ADDENDUM NO. 1
COVER SHEET

December 10, 2025

TXDOT AVIATION DIVISION
AIRFIELD LIGHTING AND REMARKING
at
NORTH TEXAS REGIONAL AIRPORT (GYI)
DENISON, TX

TXDOT PROJECT NUMBER 2501DENSN-REBID

CONTENTS

DATE: December 10, 2025

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TXDOT AVIATION DIVISION
AIRFIELD LIGHTING AND REMARKING
at
NORTH TEXAS REGIONAL AIRPORT (GYI)
DENISON, TX

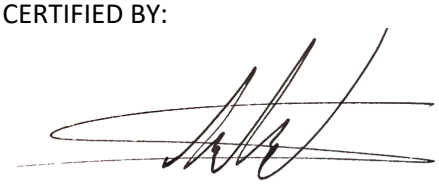
TXDOT PROJECT NUMBER 2501DENSN-REBID

TO: **All Plan-holders of Record**

The following addendum items supplement, clarify, modify, change, replace, delete from or add to, the requirements of the contract documents for this project. The articles contained in the addendum take precedence over the requirements of the previously published contract documents. Where any article of the contract specifications or any detail of the contract drawings is modified or any paragraph, subparagraph or clause thereof is modified or deleted by the articles contained in this addendum, the unaltered provisions of that article, paragraph, subparagraph or clause shall remain in effect.

PREPARED BY: Woolpert, Inc.
11750 Katy Freeway, Suite 1260
Houston, TX 77079

CERTIFIED BY:



Sebastian De Castro

ADDENDUM BEGINS

BID FORM REVISIONS

1. Bid Form
   Revision: Add a new schedule of work, Schedule III, Airfield Lighting – Taxiway, and revised Schedule I quantities to reflect just the runway lighting elements.
   Justification: A new schedule of work was created to reflect the taxiway lighting installation items.

CONSTRUCTION DRAWING UPDATES

1. Sheet Title.: COVER SHEET
   Sheet No.: 1
   Revision: Added a new schedule of work for the taxiway lighting installation elements, Schedule III Airfield Lighting – Taxiway, and updated Schedule I to reflect just the runway lighting elements to be installed during that schedule.
   Justification: Instead of all the runway and taxiway lighting to be installed in one schedule, it was broken up into two schedules, one for runway lighting and one for taxiway lighting. See attached.

2. Sheet Title.: SHEET INDEX AND SUMMARY OF APPROXIMATE QUANTITIES
   Sheet No.: 2
   Revision: Updated the summary of approximate quantities table to reflect the addition of Schedule III. Schedule I quantities were updated to show only the runway lighting elements to be installed during that schedule of work.
   Justification: A new schedule of work was added, thus the quantities were updated to show those changes. See attached.

CLARIFICATIONS / RFI RESPONSES

1. Are there as-builts available to better identify the existing pavement make up and thickness?
   a. We have attached boring information along the airfield.

2. Plan Sheet 2, Summary of Approximate Quantities does not show Item 109a Install Airfield Lighting Control and Monitoring System (ALCMS) nor is there any detailed plan sheets for this item. Also, 2501 DENSN-RE BID, Bid Form still has L-109g , please clarify this item.
   a. ALCMS has been removed. We will remove from the bid form.

ADDENDUM ENDS

CONSTRUCTION PLANS FOR IMPROVEMENTS TO

NORTH TEXAS REGIONAL AIRPORT

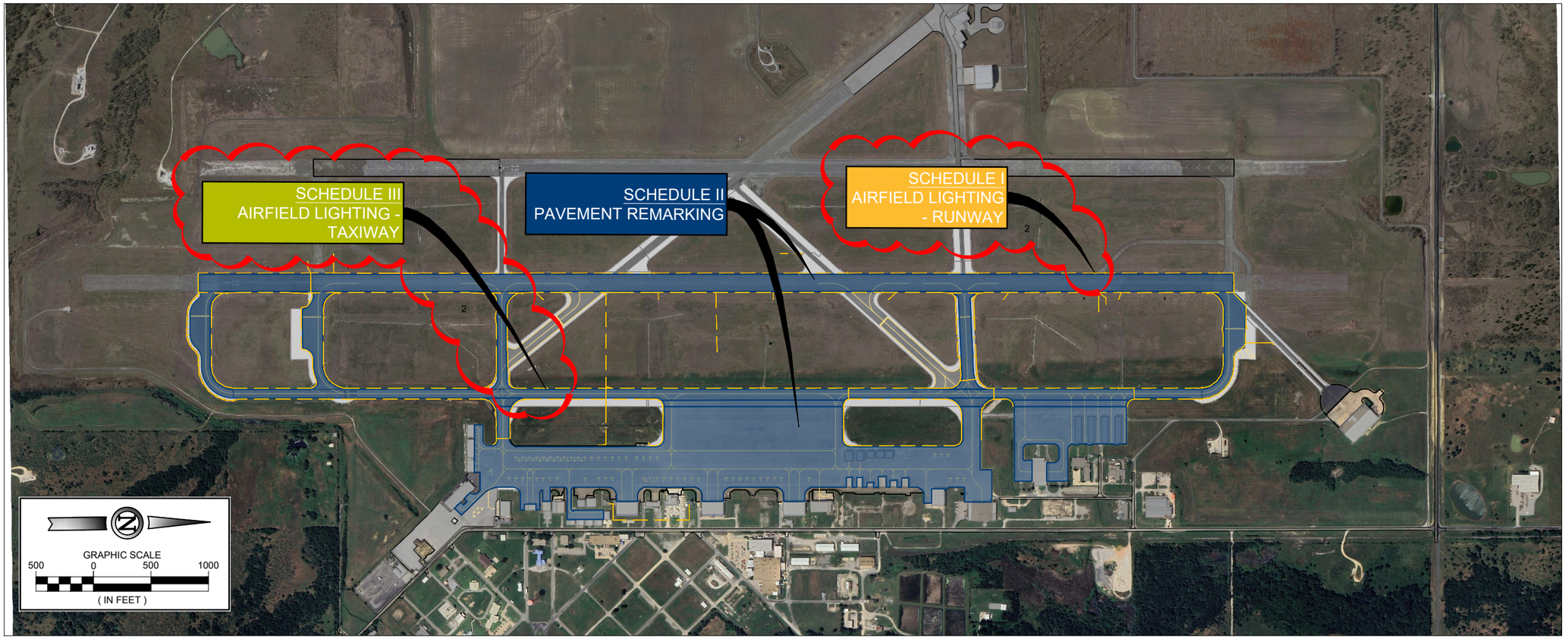
GRAYSON COUNTY, TEXAS

TXDOT CSJ NO.: 2501DENSN-REBID

• SCHEDULE I •
AIRFIELD LIGHTING - RUNWAY 2

• SCHEDULE II •
PAVEMENT MARKING REHABILITATION

• SCHEDULE III •
AIRFIELD LIGHTING - TAXIWAY 2



WOOLPERT
7250 Dallas Parkway
Suite 400
Plano, Texas 75024
Phone: 937.531.1494
Fax: 937.461.0743
woolpert.com

SPONSORED BY
- GRAYSON COUNTY, TEXAS
- TXDOT

PREPARED FOR:
NORTH TEXAS REGIONAL AIRPORT
4700 AIRPORT DRIVE
DENISON, TEXAS 75020

ISSUED FOR BID

THESE DRAWINGS ARE FOR PURPOSES ONLY. THEY WERE PREPARED BY OR UNDER THE SUPERVISION OF:

SEBASTIAN DE CASTRO PE NO. 140643 07/31/2025

FOR AND ON BEHALF OF WOOLPERT, INC.

WOOLPERT

NORTH TEXAS REGIONAL AIRPORT

DES: S.D.C.
DR: L.O.B.
CH: C.L.G.
APP: S.D.C.

ISSUE RECORD

NO.	BY	DATE	DESCRIPTION
1	S.D.C.	07/31/2025	ISSUED FOR RE-BID
2	S.D.C.	12/10/2025	ISSUED FOR ADDENDUM NO. 1

AIRFIELD LIGHTING AND REMARKING

COVER SHEET

STATE PROJ. NO.
TXDOT CSJ NO.: 2501DENSN-REBID

WOOLPERT PROJ. NO.
10018211.01

SHEET NAME
G001

SHEET NO.
1 of 74

Plotted December 10, 2025 @ 2:10 AM by Ambarlantz, Zach
L:\GY\2024 Aiufield Lighting & Remarking\pf: CAD\PLANS\000-GY\-TXDOT-24-G001-COVR.dwg

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30	C114	DEMOLITION PLAN - STA. 158+00 TO STA. 171+00, RUNWAY 18L/36R - OFFSET 600' RT TO 1500' RT
31	C115	DEMOLITION PLAN - STA. 171+00 TO STA. 184+00, RUNWAY 18L/36R - OFFSET 600' RT TO 1500' RT
32	C116	DEMOLITION PLAN - STA. 184+00 TO STA. 197+00, RUNWAY 18L/36R - OFFSET 300' RT TO 1500' RT
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56	E204	ELECTRICAL GEOMETRY PLAN - STA. 145+00 TO 158+00 - RUNWAY 18L/36R, OFFSET 300' LT TO 600' RT
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58	E206	ELECTRICAL GEOMETRY PLAN - STA. 171+00 TO 184+00 - RUNWAY 18L/36R, OFFSET 300' LT TO 600' RT
59	E207	ELECTRICAL GEOMETRY PLAN - STA. 184+00 TO 197+00 - RUNWAY 18L/36R, OFFSET 300' LT TO 600' RT
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61	E209	ELECTRICAL GEOMETRY PLAN - STA. 106+00 TO 119+00 - RUNWAY 18L/36R, OFFSET 600' RT TO 1500' RT
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SUMMARY OF APPROXIMATE QUANTITIES

△2

ITEM NO.	ITEM DESCRIPTION	UNITS	SCHEDULE I		SCHEDULE II		SCHEDULE III	
			ESTIMATE	AS BUILT	ESTIMATE	AS BUILT	ESTIMATE	AS BUILT
C-105a	MOBILIZATION (10% MAXIMUM)	LS	1		1		1	
P-620a	REFLECTORIZED PAVEMENT MARKING (WHITE & YELLOW - RWY, TWY A, B, E, F, APRON)	SF	0		201,500		0	
P-620b	NON-REFLECTORIZED PAVEMENT MARKING (BLACK - RWY, TWY A, B, E, F, APRON)	SF	0		131,250		0	
P-620c	EXISTING PAVEMENT MARKING REMOVAL	SF	0		395,500		0	
L-107a	REMOVE EXISTING PRIMARY WIND CONE AND SEGMENTED CIRCLE MARKER SYSTEM, COMPLETE	EA	1		0		0	
L-107b	INSTALL L-806 LED WIND CONE ON NEW FOUNDATION, COMPLETE	EA	2		0		0	
L-107c	INSTALL L-807 LED WIND CONE ON NEW FOUNDATION, COMPLETE	EA	1		0		0	
L-107d	INSTALL SEGMENTED CIRCLE MARKER SYSTEM, COMPLETE	EA	1		0		0	
L-108a	INSTALL #8 AWG, L-824C, 5000V, WIRE	LF	54,000		0		41,000	
L-108b	INSTALL #6 AWG, BARE COPPER COUNTERPOISE INCLUDING GROUND RODS AND TERMINATIONS	LF	22,500		0		31,000	
L-109a	REMOVE CONSTANT CURRENT REGULATOR, COMPLETE	EA	3		0		1	
L-109b	INSTALL L-829 CONSTANT CURRENT REGULATOR, 2.5KW, FERRORESONANT TYPE WITH IRMS AND INPUT MONITORING, COMPLETE	EA	2		0		0	
L-109c	INSTALL L-829 CONSTANT CURRENT REGULATOR, 7.5KW, FERRORESONANT TYPE WITH IRMS AND INPUT MONITORING, COMPLETE	EA	1		0		0	
L-109d	INSTALL L-829 CONSTANT CURRENT REGULATOR, 10KW, FERRORESONANT TYPE WITH IRMS AND INPUT MONITORING, COMPLETE	EA	0		0		1	
L-109e	INSTALL S-1 CUTOUT IN LOCKABLE NEMA-1 ENCLOSURE, COMPLETE	EA	3		0		1	
L-109f	INSTALL L-854 RADIO CONTROLLER IN EXISTING VAULT, COMPLETE	LS	1		0		0	
L-110a	INSTALL 1-2" SCH 40 PVC CONDUIT DIRECT EARTH BURIED (DEB)	LF	17,250		0		23,000	
L-110b	INSTALL 1-2" SCH 40 PVC CONDUIT CONCRETE ENCASED (CE) IN EXISTING PAVEMENT	LF	2,700		0		6,100	
L-110c	INSTALL 2-2" SCH 40 PVC CONDUIT CONCRETE ENCASED (CE) IN EXISTING PAVEMENT	LF	0		0		675	
L-110d	INSTALL 1-2" SCH 40 HDPE CONDUIT DIRECTIONALLY BORED	LF	1,950		0		900	
L-115a	REMOVE L-867 JUNCTION BOX, COMPLETE	EA	4		0		0	
L-115b	INSTALL L-867E JUNCTION BOX, COMPLETE	EA	5		0		0	
L-125a	REMOVE RUNWAY/TAXIWAY EDGE LIGHT IN SOIL, COMPLETE	EA	83		0		174	
L-125b	REMOVE RUNWAY/TAXIWAY EDGE LIGHT IN EXISTING PAVEMENT, COMPLETE	EA	16		0		124	
L-125c	INSTALL L-861 LED RUNWAY EDGE LIGHT, BASE MOUNTED, IN SOIL, COMPLETE	EA	75		0		0	
L-125d	INSTALL L-861 LED RUNWAY EDGE LIGHT, BASE MOUNTED, IN EXISTING PAVEMENT, COMPLETE	EA	9		0		0	
L-125e	INSTALL L-861E LED RUNWAY THRESHOLD LIGHT, BASE MOUNTED, IN EXISTING PAVEMENT, COMPLETE	EA	16		0		0	
L-125f	INSTALL L-861T LED TAXIWAY EDGE LIGHT, BASE MOUNTED, IN SOIL, COMPLETE	EA	0		0		205	
L-125g	INSTALL L-861T LED TAXIWAY EDGE LIGHT, BASE MOUNTED, IN EXISTING PAVEMENT, COMPLETE	EA	0		0		123	
L-125h	REMOVE L-858 GUIDANCE SIGN AND CONCRETE FOUNDATION, COMPLETE	EA	8		0		33	
L-125i	INSTALL L-858 LED GUIDANCE SIGN, SIZE 1, 2 MODULE, COMPLETE	EA	0		0		11	
L-125j	INSTALL L-858 LED GUIDANCE SIGN, SIZE 1, 3 MODULE, COMPLETE	EA	8		0		9	
L-125k	INSTALL L-858 LED GUIDANCE SIGN, SIZE 1, 4 MODULE, COMPLETE	EA	0		0		4	
L-125l	INSTALL L-858 LED RUNWAY DISTANCE REMAINING SIGN, SIZE 4, COMPLETE	EA	8		0		0	
L-125m	REMOVE VASI SYSTEM, COMPLETE	EA	2		0		0	
L-125n	INSTALL L-880 LED PAPI SYSTEM, COMPLETE	EA	2		0		0	

ISSUED FOR BID

THESE DRAWINGS ARE FOR PURPOSES ONLY. THEY WERE PREPARED BY OR UNDER THE SUPERVISION OF:

ZACHARY C. AMBARIANTZ P.E. 146546 07/31/2025

FOR AND ON BEHALF OF WOOLPERT, INC.

WOOLPERT

NORTH TEXAS REGIONAL AIRPORT

DES: Z.C.A.
DR: L.O.B.
CH: C.L.G.
APP: S.D.C.

ISSUE RECORD

NO.	BY	DATE	DESCRIPTION
1	S.D.C.	07/31/2025	ISSUED FOR RE-BID
△2	S.D.C.	12/10/2025	ISSUED FOR ADDENDUM NO. 1

AIRFIELD LIGHTING AND REMARKING

SHEET INDEX AND SUMMARY OF APPROXIMATE QUANTITIES

STATE PROJ. NO. TXDOT CSJ NO.: 2501DENSN-REBID

WOOLPERT PROJ. NO. 10018211.01

SHEET NAME G002

SHEET NO. 2 of 74

WOOLPERT

Meeting Agenda: Pre-Bid Conference

Project No. 2501DENSN
Date: Wednesday, December 2, 2025, 1:00 P.M. (Local Time)
Location: North Texas Regional Airport Terminal Building, 4700 Airport Drive, Denison, TX 75020

Attendees: See Sign-In Sheet
Agenda:

1. **RECORDING OF ATTENDEES**
   - A. Recording of attendees, firm represented, address and phone number.
   - B. Attendance & plan holder's list will be sent to all attendees.

2. **PROJECT DESCRIPTION & INTRODUCTIONS**
   - A. Project Scope of Work.
     - I. Schedule I:
       - (1) Phase 1A: Runway lighting, remarking, PAPIS
       - (2) Phase 1B: TW A, F remarking, lighting.
       - (3) Phase 2: Parallel TW Remarking, lighting.
       - (4) Phase 3: TW E Remarking, lighting, Apron remarking
       - (5) Phase 4: TW B Remarking, lighting, apron remarking
       - (6) Major Work to be completed: Erosion control measures, delineate wetland areas, clear and grub, electrical removals, existing pavement marking removals, trenching and excavation for electrical conduits, signs and light fixtures, permanent paint.
   - B. Airport Sponsor.
     - I. Bill Magers – Airport Manager.
   - C. Airport Engineering. (Woolpert, Inc.)
     - I. Sebastian De Castro, Project Manager.
     - II. Zachary Ambariantz, Electrical Engineer
   - D. Schedule:
     - I. Bidder hereby agrees to commence work under this contract on or before a date to be specified in a written "Notice to Proceed" and to fully complete the project within one hundred ninety four (194) calendar days thereafter. Of the total one hundred ninety four (194) calendar days, sixty (60) calendar days are for the procurement of materials, fourteen (14) calendar days are for staging, and one hundred twenty (120) calendar days are for on-site construction.
     - II. Phase 1: 80 Calendar Days
     - III. Phase 2: 40 Calendar Days
     - IV. Phase 3: 10 Calendar Days
     - V. Phase 4: 10 Calendar Days
   - E. Major Work Items.

