sensitive device warning symbols with appropriate cautions and warnings shall be posted in ESD special protection areas and all other ESD controlled areas. Exterior cabinets of ESD sensitive electronic equipment shall also be marked or labeled with an ESD sensitive device symbol with a warning that is visible from at least 3 feet. Any signs or labels shall be consistent with the requirements of ANSI/ESD S8.1.

4.1.3.4.5 ESD Protected Workstations

These workstations are for the maintenance and repair of ESD sensitive equipment.

4.1.3.4.5.1 ESD Protected Workstation Minimum Requirements

All ESD control items at an ESD protected workstation shall be connected to a common groundable point, i.e., ESD ground, that is connected to any SRS in the area served – except to a single point ground system. ESD protected workstations shall be free of all non-essential static charge generators; and provide a means of personnel grounding. They shall have a grounded static dissipative work surface, and grounded static dissipative ESD control floor or mat. Storage containers provided at ESD protected workstations shall provide ESD protection and shall also be connected to the ESD ground. All outlets at ESD protected workstations shall be protected with ground fault circuit interruption (GFCI) capability to minimize danger to grounded personnel from electrical shock.

4.1.3.4.5.2 Use of Ionization

Selective use of bench top or area ionizers shall be allowed at ESD protected workstations if static generative items (e.g., insulators) are deemed essential and cannot be removed from ESD

protected workstation areas or if grounding of mobile personnel would be cumbersome or create a safety hazard.

4.1.3.4.5.3 Identification of ESD Protected Workstations

The boundaries of all ESD protected workstations shall be clearly defined. The boundaries of ESD protected workstations shall extend a minimum of 24 inches beyond where ESD sensitive items will be located and will be marked with yellow tape. ESD warning signs that are yellow with black markings and lettering shall be posted that will be visible to anyone entering these areas. Signs shall include an ESD sensitive electronic device warning symbol and appropriate warnings and cautions.

4.1.3.4.6 ESD Protective Storage Areas

4.1.3.4.6.1 Shelves, Bins, and Drawers

Shelves, bins, and drawers shall be static dissipative and electrically continuous with the support structure of the storage shelves, bins, or container.

4.1.3.4.6.2 Grounding

The storage container metal support structure shall have a groundable point (GP) that shall be connected to the nearest SRS – except to a single point ground system . The resistance from the ground point of storage containers, shelving, cabinets, and bins used to store ESD sensitive items to the nearest SRS shall be less than one ohm.

4.1.3.4.6.3 Personnel Grounding

Wrist straps shall be equipped with one megohm or greater series resistance to protect personnel. Standard 0.157 inch banana jacks for personnel grounding wrist straps shall be connected to the ESD ground or directly to any SRS in the area served – except to a single point ground system. The resistance from a banana jack to a ground point and/or to the nearest SRS – except to a single point ground system shall be less than one ohm.

4.1.3.4.6.4 Materials Prohibited in ESD Protective Storage Areas

Static generative (e.g., insulative) materials shall not be used for construction in any areas where ESD sensitive items will be stored. All materials that can generate potentials greater than +/- 200 Volts shall be a minimum of 24 inches from ESD protected storage areas.

4.1.3.4.6.5 Resistance to ESD Ground for Shelves, Drawers, and Bins

All surfaces and drawers of the storage media provided shall be made with static dissipative materials and meet the requirements and be tested the same as work surfaces (ANSI/ESD S4.1). The surface-to-surface resistance (R_{tt}) and surface-to-ground resistance (R_{tg}) from the shelves, bins, and drawers of storage containers that will be used to store unprotected ESD sensitive items shall be greater than 1.0×10^6 ohms and less than 1.0×10^9 ohms (ESD ADV53.1).

4.1.3.4.6.6 Identification of ESD Protective Storage Areas

The boundaries of all ESD protective storage areas shall be clearly defined. Boundaries of ESD protective storage areas shall extend a minimum of 24 inches beyond where ESD sensitive items will be located and will be marked with yellow tape. ESD warning signs that are yellow with

black markings and lettering shall be posted that will be visible to anyone entering these areas. Signs shall include an ESD sensitive electronic device warning symbol and appropriate warnings and cautions.

4.1.3.4.7 Hard and Soft Grounds

4.1.3.4.7.1 Hard Grounds

Any item, material, or product that is a part of the ESD control system that is intentionally or unintentionally connected to an ESD ground, or directly to any SRS in the area served – except to a single point ground system – shall be considered to be hard grounded. Unless specified otherwise or justified by the OPR for this document, ESD control worksurfaces, cabinets, flooring, carpeting, test equipment, and any other items used for ESD control shall be hard grounded.

4.1.3.4.7.2 Soft Grounds

A soft ground is an intentional connection to ground through a series current limiting resistor. Soft grounding shall only be used in personnel grounding skin contact devices such as wrist straps, leg or ankle straps, conductive shoes, and heel or toe grounders. The nominal resistance of the resistor used for soft grounding of personnel shall be greater than 1.0 $X10^6$ ohms unless otherwise specified by the OPR for this document. All other elements of the ESD control system shall be hard grounded.

4.1.3.4.8 ESD Control Flooring and Floor Coverings

All ESD control floors and floor coverings shall have a point to point resistance and a surface to ground resistance of greater than 1.0 x 10^6 ohms and less than 1.0 x 10^9 ohms (ESD STM7.1). ESD control flooring and floor coverings include vinyl tile, vinyl sheet, carpet, carpet tile, carpet tile with positioning buttons and others but not to include applied coatings.

These control floors and floor coverings shall be installed, grounded, and initially tested only by trained installers. A representative ten-feet-square section of the floor system shall be tested and the results approved and accepted by FAA personnel, prior to installation of the full floor system.

ESD control floors and floor coverings shall be bonded to the nearest SRS at a minimum of four locations. The connections and method shall be recommended by the floor manufacturer and approved by the OPR. These connections shall utilize copper: strip, foil, conductive fabric ribbon, or stranded wire. Electrical contact shall be made with the underside of the floor material or connections may be embedded in the conductive permanent or releasable adhesive used to lay the floor. The ESD control flooring shall not be bonded to any single point ground system.

4.1.3.4.8.1 Surface Resistance (R_{tt})

Surface resistance (R_{tt} - Resistance top-to-top or surface-to-surface) of ESD control floors, carpets or floor mats shall be greater than 1.0 x 10^6 ohms and less than 1.0 x 10^9 ohms (ANSI/ESD S7.1). A minimum of five readings shall be taken at different locations on the floor surface and averaged together for each 500 square feet (or fraction thereof) of floor surface. These readings shall be recorded in the FRDF.

4.1.3.4.8.2 Resistance Surface-to-Ground (R_{tg})

Resistance from the floor surface to ground (R_{tg} - Resistance top-to-ground) of ESD control floors, carpets or floor mats shall be greater than 1.0×10^6 ohms and less than 1.0×10^9 ohms (ANSI/ESD S7.1). A minimum of five readings shall be taken at different locations on the floor surface and averaged together for each 500 square feet (or fraction thereof) of floor surface. These readings shall be recorded in the FRDF.

4.1.3.4.8.3 Triboelectric Charging Limitation

ESD control floors, carpets, or floor mats shall limit and control generation and accumulation of static charges to less than +/- 200 Volts in ESD controlled area.

4.1.3.4.9 ESD Requirements for Raised Floors

4.1.3.4.9.1 Resistance from Carpet Surface to Pedestal Understructure

Carpet tiles shall have a resistance from the carpeted surface of the raised floor to the pedestal greater than 1.0×10^6 ohms and less than 1.0×10^9 ohms.

4.1.3.4.9.2 Panel to Floor Understructure Resistance

Panel-to-understructure (metal-to-metal) contact resistances between individual raised floor panels and the floor understructure shall be 10 ohms or less.

4.1.3.4.9.3 Carpet Tile Installation on Raised Floor Panels

Install individual carpet tiles on raised floor panels with either permanent or releasable conductive adhesive depending on the application.

4.1.3.4.9.4 Grounding

There shall be a minimum of four connections per 1,000 square feet of installed ESD control carpeting from the carpeting undersurface and conductive adhesive to the raised floor panel understructure. The Connections and method shall be in accordance with paragraph 4.1.3.4.8.

4.1.3.4.10 ESD Protective Worksurfaces

Static dissipative materials or electrostatic dissipative laminates shall be used to cover all worksurfaces, consoles, workbenches, and writing surfaces in areas that contain ESD sensitive equipment and in all areas designated as ESD special protection areas, static-safe zones, and ESD protected areas.

4.1.3.4.10.1 Requirements for ESD Protective Worksurfaces

Static dissipative worksurfaces shall be provided for new or upgrade facilities unless otherwise specified. Permanent static dissipative worksurfaces shall be connected to any SRS in the area served – except to a single point ground system. Permanent ESD protective static dissipative worksurfaces shall have a resistance greater than 1.0×10^6 ohms point-to-point (R_{tt}) and less than 1.0×10^9 ohms (ANSI/ESD S4.1). Permanent ESD protective worksurfaces shall have a resistance from their surface to the groundable point (R_{tg}) greater than 1.0×10^6 ohms and less than 1.0×10^9 ohms (ANSI/ESD S4.1).

4.1.3.4.10.1.1 Worksurface Types

ESD protective worksurfaces used for FAA workstations shall meet the requirements of MIL-PRF-87893 Performance Specification, Workstation, Electrostatic Discharge Control and MIL-W-87893 Military Specification, Workstation, Electrostatic Discharge (ESD) Control.

4.1.3.4.10.1.2Type I Worksurface - Hard

Type I worksurfaces shall be constructed of rigid static dissipative materials of any color having an average Shore D hardness in excess of 90. Two male or female 0.395 inch ground snap (female) or stud (male) fasteners shall be installed on both corners on one of the longest sides of the worksurface to accommodate the male or female snap or stud fastener of the common point grounding cord. The locations of the two snaps or studs shall be 2 inches from each corner.

4.1.3.4.10.1.3Type II Worksurface - Soft

Type II worksurfaces shall be constructed of cushioned static dissipative materials of any color having an average Shore A (ATSM D2240) hardness in excess of 45 and less than 85. Two male or female 0.395 inch ground snap (female) or stud (male) fasteners shall be installed on both corners on one of the longest sides of the worksurface to accommodate the male or female snap or stud fastener of the common point grounding cord. The locations of the two male or female snaps or studs shall be 2 inches from each corner. No low-density open-cell materials shall be used for Type II worksurfaces.

4.1.3.4.10.2 Static Dissipative Laminates

High pressure, multi- layer static dissipative laminates shall be used to cover surfaces such as plywood, fiber board, particle board, bench tops, counter tops, and consoles in ESD controlled areas and special protection areas. Laminates shall include a buried conductive layer to provide for ease of grounding using a through bolted pressure type ESD grounding terminal.

4.1.3.4.10.3 Grounding of Laminated Surfaces

The resistance across the surface (R_{tt}) of the static dissipative laminate shall be greater.1.0 x 10^6ohms and less 1.0 x 10^9ohms. The resistance from the surface of the laminate to ground (R_{tg}) shall be greater than 1.0 x 10^6 ohms and less than 1.0 x 10^9 ohms (ANSI/ESD S4.1). A minimum of five readings of each shall be taken and averaged together. These readings and averages shall be recorded in the FRDF.

4.1.3.4.11 Static Dissipative Coatings

Permanent clear or colored static dissipative coatings used in ESD controlled areas, including all painted surfaces, shall have a point to point resistance greater than 1.0 x 10^6 ohms and less than 1.0 x 10^9 ohms.

4.1.4 Electromagnetic Compatibility Requirements

4.1.4.1 General

A comprehensive plan for the application of various sections of this document is required to assure the compatible operation of equipment in complex systems. Additional considerations of this section shall be implemented to reduce susceptibility and emissions of equipment.

4.1.4.2 Requirements

The emission and susceptibility limits contained in MIL-STD-461 shall be applied unless otherwise specified. An EMI Control and Test Plan shall be developed in accordance with MIL-HDBK-237 to assure compliance with the applicable requirements. The plan shall include a verification matrix to track the satisfaction of requirement by test, analysis or inspection. .

4.1.4.3 Approval

Control Plans and Test Plans shall be submitted to the OPR of this document for approval.

4.2 Facility Requirements

4.2.1 Passive Transient Protection Requirements

All metallic conduit, conductors and cables in NAS operational facilities are subject to currents induced by nearby lightning strikes. These induced effects can adversely affect the operation of sensitive electronic equipment.

4.2.1.1 Existing Metallic Conduit, Conductors and Cables

Unless the facility manager disapproves the removal, all unused conduits, conductors and cables shall be removed. The facility manager shall be consulted to validate the decision to remove any metallic conduit, conductors or cables prior to acting. If they are to remain, the following actions shall be accomplished to minimize the voltage differential between ends:

(a) Metallic conduits shall be bonded to adjacent grounded metalwork at both ends.
(b) Unused conductors bonded to adjacent grounded metalwork at both ends.
(c) Unused cables shall have conductors and shields bonded to adjacent grounded metalwork at both ends.

If not direct connected the above bonding shall utilize a 6AWG minimum pigtail no longer than 18 inches. Multiple conductors shall be grouped together and bonded to the adjacent metalwork directly or via a single pigtail.

Unused conductors of a structured cable system installed for spares purposes with vertical risers of no more than fifty feet and of circuit length totaling no more than three hundred feet are exempted from this requirement if they do not pass between facilities. Where circulating currents are present, installation of a SPD at one end of the cable shall be allowed for this requirement..

The OPR of this document should be contacted for additional information.

4.2.1.2 Electromagnetic Shielding for Lines, Conductors and Cables

4.2.1.2.1 Facility Entrance Conduit

All lines, conductors and cables, both overhead and buried, shall enter the facility through a minimum of 10 feet of ferrous conduit (RGS). Conduit routed by other than a direct route shall be allowed to achieve this 10-foot requirement. All entrance conduits shall be bonded to the EES with a bare copper stranded conductor, 2 AWG minimum. This entrance conduit, if buried, shall extend 5 feet beyond the earth electrode system.

4.2.1.2.2 Buried External Power Cables and Conductors

Buried external power cables and conductors shall have magnetic shielding to prevent coupling of damaging transient currents, from man made and lightning sources. This shielding can only be provided by a ferrous metal. This may be in the form of a sheath, ferrous armor or ferrous conduit (RGS). Specification details of this type of cable and potential sources are available from the OPR and the LPGBS web page. Ferrous armor cable has been shown to be extremely cost effective when compared to ferrous conduit and presents a marginal increase in cost over unarmored cable. Cables may be installed in metallic or nonmetallic conduit where permitted by the NEC. When a conduit is not used cables shall be identified for direct earth burial (DEB).

For portions of buried external power cables and conductors greater than 300 feet cable length from the facility ferrous shielding is recommended but not required. Facility entrance surge protection shall be provided that fully complies with paragraph 4.2.2 and all sub paragraphs.

4.2.1.2.3 Buried Landlines

The preferred type of buried landline that represents best engineering practice is fiber optic type. Fiber optic cable does not require electromagnetic shielding and is exempt from these requirements. Metallic buried landlines that carry NAS Critical, Essential or Mission Support Services to a facility shall have a ferrous shield or be enclosed in ferrous conduit (RGS).

For portions of these buried landlines located greater than 300 feet cable length from the facility, ferrous shielding is recommended but not required. For these landlines facility entrance surge protection shall be provided that fully complies with paragraph 4.2.2 and all sub paragraphs.

4.2.1.2.4 Conduit Joints and Fittings

Conduit joints and fittings shall be electrically continuous with bonding resistance of 5 milliohms or less between joined parts. Conduit enclosing signal, control, status, power, or other conductors to electronic equipment shall be terminated using conductive fittings to their respective junction boxes, equipment cabinets, enclosures, or other grounded metal structures.

4.2.1.3 Above Ground Ferrous Conduit Penetration of Facility

At each location, where above ground conduits first penetrate a shelter or building a bonding connection shall be made. The conduit shall be bonded directly to the EES, or to a bulkhead connector plate that is bonded to the EES in accordance with paragraph 4.2.1.6. If neither of these bonds is feasible, the bond shall be made to the main or supplemental ground plate. The bond to the EES, or the bulkhead connector plate, or to the multipoint ground plate shall be a 2 AWG stranded copper conductor using exothermic welds or UL listed pressure connectors.

4.2.1.4 Armored Direct Earth Burial (DEB) Cables

The DEB cable armor shall be bonded to the EES with a 2 AWG conductor prior to entry into the conduit. The DEB cable armor shall also be bonded to the main or supplemental ground plate. If bonding to the main or supplemental ground plates is not feasible the armor shall be bonded to the ground bus at the service disconnecting means (SDM). If armor is continued to the electronic equipment, bond it to any SRS – except to a single point ground system – of the electronic equipment unless the equipment is required to be isolated. All bonds shall be less than 5 milliohms between joined parts. Apply this requirement during initial cable installation. Complete cable replacement is not required if only a short length requires repair.

4.2.1.5 Guard Wires

A 1/0 AWG bare copper stranded guard wire shall be provided for all buried cables and conductors not routed in ferrous conduit. The guard wire shall be embedded in the soil, a minimum of 10 inches (25 cm) above the cable to be protected and located directly above and parallel to the lines or cables being protected. When the width of the cable run or duct does not exceed 3 ft (90 cm), one guard wire, centered over the cable run or duct, shall be installed. When the cable run or duct is more than 3 feet (90 cm) in width, two guard wires shall be installed. The guard wires shall be spaced at least 12 inches (30 cm) apart and be not less than 12 inches (30 cm) nor more than 18 inches (45 cm) inside the outermost wires or the edges of the duct. The guard wire shall be bonded to the EES at each end and to ground rods at approximately 90-foot intervals using exothermic welds. The spacing between ground rods must vary by 10% to 20% to prevent resonance. Install the ground rods at approximately 6 feet (2 m) on either side of the trench. Where cables run parallel to the edge of a runway, they shall be located 10 feet from the edge lights on the outside of the lights.

4.2.1.6 Metal Bulkhead Connector Plates

A metal bulkhead connector plate shall be provided where overhead axial-type cables, waveguides, etc., first enter a facility. The bulkhead connector plate shall be mounted on the outside surface of the facility, a minimum of $^{1}/_{4}$ inch thick, and shall be constructed of tin-plated copper. The plate or plates shall have the required number and types of feed-through connectors to terminate all axial cables and shall provide adequate surface area for bonding waveguides, cable shields, conduits etc. Cable shields shall be bonded and grounded, except when the shield must be isolated for proper equipment operation. If external and internal cables are of different sizes, the changeover in cable size shall be allowed by the feed-through connectors at the plate.

Axial type cables, Waveguides, etc.(and conduits where not bonded directly to the EES) shall be bonded to the bulkhead plates with a minimum 4 AWG bonding jumper. The 4 AWG bonding cable for a waveguide can be connected to the waveguide flange with an appropriately sized ring terminal. Conduits shall be bonded with a UL listed U-Bolt bonding connector. Axial cable shields shall be bonded with bonding kits sized for the specific cable type. Bonding jumpers shall be connected to the plate with either an exothermic weld or a double-bolted lug and shall be no longer than 12 inches.

The bulkhead plate shall be bonded to the EES with a minimum 4/0 AWG copper cable color-coded green with a red tracer. When the bulkhead connector plate is located within 6 feet of

building steel, the bulkhead plate shall be connected to building steel with a 4/0 AWG copper conductor color coded green with a red tracer. The building structural steel is required to be bonded to the EES. Exothermic welds shall be used for these connections.

4.2.1.7 Balanced Pair Lines

When possible, signal and control circuits routed external to equipment shall be balanced, two conductor, shielded circuits.

4.2.1.8 Fiber Optic Cable

Fiber optic cables are not inherently susceptible to electromagnetic interference or the induction fields produced by lightning. Fiber optic cables should replace metallic cables when economically and technically feasible. Ferrous conduit shielding is not required for fiber optic lines. Suppression components are not required for fiber optic cables. Where metallic or electrically conductive sheaths or strength members are present, they shall be grounded to any SRS – except to a single point ground system at each end. To prevent circulating ground currents, a SPD shall be allowed at one end for grounding. The fiber optic transmitter and receiver modules shall have 90 dB of attenuation against all sources of electromagnetic interference (EMI).

Where an external fiber optic cable uses conductive armor, the armor shall be bonded directly or via a SPD to the EES at the facility entrance using a 2 AWG bare copper conductor. If the cable is internal to the facility, conductive armor shall be bonded to any SRS – except to a single point ground system – at the equipment entrance. The bonding conductor shall be a 4 AWG stranded copper conductor insulated green with an orange tracer. The use of fiber optic cables without a conductive shield or armor is permitted. The fiber optic transmitter and receiver modules shall be contained in ferrous enclosures bonded to the nearest SRS – except to a single point ground system. Penetrations of the enclosures shall be gasketed or constructed to limit RF coupling. SPD's for the metallic signal circuits and power circuits shall be installed as equipment level protection at the fiber optic receiver or transmitter equipment entrance and bonded to the chassis.

4.2.1.9 Interior Lines, Conductors and Cables

All permanently installed single conductors, cables and wiring shall be in ferrous conduit (RGS), ferrous intermediate metal conduit (IMC), ferrous electrical metallic tubing (EMT), ferrous cable trays, or ferrous wireways (except as prohibited by the NEC). These shall be connected to any SRS – except to a single point ground system – as specified in paragraphs 4.2.6.4.1 and 4.2.6.4.2.

When routing between floors the vertical section of the runs shall be in ferrous conduit (RGS), ferrous IMC, ferrous EMT, enclosed ferrous cable trays, or ferrous wireways that are connected to any SRS – except to a single point ground system – as specified in paragraphs 4.2.6.4.1 and 4.2.6.4.2.

Cable tray systems employing single rail or wire construction are prohibited at any location.

4.2.2 Active Transient Protection Requirements

4.2.2.1 Conducted Power Line Surges

Surge protective devices (SPDs) shall be provided at the service disconnecting means (SDM), at all facility penetrations (entrances), and at feeder and branch panelboards as specified in paragraph 4.2.2.3. Additional SPDs shall be provided at the power line entrances to operational electronic equipment. SPDs at the service disconnecting means, facility penetrations (entrances), feeder and branch panelboards as well as transient suppression provided at electronic equipment power line entrances shall be coordinated in accordance with the guidance provided in paragraphs 4.2.2.2 and 4.2.2.3.

4.2.2.2 Facility Entrance Surge Protective Devices

A facility power SPD shall be installed on the load side of the facility service disconnecting means, at any facility penetration (entrance) and between the load side of a Engine Generator transfer switch and the first feeder panel.

The SPD shall be a combination of solid-state circuits, varistors, or other devices and shall meet the requirements provided in this paragraph and its subparagraphs. Protection will be provided between all lines, including neutral where provided, and ground. A surge arrestor shall also be installed on the primary side of FAA owned distribution transformers. These arresters and SPDs shall be approved by the OPR of this document.

The SPD shall be installed as close as possible (within 12 inches) to the facility SDM and with the shortest and most direct conductor connection to the SDM. Connections shall be made with UL listed connectors identified for the wire size and type used.

(a) Connections. SPD terminals shall be connected to corresponding terminals of the service disconnecting means with insulated 2 AWG (minimum) copper conductors. The conductors shall be as short and direct as possible without loops, sharp bends or kinks, be all the same size, and be color-coded in accordance with FAA-C-1217. The ground bus in the service entrance enclosure shall be bonded directly to the SPD terminal marked G or ground. The SPD enclosure shall be bonded to the SPD ground terminal.
(b) Conduit sealing. The conduit connecting the SPD enclosure to the SDM enclosure shall be sealed with duct seal or other UL listed nonflammable medium to prevent soot from entering the SDM enclosure in the event of SPD failure.

4.2.2.3 Surge Protective Devices for Feeder and Branch Panels

SPDs shall be installed on all panels providing service to NAS operational equipment or supplying exterior circuits. Examples of exterior circuits include obstruction lights, convenience outlets, guard shacks, security systems, electric gates and feeds to other facilities. Exterior circuits shall be protected in accordance with the requirements of paragraph 4.2.2.2. Where feeder and branch panels are located close together and the panels do not serve exterior circuits, the OPR of this document shall be allowed to grant relief from providing separate protection on each panel. SPD's for panels that provide service to any exterior circuits shall meet the requirements given by paragraphs 4.2.2.4.2, 4.2.2.4.3, and 4.2.2.4.4 for facility entrance SPD's. The SPD's shall be installed as close as possible to the panel they serve and in accordance with the manufacturer's instructions. The conduit connecting the SPD enclosure to the panel enclosure shall be sealed with duct seal or other UL listed nonflammable medium to prevent soot

from entering the enclosure in the event of SPD failure. A feeder or branch panel SPD shall be provided with an overcurrent device. Examples of this overcurrent device include a fuse or circuit breaker fitted internally to the SPD or fitted to the panelboard for the sole use of the SPD. The overcurrent device shall not increase the clamp voltage of the SPD by greater than 5% and shall pass the surge current levels listed in Table IV up to the 40kA level without opening. Overcurrent devices for any exterior circuits shall pass all values shown in Table IV. All overcurrent devices, both internal and external to the SPD, and SPD short circuit current ratings shall be properly sized and coordinated in accordance with the NEC and be field resettable or replaceable.

4.2.2.4 SPD General Requirements

SPDs shall be listed in accordance with UL 1449 Second Edition. All components comprising a SPD shall be packaged in a single National Electrical Manufacturers Association (NEMA) type 12 steel enclosure for indoor use only, or a NEMA type 4 steel enclosure for indoor or outdoor use. SPDs enclosed within panelboards or switchgear enclosures shall be allowed, provided the integrated SPD and panelboard or switchgear is UL listed/recognized as components and as an assembly. The use of potting material in SPDs is strictly prohibited. All SPD components must be accessible for inspection by qualified FAA personnel. Heavy duty, screw-type studs shall be provided for all input and output connections. The SPD phase and neutral terminals, when not connected, shall be electrically isolated from the enclosure by a minimum of 10 megohms resistance measured at 100V DC. The enclosure door shall be hinged and electrically bonded with a bonding jumper to the enclosure. Fuses, lights, fuse wires, and arrester elements or components shall be readily accessible for inspection and replacement. Manufacturers shall supply clear installation instructions with each unit.

4.2.2.4.1 SPD Operational Characteristics

Minimum functional and operational characteristics of SPDs are given in Table IV, Table V, and Table VI. Other characteristics will also include the following:

(a) Maximum continuous operating voltage (MCOV). The maximum continuous operating voltage is the maximum RMS voltage an SPD will withstand at its maximum operating temperature continuously without degradation or change to any of its parameters greater than +/- 10%. The MCOV shall not be less than 10 percent above the nominal system voltage. Leakage current as defined below shall not be exceeded.

(b) Leakage current. The DC leakage current shall be less than 1mA for voltages at or below 1.414 x MCOV VDC.

(c) Clamp (discharge) voltage. Clamp (discharge) voltage is the maximum voltage that appears across an SPD output terminal while conducting surge currents. This voltage, measured at 3kA (to ensure performance in the linear region without impacting the device lifetime performance) with an 8/20 microsecond waveform, shall not change more than 10 percent over the operating life (as defined in Table IV. Surge Current Lifetime Requirements) of the SPD.

(d) Overshoot voltage. Overshoot voltage shall not exceed twice the SPD clamp voltage for more than 10 nanoseconds. Overshoot voltage is the surge voltage level that appears across the SPD terminals before the device turns on and clamps the surge to the specified voltage level.

(e) Self-restoring capability. The SPD shall automatically return to an off state after surge dissipation when line voltage returns to normal.
(f) Operating lifetime. The SPD shall safely dissipate the number and amplitude of surges listed in Table IV. Surge Current Lifetime Requirements.
(g) In-line inductors. In-line inductance, other than that normally caused by routing conductors, is not permitted.
(h) Fusing. Any fuses part of a SPD installation shall be able to pass all surge currents specified in Table IV without opening.

4.2.2.4.2 Surge Levels

Table IV defines line-to-ground, line-to-neutral, neutral to ground, and line-to-line surge currents, and number of occurrences for AC services in FAA facilities below 600V. In this table, the 8/20 μs wave form defines a transient reaching peak value in 8 μs and decays to 50 percent of peak value 20 μs after inception. These devices shall be able to tolerate surges of shorter duration without malfunction.

Table IV. Surge Current Lifetime Requirements

Surge Current Amplitude 8/20μs Waveform	Surge Number Lifetime Any Facility Entrance	Surge Number Lifetime Feeder and Branch Panels
10kA	1500	1000
20kA	700	500
30kA	375	250
40kA	50	25
50kA	8	1
60kA	6	
70kA	4	
100kA	2	
200kA	1	

Each level of surge current and the number required represents a single lifetime of an SPD.

(a) Any change greater than 10% in the 8/20μs clamping voltage at 3kA during service or when the pre life/service test and the post life or in-service test results are compared is a device failure. The pre life test value shall be taken as the 100% value.
(b) Any change greater than 10% in the RMS voltage required to drive 1mA RMS through the device when the pre life/service test and the post life or in-service test results are compared is a device failure. The pre life test value will be taken as the 100% value.
(c) Any change greater than 10% in the DC voltage required to drive 1mA DC through the device when the pre life/service test and the post life or in-service test results are compared is a device failure. The pre life test value will be taken as the 100% value.
(d) Clamping voltages for each of the devices/assemblies/system voltages will be measured at 1kA and 10kA 8/20μs.

4.2.2.4.3 Slope Resistance

It is the purpose of this parameter to specify a region on the SPD characteristic where it is possible to ensure device coordination. A slope resistance (the slope of the voltage/current characteristic of an SPD in its linear region) shall be calculated from the formula below:

$R_{slope} = (V_{10}-V_1)/9000$

Where V_{10} = the clamping voltage measured at 10kA 8/20μs

and

Where V_1 = the clamping voltage measured at 1kA 8/20μs

The values of V_{10} and V_1 used will be the absolute values as measured and not as a calculated value. The slope values shall conform to Table V.

Table V. Entrance, Feeder, and Branch Panels Slope Resistance Requirements

Location	Slope Resistance
Any Facility Entrance	8 mΩ Maximum
Feeder and Branch Panels	30 mΩ +/- 15 mΩ

4.2.2.4.4 3kA Voltages V_3

The voltages that must be achieved during testing at 3kA with an 8/20μs current impulse is shown in Table VI. All voltages shall be measured at the device terminals. The 8/20μs current impulse wave shape shall not lead or lag the voltage wave shape by more than 30 degrees.

Table VI. Protection Voltages at 3kA

Location	System	V_3	Limit
Any Facility Entrance	120/208V 120/240V	400 L-N, L-G 700 L-L	Maximum
Any Facility Entrance	277/480V	700 L-L, L-G	Maximum
Any Facility Entrance	380V Delta	1200 L-L,L-G	Maximum
Any Facility Entrance	480V Delta	1200 L-L, L-G	Maximum
Feeder and Branch panels	120/208V 120/240V	475 L-N, L-G 775 L-L	+/- 45V
Feeder and Branch panels	277/480V	775 L-N, L-G 1275 L-L	+/- 45V
Feeder and Branch panels	380V Delta	1275 L-L, L-G	+/- 45V
Feeder and Branch panels	480V Delta	1275 L-L, L-G	+/- 45V

4.2.2.4.5 Indicator Lamps

Indicator lamps shall be provided for each phase on the SPD enclosure cover. They shall visually indicate normal condition (power applied to the SPD with any component fuses intact).

If indicator lamps are used that have a service life of less than 50,000 hours then two lamps per phase shall be provided.

4.2.2.4.6 Accessibility

All SPD installations shall be safely accessible for visual inspection and evaluation. The use of potting material or other encapsulating materials that prevent component inspection in SPDs shall be limited to inorganic particulates. All SPD components shall be accessible for maintenance and replacement by qualified FAA personnel. Determination of the acceptability of potting material or other encapsulating materials in a given design resides with the OPR of this document.

4.2.2.5 Signal, Control, and Data Line Protection Design

Transient protection shall be provided for all signal, data and control lines; both at facility entrances and at entrances to all electronic equipment used in direct support of the NAS including those provided or installed by a telecommunications service provider.

The suppression components at the facility and electronic equipment entrances shall be coordinated to function together and limit the transient voltage and energy safely below circuit susceptibility levels. Coordination of suppression components is dependant on several factors including separation distance, equipment system bandwidth, etc. In principle facility entrance devices and electronic equipment entrance devices shall not affect each others operation. The coordination of these protectors is achieved at the system design stage – not intended to be accomplished by field personnel (see paragraph 4.3.2).

Detailed analyses of suppression component and electronic equipment circuit characteristics are required to select components compatible with the requirements herein and to provide suppression circuits that will function without adversely affecting signals and information transmitted by individual landlines. Design requirements for selection of components are as follows:

(a) Unipolar suppression components shall be selected and installed for signals and voltages that are always positive or always negative relative to reference ground. Bipolar suppression components shall be selected for signals and voltages that are both positive and negative relative to reference ground.
(b) The total series impedance of the suppression circuits at both ends of a landline shall be designed so as not to significantly degrade electronic equipment performance.
(c) The protection components at facility entrances and equipment shall be selected so that their operating levels are coordinated and transient levels to equipment are limited safely below electronic equipment susceptibility levels for individual lines.