Woolpert, Inc.
11750 Katy Fwy., Suite 1260
Houston TX 77079
Phone – 346.409.2067

Schedule I			
C-105a	MOBILIZATION (10% MAXIMUM)	LS	1
L-107a	REMOVE EXISTING PRIMARY WIND CONE AND SEGMENTED CIRCLE MARKER SYSTEM, COMPLETE	EA	1
L-107b	INSTALL L-806 LED WIND CONE ON NEW FOUNDATION, COMPLETE	EA	2
L-107c	INSTALL L-807 LED WIND CONE ON NEW FOUNDATION, COMPLETE	EA	1
L-107d	INSTALL SEGMENTED CIRCLE MARKER SYSTEM, COMPLETE	EA	1
L-108a	INSTALL #8 AWG, L-824C, 5000V, WIRE	LF	95,000
L-108b	INSTALL #6 AWG, BARE COPPER COUNTERPOISE INCLUDING GROUND RODS AND TERMINATIONS	LF	50,000
L-109a	REMOVE CONSTANT CURRENT REGULATOR, COMPLETE	EA	4
L-109b	INSTALL L-829 CONSTANT CURRENT REGULATOR, 4KW, FERRORESONANT TYPE WITH IRMS AND INPUT MONITORING, COMPLETE	EA	2
L-109c	INSTALL L-829 CONSTANT CURRENT REGULATOR, 7.5KW, FERRORESONANT TYPE WITH IRMS AND INPUT MONITORING, COMPLETE	EA	1
L-109d	INSTALL L-829 CONSTANT CURRENT REGULATOR, 10KW, FERRORESONANT TYPE WITH IRMS AND INPUT MONITORING, COMPLETE	EA	1
L-109e	INSTALL S-1 CUTOUT IN LOCKABLE NEMA-1 ENCLOSURE, COMPLETE	EA	4
L-109f	INSTALL L-854 RADIO CONTROLLER IN EXISTING VAULT, COMPLETE	LS	1
L-109g	INSTALL AIRFIELD LIGHTING CONTROL AND MONITORING SYSTEM (ALCMS), COMPLETE	LS	1
L-110a	INSTALL 1-2” SCH 40 PVC CONDUIT DIRECT EARTH BURIED (DEB)	LF	40,000
L-110b	INSTALL 1-2” SCH 40 PVC CONDUIT CONCRETE ENCASED (CE) IN EXISTING PAVEMENT	LF	8,750
L-110c	INSTALL 2-2” SCH 40 PVC CONDUIT CONCRETE ENCASED (CE) IN EXISTING PAVEMENT	LF	675
L-110d	INSTALL 1-2” SCH 40 HDPE CONDUIT DIRECTIONALLY BORED	LF	2,750
L-115a	REMOVE L-867B JUNCTION BOX, COMPLETE	EA	4
L-115b	INSTALL L-867E JUNCTION BOX, COMPLETE	EA	7
L-125a	REMOVE RUNWAY/TAXIWAY EDGE LIGHT IN SOIL, COMPLETE	EA	257
L-125b	REMOVE RUNWAY/TAXIWAY EDGE LIGHT IN EXISTING PAVEMENT, COMPLETE	EA	140
L-125c	INSTALL L-861 LED RUNWAY EDGE LIGHT, BASE MOUNTED, IN SOIL, COMPLETE	EA	75
L-125d	INSTALL L-861 LED RUNWAY EDGE LIGHT, BASE MOUNTED, IN EXISTING PAVEMENT, COMPLETE	EA	9
L-125e	INSTALL L-861E LED RUNWAY THRESHOLD LIGHT, BASE MOUNTED, IN EXISTING PAVEMENT, COMPLETE	EA	16
L-125f	INSTALL L-861T LED TAXIWAY EDGE LIGHT, BASE MOUNTED, IN SOIL, COMPLETE	EA	205
L-125g	INSTALL L-861T LED TAXIWAY EDGE LIGHT, BASE MOUNTED, IN EXISTING PAVEMENT, COMPLETE	EA	123
L-125h	REMOVE L-858 GUIDANCE SIGN AND CONCRETE FOUNDATION, COMPLETE	EA	41
L-125i	INSTALL L-858 LED GUIDANCE SIGN, SIZE 1, 2 MODULE, COMPLETE	EA	11
L-125j	INSTALL L-858 LED GUIDANCE SIGN, SIZE 1, 3 MODULE, COMPLETE	EA	17
L-125k	INSTALL L-858 LED GUIDANCE SIGN, SIZE 1, 4 MODULE, COMPLETE	EA	4
L-125l	INSTALL L-858 LED RUNWAY DISTANCE REMAINING SIGN, SIZE 4, COMPLETE	EA	8
L-125m	REMOVE VASI SYSTEM, COMPLETE	EA	2
L-125n	INSTALL L-880 LED PAPI SYSTEM, COMPLETE	EA	2

Schedule II			
C-105a	MOBILIZATION (10% MAXIMUM)	LS	1
P-620a	REFLECTORIZED PAVEMENT MARKING (WHITE & YELLOW - RWY, TWY A, B, E, F, APRON)	SF	201,500
P-620b	NON-REFLECTORIZED PAVEMENT MARKING (BLACK - RWY, TWY A, B, E, F, APRON)	SF	131,250
P-620c	EXISTING PAVEMENT MARKING REMOVAL	SF	395,500

BID OPENING DATE & TIME

F. Date: December 18, 2025, 2:00 pm (Local Time)
Mailed to: Kelle Chancey, TxDOT Aviation Division, 6230 E. Stassney Lane, 2nd Floor, Austin, Texas 78744. The delivered package must be clearly marked as "Bid Proposal".
G. Opened at: TXDOT Stassney Campus
6230 E Stassney Lane
Austin, TX
H. Bid security: 2% of bid amount
I. Bid proposal: TXDOT bid form

3. **DBE GOALS**
   A. X% of Contract Amount. – Refer to Eli Lopez
   B. Turned in no later than 5 days after opening

4. **QUALIFICATION OF BIDDERS**
   A. Qualifications shall be furnished per Section 20-02.

5. **CRITICAL CONTRACT DATES**
   A. Notice of Award: TBD
   B. Notice to Proceed: TBD

6. **BONDING**
   A. Payment Bond: 100% of Bid Amount.
   B. Performance Bond: 100% of Bid Amount.

7. **INSURANCE REQUIREMENTS**
   A. Aviation Division General Construction Contract Provisions, volume dated February 2013.

8. **FEDERAL WAGE RATES (DAVIS BACON ACT)**
   A. Federal wage rates are required for this project. Refer to Part 6.
   B. Contractor and all Subcontractors are required to submit certified payrolls.

9. **ENGINEER/RESIDENT PROJECT REPRESENTATIVE (RPR) FIELD OFFICE**
   A. Not Required. Refer to Part 4, Section 60-05 for more information.

10. **CONSTRUCTION SAFETY AND PHASING PLAN (CSPP)**
    A. The Contractor shall review and adhere to the CSPP prepared by the Engineer.
    B. The Contractor shall submit a Safety Plan Compliance Document (SPCD) (Refer to Part 7) to the engineer and airport operator for approval PRIOR to the issuance of Notice to Proceed as required by FAA Advisory Circular (AC) 150/5370-2G "Operational Safety on Airports During Construction".

11. **ENVIRONMENTAL REQUIREMENTS**
    A. Discuss all project specific requirements for environmentally sensitive areas. Discuss protocols for working in and around these sensitive areas. Adherence to these requirements will be strictly enforced.
    B. All changes to haul routes, staging areas, material storage areas, borrow/waste areas, and limits of disturbance will require approval by FAA Environmental.

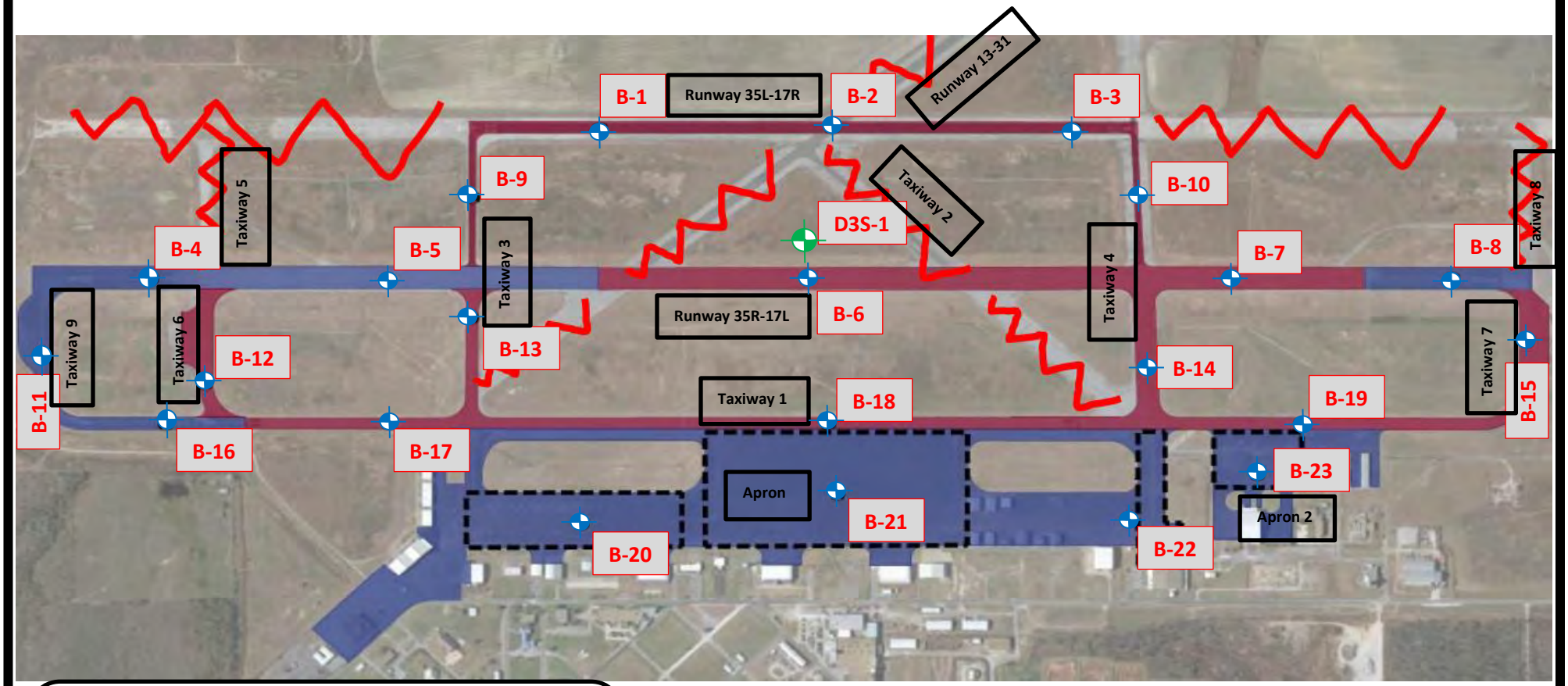
12. **LIQUIDATED DAMAGES**
    A. Bidder agrees to pay as liquidated damages the sum of $1,000 for each calendar day to complete the work beyond the allotted time or as extended by an approved Change Order or Supplemental Agreement.

13. **MISCELLANEOUS**
    A. Airport Security – Badging is not required for this project.
    B. Airport Driving – no safety course required.
    C. Review Construction Safety Overall Phasing Plan G050 – note the Staging Area & Airport Access gate.
    D. Review Construction Layout 4 Phases G052 thru G055 – the contractor shall install flasher barricades around the perimeter of the construction site bordering the airfield to isolate the contractor from aircraft.
    E. Contractor shall stay within project boundaries.
    F. Radios for the project to be provided by Contractor. See Part 7 CSPP. The Air Traffic Control Tower can assist and alert the contractor as necessary.
    G. State Sales & Use Tax Exempt – not exempt.
    H. Quality Assurance testing will be completed by QA Firm under the direction of the Engineer. The Quality Control testing and Quality Assurance testing shall be completed by separate firms.
    I. Construction Management Plan submitted by Contractor.
    J. Water availability –To discuss with Scott Ford.
    K. Questions will only be taken via written format to the Project Manager Until June 4th, when the final addendum is due.

14. **ADDENDUM UPDATE**

15. **QUESTIONS / ANSWERS**

16. **PROJECT SITE TOUR**



LEGEND

Approximate Boring Location

Approximate Bulk Sample Location

W S N E

Concrete Pavement

HMAC Pavement

Apron HFWD Focus

BORING LOCATION DIAGRAM

North Texas Regional Airport Pavement Evaluation

4700 Airport Drive, Denison, TX

ENGINEER	**KB01**
SOURCE	**Site Plan**
PROJECT NO.	**19:7895**
SHEET	**1 OF 1**
DATE	**2/24/20**

REGIONAL GEOLOGY

North Texas Regional Airport Pavement Evaluation

Kef – Eagle Ford Formation
Geologic Atlas of Texas, Sherman Sheet, 1991

4700 Airport Drive, Denison, TX

ENGINEER	KB01
SOURCE	
PROJECT NO.	19:7895
SHEET	1 OF 1
DATE	2/24/20

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Boring Logs B-1 to B-23
Pavement Core Pictures

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]	
	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
	FILL[3] MAN-PLACED SOILS
GW	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GP	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GM	**SILTY GRAVEL** gravel-sand-silt mixtures
GC	**CLAYEY GRAVEL** gravel-sand-clay mixtures
SW	**WELL-GRADED SAND** gravelly sand, little or no fines
SP	**POORLY-GRADED SAND** gravelly sand, little or no fines
SM	**SILTY SAND** sand-silt mixtures
SC	**CLAYEY SAND** sand-clay mixtures
ML	**SILT** non-plastic to medium plasticity
MH	**ELASTIC SILT** high plasticity
CL	**LEAN CLAY** low to medium plasticity
CH	**FAT CLAY** high plasticity
OL	**ORGANIC SILT or CLAY** non-plastic to low plasticity
OH	**ORGANIC SILT or CLAY** high plasticity
PT	**PEAT** highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS			
SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION		
DESIGNATION		**PARTICLE SIZES**
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS		
UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	**SPT[5] (BPF)**	**CONSISTENCY[7] (COHESIVE)**
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS	
SPT[5]	**DENSITY**
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
Dual Symbol *(ex: SW-SM)*	10	10
With	15 - 20	15 - 25
Adjective *(ex: "Silty")*	≥25	≥30

WATER LEVELS[6]		
	WL	Water Level (WS)(WD)
		(WS) While Sampling
		(WD) While Drilling
	SHW	Seasonal High WT
	ACR	After Casing Removal
	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

[1] *Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.*

[2] *To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.*

[3] *Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-**FILL**)].*

[4] *Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).*

[5] *Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).*

[6] *The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.*

[7] *Minor deviation from ASTM D 2488-09 Note 16.*

[8] *Percentages are estimated to the nearest 5% per ASTM D 2488-09.*

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-1
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7108, -96.6765
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**4" asphalt, 4.5" cement treated base, 15.5" flexible base**		
	1				
	1.5				
	2				
	2.5		**(CL) LEAN CLAY,** light brown and grayish brown, moist, stiff to hard, with gravel	4.5+	
	3				
	3.5			4.25	
	4				
	4.5			3.5	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-2
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7148, -96.6763
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**4.5" asphalt, 6" cement treated base, 4.5" flexible base**		
	1				
	1.5			4.5+	
	2		**(CH) FAT CLAY**, grayish brown, moist, stiff to hard, slightly sandy		
	2.5				
	3				
	3.5			3.75	
	4				
	4.5			2	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-3
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7187, -96.6762
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**3.5" asphalt, 6" cement treated base, 6" flexible base**		
	1				
	1.5			0.5	
	2		**(CL) LEAN CLAY**, light brown and grayish brown, moist, stiff to hard, slightly sandy with gravel		
	2.5				
	3				
	3.5			2	
	4				
	4.5		**(CH) FAT CLAY**, grayish brown, moist, stiff to hard, slightly sandy	2.5	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-4
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7034, -96.6735
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD Continuous Flight Augers		**DRILLER:** Stratabore, LLC	
BORING STARTED: 1/31/2020		**BORING COMPLETED** 2/3/2020	

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**11.5" concrete, 6" flexible base**		
	1				
	1.5				**SPT, N = 4 (bpf)**
	2		**(SC) CLAYEY SAND**, brown to light brown, moist		
	2.5				
	3		**(CL) LEAN CLAY**, light brown and grayish brown, moist, stiff to very stiff, with gravel		
	3.5			1	
	4				
	4.5			2	
	5		**(CH) FAT CLAY**, grayish brown, moist, hard, slightly sandy		
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING: 0 FT @ 0 HRS	**CAVE-IN DEPTH:** 0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-5
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7074, -96.6733
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	1/31/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**10.5" concrete, 6" flexible base**		
	1				
	1.5			1.5	
	2		**(SC) CLAYEY SAND**, brown to light brown, moist		
	2.5				
	3		**(CL) LEAN CLAY**, light brown and grayish brown, moist, stiff, with gravel		
	3.5			3	
	4				
	4.5			4.5+	
	5		**(CH) FAT CLAY**, grayish brown, moist, very stiff, slightly sandy		
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING: 0 FT @ 0 HRS	**CAVE-IN DEPTH:** 0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-6
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7142, -96.6731
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	1/31/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**7.5" (3.5" + 4") asphalt, 6" possible cement treated base / flexible base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, brown to light brown, moist		
	2.5			2.25	
	3		**(CL) LEAN CLAY**, light brown and grayish brown, moist, very stiff, with gravel		
	3.5			2.25	
	4		**(CH) FAT CLAY**, grayish brown, moist, stiff, slightly sandy		
	4.5			0.50	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-7
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7212, -96.6728
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	1/31/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**9.5" (2.5"+2.25"+4.75") asphalt, 3.5" cement treated base, 6" possible cement treated base / flexible base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, brown to light brown, moist		
	2.5			2.50	
	3		**(CL) LEAN CLAY**, light brown and grayish brown, moist, very stiff to hard, with gravel		
	3.5			4.25	
	4				
	4.5			4.00	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-8
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7251, -96.6727
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	1/31/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**12" concrete, 6" flexible base**		
	1				
	1.5		**(SC) CLAYEY SAND**, brown to light brown, moist		
	2				
	2.5		**(CL) LEAN CLAY**, light brown and grayish brown, moist, very stiff, with gravel	3.00	
	3				
	3.5			2.50	
	4				
	4.5			3.75	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-9
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7088, -96.6752
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**3" asphalt, 6" flexible base**		
	1				
	1.5		**(SC) CLAYEY SAND**, reddish brown, moist		
	2				
	2.5		**(CH) FAT CLAY**, grayish brown, moist, stiff to very stiff, slightly sandy		
	3				
	3.5			1.25	
	4				
	4.5			2.5	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-10
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7198, -96.6748
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**2.5" asphalt, 6.5" concrete**		
	1				
	1.5		**(CH) FAT CLAY**, grayish brown, moist, stiff to very stiff, slightly sandy	2.25	
	2				
	2.5				
	3				
	3.5			1.5	
	4				
	4.5			2	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-11
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7016, -96.6717
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**11.25" concrete, 6" flexible base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, light brown, moist		
	2.5		**(CH) FAT CLAY,** grayish brown, moist, very stiff to hard, slightly sandy		
	3				
	3.5			3.25	
	4				
	4.5			4	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-12
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7043, -96.6712
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**11.25" asphalt (4.75" + 3.25" + 3.25"), 6" flexible base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, redish brown, moist		
	2.5				
	3				
	3.5				
	4				
	4.5		**(CH) FAT CLAY**, grayish brown, moist, hard, slightly sandy	4	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-13
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7087, -96.6724
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**13.75" asphalt (2.75" + 2.25"+8.75"), 6" flexible base**		
	1				
	1.5				
	2				
	2.5		**(SC) CLAYEY SAND**, reddish brown to light brown, moist	1.25	
	3				
	3.5			1	
	4				
	4.5		**(CH) FAT CLAY**, grayish brown, moist, stiff, slightly sandy	1.25	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-14
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7199, -96.6709
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**8.25" asphalt (2" + 2" + 4.25"), 6.25" flexible base**		
	1				
	1.5				
	2		**(CH) FAT CLAY**, grayish brown, moist, stiff, slightly sandy		
	2.5			1.5	
	3				
	3.5			1	
	4				
	4.5			0.5	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-15
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7261, -96.6711
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	1/31/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**11" asphalt (4"+2.75"+4.25"), 6" flexible base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, light brown, moist		
	2.5		**(CH) FAT CLAY,** grayish brown, moist, very stiff, slightly sandy	2	
	3				
	3.5			2	
	4				
	4.5			2.25	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-16
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7036, -96.6701
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**11" concrete, 6" flexible base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, reddish brown to brown, moist		
	2.5		**(CH) FAT CLAY,** grayish brown, moist, very stiff, slightly sandy		
	3				
	3.5			2.75	
	4				
	4.5			2.25	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-17
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7073, -96.6700
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**7.75" asphalt (3.25" + 4.5"), 7" cement treated base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, redish brown to light brown, moist		
	2.5				
	3				
	3.5			3	
	4				
	4.5		**(CH) FAT CLAY**, grayish brown, moist, very stiff, slightly sandy	2.25	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-18
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7147, -96.6697
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**8" asphalt (2" + 2" + 4"), 20" cement treated base**		
	1				
	1.5				
	2				
	2.5				
	3		**(CH) FAT CLAY**, grayish brown, moist, stiff to very stiff, slightly sandy		
	3.5			1	
	4				
	4.5			2	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-19
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7224, -96.6694
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	1/31/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5 1 1.5 2		**9" asphalt (1.75" + 2.75" + 4.5"), 12" possible cement treated base / flexible base**		
	2.5		**(SC) CLAYEY SAND**, light brown, moist	4	
	3 3.5 4 4.5 5		**(CH) FAT CLAY**, grayish brown, moist, very stiff, slightly sandy	2.75 2.5	
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-20
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7106, -96.6675
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**10.5" concrete, 6" flexible base**		
	1				
	1.5				
	2		**(SC) CLAYEY SAND**, light brown, moist		
	2.5		**(CH) FAT CLAY,** grayish brown to light brown, moist, very stiff to hard, slightly sandy		
	3				
	3.5			4.5+	
	4				
	4.5			2.5	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-21
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7148, -96.6682
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**16" concrete (10" + 6"), 12" flexible base**		
	1				
	1.5				
	2				
	2.5			1	
	3		**(SC) CLAYEY SAND**, light brown, moist		
	3.5			1.25	
	4		**(CH) FAT CLAY,** grayish brown to light brown, moist, very stiff to hard, slightly sandy		
	4.5			1	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-22
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7197, -96.6675
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**15.25" concrete (8.25" + 7"), 12" flexible base**		
	1				
	1.5				
	2				
	2.5			0.5	
	3		**(SC) CLAYEY SAND**, light brown, moist		
	3.5		**(CH) FAT CLAY,** grayish brown to light brown, moist, very stiff to hard, slightly sandy	3.75	
	4				
	4.5			4.25	
	5				
			End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.
P: Pocket Pen Readings
THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

BORING LOG

PROJECT NO.:	7895	**BORING NO:**	B-23
OWNER:	Applied Reseach Associates, Inc. (ARA)	**SHEET:**	1
PROJECT NAME:	North Texas Regional Airport Pavement Evaluation	**GPS Co-ord:**	33.7216, -96.6685
LOCATION:	Denison, Texas	**SURF. ELEV (FT):**	N/A
DRILLING METHOD	Continuous Flight Augers	**DRILLER:**	Stratabore, LLC
BORING STARTED:	2/3/2020	**BORING COMPLETED**	2/3/2020

ELEV. (FEET)	DEPTH (FEET)	SAMPLE	DESCRIPTION OF MATERIALS (CLASSIFICATION)	P tsf	NOTES
	0.5		**11" concrete, 6" flexible base**		
	1				
	1.5				
	2		**(CH) FAT CLAY,** grayish brown to light brown, moist, very stiff to hard, slightly sandy		
	2.5			1	
	3				
	3.5			2	
	4				
	4.5			4	
	5		End of Boring @ 5 feet		

WATER DEPTH AFTER DRILLING:	0 FT @ 0 HRS	**CAVE-IN DEPTH:**	0 ft

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES.

P: Pocket Pen Readings

THE STANDARD PENETRATION RESISTANCE (N-VALUE) IS THE SUM OF THE 2nd and 3rd SET OF BLOWS (6" INCREMENTS) REQUIRED TO DRIVE A 2" O.D. (1.375" I.D.) SPLIT-SPOON SAMPLER A DISTANCE OF 18" OR 24", USING A 140 LB HAMMER DROPPING 30".

EOPC

Engineers Estimate of Probable Cost for this project is as follows:

Schedule 1 – Airfield Lighting: $ 3,905,275.00

Schedule 2 – Pavement Remarking: $ 892, 581.50

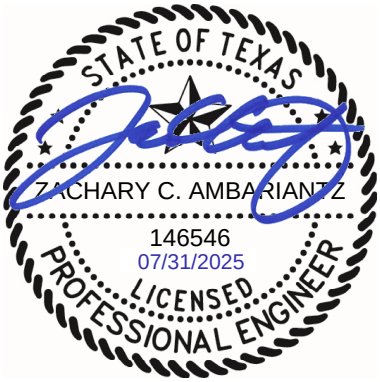
TECHNICAL SPECIFICATIONS

Schedule I
Airfield Lighting and Pavement Remarking

TXDOT CSJ NO.: 2501DENSN-REBID

North Texas Regional Airport

Denison, Texas



Sponsored By:
Grayson County
Texas Department of Transportation – Aviation Division

Issued for Re-Bid
July 31, 2025

WOOLPERT

Woolpert, Inc.
11750 Katy Freeway, Suite 1260
Houston, TX 77079
800.414.1045

TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS

All references in the included Texas Department of Transportation (TxDOT) specifications to additional TxDOT specifications that are not included in these contract documents are henceforth made by reference only and can be found in the "Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" adopted by the Texas Department of Transportation on November 1, 2014. These specifications can be found in their entirety on TxDOT's website, along with any Statewide Special Provisions related to their use.

ITEM C-105
MOBILIZATION

Item C-105 Mobilization is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 105-4 as follows:

105-4 ENGINEER/RPR FIELD OFFICE. ~~The Contractor shall provide dedicated space for the use of the field RPR and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity in accordance with local building codes.~~ An Engineer/RPR field office is not required.

Revise Section METHOD OF MEASUREMENT as follows:

METHOD OF MEASUREMENT

105-5 BASIS OF MEASUREMENT AND PAYMENT. Partial payments for mobilization will be made once each month as the work progresses. Provided all requirements of applicable General and Special Provisions have been accomplished to the satisfaction of the Engineer, partial payments will be made as follows:

a. When 5% of the original contract amount is earned, 20% of the amount bid for this item will be paid, not to exceed 2% of the original contract amount.

b. When 20% of the original contract amount is earned, 50% of the amount bid for this item, less all-previous payments, will be paid, not to exceed 5% of the original contract amount.

c. When 35% of the original contract amount is earned, 60% of the amount bid for this item, less all-previous payments, will be paid, not to exceed 6% of the original contract amount.

d. When 75% of the original contract amount is earned, the amount bid for this item, less all-previous payments, will be paid, not to exceed 10% of the original contract amount.

e. When 90% of the original contract amount is earned, the amount in excess of 10% of the original contract amount, less all previous payments, will be paid.

For the purpose of the Specification that term "original contract amount" as used above shall mean the amount of the award for the construction items on this contract not including the amount bid for mobilization. Payments for materials on hand will not be included as a percent of original contract amount earned until said materials on hand have been incorporated into the work and accepted and paid for as contract items. For multiple schedule projects, the above "original contract amount" shall be interpreted by schedule.

This price shall extend to the general contractor and to any and all subcontractors. No additional payment will be made to any bid item to compensate the Contractor or subcontractor for loss of profits attributed to mobilization costs.

~~Based upon the contract lump sum price for "Mobilization" partial payments will be allowed as follows:~~
~~[a. With first pay request, 25%.~~
~~b. When 25% or more of the original contract is earned, an additional 25%.~~
~~c. When 50% or more of the original contract is earned, an additional 40%.~~
~~d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90, paragraph 90-11, *Contractor Final Project Documentation,* the final 10%.]~~

Revise Section BASIS OF PAYMENT as follows:

BASIS OF PAYMENT

105-6 BASIS FOR PAYMENT

105-6.1 Payment shall be at the contract unit price of lump sum for "C-105 Mobilization". That price shall be full compensation for all labor, equipment, and supplies needed to complete the item. ~~Payment will be made under:~~

Item C 105a Moblilization – per lump sum (LS)

ITEM C-105
MOBILIZATION

105-1 DESCRIPTION. This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, facilities, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

105-2 MOBILIZATION LIMIT. Mobilization shall be limited to 10 percent of the total project cost.

105-3 POSTED NOTICES. Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105-4 ENGINEER/RPR FIELD OFFICE. ~~The Contractor shall provide dedicated space for the use of the field RPR and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity in accordance with local building codes.~~ An Engineer/RPR field office is not required.

METHOD OF MEASUREMENT

105-5 BASIS OF MEASUREMENT AND PAYMENT. Partial payments for mobilization will be made once each month as the work progresses. Provided all requirements of applicable General and Special Provisions have been accomplished to the satisfaction of the Engineer, partial payments will be made as follows:

a. When 5% of the original contract amount is earned, 20% of the amount bid for this item will be paid, not to exceed 2% of the original contract amount.

b. When 20% of the original contract amount is earned, 50% of the amount bid for this item, less all-previous payments, will be paid, not to exceed 5% of the original contract amount.

c. When 35% of the original contract amount is earned, 60% of the amount bid for this item, less all-previous payments, will be paid, not to exceed 6% of the original contract amount.

d. When 75% of the original contract amount is earned, the amount bid for this item, less all-previous payments, will be paid, not to exceed 10% of the original contract amount.

e. When 90% of the original contract amount is earned, the amount in excess of 10% of the original contract amount, less all previous payments, will be paid.

For the purpose of the Specification that term "original contract amount" as used above shall mean the amount of the award for the construction items on this contract not including the amount bid for mobilization. Payments for materials on hand will not be included as a percent of original contract amount earned until said materials on hand have been incorporated into the work and accepted and paid for as contract items. For multiple schedule projects, the above "original contract amount" shall be interpreted by schedule.

This price shall extend to the general contractor and to any and all subcontractors. No additional payment will be made to any bid item to compensate the Contractor or subcontractor for loss of profits attributed to mobilization costs.

~~Based upon the contract lump sum price for "Mobilization" partial payments will be allowed as follows:~~
~~[a. With first pay request, 25%.~~
~~b. When 25% or more of the original contract is earned, an additional 25%.~~
~~c. When 50% or more of the original contract is earned, an additional 40%.~~
~~d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90, paragraph 90-11, *Contractor Final Project Documentation,* the final 10%.]~~

BASIS OF PAYMENT

105-6 BASIS FOR PAYMENT

105-6.1 Payment shall be at the contract unit price of lump sum for "C-105 Mobilization". That price shall be full compensation for all labor, equipment, and supplies needed to complete the item. ~~Payment will be made under:~~

Item C 105a Moblilization – per lump sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

END OF ITEM C-105

ITEM P-152 EXCAVATION, SUBGRADE, AND EMBANKMENT

Item P-152 Excavation, Subgrade, and Embankment is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 152-1.2 as follows:

152-1.2 CLASSIFICATION. All material excavated shall be classified as defined below:

a. Unclassified excavation. Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature which is not otherwise classified and paid for under one of the following items.

~~[b. [___]~~

~~[**Rock excavation**. Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers. All boulders containing a volume of more than 1/2 cubic yard (0.4 m^3) will be classified as "rock excavation."]~~

~~[**Muck excavation**. Muck excavation shall consist of the removal and disposal of deposits or mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials that will decay or produce subsidence in the embankment. It may consist of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment.]~~

~~[**Drainage excavation**. Drainage excavation shall consist of all excavation made for the primary purpose of drainage and includes drainage ditches, such as intercepting, inlet or outlet ditches; temporary levee construction; or any other type as shown on the plans.]~~

~~[**Borrow excavation**. Borrow excavation shall consist of approved material required for the construction of embankments or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas designated by the Resident Project Representative (RPR) within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport boundaries.]~~

~~[**Other.**]]~~

Revise Section 152-2.1, blasting, as follows:

a. Blasting. Blasting shall not be allowed. ~~[Blasting will be permitted as directed by the RPR and in accordance with the following:~~

~~Blasting will be permitted only when proper precautions are taken for the safety of all persons, work, and property. All damage done to the work or property shall be repaired by the Contractor. The cost of repair is incidental to this item. All operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all federal, state and local regulations and explosive manufacturers' instructions, with applicable approved permits reviewed by the RPR. Any approval will not relieve the Contractor of their responsibility in blasting operations.~~

~~Where blasting is approved, the Contractor shall employ a vibration consultant, approved by the RPR, to advise on explosive charge weights per delay and to analyze records from seismograph~~

~~recordings. The seismograph shall be capable of producing a permanent record of the three components of the motion in terms of particle velocity, and in addition shall be capable of internal dynamic calibration.~~

~~In each distinct blasting area, where pertinent factors affecting blast vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the RPR for approval. This plan must consist of hole size, depth, spacing, burden, type of explosives, type of delay sequence, maximum amount of explosive on any one delay period, depth of rock, and depth of overburden if any. The maximum explosive charge weights per delay included in the plan shall not be increased without the approval of the RPR.~~

~~The Contractor shall keep a record of each blast: its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location.~~

~~Blasting and explosive storage shall be in accordance with Section 70, paragraph 70-09 and all federal, state, and local safety regulations.~~

~~These records shall be made available to the RPR on a monthly basis or in tabulated form at other times as required.]~~

Revise Section 152-2.2 as follows:

152-2.2 EXCAVATION. No excavation shall be started until the work has been staked out by the Contractor and the RPR has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and RPR shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines.

~~[Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces were used to develop the design plans.~~

~~[Volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and generating Triangle Volume Reports. Electronic copies of DTM files and a paper copy of the original topographic map will be issued to the successful bidder.]~~

~~[Volumetric quantities were calculated using design cross sections which were created for this project using the DTM files of the applicable design surfaces and generating End Area Volume Reports. Paper copies of design cross sections and a paper copy of the original topographic map will be issued to the successful bidder.]~~

~~Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within [0.1 foot (30 mm)] of the stated elevations for ground surfaces, or within [0.04 foot (12 mm)] for hard surfaces (pavements, buildings, foundations,~~

~~structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Contractor's verification identifies discrepancies in the topographic map, Contractor shall notify the RPR in writing at least [two weeks] before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.]~~

All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the RPR. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

The grade shall be maintained so that the surface is well drained at all times.

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the RPR. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

a. **Selective grading.** ~~When selective grading is indicated on the plans, the more suitable material designated by the RPR shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved.~~ **Not used.**

b. **Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches (300 mm) below the subgrade or to the depth specified by the RPR. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the plans ~~disposed off the airport.~~ The cost is incidental to this item~~. This excavated material shall be paid for at the contract unit price per cubic yard (per cubic meter) for unclassified excavation.~~ The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans. Undercutting will be paid as unclassified excavation ~~[rock excavation]~~.

c. **Over-break.** ~~Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the RPR. All over-break shall be graded or removed by the Contractor and disposed of as directed by the RPR. The RPR shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the RPR determines as avoidable. Unavoidable over-break will be classified as "Unclassified Excavation."~~ **Not used.**

d. **Removal of utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished ~~by someone other than~~ the Contractor ~~[by the Contractor]~~ as indicated on the plans. All existing foundations shall be excavated at least 2 feet (60 cm) below the top of subgrade or as indicated on the plans, and the material disposed of as

directed by the RPR. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as shown on the plans.

152-2.3 Borrow excavation. Borrow areas are not required~~. [ ] [Borrow areas within the airport property are indicated on the plans. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed by the RPR. All unsuitable material shall be disposed of by the Contractor as shown on the plans. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant. [___]].~~

~~[There are no borrow sources within the boundaries of the airport property. The Contractor shall locate and obtain borrow sources, subject to the approval of the RPR. The Contractor shall notify the RPR at least [15] days prior to beginning the excavation so necessary measurements and tests can be made by the RPR. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant~~.

Revise Section 152-2.8 sections as follows:

The **Contractor** ~~RPR~~ will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM ~~D698] [D 1557.~~ A new Proctor shall be developed for each soil type based on visual classification.

Density tests will be taken by the **~~RPR~~ contractor** for every 3,000 square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the RPR.

If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow AASHTO T-180 Annex Correction of maximum dry density and optimum moisture for oversized particles.

Rolling operations shall be continued until the embankment is compacted to not less than 100% of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM **D6981557**. Under all areas to be paved, the embankments shall be compacted to a depth of **12 inches** and to a density of not less than **95** percent of the maximum density as determined by ASTM **D6981557.** As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches (100 mm) which shall be prepared for a seedbed in accordance with Item T-901 ~~] [T-906].~~

The **~~RPR~~Contractor** shall perform all density tests~~. [Contractor's laboratory shall perform all density tests in the RPR's presence and provide the test results upon completion to the RPR for acceptance].~~ If the specified density is not attained, the area represented by the test or as designated by the RPR shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in lifts, compacting, discing, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for excavation~~, borrow, or other items.] [Payment for compacted embankment will be made under embankment in place and no payment will be made for excavation,~~ borrow, or other items.

Revise Section 152-2.9 as follows:

152-2.9 PROOF ROLLING. The purpose of proof rolling the subgrade is to identify any weak areas in the subgrade and not for compaction of the subgrade. Before start of embankment, ~~[and] [~~ after compaction is completed, the subgrade area shall be proof rolled with a 20 ton (18.1 metric ton) Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to 80/100/150 psi (0.551 MPa/0.689 MPa/1.034 MPa) ~~]] [[___]~~ ton Proof Roller with tires spaced not more than 32 inches (0.8 m) on-center with tires inflated to ~~[100/125/150 psi (0.689 MPa/0.861 MPa/1.034 MPa)]]~~ in the presence of the RPR. Apply a minimum of **50%** coverage, or as specified by the RPR, under pavement areas. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch (25 mm) or show permanent deformation greater than 1 inch (25 mm) shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

Revise Section 152-2.10 as follows:

152-2.10 COMPACTION REQUIREMENTS. The subgrade under areas to be paved shall be compacted to a depth of 12 inches (300 mm) and to a density of not less than 100 percent of the maximum dry density as determined by ASTM **D1557** ~~] [D698].~~ The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of 12 inches (300 mm) and to a density of not less than 95 percent of the maximum density as determined by ASTM ~~D698~~ **D1557.**

The material to be compacted shall be within ±2% of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent retained on the ¾ inch (19.0 mm) sieve, follow the methods in ~~[ASTM D698] [~~ ASTM D1557 ~~]]~~ ~~[procedures in AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles.]~~ . Tests for moisture content and compaction will be taken at a minimum of **500** S.Y. of subgrade. All quality assurance testing shall be done by the **Contractor.** ~~[the Contractor's laboratory in the presence of the RPR, and density test results shall be furnished upon completion to the RPR for acceptance determination.]~~

Revise Section 152-2.14 as follows:

152-2.14 TOPSOIL. When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on the plans and the approved CSPP, and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the RPR, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

~~Upon completion of grading operations, stockpiled topsoil shall be handled and placed as shown on the plans and as required in Item T-905. Topsoil shall be paid for as provided in Item T-905. No direct payment will be made for topsoil under Item P-152.~~

Revise Section METHOD OF MEASUREMENT as follows:

METHOD OF MEASUREMENT

~~**152-3.1** Measurement for payment specified by the cubic yard (cubic meter) shall be computed by the **[** average end areas of design cross sections **] [** the comparison of digital terrain model (DTM) surfaces **]** for computation of neat line design quantities **]**. The end area is that bound by the original ground line established by field cross sections and the final theoretical pay line established by cross sections shown on the plans, subject to verification by the RPR.~~

152-3.1 ~~The quantity of **[** unclassified **] [** rock **] [** muck **] [** drainage **]** excavation to be paid for shall be the number of cubic yards (cubic meters) measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed~~. **The excavation and embankment quantities shall be considered incidental to other pay items and no separate payment will be made for this material.**

~~**[152-3.2** The quantity of embankment in place shall be the number of cubic yards (cubic meters) measured in its final position. **]**~~

~~**[152-3.3 [** Stockpiled material shall be paid for on the basis of the number of cubic yards (cubic meters) measured in the stockpiled position. **] [** Stockpiled material shall not be measured for payment in the stockpiled position. **]]**~~

Revise Section BASIS OF PAYMENT as follows:

BASIS OF PAYMENT

152-4.1 The excavation and embankment quantities shall be considered incidental to other pay items and no separate payment will be made for this material.~~Unclassified excavation **] [** Rock Excavation **] [** Muck Excavation **] [** Drainage Excavation **] [** Stockpiled Material **]** payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.~~

~~**[152-4.2** For embankment in place, payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item. **]**~~

~~**[152-4.3** Stockpiled material shall be paid for on the basis of the number of cubic yards (cubic meters) measured in the stockpiled position. **]**~~

~~Payment will be made under:~~

~~**[** Item P-152-4.1 **[[** Unclassified **] [** Rock **] [** Muck **] [** Drainage **]** Excavation **] [** Stockpiled material **]]** - per cubic yard (cubic meter) **]**~~

~~**[** Item P-152-4.2 Embankment in place - per cubic yard (cubic meter) **]**~~

~~**[** Item P-152-4.3 Stockpiled material – per cubic yard (cubic meter) **]**~~

ITEM P-152 EXCAVATION, SUBGRADE, AND EMBANKMENT

DESCRIPTION

152-1.1 This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans.

152-1.2 CLASSIFICATION. All material excavated shall be classified as defined below:

a. Unclassified excavation. Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature which is not otherwise classified and paid for under one of the following items.

~~**[b. [___]**~~

~~**[Rock excavation**. Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers. All boulders containing a volume of more than 1/2 cubic yard (0.4 m^3) will be classified as "rock excavation." **]**~~

~~**[Muck excavation**. Muck excavation shall consist of the removal and disposal of deposits or mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials that will decay or produce subsidence in the embankment. It may consist of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment. **]**~~

~~**[Drainage excavation**. Drainage excavation shall consist of all excavation made for the primary purpose of drainage and includes drainage ditches, such as intercepting, inlet or outlet ditches; temporary levee construction; or any other type as shown on the plans. **]**~~

~~**[Borrow excavation**. Borrow excavation shall consist of approved material required for the construction of embankments or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas designated by the Resident Project Representative (RPR) within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport boundaries. **]**~~

~~**[Other.]]**~~

152-1.3 UNSUITABLE EXCAVATION. Unsuitable material shall be disposed in designated waste areas as shown on the plans. Materials containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material suitable for topsoil may be used on the embankment slope when approved by the RPR.

CONSTRUCTION METHODS

152-2.1 GENERAL. Before beginning excavation, grading, and embankment operations in any area, the area shall be cleared or cleared and grubbed in accordance with Item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the RPR. All unsuitable material shall be disposed of in waste areas as shown on the plans. All waste areas shall be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas shall be specified on the plans or approved by the RPR.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the RPR notified per Section 70, paragraph 70-20. At the direction of the RPR, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches (100 mm), to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not be permitted in the top 6 inches (150 mm) of the subgrade.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the RPR, who shall arrange for their removal if necessary. The Contractor, at their own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

a. Blasting. Blasting shall not be allowed. ~~[Blasting will be permitted as directed by the RPR and in accordance with the following:~~

~~Blasting will be permitted only when proper precautions are taken for the safety of all persons, work, and property. All damage done to the work or property shall be repaired by the Contractor. The cost of repair is incidental to this item. All operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all federal, state and local regulations and explosive manufacturers' instructions, with applicable approved permits reviewed by the RPR. Any approval will not relieve the Contractor of their responsibility in blasting operations.~~

~~Where blasting is approved, the Contractor shall employ a vibration consultant, approved by the RPR, to advise on explosive charge weights per delay and to analyze records from seismograph recordings. The seismograph shall be capable of producing a permanent record of the three components of the motion in terms of particle velocity, and in addition shall be capable of internal dynamic calibration.~~

~~In each distinct blasting area, where pertinent factors affecting blast vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the RPR for approval. This plan must consist of hole size, depth, spacing, burden, type of explosives, type of delay sequence, maximum amount of explosive on any one delay period, depth of rock, and depth of overburden if any. The maximum explosive charge weights per delay included in the plan shall not be increased without the approval of the RPR.~~

~~The Contractor shall keep a record of each blast: its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location.~~

~~Blasting and explosive storage shall be in accordance with Section 70, paragraph 70-09 and all federal, state, and local safety regulations.~~

These records shall be made available to the RPR on a monthly basis or in tabulated form at other times as required.]

152-2.2 EXCAVATION. No excavation shall be started until the work has been staked out by the Contractor and the RPR has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and RPR shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines.

[Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces were used to develop the design plans.

[Volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and generating Triangle Volume Reports. Electronic copies of DTM files and a paper copy of the original topographic map will be issued to the successful bidder.]

[Volumetric quantities were calculated using design cross sections which were created for this project using the DTM files of the applicable design surfaces and generating End Area Volume Reports. Paper copies of design cross sections and a paper copy of the original topographic map will be issued to the successful bidder.]

Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within [0.1 foot (30 mm)] of the stated elevations for ground surfaces, or within [0.04 foot (12 mm)] for hard surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Contractor's verification identifies discrepancies in the topographic map, Contractor shall notify the RPR in writing at least [two weeks] before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.]

All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the RPR. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

The grade shall be maintained so that the surface is well drained at all times.

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the RPR. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

a. Selective grading. When selective grading is indicated on the plans, the more suitable material designated by the RPR shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved. **Not used.**

b. Undercutting. Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches (300 mm) below the subgrade or to the depth specified by the RPR. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the plans disposed off the airport. The cost is incidental to this item. This excavated material shall be paid for at the contract unit price per cubic yard (per cubic meter) for unclassified excavation. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans. Undercutting will be paid as unclassified excavation **[** rock excavation **]**.

c. Over-break. Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the RPR. All over-break shall be graded or removed by the Contractor and disposed of as directed by the RPR. The RPR shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the RPR determines as avoidable. Unavoidable over-break will be classified as "Unclassified Excavation." **Not used.**

d. Removal of utilities. The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor **[** by the Contractor as indicated on the plans. All existing foundations shall be excavated at least 2 feet (60 cm) below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the RPR. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as shown on the plans.

152-2.3 Borrow excavation. Borrow areas are not required. **] [** Borrow areas within the airport property are indicated on the plans. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed by the RPR. All unsuitable material shall be disposed of by the Contractor as shown on the plans. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant. **[___]].**

[There are no borrow sources within the boundaries of the airport property. The Contractor shall locate and obtain borrow sources, subject to the approval of the RPR. The Contractor shall notify the RPR at least **[** 15 **]** days prior to beginning the excavation so necessary measurements and tests can be made by the RPR. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant.

152-2.4 DRAINAGE EXCAVATION. Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be

performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the RPR. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

152-2.5 PREPARATION OF CUT AREAS OR AREAS WHERE EXISTING PAVEMENT HAS BEEN REMOVED. In those areas on which a subbase or base course is to be placed, or under any areas to be paved, the top 12 inches (300 mm) of subgrade shall be compacted to not less than 100 % of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM **D6981557**. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

152-2.6 PREPARATION OF EMBANKMENT AREA. All sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches (150 mm) and shall then be compacted per paragraph 152-2.10.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches (300 mm) and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

152-2.7 CONTROL STRIP. The first half-day of construction of subgrade and/or embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches (300 mm) upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the RPR. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

152-2.8 FORMATION OF EMBANKMENTS. The material shall be constructed in lifts as established in the control strip, but not less than 6 inches (150 mm) nor more than 12 inches (300 mm) of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the RPR. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each lift shall be within ±2% of optimum moisture content before rolling to obtain the prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or manipulation alone to increase the rate of evaporation.

The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

The **Contractor** ~~RPR~~ will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM ~~D698] [D 1557.~~ A new Proctor shall be developed for each soil type based on visual classification.

Density tests will be taken by the **~~RPR~~**][contractor] for every 3,000 square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the RPR.

If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow AASHTO T-180 Annex Correction of maximum dry density and optimum moisture for oversized particles.

Rolling operations shall be continued until the embankment is compacted to not less than 100% of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM **D6981~~557~~**. Under all areas to be paved, the embankments shall be compacted to a depth of **12 inches** and to a density of not less than **95** percent of the maximum density as determined by ASTM **D6981~~557~~.** As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches (100 mm) which shall be prepared for a seedbed in accordance with Item T-901 ~~] [T-906].~~

The in-place field density shall be determined in accordance with ASTM D1556 **or** ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938.

The **~~RPR~~Contractor** shall perform all density tests~~. [Contractor's laboratory shall perform all density tests in the RPR's presence and provide the test results upon completion to the RPR for acceptance].~~ If the specified density is not attained, the area represented by the test or as designated by the RPR shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of

the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the embankment and the subgrade material shall be incorporated under the future paved areas. Stones, fragmentary rock, and recycled pavement larger than 4 inches (100 mm) in their greatest dimensions will not be allowed in the top 12 inches (300 mm) of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the RPR and the finer material shall be used to fill the voids forming a dense, compact mass. Rock, cement concrete pavement, asphalt pavement, and other embankment material shall not be disposed of except at places and in the manner designated on the plans or by the RPR.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding 2 feet (60 cm) in thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation 4 feet (1.2 m) below the finished subgrade.

There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in lifts, compacting, discing, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for excavation~~, borrow, or other items.] [Payment for compacted embankment will be made under embankment in-place and no payment will be made for excavation,~~ borrow, or other items.

152-2.9 PROOF ROLLING. The purpose of proof rolling the subgrade is to identify any weak areas in the subgrade and not for compaction of the subgrade. Before start of embankment, ~~[and] [~~ after compaction is completed, the subgrade area shall be proof rolled with a 20 ton (18.1 metric ton) Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to 80/100/150 psi (0.551 MPa/0.689 MPa/1.034 MPa) ~~]] [[___] ton Proof Roller with tires spaced not more than 32 inches (0.8 m) on center with tires inflated to [100/125/150 psi (0.689 MPa/0.861 MPa/1.034 MPa)]]~~ in the presence of the RPR. Apply a minimum of **50%** coverage, or as specified by the RPR, under pavement areas. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch (25 mm) or show permanent deformation greater than 1 inch (25 mm) shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

152-2.10 COMPACTION REQUIREMENTS. The subgrade under areas to be paved shall be compacted to a depth of 12 inches (300 mm) and to a density of not less than 100 percent of the maximum dry density as determined by ASTM **D1557** ~~] [D698].~~ The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of 12 inches (300 mm) and to a density of not less than 95 percent of the maximum density as determined by ASTM ~~D698~~ **D1557.**

The material to be compacted shall be within ±2% of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent retained on the ¾ inch (19.0 mm) sieve, follow the methods in ~~[ASTM D698] [~~ ASTM D1557 ~~]] [procedures in AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles.]~~ . Tests for moisture content and compaction will be taken at a minimum of **500** S.Y. of subgrade. All quality assurance testing shall be done by the **Contractor.** ~~[the Contractor's laboratory in the presence of the RPR, and density test results shall be furnished upon completion to the RPR for acceptance determination.]~~

The in-place field density shall be determined in accordance with ASTM D1556 **or** ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938 within 12 months prior to its use on this contract. The gage shall be field standardized daily.

Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the RPR and the finished subgrade shall be maintained.

152-2.11 FINISHING AND PROTECTION OF SUBGRADE. Finishing and protection of the subgrade is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans. All ruts or rough places that develop in the completed subgrade shall be graded, re-compacted, and retested. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been accepted by the RPR.

152-2.12 HAUL. All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling operations shall be repaired at the Contractor's expense.

The Contractor shall be responsible for providing, maintaining and removing any haul roads or routes within or outside of the work area, and shall return the affected areas to their former condition, unless otherwise authorized in writing by the Owner. No separate payment will be made for any work or materials associated with providing, maintaining and removing haul roads or routes.

152-2.13 SURFACE TOLERANCEs. In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the RPR. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

a. Smoothness. The finished surface shall not vary more than +/- ½ inch (12 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.

b. Grade. The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/- 0.05 feet (15 mm) of the specified grade.

On safety areas, turfed areas and other designated areas within the grading limits where no subbase or base is to placed, grade shall not vary more than 0.10 feet (30 mm) from specified grade. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

152-2.14 TOPSOIL. When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on the plans and the approved CSPP, and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the RPR, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

~~Upon completion of grading operations, stockpiled topsoil shall be handled and placed as shown on the plans and as required in Item T-905. Topsoil shall be paid for as provided in Item T-905. No direct payment will be made for topsoil under Item P-152.~~

METHOD OF MEASUREMENT

~~**152-3.1** Measurement for payment specified by the cubic yard (cubic meter) shall be computed by the **[** average end areas of design cross sections **] [** the comparison of digital terrain model (DTM) surfaces **]** for computation of neat line design quantities **]**. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by cross-sections shown on the plans, subject to verification by the RPR.~~

152-3.1 ~~The quantity of **[** unclassified **] [** rock **] [** muck **] [** drainage **]** excavation to be paid for shall be the number of cubic yards (cubic meters) measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.~~ **The excavation and embankment quantities shall be considered incidental to other pay items and no separate payment will be made for this material.**

~~**[152-3.2** The quantity of embankment in place shall be the number of cubic yards (cubic meters) measured in its final position. **]**~~

~~**[152-3.3 [** Stockpiled material shall be paid for on the basis of the number of cubic yards (cubic meters) measured in the stockpiled position. **] [** Stockpiled material shall not be measured for payment in the stockpiled position. **]]**~~

BASIS OF PAYMENT

152-4.1 The excavation and embankment quantities shall be considered incidental to other pay items and no separate payment will be made for this material.~~Unclassified excavation **] [** Rock Excavation **] [** Muck Excavation **] [** Drainage Excavation **] [** Stockpiled Material **]** payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.~~

~~**[152-4.2** For embankment in place, payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item. **]**~~

~~**[152-4.3** Stockpiled material shall be paid for on the basis of the number of cubic yards (cubic meters) measured in the stockpiled position. **]**~~

~~Payment will be made under:~~

~~**[** Item P-152-4.1 **[[** Unclassified **] [** Rock **] [** Muck **] [** Drainage **]** **[** Excavation **] [** Stockpiled material **]]** - per cubic yard (cubic meter) **]**~~

~~**[** Item P-152-4.2 Embankment in place per cubic yard (cubic meter) **]**~~

~~**[** Item P-152-4.3 Stockpiled material per cubic yard (cubic meter) **]**~~

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T-180	Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

ASTM International (ASTM)

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Advisory Circulars (AC)

AC 150/5370-2	Operational Safety on Airports During Construction Software

Software

FAARFIELD – FAA Rigid and Flexible Iterative Elastic Layered Design

U.S. Department of Transportation

FAA RD-76-66	Design and Construction of Airport Pavements on Expansive Soils

****END OF ITEM P-152****

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P-610 CONCRETE FOR MISCELLANEOUS STRUCTURES

Item P-610 Concrete For Miscellaneous Structures is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 610-2.4 as follows:

610-2.4 CEMENT. Cement shall conform to the requirements of ~~[___]~~**ASTM C 150 Type II** ~~[___]~~**or ASTM C595 Type IP. Low alkali cements (less than 0.6% equivalent alkalies shall be utilized. Total Alkalies (Na2O and K2O) of the cement secured for the production of concrete shall be independently verified in accordance with ASTM C114 or ASTM C1365.**

Revise Section 610-2.10 as follows:

610-2.10 STEEL REINFORCEMENT. Reinforcing shall consist of Reinforcing Steel and Welded Steel Wire Fabric conforming to the requirements shown below as shown on the plans.

Steel Reinforcement

Reinforcing Steel	**ASTM A615, ASTM A706, ASTM A775, ASTM A934**
Welded Steel Wire Fabric	**ASTM A1064, ASTM A884**
~~**Welded Deformed Steel Fabric**~~	~~**ASTM A1064**~~
~~**Bar Mats**~~	~~**ASTM A184 or ASTM A704**~~

Revise Section 610-2.11 as follows:

610-2.11 MATERIALS FOR CURING CONCRETE. Curing materials shall conform to **following:**

Materials for Curing

~~**Waterproof paper**~~	~~**ASTM C171**~~
~~**Clear or white Polyethylene Sheeting**~~	~~**ASTM C171**~~
White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B	**ASTM C309**

Revise Section 610-3.2 as follows:

610-3.2 CONCRETE MIXTURE. The concrete shall develop a compressive strength of **4000 psi 28 MPa** in 28 days as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. The concrete shall contain not less than 470 pounds of cementitious material per cubic yard (280 kg per cubic meter). The water cementitious ratio shall not exceed 0.45 by weight. The air content of the concrete shall be 5% +/- 1.2% as determined by ASTM C231 and shall have a slump of not more than 4 inches (100 mm) as determined by ASTM C143.

Revise Section METHOD OF MEASUREMENT as follows:

METHOD OF MEASUREMENT

610-5.1 Concrete shall be ~~[measured by the number of cubic yards (cubic meters) based on batch tickets of material] [measured by the number of square yards (square meters) based on the dimensions shown on the plans] [lump sum] [~~ **considered incidental and no separate measurement shall be made.** ~~of concrete complete in place and accepted.~~

Revise Section BASIS OF PAYMENT as follows:

BASIS OF PAYMENT

610-6.1 ~~Payment shall be made at the contract price [by the number of cubic yards (cubic meters) based on batch tickets of material] [by the number of square yards (square meters)] [lump sum] [~~ **Concrete shall be considered incidental and no separate payment shall be made**. ~~] This price shall be full compensation for furnishing all materials including reinforcement and embedded items and for all preparation, delivery, installation, and curing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

~~Payment will be made under:~~

~~REFER TO APPENDIX P FOR ITEM DESCRIPTIONS~~

P-610 CONCRETE FOR MISCELLANEOUS STRUCTURES

DESCRIPTION

610-1.1 This item shall consist of concrete and reinforcement, as shown on the plans, prepared and constructed in accordance with these specifications. This specification shall be used for all concrete other than airfield pavement which are cast-in-place.

MATERIALS

610-2.1 GENERAL. Only approved materials, conforming to the requirements of these specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the Resident Project Representative (RPR) before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

a. **Reactivity.** Fine aggregate and coarse aggregates to be used in all concrete shall have been tested separately within six months of the project in accordance with ASTM C1260. Test results shall be submitted to the RPR. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.08% at 14 days (16 days from casting). If the expansion either or both test specimen is greater than 0.08% at 14 days, but less than 0.20%, a minimum of 25% of Type F fly ash, or between 40% and 55% of slag cement shall be used in the concrete mix.

If the expansion is greater than 0.20%, the aggregates shall not be used, and test results for other aggregates must be submitted for evaluation; or aggregates that meet P-501 reactivity test requirements may be utilized.

610-2.2 COARSE AGGREGATE. The coarse aggregate for concrete shall meet the requirements of ASTM C33 and the requirements of Table 4, Class Designation 5S; and the grading requirements shown below, as required for the project.

Coarse Aggregate Grading Requirements

Maximum Aggregate Size	ASTM C33, Table 3 Grading Requirements (Size No.)
1 1/2 inch (37.5 mm)	467 or 4 and 67
1 inch (25 mm)	57
¾ inch (19 mm)	67
½ inch (12.5 mm)	7

610-2.2.1 COARSE AGGREGATE SUSCEPTIBILITY TO DURABILITY (D) CRACKING.

~~[Not used.]~~

[Coarse aggregate may only be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated or which are over one (1) year old or which are for different gradations will not be accepted.

Crushed granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite or trap rock are considered to meet the D-cracking test requirements but must meet all other quality tests specified in Item P-501.

610-2.3 FINE AGGREGATE. The fine aggregate for concrete shall meet all fine aggregate requirements of ASTM C33.

610-2.4 CEMENT. Cement shall conform to the requirements of ~~[ ]~~**ASTM C 150 Type II** ~~[ ]~~**or ASTM C595 Type IP. Low alkali cements (less than 0.6% equivalent alkalies shall be utilized. Total Alkalies (Na2O and K2O) of the cement secured for the production of concrete shall be independently verified in accordance with ASTM C114 or ASTM C1365.**

610-2.5 CEMENTITIOUS MATERIALS.

a. **Fly ash.** Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total available alkali content less than 3% per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the RPR.

b. **Slag cement (ground granulated blast furnace (GGBF)).** Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

610-2.6 WATER. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

610-2.7 ADMIXTURES. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the RPR may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the RPR from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

a. **Air-entraining admixtures**. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

b. Water-reducing admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

c. Other chemical admixtures. The use of set retarding, and set-accelerating admixtures shall be approved by the RPR. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

610-2.8 PREMOLDED JOINT MATERIAL. Premolded joint material for expansion joints shall meet the requirements of ASTM **D1751**

610-2.9 JOINT FILLER. The filler for joints shall meet the requirements of Item P-605, unless otherwise specified.

610-2.10 STEEL REINFORCEMENT. Reinforcing shall consist of Reinforcing Steel and Welded Steel Wire Fabric conforming to the requirements shown below as shown on the plans.

Steel Reinforcement

Reinforcing Steel	**ASTM A615, ASTM A706, ASTM A775, ASTM A934**
Welded Steel Wire Fabric	**ASTM A1064, ASTM A884**
~~**Welded Deformed Steel Fabric**~~	~~**ASTM A1064**~~
~~**Bar Mats**~~	~~**ASTM A184 or ASTM A704**~~

610-2.11 MATERIALS FOR CURING CONCRETE. Curing materials shall conform to **following:**

Materials for Curing

~~**Waterproof paper**~~	~~**ASTM C171**~~
~~**Clear or white Polyethylene Sheeting**~~	~~**ASTM C171**~~
White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B	**ASTM C309**

CONSTRUCTION METHODS

610-3.1 GENERAL. The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the RPR.

610-3.2 CONCRETE MIXTURE. The concrete shall develop a compressive strength of **4000 psi 28 MPa** in 28 days as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. The concrete shall contain not less than 470 pounds of cementitious material per cubic yard (280 kg per cubic meter). The water cementitious ratio shall not exceed 0.45 by weight. The air content of the concrete shall be 5% +/- 1.2% as determined by ASTM C231 and shall have a slump of not more than 4 inches (100 mm) as determined by ASTM C143.

610-3.3 MIXING. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94 or ASTM C685.

The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F (4°C) without the RPRs approval. If approval is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F (10°C) nor more than 100°F (38°C). The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his expense.

Retempering of concrete by adding water or any other material is not permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.

610-3.4 FORMS. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the RPR. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface.

610-3.5 PLACING REINFORCEMENT. All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

610-3.6 EMBEDDED ITEMS. Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

610-3.7 CONCRETE CONSISTENCY. The Contractor shall monitor the consistency of the concrete delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each truck at the project site in accordance with ASTM C143.

610-3.8 PLACING CONCRETE. All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the RPR. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet (1.5 m). Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

610-3.9 VIBRATION. Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309R, Guide for Consolidation of Concrete.

610-3.10 JOINTS. Joints shall be constructed as indicated on the plans.

610-3.11 FINISHING. All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with the finished top surface struck-off with a straightedge and floated.

610-3.12 CURING AND PROTECTION. All concrete shall be properly cured in accordance with the recommendations in American Concrete Institute (ACI) 308R, Guide to External Curing of Concrete. The concrete shall be protected from damage until project acceptance.

610-3.13 COLD WEATHER PLACING. When concrete is placed at temperatures below 40°F (4°C), follow the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

610-3.14 HOT WEATHER PLACING. When concrete is placed in hot weather greater than 85ºF (30 ºC), follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.

QUALITY ASSURANCE (QA)

610-4.1 QUALITY ASSURANCE SAMPLING AND TESTING. Concrete for each day's placement will be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The RPR will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; test air content in accordance with ASTM C231; make and cure compressive strength specimens in accordance with ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of ASTM C1077.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

610-4.2 DEFECTIVE WORK. Any defective work that cannot be satisfactorily repaired as determined by the RPR, shall be removed and replaced at the Contractor's expense. Defective work includes, but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the concrete.

METHOD OF MEASUREMENT

610-5.1 Concrete shall be ~~[measured by the number of cubic yards (cubic meters) based on batch tickets of material] [measured by the number of square yards (square meters) based on the dimensions shown on the plans] [lump sum] [~~ **considered incidental and no separate measurement shall be made**~~. of concrete complete in place and accepted.~~

BASIS OF PAYMENT

610-6.1 ~~Payment shall be made at the contract price [by the number of cubic yards (cubic meters) based on batch tickets of material] [by the number of square yards (square meters)] [lump sum] [~~ **Concrete shall be considered incidental and no separate payment shall be made**. ~~] This price shall be full compensation for furnishing all materials including reinforcement and embedded items and for all preparation, delivery, installation, and curing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

~~Payment will be made under:~~

~~REFER TO APPENDIX P FOR ITEM DESCRIPTIONS~~

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete

ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

American Concrete Institute (ACI)

ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308R	Guide to External Curing of Concrete
ACI 309R	Guide for Consolidation of Concrete

****END OF ITEM P-610****

ITEM P-620 RUNWAY AND TAXIWAY MARKING

Item P-620 Runway and Taxiway Marking is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 620-2.2 as follows:

620-2.2 MARKING MATERIALS.