Surge protective devices shall be placed on both ends of signal, data and control lines longer than 10 feet connecting pieces of equipment or facilities not located on and bonded to the same SRS, or when the SRGG, SRGP, and the multipoint ground system is located in different rooms or on different floors. This includes all signal, data, control, and status lines both internal and external. This also includes interfacility lines installed above and below grade between facility structures and to externally mounted electronic equipment and particularly vertically routed conductors and

cables such as those between an ATCT cab and base building or radar tower and base building. This requirement includes fire alarm and security wiring where it has direct impact on NAS equipment.

All unused conductors of a cable shall be grounded at each end. Grounding through an SPD is permissible if grounding both ends of the conductors degrades system performance.

4.2.2.6 SPD Requirements for Signal Data and Control Lines

Facility level SPDs for signal, data, and control lines shall be installed at the point where the lines transfer to FAA control and at any building/structure entrance under FAA control. Where a battery feeds signal, data or control lines, the suppression components shall be housed in a metal enclosure. For facility level SPD enclosures, a ground bus bar, electrically isolated from the enclosure, shall be provided to serve as the ground point. This ground bus bar shall be directly connected to the EES with an insulated 4 AWG or larger copper conductor of minimum length with no loops, sharp bends or kinks, and ensure a short direct path for connection to the SPD's. NOTE: When at the top of a tall ATCT (greater than 100 feet) the main ground plate on the lowest level containing NAS electronic equipment serves in lieu of the EES. The conductor insulation shall be color-coded green with a red tracer. A UL listed double bolted lug shall be used to bond the conductor to the ground bus bar. The bonding to the EES shall be an exothermic weld. The ground bus bar location shall ensure a short, direct path to ground for SPD's. The installation shall provide easy access to component terminals for visual inspection, test and replacement.

SPD's for landlines that combine the protection specified herein shall be located at the facility entrance, and have approval by the OPR of this document prior to implementation of vendor proposed protection. (Reference paragraph 4.2.2.5)

Field designed protection schemes shall be submitted to the OPR of this document for guidance and approval.

Transient suppression components for axial-type cables shall be packaged in a sealed metal enclosure with appropriate connectors at each end to permit in-line installation at the bulkhead connector plate required in paragraph 4.2.1.6.

4.2.2.6.1 Signal, Control, and Data Line Protection Requirements

The 10/1000 μs waveform defines a transient with a 10μs rise time and decay to 50 percent of the peak voltage in 1000 μs. SPDs must survive the transients listed in Table VII. Failure or end of life performance of a protector shall not normally disrupt the operation of the circuit being protected.

Table VII. SPD Lifetime Conducted Landline Transient Level Requirements

Lifetime Number of Transients	Transient Levels	
1,000	100V	50A
500	500V	100A
50	750V	375A
5	1000V	1000A

Each level of surge current and the number required represents a single lifetime of an SPD.

4.2.2.7 Axial Cable Protection Design

Special attention shall be given to the design of transient protection for axial-type cables. Design of transient protection is particularly critical at RF frequencies due to insertion losses. The following design requirements apply:

(a) Analyses and tests shall be performed to assure that suppression components do not degrade signals to an unacceptable degree or cause marginal performance of electronic equipment.
(b) Particular attention shall be given to the impedance, insertion loss, phase distortion, and voltage standing wave ratio for RF signals.
(c) Transient protection for electronic equipment using coaxial, tri-axial, and twin-axial cables shall be provided both at facility entrances and at the electronic equipment.

Transient suppression shall be provided for each axial conductor and for shields that are not bonded directly to the electronic equipment case.

4.2.3 Lightning Protection System Requirements

4.2.3.1 General

The intended purpose of the lightning protection system is to provide preferred paths for lightning discharges to enter or leave the earth without causing facility damage or injury to personnel or equipment. The essential components of a lightning protection system are air terminals, roof and down conductors connecting to the EES, the EES and SPDs. These components act together as a system to dissipate lightning energy. The lightning protection system shall meet or exceed the requirements of all relevant FAA standards and orders; Standard for the Installation of Lightning Protection Systems, National Fire Protection Association (NFPA 780); Installation Requirements for Lightning Protection Systems, Underwriters Laboratories (UL 96A); and, as specified herein. The risk assessment guide in NFPA 780 indicates that many NAS facilities have a high risk index. Accordingly lightning protection that exceeds the minimum requirement of NFPA 780 is specified. The provision of a UL Master label is not sufficient to indicate compliance with this document.

4.2.3.2 Lightning Protection System Materials

All equipment shall be UL listed for lightning protection purposes and marked in accordance with UL requirements. All equipment shall be new and of a design and construction to suit the application in accordance with UL 96A requirements, except that aluminum shall only be used on aluminum roofs, aluminum siding or other aluminum surfaces. Bimetallic connectors shall be used for interconnecting copper and aluminum conductors. Dissimilar materials shall conform to the bonding requirements of paragraph 4.1.1.2.3.

4.2.3.2.1 Lightning Protection System Conductors

All conductors used in a lightning protection system (main and bonding) shall be class 2 main sized conductors as defined by NFPA 780 or larger.

4.2.3.2.2 Lightning Protection System Hardware

4.2.3.2.2.1 Fasteners

Roof and down conductors shall be fastened at intervals not exceeding 3 feet (0.9 m). Fasteners shall be of the same material as the conductor base material or bracket being fastened, or other equally corrosion resistant material. Plastic, galvanized or plated materials shall not be used. Where fasteners are used for bonding the surface shall be prepared and protected in accordance with paragraphs 4.1.1.7 and 4.1.1.8.

4.2.3.2.2.2 Fittings

Bonding devices, conductor splices, conductor attachments and connectors shall be suitable for use with the installed conductor and shall be stainless steel, copper, bronze, or aluminum with bolt pressure connections to the conductor. Crimp type fittings shall not be used anywhere for any purpose in the lightning protection system. Aluminum fittings shall only be used with aluminum conductors. Copper and bronze fittings shall only be used with copper conductors. Interconnection between copper and aluminum portions of the lightning protection system shall be accomplished with bimetallic connectors.

4.2.3.2.3 Guards

Guards shall be provided for down conductors located in or next to driveways, walkways or other areas where they are at risk of being displaced or damaged. Guards shall extend at least 6 feet (1.8 m) above and 1 foot (0.3 m) below grade level. Guards shall be schedule 40 polyvinyl chloride (PVC) conduit or better. When metal guards are used, the guard shall be bonded to the down conductor at both ends of the guard. Bonding jumpers shall be of the same size as the down conductor. PVC guards do not require bonding.

4.2.3.3 Lightning Protection System Bonds

4.2.3.3.1 Metallic Bodies Subject to Direct Lightning Strikes

Metallic bodies that protrude beyond the zone of protection provided by the installed air terminals, are subject to direct lightning strikes. This includes, but is not limited to, exhaust pipes, exhaust fans, metal cooling towers, HVAC units, ladders, railings, antennas, and large louvered structures, etc. When these metallic bodies have a metal thickness of $^{3}/_{16}$ inch or greater, they shall be bonded to the nearest main lightning protection system conductor. These

fittings shall provide bonding surfaces of not less than 3 square inches. If the metal parts of these units are less than $^{3}/_{16}$ inch thick, additional air terminals, main conductors and fittings shall be installed, providing two paths to ground from the air terminals.

4.2.3.3.2 Metallic Bodies Subject to Induced Charges

Metallic bodies that are subject to induced charges from lightning (including those in a zone of protection) shall be bonded to the lightning protection system in accordance with the guidance provided in NFPA 780. This includes, but is not limited to, roof drains, vents, coping, flashing, gutters, downspouts, doors, door and window frames, balcony railing, conduits, pipes, etc.

4.2.3.3.3 Exhaust Stack Grounding.

Bond all fossil fuel exhaust stacks to the nearest point in the lightning protection system or directly to the EES with a conductor of equal size as the main conductor. The bond to the exhaust stacks shall be made with an exothermic weld or a mechanical connector. Where exhaust stacks are not in close proximity (6 feet) to a main conductor, they shall be bonded directly to a ground rod in the EES.

4.2.3.3.4 Above Ground Fuel and Oil Storage Tanks.

Lightning protection shall be provided for all above-ground fuel and oil storage tanks. An air terminal shall be mounted to the top of non-pressurized fuel and oil tank vent pipes, high enough to provide the required zone of protection for the entire tank, and be connected directly to the EES using a main-sized down conductor.

Tanks shall be provided with at least two easily accessible, widely separated grounding points. Each of these grounding points shall be bonded directly to the EES. All other metallic components, e.g., stairs and skids, shall be bonded with 4/0 AWG copper conductors or if 4/0 AWG is not feasible then the largest feasible conductors. These conductors shall be exothermically welded to the EES.

Pressurized fuel tanks (propane, compressed natural gas, etc.) shall be bonded directly to the EES at one of the support legs.

4.2.3.4 Conductor Routing

Down conductors shall follow the most direct downward course. Main and bonding conductors must maintain a downward or horizontal course, and are permitted to rise at no greater than ¼ pitch.

No bend in a main and bonding conductor shall form an included angle of less than 90 degrees, nor shall it have a bend radius (sweep) of less than 8 inches. Connections between crossing conductors will use sweeps in all directions. T-connectors shall be allowed only for mechanical support.

Conductors shall be routed outside of any structure and not penetrate or invade that structure (except as indicated below in paragraph 4.2.3.6). Conductors shall be routed 6 feet or more from

power or signal conductors in air or through walls. If this clearance cannot be met, the power and signal conductors shall be routed in ferrous conduit (RGS) or enclosed ferrous cable tray.

Conductors shall be allowed to pass through a parapet, eave, walkway, wall, etc., where necessary to maintain horizontal or downward course of main conductors. Pass-throughs shall always be accomplished using main conductors, routed through Trade Size 2, Schedule 80, rigid PVC conduit. When a conductor penetrates a metallic structure of any thickness, the conductor shall be bonded to the metallic structure. Conductors passing through gratings or plates do not require conduit but do require bonding.

4.2.3.4.1 Down Conductors on Fiberglass Mounting Poles

Where a fiberglass pole is used to mount an air terminal, the air terminal shall extend two feet above the top of the pole and shall be securely fastened to the pole in accordance with the requirements of NFPA 780. The down conductor from the air terminal shall be run on the exterior of the fiberglass pole and shall be fastened to the pole at intervals not exceeding 3 feet. This down conductor shall be connected to the EES in accordance with paragraph 4.2.3.4.2.

4.2.3.4.2 Down Conductor Terminations

Down conductors shall be exothermically welded to a 4/0 AWG copper conductor prior to entering the ground at not less than 18 inches above the ground level. The 4/0 AWG copper conductor shall enter the ground and be welded to a ground rod that is exothermically welded to the EES.

4.2.3.5 Lightning Protection for Buildings and Structures

Lightning protection shall be provided for all buildings and structures, or parts thereof, not within a zone of protection provided by another building or higher part of a building, or by an antenna or tower. Zones of protection for all structures shall be as defined in NFPA 780.

4.2.3.5.1 Air Terminals

Air terminals shall be solid copper, bronze, or aluminum. In areas of high corrosion, air terminals shall be stainless steel. Copper air terminals shall be allowed to have nickel-plating. Air terminals shall be a minimum of 12 inches in height, at least $^{1}/_{2}$ inch in diameter for copper and at least $^{5}/_{8}$ inch in diameter for aluminum. Air terminals shall be located and installed in accordance with the requirements of NFPA 780 and UL 96A, and as required by this document. Closer spacing shall be allowed for unique geometries. Air terminals shall extend at least 10 inches above the object or area it is to protect. Air terminals shall be placed on the ridges of pitched roofs and around the perimeter of flat or gently sloping roofs at intervals not exceeding 20 feet except that air terminals 24 inches or higher shall be allowed at intervals not exceeding 25 feet.

SAFETY NOTE:
The tip of vertical air terminals shall not be less than 5 feet above adjacent walking or working surfaces to avoid the risk of personnel injury.

4.2.3.5.2 ATCT Potential Equalization

A continuous potential equalization loop (halo ring) shall be installed on the roof or roof parapet, within 24 inches of the periphery of the structure. All air terminals and down conductors shall be connected to this loop. Any parts of the structure below the roof level that extend outboard of the potential equalization loop shall be provided with additional air terminals at the extremities of the structure.

Potential equalization loops shall be installed at intermediate levels, evenly spaced no more than 60 feet apart, measured from the roof loop. Additional horizontal air terminals will be installed at each potential equalization loop.

All exterior catwalks and personnel access areas shall be provided with a potential equalization loop interconnected to the down conductors. Horizontal air terminals shall be installed at each corner.

4.2.3.5.3 Number of Down Conductors for Buildings

The number of down conductors shall be based of both the building height and perimeter. For the purpose of this paragraph, an ATCT with a base building shall be treated as two separate buildings.

Buildings and structures less than 50 feet high (measured to the highest point of the building or structure) shall have at least two down conductors. Buildings and structures more than 50 feet and less than 100 feet high shall have at least four down conductors. Buildings and structures more than 100 feet high, other than antenna towers, shall have one additional down conductor for each 50 feet of height or part thereof, e.g., a 150 foot building would have a minimum of five down conductors, a 300 foot building would have a minimum of eight down conductors, etc.

Buildings and structures with perimeters in excess of 250 feet shall have an additional down conductor for each 100 feet of perimeter distance or part thereof. Down conductors shall be as widely separated as possible, e.g., at diagonally opposite corners on square or rectangular buildings. The down conductors shall be equally spaced and without any sharp bends, or kinks. Building steel, metal supporting structures, and conduits shall not be used in place of down conductors.

4.2.3.5.4 Metal Parts of Buildings

Metal roofing, structural and reinforcing steel, siding, eave troughs, down spouts, ladders, duct, and similar metal parts shall not be used as substitutes for roof or down conductors. A lightning protection system shall be applied to the metal roof and to the metal siding of a metal clad building in the same manner as on a building without metal covering. Building metal parts shall be bonded in accordance with paragraph 4.2.3.3.

4.2.3.5.5 Roof Mounted Antenna Masts

Unless it is a radiating or receiving part of the antenna, a metallic mast of a roof-mounted antenna shall be bonded to the nearest roof or down conductor. If a roof or down conductor is not available then the antenna mast shall be bonded directly to the EES.

4.2.3.6 Lightning Protection for Antenna Towers

4.2.3.6.1 Number of Down Conductors for Towers

Towers that consist of multiple, parallel segments or legs that sit on a single pad or footing not over nine square feet in area are also considered pole type towers. All other towers shall have at least two down conductors. Large towers, such as radar towers, shall have one down conductor per leg. Down conductors on all towers shall be bonded to each tower section. Down conductors shall be routed down the inside of the legs wherever practical and secured at intervals not exceeding 3 feet.

4.2.3.6.2 Pole Type Towers

Pole type towers shall be protected by at least one air terminal and have at least one down conductor. This is to provide a zone of protection for all antennas located on the tower.

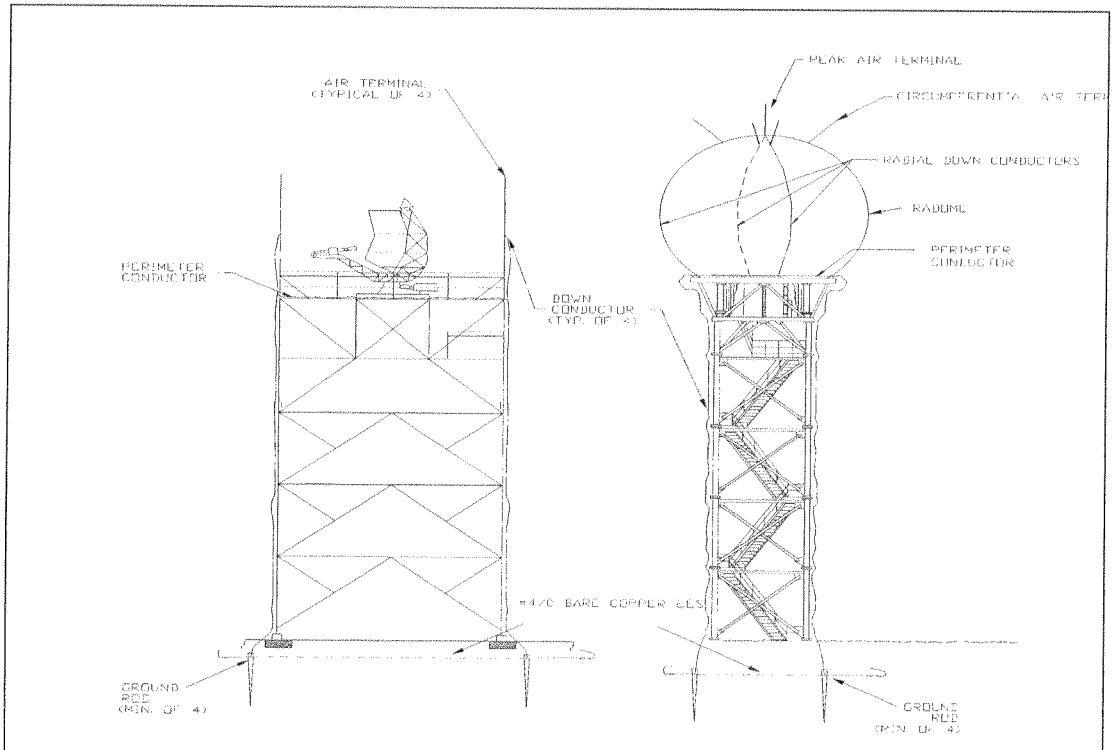
4.2.3.6.3 Towers without Radomes

Protection shall be provided for large radar antennas by extending structural members above the antenna and mounting the air terminal on top as shown in Figure V unless specifically disapproved by the Radar system OPR. Structural members shall be braced as necessary and shall not be used as part of the air terminal or down conductor. The air terminal shall be supported on the structural member and shall have a UL listed fitting on its base. The down conductor from the air terminal shall be connected to a perimeter conductor that forms a loop around the perimeter of the tower platform. Down conductors shall be run from the perimeter conductor to the EES. Each air terminal shall be provided with at least two paths to ground. All conductors shall be in accordance with NFPA 780 requirements for main conductors. All tower legs shall be bonded to the EES with a 4/0 AWG copper conductor exothermically welded at each end. This bonding conductor shall be either a separate conductor, or is permitted to be a part of the down conductor, as described in paragraph 4.2.3.4.2.

4.2.3.6.4 Radomes

Radomes shall be located within a zone of protection established according to the 100 foot radius "rolling sphere model" as described in NFPA 780. This protection can be either from air terminals mounted on the radome or air terminals or catenary wires mounted independently of the radome. When air terminals are mounted on the radome they must have two paths to the EES. A perimeter conductor shall be established at the radar antenna deck level.

Lightning protection systems for standalone radomes shall be designed and installed in consultation between the system OPR and the OPR of this document. The narrative in paragraph 4.2.3.6.5 shall be used as guidance in developing lightning protection systems for these radomes.



NOTES:

1. BOND DOWN CONDUCTORS TO EACH TOWER LEG SECTION. EXOTHERMICALLY WELD DOWN CONDUCTOR TO A 4/0 AWG COPPER CONDUCTOR ABOVE GRADE. ROUTE 4/0 CONDUCTOR THROUGH 1" PVC CONDUIT AROUND CONCRETE PIER AND 12" BELOW GRADE TO THE EES.
2. WHERE A RADOME HAS AN ELECTRICALLY CONTINUOUS FRAME, THE FRAMING MAY BE USED IN LIEU OF THE LOWER AIR TERMINALS.
3. ALL LIGHTNING PROTECTION CONNECTIONS SHALL BE FREE OF PAINT AND GALVANIZING. SCRAPE ALL STEEL FREE OF SURFACE CONTAMINANTS OR SURFACE TREATMENTS PRIOR TO MAKING EXOTHERMIC WELDS OR MECHANICAL CONNECTIONS.

Figure V. Lightning Protection for Radomes and Radar Antenna Platforms

4.2.3.6.5 Towers with Radomes

Lightning protection systems for towers with radomes shall be designed and installed in consultation between the system OPR and the OPR of this document. The narrative below shall be used as guidance in developing lightning protection systems for these structures.

Towers with radomes shall be protected with a minimum 2 foot (0.62 m) air terminal at the peak and four or more air terminals equally spaced around the circumference of the radome and oriented perpendicular to the radome. The spacing and quantity of the circumferential air terminals shall be adjusted if the antenna pattern is affected, but their sizing, position and height shall establish a protection zone as specified in 4.2.3.6.4. The circumferential air terminals shall be interconnected with main sized conductors. The radial down conductors, as indicated in Figure V, shall be connected to the air terminal on the peak. The radial down conductors shall also be connected to the perimeter conductor that forms a loop around the base of the radome.

The radial down conductors on the radome shall be routed from the air terminal at the peak of the radome, in a path following the contour of the radome, to connection with the circumferential air terminals and then to connection with the perimeter conductor as shown in Figure V. Deviations from the shortest possible path shall be allowed where near field radar analyses determine that interference from the conductors will degrade the performance of the radar. Any bends in the radial down conductors on the radome shall maintain the largest possible radii and in no case be less than 12 inches. One down conductor per leg shall connect the perimeter conductor at the base of the radome to the EES. The down conductors shall be bonded to each leg section. All tower legs shall be bonded to the EES with a 4/0 AWG copper conductor exothermically welded at each end. This bonding conductor can be the same conductor required in paragraph 4.2.3.4.2.

4.2.3.6.6 Antenna Protection

Air terminals shall be placed to protect structural towers and buildings, and antennas mounted to towers and on buildings.

4.2.3.6.7 Tower Guying

All metallic guy wire systems without insulators shall be connected to the EES with a 4/0 AWG copper conductor.

4.2.3.6.7.1 Anchors

Where multiple guy wires terminate on a single anchor, one jumper shall be allowed to connect all guy wires to the EES. The jumper shall be exothermically welded to a ground rod that is exothermically welded to the EES. Mechanically bonded jumpers of the same material and size as the guy wire shall be placed across any intermediate turnbuckles in a guy wire. On guy wires terminating in low conductivity anchors (such as concrete), a jumper of the same material and size as the guy wire shall be mechanically bonded to each guy wire above its lowest turnbuckle and bonded to the EES. All jumper connections to the guy wires shall be made with appropriate compatible connectors.

4.2.3.6.8 Waveguide, Axial Cable, and Conduit Grounding

Waveguide, axial cable, and conduit located on the tower and feeding into the facility shall be separately bonded to a ground plate mounted on the tower or directly to the EES. This bond shall be above and no greater than 2 feet (0.6 m) from the transition bend (90 degree bend) near the tower's base. Bond the ground plate to the EES with a 4/0 AWG copper conductor in accordance with the requirement in paragraph 4.2.1.6. A separate bond shall be made from the point of origin within the tower structure of each waveguide, axial cable, or conduit to the metallic tower structure. These are in addition to the bulkhead connector plate required in paragraph 4.2.1.6.

4.2.3.6.9 Staircase/Ladder Protection

The metallic access to the tower, i.e., staircase, ladder, etc., shall be exothermically bonded near its base to the EES with a 4/0 AWG copper conductor installed in a location that avoids accidental tripping or striking that could result in personnel injury. Where staircase sections, platforms etc. are not welded together, bonding jumpers shall be installed between them.

4.2.3.7 Lightning Protection for Facilities without Buildings or Antennas

Facilities such as Runway Visual Ranges are commonly built without buildings or antennas. While these are small facilities their loss can have an impact on the NAS far out of proportion to their size. These small facilities must be included within a zone of protection established with either air terminals or overhead catenary wires to prevent damage from lightning strikes.

4.2.3.8 Lightning Protection for Fences and Gates

General airport fencing is not subject to the mandates of this document. Non-FAA owned fencing, that is adjacent to FAA facilities and meets the distance criteria set out in this and sub paragraphs, shall be protected as mandated after agreement with the owner of the fencing. Fences shall be constructed using electrically conducting materials e.g., chain link fabric, metal crossbar, stranded wire, etc., using metal posts that extend a minimum of 2 feet (0.6 m) below grade into a concrete base. Metallic fence fabric with non-conductive coatings shall not be used.

A ground rod shall be installed at spacings no greater than 100 feet, and bonded to a fence post with a 4/0 AWG stranded copper conductor, exothermically welded. Install a 1 inch by $^{1}/_{8}$ inch flexible tinned copper bond strap or an insulated 4/0 AWG flexible (welding) copper conductor from any gate to the adjacent post (exothermic welding is recommended). Install the bonding strap from the gate to the post so it will not limit full motion of the gate (whether swing or slide type). Exothermically weld a 4/0 AWG bare copper conductor from the posts at each side of the gate to ground rods installed at each side of the gate. Connect the conductor to the gateposts at a height no greater than one foot above grade. Interconnect the ground rods at either side of the gate with an exothermically welded 4/0 AWG bare copper conductor buried a minimum of 18 inches below grade.

Bond across any terminations in the security wire using a short piece of the security wire material and UL listed bonding connectors. Bond the security wires to the fence posts at intervals of approximately 40 feet using a 6 AWG stranded tinned copper conductor and UL listed bonding connectors. Attach the metallic fence fabric to the fence posts with wire ties of the same material. The method of bonding fences is illustrated in Figure VII.

For gates, a horizontal bare 6 AWG stranded tinned copper conductor shall be threaded continuously through the gate fabric and mechanically bonded to the vertical gate rails.

Portions of a fence that are within 22 feet of a facility EES shall be bonded to that EES with a 4/0 AWG bare copper conductor exothermically welded to a fence post ground rod. Connections shall be made at a maximum interval of 40 feet with a minimum of two connections.

The above requirements are designed to meet the minimum National Electrical Safety Code (NESC) ANSI C2, Rule 92E.and IEEE Std 80.

Long fences, of 100 feet or greater, shall be positioned so they do not approach any part of an FAA lightning protection system closer than 50 feet if at all feasible. Grounding for portions of long fences that approach closer than 50 feet to any part of a FAA lightning protection system shall be referred to the OPR of this document.

4.2.3.8.1 Fences in High Risk Locations

NFPA 780 identifies the ability of structures to attract lightning from a significant surrounding area increasing the lightning strike frequency. For NAS facilities, the calculated high risk indices and lightning strike frequency values identify an "increased risk of strike", resultant damage, step potentials and touch potentials for adjacent areas. Consequently certain facilities require additional fence grounding for portions of the fence that fall within the combined area produced by drawing a boundary around each structure equal to 1.5 times the height of that structure in accordance with Figure VI Common Collective Area of Increased Risk. This additional fence grounding shall be in accordance with paragraph 4.2.3.8.2. This requirement applies to the following facilities.

a) Radar sites such as ASR, ARSR, TDWR, PRM.
b) ARTCC's
c) ATCT's over 100 feet in height (tall towers)
d) Large TRACON's

Grounding for fences for structures such as VOR, RTR, RCAG and lighted Navaids shall be in accordance with the site configuration design controlled by the program offices for those systems and have the approval of the OPR of this document.

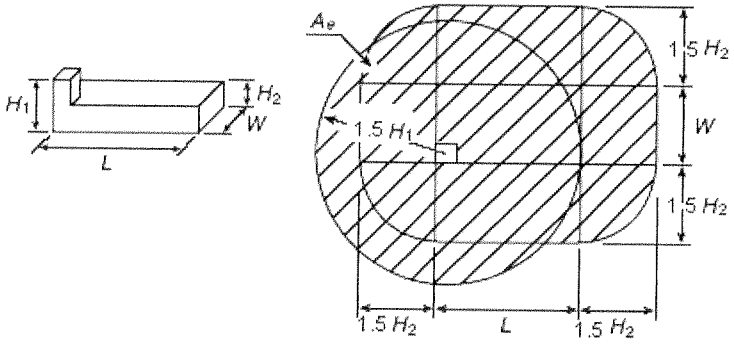


Figure VI Common Collective Area of Increased Risk

4.2.3.8.2 Fence Grounding for High Risk Locations

A buried bare 4/0 AWG stranded copper conductor (fence EES) shall be installed outside the fence where feasible (inside where not), within three feet of the fence, and two feet below grade. A horizontal bare 6 AWG stranded tinned copper conductor shall be threaded through the fencing fabric, approximately midpoint of the fence fabric, and shall be mechanically bonded to the fence posts at intervals not greater than 40 feet. A ground rod is required at these bonding locations and exothermically welded to the fence EES. The fence posts at these bonding locations shall be bonded to the fence EES with a bare 4/0 AWG stranded copper conductor,

exothermically welded to the fence posts and to the ground rod. The method of bonding a fence requiring an EES is illustrated in Figure VIII.

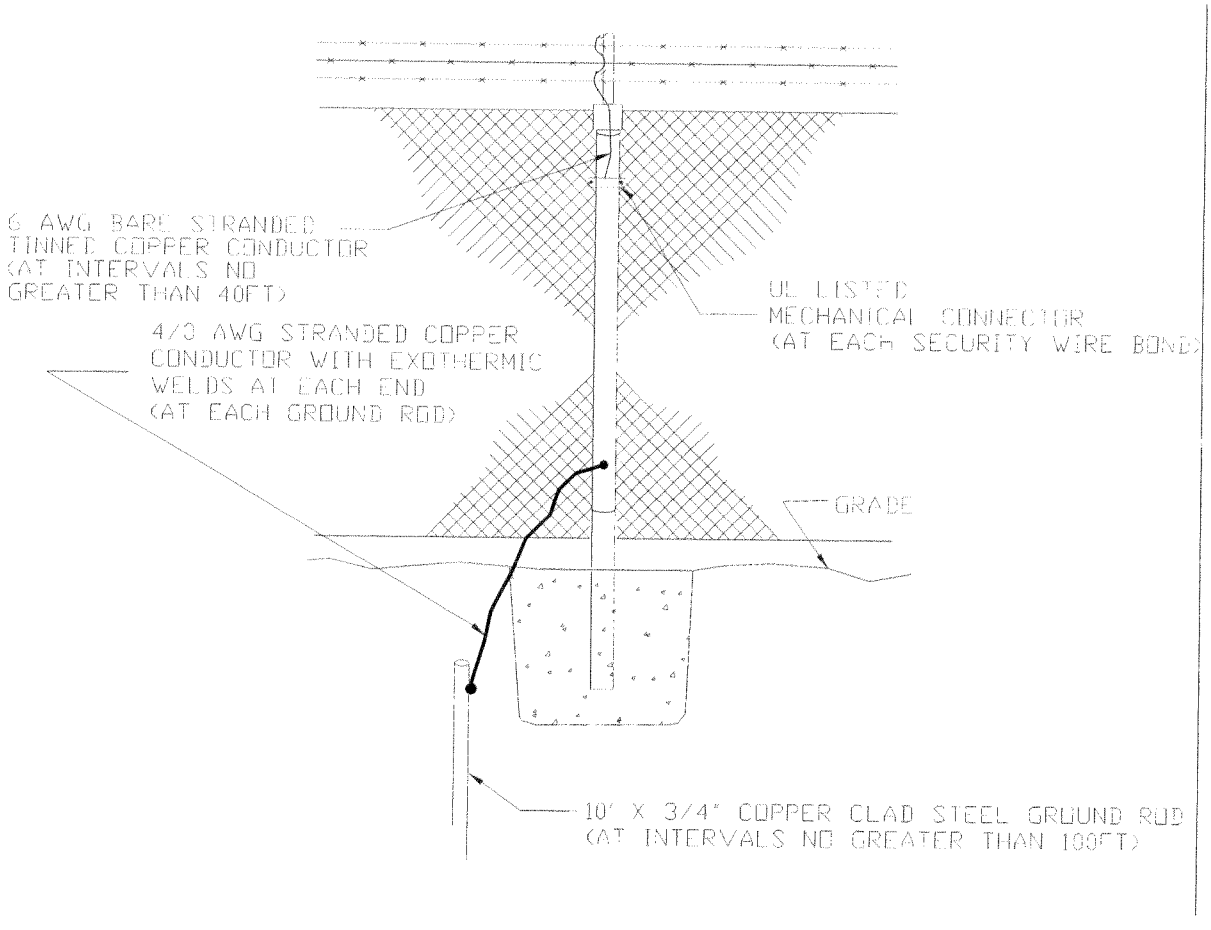


Figure VII. Fence Grounding

The fence EES shall be connected to other EES within the fence EES using buried bare 4/0 AWG stranded copper conductors. A minimum of four connections shall be installed between the fence EES and other EES for structures or buildings with an aggregate footprint of 5,000 square feet or less (preferably at the corners). A minimum of eight connections shall be installed between the fence EES and other EES for structures or buildings with an aggregate footprint greater than 5,000 square feet (preferably at the corners and at the midpoints). Aggregate footprint is defined as the sum of all building and structure footprints.

For swing gates, the horizontal bare 6 AWG stranded tinned copper conductor in the fence fabric shall continue to and be threaded through the gate fabric.

4.2.3.8.3 Fences Crossed by Overhead Power Lines

When overhead power lines cross a fence, bond a fence post on each side of the crossing to a ground rod with a bare 4/0 AWG copper conductor. These connections shall be on each side of and at least 20 feet from the overhead wire crossing. Bond the fence fabric at the top, middle and bottom of the fence and each strand of security wire placed above the fencing fabric to the grounded post with a bare 6 AWG tinned copper conductor. Where crossbars or stranded wire is used, each horizontal strand or cross bar shall be bonded to these posts. Figure VIII shows a typical fence post grounding and bonding.