Table 1. Marking Materials

Paint[1]				Glass Beads[2]	
Type	**Color**	**Fed Std. 595 Number**	**Application Rate Maximum**	**Type**	**Application Rate Minimum**
Waterborne Type I	**Red**	**31136**	**115 ft²/gal**	**Type I, Gradation A**	**5 lb/gal**
Waterborne Type I*	**Yellow**	**33538 or 33655**	**115 ft²/gal**	**Type III, Gradation A**	**7 lb/gal**
Waterborne Type I*	**Black**	**37038**	**115 ft²/gal**	**Not Used**	**N/A**
Waterborne Type I*	**White**	**37925**	**115 ft²/gal**	**Type III, Gradation A**	**7 lb/gal**
Temporary Marking Waterborne	**All**	**See Above**	**230 ft²/gal**	**Type I, Gradation A**	**10 lb/gal**

~~**TABLE 1. MARKING MATERIALS**~~

~~Paint[1]~~				~~Glass Beads[2]~~	
~~**Type**~~	~~**Color**~~	~~**Fed Std. 595 Number**~~	~~**Application Rate Maximum**~~	~~**Type**~~	~~**Application Rate Minimum**~~
~~*~~	~~*~~	~~*~~	~~*~~	~~*~~	~~*~~
~~*~~	~~*~~	~~*~~	~~*~~	~~*~~	~~*~~

[1] See paragraph 620-2.2a

[2] See paragraph 620-2.2b

a. Paint. Paint shall be waterborne ~~] [epoxy] [methacrylate] [solvent-base] and preformed thermoplastics~~ in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

~~[___]~~

[Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, Type I. ~~] [Type II] [Type III]~~. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. ~~[The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm-1 with intensities equal to those produced by an acrylic resin known to be 100% cross linking.]~~

[Epoxy. Paint shall be a two component, minimum 99% solids type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 18% minimum (16.5% minimum at 100% purity).

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 14 to 17%.
- Epoxy resin shall be 75 to 79%.
- Organic yellow, other colors, and tinting as required to meet color standard.

(2) Epoxy content. Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D1652 shall be the manufacturer's target ±50.

(3) Amine number. Component B. When tested in accordance with ASTM D2074 shall be the manufacturer's target ±50.

(4) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(5) Daylight directional reflectance.

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

(6) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013-inch (0.33 mm) to four 3 × 6-inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 5 above. Evaluate for conformance with the color requirements.

(7) Volatile organic content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(8) Dry opacity. Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

(9) Abrasion resistance. Subject the panels prepared in paragraph 620-2.2b(6) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg)) of sand for the removal of the paint films.

(10) Hardness, shore. Hardness shall be at least 80 when tested in accordance with ASTM D2240. **]**

[Methacrylate. Paint shall be a two component, minimum 99% solids-type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.
- Methacrylate resin shall be 18% minimum.

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum.

  Organic yellow, other colors, and tinting as required to meet color standard.
- Methacrylate resin shall be 18% minimum.

(2) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(3) Daylight directional reflectance:

(a) White: The daylight directional reflectance of the white paint shall not be less than 80% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

(4) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 × 6 inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G154 using both Ultra Violet (UV B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 3 above. Evaluate for conformance with the color requirements.

(5) Volatile organic content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(6) Dry opacity. Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

(7) Abrasion resistance. Subject the panels prepared in paragraph 620-2.2c(4) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg) of sand for the removal of the paint films.

(8) Hardness, shore. Hardness shall be at least 60 when tested in accordance with ASTM D2240.

(9) Additional requirements for methacrylate splatter profiled pavement marking. Pavement markings of this type shall comply with all above requirements for methacrylate paint, except as noted below:

(a) The thickness of the marking will be irregular ranging from 0.000 to 0.250 inches (0.00 to 6.4 mm), applied in a splatter pattern which comprises a minimum of 80% of the visible line (when traveling at 5 mph the line appears to be solid.).

(b) The hardness shall be 48 Shore D minimum. **]**

[Solvent Base. Paint shall meet the requirements of Commercial Item Description **[** A-A-2886B Type I, Type II, and Type III **].]**

Preformed Thermoplastic Airport Pavement Markings. Markings must be composed of ester modified resins in conjunction with aggregates, pigments, and binders that have been factory produced as a finished product. The material must be impervious to degradation by aviation fuels, motor fuels, and lubricants.

(1) The markings must be able to be applied in temperatures as low as 35°F without any special storage, preheating, or treatment of the material before application.

(a) The markings must be supplied with an integral, non-reflectorized black border.

(2) Graded glass beads.

(a) The material must contain a minimum of 30% intermixed graded glass beads by weight. The intermixed beads shall conform to Federal Specification TT-B-1325D, Type I, gradation A and Federal Specification TT-B-1325D, Type IV.

(b) The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of one (1) lb (0.45 kg) (±10%) per 10 square feet (1 sq m). These factory-applied coated surface beads shall have a minimum of 90% true spheres, minimum refractive index of 1.50, and meet the following gradation.

Preformed Thermoplastic Bead Gradation

Size Gradation		**Retained, %**	**Passing, %**
U.S. Mesh	**µm**		
12	1700	0 - 2	98 - 100
14	1400	0 - 3.5	96.5 - 100
16	1180	2 - 25	75 - 98
18	1000	28 - 63	37 - 72
20	850	63 - 72	28 - 37
30	600	67 - 77	23 - 33
50	300	89 - 95	5 - 11
80	200	97 - 100	0 - 3

(3) Heating indicators. The material manufacturer shall provide a method to indicate that the material has achieved satisfactory adhesion and proper bead embedment during application and that the installation procedures have been followed.

(4) Pigments. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum.
- Organic yellow, other colors, and tinting as required to meet color standard.

(5) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(6) Daylight directional reflectance.

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 45% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x – .462	x – .470	x – .479	x – .501
y – .438	y – .455	y – .428	y – .452

(7) Skid resistance. The surface, with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E303.

(8) Thickness. The material must be supplied at a nominal thickness of 65 mil (1.7 mm).

(9) Environmental resistance. The material must be resistant to deterioration due to exposure to sunlight, water, salt, or adverse weather conditions and impervious to aviation fuels, gasoline, and oil.

(10) Retroreflectivity. The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of nighttime retroreflection when tested in accordance to ASTM E1710.

(11) Packaging. Packaging shall protect the material from environmental conditions until installation.

(12) Preformed thermoplastic airport pavement marking requirements.

(a) The markings must be a resilient thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area. The markings must be resistant to the detrimental effects of aviation fuels, motor fuels and lubricants, hydraulic fluids, deicers, anti-icers, protective coatings, etc. Lines, legends, and symbols must be capable of being affixed to asphalt and/or Portland cement concrete pavements by the use of a large radiant heater. Colors shall be available as required.

(b) The markings must be capable of conforming to pavement contours, breaks, and faults through the action of airport traffic at normal pavement temperatures. The markings must be capable of fully conforming to grooved pavements, including pavement grooving per advisory circular (AC) 150/5320-12, current version. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastics when heated with a heat source per manufacturer's recommendation.

(c) Multicolored markings must consist of interconnected individual pieces of preformed thermoplastic pavement marking material, which through a variety of colors and patterns, make up the desired design. The individual pieces in each large marking segment (typically more than 20 feet (6 m) long) must be factory assembled with a compatible material and interconnected so that in the field it is not necessary to assemble the individual pieces within a marking segment. Obtaining multicolored effect by overlaying materials of different colors is not acceptable due to resulting inconsistent marking thickness and inconsistent application temperature in the marking/substrate interface.

(d) The marking material must set up rapidly, permitting the access route to be re-opened to traffic after application.

~~**(c)** The marking material shall have an integral color throughout the thickness of the marking material~~**b. Reflective media.** ~~Glass beads for white and yellow paint for temporary pavement markings shall meet the requirements for Federal Specification TT-B-1325D Type I, Gradation A.~~

~~Glass beads for white and yellow paint for permanent pavement markings shall meet the requirements for Federal Specification TT-B-1325D Type III, Gradation A~~

~~Glass beads for red and pink paint shall meet the requirements for Type I, Gradation A.~~

~~Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.~~

~~Glass beads shall not be used in black and green paint.~~

~~Type III glass beads shall not be used in red and pink paint.~~

Revise Section 620-3.4 as follows:

620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.~~[The locations of markings to receive silica sand shall be shown on the plans.]~~

Revise Section 620-3.6 as follows:

620-3.6 APPLICATION--PREFORMED THERMOPLASTIC AIRPORT PAVEMENT MARKINGS. ~~Preformed thermoplastic pavement markings not used.~~ To ensure minimum single-pass application time and optimum bond in the marking/substrate interface, the materials must be applied using a variable speed self-propelled mobile heater with an effective heating width of no less than 16 feet (5 m) and a free span between supporting wheels of no less than 18 feet (5.5 m). The heater must emit thermal radiation to the marking material in such a manner that the difference in temperature of 2 inches (50 mm) wide linear segments in the direction of heater travel must be within 5% of the overall average temperature of the heated thermoplastic material as it exits the heater. The material must be able to be applied at ambient and pavement temperatures down to 35°F (2°C) without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry, and free of debris. A non-volatile organic content (non-VOC) sealer with a maximum applied viscosity of 250 centiPoise must be applied to the pavement shortly before the markings are applied. The supplier must enclose application instructions with each box/package.

Revise Section METHOD OF MEASUREMENT as follows:

METHOD OF MEASUREMENT

~~**620-4.1a** The quantity of surface preparation shall be measured by [the number of square feet (square meters) for each type of surface preparation specified in paragraph 620-3.3] [lump sum].~~
620-4.1a The quantity of markings shall be paid for shall be measured by the number of square feet (square meters) of painting **and shall include all costs for surface preparation and reflective media** ~~] [by lump sum].~~

~~**620-4.1c** The quantity of reflective media shall be paid for by **[** the number of pounds (km) **] [** lump sum **]** of reflective media.~~
~~**620-4.1bd [** The quantity of temporary markings to be paid for shall be **[** the number of square feet (square meters) of painting **] [** lump sum price **]** performed in accordance with the specifications and accepted by the RPR.~~ Temporary marking includes surface preparation, application and complete removal of the temporary marking.~~ **] [** Temporary markings not required. **]**~~
~~[620-4.1E **THE QUANTITY OF PREFORMED MARKINGS TO BE PAID FOR SHALL BE [THE NUMBER OF SQUARE FEET (SQUARE METERS) OF PREFORMED MARKINGS**] [**LUMP SUM**]].~~

Revise Section BASIS OF PAYMENT as follows:

BASIS OF PAYMENT

~~**620-5.1a** Payment for surface preparation shall be made at the contract price for **[** the number of square feet (square meters) for each type of surface preparation specified in paragraph 620-3.3 **] [** lump sum **]**.~~
620-5.2a Payment for markings shall be made at the contract price for the number of square feet (square meters) of painting ~~and the number of pounds (km) of reflective media **] [** by the number of square feet (square meters) of painting **] [** by lump sum **]**.~~

~~**620-5.3c** Payment for reflective media shall be made at the contract unit price for **[** the number of pounds (km) of reflective media **] [** lump sum **]**.~~
~~**620-5.4b** Payment for temporary markings shall be made at the contract price for **[** the number of square feet (square meters) of **paintins**~~**shall be made at the contract unit price per each surface painted sign. This price shall consist of both temporary and permanent paint applications** ~~**] [** lump sum price **]**. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item. **[** Temporary markings are not required. **]**~~
~~**[620-5.5c** Payment for preformed markings shall be made at the contract price for **[** the number of square feet (square meters) of preformed markings **] [** lump sum price **].]**~~
Payment will be made under:

~~Item P-620-5.1aSurface Preparation **[** per square foot (square meter) **] [** lump sum **]~~
~~Item P-620-5.2b Marking **[** per square foot (square meter) **] [** lump sum **]~~
~~Item P-620-5.3c Reflective Media **[** per pound (km) **] [** lump sum **]~~

Item P-620a	**Reflectorized Pavement Marking (RWY, TWY A, B, E, F, APRON) – per square foot**
Item P-620b	**Non-Reflectorized Pavement Marking (RWY, TWY A, B, E, F, APRON) – per square foot**
Item P-620c	**Existing Pavement Marking Removal - per square foot**

ITEM P-620 RUNWAY AND TAXIWAY MARKING

DESCRIPTION

620-1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative (RPR). The terms "paint" and "marking material" as well as "painting" and "application of markings" are interchangeable throughout this specification.

MATERIALS

620-2.1 MATERIALS ACCEPTANCE. The Contractor shall furnish manufacturer's certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer's surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the Resident Project Representative (RPR) prior to the initial application of markings. The reports can be used for material acceptance or the RPR may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the RPR upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the RPR.

620-2.2 MARKING MATERIALS.

Table 1. Marking Materials

Paint[1]				Glass Beads[2]	
Type	**Color**	**Fed Std. 595 Number**	**Application Rate Maximum**	**Type**	**Application Rate Minimum**
Waterborne Type I	**Red**	**31136**	**115 ft²/gal**	**Type I, Gradation A**	**5 lb/gal**
Waterborne Type I*	**Yellow**	**33538 or 33655**	**115 ft²/gal**	**Type III, Gradation A**	**7 lb/gal**
Waterborne Type I*	**Black**	**37038**	**115 ft²/gal**	**Not Used**	**N/A**
Waterborne Type I*	**White**	**37925**	**115 ft²/gal**	**Type III, Gradation A**	**7 lb/gal**
Temporary Marking Waterborne	**All**	**See Above**	**230 ft²/gal**	**Type I, Gradation A**	**10 lb/gal**

TABLE 1. MARKING MATERIALS

Paint[1]				Glass Beads[2]	
Type	Color	Fed Std. 595 Number	Application Rate Maximum	Type	Application Rate Minimum
*	*	*	*	*	*
*	*	*	*	*	*

[1] **See paragraph 620-2.2a**

[2] **See paragraph 620-2.2b**

a. Paint. Paint shall be waterborne] [epoxy] [methacrylate] [solvent-base] and preformed thermoplastics in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

[___]

[Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, Type I.] [Type II] [Type III]. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. [The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm-1 with intensities equal to those produced by an acrylic resin known to be 100% cross linking.]

[**Epoxy.** Paint shall be a two component, minimum 99% solids type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 18% minimum (16.5% minimum at 100% purity).

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 14 to 17%.
- Epoxy resin shall be 75 to 79%.
- Organic yellow, other colors, and tinting as required to meet color standard.

(2) Epoxy content. Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D1652 shall be the manufacturer's target ±50.

(3) Amine number. Component B. When tested in accordance with ASTM D2074 shall be the manufacturer's target ±50.

(4) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(5) Daylight directional reflectance.

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

(6) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013-inch (0.33 mm) to four 3 × 6-inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 5 above. Evaluate for conformance with the color requirements.

(7) Volatile organic content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(8) Dry opacity. Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

(9) Abrasion resistance. Subject the panels prepared in paragraph 620-2.2b(6) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg)) of sand for the removal of the paint films.

(10) Hardness, shore. Hardness shall be at least 80 when tested in accordance with ASTM D2240. **]**

[Methacrylate. Paint shall be a two component, minimum 99% solids-type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.
- Methacrylate resin shall be 18% minimum.

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum.

  Organic yellow, other colors, and tinting as required to meet color standard.

- Methacrylate resin shall be 18% minimum.

(2) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(3) Daylight directional reflectance:

(a) White: The daylight directional reflectance of the white paint shall not be less than 80% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

(4) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 × 6-inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 3 above. Evaluate for conformance with the color requirements.

(5) Volatile organic content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(6) Dry opacity. Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

(7) Abrasion resistance. Subject the panels prepared in paragraph 620-2.2e(4) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg) of sand for the removal of the paint films.

(8) Hardness, shore. Hardness shall be at least 60 when tested in accordance with ASTM D2240.

(9) Additional requirements for methacrylate splatter profiled pavement marking. Pavement markings of this type shall comply with all above requirements for methacrylate paint, except as noted below:

(a) The thickness of the marking will be irregular ranging from 0.000 to 0.250 inches (0.00 to 6.4 mm), applied in a splatter pattern which comprises a minimum of 80% of the visible line (when traveling at 5 mph the line appears to be solid.).

(b) The hardness shall be 48 Shore D minimum. **]**

[Solvent-Base. Paint shall meet the requirements of Commercial Item Description **[** A-A-2886B Type I, Type II, and Type III **].]**

Preformed Thermoplastic Airport Pavement Markings. Markings must be composed of ester modified resins in conjunction with aggregates, pigments, and binders that have been factory produced as a finished product. The material must be impervious to degradation by aviation fuels, motor fuels, and lubricants.

(1) The markings must be able to be applied in temperatures as low as 35°F without any special storage, preheating, or treatment of the material before application.

(a) The markings must be supplied with an integral, non-reflectorized black border.

(2) Graded glass beads.

(a) The material must contain a minimum of 30% intermixed graded glass beads by weight. The intermixed beads shall conform to Federal Specification TT-B-1325D, Type I, gradation A and Federal Specification TT-B-1325D, Type IV.

(b) The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of one (1) lb (0.45 kg) (±10%) per 10 square feet (1 sq m). These factory-applied coated surface beads shall have a minimum of 90% true spheres, minimum refractive index of 1.50, and meet the following gradation.

Preformed Thermoplastic Bead Gradation

Size Gradation		Retained, %	Passing, %
U.S. Mesh	µm		
12	1700	0 - 2	98 - 100
14	1400	0 - 3.5	96.5 - 100
16	1180	2 - 25	75 - 98
18	1000	28 - 63	37 - 72
20	850	63 - 72	28 - 37
30	600	67 - 77	23 - 33
50	300	89 - 95	5 - 11
80	200	97 - 100	0 - 3

(3) Heating indicators. The material manufacturer shall provide a method to indicate that the material has achieved satisfactory adhesion and proper bead embedment during application and that the installation procedures have been followed.

(4) Pigments. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum.
- Organic yellow, other colors, and tinting as required to meet color standard.

(5) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(6) Daylight directional reflectance.

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 45% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

(7) Skid resistance. The surface, with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E303.

(8) Thickness. The material must be supplied at a nominal thickness of 65 mil (1.7 mm).

(9) Environmental resistance. The material must be resistant to deterioration due to exposure to sunlight, water, salt, or adverse weather conditions and impervious to aviation fuels, gasoline, and oil.

(10) Retroreflectivity. The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of nighttime retroreflection when tested in accordance to ASTM E1710.

(11) Packaging. Packaging shall protect the material from environmental conditions until installation.

(12) Preformed thermoplastic airport pavement marking requirements.

(a) The markings must be a resilient thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area. The markings must be resistant to the detrimental effects of aviation fuels, motor fuels and lubricants, hydraulic fluids, deicers, anti-icers, protective coatings, etc. Lines, legends, and symbols must be capable of being affixed to asphalt and/or Portland cement concrete pavements by the use of a large radiant heater. Colors shall be available as required.

(b) The markings must be capable of conforming to pavement contours, breaks, and faults through the action of airport traffic at normal pavement temperatures. The markings must be capable of fully conforming to grooved pavements, including pavement grooving per advisory circular (AC) 150/5320-12, current version. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastics when heated with a heat source per manufacturer's recommendation.

(c) Multicolored markings must consist of interconnected individual pieces of preformed thermoplastic pavement marking material, which through a variety of colors and patterns, make up the desired design. The individual pieces in each large marking segment (typically more than 20 feet (6 m) long) must be factory assembled with a compatible material and interconnected so that in the field it is not necessary to assemble the individual pieces within a marking segment. Obtaining multicolored effect by overlaying materials of different colors is not acceptable due to resulting inconsistent marking thickness and inconsistent application temperature in the marking/substrate interface.

(d) The marking material must set up rapidly, permitting the access route to be re-opened to traffic after application.

(e) The marking material shall have an integral color throughout the thickness of the marking material**b. Reflective media.** Glass beads for white and yellow paint for temporary pavement markings shall meet the requirements for Federal Specification TT-B-1325D Type I, Gradation A.

Glass beads for white and yellow paint for permanent pavement markings shall meet the requirements for Federal Specification TT-B-1325D Type III, Gradation A

Glass beads for red and pink paint shall meet the requirements for Type I, Gradation A.

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time.

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.
The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

620-3.3 PREPARATION OF SURFACES. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminates that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the RPR. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

a. **Preparation of new pavement surfaces.** The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the RPR to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.
b. **Preparation of pavement to remove existing markings.** Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the RPR minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.
c. **Preparation of pavement markings prior to remarking.** Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the RPR. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the RPR prior to the initial application of markings.

620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans. ~~[The locations of markings to receive silica sand shall be shown on the plans.]~~

620-3.5 APPLICATION. A period of **30 days** shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the RPR.

The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacing shall be within the following tolerances:

MARKING DIMENSIONS AND SPACING TOLERANCE

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

620-3.6 APPLICATION--PREFORMED THERMOPLASTIC AIRPORT PAVEMENT MARKINGS. ~~Preformed thermoplastic pavement markings not used.~~ To ensure minimum single-pass application time and optimum bond in the marking/substrate interface, the materials must be applied using a variable speed self-propelled mobile heater with an effective heating width of no less than 16 feet (5 m) and a free span between supporting wheels of no less than 18 feet (5.5 m). The heater must emit thermal radiation to the marking material in such a manner that the difference in temperature of 2 inches (50 mm) wide linear segments in the direction of heater travel must be within 5% of the overall average temperature of the heated thermoplastic material as it exits the heater. The material must be able to be applied at ambient and pavement temperatures down to 35°F (2°C) without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry, and free of debris. A non-volatile organic content (non-VOC) sealer with a maximum applied viscosity of 250 centiPoise must be applied to the pavement shortly before the markings are applied. The supplier must enclose application instructions with each box/package.