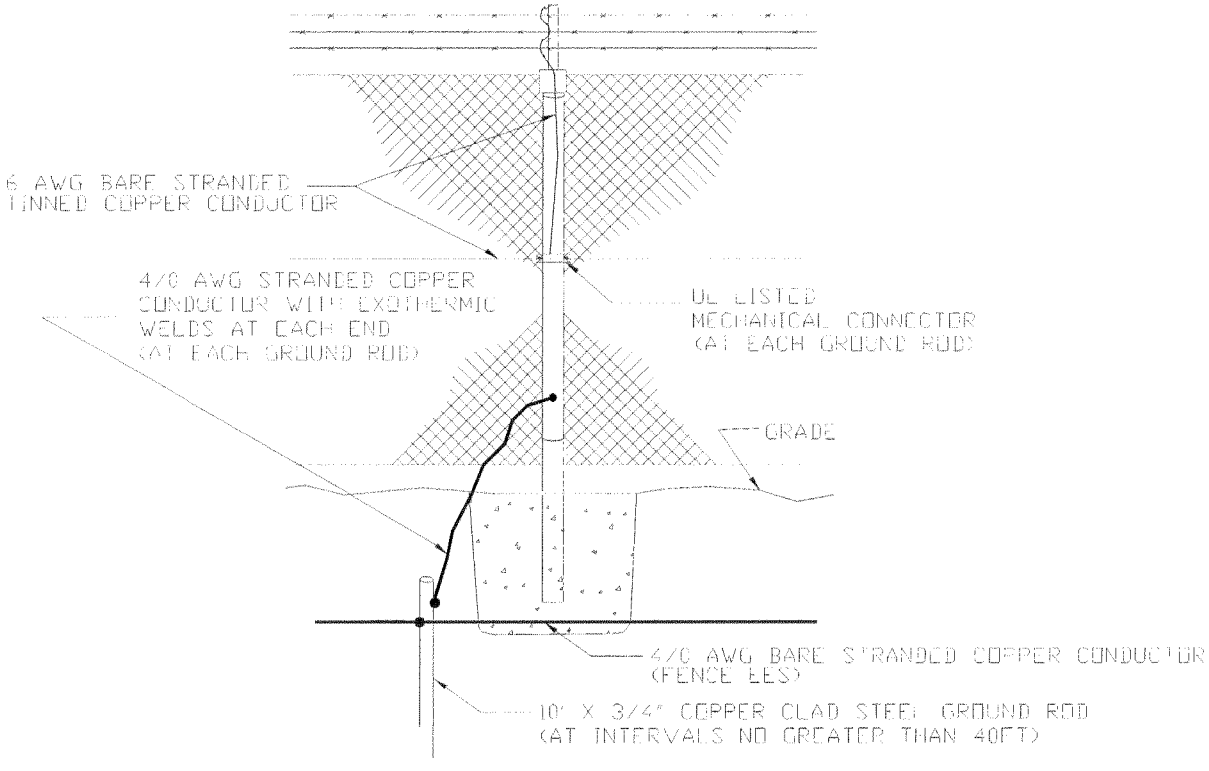


Figure VIII. Grounding Fences Requiring an EES

4.2.4 Earth Electrode System (EES) Requirements

4.2.4.1 General

An EES shall be installed at each facility. The purpose of the EES is to provide a low resistance to earth for lightning discharges, electrical and electronic equipment grounding and surge and transient protection. The EES shall be capable of dissipating within the earth the energy of direct

lightning strikes with no ensuing degradation to itself. The system shall dissipate DC, AC and RF currents from equipment and facility grounding conductors.

4.2.4.2 Site Survey

A site survey shall be conducted for all sites to determine the geological and other physical characteristics. Information to be collected shall include location of rock formations, gravel deposits, soil types etc. Perform a soil resistivity test at probe spacings of 10, 20, 30 and 40 feet (3, 6, 9 and 12m) in four directions from the proposed facility. All survey data, including soil resistivity measurements, shall be noted on a scaled drawing or sketch of the site and included in the Facility Reference Data File. Additional guidance can be found in FAA Orders 6950.19 and 6950.20.

4.2.4.3 Design

The EES shall normally consist of driven ground rods, buried interconnecting conductors and connections to underground metallic pipes (not including gas lines), and tanks. The site survey required in paragraph 4.2.4.2 shall be used as the basis for the design of the EES. The design goal for the resistance to earth of the EES shall be as low as practicable and not over 10 ohms. Where conditions are encountered such as rock near the surface, shallow soils, permafrost and soils with low moisture or mineral content, after evaluation, one of the ground enhancements listed in paragraphs 4.2.4.3.1 through 4.2.4.3.4 shall be used.

4.2.4.3.1 Chemical Enhancements.

Chemical enhancements (doping) with materials such as mineral salts, Epsom salts, sulfates, etc. should only be utilized as a last resort. Chemical enhancement is dependent on soil moisture content and requires periodic (usually yearly) re-treatment and continuous monitoring to be effective. The chemicals leach into the surrounding soil and can be deposited into the water table. Typical installation is in bored holes with ground rods and in trenches.

4.2.4.3.2 Chemical Rods.

Chemical rods also require re-treatment and monitoring to ensure continuous effectiveness. Many of these systems require a drip irrigation system in dry soil conditions. Inspections must be conducted frequently for timely detection of corrosion at connection points between conductors and the chemical rod attachment point. Normal installation is insertion into the soil in accordance with manufacturer's instructions.

4.2.4.3.3 Engineered Soil Materials

Engineered soil materials are cements, soils or clays treated with a variety of materials to enhance their conductive properties. These engineered soils can be a mixture of moisture absorbing materials such as Bentonite or homogenous clays in combination with native soils and/or chemicals. Some engineered soil enhancements utilize concrete-based materials. These materials should be avoided in areas with soil movement. The concrete can break the interconnecting conductor when combined with soil movement. Engineered soil requires the presence of moisture (> 14%) to be effective. Concrete type enhancements can be very expensive. Normal installation is installation in bored holes with ground rods and in trenches.

4.2.4.3.4 Coke Breeze

Coke breeze is a material that is produced as a by-product of coke production. Coke breeze is environmentally safe, stable, and conductive even when completely dry or frozen, non-moisture dependant, compactable and very economical to install. Normal installation is in a one-foot square trench in an EES configuration with a continuous 4/0 AWG stranded copper conductor in the center of the material (see Figure IX). Placement of the trench is based on the geometry of the facility and the physical site location. Radial trenches with a center conductor can be utilized to enhance Radio Frequency (RF) ground planes in communication facilities. The top of the coke breeze trench must be covered by a minimum of one foot of native soil. Coke breeze shall contain no more than 1% sulfur by weight. Charcoal and/or petroleum-based coke breeze shall not be substituted for coke breeze derived from coal in coke ovens. Charcoal and petroleum coke typically contain high levels of sulfur, which in the presence of moisture will accelerate corrosion of the EES.

4.2.4.3.5 Ground Dissipation Plates

In shallow soil locations with limited surface space, ground dissipation plates shall be allowed in place of ground rods in the earth electrode system. The plates shall be installed at the corners of the EES at the farthest accessible point from the facility to be protected. Plates shall be constructed of a minimum one quarter-inch thick copper and be a minimum of two feet square. These plates should be installed in a vertical plane to take advantage of seasonal moisture and temperature changes in the soil. Install the plates at the same depth or deeper than the interconnecting conductor, but maintain a minimum of one-foot of native soil above the upper edge of the plate. Attachment to the EES shall be with a 4/0 AWG bare stranded copper conductor, exothermically welded to the EES and the plate. For maximum performance, the attachment point at the plate shall be at the center of the plate, not near the edge or the corners. To further enhance the effectiveness of ground dissipation plates, they shall be configured as a Jordan Dissipation Plate Design or equal as shown in Figure X. This configuration provides 2/3 more surface area at the edge than a square plate and provides multiple sharp points for increased dissipation capability. In difficult soils/areas a combination of coke breeze trenches and ground dissipation plates is highly recommended (see Figure IX and Figure X).

4.2.4.3.6 Installation of Earth Electrode Systems in Corrosive Soils

Careful consideration must be given to the installation of any grounding system in soils with corrosive elements. Two geological areas of known concern are the volcanic soils in Hawaii and Alaska. It is recommended that supplemental cathodic protection be applied to the grounding system at these locations. A buried steel plate (acting as a sacrificial anode) is connected to the EES by a 4/0 AWG stranded bare copper conductor. The 4/0 AWG conductor shall be exothermically welded to the EES and to the sacrificial plate. The conductor shall be welded to the center of the plate, not near the edge or near the corners. Minimum sizing for the sacrificial plate is four feet square (4'x4') at ½ inch thickness. In shallow soils, this would be in addition to the standard copper ground plates. For enhanced performance, plates shall be a Jordan Dissipation Plate Design or equal (see Figure X).

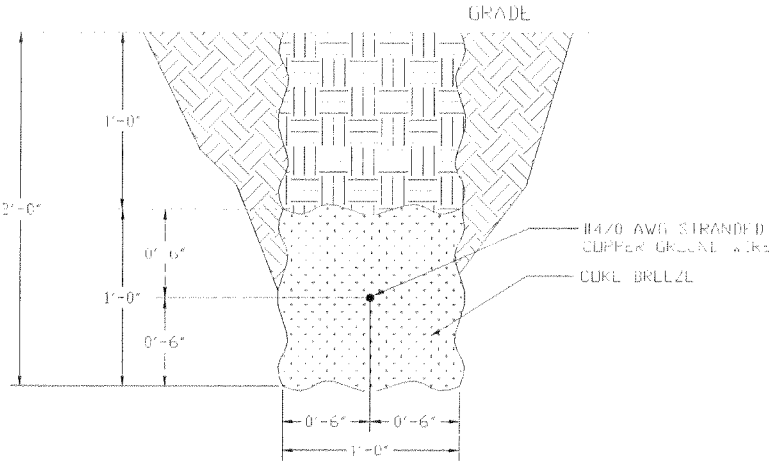


Figure IX. Grounding Trench Detail

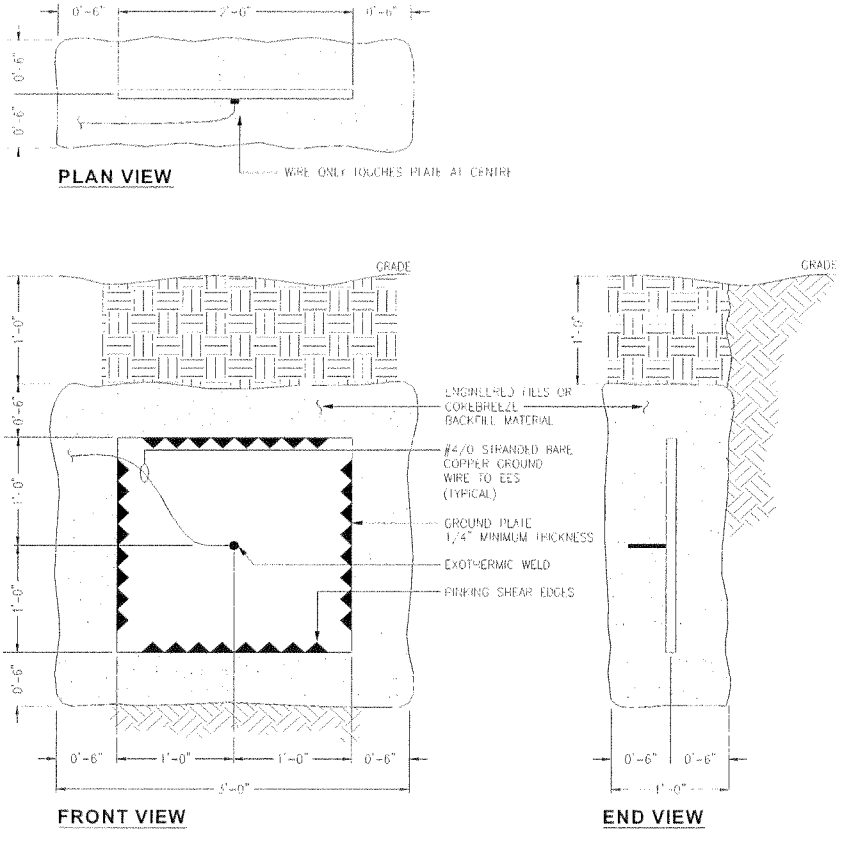


Figure X. Jordan Dissipation Plate Design

4.2.4.3.7 Configuration

The EES shall consist of at least four ground rods whose configuration and depth shall be determined by a soil test included in the site survey. At facilities that have two or more structures, e.g. a building and antenna tower, separated by 15 feet or less, a single EES surrounding both structures shall be provided. Where structures are separated by more than 15 feet but less than 30 feet, an EES shall be provided for each structure, but the EES for each structure shall be allowed to share a common side. Where the structures are separated by more than 30 feet but less than 100 feet an EES shall surround each structure and the EESs shall be interconnected by at least two buried conductors. Guidance is provided in FAA Orders 6950.19 and 6950.20.

4.2.4.3.8 Ground rods

Ground rods and their installation shall meet the following requirements:

(a) Material and Size. Ground rods shall be copper or copper clad steel, a minimum of 10 feet in length and ¾ inch in diameter. Rod cladding shall not be less than 1/100 inch thick.
(b) Spacing. Ground rods shall be as widely spaced as possible, and in no case spaced less than one-rod length. Nominal spacing between ground rods is between two and three times the rod length.
(c) Depth of Rods. Tops of ground rods shall be not less than 1 foot below grade level.
(d) Location. Ground rods shall be located 2 to 6 feet outside the foundation or exterior footing of the structure. On buildings with overhangs or sidewalks in close proximity, ground rods shall be allowed at locations further out.

4.2.4.3.9 Interconnections

Ground rods shall be interconnected by a buried, bare, 4/0 AWG copper conductor. The conductor shall be buried at least 2 feet (0.6 m) below grade level. Connections to the ground rods shall be exothermically welded. The interconnecting conductor shall close on itself forming a complete loop with the ends exothermically welded. The structural steel columns of buildings shall be connected to the EES at approximately every other column at intervals not over 60 feet with a bare, 4/0 AWG stranded copper conductor. Connections shall be by exothermic welds. All underground metallic pipes, except where prohibited by the NEC (for example gas piping), and tanks (unless cathodically protected), and the telephone ground, if present, shall be connected to the EES by a copper conductor no smaller than 2 AWG. All underground, interconnecting conductors shall be bare. Exothermic welds shall not be used where hazards exist, i.e. near fuel tanks. In these cases, connections shall be accomplished with hydraulically-crimped terminations using a minimum force of 12 tons concentrically applied. The bonding resistance of all interconnections shall be one milliohm or less for each bond when measured with a 4-terminal milliohm meter.

4.2.4.3.10 Access Well

Access wells are permissible at facilities. The well should be located at a ground rod that is in an area with access to the open soil so that checks of the EES can be made once the facility is in use. The access well shall be made from clay pipe, poured concrete, or other approved wall material and shall have a removable cover. The access well shall be constructed to provide a minimum clearance (12 inches radius) from the center of the ground rod to the inside wall of the

access well. The access well shall have an opening of a minimum 12 inch radius. Connections shall be by exothermic welds.

4.2.5 Main and Supplemental Ground Plates

A main ground plate shall be established as a common point of connection for all Signal Reference Structures (SRSs) for the entire facility. This main ground plate shall be connected to the EES with one 500 kcmil conductor. The conductor from the main ground plate to the EES shall be exothermically welded at the EES and shall be exothermically welded or connected with a UL listed pressure connector to the main ground plate. The main ground plate location shall be chosen to minimize conductor length, but shall not be more than 50 feet from the EES. Ground plates shall be copper and at least 12 inches (305 mm) long, 6 inches(152 mm) wide and $^1/_4$ inch (6.4 mm) thick. The main ground plate shall have a clear plastic cover that bears the caption "MAIN GROUND PLATE" in black 3/8 inch (10 mm) high letters and green slashes around the caption. The main ground plate conductor shall be color-coded green at each end.

A supplemental ground plate shall be established at the opposite side of the facility to the main ground plate and shall be color coded green/orange. This supplemental ground plate shall be used only for a second connection of the signal reference plane (SRP) and multipoint ground (MPG) systems to the EES. A large facility shall be allowed to employ more than one supplemental ground plate (contact the OPR when more than one supplemental ground plate is considered). Each supplemental ground plate or plates shall be connected to the EES with a 500 kcmil conductor. The conductor from each supplemental ground plate to the EES shall be exothermically welded at the EES and shall be exothermically welded or connected with UL listed pressure connector to the plate. The length of this conductor shall be 30% longer or shorter than the conductor between the main ground plate and the EES. Ground plates shall be copper and at least 12 inches long, 6 inches wide and $^1/_4$ inch thick. The supplemental ground plate shall have a clear plastic cover that bears the caption "SUPPLEMENTAL GROUND PLATE" in black 3/8 inch high letters and green slashes around the caption. The supplemental ground plate conductor shall be color-coded green with red tracer.

A 4/0 AWG bonding conductor shall be provided internally between the main and each supplemental ground plate and shall be color-coded green with orange tracer.

4.2.6 General Grounding and Bonding Requirements

4.2.6.1 Secure Facilities

In all areas of facilities required to maintain communications security, equipment and power systems shall be grounded in accordance with NACSIM-5203 and MIL-HDBK-232A.

4.2.6.2 Electronic Signal Return Path

The electronic signal return path shall be routed with the circuit conductor. For axial circuits, the shield serves this purpose. The electronic equipment case and SRS shall not be used as a signal return conductor.

4.2.6.3 Interior Metal Piping Systems

The interior metal piping systems shall be bonded in accordance with the NEC. An additional bond shall be required in the tower cab between the power ground system and water supply systems. Where there is a separately derived power system for the tower cab, the interior metallic piping systems near the top of the ATCT shall also be bonded to the ground plate as required in paragraph 4.2.11.2.

4.2.6.4 Electrical Supporting Structures

All metallic electrical support structures shall be electrically continuous and shall be bonded to the signal reference plane (SRP) or multipoint ground (MPG) system and to the EES.

4.2.6.4.1 Conduit

All metal conduits shall be grounded as follows:

(a) Conduit shall have a means to be bonded, prior to entering a structure, to a ground plate or bulkhead plate located outside the structure or directly to the EES. Plate(s) shall be bonded to the EES with an insulated 4/0 AWG stranded copper conductor color-coded green with a red tracer.
(b) All joints between conduit sections and between conduit, couplings, and boxes shall be electrically continuous. Surfaces shall be prepared in accordance with paragraph 4.1.1.7. Joints that are not otherwise electrically continuous shall be bonded with short jumpers of 6 AWG or larger copper conductor. The jumpers shall be welded in place or shall be attached with clamps, grounding bushings, or other devices approved for this purpose. All bonds shall be protected against corrosion in accordance with paragraph 4.1.1.8.3.
(c) Cover plates of conduit fittings, pull boxes, junction boxes, and outlet boxes shall be grounded by securely tightening all available screws.
(d) Every component of metallic conduit runs such as individual sections, couplings, line fittings, pull boxes, junction boxes and outlet boxes shall be bonded, either directly or indirectly, to the SRP or MPG system or facility steel at intervals not exceeding 50 feet.
(e) Conduit brackets and hangers shall be securely bonded to the conduit and to the metal structure to which they are attached.

4.2.6.4.2 Cable Trays and Wireways

The individual sections of all metallic support structures (cable tray systems) and wireways shall be bonded together with a minimum 6 AWG insulated copper conductor. All bonds shall be in accordance with procedures and requirements specified in paragraph 4.1.1. All cable trays shall be bonded to the SRP or MPG system within 2 feet (0.6 m) of each end of the run and at intervals not exceeding 50 feet (15 m). The resistance of each of these connections shall not exceed 5 milliohms. The minimum size bonding conductor for connection of a cable tray and wireway to the SRP or the MPG shall be 2 AWG copper conductor.

Table VIII. Grounding Conductor Color Codes

Color	Use
Solid green	NEC required grounds
Green with red and yellow tracers	Isolated grounds
Green with yellow tracer	Single point ground
Green with orange tracer	Multipoint ground
Green with red tracer	High-Energy ground

Note: Some commercial-off-the-shelf (COTS) equipment uses green with yellow tracer as a color code for equipment grounding conductors. These conductors shall be retained and grounded as required by the NEC.

4.2.6.5 Building Structural Steel Bonding Requirements

Major structural metal members internal to and about the periphery of NAS electronic equipment rooms shall be made electrically continuous by welding each joint. This shall be accomplished for all the joints of each major structural member, including welding of each roof truss to each column location. In addition, vertical columns on the periphery of the building that are bonded to the EES (paragraph 4.2.4.3.9) shall be welded as described above. Where rebar exists, it shall be connected to the EES with a minimum 2 AWG copper conductor that is applied via an exothermic weld or a hydraulically crimped termination.

In NAS electronic equipment rooms, where steel material is used in construction (including preformed decking, wall covering, etc), it shall be directly bonded (welded) to structural steel or to reinforcing bar. Where direct bonding is not practical, indirect bonds with copper conductor conforming to Table IX shall be used with a minimum of two 2 AWG conductors per 100 square feet of steel decking, wall covering etc. These connections shall be applied via an exothermic weld or a hydraulically crimped two-hole termination. All surface coatings shall be removed in accordance with paragraph 4.1.1.7. For additional installation guidance, contact the OPR of this document.

4.2.6.6 High RF Field Bonding Requirements

FAA facilities that are located in proximity to other facilities that generate high RF levels need additional shielding to protect personnel and sensitive equipment from these external RF sources. Where a determination has been made that the signal level is sufficient to cause concern the following shall be accomplished. Metal building components and attachments such as walls, roofs, floors, door and window frames, gratings and other metallic architectural features shall be directly bonded to structural steel or to reinforcing bar if structural steel is not present, in accordance with paragraph 4.1.1. Where direct bonding is not practical, indirect bonds with copper conductor conforming to Table IX shall be used. Removable or adjustable parts and objects shall be grounded with an appropriate type bond strap as specified in paragraph 4.1.1.3. All bonds shall conform to the requirements of paragraph 4.1.1. Metal building components with a maximum dimension of 3 feet (0.9 m) or less are exempt from the requirements of this paragraph as they are not efficient receiving antennas.

4.2.7 Signal Reference Structures Requirements

All FAA enclosed building facilities, used to house NAS equipment, shall be equipped with a Signal Reference Structure (SRS). Types of SRS include the following systems:

(a) Multipoint Ground (MPG) systems
    1. Conductor and plate
(b) Signal Reference Plane (SRP)
    1. Signal Reference Ground Plane (SRGP)
    2. Signal Reference Ground Grid (SRGG)
(c) Single Point Ground (SPG) systems
(d) Combination of engineered hybrid system as approved by the OPR of this document.

A SRS shall be constructed in the following areas:

a) All facility operational areas (entire room area).
b) All other areas containing electronic equipment supporting facility operations (entire room area).
c) Any area containing electrical equipment installed to address power quality (e.g., isolation transformers, power conditioning equipment, etc.) not in the same area as the operational or electronic equipment (on different floors, etc.) shall be bonded to the SRS system described above.

The above referenced operational, electronic and electrical equipment shall be bonded to the SRS installations in the area. In turn, all installed SRS's - on the same floor and on different floors - shall be bonded together. Individual areas of the SRS on a single floor shall be bonded to adjacent areas via at least two separate paths. The grounding system on each floor with electrical, electromechanical, or electronic equipment shall be bonded to adjacent floors via at least two separate paths.

The specific SRS type shall be selected by the OPR. SRS systems will be designed for the site-specific requirements of the facilities and equipment. SRS applications require the analysis of equipment bandwidth, and equipment and SRS impedances. SRS analysis will consider, among other parameters, operating frequencies and impedances, transmission line communication models for bonding wires, noise levels in low frequency analog-based equipment, and the influence of high frequency digital signal and logic equipment. SRGGs and SRGPs will be considered when recommended by a vendor. MPGs, SRGGs, and SRGPs can be constructed on ceilings, walls, or floors.

Multiple components of the facility SRS – except any SPGs – shall be bonded together with a minimum of two 4/0 AWG conductors.

All signal-carrying conductors, axial lines, and waveguides and cabling and interconnections between equipments shall be routed in immediate proximity to the SRGG or SRGP when utilized.

A typical ground system is shown in Figure XI.

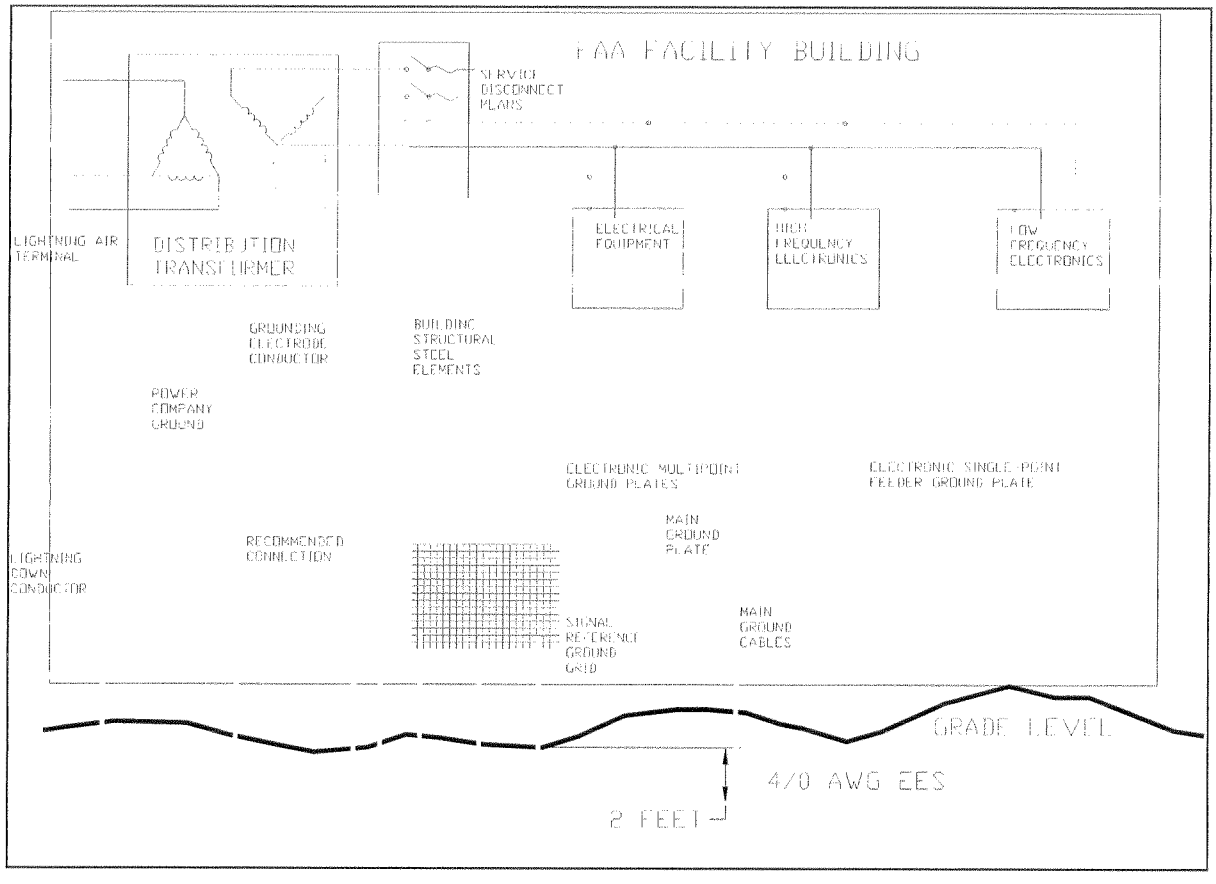


Figure XI. Facility Grounding System

Note figure colors are to distinguish systems and do not form part of a required color code

4.2.7.1 Multipoint Ground Systems

The protection of electronic equipment against potential differences and static charge buildup shall be provided by interconnecting all non-current-carrying metal objects to a multipoint ground system that is effectively connected to the EES. The multipoint ground system consists of installed network of plates and bonding jumpers, racks, frames, cabinets, conduits, wireways, cable trays enclosing electronic conductors, structural steel members, and conductors used for interconnections. The multipoint ground system shall provide multiple low impedance paths to the EES as well as between various parts of the facility, and the electronic equipment within the facility so that any point of the system has a low impedance path to the EES. This will minimize the effects of spurious currents present in the ground system due to equipment operation or malfunction, or from lightning discharges. The multipoint ground system shall not be used in lieu of the safety ground required by the NEC. The multipoint ground system is not to be used as a signal return path.

Exception: For buildings of 200 ft^2 or less, only the main ground plate is required which shall be connected to the EES with two 4/0 AWG stranded copper conductors. One of the conductors shall be 30% longer than the other. All signal grounding (single point or multipoint) shall terminate on this plate. No additional plates are required.

4.2.7.1.1 Multipoint Ground Plates and Buses

The location of the ground plate shall be chosen to facilitate the interconnection of all equipment cabinets, racks and cases within a particular area. If more than one ground plate is necessary, they shall be installed at various locations within the facility. Ground buses shall be used when distributed grounding is desired with a long row of equipment cabinets. Ground plates shall be copper and at least 12 inches long, 6 inches wide and ¼ inch thick. Ground buses shall be copper. Ground bus width and thickness shall be selected from Table IX, and shall be as long as required. Ground plates and buses shall be identified with a permanently attached plastic or metal label that is green with distinguishing bright orange slashes. The label shall bear the caption "ELECTRONIC MULTIPOINT GROUND SYSTEM" in black 3/8-inch (10 mm) high letters.

4.2.7.1.2 Ground Conductors - Plate to Plate and Plate to Bus

Conductors between plates and buses in the multipoint system shall be insulated and sized in accordance with Table IX based on the maximum path length to the farthest point in the multipoint ground system from the EES. To determine the distance to the farthest point in the multipoint system, add the length of all conductors in the multipoint system to reach the farthest plate in the system via the longest path as shown in Figure XII. Divide the sum obtained by two to obtain the maximum path length. Utilize this path length to determine the conductor size from Table IX, but in no case use a conductor smaller than 4/0 AWG. These conductors shall be color-coded green with an orange tracer or shall be clearly marked for four inches at each end and wherever exposed with a green tape overlaid with an orange tracer. Additionally, when routed in cable trays, conductors shall be color-coded every three feet. Where conductors are routed through cable trays, they shall be insulated and separated from the other conductors as far as possible. These conductors shall be insulated.

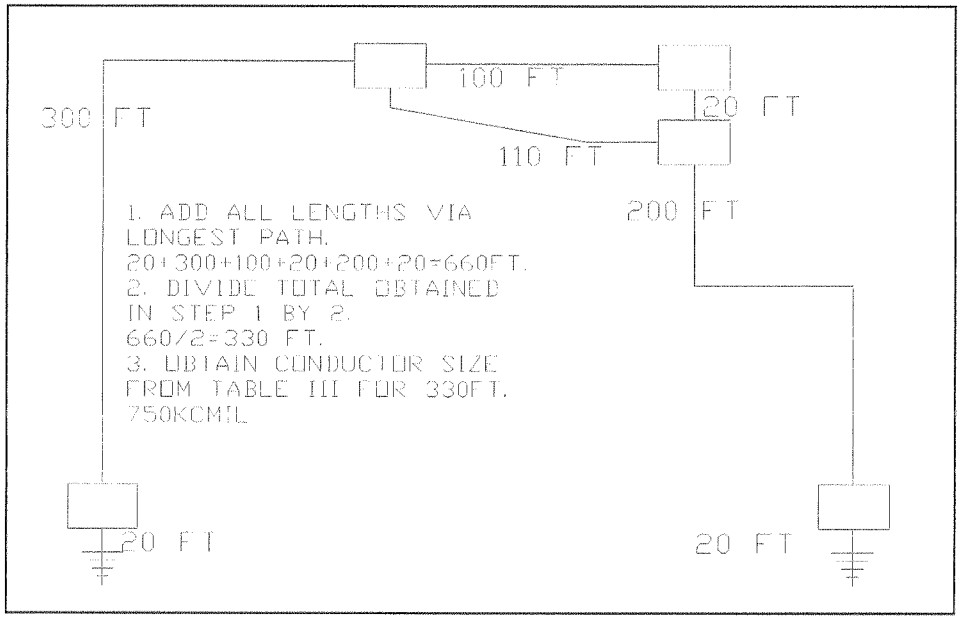


Figure XII. Multipoint Ground Conductor Size Determination

4.2.7.1.3 Ground Conductors (Plate and Bus to Equipment)

Conductors from plates and buses in the multipoint system to equipment chassis shall be sized in accordance with Table IX based on the maximum path length from the plate or bus to the equipment. These insulated conductors shall be color-coded green with an orange tracer or shall be clearly marked for 4 inches at each end and wherever exposed with a green tape overlaid with an orange tracer. Where routed through wireways, the color-coding shall be visible by opening any cover. Provide color-coding 4 inches long at intervals not exceeding 3 feet where ground conductors are routed through cable trays.

Table IX. Size of Electronic Multipoint Ground Interconnecting Conductors

Conductor Size	Max. Path Length		Bus Bar Size		Max. Path Length	
	Ft.	(m)	Inch	(mm)	Ft.	(m)
750 kcmil*	375	(114.3)	4 x 1/4	(100 x 6.4)	636	(193.9)
600 kcmil*	300	(91.4)	4 x 1/8	(100 x 3.2)	318	(96.9)
500 kcmil	250	(76.2)	3 x 1/4	(75 x 6.4)	476	(145.1)
350 kcmil	175	(53.3)	3 x 1/8	(75 x 3.2)	238	(72.5)
300 kcmil	150	(45.7)	2 x 1/4	(50 x 6.4)	318	(96.9)
250 kcmil	125	(38.1)	2 x 1/8	(50 x 3.2)	159	(48.5)
4/0 AWG	105	(32.0)	2 x 1/16	(50 x 1.6)	79	(24.1)
3/0 AWG	84	(25.6)	1 x 1/4	(25 x 6.4)	159	(48.5)
2/0 AWG	66	(20.1)	1 x 1/8	(25 x 3.2)	79	(24.1)
1/0 AWG	53	(16.2)	1 x 1/16	(25 x 1.6)	39	(11.9)
1 AWG	41	(12.5)				
2 AWG	33	(10.1)				
4 AWG	21	(6.4)				
6 AWG	13	(4.0)				

* Where these conductors are not available, parallel conductors shall be allowed, such as three 250 kcmil conductors in place of one 750 kcmil conductor, or two 300 kcmil conductors in place of one 600 kcmil conductor. The conductor sizing is based on providing a cross-sectional area of 2000 circular mils per linear foot. The bus bar sizes are chosen from available cross sections and exceed the cross-sectional requirement of 2000 circular mils per linear foot.

4.2.7.1.4 Protection

Provide mechanical protection for all conductors in the electronic multipoint ground system where they are subject to physical damage. This protection shall be provided by conduit, floor trenches, routing behind permanent structural members, or other means as applicable. Where routed through metal conduit, the conduit shall be bonded to the conductor at each end.

4.2.7.1.5 Conductor Labeling

At each multipoint grounding conductor termination the conductor shall be labeled to identify the point of termination of the other end of the conductor. This shall be accomplished by

embossed label. These conductors shall also be identified every 50 feet and in junction boxes in the manner above indicating both ends.

4.2.7.2 Signal Reference Planes

Signal reference planes (SRPs) shall be constructed of either an SRGG, SRGP, or a combination of both, in accordance with the narrative below:

(a) Signal Reference Ground Grid (SRGG): A SRGG shall consist of a grid of two inch wide copper strips, 26 gauge or thicker, laid on a two feet by two feet grid, welded at each grid intersection. The SRGG shall be installed below a raised floor, at or above a dropped ceiling, or both. The perimeter of the SRGG shall extend to within six inches of the room perimeter or the edge of the raised floor (and/or dropped ceiling) area if the raised floor (and/or dropped ceiling) does not fill the entire room. The SRGG and raised floor shall be bonded together at least every six feet with bare conductors. Dropped ceiling metalwork shall be bonded to ceiling mounted SRGG using guidance provided by the OPR. A 4/0 AWG or larger bare copper conductor shall be routed around the SRGG within six inches of the grid perimeter. The copper strips of the SRGG shall be bonded to the perimeter 4/0 AWG bare copper conductor at every intersection with 4 AWG bare copper conductors. The 4/0 AWG perimeter conductor shall be bonded to the EES with a minimum of four 4/0 AWG conductors spaced as widely apart as practicable.

    Building structural steel within the perimeter of the grid and within 6 feet of the grid shall be bonded to the SRGG with a 4/0 AWG or larger conductor. All conduits, wireways, pipes, cable trays, or other metallic elements that penetrate the area shall be bonded to the SRGG where they enter the area and every 25 feet for their entire length within the area. All conduits, wireways, pipes, cable trays, or other metallic elements within 6 feet of the grid shall be bonded to the SRGG. These bonds shall be made with 4 AWG copper conductors minimum.

(b) Signal Reference Ground Plane (SRGP): All SRGP designs shall be approved by the OPR of this document. A SRGP shall consist of copper sheets, 24 gauge thickness minimum. The sheets shall be welded by any method approved by the OPR including butt, pan or lap methods. The SRGP shall be bonded to the EES with a minimum of four 4/0 AWG conductors spaced as widely as practicable.

    Building structural steel within the perimeter of the ground plane and within 6 feet of the ground plane shall be bonded to the SRGP with a 4/0 AWG or larger conductor. All conduits, wireways, pipes, cable trays, or other metallic elements that penetrate the area shall be bonded to the SRGP where they enter the area and every 25 feet for their entire length within the area. All conduits, wireways, pipes, cable trays, or other metallic elements within 6 feet of the ground plane shall be bonded to the SRGP. These bonds shall be made with 4 AWG copper conductors minimum.

All conductors and cabling shall lay on or very close (nominally, less than $\lambda/20$ of the highest system frequency) to the SRGG or SRGP. Installation of a SRGG or a SRGP shall be permitted below a raised floor, at or above a dropped ceiling, or both. Floor and ceiling portions of a

SRGG or a SRGP shall be bonded together with a minimum of four 4/0 AWG conductors spaced as widely spaced as practicable. All bonding connections between the equipment and the SRGG or SRGP shall be close-coupled, i.e., the bonding jumpers shall be as short as possible, and routed to the closest SRGG or SRGP location. When either an SRGG or an SRGP is utilized under equipment, a raised floor construction is preferred to enable routing of all connecting conductors and cabling close to the SRGG or SRGP. In this case conductors and cabling shall enter at the base of the equipment

4.2.7.3 Connection of MPG and SRP Systems to the Main and Supplemental Ground Plates

The MPG and SRP systems shall be connected to the Main and Supplemental ground plates with conductors sized in accordance with paragraph 4.2.7.1.2. Each connection shall be to the nearest MPG plate or SRP.

4.2.7.4 Connection of Electronic Enclosures to the SRS

Bonding connections to the SRS shall be allowed either to the below floor SRP or directly to the raised floor system or alternatively to an MPG as constructed in paragraph 4.2.7.1. The length of the bonding conductor shall be less than 19 inches. To prevent the possibility of problems due to resonance of a single bonding strap, two widely spaced straps of unequal length (one of the conductors shall be 30% longer or shorter than the other) shall be used to bond the equipment to the SRS. Bonding straps shall be at least 1" wide and at least 26 gauge. Bonding straps shall be in accordance with paragraph 4.1.1.3 and installed in accordance with paragraph 4.1.1.2. When necessary, any radius in the bonding connectors shall be 8 inches minimum.

4.2.8 Electronic Single Point Ground System Requirements

4.2.8.1 General

Electronic single point ground systems shall be installed in FAA facilities where required by equipment or requested by the vendor and approved by the OPR of this document. FAA facilities that do not utilize single point ground equipment are not required to install a single point ground system. The electronic single point ground system shall be isolated from the power grounding system, the lightning protection system and SRP or MPG systems (except at the main ground plate). The electronic single point ground system shall be terminated at the main ground plate or to the EES, whichever is the closest. The electronic single point ground system shall be configured to minimize conductor lengths. Conductive loops shall be avoided by maintaining a trunk and branch arrangement as shown in Figure XIII.

4.2.8.2 Ground Plates

Main, branch and feeder ground plates shall be of copper and at least 12 inches long, 6 inches wide, and ¼ inch thick. The plates shall be mounted on non-conductive material of sufficient cross section to rigidly support the plates after all conductors are connected. Bolts or other devices used to secure the plates in place shall be insulated or shall be of a non-conducting material. The plates shall be mounted in a manner that provides ready accessibility for future inspection and maintenance.

4.2.8.3 Isolation between Single Point and SRP or MPG Systems

The minimum resistance between the electronic single point ground and the SRP or MPG systems shall be 10 megohms. The resistance shall be measured after the complete network is installed and before connection to the EES or to the SRP or MPG system at the main ground plate.

4.2.8.3.1 Resistance

The maximum resistance of any bond to a ground plate shall not be greater than 1 milliohm.

4.2.8.4 Ground Conductors

All ground conductors shall be insulated copper conductors color-coded green with a yellow tracer.

4.2.8.4.1 Main Ground Conductor

When a single point ground system is established directly from the EES, the single point main ground conductor shall be an insulated 500 kcmil copper conductor not exceeding 50 feet in length. The main ground conductor shall be connected to the EES by an exothermic weld in accordance with paragraph 4.1.1.2.1.

4.2.8.4.2 Trunk and Branch Ground Conductors

An insulated trunk ground conductor shall be installed in each facility from the main ground plate to each of the branch plates as shown in Figure XIII. Insulated copper branch ground conductors shall be installed between feeder plates and branch ground plates. These conductors shall be routed to provide the shortest practical path. Trunk conductors shall be 4/0 AWG insulated copper conductors with a yellow tracer for systems where the farthest feeder plate in the system is no more than 400 feet from the EES via the conductor runs. For longer runs, select a conductor size based on providing a cross sectional area of 500 circular mils (cmil) per running foot of conductor length but in no case smaller than 250 kcmil. Trunk ground conductors shall be exothermically welded or connected with UL listed double bolted connectors to the ground plates in accordance with paragraph 4.1.1.2.4 and shall be mounted as shown on the facility drawings.

4.2.8.4.3 Electronic Equipment Ground Conductors

The conductor from the feeder ground plate (branch ground plate if there is no need for a feeder ground plate in the conductor run) to the isolated terminal or bus on the electronic equipment shall be sized at 500 cmil per running foot with a minimum size of 6 AWG.

4.2.8.5 Interconnections

All connections to the single point ground system shall be made on ground plates or buses. Split bolts and other connections to existing conductors are not allowed.

4.2.8.6 Labeling

The single point ground system shall be clearly labeled to preserve its integrity as described in the following sections.

4.2.8.6.1 Conductor Identification

At each single point grounding conductor termination the conductor shall be labeled to identify the point of termination of the other end of the conductor. This shall be accomplished by embossed label. These conductors shall also be identified every 50 feet and in junction boxes in the manner above indicating both ends.

4.2.8.6.2 Ground Plate Labeling

All ground plates shall be protected with a clear plastic protective cover spaced ¾ inch (19 mm) from the plate and extending 1 inch (25.4 mm) beyond each edge. This cover shall have a green label with distinguishing bright yellow slashes attached bearing the caption: "CAUTION, ELECTRONIC SINGLE POINT GROUND" in black $^{3}/_{8}$ inch high (10 mm) letters.

4.2.8.6.3 Protection

Provide mechanical protection for all conductors in the electronic single point ground system where they are subject to damage. This protection shall be provided by conduit, floor trenches, routing behind permanent structural members, or other means as applicable. Single point ground conductors shall be isolated from contact with any metal elements.

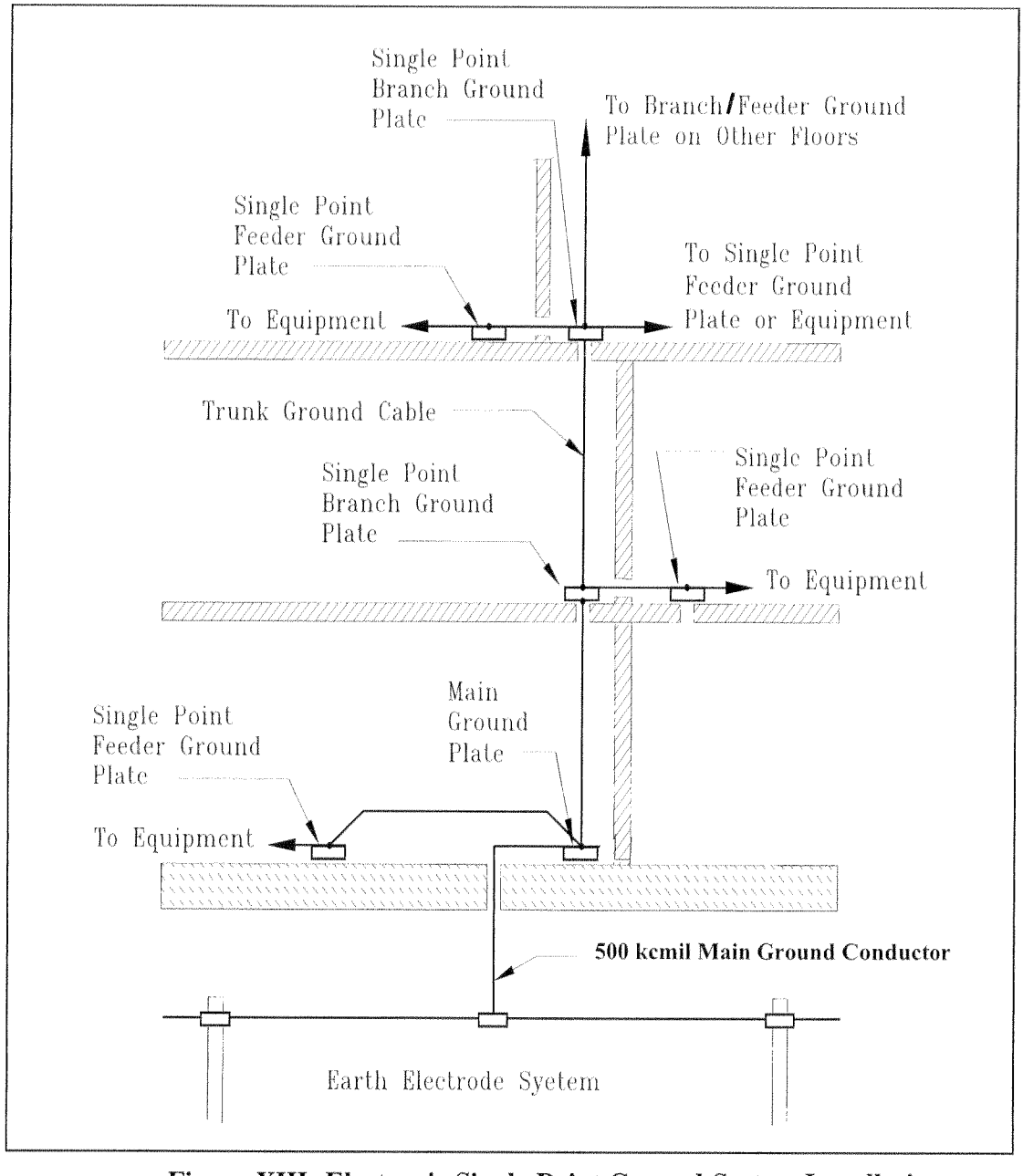


Figure XIII. Electronic Single Point Ground System Installation

4.2.9 DC Bus Grounding Requirements

Contact the OPR for specific DC Bus grounding designs.

4.2.10 National Electrical Code (NEC) Grounding Compliance

4.2.10.1 General

The facility electrical grounding shall exceed requirements of NEC Article 250 as specified herein.

4.2.10.2 Grounding Electrode Conductors

Grounding electrode conductors shall conform to the following:

(a) Facilities shall have the grounded conductor (neutral) connected to the EES by a copper grounding electrode conductor at the service disconnecting means. The grounding electrode conductor shall be sized in accordance with the NEC, but never smaller than 2 AWG.
(b) The grounding electrode conductor connection shall be made to the neutral bus in the service disconnecting means.
(c) If the grounding electrode conductor is spliced using a hydraulically crimped connector, the connector will comply with paragraph 4.1.1.2.4.4. When a grounding electrode conductor is routed through a metal enclosure, e.g., conduit, the enclosure shall be bonded at each end to the grounding electrode conductor.
(d) An equipment grounding conductor shall be routed with associated phase conductors to a second building or structure. The grounded conductor routed from the first building or structure shall not be connected to the equipment grounding conductor or EES at the second building or structure.
(e) For a separately derived system, the system bonding jumper and the grounding electrode conductor shall be located at the first downstream system disconnecting means or overcurrent device. For the grounding electrode conductor the connection shall be to the nearest effectively grounded structural metal member. Where it is not feasible to connect the grounding electrode conductor to a structural metal member, the EES shall be used. The grounding electrode conductor shall be copper and sized in accordance with NEC requirements, except that it shall not be smaller than 2 AWG.

    Separately derived systems, other than at the top of a tall ATCT, serving NAS critical and essential services shall have an additional grounding electrode conductor terminated to the EES.

4.2.10.3 Equipment Grounding Conductors

The equipment grounding conductor shall be a green-insulated wire routed in the same raceway as its' related phase and neutral conductors. Cord-connected equipment requiring an equipment ground shall include the equipment grounding conductor as an integral part of the power cord. Where power is supplied to electronic equipment through a cable and connector, the connector shall contain a pin to continue the equipment grounding conductor to the equipment chassis. Conduit or cable shields shall not be used as the equipment grounding conductor. All installations shall be in accordance with the NEC, FAA-C-1217 and with the following:

(a) Parity-sized equipment grounding conductors, same sized as the associated phase conductors, shall be used when it is recommended as good practice in a manufacturer's equipment installation requirements. Where a parity-sized equipment grounding conductor is installed it shall be bonded to bonding bushings at each end of the raceway with a bonding jumper the same size as the equipment grounding conductor. This shall be accomplished for branch circuits as a minimum.
(b) Grounding terminals in all receptacles on multioutlet assemblies shall be hardwired to an equipment grounding conductor. Strips that depend upon serrated or toothed fingers for

grounding shall not be used.

(c) All flexible metal conduits shall be provided with an external bonding jumper in addition to the internal equipment grounding conductor. The bonding jumper shall be a 6 AWG green-insulated stranded copper conductor. The bonding jumper shall terminate on fittings listed for grounding at each end of the flexible metal conduit.

(d) A seperate equipment grounding conductor shall be provided for each overcurrent device and as required by the NEC.

4.2.10.4 Color Coding of Conductors

4.2.10.4.1 Grounded Conductors

(a) Grounded conductors shall be insulated and color-coded white for 120/208V and 120/240V and gray for voltages above 120/240V. Conductors larger than 6 AWG shall be allowed to be re-identified as the grounded conductor except that green conductors shall not be re-identified.

(b) In any raceway, box, cable tray, or enclosure, where grounded conductors of different systems are present, each grounded conductor shall be identified by system, in accordance with the NEC.

(c) Color-coding of grounded conductors shall be applied at each connection and at every point where the conductor is accessible. Where routed through raceways with covers, the color coding shall be visible by removing or opening any cover. Where conductors are routed through cable trays, color coding 3 inches (75 mm) in length shall be provided at intervals not exceeding 3 feet (0.9 m).

4.2.10.4.2 Equipment Grounding Conductors

(a) Equipment grounding conductors shall be solid green in color. Insulated conductors larger than 6 AWG shall be allowed to be re-identified with green tape. White or gray conductors shall not be re-identified as equipment grounding conductors. The equipment grounding conductor from the grounding terminal of an isolated receptacle shall be color-coded green with yellow and red tracers.

(b) Color-coding of equipment grounding conductors shall be applied at each connection and at every point where the conductor is accessible. Where routed through raceways with covers, the coding shall be visible by removing or opening any cover. Where conductors are routed through cable trays, color coding 3 inches (75 mm) long shall be provided at intervals not exceeding 3 feet (0.9 m).

(c) Some COTS equipment is supplied with a green and yellow equipment grounding conductor. These conductors do not need to be replaced. These conductors shall not be connected to the single point ground system.

4.2.10.4.3 Control and DC Power Cables and Conductors

Color-coding for conductors in control cables shall be in accordance with NEMA Standard WC-5. DC power conductors, including battery cables, shall be color-coded as follows: a red for positive conductor and black for a negative conductor. The red conductor shall be marked with a positive (+) symbol and the black conductor shall be marked with a (-) symbol. The symbols shall be applied to the conductor with a shrink embossed label.

4.2.10.5 Non-Current-Carrying Metal Equipment Enclosures

(a) All non-current-carrying metal enclosures such as raceways, cable trays and panel boards shall be electrically continuous. Insulating finishes shall be removed between grounding/bonding areas of mating surfaces or bonding jumpers. Ferrous conduit (galvanized rigid metal conduit only) shall be equipped with bonding bushings at each end and the equipment grounding conductor shall be bonded to the bushings with a bonding jumper the same size as the equipment grounding conductor. This shall be accomplished in accordance with Figure XIV.
(b) Ferrous materials shall be used for enclosures, raceways, and cable trays to provide shielding from magnetic fields
(c) All battery supporting racks shall be bonded either directly to the EES or to any grounded structure with a 2 AWG conductor.

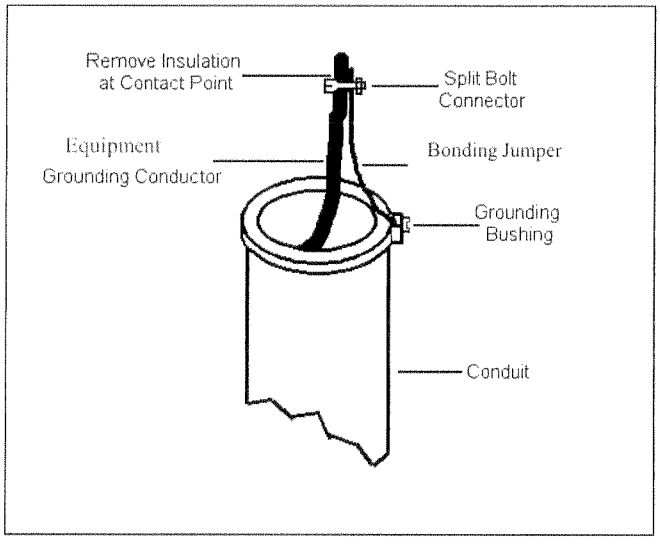


Figure XIV. Bonding of Conduit and Grounding Conductor

4.2.11 Airport Traffic Control Towers (ATCT) Special Requirements

ATCT's (Figure XV) having electronic areas in the cab, junction and sub-junction levels at the top of the shaft and also in the associated base building present a unique set of challenges for implementing lightning and transient protection. The numerous conductors running between electronic equipment located in the base building and beneath the tower cab are subject to large electromagnetic fields during a lightning strike. For this reason, special techniques shall be applied to provide an environment that minimizes the damaging effects of lightning. These techniques are mandatory for ATCT facilities with base buildings that meet the following:

(a) Over 100 feet in height to the highest point of the building, and
(b) Located in areas with a lightning flash density of 0.5/km^2/year (1.3/mile^2/year) or greater.

These techniques are recommended for application to all ATCT facilities.

4.2.11.1 General

The lightning protection, electrical, electromechanical, electronic systems, and building steel of structures shall be bonded together for safety. It is not possible for equipment near the top of the tower and at the base to have the same electrical potential during a lightning strike. It is therefore necessary to reference all systems at the top of the tower to each other and treat this area as a separate facility. SPD's shall be provided at the base building/tower shaft facility entrance and at the top of the shaft.

4.2.11.2 Main Ground Connections

In order to assure good high frequency grounding during normal operation a low impedance connection must be provided to the EES. A main ground plate shall be established on the lowest level with electrical, electromechanical, or electronic equipment serving the ATCT cab (see Figure XV). All grounding systems present at or above this level within the ATCT shall be connected to this main ground plate. A 1-foot wide 26 gauge or thicker copper strap shall connect this main ground plate to a plate at the base of the ATCT. This strap shall be routed continuously from the main ground plate to the base plate without sharp bends, loops, kinks, or splices and will provide two square feet of surface per linear foot of conductor. Substitution of a combination of conductors providing the same surface area per linear foot shall be allowed. This strap or conductors shall be mechanically bonded to the main ground plate and the base plate. The strap shall be sandwiched between the plate at each end and a 1'x1"x1/8" copper bar to insure good electrical contact and mechanical strength. Connect the base plate to the EES in an access well with two exothermically welded 500 kcmil conductors. The OPR should be consulted for assistance in meeting this requirement.

4.2.11.3 Power Distribution

All power distribution for the areas at the top of the ATCT shall be via separately derived systems. These separately derived systems shall be grounded in accordance with the requirements of NEC article 250 and paragraph 4.2.10.2(e) at the first downstream disconnecting means or overcurrent device. This point of connection is mandated to facilitate the effective installation of an SPD. An SPD, in accordance with paragraph 4.2.2.2 shall be installed on the load side of the first downstream disconnecting means or overcurrent device of each separately derived system. The ground bus at the first disconnecting means or overcurrent device shall be bonded to the main ground plate established in accordance with the requirements paragraph4.2.11.2. This connection is in addition to the grounding electrode conductor requirements of NEC article 250.

The interior metallic piping systems at the top of the ATCT shall be bonded to the main ground plate established in accordance with the requirements paragraph4.2.11.2. This connection is in addition to the bonding requirements of NEC article 250.

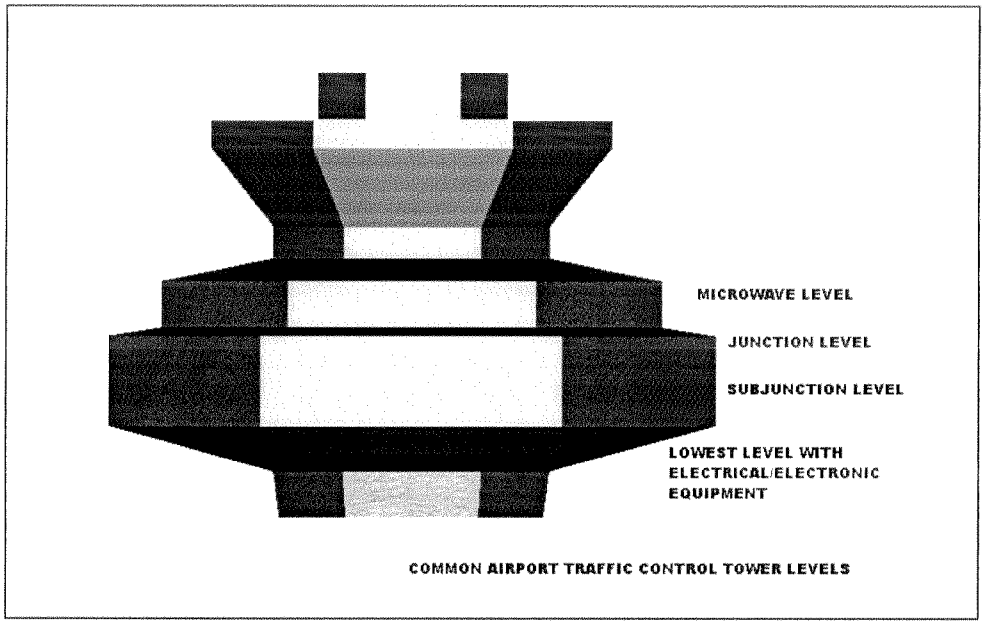


Figure XV. Airport Traffic Control Tower Levels

4.2.11.4 Bonding

Metal elements comprising the ATCT shall be bonded together and to the EES.

Provision shall be made to ensure that all rebar used in tower construction is electrically bonded together – continuous laterally and vertically to the EES – for the entire ATCT. Rebar shall be bonded to the EES with a minimum 2 AWG copper conductor that is applied via an exothermic weld or a hydraulically crimped termination.

At the top of the ATCT, the tower cab and all equipment locations supporting the cab shall be enveloped in a rudimentary Faraday cage. This shall be accomplished by bonding together all structural and fabrication steel. In turn, this steel cage shall be electrically bonded to the rebar in the concrete construction. Penetrations of the Faraday cage, e.g., conduit, water pipe, etc., shall be bonded to the cage at the point of entry. Bonding jumpers shall be a minimum 2 AWG copper conductor.

At all levels of an ATCT, horizontal metal transitions (floors, stairs, walkways, etc.) shall be bonded to structural steel and/or rebar. Elevator support structures shall be bonded to horizontal metal transitions and to the EES. All bonding jumpers shall be a minimum 2 AWG copper conductor.

If this last requirement cannot be met, contact the OPR of this document.

4.2.11.5 Signal, Communications, Axial Cables and Control Line Protection

Transient protection shall be applied at each end of vertical cables routed between the equipment room near the top of the ATCT and the associated base building. Cables between the tower cab

and equipment room areas shall be protected in accordance with paragraphs 4.2.2.5 through 4.2.2.7. Both facility and equipment levels of protection shall be provided for these lines. Enclosing metallic cabling in ferrous conduit or the use of all dielectric fiber optic cable can significantly reduce the threat of lightning related damage to ATCT and base building circuits.

4.2.11.6 Signal Reference Structure

An SRS shall be constructed in accordance with paragraph 4.2.7. This shall be accomplished for the cab and all other areas at the top of the ATCT that contain electrical, electromechanical or electronic equipment serving the cab.

4.2.11.7 Floor Coverings for Electronic Equipment and Operational Areas

Floor coverings for the cab and areas serving the cab shall be either tile or carpeting and shall be of static dissipative material. These shall be installed per manufacturers' specifications and connected to a component of the SRS – except to any single point ground system. The floor covering and installation shall meet the requirements of paragraph 4.1.3.4.8.

4.2.11.8 Single Point Grounding

Single point ground systems, if required, shall be constructed in accordance with paragraph 4.2.8. All single point ground systems and independent ground systems mandated by equipment manufacturers shall be bonded to the ATCT main ground plate established in accordance with the requirements paragraph4.2.11.2.

4.3 Equipment Requirements

Electronic equipment installed in FAA NAS facilities must comply with the requirements contained in this section.

4.3.1 Electronic Signal Lines and Cables

Electronic signal lines shall be shielded twisted pairs with an insulated covering. Cables consisting of multiple twisted pairs shall have the individual shields isolated from each other. Cables shall have an overall shield with an overall insulated covering.

4.3.1.1 Termination of Individual Shields

Termination of individual shields shall be in accordance with paragraph 4.1.2.3.2.

4.3.1.2 Termination of Overall Shields

Termination of overall shields shall be in accordance with paragraph 4.1.2.3.3.

4.3.2 Signal Control and Data Line Entrance

Procurement organizations are responsible for ensuring that electronic equipment, such as radars, navaids, or transmitters, supplied for use in FAA operational facilities, shall be provided with transient protection that reduce surges and transients to below the equipment transient susceptibility level. Signal control and data line entrance protection shall be provided as an integral part of all electronic equipment mounted internally or on the exterior of the equipment and at the facility entrance. The equipment susceptibility level is defined as the transient level

on the signal, control or data lines that cause damage, degradation, or upset to electronic circuitry connected to the line. Protection for these lines is in addition to the facility protection levels specified in paragraphs 4.2.2.5 through 4.2.2.7. The procurement organizations are responsible for ensuring that testing is performed to determine voltage, current, or energy levels that will cause immediate damage to components, shorten operating life, or cause operational upset to the equipment. These tests shall consider all electrical and electronic equipment components exposed to the effects of surges or transients. The procurement organization shall ensure that facility and equipment entrance protection is coordinated to limit transients at the equipment to below the equipment susceptibility level. Requirements of this paragraph shall be included in the comprehensive control and test plans outlined in paragraph 4.1.4.2. In all cases, the following characteristics shall be evaluated.

(a) Component damage threshold. The damage threshold is the transient level that renders the component nonfunctional or operationally deficient. For solid-state components, voltage is usually the relevant parameter.
(b) Component degradation level. The component degradation level is the transient voltage or energy level that shortens the useful life of the component.
(c) Operational upset level. The operational upset level is the transient voltage or energy level that causes an unacceptable change in operating characteristics for longer than 10 milliseconds for analog equipment or a change of logic state for digital equipment.

4.3.2.1 Lines and Cables Requiring Protection

Surge protective devices shall be placed on both ends of signal, data, and control lines longer than 10 feet connecting pieces of equipment not located on and bonded to the same SRS, or when the SRGG, SRGP, and the multipoint ground system is located in different rooms or on different floors. (refer to Figure XVI). This includes all signal, data, and control lines. This equipment shall be protected as specified in paragraph 4.3.2.

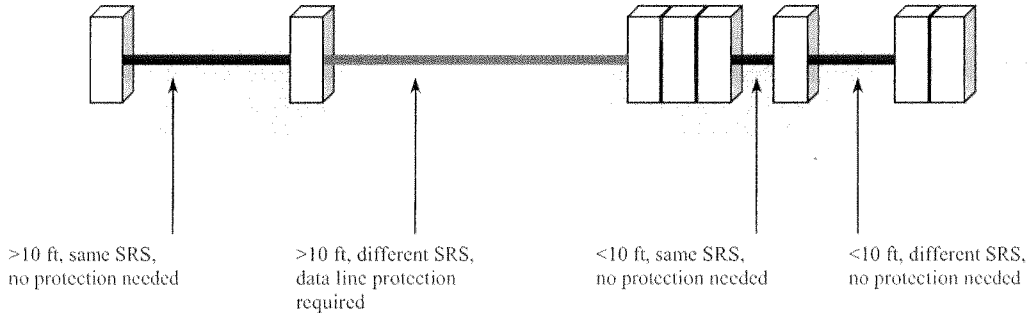


Figure XVI. Lines and Cables Requiring Protection

4.3.3 Power Entrance

Surge protective devices, components or circuits for protection of electronic equipment power lines shall be provided by the equipment manufacturer as an integral part of all electronic equipment mounted internally or on the exterior of the equipment at the cable entrance (see paragraph 4.2.2.1). These devices shall be positioned at the AC power conductor entrance to electronic equipment housed in a shielded, compartmentalized enclosure. SPDs at equipment shall provide a clamping level less than the equipment operational upset susceptibility level as

defined in paragraph 4.3.2(c) and must conform to the relevant columns of Table X, Table XI, and Table XII.