620-3.7 CONTROL STRIP. Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the RPR. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

620-3.8 RETRO-REFLECTANCE. [Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

MINIMUM RETRO-REFLECTANCE VALUES

Material	**Retro-reflectance mcd/m2/lux**		
	White	Yellow	Red
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than1	100	75	10

1 'Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

620-3.9 PROTECTION AND CLEANUP. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the RPR. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

METHOD OF MEASUREMENT

~~**620-4.1a** The quantity of surface preparation shall be measured by **[** the number of square feet (square meters) for each type of surface preparation specified in paragraph 620-3.3 **] [** lump sum **]**.~~
620-4.1a The quantity of markings shall be paid for shall be measured by the number of square feet (square meters) of painting **and shall include all costs for surface preparation and reflective media** ~~**] [** by lump sum **].**~~

~~**620-4.1c** The quantity of reflective media shall be paid for by **[** the number of pounds (km) **] [** lump sum **]** of reflective media.~~
~~**620-4.1bd [** The quantity of temporary markings to be paid for shall be **[** the number of square feet (square meters) of painting **] [** lump sum price **]** performed in accordance with the specifications and accepted by the RPR.~~ Temporary marking includes surface preparation, application and complete removal of the temporary marking. ~~**] [** Temporary markings not required. **]**~~
~~[620-4.1E **THE QUANTITY OF PREFORMED MARKINGS TO BE PAID FOR SHALL BE [THE NUMBER OF SQUARE FEET (SQUARE METERS) OF PREFORMED MARKINGS] [LUMP SUM]].~~

BASIS OF PAYMENT

620-5.1 This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item complete in place and accepted by the RPR in accordance with these specifications.

~~**620-5.1a** Payment for surface preparation shall be made at the contract price for **[** the number of square feet (square meters) for each type of surface preparation specified in paragraph 620-3.3 **] [** lump sum **]**.~~

620-5.2a Payment for markings shall be made at the contract price for the number of square feet (square meters) of painting ~~and the number of pounds (km) of reflective media **] [** by the number of square feet (square meters) of painting **] [** by lump sum **]**.~~

~~**620-5.3c** Payment for reflective media shall be made at the contract unit price for **[** the number of pounds (km) of reflective media **] [** lump sum **]**.~~

620-5.4b ~~Payment for temporary markings shall be made at the contract price for **[** the number of square feet (square meters) of **paintin**~~**shall be made at the contract unit price per each surface painted sign. This price shall consist of both temporary and permanent paint applications** ~~**] [** lump sum price **]**. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item. **[** Temporary markings are not required. **]**~~

~~**[620-5.5c** Payment for preformed markings shall be made at the contract price for **[** the number of square feet (square meters) of preformed markings **] [** lump sum price **].]**~~

Payment will be made under:

~~Item P-620-5.1aSurface Preparation **[** per square foot (square meter) **] [** lump sum **]~~

~~Item P-620-5.2b Marking **[** per square foot (square meter) **] [** lump sum **]~~

~~Item P-620-5.3c Reflective Media **[** per pound (km) **] [** lump sum **]~~

Item P-620a	**Reflectorized Pavement Marking (RWY, TWY A, B, E, F, APRON) – per square foot**
Item P-620b	**Non-Reflectorized Pavement Marking (RWY, TWY A, B, E, F, APRON) – per square foot**
Item P-620c	**Existing Pavement Marking Removal - per square foot**

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Code of Federal Regulations (CFR)

40 CFR Part 60, Appendix A-7, Method 24	Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication

Federal Specifications (FED SPEC)

FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
FED SPEC TT-P-1952F	Paint, Traffic and Airfield Marking, Waterborne
FED STD 595	Colors used in Government Procurement

Commercial Item Description

A-A-2886B	Paint, Traffic, Solvent Based

Advisory Circulars (AC)

AC 150/5340-1	Standards for Airport Markings
AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

****END OF ITEM P-620****

ITEM T-901 SEEDING

Item T-901 Seeding is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 902-1 as follows:

Seeds shall be applied as follows:

Seed Properties and Rate of Application

Seed	Minimum Seed Purity (Percent)	Rate of Application lb/acre (or lb/acre)
Bermudagrass (seeded)	**100**	**3.0**

Revise Section 105-4 as follows:

901-2.2 LIME. ~~[Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 (850 µm) mesh sieve and 50% will pass through a No. 100 (150 µm) mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of [___]. All liming materials shall conform to the requirements of ASTM C602.] [~~ Not required.

Revise Section 901-3.2 as follows:

901-3.2 DRY APPLICATION METHOD.

a. **Liming.** ~~[Lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds that have previously been prepared as described above. The lime shall then be worked into the top 3 inches (75 mm) of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.] [~~ Not required.

b. **Fertilizing.** Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in paragraph 901-2.3. ~~]~~ ~~[Not required.]~~

Revise Section METHOD OF MEASUREMENT as follows:

METHOD OF MEASUREMENT

901-4.1 The quantity of seeding to be **considered incidental to the various bid items.**

Revise Section BASIS OF PAYMENT as follows:

BASIS OF PAYMENT

901-5.1 Separate payment shall **not** be made, **but shall be considered incidental to the various bid items.** ~~at the contract unit price per [1,000 square feet (sq m)] [acre (sq m)] or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.~~

Payment will be made under:

~~Item T-901-5.1a~~	~~Seeding with Hydromulch - per [1,000 square feet (sq m)] [acre (sq m)]~~

ITEM T-901 SEEDING

DESCRIPTION

901-1.1 This item shall consist of soil preparation, seeding the areas shown on the plans or as directed by the RPR in accordance with these specifications.

MATERIALS

901-2.1 SEED. The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the RPR duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seeds shall be applied as follows:

Seed Properties and Rate of Application

Seed	Minimum Seed Purity (Percent)	Rate of Application lb/acre (or lb/acre)
Bermudagrass (seeded)	100	3.0

Seeding shall be performed during the period between **March 1** and **September 30** inclusive, unless otherwise approved by the RPR.

901-2.2 LIME. [~~Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 (850 µm) mesh sieve and 50% will pass through a No. 100 (150 µm) mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of **[___]**. All liming materials shall conform to the requirements of ASTM C602.~~ **] [** ~~~~Not required.

901-2.3 FERTILIZER. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified, and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;

b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be 16-8-8 commercial fertilizer and shall be spread at the rate of **one pound of Nitrogen per 1,000 square feet.**

901-2.4 SOIL FOR REPAIRS. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the RPR before being placed.

CONSTRUCTION METHODS

901-3.1 ADVANCE PREPARATION AND CLEANUP. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 inches (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 inches (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.
When the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 inches (125 mm). Clods shall be broken and the top 3 inches (75 mm) of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

901-3.2 DRY APPLICATION METHOD.

a. **Liming.** ~~[Lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds that have previously been prepared as described above. The lime shall then be worked into the top 3 inches (75 mm) of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.] [~~ Not required.

b. **Fertilizing.** Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in paragraph 901-2.3. ~~]~~
~~[Not required.]~~

c. **Seeding.** Grass seed shall be sown at the rate specified in paragraph 901-2.1 immediately after fertilizing. The fertilizer and seed shall be raked within the depth range stated in the special provisions. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the manufacturer of the inoculant. When seeding is required at other than the seasons shown on the plans or in the special provisions, a cover crop shall be sown by the same methods required for grass and legume seeding.

d. **Rolling.** After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawn roller, weighing 40 to 65 pounds per foot (60 to 97 kg per meter)

of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per foot (223 to 298 kg per meter) of width for sandy or light soils.

901-3.3 WET APPLICATION METHOD.

a. General. The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.

b. Spraying equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons (190 liters) over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons (380 liters) per minute at a pressure of 100 lb / sq inches (690 kPa). The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 inch (16 mm) solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet (6 to 30 m). One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet (15 m) in length shall be provided to which the nozzles may be connected.

c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds (100 kg) of lime shall be added to and mixed with each 100 gallons (380 liters) of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds (100 kg) of these combined solids shall be added to and mixed with each 100 gallons (380 liters) of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. The Contractor shall identify to the RPR all sources of water at least two (2) weeks prior to use. The RPR may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the RPR following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed or they shall be wasted and disposed of at approved locations.

d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 inches (75 mm), after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the RPR, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

901-3.4 MAINTENANCE OF SEEDED AREAS. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the RPR. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the RPR. A grass stand shall be considered adequate when bare spots are one square foot (0.01 sq m) or less, randomly dispersed, and do not exceed 3% of the area seeded.

METHOD OF MEASUREMENT

901-4.1 The quantity of seeding to be **considered incidental to the various bid items.**

BASIS OF PAYMENT

901-5.1 Separate payment shall **not** be made, **but shall be considered incidental to the various bid items.** ~~at the contract unit price per [1,000 square feet (sq m)] [acre (sq m)] or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.~~

Payment will be made under:

~~Item T-901-5.1a Seeding with Hydromulch - per [1,000 square feet (sq m)] [acre (sq m)]~~

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C602 Standard Specification for Agricultural Liming Materials

Federal Specifications (FED SPEC)

FED SPEC JJJ-S-181, Federal Specification, Seeds, Agricultural

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

****END OF ITEM T-901****

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ITEM L-107 AIRPORT WIND CONES

Item L-107 Airport Wind Cones is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 107-2.1 as follows:

107-2.1 GENERAL.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

Revise Section 107-2.2 as follows:

107-2.2 WIND CONES. ~~The [primary] [supplemental] wind cone assembly shall be Type [___], Style [___], Size [___].~~
The primary wind cone assembly shall be Type L-807, LED, Style I-B, Size 2. The supplemental wind cone assembly shall Type L-806, LED, Style I-B, Size 1.

Revise Section 107-3.4 as follows:

101-3.10 BOOSTER TRANSFORMER. ~~[The installation shall be as indicated in the plans and described in the specifications.] [~~ Not used. ~~]~~

Revise Section 107-3.5 as follows:

107-3.5 GROUND CONNECTION AND GROUND ROD. The Contractor shall furnish and install a ground rod, grounding cable, and ground clamps for grounding the "A" frame of the 12-foot (3.7-m) assembly or pipe support of the 8-foot (2.4-m) support near the base. The ground rod shall be of the type, diameter and length specified in Item L-108, Underground Power Cable for Airports. The ground rod shall be driven into the ground adjacent to the concrete foundation (minimum distance from foundation of 2 feet (60 cm)) so that the top is at least 6 inches (150 mm) below grade. The grounding cable shall consist of No. ~~[6] [4] [2]~~ American wire gauge (AWG) minimum stranded copper wire or larger and shall be firmly attached to the ground rod by exothermic welding. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. The other end of the grounding cable shall be securely attached to a leg of the frame or to the base of the pipe support with non-corrosive metal and shall be of substantial construction. The resistance to ground shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than 10 feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze.

Revise Sections 107-5.1/5.2 as follows:

~~**107-5.1** Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for **[** removal of existing airport wind cones; **]** furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.~~

~~**107-5.2** Payment will be made at the contract unit price for each segmented circle airport marker system. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.~~

~~Payment will be made under:~~

~~Item L-107-5.1 **[** List type, style, size **]** Wind Cone and Foundation, in Place -- per Each~~

~~Item L-107-5.2 Segmented Circle Marker System, in Place -- per Each~~

107-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for removal of existing airport wind cones; furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

107-5.2 Payment will be made at the contract unit price for each segmented circle airport marker system. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-107a	Remove Existing Primary Wind Cone and Segmented Circle Marker System, Complete – per each
Item L-107b	Install L-806 LED Wind Cone on New Foundation, Complete – per each
Item L-107c	Install L-807 LED Wind Cone on New Foundation, Complete – per each
Item L-107d	Install Segmented Circle Marker System, Complete – per each

ITEM L-107 AIRPORT WIND CONES

DESCRIPTION

107-1.1 This item shall consist of removal of existing airport wind cones; furnishing and installing an airport wind cone per these specifications and per the dimensions, design, and details shown in the plans.

The work shall include the furnishing and installation of a support for mounting the wind cone, the specified interconnecting wire, and a concrete foundation. The item shall also include all cable connections, conduit and conduit fittings, the furnishing and installation of all lamps, ground rod and ground connection, the testing of the installation, and all incidentals necessary to place the wind cone in operation (as a completed unit) to the satisfaction of the RPR.

EQUIPMENT AND MATERIALS

107-2.1 GENERAL.

a. Airport lighting equipment and materials covered by advisory circulars (ACs) shall be certified in AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications, at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

107-2.2 WIND CONES. ~~The [primary] [supplemental] wind cone assembly shall be Type [___], Style [___], Size [___].~~
The primary wind cone assembly shall be Type L-807, LED, Style I-B, Size 2. The supplemental wind cone assembly shall Type L-806, LED, Style I-B, Size 1.

107-2.3 ELECTRICAL WIRE AND CABLE. Cable rated up to 5,000 volts in conduit shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat-resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

107-2.4 CONDUIT. Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242

107-2.5 PLASTIC CONDUIT (FOR USE BELOW GRADE ONLY). Plastic conduit and fittings shall be per the following:

- UL 514B covers W-C-1094 - Conduit fittings all types, Classes 1 thru 3 and 6 thru 10
- UL 514C covers W-C-1094 - all types, Class 5 junction box and cover in plastic (polyvinyl chloride (PVC))
- UL 651 covers W-C-1094 - Rigid PVC Conduit, types I and II, Class 4
- UL 651A covers W-C-1094 - Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4

Underwriters Laboratories Standard UL-651 shall be one of the following, as shown in the plans:

a. Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

Plastic conduit adhesive shall be a solvent cement manufactured specifically for the purpose of gluing the type of plastic conduit and fitting.

107-2.6 CONCRETE. The concrete for foundations shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

107-2.7 PAINT.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

b. Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint conforming to MIL-DTL-24441C/19B. Use MIL-24441 thinner per paint manufacturer's recommendations.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint per Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standards 595, International Orange, Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the MPI, Reference #9, Exterior Alkyd, Gloss.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified aviation-orange or white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

107-3.1 INSTALLATION. The hinged support or hinged pole shall be installed on a concrete foundation per the plans.

107-3.2 SUPPORT POLE ERECTION. The Contractor shall erect the pole on the foundation following the manufacturer's requirements and erection details. The pole shall be level and secure.

107-3.3 ELECTRICAL CONNECTION. The Contractor shall furnish all labor and materials and shall make complete electrical connections per the wiring diagram furnished with the project plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electric Code (NEC).

Underground cable and duct for cable installation shall be installed in accordance with Item L-108, Underground Power Cables for Airports, and Item L-110, Airport Underground Electrical Duct Banks and Conduits in locations as shown on the plans.

101-3.10 BOOSTER TRANSFORMER. ~~[The installation shall be as indicated in the plans and described in the specifications.] [~~ Not used. ~~]~~

107-3.5 GROUND CONNECTION AND GROUND ROD. The Contractor shall furnish and install a ground rod, grounding cable, and ground clamps for grounding the "A" frame of the 12-foot (3.7-m) assembly or pipe support of the 8-foot (2.4-m) support near the base. The ground rod shall be of the type, diameter and length specified in Item L-108, Underground Power Cable for Airports. The ground rod shall be driven into the ground adjacent to the concrete foundation (minimum distance from foundation of 2 feet (60 cm)) so that the top is at least 6 inches (150 mm) below grade. The grounding cable shall consist of No.~~[6] [4] [2]~~American wire gauge (AWG) minimum stranded copper wire or larger and shall be firmly attached to the ground rod by exothermic welding. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. The other end of the grounding cable shall be securely attached to a leg of the frame or to the base of the pipe support with non-corrosive metal and shall be of substantial construction. The resistance to ground shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than 10 feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze.

107-3.6 PAINTING. Three coats of paint shall be applied (one prime, one body, and one finish) to all exposed material installed under this item except the fabric cone, obstruction light globe, and lamp reflectors. The wind cone assembly, if already painted upon receipt, shall be given one finish coat of paint in lieu of the three coats specified above. The paint shall be per MPI Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange, Number 12197.

107-3.7 LIGHT SOURCES. The Contractor shall furnish and install lamps per the manufacturer's instruction book.

107-3.8 CHAIN AND PADLOCK. The Contractor shall furnish and install a suitable operating chain for lowering and raising the hinged top section. The chain shall be attached to the pole support in a manner to prevent the light fixture assembly from striking the ground in the lowered position.

A padlock shall also be furnished by the Contractor on the 8-foot (2.4-m) wind cone for securing the hinged top section to the fixed lower section. Keys for the padlock shall be delivered to the RPR.

107-3.9 SEGMENTED CIRCLE. The segmented circle shall be constructed as shown on the Plans.

METHOD OF MEASUREMENT

107-4.1 The quantity to be paid shall be the number of wind cones installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

~~**107-5.1** Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for **[** removal of existing airport wind cones; **]** furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.~~

~~**107-5.2** Payment will be made at the contract unit price for each segmented circle airport marker system. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.~~

~~Payment will be made under:~~

~~Item L-107-5.1 **[** List type, style, size **]** Wind Cone and Foundation, in Place -- per Each~~

~~Item L-107-5.2 Segmented Circle Marker System, in Place -- per Each~~

107-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for removal of existing airport wind cones; furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

107-5.2 Payment will be made at the contract unit price for each segmented circle airport marker system. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-107a	Remove Existing Primary Wind Cone and Segmented Circle Marker System, Complete – per each
Item L-107b	Install L-806 LED Wind Cone on New Foundation, Complete – per each
Item L-107c	Install L-807 LED Wind Cone on New Foundation, Complete – per each

Item L-107d Install Segmented Circle Marker System, Complete – per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
Advisory Circulars (AC)

AC 150/5340-5 Segmented Circle Airport Marker System

AC 150/5340-30 Design and Installation Details for airport Visual Aids

AC 150/5345-7 Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-27 Specification for Wind Cone Assemblies

AC 150/5345-53 Airport Lighting Equipment Certification Program

Commercial Item Description

A-A-59544 Cable and Wire, Electrical (Power, Fixed Installation)

Federal Standard (FED STD)

FED STD 595 Colors Used in Government Procurement

Master Painter's Institute (MPI)

MPI Reference #9 Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Mil Standard

MIL-DTL-24441C/19B Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

Underwriters Laboratories (UL)

UL Standard 6 Electrical Rigid Metal Conduit – Steel

UL Standard 514B Conduit, Tubing, and Cable Fittings

UL Standard 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL Standard 651 Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

UL Standard 651A Type EB and A Rigid PVC Conduit and HDPE Conduit

UL Standard 1242 Electrical Intermediate Metal Conduit - Steel

National Fire Protection Association (NFPA)

NFPA-70 National Electric Code (NEC)

****END OF ITEM L-107****

ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS

Item L-108 Underground Power Cable for Airports is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 108-2.1 as follows:

108-2.1 GENERAL.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder]~~ [in an electronic pdf file format,] tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

Revise Section 108-2.3 as follows:

108-2.3 BARE COPPER WIRE (COUNTERPOISE, BARE COPPER WIRE GROUND AND GROUND RODS). Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6AWG insulated stranded for grounding bond wire per ASTM B3 and ASTM B8, and shall be ~~[bare copper wire]~~ [tinned copper wire per ASTM B33]. For voltage powered circuits, the equipment grounding conductor shall comply with NEC Article 250.

Ground rods shall be ~~[solid stainless steel]~~ ~~[copper]~~ ~~or~~ [copper-clad steel] ~~[sectional copper-clad steel]~~. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than ~~[8 feet (2.4 m)]~~ [10 feet (2.54 m)] long and ~~[5/8 inch (16 mm)]~~ [3/4 inch (19 mm)] in diameter.

Revise Section 108-3.3 as follows:

108-3.3 INSTALLATION OF DIRECT-BURIED CABLE IN TRENCHES.

b. Backfilling. After the cable has been installed, the trench shall be backfilled. The first layer of backfill in the trench shall encompass all cables ; be 3 inches (75 mm) deep, loose measurement; and shall be either earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. This layer shall not be compacted. The second layer shall be 5 inches (125 mm) deep, loose measurement, and shall contain no particles that would be retained on a one inch (25.0 mm) sieve. The remaining third and subsequent layers of backfill shall not exceed 8 inches (20 cm) of loose measurement and be excavated or imported material and shall not contain stone or aggregate larger than 4 inches (100 mm) maximum diameter.

The second and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent material. If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the backfill compaction shall be [to a minimum of 100 percent of ASTM D1557.] ~~[backfill with controlled low strength material (CLSM) in accordance with P-153]~~.

c. Restoration. Following restoration of all trenching near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include the ~~[sodding] [topsoiling] [fertilizing] [liming] [~~ seeding ~~] [sprigging] [mulching]~~ as shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When trenching is through paved areas, restoration shall be equal to existing conditions. If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the backfill compaction shall be ~~[~~ to a minimum of 100 percent of ASTM D1557 ~~] [backfill with controlled low strength material (CLSM) in accordance with P-153]~~. Restoration shall be considered incidental to the pay item of which it is a component part.