(a) Maximum continuous operating voltage (MCOV). The maximum continuous operating voltage is the maximum RMS voltage an SPD will withstand at its maximum operating temperature continuously without degradation or change to any of its parameters greater than +/-10%. The MCOV will be at least 10% above the nominal system voltage. Leakage current as defined below shall not be exceeded.
(b) Leakage current. The DC leakage current will be less than 1mA for voltages at or below 1.414 x MCOV VDC.
(c) Clamp (discharge) voltage. Clamp (discharge) voltage is the maximum voltage that appears across an SPD output terminal while conducting surge currents. Clamp (discharge) voltage measured at 3kA (to ensure performance in the linear region without impacting the device lifetime performance) 8/20 microseconds shall not change more than 10% over the operating life of the Surge Protection Device as defined in Table XII. Electronic Equipment Power Entrance SPD Requirements.
(d) Overshoot voltage. Overshoot voltage shall not exceed 2 times the SPD clamp voltage for more than 10 nanoseconds. Overshoot voltage is the surge voltage level that appears across the SPD terminals before the device turns on and clamps the surge to the specified voltage level.
(e) Self-restoring capability. The SPD shall automatically return to an off state after surge dissipation when line voltage returns to normal.
(f) Operating lifetime. The SPD shall safely dissipate the number and amplitude of surges listed in Table XII.
(g) Fusing. Any fusing shall not increase the clamp voltage of the SPD and shall pass the surge current levels listed in Table XII up to the 20kA level without opening. Any fusing provided shall be coordinated with the supply fusing.

4.3.3.1 Slope Resistance

It is the purpose of this parameter to create a regime where it is possible to ensure device coordination. The slope resistance for the equipment protection shall meet the requirements of Table X and is calculated via the formula below:

$R_{slope} = (V_{10} - V_1)/9000$

Where V_{10} = the clamping voltage measured at 10kA 8/20μs
and
Where V_1 = the clamping voltage measured at 1kA 8/20μs
The values of V_{10} and V_1 used shall be measured values determined in actual testing of the SPDs and not calculated.

Table X. Equipment Power Entrance Slope Resistance Requirements

Location	Slope Resistance
Electronic equipment power entrance	60 mΩ Minimum

The voltages that must be achieved during testing at 3kA with an 8/20μs current impulse is shown in Table VI. All voltages shall be measured at the device terminals. The 8/20μs current impulse wave shape shall not lead or lag the voltage wave shape by more than 30 degrees.

Table XI. Protection Voltages at 3kA for the Equipment Power Entrance

Location	System Voltage	V_3	Limit
Electronic equipment power entrance	120/208 120/240	550 L-N, L-G 850 L-L	Minimum
Electronic equipment power entrance	277/480	850 L-N, L-G 1350 L-L	Minimum
Electronic equipment power entrance	380Delta	1350 L-L, L-G	Minimum
Electronic equipment power entrance	480 Delta	1350 L-L, L-G	Minimum

Table XII. Electronic Equipment Power Entrance SPD Requirements

Surge Current Amplitude 8/20μs Waveform	Surge Number lifetime Electronic equipment power entrance
1kA	100
10kA	25
20kA	1

Each level of surge current and the number required represents a single lifetime of an SPD.

4.3.3.2 DC Power Supply Transient Suppression

Procurement organizations are responsible for ensuring that power supplies that use 60 Hertz (Hz) power and furnish DC operating voltages to solid-state equipment used in direct support of the NAS, shall have transient suppression components from each output of the power supply to the equipment chassis. The chassis side of suppressors shall be connected as directly as possible to rectifier output ground. Operating characteristics of suppression components provided for power supply rectifier output lines shall be as follows:

(a) Operating lifetime. The transient suppressors shall safely dissipate 1000 surges with an amplitude of 200 Amps and a waveform of 1.2/50 μs. Methods of testing shall be in accordance with the guidance in IEEE C62.45.
(b) Limiting Voltage. The voltage shall be limited to a point 20% below the maximum Peak Inverse Voltage (PIV) of the DC rectifier.

4.3.3.3 Externally Mounted Electronic Equipment

When electronic equipment is not enclosed in a facility (e.g. RVR, LLWAS, OM, etc.) the power SPD protection specified in this document rated for facility entrance shall be provided. For the signal and control cables of this equipment both facility and electronic equipment entrance shall be provided at the equipment entrance as a combined protector. The grounding conductor shall be bonded to the equipment chassis and shall be of minimum length and routed to avoid sharp bends, kinks or loops. Access shall be provided for visual inspection and replacement of these SPDs.

4.3.4 Electronic Equipment Grounding

4.3.4.1 Electronic Cabinets, Racks, and Cases

All electronic cabinets, racks, and cases shall provide a grounding terminal or bus whereby a grounding jumper or wire can be mechanically connected through an electrically conductive surface to the basic frame. The metal enclosure of each individual unit or piece of electronic equipment shall be bonded to its cabinet, rack, or directly to the SRP or MPG system.

4.3.4.2 Isolated Grounding Receptacles

For reduction of electrical noise, isolated receptacles installed in accordance with the NEC shall be permitted. The isolated equipment grounding conductors used for these receptacles shall be color-coded green with red and yellow tracers at each termination, and when passing through an enclosure without termination.

4.3.4.3 Portable Equipment (with grounding conductor)

Portable electrical or electronic equipment cases, enclosures, and housings shall be considered to be adequately grounded for fault protection through the equipment grounding conductor of the power cord, provided continuity is firmly established between the case, enclosure or housing, and the receptacle ground terminal. The power cord equipment grounding conductor shall not be used for signal grounding.

4.3.4.4 AC Power Filters

All filter cases shall be directly bonded in accordance with paragraph 4.1.1.10 to the equipment case or enclosure. Filter leakage current shall not exceed 5 milliamperes (mA) per filter. Transient suppression devices, components or circuits shall be installed in accordance with paragraph 4.2.2.1.

4.3.5 Equipment Signal Grounding Requirements

4.3.5.1 Input and Output Electronic Signals

Where a common signal reference is used, low frequency analog input and output signals shall be balanced with respect to the signal reference. Extreme care shall be taken to maintain isolation between the single point ground system and the SRP or MPG system, except at the main ground plate or EES.

4.3.5.2 Multipoint Grounding of Electronic Equipment

When permitted by circuit design requirements, all internal ground references shall be directly bonded to the chassis and the equipment case. Where mounted in a rack, cabinet or enclosure, the electronic equipment case shall be bonded to the racks, cabinet or enclosure in accordance with paragraph 4.3.4.1. The DC resistance between any two points within a chassis or electronic equipment cabinet serving as ground shall be less than 25 milliohms total and not more than 2.5 milliohms per joint. Shields shall be provided as required for personnel protection and electromagnetic interference reduction.

4.3.5.2.1 Prevention of Resonance in Bonding Straps

To prevent the possibility of problems due to resonance of a single bonding strap, two widely spaced straps of unequal length shall be used to connect the equipment to the multipoint grounding bus in the equipment cabinet. Bonding shall be in accordance with the recommended practices as expressed in paragraph 4.2.7.4 and IEEE Std 1100-1999 paragraph 8.5.4.6.

4.3.5.3 Single Point Grounding of Electronic Equipment

When electronic equipment performance necessitates an isolated electronic single point ground system for proper operation, all the equipment and its installation shall comply with the following:

The single point ground system or plane shall be isolated from the electronic equipment case. If a metal chassis is used as the electronic single point ground, the chassis shall be floated relative to the case. Design practices shall be such that the single point ground of the electronic equipment can be properly interfaced with other electronic equipment without compromising the system. If necessary, this single point ground system shall be filtered for high frequencies.

4.3.5.3.1 Single Point Input and Output Signal Requirements

The "high" and "low" sides of input and output signals shall be isolated from the electronic equipment case and balanced with respect to the signal reference. Operating and adjusting controls, readouts or indicating devices, protective devices, monitoring jacks and signal connectors shall be designed to isolate both the high and low side of the signal from the case.

4.3.5.3.2 Single Point Case Isolation Requirements

The isolation between the single point ground system terminals and the case shall be 10 megohms or greater with all external power, signal and control lines disconnected from the electronic equipment.

4.3.5.3.3 Single Point Power Isolation Requirements

The isolation between the single point ground system terminals and each power conductor (including AC neutral) shall be 10 megohms or greater with the power switch in the on position and the power disconnected from the supply.

4.3.5.4 Equipment Single Point Ground Terminals

Insulated single point ground system terminal(s) shall be provided on each electronic equipment case where an isolated signal reference is required. The single point ground reference for the internal circuits shall be connected to this terminal. This terminal(s) shall be used to terminate cable shields as appropriate, and to connect the isolated signal ground of the electronic equipment to the single point ground system in the facility. A connector pin, a screw or pin on a terminal strip, an insulated stud, jack or feed through, or an insulated wire shall be an acceptable terminal so long as each terminal is clearly marked, labeled, or coded in a manner that does not interfere with its intended function. These marks, codes, or labels shall be permanently affixed and shall utilize green with yellow stripes. Wire insulation shall be green with a yellow tracer.

4.3.5.4.1 Connection of Electronic Equipment to the Single Point Ground System

Each equipment single point ground terminal shall be connected to the facility single point ground system in accordance with the following:

(a) Individual units or pieces of electronic equipment which by nature of their location or function cannot or should not be mounted with other electronic equipment, shall have an insulated copper conductor installed between the electronic single point ground terminal specified in paragraph 4.3.5.4 and the nearest electronic single point ground system ground plate. This conductor shall have a cross-sectional area of 500 circular mils per linear foot with a minimum size of 6 AWG.

(b) Where two or more units or pieces of electronic equipment are mounted together in a rack or cabinet, a single point ground bus bar shall be installed as shown in Figure XVII. The bus bar shall be copper and shall provide a minimum cross-sectional area of 125,000 circular mils (e.g., a 1inch by 1/8inch bus bar). The bus bar shall be drilled and tapped for #10 screws. The holes shall be located as required by the relative location of the isolated electronic single point grounding terminals on the electronic equipment. The bus bar shall be mounted on insulating supports that provide at least 10 megohms resistance between the bus bar and the rack or cabinet.

(c) Each electronic equipment isolated single point ground terminal shall be interconnected to the bus bar by means of a solid or flexible tinned (6 AWG minimum) copper jumper of sufficient cross sectional area so that its resistance is 5 milliohms or less. The jumper shall be insulated or mounted in a manner that maintains the required degree of isolation between the reference conductor and the enclosure. The interconnecting jumper shall be attached to the bus bar at a point nearest to the single point ground terminal to which the strap is attached. An insulated copper conductor shall be installed from the bus bar in the cabinet to the nearest electronic single point ground system. This conductor shall provide at least 500 circular mils per linear foot, and must be a minimum 6 AWG conductor.

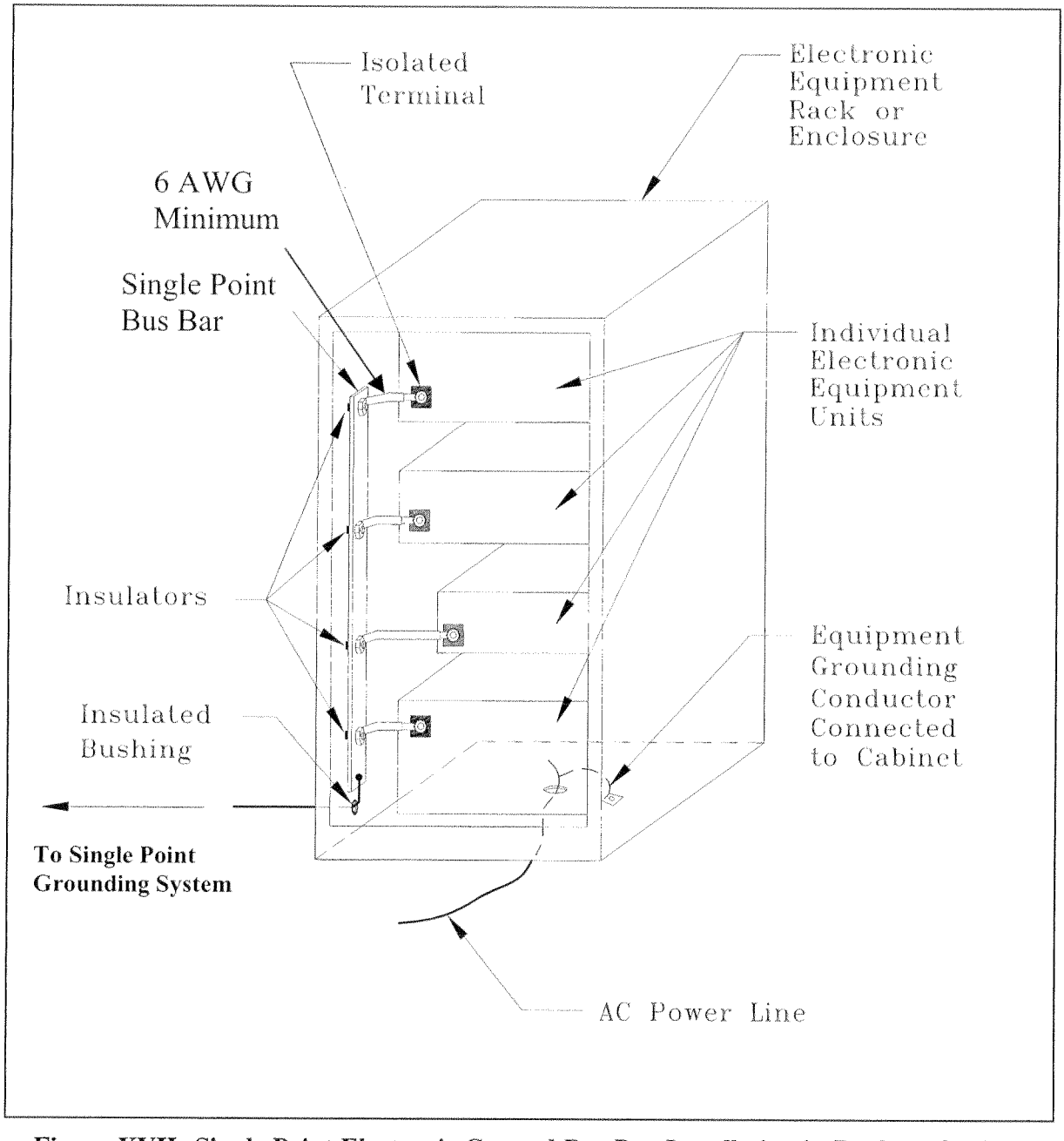


Figure XVII. Single Point Electronic Ground Bus Bar Installation in Rack or Cabinet

4.3.6 Equipment Shielding Requirements

4.3.6.1 Control of Apertures
Unnecessary apertures shall be avoided. Only those shield openings needed to achieve proper functioning and operation of the equipment shall be provided. Controls, switches, and fuse holders shall be mounted so close metal-to-metal contact is maintained between the cover housing of the devices and the case. Metal control shafts shall be grounded in accordance with paragraph 4.3.6.2. Where nonconductive control shafts are necessary, a close fitting metal sleeve peripherally bonded to the case shall be provided for the shaft. The length of the sleeve shall be no less than four times its diameter. Lights shall be filtered or shielded as needed to maintain the required degree of shielding effectiveness. Ventilation and drainage holes shall utilize appropriate shielding techniques. Care shall be taken to assure that the shielding is well bonded to the shield completely around the opening.

4.3.6.2 Metal Control Shafts
Metal control shafts shall be grounded to the equipment case through a low impedance path provided by close-fitting conductive gaskets, metal finger stock, or grounding nuts.

4.3.6.3 Shielded Compartments
Shields shall be bonded to the chassis for fault protection in accordance with paragraph 4.1.1.

4.3.7 Circuit and Equipment ESD Design Requirements

4.3.7.1 Circuit Design and Layout
The design, layout, and packaging of assemblies, circuits, and components integrated into electrical and electronic equipment shall incorporate methods and techniques to reduce susceptibility to ESD.

4.3.7.2 Component Protection
External protection shall be provided for all integrated circuits, discrete components, and other parts without internal ESD protection that are inherently susceptible to ESD. Protective components shall be installed as close as possible to the ESD susceptible item.

4.3.7.3 ESD Withstand Requirements
In the installed and operational configuration, all equipment cabinets, enclosures, racks, controls, meters, displays, test points, interfaces, etc., shall withstand a static discharge of 15,000 Volts per ESD Association Standard Test Method ESD-STM 5.1, Electrostatic Discharge Sensitivity Testing – Human Body Model (HBM). Equipment that is tested shall not suffer any operational upset or damage to any component or assembly to successfully pass ESD withstand requirements.

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5 DETAILED REQUIREMENTS

Section is not applicable to this standard.

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6 NOTES

6.1 Acronyms and Abbreviations

The following are acronyms and abbreviations used in this standard

A	Amperes	L-L	Line to Line
AC	Alternating current	L-N	Line to Neutral
ANSI	American National Standards Institute	LRU	Line replacement unit
AWG	American Wire Gauge	m	Meter
Cm	Centimeter(s)	mA	Milliampere
Cmil	Circular mils	MCM	See kcmil
DC	Direct current	MCOV	Maximum continuous operating voltage
e.g.	For example	MHz	Megahertz
EES	Earth electrode system	MPG	Electronic multipoint ground system
EMI	Electromagnetic interference	mm	Millimeter(s)
EPP	Equipotential plane	NAS	National Airspace System
EOS	Electrical overstress	NEC	National Electrical Code
ESD	Electrostatic discharge	NEMA	National Electrical Manufacturers Association
Et.al.	And others	NFPA	National Fire Protection Association
FAA	Federal Aviation Administration	No.	Number
ft.	Foot (feet)	OPR	Office of Primary Responsibility
GP	Groundable point	PVC	Polyvinyl chloride
Hz	Hertz	RF	Radio frequency
i.e.	That is	RGS	Rigid galvanized steel
in.	Inch(es)	RFI	Radio frequency interference
IEEE	Institute of Electrical and Electronics Engineers	RMM	Remote maintenance monitoring
kA	Kiloampere	SAS	Silicon avalanche diode suppressors
kcmil	Thousand circular mils	SDM	Service disconnecting means
kg	Kilogram	SPD	Surge protective device
kHz	Kilohertz	SPG	Electronic single point ground system
LAN	Local area network	SRG	Signal reference grid
LPGBS	Lightning Protection, Grounding, Bonding and Sheilding	UL	Underwriters Laboratories
“	Inch(es)	μs	Microseconds
#	Number	‘	Foot (feet)
L-G	Line to Ground	V	Volts

6.2 Guidelines

Engineering design guidelines are provided for lightning protection, grounding, bonding, shielding, and transient protection in FAA Orders 6950.19 and 6950.20. Guidance for EMI protection is in MIL-HDBK-253, and for electrostatic discharge (ESD) in NFPA 77, DOD-HDBK-263, DOD-STD-1686 and IEEE1100.

6.3 Version Cross-Reference

Due to the major reorganization of FAA-STD-019e it is not feasible to provide an exact cross-reference between this standard and the previous version, FAA-STD-019d. However the handbook to FAA-STD-019e will provide information on requirements revisions and detail cost effective methods of applying them. Where possible references to the original requirements in FAA-STD-019d will be provided.

APPENDIX D

DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION, PAR-56 LAMPHOLDER

FAA-E-982j
Dated May 6, 2003
SUPERSEDING
FAA-E-982h
July 22, 1987

U.S. Department Of Transportation

Federal Aviation Administration

Specification

PAR-56 LAMPHOLDER

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

CONTENTS

Paragraph Page

FIGURES

TABLES

1. SCOPE

1.1 Scope.

This specification covers the requirements of the Federal Aviation Administration for an aluminum PAR-56 lampholder for use in approach lighting systems.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.

The following FAA specifications, standards, and drawings of the issues in effect on the date for invitation-for-bids or request-for-proposals, form a part of this specification and are applicable to the extent specified herein.

2.1.1 FAA specifications.

FAA-E-2408	Lamps, PAR-56, Incandescent, Aviation Service
FAA-E-2604	Low-Impact Resistant Structures for Medium Intensity Approach Lighting System (MALS)
FAA-E-2702	Low-Impact Resistant Structures
FAA-G-2100	Electronic Equipment, General Requirements
AC 150/5345	Isolation Transformers for Airport Lighting Systems

2.1.2 FAA standards.

FAA-STD-012	Paint Systems for Equipment
FAA-STD-013	Quality Control Program Requirements

2.1.3 FAA drawings.

A-4885-1	High Intensity Approach Lights, Color Screen, 8-Inch Diameter
C-5407-1	Lamps, Incandescent PAR-56
C-6046	Frangible Coupling, Type I and IA, Details
C-21216	Standard Nameplate
D-5870-4	Approach Lighting System, 5-Light Bar, Frangible Mounting, Maximum Mounting Height 6'-0"

D-6071-15	ALSF-2, Approach Lighting System, 6'-10" to 128'-0", Low-Impact Resistant Structures, Types T-4 and T-3, Tee-Assembly Details, Light Mounting Height 6'-0" to 128'-0"

2.2 Military and federal documents.

The following military and federal documents, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military specifications.

MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-E-17555	Electronic and Electrical Equipment, Accessories and Repair Parts, Packaging and Packing of
MIL-S-25043	Steel Plate, Sheet & Strip, 17-7PH
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys

2.2.2 Military standards.

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-130	Identification Marking of U.S. Military Property

2.2.3 Federal standard.

FED-STD-595	Colors

2.2.4 Federal specification.

QQ-P-35	Passivation Treatments for Corrosion-Resisting Steel

2.3 Other documents.

ANSI A360.0	Aluminum Die Casting Alloy Data
ASTM A240	Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

ASTM A313	Specification for Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire
ASTM B85	Standard Specification for Aluminum-Alloy Die Castings
ASTM B135	Standard Specification for Seamless Brass Tube
ASTM B174	Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM B534	Standard Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
UNS C17500	Copper-Cobalt-Beryllium alloy, H04 Temper strip, "Unified Numbering System for Metals and Alloys"

(Copies of applicable FAA specifications, standards, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration office issuing the invitation-for-bids or request-for-proposals. Requests should fully identify material desired; i.e., specification, standard, or drawing number and date. Requests should cite the invitation-for-bids, request-for-proposal. or contract involved or other use to be made of the requested material.)

(Single copies of military specifications and standards may be obtained from Federal Aviation Administration, Washington, D.C. 20590, ATTN: Contracting Officer. Requests should cite the invitation-for-bids, request-for-proposals. or contract for which the material is needed. Mail requests, if found acceptable, will be forwarded to a military source of supply for filling; hence, ample time should be allowed. Single copies of military specifications, standards, and publications also may be obtained directly from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

(Information on obtaining Federal specifications and standards may be obtained from the General Services Administration offices in Washington, D.C.; Atlanta; Boston; Chicago; Denver; Kansas City, Missouri; New York; San Francisco; and Seattle.)

(ASTM International. For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org.)

(American National Standards Institute/American Society for Quality Control (ANSI/ASQC) documents may be obtained from ASQC, 611 East Wisconsin Avenue, Milwaukee, Wisconsin 53202. American National Standards Institute (ANSI) documents can be obtained electronically from http://webstore.ansi.org/ansidocstore/shopper_lookup.asp . Paper standards are available through Global Engineering Documents.)

3. REQUIREMENTS

3.1 General.

The PAR-56 lampholder is part of an elevated low-impact resistant approach lighting system. The types of mountings are depicted on FAA Drawings D-6071-15 and D-5870-4.

3.2 Equipment to be furnished by contractor.

The equipments to be furnished under this specification are:

(a) PAR-56 lampholder assembly (3.3.1). Quantities shall be as specified in the contract schedule.
(b) shorting device assembly (3.3.2)
(c) aiming device (3.3.3)
(d) instruction sheet (3.12)
(e) lamp retainer ring

3.3 Functional requirements.

The PAR-56 lampholder shall secure, in the proper operating position, a 300-Watt or a 500-Watt, 20 ampere (A). PAR-56 lamp made in accordance with Specification FAA-E-2408. The PAR-56 lampholder shall also secure the color filter screen, FAA Drawing A-4885-1, using the color screen holder shown on figure 1. The PAR-56 lampholder shall be designed for continuous operation under the environmental conditions specified in 3.4.

3.3.1 PAR-56 lampholder assembly.

The PAR-56 lampholder assembly, figure 2, shall consist of the following parts: a lamp clip assembly, a housing, a mounting assembly, and a lamp connector.

3.3.1.1 Lamp clip assembly.

The lamp clip assembly details, figure 6, shall secure the PAR-56 lamp in place using a minimum of three clips. The lamp clips shall secure the lamp firmly in position with a uniform pressure at 120 degrees points on the periphery of the lamp and lampholder.

3.3.1.2 Color filter clips.

Color filter clips, figure 2, shall be designed in accordance with figure 1 to secure a color filter, FAA Drawing A-4885-1, in front of the PAR-56 lamp. These clips shall be furnished with the lampholder that has 500 Watt lamp. There shall be three clips spaced at 120 degrees around the lamp clip assembly.

3.3.1.3 Housing.

The housing shall consist of a shell with a mounting assembly, a shorting device, and a lamp connector assembly. The housing weight shall not exceed 6 pounds. The housing shall be assembled complete with the lamp clip assembly.

3.3.1.3.1 Shell.

The housing shell, figure 4, shall be formed from aluminum casting A-360, with space provided for a shorting device (3.3.2). The shell shall be able to withstand temperatures in the range of -55 C (-67 F) to 290 C (554 F). A lamp indexing ring shall be provided on the shell. The ring shall be designed to prevent the PAR-56 lamp from being improperly installed. The shell shall retain shape and alignment under the environmental conditions specified in 3.4. The shell shall be capable of operating continuously with a PAR-56, 300-Watt lamp or a PAR-56, 500-Watt lamp. The shell shall not deform, discolor, or show deterioration in continuous operation. All interior and exterior surfaces of the shell shall be smooth and free of pits and marks. An adjustable mounting assembly (3.3.1.4) shall be securely attached to the lampholder shell. Indexing marks shall be provided for aligning the shell. When the indexing mark is placed on the "O" mark on the mounting assembly, the horizontal axis of the shell shall be 90 + 1/2 to the vertical axis of the support. Indexing markings shall be minimum 1/32 inch (0.79 mm) raised and 3/16 inch (4.7 mm) long. Indexing marks shall be provided from 0 to 25 above horizontal in 5 degrees intervals with each 5 degrees labeled. An Underwriter Laboratory (UL) approved grounding lug shall be provided with the shell for a one-conductor number 16 American Wire Gage (AWG) copper grounding wire.

3.3.1.3.2 Lamp connector.

The housing lamp connector made of porcelain, figure 3, shall be rated for at least 750 Watts at 20 A load current and 37.5 Volts (V) rms, 60 Hertz (Hz) working voltage. The lamp connector shall be a push on connector matching the lamp prongs shown on FAA Drawing C-5407-1, with the spring-loaded socket contacts spot-welded to copper leads that are 6 inches (152.4 mm) long, Number 12 American Wire Gage (AWG), 600 Volt teflon insulated, ASTM B174 Class K copper fine-strand, and concentrically wound. Floor lamp connectors connected to shorting devices, the lamp connector leads shall originate from the shorting devices as described in 3.3.2. For other connectors, the lamp connector leads shall be terminated in nylon insulated male connectors that connect directly to matching female connectors of the incoming power leads. The connector contacts shall provide freedom from welding at points of contact with the lamp under continuous duty at 20A. The lamp connector shall provide a strain relief encompassing the conductor insulation as an integral part of the receptacle. The initial pull force necessary to remove a lamp prong, or a prong similar in appearance and physical characteristics to a lamp prong, from each of the connector prong sockets shall be greater that 24 ounces (weight).

3.3.1.3.3 External service entrance.

The incoming electrical power leads to the housing shall be through the center of the mounting assembly. The service entrance opening shall provide entrance for three 1-conductor insulated cables, two No. 12 AWG, 600 V, and one No. 12 green ground wire.

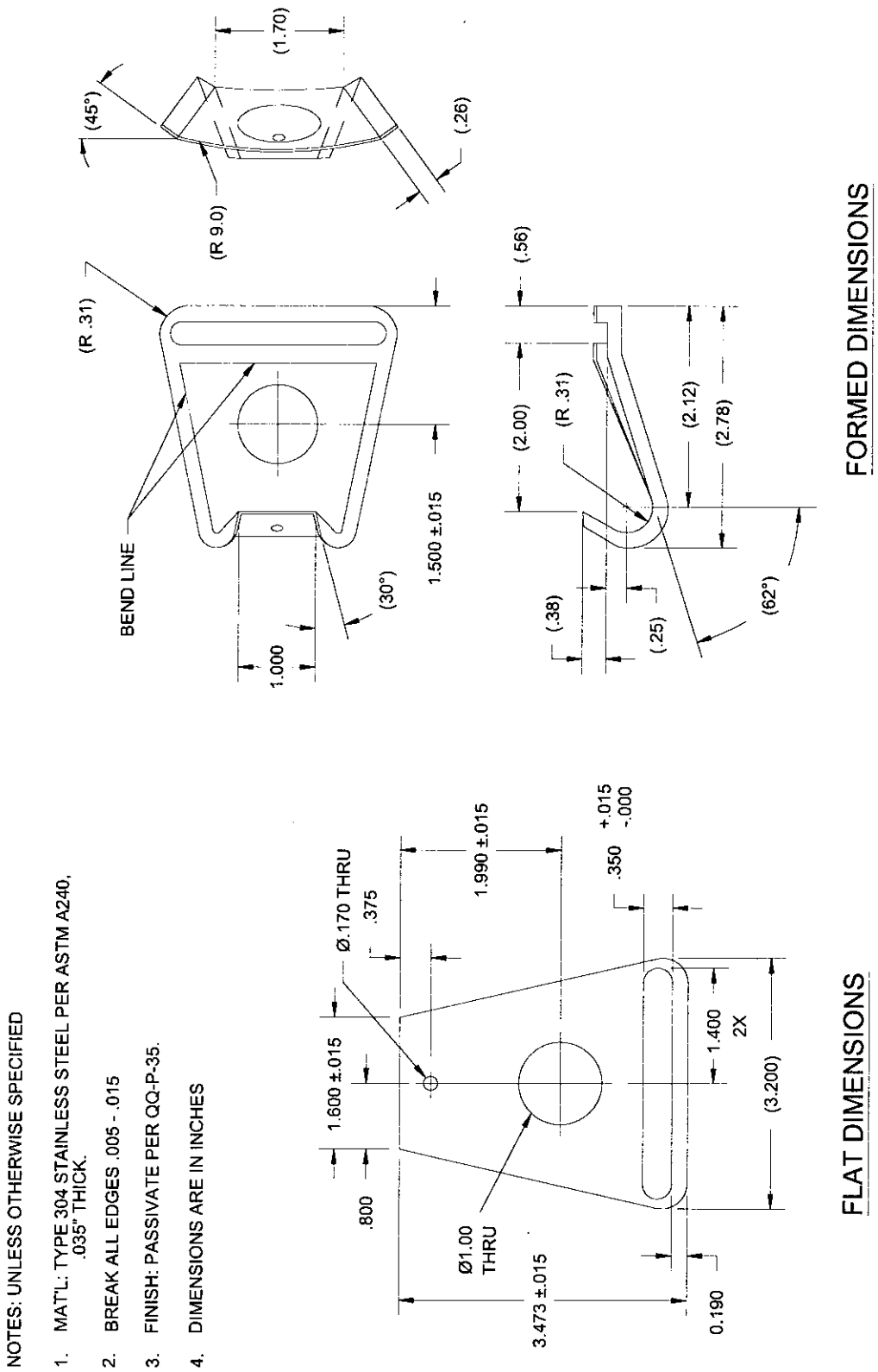

Figure 1. Color Screen Holder Detail

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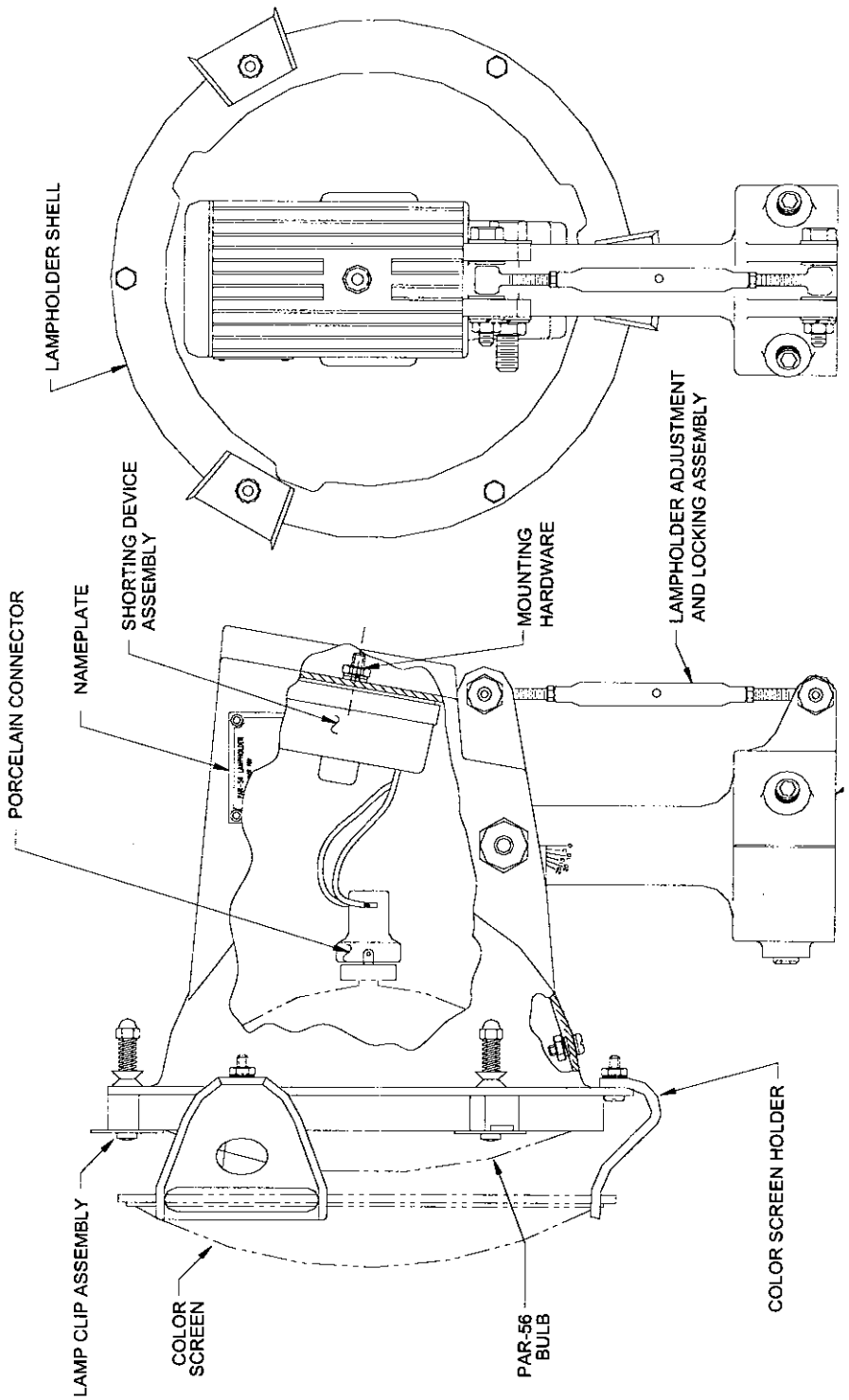

Figure 2. PAR-56 Lampholder Assembly

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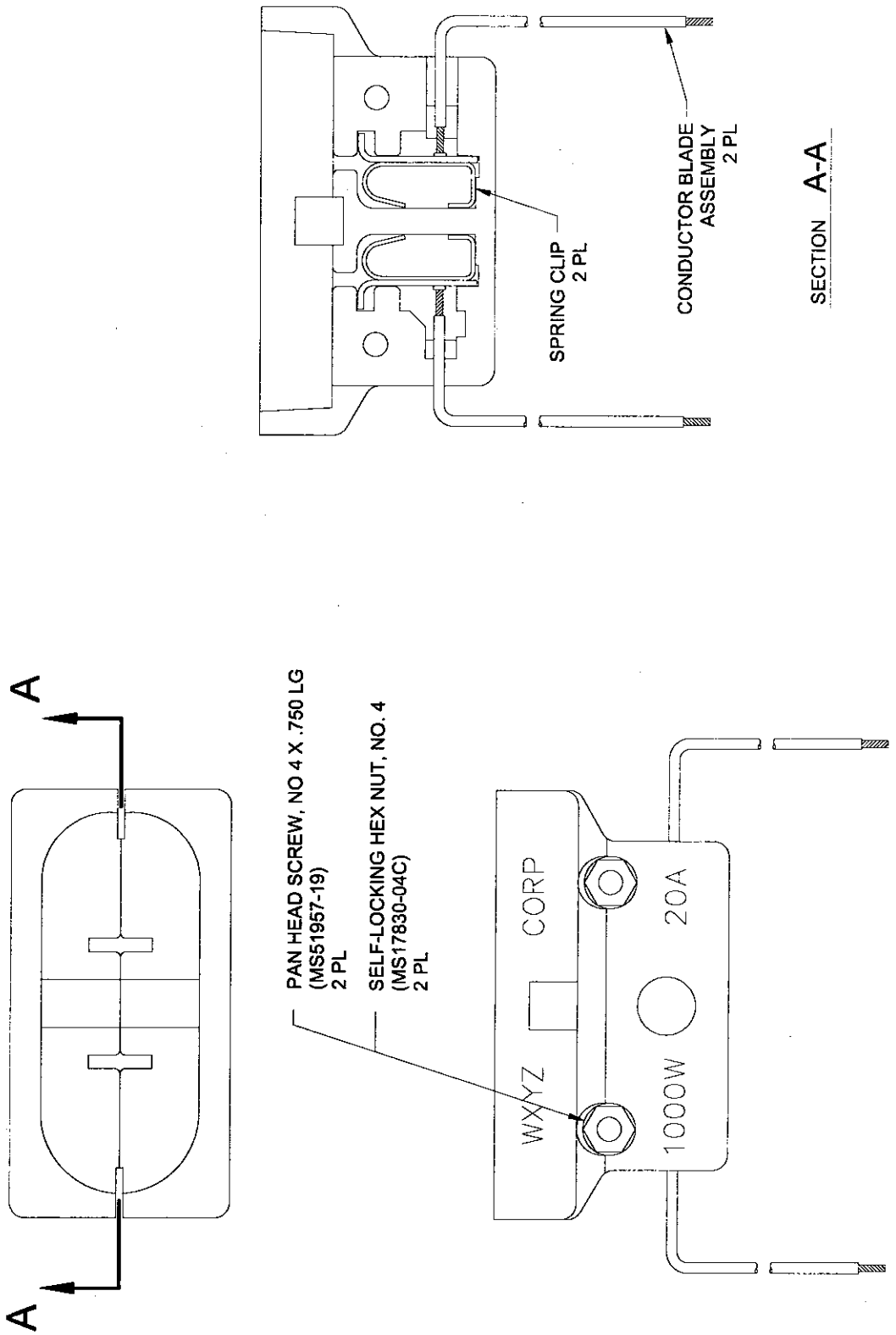


Figure 3. PAR-56 Lampholder, Lamp Connector Detail (Sht 1 of 5)

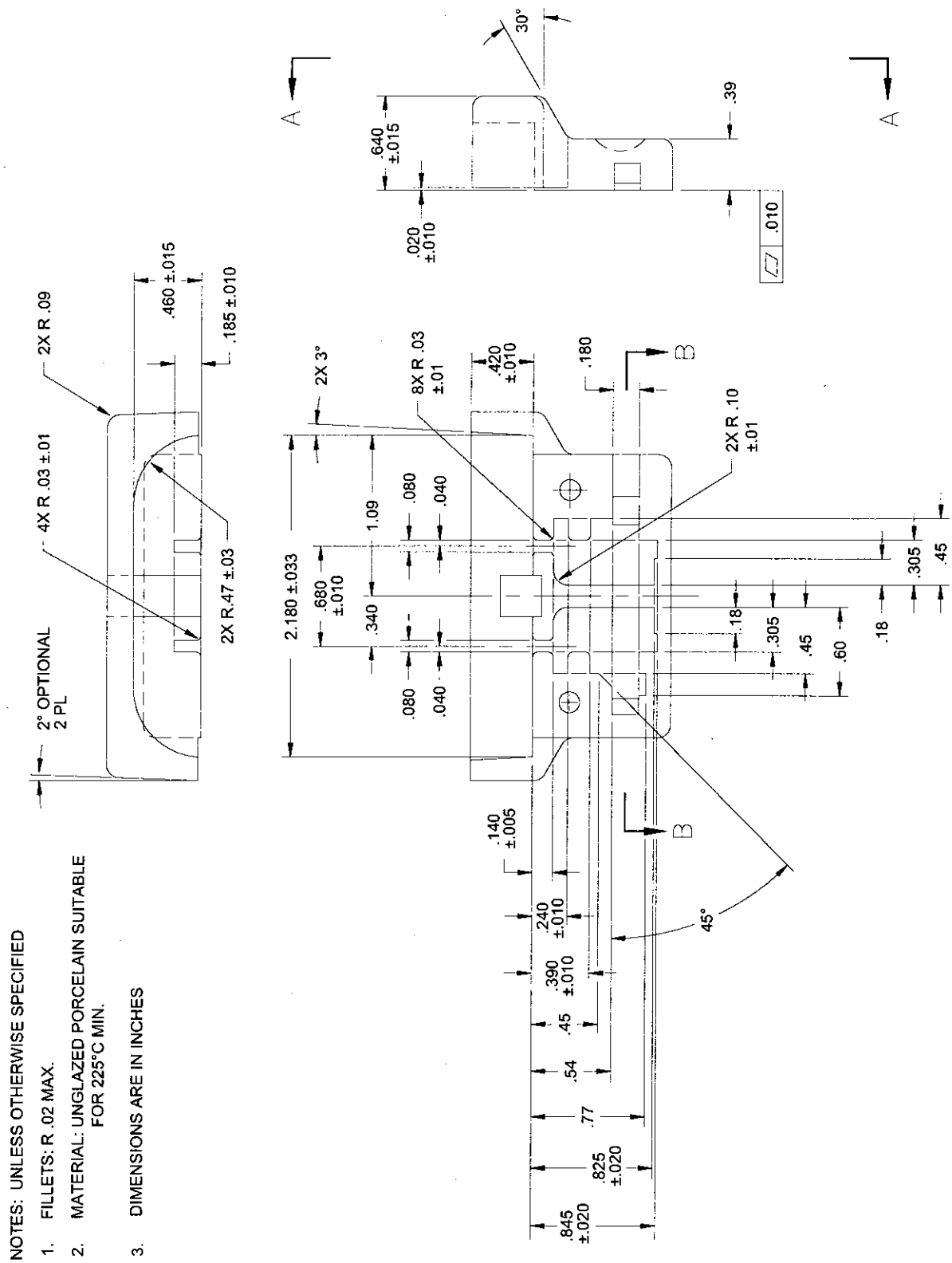
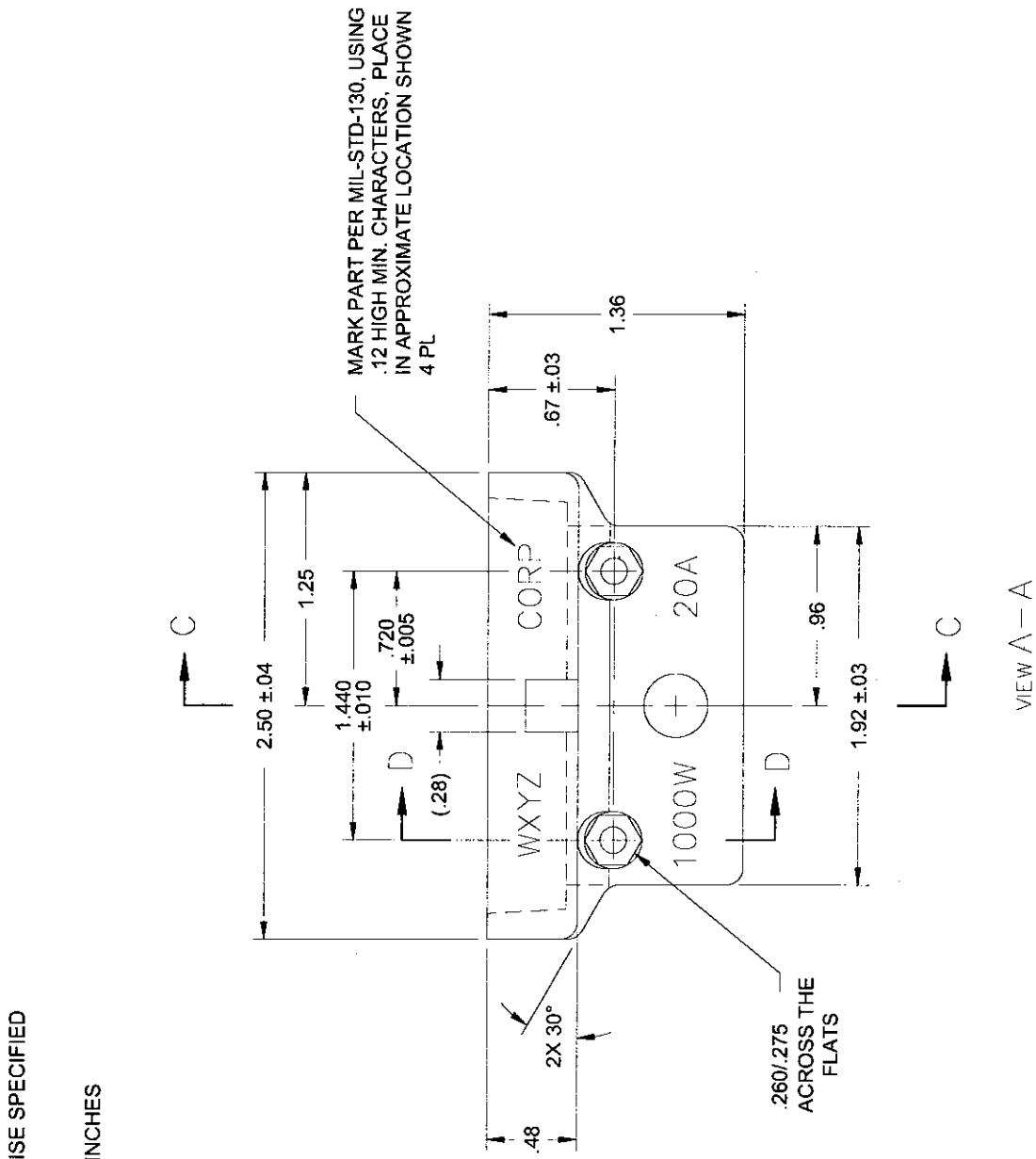


Figure 3. PAR-56 Lampholder, Lamp Connector Detail (Sht 2 of 5)



NOTES: UNLESS OTHERWISE SPECIFIED

1. FILLETS: R .02 MAX.
2. DIMENSIONS ARE IN INCHES

Figure 3. PAR-56 Lampholder, Lamp Connector Detail (Sht 3 of 5)

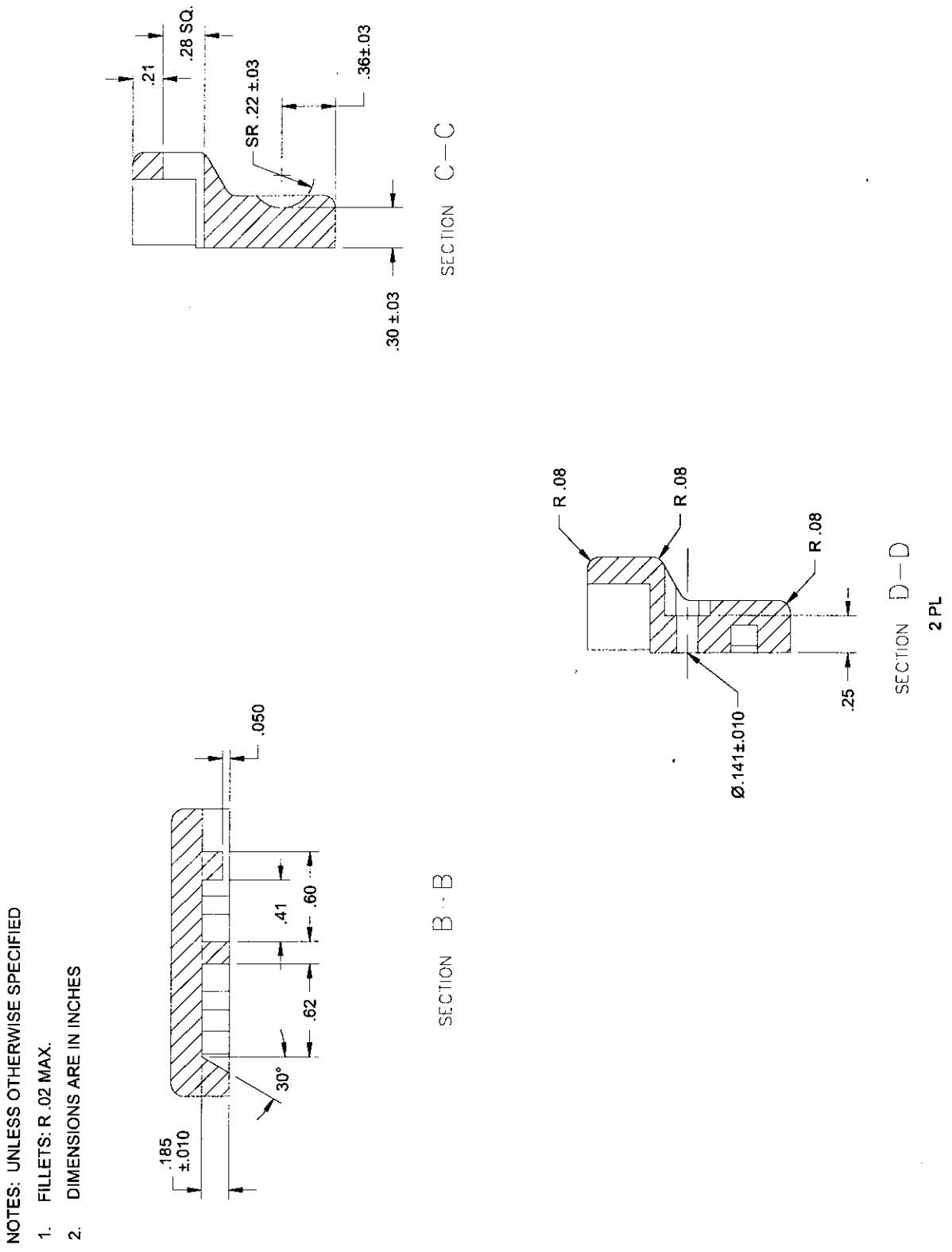
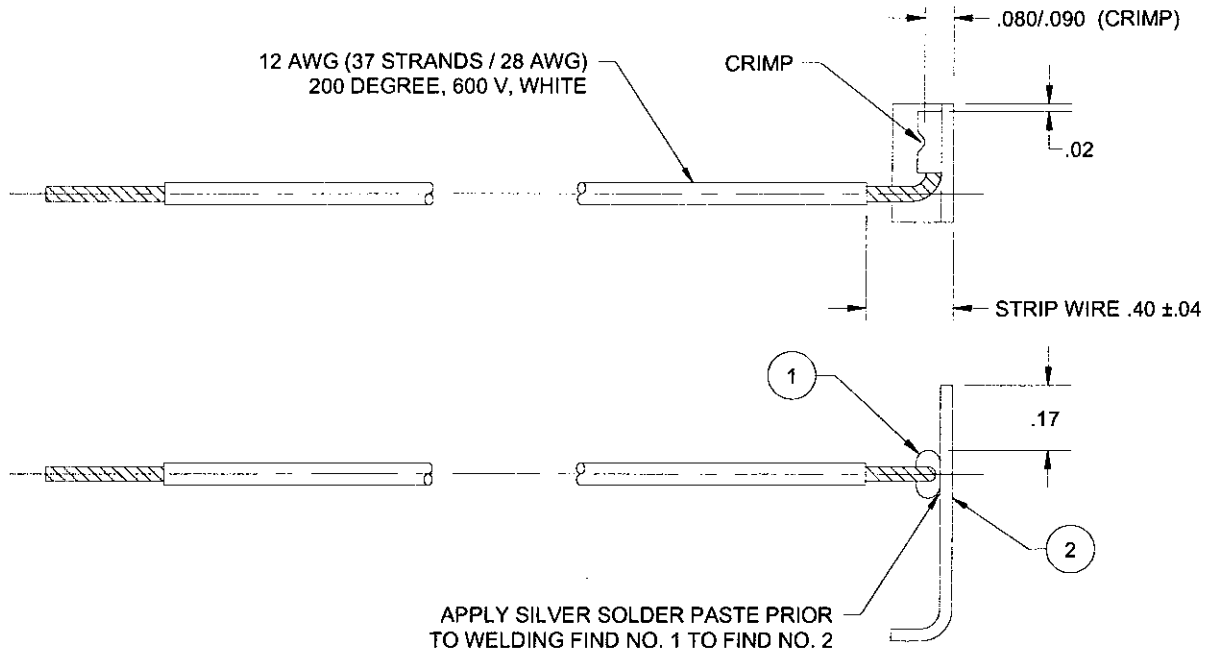


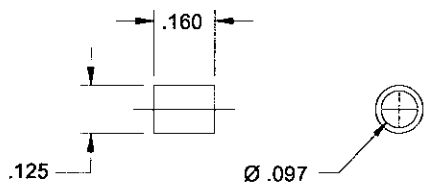
Figure 3. PAR-56 Lampholder, Lamp Connector Detail (Sht 4 of 5)

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES.

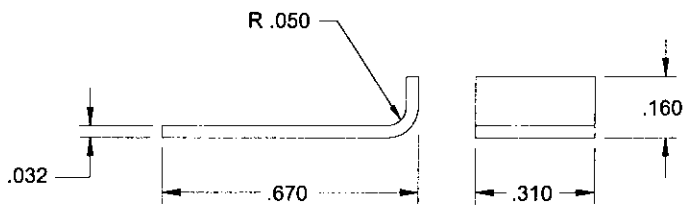


CONNECTOR BLADE ASSEMBLY



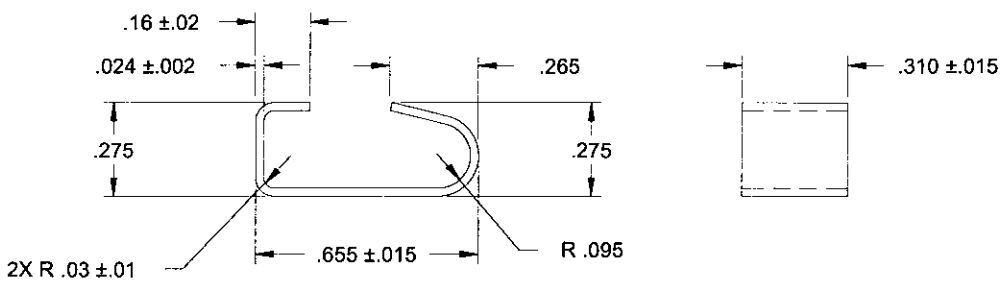
MATERIAL: HARD DRAWN BRASS TUBING PER
ASTM-B-135-91, ALLOY C33000.

1 CRIMP RING DETAIL



MATERIAL: BERYLLIUM COPPER PER UNS C17500
ASTM B534 .25 HARD MINIMUM.

2 CONNECTOR BLADE DETAIL



SPRING CLIP DETAIL

MATERIAL: .024 THK (24 GA) 17-7 PH STAINLESS STEEL

Figure 3. PAR-56 Lampholder, Lamp Connector Detail (Sht 5 of 5)

NOTES: UNLESS OTHERWISE SPECIFIED

1. FILLET RADII .06 MIN. INSIDE, .10 MIN. OUTSIDE.
2. CORNER RADII .03 MIN.
3. CORNERS SHOWN SHARP TO .03 MAXIMUM BREAK.
4. REMOVE BURRS, GATES, FINS, ETC., FLUSH WITH CONTOUR ±.03.
5. SURFACE BLEMISH (DISCONTINUITY) NOT TO EXCEED .010.
6. MATERIAL: ALUMINUM - ALLOY ANSI A360.0 PER ASTM B85.
7. FINISH: CONVERSION COATING PER MIL-C-5541, CLASS 3, YELLOW.
   PAINT OUTSIDE OF SHELL, OVER SPRAY PERMISSABLE WITH NO PRIMER,
   PAINT USING POWDER COATING, SMOOTH, HIGH GLOSS, COLOR ORANGE
   NO. 12197 PER FED-STD-595.
8. DIMENSIONS ARE IN INCHES.

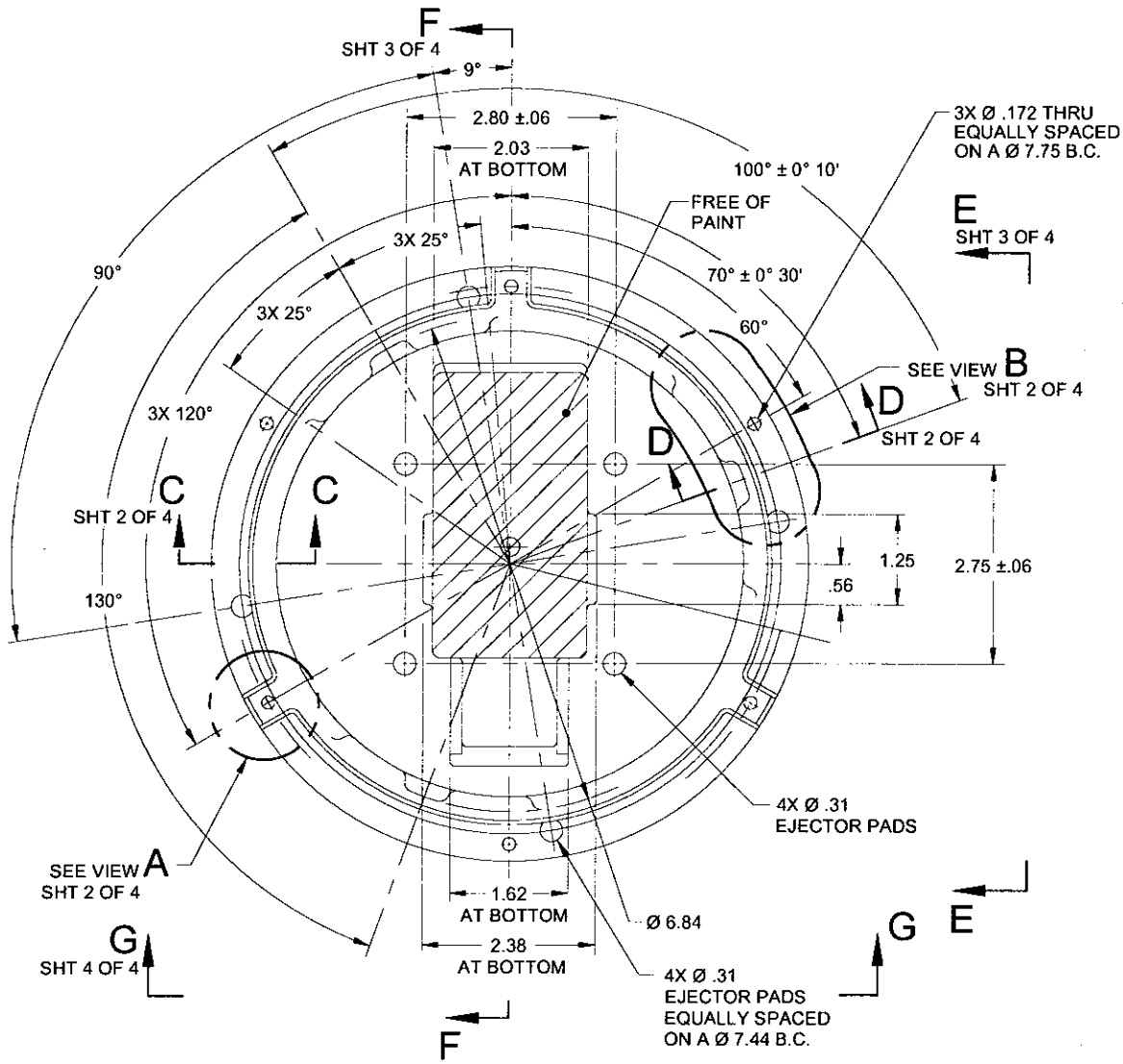


Figure 4. PAR-56 Lampholder Shell (Sht 1 of 4)

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES.

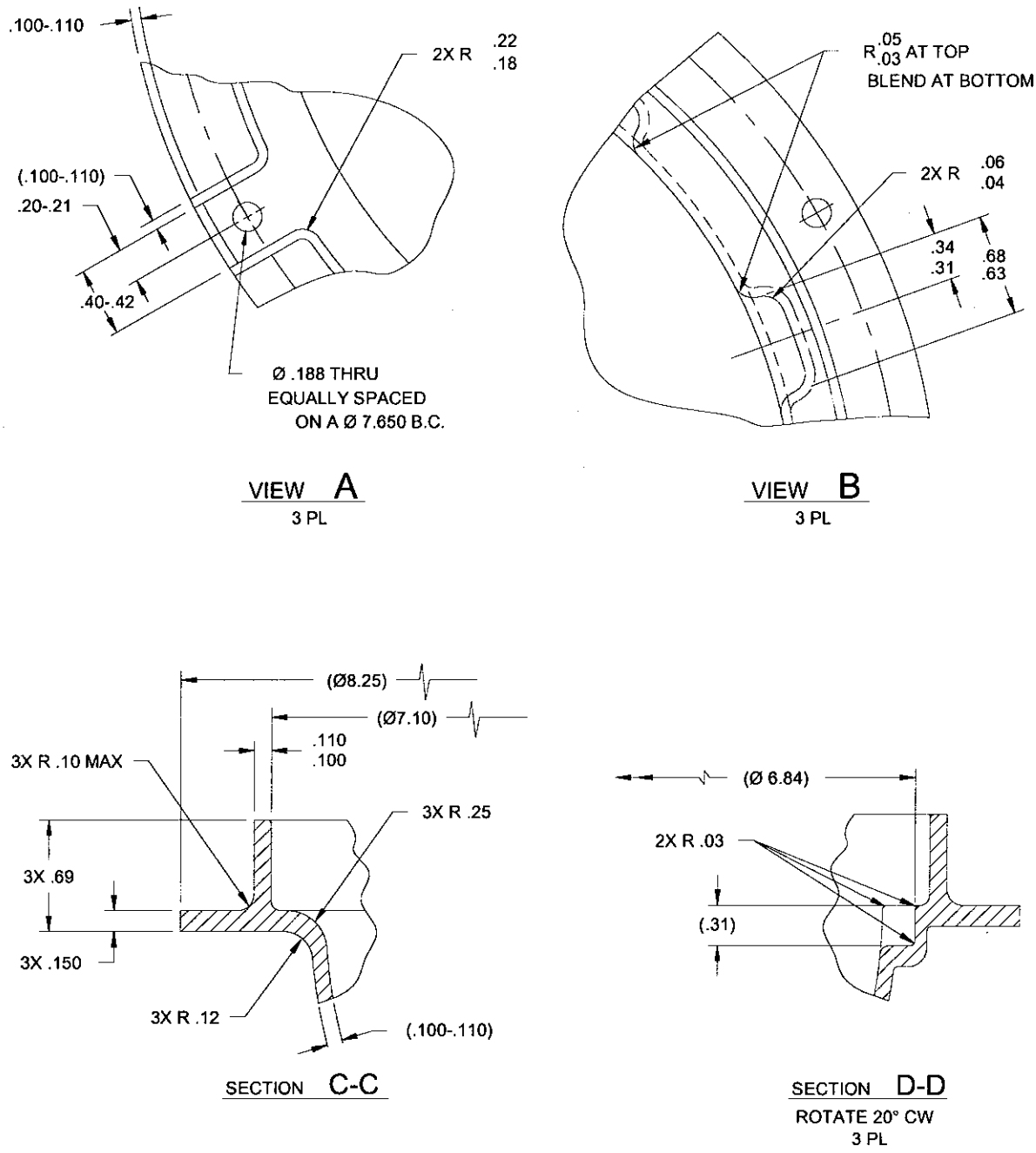


Figure 4. PAR-56 Lampholer Shell (Sht 2 of 4)

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES.

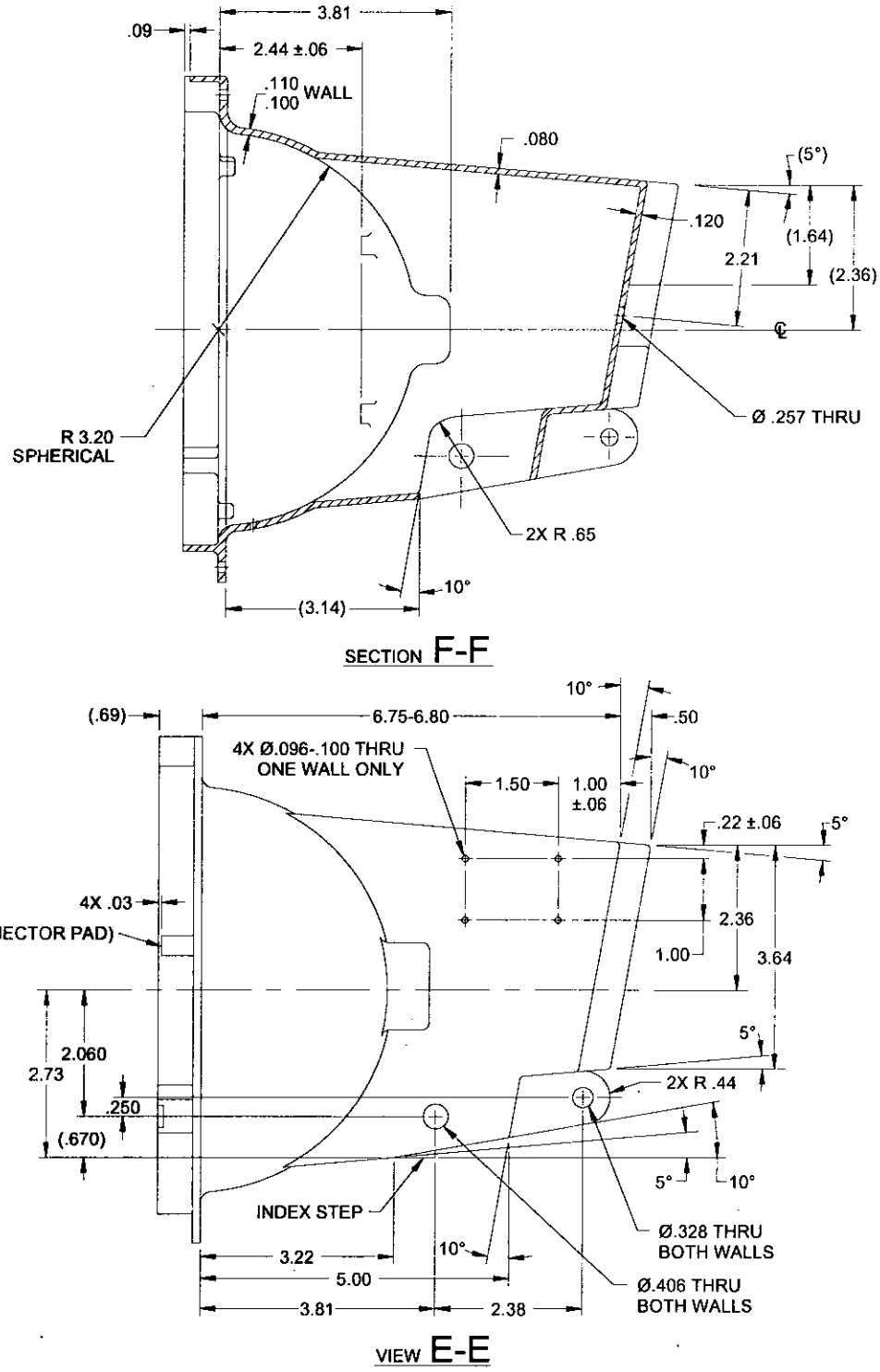


Figure 4. PAR-56 Lampholder Shell (Sht 3 of 4)

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES.