Revise Section 108-3.6 as follows:

108-3.6 BARE COUNTERPOISE WIRE INSTALLATION FOR LIGHTNING PROTECTION AND GROUNDING. If shown on the plans or included in the job specifications, bare solid ~~[~~ #6 AWG ~~]~~ copper counterpoise wire shall be installed for lightning protection of the underground cables. The RPR shall select one of two methods of lightning protection for the airfield lighting circuit based upon sound engineering practice and lightning strike density.

a. Equipotential. ~~[~~The counterpoise size is as shown on the plans. The equipotential method is applicable to all airfield lighting systems; i.e. runway, taxiway, apron – touchdown zone, centerline, edge, threshold and approach lighting systems. The equipotential method is also successfully applied to provide lightning protection for power, signal and communication systems. The light bases, counterpoise, etc – all components - are bonded together and bonded to the vault power system ground loop/electrode.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables. The counterpoise is centered over the cable/conduit/duct to be protected.

The counterpoise conductor shall be installed no less than 8 inches (200 mm) minimum or 12 inches (300 mm) maximum above the raceway or cable to be protected, except as permitted below:

(1) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

(2) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection, (45 degrees on each side of vertical creating a 90 degree angle).

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

All components rise and fall at the same potential; with no potential difference, no damaging arcing and no damaging current flow.

See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Equipotential Method of lightning protection.

Reference FAA STD-019E, Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment, Part 4.1.1.7.~~][not used]~~

~~b.~~ **Isolation** – ~~[Counterpoise size is as shown on the plans. The isolation method is an alternate method for use only with edge lights installed in turf and stabilized soils and raceways installed parallel to and adjacent to the edge of the pavement. NFPA 780 uses 15 feet to define "adjacent to".~~

~~The counterpoise conductor shall be installed halfway between the pavement edge and the light base, mounting stake, raceway, or cable being protected.~~

~~The counterpoise conductor shall be installed 8 inches (203 mm) minimum below grade. The counterpoise is not connected to the light base or mounting stake. An additional grounding electrode is required at each light base or mounting stake. The grounding electrode is bonded to the light base or mounting stake with a 6 AWG solid copper conductor.~~

~~See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Isolation Method of lightning protection.]~~[Not used.]

Revise Section 108-3.10 as follows:

108-3.10 TESTING. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the RPR. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the RPR. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the RPR for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the RPR. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The RPR shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the RPR the following:

a. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

b. That all affected circuits (existing and new) are free from unspecified grounds.

c. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than~~[50]~~ megohms. Verify continuity of all series airfield lighting circuits prior to energization.

d. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

e. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

f. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

g. That the impedance to ground of each ground rod does not exceed~~[25]~~ ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the RPR prior to performing the testing.

Revise Section 108-4.1/4.2/4.3 as follows:

METHOD OF MEASUREMENT

~~**108-4.1 [** Trenching shall be measured by the linear feet (meters) of trench, including the excavation, backfill, and restoration, completed, measured as excavated, and accepted as satisfactory. When specified, separate measurement shall be made for trenches of various specified widths. **]**~~

~~**[** The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work. **]**~~

~~**108-4.2** Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item **[** shall **] [** shall not **]** include additional quantities required for slack.~~

~~**108-4.3** [No separate payment will be made for ground rods.][Ground rods shall be measured by each [8-foot] section installed complete.]~~

108-4.1 The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work

108-4.2. Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank, or conduit. The measurement for this item shall not include additional quantities required

for slack. Cable and counterpoise slack is considered incidental to this item and is included in the Contractor's unit price. No separate measurement or payment will be made for cable or counterpoise slack.

108-4.3 No separate payment will be made for ground rods.

Revise Section 108-5.1 as follows:

BASIS OF PAYMENT

~~**108-5.1** Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the RPR. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.~~

~~Payment will be made under:~~

~~Item L-108-5.1~~	~~Trenching for direct-buried cable, 18-inch minimum depth - per linear foot (meter)~~
~~Item L-108-5.2~~	~~[No. 8 AWG] [No. 6 AWG], [5 kV] [600V], L-824, [Type C] [Type B] Cable, Installed in Trench, Duct Bank or Conduit - per liner foot (meter)~~
~~Item L-108-5.3~~	~~No. [6] [4] [2] AWG, Solid, Bare Copper Counterpoise Wire, Installed [in Trench], [Above the Duct Bank or Conduit], Including Connections/Terminations - per linear foot (meter)~~
~~Item L-108-5.4~~	~~No. [6] [4] [2] AWG, [Bare] [Insulated], Stranded Equipment [bonding] [Ground], Installed in Duct Bank or Conduit – per linear foot (meter).~~

108-5.1 Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the RPR. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.

Payment will be made under:

Item L-108a	Install #8 AWG, L-824C, 5000V Wire – per linear foot
Item L-108b	Install #6 AWG, Bare Copper Counterpoise including Ground Rods and Terminations – per linear foot

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ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS

DESCRIPTION

108-1.1 This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the RPR. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities.

EQUIPMENT AND MATERIALS

108-2.1 GENERAL.

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the RPR.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3 ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced,

at the Owner's discretion, with no additional cost to the Owner. The Contractor shall maintain a minimum insulation resistance in accordance with paragraph 108-3.10e with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period when tested in accordance with AC 150/5340-26, Maintenance Airport Visual Aid Facilities, paragraph 5.1.3.1, Insulation Resistance Test.

108-2.2 CABLE. Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge (AWG), L-824 Type B, 5,000 volts, non-shielded, with, cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 AWG, L-824, Type C, 5,000 volts, non-shielded, with, cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Commercial Item Description A-A-59544A and shall be type THWN-2, 75°C for installation in conduit and RHW-2, 75°C for direct burial installations. Conductors for parallel (voltage) circuits shall be type and size and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600-volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600-volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

108-2.3 BARE COPPER WIRE (COUNTERPOISE, BARE COPPER WIRE GROUND AND GROUND RODS). Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6AWG insulated stranded for grounding bond wire per ASTM B3 and ASTM B8, and shall be ~~[bare copper wire][~~ tinned copper wire per ASTM B33 ~~]~~. For voltage powered circuits, the equipment grounding conductor shall comply with NEC Article 250.

Ground rods shall be ~~[solid stainless steel][copper] or [~~ copper-clad steel ~~][sectional copper-clad steel]~~. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than ~~[8 feet (2.4 m)][~~ 10 feet (2.54 m) ~~]~~ long and ~~[5/8 inch (16 mm)][~~ 3/4 inch (19 mm) ~~]~~ in diameter.

108-2.4 CABLE CONNECTIONS. In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

a. **The cast splice.** A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, "Scotchcast" Kit No. 82-B, or an approved equivalent, used for potting the splice is acceptable.

b. **The field-attached plug-in splice.** Field attached plug-in splices shall be installed as shown on the plans. The Contractor shall determine the outside diameter of the cable to be spliced and furnish appropriately sized connector kits and/or adapters. Tape or heat shrink tubing with integral sealant shall be in accordance with the manufacturer's requirements. Primary Connector Kits manufactured by Amerace, "Super Kit", Integro "Complete Kit", or approved equal is acceptable.

c. **The factory-molded plug-in splice.** Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

d. **The taped or heat-shrink splice.** Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

108-2.5 SPLICER QUALIFICATIONS. Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the RPR proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

108-2.6 CONCRETE. Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

108-2.7 FLOWABLE BACKFILL. Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

108-2.8 CABLE IDENTIFICATION TAGS. Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

108-2.9 TAPE. Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

108-2.10 ELECTRICAL COATING. Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

108-2.11 EXISTING CIRCUITS. Whenever the scope of work requires connection to an existing circuit, the existing circuit's insulation resistance shall be tested, in the presence of the RPR. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the RPR. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the RPR. The Contractor shall record the results on forms acceptable to the RPR. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the existing circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

108-2.12 DETECTABLE WARNING TAPE. Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item. Detectable warning tape for communication cables shall be orange. Detectable warning tape color code shall comply with the APWA Uniform Color Code.

CONSTRUCTION METHODS

108-3.1 GENERAL. The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Cable shall be run without splices, from fixture to fixture.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the RPR or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed and on both sides of slack loops where a future connector would be installed.

Provide not less than 3 feet (1 m) of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot (30 cm) vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the RPR.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the

cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable circuit identification shall match the circuits noted on the construction plans.

108-3.2 INSTALLATION IN DUCT BANKS OR CONDUITS. This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the RPR of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

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

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

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

108-3.3 INSTALLATION OF DIRECT-BURIED CABLE IN TRENCHES. Unless otherwise specified, the Contractor shall not use a cable plow for installing the cable. Cable shall be unreeled uniformly in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one end. Slack cable sufficient to provide strain relief shall be placed in the trench in a series of S curves. Sharp bends or kinks in the cable shall not be permitted.

Where cables must cross over each other, a minimum of 3 inches (75 mm) vertical displacement shall be provided with the topmost cable depth at or below the minimum required depth below finished grade.

a. Trenching. Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed. Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches (0.5 m) below finished grade per NEC Table 300.5, except as follows:

- When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches (91 cm) unless otherwise specified.

- Minimum cable depth when crossing under a railroad track, shall be 42 inches (1 m) unless otherwise specified.

The Contractor shall excavate all cable trenches to a width not less than 6 inches (150 mm). Unless otherwise specified on the plans, all cables in the same location and running in the same general direction shall be installed in the same trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. Flowable backfill material may alternatively be used.

Duct bank or conduit markers temporarily removed for trench excavations shall be replaced as required.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

(1) Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.

(2) Trenching, etc., in cable areas shall then proceed, with approval of the RPR, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair or replacement.

b. Backfilling. After the cable has been installed, the trench shall be backfilled. The first layer of backfill in the trench shall encompass all cables ; be 3 inches (75 mm) deep, loose measurement; and shall be either earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. This layer shall not be compacted. The second layer shall be 5 inches (125 mm) deep, loose measurement, and shall contain no particles that would be retained on a one inch (25.0 mm) sieve. The remaining third and subsequent layers of backfill shall not exceed 8 inches (20 cm) of loose measurement and be excavated or imported material and shall not contain stone or aggregate larger than 4 inches (100 mm) maximum diameter.

The second and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent material. If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the backfill compaction shall be [to a minimum of 100 percent of ASTM D1557.] [~~backfill with controlled low strength material (CLSM) in accordance with P-153~~].

Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when turf is to be established over the trench, the backfilling shall be stopped at an appropriate depth consistent with the type of turfing operation to be accommodated. A proper allowance for settlement shall also be provided. Any excess excavated material shall be removed and disposed of per the plans and specifications.

Underground electrical warning (caution) tape shall be installed in the trench above all direct-buried cable. Contractor shall submit a sample of the proposed warning tape for acceptance by the RPR. If not shown on the plans, the warning tape shall be located 6 inches (150 mm) above the direct-buried cable or the counterpoise wire if present. A 3-6 inch (75 - 150 mm) wide polyethylene film detectable tape, with a metalized foil core, shall be installed above all direct buried cable or counterpoise. The tape shall be of the color and have a continuous legend as indicated on the plans. The tape shall be installed 8 inches (200 mm) minimum below finished grade.

c. Restoration. Following restoration of all trenching near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include the [~~sodding~~] [~~topsoiling~~] [~~fertilizing~~] [~~liming~~] [seeding] [~~sprigging~~] [~~mulching~~] as shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When trenching is through paved areas, restoration shall be equal to existing conditions. If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the backfill compaction shall be [to a minimum of 100 percent of ASTM D1557] [~~backfill with controlled low strength material (CLSM) in accordance with P-153~~]. Restoration shall be considered incidental to the pay item of which it is a component part.

108-3.4 CABLE MARKERS FOR DIRECT-BURIED CABLE. The location of direct buried circuits shall be marked by a concrete slab marker, 2 feet (60 cm) square and 4-6 inch (10 - 15 cm) thick, extending approximately one inch (25 mm) above the surface. Each cable run from a line of lights and signs to the equipment vault shall be marked at approximately every 200 feet (61 m) along the cable run, with an additional marker at each change of direction of cable run. All other direct-buried cable shall be marked in the same manner. Cable markers shall be installed directly above the cable. The Contractor shall impress the word "CABLE" and directional arrows on each cable marking slab. The letters shall be approximately 4 inches (100

mm) high and 3 inches (75 mm) wide, with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep. Stencils shall be used for cable marker lettering; no hand lettering shall be permitted.

At the location of each underground cable connection/splice, except at lighting units, or isolation transformers, a concrete marker slab shall be installed to mark the location of the connection/splice. The Contractor shall impress the word "SPLICE" on each slab. The Contractor also shall impress additional circuit identification symbols on each slab as directed by the RPR. All cable markers and splice markers shall be painted international orange. Paint shall be specifically manufactured for uncured exterior concrete. After placement, all cable or splice markers shall be given one coat of high-visibility aviation orange paint as approved by the RPR. Furnishing and installation of cable markers is incidental to the respective cable pay item.

108-3.5 SPLICING. Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. **Cast splices.** These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer's instructions and to the satisfaction of the RPR.

b. **Field-attached plug-in splices.** These shall be assembled per the manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint or (3) On connector kits equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

c. **Factory-molded plug-in splices.** These shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) Wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint. (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint. or (3) On connector kits so equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

d. **Taped or heat-shrink splices.** A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches (75 mm) on each end) is clean. After scraping, wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. The manufacturer's

recommendation for stretching tape during splicing shall be followed. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

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

e. Assembly. Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

108-3.6 BARE COUNTERPOISE WIRE INSTALLATION FOR LIGHTNING PROTECTION AND GROUNDING. If shown on the plans or included in the job specifications, bare solid ~~[~~ #6 AWG ~~]~~ copper counterpoise wire shall be installed for lightning protection of the underground cables. The RPR shall select one of two methods of lightning protection for the airfield lighting circuit based upon sound engineering practice and lightning strike density.

a. Equipotential. ~~[~~ The counterpoise size is as shown on the plans. The equipotential method is applicable to all airfield lighting systems; i.e. runway, taxiway, apron – touchdown zone, centerline, edge, threshold and approach lighting systems. The equipotential method is also successfully applied to provide lightning protection for power, signal and communication systems. The light bases, counterpoise, etc – all components - are bonded together and bonded to the vault power system ground loop/electrode.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables. The counterpoise is centered over the cable/conduit/duct to be protected.

The counterpoise conductor shall be installed no less than 8 inches (200 mm) minimum or 12 inches (300 mm) maximum above the raceway or cable to be protected, except as permitted below:

(1) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

(2) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection, (45 degrees on each side of vertical creating a 90 degree angle).

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

All components rise and fall at the same potential; with no potential difference, no damaging arcing and no damaging current flow.

See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Equipotential Method of lightning protection.

Reference FAA STD-019E, Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment, Part 4.1.1.7.~~][not used]~~

~~b.~~ **Isolation** – ~~[Counterpoise size is as shown on the plans. The isolation method is an alternate method for use only with edge lights installed in turf and stabilized soils and raceways installed parallel to and adjacent to the edge of the pavement. NFPA 780 uses 15 feet to define "adjacent to".~~

~~The counterpoise conductor shall be installed halfway between the pavement edge and the light base, mounting stake, raceway, or cable being protected.~~

~~The counterpoise conductor shall be installed 8 inches (203 mm) minimum below grade. The counterpoise is not connected to the light base or mounting stake. An additional grounding electrode is required at each light base or mounting stake. The grounding electrode is bonded to the light base or mounting stake with a 6 AWG solid copper conductor.~~

~~See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Isolation Method of lightning protection.]~~[Not used.]

c. **Common Installation requirements**. When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

Grounding electrodes may be rods, ground dissipation plates, radials, or other electrodes listed in the NFPA 70 (NEC) or NFPA 780.

Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet (150 m) apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

d. Parallel Voltage Systems. Provide grounding and bonding in accordance with NFPA 70, National Electrical Code.

108-3.7 COUNTERPOISE INSTALLATION ABOVE MULTIPLE CONDUITS AND DUCT BANKS. Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete area of protection measured 45 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

108-3.8 COUNTERPOISE INSTALLATION AT EXISTING DUCT BANKS. When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

108-3.9 EXOTHERMIC BONDING. Bonding of counterpoise wire shall be by the exothermic welding process or equivalent method accepted by the RPR. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the RPR, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

a. All slag shall be removed from welds.

b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See AC 150/5340-30 for galvanized light base exception.

c. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3MTM ScotchkoteTM, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

108-3.10 TESTING. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the RPR. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the RPR. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the RPR for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the RPR. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The RPR shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the RPR the following:

a. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

b. That all affected circuits (existing and new) are free from unspecified grounds.

c. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than~~┼ 50 ┼~~megohms. Verify continuity of all series airfield lighting circuits prior to energization.

d. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

e. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

f. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

g. That the impedance to ground of each ground rod does not exceed ~~┼ 25 ┼~~ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the RPR prior to performing the testing.

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

There are no approved "repair" procedures for items that have failed testing other than complete replacement.

METHOD OF MEASUREMENT

~~**108-4.1 [** Trenching shall be measured by the linear feet (meters) of trench, including the excavation, backfill, and restoration, completed, measured as excavated, and accepted as satisfactory. When specified, separate measurement shall be made for trenches of various specified widths. **]**~~

~~**[** The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work. **]**~~

~~**108-4.2** Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and~~

~~accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item [shall] [shall not] include additional quantities required for slack.~~

~~**108-4.3** [No separate payment will be made for ground rods.][Ground rods shall be measured by each [8-foot] section installed complete.]~~

108-4.1 The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work

108-4.2. Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank, or conduit. The measurement for this item shall not include additional quantities required for slack. Cable and counterpoise slack is considered incidental to this item and is included in the Contractor's unit price. No separate measurement or payment will be made for cable or counterpoise slack.

108-4.3 No separate payment will be made for ground rods.

BASIS OF PAYMENT

~~**108-5.1** Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the RPR. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.~~

~~Payment will be made under:~~

~~Item L-108-5.1~~	~~Trenching for direct-buried cable, 18-inch minimum depth - per linear foot (meter)~~
~~Item L-108-5.2~~	~~[No. 8 AWG] [No. 6 AWG], [5 kV] [600V], L-824, [Type C] [Type B] Cable, Installed in Trench, Duct Bank or Conduit - per liner foot (meter)~~
~~Item L-108-5.3~~	~~No. [6] [4] [2] AWG, Solid, Bare Copper Counterpoise Wire, Installed [in Trench], [Above the Duct Bank or Conduit], Including Connections/Terminations - per linear foot (meter)~~
~~Item L-108-5.4~~	~~No. [6] [4] [2] AWG, [Bare] [Insulated], Stranded Equipment [bonding] [Ground], Installed in Duct Bank or Conduit – per linear foot (meter).~~

108-5.1 Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the RPR. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.

Payment will be made under:

Item L-108a	Install #8 AWG, L-824C, 5000V Wire – per linear foot
Item L-108b	Install #6 AWG, Bare Copper Counterpoise including Ground Rods and Terminations – per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

ASTM International (ASTM)

ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

Mil Spec

MIL-PRF-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems

American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Federal Aviation Administration Standard

FAA STD-019E	Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment

****END OF ITEM L-108****

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ITEM L-109 AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

Item L-109 Airport Transformer Vault and Vault Equipment is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 109-2.1 as follows:

109-2.1 GENERAL.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder] [~~ in an electronic pdf file format, ~~]~~tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

Revise Section 109-3 CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING as follows:

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

~~**109-3.1 ELECTRICAL VAULT BUILDING.** The electrical vault building must comply with NEC Article 110.31, Enclosure for Electrical Installations, Item (A) Electrical Vaults. Construct the building of materials having adequate structural strength for the conditions and installed location, has a minimum fire rating of two or three hours as determined by the authority having jurisdiction (AHJ), and is bullet resistant to minimum UL 752 Level 4.~~

~~**109-3.2 CONCRETE.** Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.~~

~~**109-3.3 PRECAST CONCRETE STRUCTURES.** Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program. Precast concrete structures shall conform to ASTM C478.~~

~~**109-3.4 REINFORCING STEEL.** Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A615.~~

~~**109-3.5 BRICK.** Brick shall be per ASTM C62, Grade SW.~~

109-3.6 RIGID STEEL CONDUIT. Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6 and 514B.

109-3.7 PLASTIC CONDUIT AND FITTINGS. Plastic Conduit and fittings shall conform to the requirements of UL-651 and UL-654 schedule 40 polyvinyl chloride (PVC) suitable for use above or below ground.

~~**109-3.8 LIGHTING.** Vault or metal-housing light fixtures shall be of a vapor-proof type.~~

~~**109-3.9 OUTLETS.** Convenience outlets shall be heavy-duty duplex units designed for industrial service.~~

~~**109-3.10 SWITCHES.** Vault or metal-housing light switches shall be single-pole switches.~~

~~**109-3.11 PAINT.**~~

~~**a.** Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.~~

~~**b.** White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.~~

~~**c.** Priming paint for wood surfaces shall be mixed on the job by thinning the specified white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon (liter).~~

~~**d.** Paint for the floor, ceiling, and inside walls shall be per Porter Paint Company 69, 71, and 79 or equivalent. Walls and ceiling shall be light gray and the floor shall be medium gray.~~

~~**e.** The roof coating shall be hot asphalt material per ASTM D2823. Asbestos-free roof coating per ASTM D4479 may be substituted if required by local codes.~~

109-3.12 GROUND BUS. Ground bus shall be 1/8 × 3/4 inch (3 × 19 mm) minimum copper bus bar.

109-3.13 SQUARE DUCT. Duct shall be square similar to that manufactured by the Square D Company (or equivalent), or the Trumbull Electric Manufacturing Company (or equivalent). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross-section of the duct shall be not less than 4 × 4 inch (100 × 100 mm) except where otherwise shown in the plans.