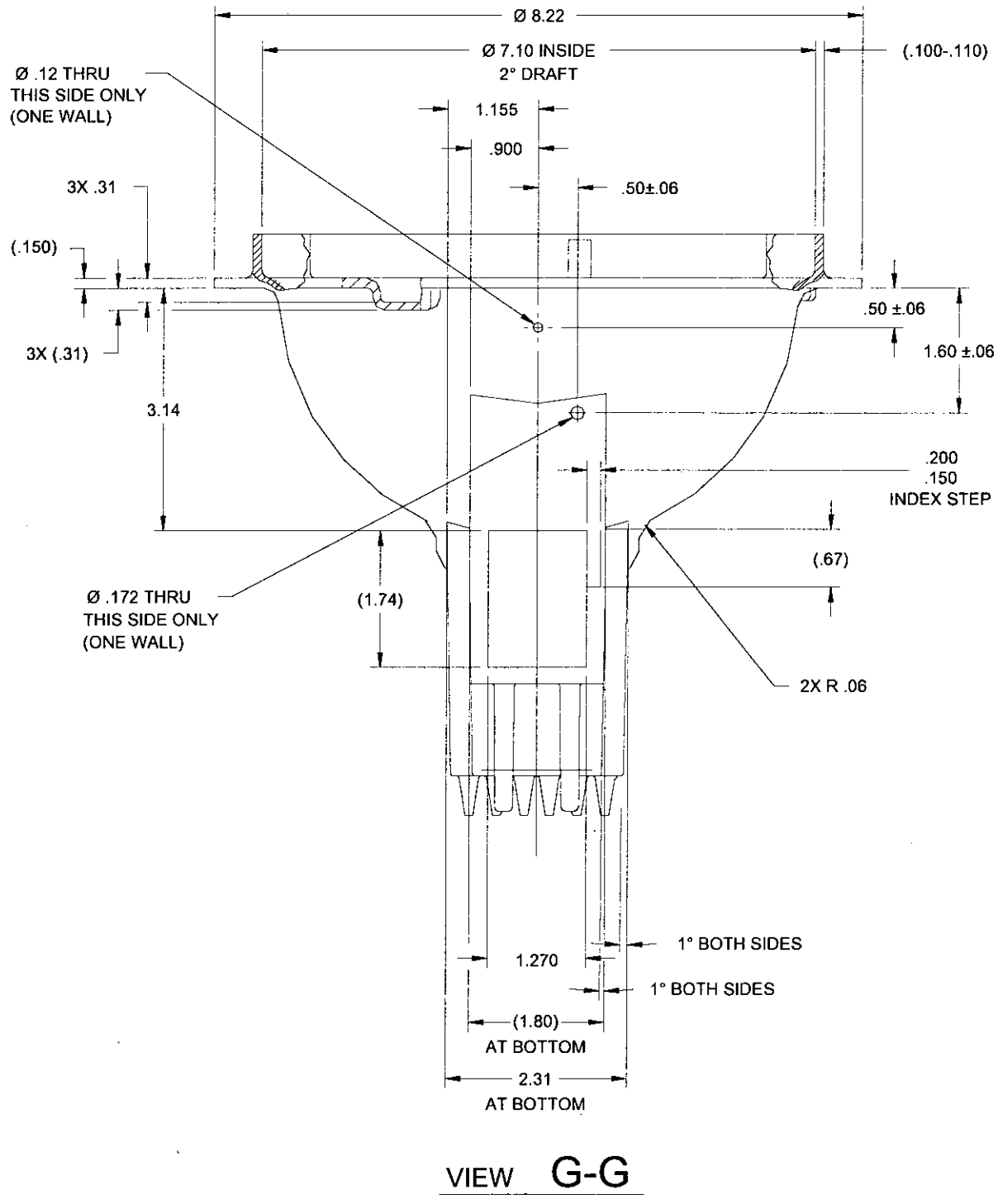


Figure 4. PAR-56 Lampholder Shell (Sht 4 of 4)

3.3.1.3.4 Finish.

The exterior finish of the housing shall be aviation orange in accordance with Federal Standard 595, Color No. 12197. After cleaning, apply chemical conversion coating per MIL-C-5541, Class 3, Yellow. Paint shall be applied according to FAA-STD-012 on all metal surfaces of the shell, mounting assembly and lamp retaining ring.

3.3.1.4 Mounting assembly.

An adjustable mounting assembly (slip filter), figure 5, shall be furnished to secure the lampholder to the support structure. The support structure will be a 2-inch (50.8 mm) frangible coupling, or a 2-inch electrical metallic tubing (emt). The external service entrance shall be through a 1/2 inch (12.7 mm) minimum diameter hole in the center of the assembly. No cable shall be visible once the lampholder is mounted on the structure. The top of the lampholder shall not exceed 14 inches (355.6 mm) above the ground plane when installed on a 2-inch frangible coupling (FAA Drawing C-6046). The 14-inch measurement shall be made with the lampholder aimed at 10 degrees elevation.

3.3.2 Shorting device assembly.

The shorting device assembly, figure 7, shall mount in the rear of the lamphousing shell. The shorting device assembly shall consist of:(a) a shorting device and (b) a lamp connector. The shorting device shall be electrically parallel to the terminals of the PAR-56 lamp when the lamp burns out. The shorting device shall load the 20 ampere (A) circuit with no more than a 3-Watt circuit loading when the lamp is burning. The shorting device shall be mounted within the shell. The device shall maintain the integrity of the 20 A series circuit when a PAR-56 lamp burns out with circuit current varying from 20 A to 8.5 A. Two pairs of wires shall be provided for each shorting device. One pair of wires shall be used to receive the incoming power, and the other pair shall be used to transfer power to the lamp through the attached lamp connector. One pair of wires shall be connected to the incoming power leads by means of a male connector, and the other pair shall be connected to the attached lamp connector by means of a beryllium copper female disconnect. The incoming power leads shall be terminated in female connectors that match the male connectors on the shorting device power leads. Wires leaving the shorting device shall be teflon insulated. The device shall be capable of a minimum of 1,000 operations. An operation is defined as one activation of the device. The shorting device circuit shall be capable of withstanding voltage transients up to 4000 V (peak). The shorting device shall with stand a 10 kV, dc, insulation resistance test voltage applied to the primary of the isolation transformer with the secondary connected to the shorting device input terminals and the mounting lug grounded.

3.3.3 Aiming device for PAR-56 lampholder.

The aiming device, figure 8, shall be designed for use on the PAR-56 lampholder. The aiming device shall be mounted firmly in place on the lampholder. The aiming device shall permit field aiming of the lamp axis perpendicular to the horizontal plane at any angle for 0° to + 25° above the horizontal. The device shall be capable of remotely aiming the PAR-56 lamp when mounted on low impact resistant structures that conform to FAA-E-2604 or FAA-E-2702. Starting with the structure in the elevated position, the device shall permit an individual to accurately aim the

lamp from the ground after lowering the structure a maximum of two times regardless of the tilting direction of the structure.

The aiming device also shall be capable of aiming PAR-56 lamp unit mounted on a frangible coupling (FAA Drawing C-6046). The aiming angle shall be indicated on a scale calibrated in 1° intervals and shall be accurate to within +1/2° of the actual aiming angle with the device attached. The final aimed angle of the lamp with the device unattached shall be accurate within 1° of the actual angle.

3.3.4 Lamp retainer ring.

In addition to the PAR-56 lamp clips required by 3.3.1.1 an additional PAR-56 Lamp Retainer Ring shall be designed that will retain the PAR-56 lamp within the lampholder under lampholder vibration. The Lamp Retainer Ring shall be painted the same color as the Lampholder. The back side of the ring shall be marked with the manufacturers name and part number.

3.4 Environmental conditions.

The PAR-56 lampholder shall be designed to operate under the following environmental conditions.

3.4.1 Temperature.

Any ambient temperature between -55° C (-67° F) to +70° C (158° F) (4.5.1.1).

3.4.2 Humidity.

Exposure to atmosphere of 100 percent relative humidity (4.5.1.2).

3.4.3 Sand and dust.

Exposure to windblown sand and dust particles that may be encountered in an arid region (4.5.1.3).

3.4.4 Salt spray.

Exposure to atmosphere containing salt laden moisture (4.5.1.4).

3.4.5 Rain.

Exposure to windblown rain (4.5.1.5).

3.4.6 Temperature shock.

Exposure to extreme thermal changes while under operation (4.5.1.6).

3.4.7 Solar radiation.

Exposure to accelerated fading, thermal, and radiation effects when exposed to solar radiation (4.5.1.7).

3.4.8 Vibration.

The PAR-56 lampholder assembly shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 hertz (4.8).

3.5 Interchangeability.

All parts of the lampholder shall be interchangeable with other similar parts of another identical unit, except for those items that may be permanently bonded to the lampholder housing.

3.6 Repairs and adjustments.

The design shall permit repairs and adjustments in the field using only an open-end wrench and slotted-head screwdriver.

3.7 Structural integrity.

The lampholder shall be able to withstand, without damage, jars and vibrations normally experienced during shipment, installation, and service.

3.8 Materials.

Material for parts shall be as specified herein and in Specification FAA-G-2100. All aluminum parts shall be anodized to 0.0005 inch (0.0127 millimeter (mm)) of thickness in accordance with Specification MIL-A-8625, Type II, Class 1.

3.9 Workmanship.

Workmanship shall be in accordance with the quality control program of FAA-G-2100. All parts shall be assembled so that they will not vibrate or become loose during normal operation. Surfaces shall be smooth and free of pits and marks. All corners and edges within wireway shall be rounded to prevent cutting of wire insulation.

3.10 Hardware.

The screws, nuts, bolts, and washers used in the assembly and mounting of the lampholder shall be stainless steel or materials that shall withstand the environmental requirements.

3.11 Nameplate.

A nameplate shall be fastened with Type 430 or 18-8 stainless steel drive screws or aluminum rivets to the back of the lampholder. The nameplate shall be constructed, in accordance with FAA Drawing C-21216, of aluminum or nickel silver material, and shall contain at least a description noun, type number, contract number, and manufacturer's name and address.

3.12 Instruction sheet.

When the end product is furnished individually, not as a part of a system, an instruction sheet shall be furnished with each PAR-56 lampholder containing brief instructions for assembling, installing, aiming, relamping, and maintaining the unit. An exploded or composite view shall identify all parts and list them in a parts list, showing each part's name, manufacturer's name, contractor's catalog number, quantity per light unit, space for National Stock Number, and unit cost for each part.

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NOTES: UNLESS OTHERWISE SPECIFIED

1. CORNERS SHOWN SHARP TO .03 MAXIMUM BREAK.
2. REMOVE BURRS, GATES, FINS, ETC., FLUSH WITH CONTOUR ±.03.
3. ALL THREADED HOLES TO BE FREE OF PAINT.
4. MATERIAL: ALUMINUM ALLOY ANSI A360.0 PER ASTM B85.
5. FINISH: CONVERSION COATING PER MIL-C-5541, CLASS 3, YELLOW. PAINT USING POWDER COATING, SMOOTH HIGH GLOSS, COLOR ORANGE NO. 12197 PER FED-STD-595.
6. DIMENSIONS ARE IN INCHES.

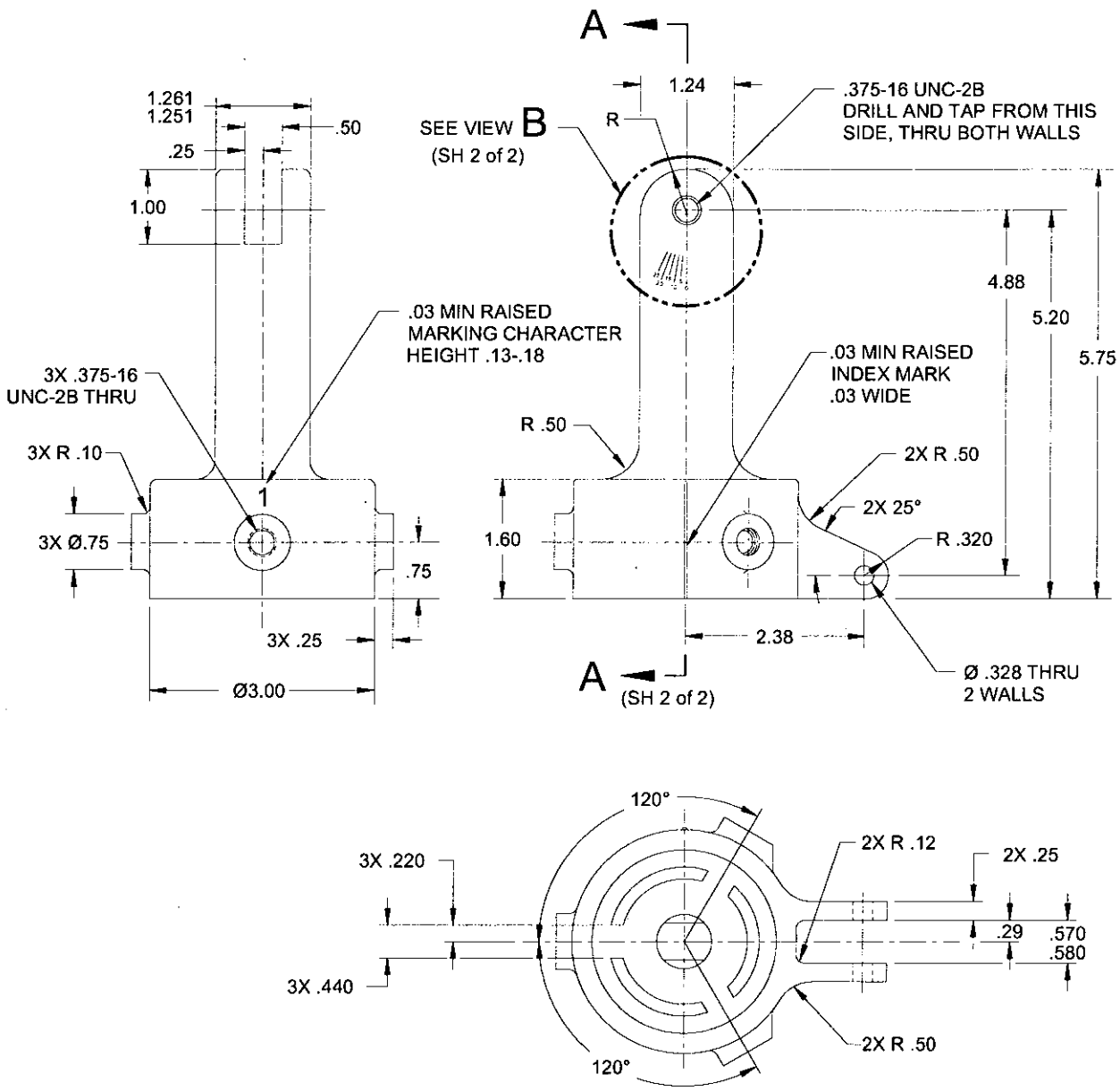


Figure 5. PAR-56 Lampholder Slip Fitter Mounting (Sht 1 of 2)

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES.

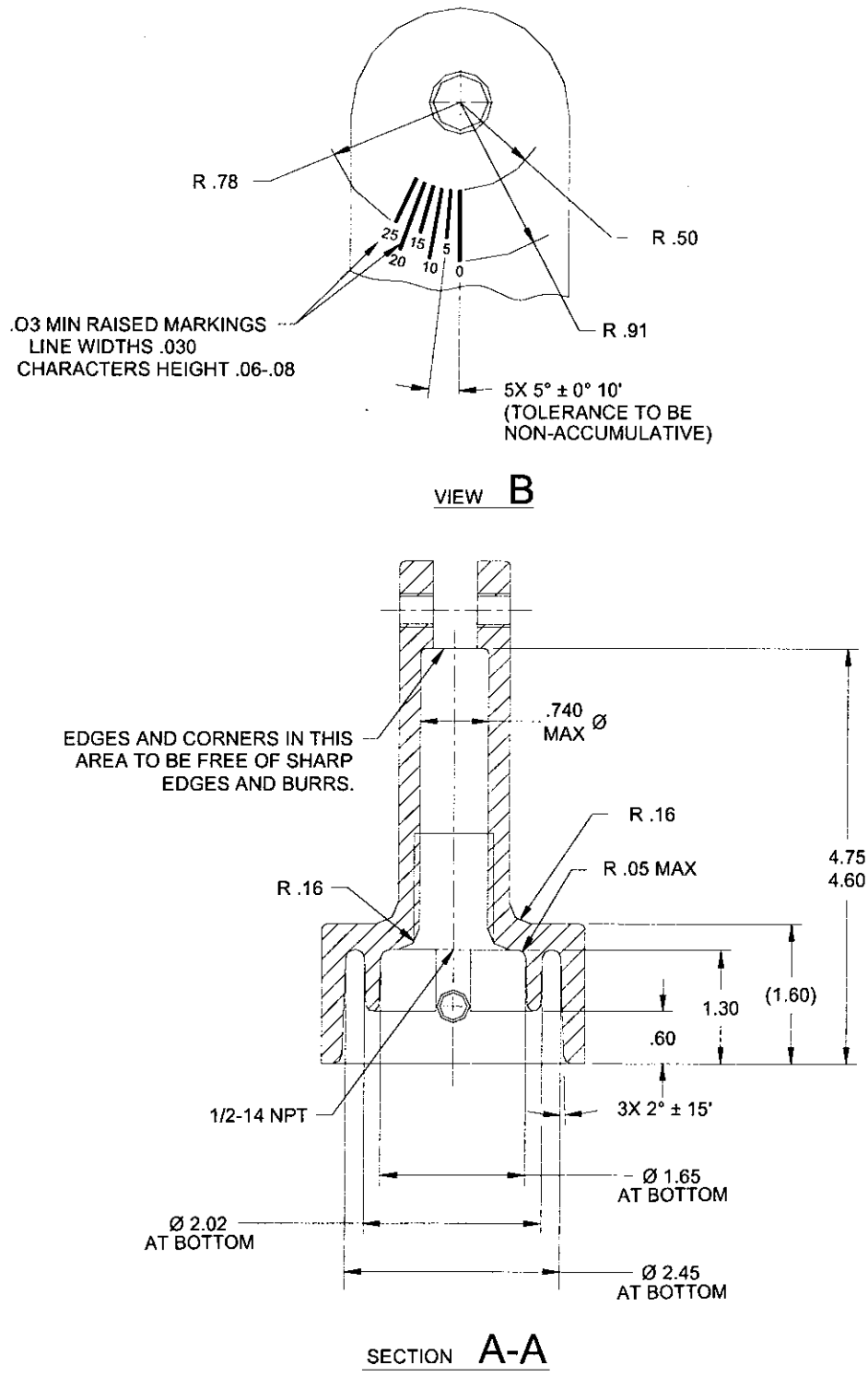
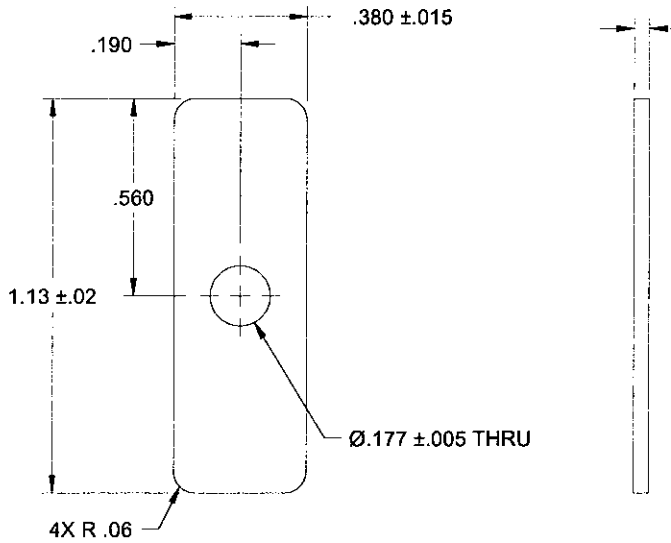


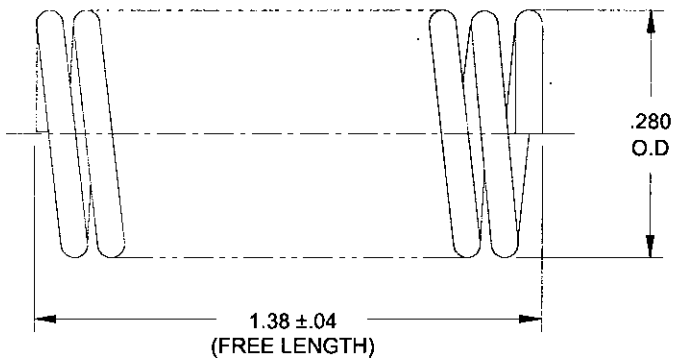
Figure 5. PAR-52 Lampholder, Slip Fitter Mounting (Sht 2 of 2)



NOTES:

1. REMOVE ALL BURRS AND SHARP EDGES.
2. FINISH: PASSIVATE PER QQ-P-35.
3. MATERIAL: 304 STAINLESS STEEL PER AMS 5513, .040 THK (20 GA.).
4. DIMENSIONS ARE IN INCHES.

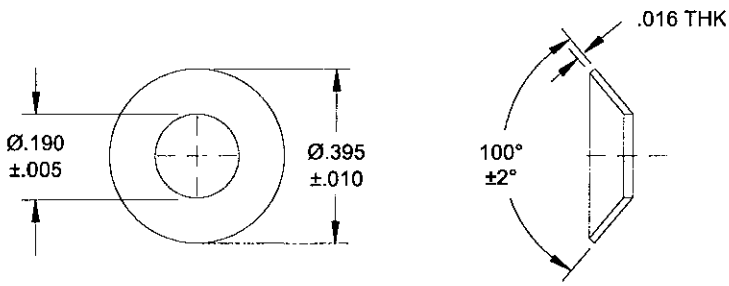
LAMP CLIP (1)



NOTES:

1. REMOVE ALL BURRS AND SHARP EDGES.
2. FINISH: PASSIVATE PER QQ-P-35.
3. MATERIAL: TYPE 302 SST PER ASTM-A313, Ø.030±.0015, SPRING RATE 6.48 LB/IN.
4. CONSTRUCTION:
   TOTAL COILS - 12
   ACTIVE COILS - 10
   ENDS-CLOSED NOT GROUND
   DIRECTION OF WIND OPTIONAL.
5. DIMENSIONS ARE IN INCHES.

SPRING (2)



NOTES:

1. REMOVE ALL BURRS AND SHARP EDGES.
2. FINISH: PASSIVATE PER QQ-P-35.
3. MATERIAL: 300 SERIES STAINLESS STEEL.
4. DIMENSIONS ARE IN INCHES.

CUP WASHER (3)

Figure 6. PAR-56 Lampholder Clip, Spring, and Cup Washer Details.

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NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES.

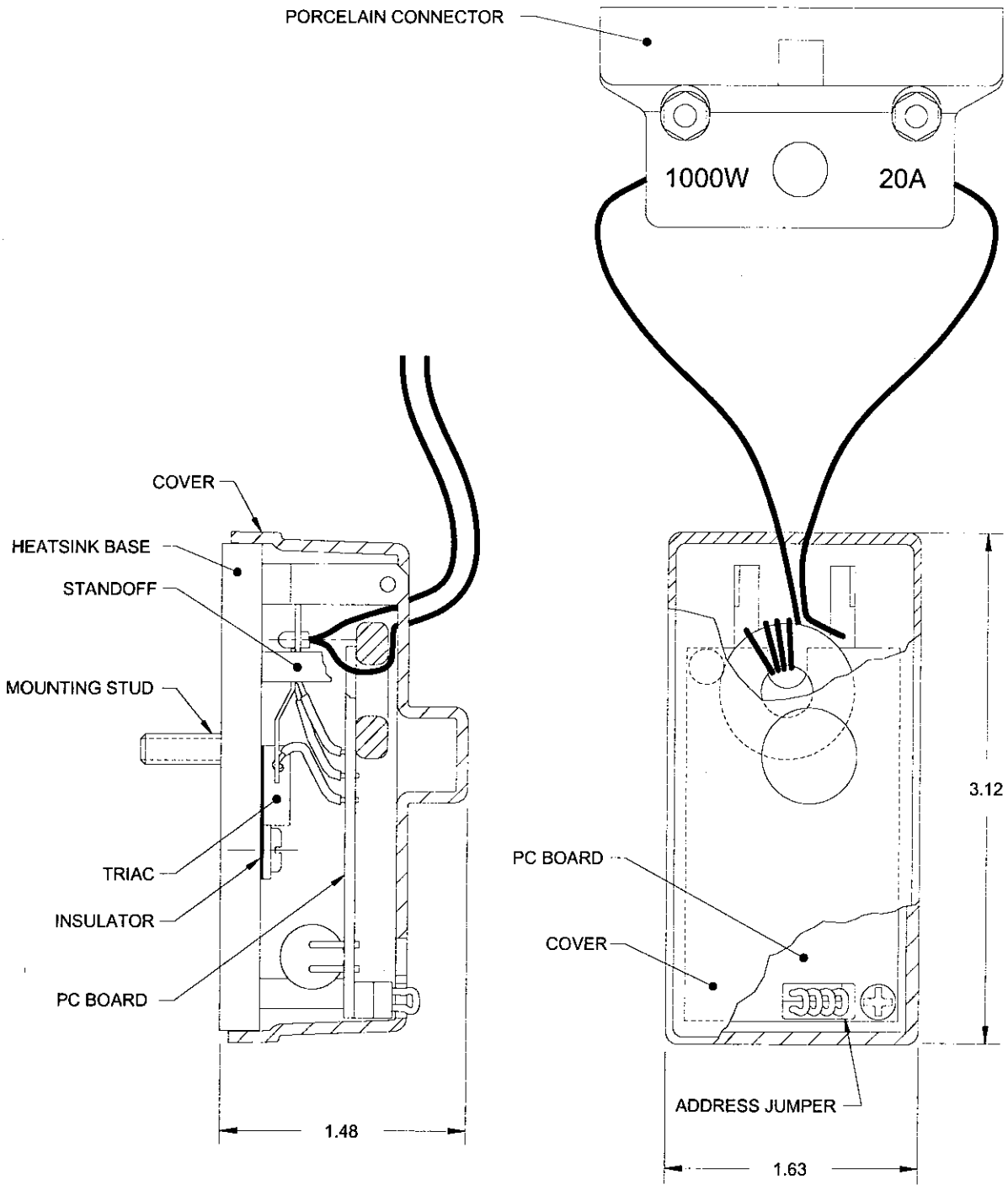

Figure 7. Shorting Devices Assembly

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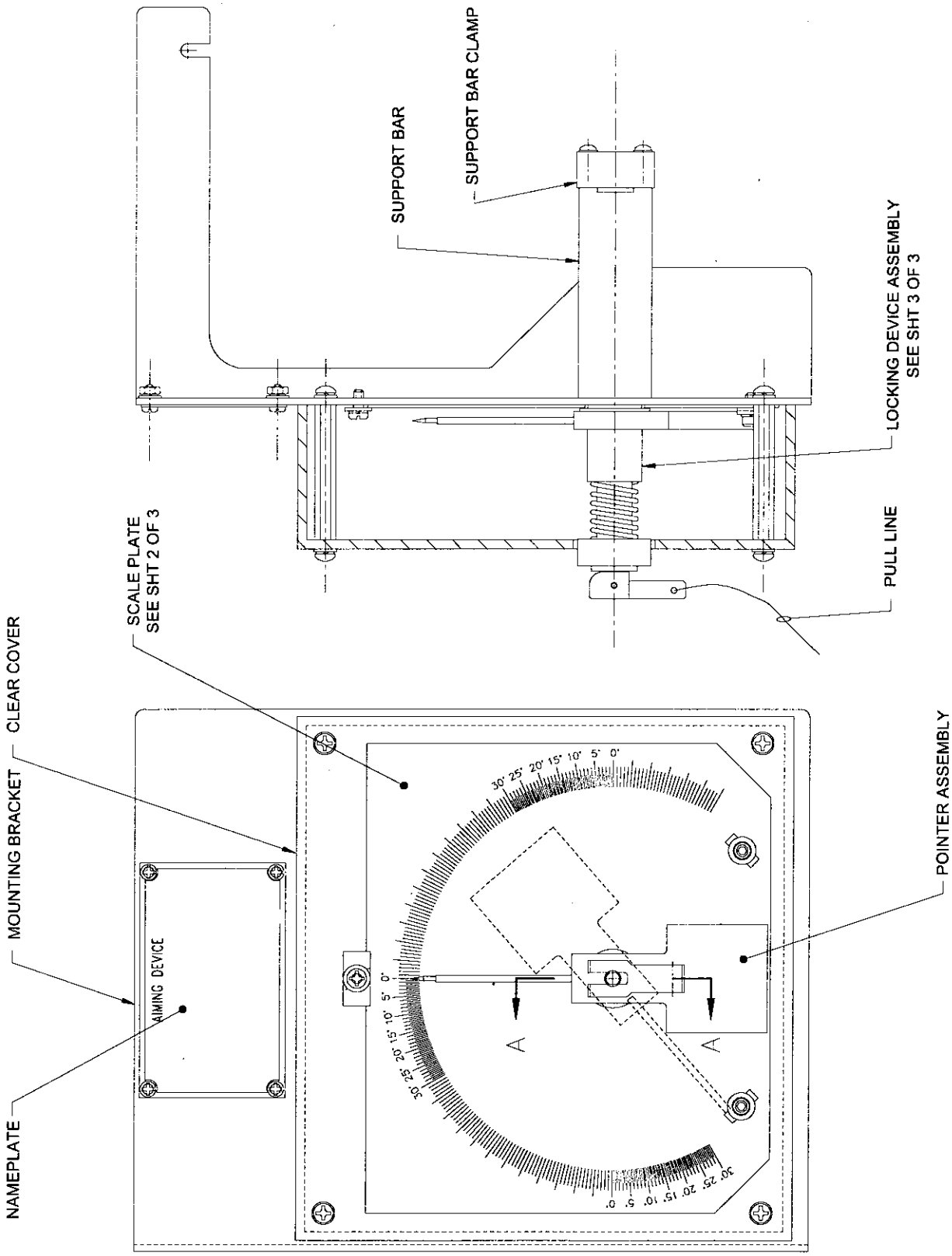

Figure 8. PAR-56 Lampholder, Aiming Device (Sht 1 of 3)

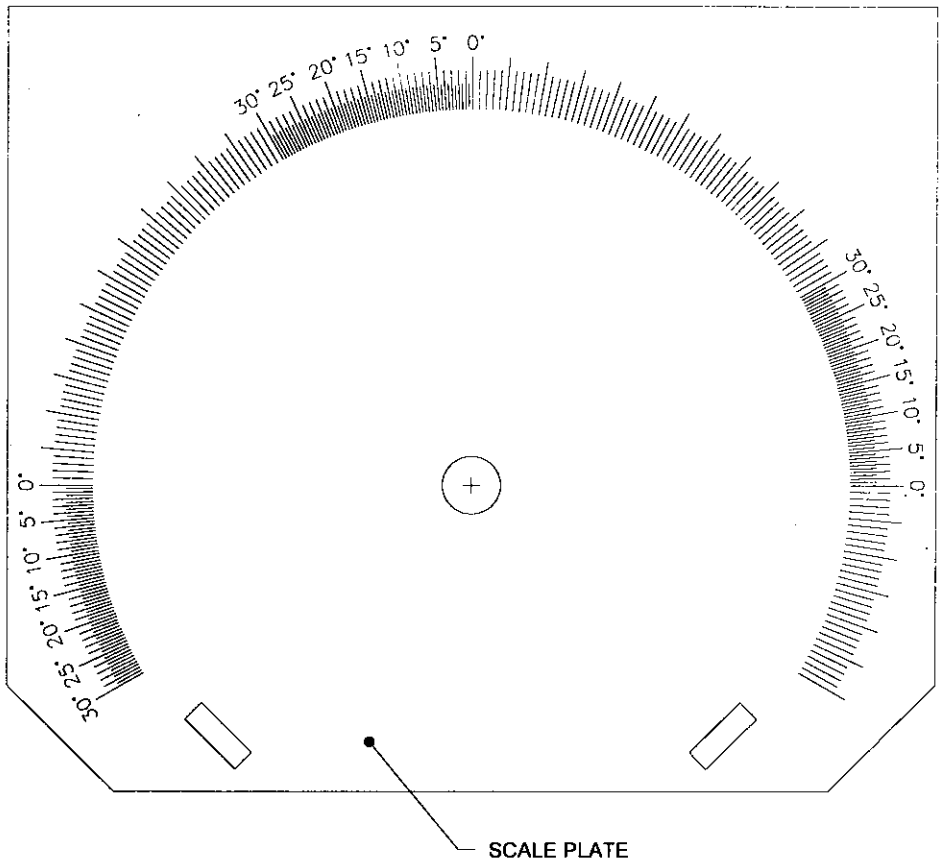

Figure 8. PAR-56 Lampholder, Aiming Devie (Sht 2 of 3)

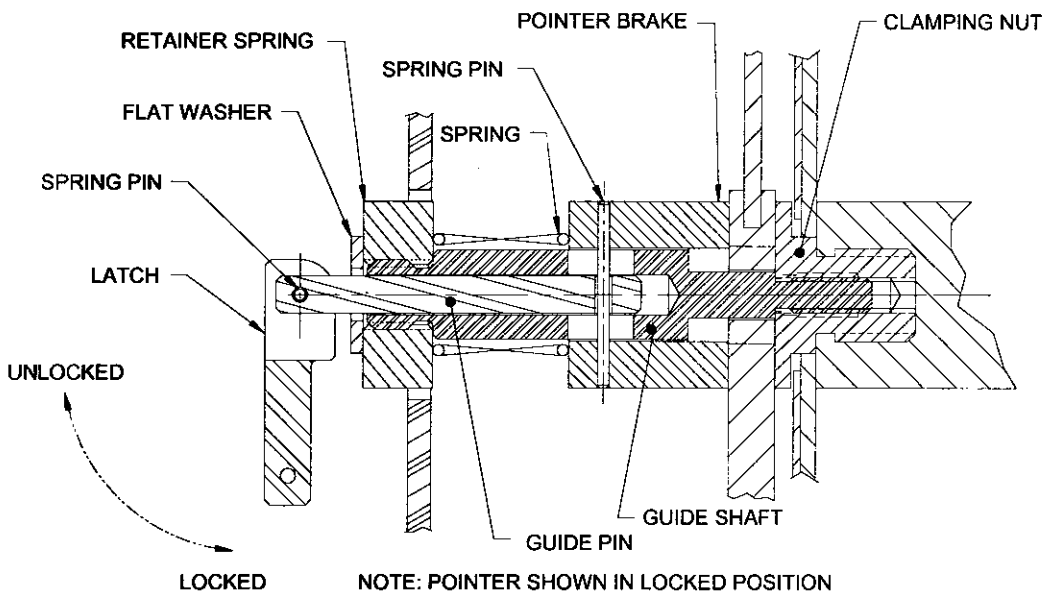

Figure 8. PAR-56 Lampholder, Aiming Device (Sht 3 of 3)

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4. QUALITY ASSURANCE PROVISIONS

4.1 Quality control program.

The contractor shall provide and maintain a quality control program in accordance with FAA-STD-013. All tests and inspections made by the contractor shall be subjected to government inspection. The term "government inspection", as used in this specification, means that an FAA representative will witness the contractor's testing and inspection, and will carry out such visual and other inspection as deemed necessary to assure compliance with contract requirements.

4.2 Notification of readiness for inspection.

After receipt of approval of test procedures (4.5.1) and test data forms (FAA-STD-013), the contractor shall notify the Contracting Officer in writing that he is ready for Government inspection. Such notification shall be given in time to reach the Contracting Officer not less that 5 work days before the contractor desires inspection to start. All testing described herein shall be performed at the contractor's expense at the contractor's facility or at an FAA approved location or independent testing laboratory.

4.3 Invoice submission.

Prior to the first inspection, the contractor shall submit to the FAA representative three copies of invoices covering the shipment of all items from the supplier's plant to the contractor. A vendor's certification of each item supplies shall meet the requirements of this specification and it shall be traceable to any quantitative tests for the item. This certification does not constitute FAA acceptance of the equipment or release the contractor from any acceptance tests once the item is incorporated into the equipment.

4.4 Test methods.

Testing of the equipment shall be performed as follows:

4.4.1 Production model test.

The first five units of production of each component are designated as the production models. The production models shall be subjected to the tests as specified in 4.5, 4.6.1, 4.6.2, 4.6.3, and 4.7 through 4.10, and in this sequence.

4.4.2 Production unit tests.

Testing of the production units shall commence after the acceptance of the production model. Tests on the production units shall be as specified in 4.6.1, 4.6.4, 4.7.1, and 4.9, and in this sequence.

4.5 Environmental tests.

4.5.1 Test procedure.

The environmental tests, as specified in paragraphs 3.4.1 through 3.4.8, shall be conducted on the production model. All test data shall be forwarded to the Contracting Officer upon completion of the tests.

4.5.1.1 Temperature.

The high temperature test shall be in accordance with Procedure II, Method 501.3, extreme induced conditions, of MIL-STD-810, except the temperature shall be constant, +70° C (158° F), and maintained for 6 hours. The low temperature test shall be in accordance with Procedure II, Method 502.3, of MIL-STD-810, except the temperature test shall be constant, - 55° C (-67° F), and maintained for a period of 6 hours. The temperature sensors shall be installed around the production model in the test chamber. A 2-hour shorting device test (4.6.3) shall be performed after temperature stabilization on the lamp and shorting device.

4.5.1.2 Humidity.

The humidity test shall be in accordance with Procedure II, Method 507.3 of MIL-STD-810, except that a total of three complete 24-hour cycles (72 hours) shall be required (Table 507.3-I (cycle 5)). The maximum temperature shall be +70° C (158° F) and the highest relative humidity shall be 100% instead of 75%.

4.5.1.3 Sand and dust.

The sand and dust tests shall be in accordance with Procedures I and II, Method 510.3, of MIL-STD-810. The air velocities used in the sand and dust tests shall be 29 m/s (5700 ft/min) and 8.9 m/s (1750 ft/min) respectively. The test duration shall be 6 hours, and the equipment shall be rotated twice during the conduct of the test.

4.5.1.4 Salt Spray.

The salt spray test shall be in accordance with Procedure I, Method 509.3, of MIL-STD-810. The equipment shall be exposed for a period of 72 hours, followed by a 48-hour drying period. At the conclusion of the test, salt buildup may be removed with tap water.

4.5.1.5 Rain.

The rain test shall be in accordance with Procedure I, Method 506.3, of MIL-STD-810. The wind velocity shall be 18 m/s (40 mph), and the rainfall rate shall be 10 cm/h (4 in/h). The test item temperature shall be at least 10° +3° C (50°+37° F) higher than the rain temperature at the beginning.

4.5.1.6 Temperature shock.

The temperature shock test shall be in accordance with Procedure I, Method 503.3, of MIL-STD-810. The test temperature extremes shall be 70° C (158° F) and -55° C (-67° F), and the test item response temperature shall be 40° C (104° F).

4.5.1.7 Solar radiation.

The solar radiation test shall be in accordance with Procedure II, Method 505.3 of MIL-STD-810. Step 5 shall be conducted for a total of two cycles.

4.6 Other tests.

4.6.1 Visual inspection.

All components shall be visually inspected for conformance with this specification.

4.6.2 Operational tests.

Five lampholder assemblies (including shorting devices) shall be operated continuously for 240 hours with 500-Watt, PAR-56 lamps with green filter lenses. This test shall be performed with a 60 Hz current maintained at 20 A + 0.5A through the lampholder input terminals. Any deformation, discoloration, deterioration, or malfunction of the lampholder will be cause for rejection.

4.6.3 Shorting device test.

After the 240-hour operational test, each of the lighting loops in Procedures I, II, and III, complete with isolation transformers, PAR-56 lamps, and lamp monitors/shorting devices, shall withstand being disconnected from the Constant Current Regulator output and 10k Vdc applied to the lighting loop and ground for at least one minute after the meter reading has stabilized on the 10k Vdc test instrument. During the 10k Vdc test each lampholder shall be connected to the same ground as the test instrument. After the 10k Vdc test, perform the test procedures described below. An open lamp filament (lamp failure) may be simulated by opening an electrical contact in series with the lamp filament, or by removing a PAR-56 lamp from the lampholder. Any malfunction or intermittent operation of the shorting devices during the conduct of this test shall be cause for rejection.

4.6.3.1 Procedure I.

Set up nine PAR-56 lampholders with shorting devices and lamps as shown in figure 9, and proceed as follows.

(a) Turn the 30/50 kiloWatt (Kw) Constant Current Regulator(CCR) on to supply a 20 ampere (A) output current to the test circuit; all lamps shall be burning.

(b) Turn the CCR off.

(c) Remove the PAR-56 lamps from lampholders 1, 4, and 7 to simulate lamp failures.

(d) Turn the CCR on; lamps 2, 3, 5, 6, 8, and 9 shall be burning.

(e) Turn CCR off.

(f) Remove the PAR-56 lamps from lampholders 2, 5, and 8 to simulate lamp failures. Turn CCR on. lamps 3, 6, and 9 shall be burning.

(g) Turn CCR off. Replace lamps into lampholders 1, 4, and 7.

(h) Turn the CCR on; lamps 1, 3, 4, 6, 7, and 9 shall be burning.

(i) Turn the CCR off.

(j) Replace lamps into lampholders 2, 5, and 8.

(k) Repeat steps (a) through (j) four more times.

(l) Turn the regulator off.

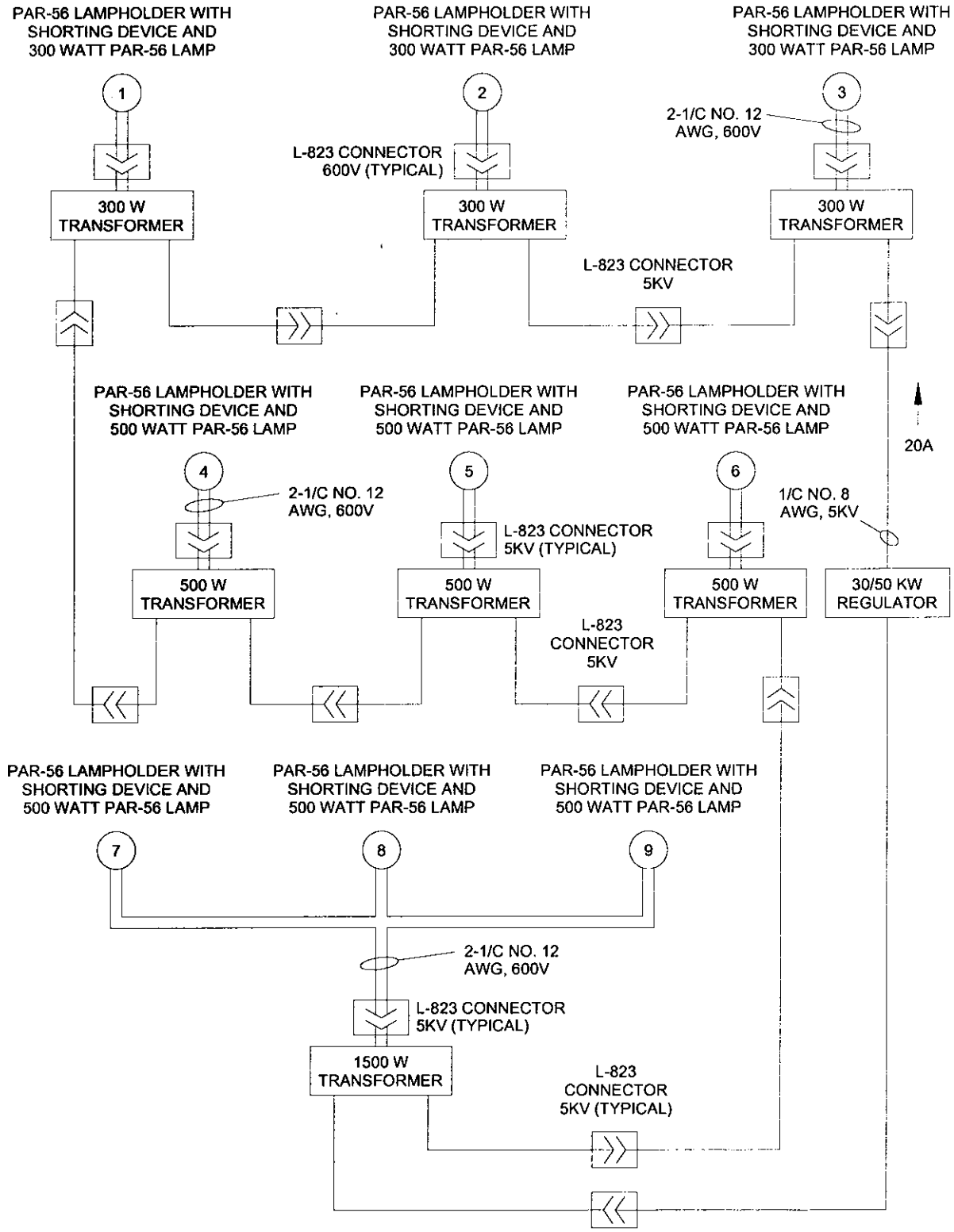

Figure 9. Layout for Test Procedure I

4.6.3.2 Procedure II.

Connect six PAR-56 lampholders with shorting devices and lamps as shown in figure 10, then perform the following steps:

(a) Measure the insulation resistance to ground of all the shorting device leads with a 500 Volt insulation tester. The minimum acceptable insulation resistance shall be 50 megohms.

(b) Turn the 30/50 Kw Constant Current Regulator (CCR) on to provide a 20 A output current to the test circuit; all lamps shall be burning.

(c) Turn the CCR off and remove the PAR-56 lamps from lampholders 1 and 4 to simulate lamp failures.

(d) Inject 4000-Volt peak, 120 hertz (Hz) voltage pulses across the line side of each shorting device in lampholders 1 and 4 for a minimum of one second. The pulse width shall be a minimum of two milliseconds at ten percent of amplitude.

(e) Replace lamps into lampholders 1 and 4.

(f) Turn on the CCR to provide a 20 A output current to the test circuit; all lamps shall be burning.

(g) Turn off CCR and remove the PAR-56 lamps from lampholders 1 and 4 to simulate lamp failures.

(h) Operate CCR at 20 A for 72 hours.

(i) Measure the wattage of the shorting device in lampholders 1 and 4 with 20 A applied. Each shorting device in the shorted state shall load the 20 A circuit with 30 Watts or less.

(j) Turn off the CCR.

(k) Measure the insulation resistance to ground of all the shorting device leads with a 500 Volt insulation tester. The minimum acceptable insulation resistance shall be 50 megohms.

(l) Replace lamps into lampholders 1 and 4.

(m) Turn on the CCR at 8.5 A output; all lamps shall be burning.

(n) Turn off the CCR and remove the PAR-56 lamps from lampholders 1 and 4 to simulate lamp failures. Turn on the CCR, lamps 2, 3, 5, and 6 shall be burning.

(o) Turn off the CCR and remove the PAR-56 lamps from lampholders 2 and 5 to simulate lamp failures. Turn on the CCR, lamps 3 and 6 shall be burning.

(p) Turn off the CCR and remove the PAR-56 lamps from lampholders 3 and 6 to simulate lamp failures.

(q) Turn on the CCR and verify that the shorting devices in lampholders 3 and 6 are shorted.

(r) Turn off the CCR.

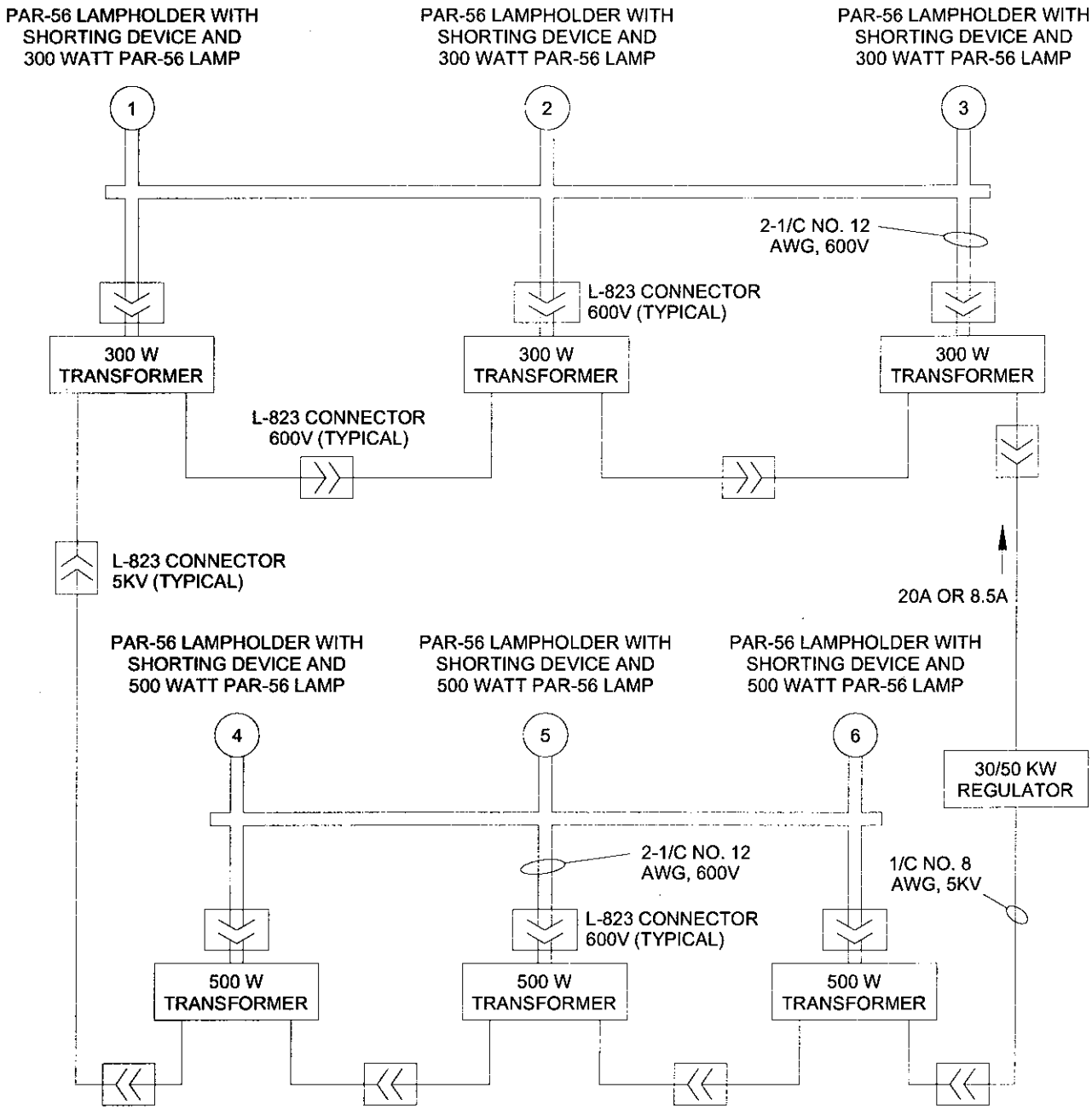

Figure 10. Layout for Test Procedure II

4.6.3.3 Procedure III.

Using the same PAR-56 lampholders with shorting devices as used in Procedure II, replace lamps and set up the six lampholders as shown in figure 11, then perform the following steps:

(a) Turn the 30/50 kw Constant Current Regulator (CCR) on with a 20 A output; all lamps shall be burning.

(b) Turn off the CCR and Remove the PAR-56 lamps from lampholders 1 and 4 to simulate lamp failures.

(c) Remove the PAR-56 lamps from lampholders 2 and 5 to simulate lamp failures.

(d) Remove the PAR-56 lamps from lampholders 3 and 6 to simulate lamp failures.

(e) Inject 4000-Volt peak, 120 Hz voltage pulses across the line side of each shorting device in lampholders 1, 2, 3, 4, 5, and 6. The pulse width shall be a minimum of 2 milliseconds at 10 percent of amplitude.

(f) Replace lamps into lmapholders 1, 2, 3, 4, 5, and 6.

(g) Turn on the CCR to provide an output of 20 A to the test circuit. All lamps shall be burning.

(i) Turn off the CCR and remove the PAR-56 lamps from lampholders 1 and 4 to simulate lamp failures.

(j) Remove the PAR-56 lamps from lampholders 2 and 5 to simulate lamp failures. Turn the CCR on, Lamps 3 and 6 shall be burning.

(k) Measure the wattage of the shorting devices in lampholders 1, 2, 4, and 5 with 20 A applied. Each shorting device, in the shorted state, shall load the 20 A circuit with 30 Watts or less.

(l) Turn off the CCR.

(m) Measure the insulation resistance to ground of all the shorting device leads with a 500 Volt insulation tester. The minimum acceptable insulation resistance shall be 50 megohms.

(n) Replace lamps in lampholders 1, 2, 4, and 5.

(o) Turn on the CCR to provide an 8.5 A output current to the test circuit; all lamps shall be burning.

(p) Turn off the CCR and remove the PAR-56 lamps from lampholders 1 and 4 to simulate lamp failures. Turn on the CCR. Lamps 2, 3, 5, and 6 shall be burning.

(q) Turn off the CCR and remove the PAR-56 lamps from lampholders 2 and 5 to simulate lamp failures. Turn the CCR on. Lamps 3 and 6 shall be burning.

(r) Turn off the CCR and remove the PAR-56 lamps from lampholders 3 and 6 to simulate lamp failures.

(s) Turn on the CCR. Verify that the shorting devices in lampholders 3 and 6 are shorted. Turn off the CCR.

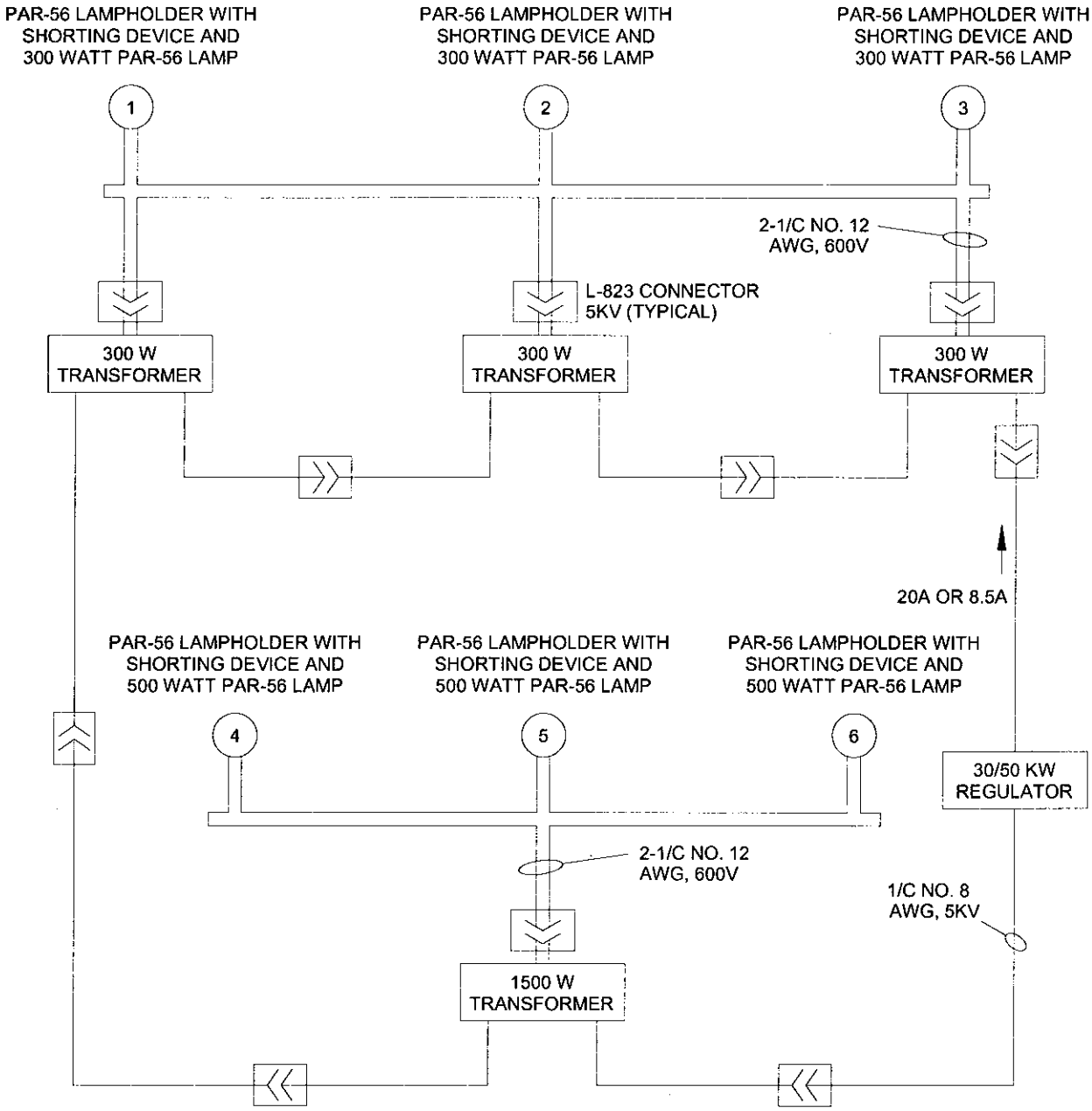

Figure 11. Layout for Test Procedure III

4.6.4 Shorting device production unit operational test.

This test shall demonstrate that the shorting device operates with 8.5 A and 20 A circuit current. A minimum of three 500-Watt PAR-56 lamps shall be installed in three lampholder assemblies, powered and connected as described in 4.6.3. The following steps shall be exercised.

(a) Energize the circuit with a 20 A constant current source. The lamp shall be burning.

(b) Turn off power to the circuit.

(c) Remove one PAR-56 lamp to simulate an open filament.

(d) Turn on power to the circuit.

(e) Repeat steps (a) through (d) until one PAR-56 lamp remains in the circuit. Perform step (c), install the remaining lamp in the adjacent lampholder assembly. Repeat steps (a) through (d).

(f) Reinstall all the lamps previously removed and repeat steps (a) through (e) 10 times.

The same test shall be conducted with an 8.5 A + 0.5 A constant current source. Any malfunction or intermittent operation of the shorting devices leading to the opening of the circuit shall be cause for rejection.

4.7 Lamp connector operational test.

Five 500-watt PAR-56 lamps shall be installed in lampholder assemblies equipped with green filters. The lampholder assemblies mounted on 2-inch (5.08 cm) frangible couplings shall be connected in series and energized by a 20 A constant current source for a period of 720 hours. At the conclusion of the 720-hour continuous operation test, the lamp connectors shall be checked to verify that they are not welded to the PAR-56 lamp prongs. The pull force to remove a lamp prong, or a prong similar in appearance and physical characteristics to a lamp prong, from each of the connector prong sockets shall be greater than 48 ounces (weight) after the 720-hour operational test. The pull force to overcome the static friction between a prong similar to a lamp prong and each connector prong socket shall be measured at zero velocity. The pull force shall be measured on each of the connector prong sockets. The scale used to measure the pull force shall have a maximum force indication until the scale is reset. The lamp prong or similar prong shall be cleaned with alcohol and dried before each test measurement.

4.7.1 Lamp connector test.

The initial pull force to remove a lamp prong, or a prong similar to a lamp prong, from each of the connector prong sockets shall be greater than 48 ounces (weight). The method of measurement shall be as described above in 4.7. Ten lamp Connectors selected from each group of 100 connectors shall be tested for initial pull force. If any of the 10 selected lamp connectors

has less than 48 ounces (weight) initial pull force, then all 100 units shall be measured for compliance with the specification.

4.7.2 Lamp connector temperature rise test.

The temperature rise of each PAR-56 lamp connector shall be 18 degrees centigrade or less when determined by measuring the difference between the ambient temperature and the lamp connector prong socket temperature with a wire test lead installed and the connector is carrying 20 amperes. The test ambient temperature shall be as specified in paragraph 3.4.1.

Construct a wire test lead by soldering a test lamp prong (the prong being of the same dimensions, tolerances, and characteristics as described in specification FAA-E-2408) onto one end of a five inch long 12 AWG wire. Insert the prong end of the test lead into one of the PAR-56 lamp connector sockets to a depth of .500 plus or minus .035 inch. Attach a thermocouple of small gauge wire (22 to 32 AWG) onto the side of the current carrying metal parts of the socket containing the prong.

WARNING:

The thermocouple is connected to a live circuit, therefore do not connect the thermocouple to a grounded meter.

Connect one side of the power source to the input lead of the shorting device and the other side to the other end of the test lead constructed above so as to provide a constant 20 amperes of current flow through one lamp connector socket. Temperature measurements shall be made at 30 minute intervals until three consecutive readings establish a temperature stabilized to within plus or minus two degrees centigrade. The difference between this stabilized temperature and the ambient temperature shall not be greater than 18 degrees centigrade. Repeat the process for the other lamp connector socket.

4.8 Vibration.

The vibration test shall be conducted on six shorting devices installed in PAR-56 lampholders (figure 11). At least two good lamps and two green filters shall be mounted in two of the six lampholders (i.e., lamps 2 and 5 in figure 11) The test circuit shall be operated at 20 A and the test assemblies shall be vibrated in the following three planes:

(a) Perpendicular to the vibration table (vertically)

(b) Horizontally, parallel to the light beam axis.

(c) Horizontally, at right angles to the light beam axis (side)

4.8.1 Vibration levels.

The vibration levels are shown in table I. The duration of each sweep shall be 10 minutes. A sweep is the vibration of a unit throughout a given frequency range. Observe the two good lamps throughout the test. If one or two of the good lamps cease to operate, discontinue the test and test the lamp(s) terminals for continuity. If the lamp(s) are in good condition, the shorting

devices(s) is malfunctioning. If the lamp(s) are burned out, stop the test and place a new lamp in one of the lampholders. The new lamp should be burning. Continue test. If the lamp is not burning, one or more of the shorting devices is malfunctioning. Any malfunction of the shorting device(s) shall be cause for rejection.

4.9 Aiming device test.

The contractor shall provide an aiming platform for mounting the lampholder assembly and for testing each aiming device. The platform shall be calibrated to the same tolerances specified for the aiming device and shall permit verification of the angular readings taken from the mounted aiming device from 0 to 25 in 2 increments.

Table I. Vibration Test Levels

FREQUENCY RANGE, (HERTZ)	ACCELERATION IN GRAVITIES		
	VERTICAL AXIS	LIGHT BEAM AXIS	SIDE AXIS
10-70	0.020 inch double amplitude (displacement)		
70-200	5	5	5
200-500	5	10	10
500-2,000	5	10	5

4.10 Lamp retainer ring test.

Install a PAR-56 lamp into a PAR-56 lampholder with lamp clip assembly 3.3.1.1. Install the assembled fixture and lamp onto a 2 inch diameter electrical metalic tube (EMT) that is 6 foot long. Pin connect the opposite end of the EMT to a bench. Support the lampholder end of the EMT three inches away from the lampholder slipfitter. The EMT shall be in a horzontal position three feet above the floor with the PAR-56 lamp facing the floor. Place soft material on the floor to catch the lamp so it does not break. Start at horizontal and raise the lampholder in 10 degree incroments and release the lampholder. Increase the height in 10 degree incroments and release until the lamp ejects from the lampholder. Then install the lamp retainer ring with the lamp in the lampholder and increase the height 10 degrees more and release the lampholder. The PAR-56 lamp shall be retained in the lampholder to pass the test.

5. PREPARATION FOR DELIVERY

5.1 General.

The equipment shall be prepared for delivery in accordance with the following subparagraphs.

5.1.1 Packaging.

Packaging shall be in accordance with Specification MIL-E-17555, Method III. The lampholder assembly and the shorting device assembly shall each have separate packaging.

5.1.2 Packing.

Packing shall be in accordance with Specification MIL-E-17555. level B.

5.1.3 Marking.

Packages shall be durably and legibly marked with the following information and MIL-STD-129:

N.S.N.	_____		
Type	_____	Spec. No.	_____
Cage & P/N	_____		
Description	_____		
Qty.	_____	SerNo	_____
Contract Number	_____		
Packaging Level	_____	Mo/Yr	_____
Weight	_____	CU	_____
Mfr's Name	_____		
Address	_____		

6. NOTES

The contents of the subparagraphs below are only for the information of the Contracting Officer. They are not contract requirements, and are not binding on either the Government or the contractor, except to the extent that they may be specified elsewhere in the contract as such. Any reliance placed by the contractor on the information is wholly at the contractor's own risk.

6.1 Deliverable items.

The quantity of the following items shall be called out in the contract documents as deliverable items under this specification. Lampholders destroyed during testing shall not be considered as deliverables under this specification. It is recommended that the Lamp Retainer Ring design be submitted for contracting officer approval.

(a) PAR-56 Lampholder assembly
(b) Shorting device with lamp connector assembly
(c) Aiming device
(d) Instruction sheet
(e) Lamp retainer ring

6.2 Government furnished equipments.

The following items are government furnished equipments under this specification.

(a) Five 300-Watt transformers
(b) Five 500-Watt transformers
(c) One 1,500-Watt transformer
(d) One 30 Kw constant current regulator
(e) 12 each, PAR-56, 300-Watt 20A Lamps
(f) 12 each, PAR-56, 500-Watt 20A Lamps
(g) 9 each, PAR-56 Lampholders (when buying only shorting device assemblies)
(h) 9 each, green filters

6.3 Test results.

All test results shall be delivered to the Contracting Officer.