109-3.14 GROUND RODS. Ground rods shall be in accordance with Item L-108.

~~**109-3.15 VAULT PREFABRICATED METAL HOUSING.** The prefabricated metal housing shall be a commercially available unit.~~

109-3.16 FAA-APPROVED EQUIPMENT. Certain items of airport lighting equipment installed in vaults are covered by individual ACs listed below:

AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.
AC 150/5345-49	Specification for L-854, Radio Control Equipment

AC 150/5345-56 Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)

109-3.17 OTHER ELECTRICAL EQUIPMENT. Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications and ACs shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers (IEEE) or the National Electrical Manufacturers Association (NEMA). When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and plans. Equipment selected and installed by the Contractor shall maintain the interrupting current rating of the existing systems or specified rating whichever is greater.

109-3.18 WIRE. Wire (in conduit) rated up to 5,000 volts shall be per AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

a. Control circuits. Unless otherwise indicated on the plans, wire shall be not less than No. 12 American wire gauge (AWG) and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable per ANSI/Insulated Cable Engineers Association (ICEA) S-85-625 specifications shall be used.

b. Power circuits.

(1) 600 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.

(2) 3,000 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 3,000 volts.

(3) Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.

~~**109-3.19 SHORT CIRCUIT / COORDINATION / DEVICE EVALUATION / ARC FLASH ANALYSIS.** The Contractor shall, based upon the equipment provided, include as a part of the submittal process the electrical system "Short Circuit / Coordination / Device evaluation / Arc Flash Analysis". The analysis shall be performed by the equipment manufacturer and submitted in a written report. The analysis shall be signed and sealed by a registered professional Engineer from the state in which the project is located. The analysis shall comply with NFPA-70E and IEEE 1584.~~

~~The analysis will include: one line diagrams, short circuit analysis, coordination analysis, equipment evaluation, arc flash analysis and arc flash labels containing at a minimum, equipment name, voltage/current rating, available incident energy and flash protection boundary.~~

~~The selected firms field service Engineer shall perform data gathering for analysis completion and device settings, perform device setting as recommended by the analysis and will furnish and install the arc flash labels. The components worst case incident energy will be considered the available arc flash energy at that specific point in the system. Submit three written copies and one electronic copy of the report.~~

Revise Section 109-4 CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING as follows:

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

~~**109-4.1 GENERAL.** The Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the plans. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the plans. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program.~~

~~The Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet (3 m) on all sides. The slope shall be not less than 1/2 inch per foot (12 mm per 0.3 m) away from the vault or metal housing in all directions.~~

~~The vault shall provide adequate protection against weather elements, including rain, wind-driven dust, snow, ice and excessive heat. The vault shall have sufficient filtered ventilation, to assure that the interior room temperatures and conditions do not exceed the recommended limits of the electrical equipment to be installed in the vault. The Contractor is responsible for contacting the manufacturer of the equipment to be installed to obtain environmental limitations of the equipment to be installed. Refer to the electrical vault detail plan sheets for construction requirements.~~

~~**109-4.2 FOUNDATION AND WALLS.**~~

~~**a. Reinforced concrete construction.** The Contractor shall construct the foundation and walls per the details shown in the plans. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least one inch (25 mm) beneath the concrete surface; the holes shall be plugged and finished to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.~~

~~The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.~~

~~The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equivalent quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equivalent quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.~~

~~**b. Brick and concrete construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The outer edge of the foundation~~

~~at the floor level shall be beveled 1-1/2 inches (38 mm) at 45 degrees. Brick walls shall be 8 inches (200 mm) thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (one part masonry cement and 3 parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar, and facing brick shall be back-parged with mortar as work progresses. All joints shall be 3/8 inch (9 mm) thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, 3/8 inch (9 mm) in diameter and 12 inches (300 mm) long, shall be set vertically in the center of the brick wall on not more than 2 feet (60 cm) centers to project 2-1/2 inches (60 mm) into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two 4 × 3 × 3/8 inch (100 × 75 × 9 mm) steel angles. Lintels shall be painted with one coat of corrosion-inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.~~

~~Window sills may be concrete poured in place or precast concrete as indicated in the plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than one part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.~~

~~**c. Concrete masonry construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C90 and shall include the closures, jambs, and other shapes required by the construction as shown in the plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be Portland cement plaster.~~

~~**109-4.3 ROOF.** The roof shall be reinforced concrete as shown in the plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.~~

~~One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.~~

~~**109-4.4 FLOOR.** Construct building foundation in accordance with the details shown in the plans. The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of 8 inches (200 mm), unless a greater depth is specified in the invitation for bids. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed 4 inches (100 mm) and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched 1/4 inch (6 mm) per foot downward toward the drain. A 1/4 inch (6-mm) asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.~~

~~**109-4.5 FLOOR DRAIN.** If shown in the plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 × 4 feet (1.2 × 1.2 m) square and to a depth of 4 feet (1.2 m) below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a 2 inch (50 mm) mesh sieve and shall all be retained on a 1/4 inch (6.3 mm) mesh sieve. The gravel backfill shall be placed in 6 inch (150 mm) maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds (11 kg) and having a face area of not more than 36 square inches (232 square cm) nor less than 16 square inches (103 square cm). The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than 8 inches (200 mm) in diameter.~~

~~**109-4.6 CONDUITS IN FLOOR AND FOUNDATION.** Conduits shall be installed in the floor and through the foundation walls per the details shown in the plans. All underground conduit shall be painted with an asphalt compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.~~

~~**109-4.7 DOORS.** Doors shall be metal-clad fireproof Class A (three (3) hour rated) doors conforming to requirements of the National Electrical Code (NEC) and local electrical codes. Panic bar exit hardware shall be installed per NEC requirements. Refer to the new electrical vault detail plan sheets for construction requirements.~~

~~**109-4.8 PAINTING.** The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving 2 pounds (0.9 kg) of magnesium fluorosilicate or zinc sulfate crystals in one gallon (liter) of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the RPR. The floor paint shall be a medium gray color approved by the RPR. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3-quart (0.63 liters) of spar varnish and 1/3-quart (0.31 liters) of turpentine to each gallon (liter) of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.~~

~~**109-4.9 LIGHTS AND SWITCHES.** The Contractor shall furnish and install a minimum of two duplex convenience outlets in the vault room. Where a control room is specified, at least two duplex outlets shall be installed.~~

Revise Section 109-6.1/6.2/6.3 as follows:

METHOD OF MEASUREMENT

~~**109-6.1** The quantity of vaults to be paid for under this item shall consist of the number of vaults constructed in place and accepted as a complete unit.~~

~~**109-6.2** The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit.~~

109-6.3 The quantity of equipment to be paid for under this item shall consist of all equipment installed, connected and accepted as a complete unit ready for operation within an existing vault or prefabricated metal housing.

Revise Section 109-7.1 as follows:

BASIS OF PAYMENT

~~**109-7.1** Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

~~Payment will be made under:~~

~~Item L-109-7.1~~	~~Construction of Airport Transformer Vault in Place - per unit~~
~~Item L-109-7.2~~	~~Installation of Airport Transformer Vault Equipment in Place - per unit~~
~~Item L-109-7.3~~	~~Construction of [Prefabricated Metal Housing] [Prefabricated Concrete Building] and Foundation in Place - per unit~~
~~Item L-109-7.4~~	~~Installation of Equipment with in existing vault or prefabricated metal housing in Place - per unit~~

109-7.1 Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item L-109a	Remove Constant Current Regulator, Complete – per each
Item L-109b	Install L-829 Constant Current Regulator, 2.5KW, Ferroresonant Type with IRMS and Input Monitoring, Complete – per each
Item L-109c	Install L-829 Constant Current Regulator, 7.5KW, Ferroresonant Type with IRMS and Input Monitoring, Complete – per each
Item L-109d	Install L-829 Constant Current Regulator, 10KW, Ferroresonant Type with IRMS and Input Monitoring, Complete – per each
Item L-109e	Install S-1 Cutout in Lockable NEMA-1 Enclosure, Complete – per each
Item L-109f	Install L-854 Radio Controller in Existing Vault, Complete – per each

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ITEM L-109 AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

DESCRIPTION

109-1.1 This item shall consist of constructing an airport transformer vault or a prefabricated metal housing per these specifications and per the design and dimensions shown in the plans. This work shall also include the installation of conduits in the floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals that are necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing vault is to be used shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, potheads, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the RPR.

EQUIPMENT AND MATERIALS

109-2.1 GENERAL.

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be certified in AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

~~**109-3.1 ELECTRICAL VAULT BUILDING.** The electrical vault building must comply with NEC Article 110.31, Enclosure for Electrical Installations, Item (A) Electrical Vaults. Construct the building of materials having adequate structural strength for the conditions and installed location, has a minimum fire rating of two or three hours as determined by the authority having jurisdiction (AHJ), and is bullet resistant to minimum UL 752 Level 4.~~

~~**109-3.2 CONCRETE.** Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.~~

~~**109-3.3 PRECAST CONCRETE STRUCTURES.** Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program. Precast concrete structures shall conform to ASTM C478.~~

~~**109-3.4 REINFORCING STEEL.** Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A615.~~

~~**109-3.5 BRICK.** Brick shall be per ASTM C62, Grade SW.~~

109-3.6 RIGID STEEL CONDUIT. Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6 and 514B.

109-3.7 PLASTIC CONDUIT AND FITTINGS. Plastic Conduit and fittings shall conform to the requirements of UL-651 and UL-654 schedule 40 polyvinyl chloride (PVC) suitable for use above or below ground.

~~**109-3.8 LIGHTING.** Vault or metal housing light fixtures shall be of a vapor proof type.~~

~~**109-3.9 OUTLETS.** Convenience outlets shall be heavy-duty duplex units designed for industrial service.~~

~~**109-3.10 SWITCHES.** Vault or metal-housing light switches shall be single-pole switches.~~

~~**109-3.11 PAINT.**~~

~~**a.** Priming paint for non galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.~~

~~**b.** White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.~~

~~**c.** Priming paint for wood surfaces shall be mixed on the job by thinning the specified white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon (liter).~~

~~**d.** Paint for the floor, ceiling, and inside walls shall be per Porter Paint Company 69, 71, and 79 or equivalent. Walls and ceiling shall be light gray and the floor shall be medium gray.~~

~~**e.** The roof coating shall be hot asphalt material per ASTM D2823. Asbestos-free roof coating per ASTM D4479 may be substituted if required by local codes.~~

109-3.12 GROUND BUS. Ground bus shall be 1/8 × 3/4 inch (3 × 19 mm) minimum copper bus bar.

109-3.13 SQUARE DUCT. Duct shall be square similar to that manufactured by the Square D Company (or equivalent), or the Trumbull Electric Manufacturing Company (or equivalent). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross-section of the duct shall be not less than 4 × 4 inch (100 × 100 mm) except where otherwise shown in the plans.

109-3.14 GROUND RODS. Ground rods shall be in accordance with Item L-108.

~~**109-3.15 VAULT PREFABRICATED METAL HOUSING.** The prefabricated metal housing shall be a commercially available unit.~~

109-3.16 FAA-APPROVED EQUIPMENT. Certain items of airport lighting equipment installed in vaults are covered by individual ACs listed below:

AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.
AC 150/5345-49	Specification for L-854, Radio Control Equipment
AC 150/5345-56	Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)

109-3.17 OTHER ELECTRICAL EQUIPMENT. Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications and ACs shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers (IEEE) or the National Electrical Manufacturers Association (NEMA). When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and plans. Equipment selected and installed by the Contractor shall maintain the interrupting current rating of the existing systems or specified rating whichever is greater.

109-3.18 WIRE. Wire (in conduit) rated up to 5,000 volts shall be per AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat

resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

a. Control circuits. Unless otherwise indicated on the plans, wire shall be not less than No. 12 American wire gauge (AWG) and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable per ANSI/Insulated Cable Engineers Association (ICEA) S-85-625 specifications shall be used.

b. Power circuits.

(1) 600 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.

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(3) Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.

~~**109-3.19 SHORT CIRCUIT / COORDINATION / DEVICE EVALUATION / ARC FLASH ANALYSIS.** The Contractor shall, based upon the equipment provided, include as a part of the submittal process the electrical system "Short Circuit / Coordination / Device evaluation / Arc Flash Analysis". The analysis shall be performed by the equipment manufacturer and submitted in a written report. The analysis shall be signed and sealed by a registered professional Engineer from the state in which the project is located. The analysis shall comply with NFPA-70E and IEEE 1584.~~

~~The analysis will include: one line diagrams, short circuit analysis, coordination analysis, equipment evaluation, arc flash analysis and arc flash labels containing at a minimum, equipment name, voltage/current rating, available incident energy and flash protection boundary.~~

~~The selected firms field service Engineer shall perform data gathering for analysis completion and device settings, perform device setting as recommended by the analysis and will furnish and install the arc flash labels. The components worst case incident energy will be considered the available arc flash energy at that specific point in the system. Submit three written copies and one electronic copy of the report.~~

CONSTRUCTION METHODS

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

~~**109-4.1 GENERAL.** The Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the plans. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the plans. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program.~~

~~The Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet (3 m) on all sides. The slope shall be not less than 1/2 inch per foot (12 mm per 0.3 m) away from the vault or metal housing in all directions.~~

The vault shall provide adequate protection against weather elements, including rain, wind-driven dust, snow, ice and excessive heat. The vault shall have sufficient filtered ventilation, to assure that the interior room temperatures and conditions do not exceed the recommended limits of the electrical equipment to be installed in the vault. The Contractor is responsible for contacting the manufacturer of the equipment to be installed to obtain environmental limitations of the equipment to be installed. Refer to the electrical vault detail plan sheets for construction requirements.

109-4.2 FOUNDATION AND WALLS.

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The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equivalent quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equivalent quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

b. Brick and concrete construction. When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The outer edge of the foundation at the floor level shall be beveled 1-1/2 inches (38 mm) at 45 degrees. Brick walls shall be 8 inches (200 mm) thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (one part masonry cement and 3 parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar, and facing brick shall be back-parged with mortar as work progresses. All joints shall be 3/8 inch (9 mm) thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, 3/8 inch (9 mm) in diameter and 12 inches (300 mm) long, shall be set vertically in the center of the brick wall on not more than 2 feet (60 cm) centers to project 2-1/2 inches (60 mm) into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two 4 × 3 × 3/8 inch (100 × 75 × 9 mm) steel angles. Lintels shall be painted with one coat of corrosion-inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.

Window sills may be concrete poured in place or precast concrete as indicated in the plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of

muriatic acid and water in the proportions of not less than one part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.

c. **Concrete masonry construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C90 and shall include the closures, jambs, and other shapes required by the construction as shown in the plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be Portland cement plaster.

109-4.3 ROOF. The roof shall be reinforced concrete as shown in the plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.

One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

109-4.4 FLOOR. Construct building foundation in accordance with the details shown in the plans. The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of 8 inches (200 mm), unless a greater depth is specified in the invitation for bids. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed 4 inches (100 mm) and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched 1/4 inch (6 mm) per foot downward toward the drain. A 1/4 inch (6-mm) asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.

109-4.5 FLOOR DRAIN. If shown in the plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 × 4 feet (1.2 × 1.2 m) square and to a depth of 4 feet (1.2 m) below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a 2-inch (50 mm) mesh sieve and shall all be retained on a 1/4-inch (6.3 mm) mesh sieve. The gravel backfill shall be placed in 6 inch (150 mm) maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds (11 kg) and having a face area of not more than 36 square inches (232 square cm) nor less than 16 square inches (103 square cm). The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than 8 inches (200 mm) in diameter.

109-4.6 CONDUITS IN FLOOR AND FOUNDATION. Conduits shall be installed in the floor and through the foundation walls per the details shown in the plans. All underground conduit shall be painted with an asphalt compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.

~~**109-4.7 DOORS.** Doors shall be metal-clad fireproof Class A (three (3) hour rated) doors conforming to requirements of the National Electrical Code (NEC) and local electrical codes. Panic bar exit hardware shall be installed per NEC requirements. Refer to the new electrical vault detail plan sheets for construction requirements.~~

~~**109-4.8 PAINTING.** The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving 2 pounds (0.9 kg) of magnesium fluorosilicate or zinc sulfate crystals in one gallon (liter) of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the RPR. The floor paint shall be a medium gray color approved by the RPR. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3 quart (0.63 liters) of spar varnish and 1/3 quart (0.31 liters) of turpentine to each gallon (liter) of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.~~

~~**109-4.9 LIGHTS AND SWITCHES.** The Contractor shall furnish and install a minimum of two duplex convenience outlets in the vault room. Where a control room is specified, at least two duplex outlets shall be installed.~~

INSTALLATION OF EQUIPMENT IN VAULT OR PREFABRICATED METAL HOUSING

109-5.1 GENERAL. The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to ensure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the plans. When specified, an emergency power supply and transfer switch shall be provided and installed.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and local code agency having jurisdiction. All electrical work shall comply with the NEC and local code agency having jurisdiction including the separation of under 600V work from 5,000V work."

109-5.2 POWER SUPPLY EQUIPMENT. Transformers, regulators, booster transformers, and other power supply equipment items shall be furnished and installed at the location shown in the plans or as directed by the RPR. The power supply equipment shall be set on steel "H" sections, "I" beams, channels, or concrete blocks to provide a minimum space of 1-1/2 inch (38 mm) between the equipment and the floor. The equipment shall be placed so as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured.

If specified in the plans and specifications, equipment for an alternate power source or an emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic changeover switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

109-5.3 SWITCHGEAR AND PANELS. Oil switches, fused cutouts, relays, transfer switches, panels, panel boards, and other similar items shall be furnished and installed at the location shown in the plans or as directed by the RPR. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than 3/8-inch (9 mm) diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

109-5.4 DUCT AND CONDUIT. The Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.

Wall brackets for square ducts shall be installed at all joints 2 feet (60 cm) or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.

109-5.5 WIRING AND CONNECTIONS. The Contractor shall make all necessary electrical connections in the vault per the wiring diagrams furnished and as directed by the RPR. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

109-5.6 MARKING AND LABELING. All equipment, control wires, terminal blocks, etc., shall be tagged, marked, or labeled as specified below:

a. **Wire identification.** The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer's recommended size for the wire involved. Identification -markings designated in the plans shall be followed. Tags, if used, shall be of fiber not less than 3/4 inch (19 mm) in diameter and not less than 1/32 inch (1 mm) thick. Identification markings designated in the plans shall be stamped on tags by means of small tool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.

b. **Labels.** The Contractor shall stencil identifying labels on the cases of regulators, breakers, and distribution and control relay cases with white oil paint as designated by the RPR. The letters and numerals shall be not less than one inch (25 mm) in height and shall be of proportionate width. The Contractor shall also mark the correct circuit designations per the wiring diagram on the terminal marking strips, which are a part of each terminal block.

METHOD OF MEASUREMENT

~~**109-6.1** The quantity of vaults to be paid for under this item shall consist of the number of vaults constructed in place and accepted as a complete unit.~~

~~**109-6.2** The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit.~~

109-6.3 The quantity of equipment to be paid for under this item shall consist of all equipment installed, connected and accepted as a complete unit ready for operation within an existing vault or prefabricated metal housing.

BASIS OF PAYMENT

~~**109-7.1** Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

~~Payment will be made under:~~

~~Item L-109-7.1 Construction of Airport Transformer Vault in Place - per unit~~

~~Item L-109-7.2 Installation of Airport Transformer Vault Equipment in Place - per unit~~

~~Item L-109-7.3 Construction of [Prefabricated Metal Housing] [Prefabricated Concrete Building] and Foundation in Place - per unit~~

~~Item L-109-7.4 Installation of Equipment with in existing vault or prefabricated metal housing in Place - per unit~~

109-7.1 Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item L-109a	Remove Constant Current Regulator, Complete – per each
Item L-109b	Install L-829 Constant Current Regulator, 2.5KW, Ferroresonant Type with IRMS and Input Monitoring, Complete – per each
Item L-109c	Install L-829 Constant Current Regulator, 7.5KW, Ferroresonant Type with IRMS and Input Monitoring, Complete – per each
Item L-109d	Install L-829 Constant Current Regulator, 10KW, Ferroresonant Type with IRMS and Input Monitoring, Complete – per each
Item L-109e	Install S-1 Cutout in Lockable NEMA-1 Enclosure, Complete – per each
Item L-109f	Install L-854 Radio Controller in Existing Vault, Complete – per each
Item L-109g	Install Airport Lighting Control and Monitoring System (ALCMS), Complete – per lump sum

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
AC 150/5345-49	Specification L-854, Radio Control Equipment;
AC 150/5345-53	Airport Lighting Equipment Certification Program

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/ICEA S-85-625	Standard for Telecommunications Cable Aircore, Polyolefin Insulated, Copper Conductor Technical Requirements

ASTM International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM D2823	Standard Specification for Asphalt Roof Coatings, Asbestos Containing
ASTM D4479	Standard Specification for Asphalt Roof Coatings – Asbestos-Free

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation) Institute of Electrical and Electronic Engineers (IEEE)
IEEE 1584	Guide for Performing Arc-Flash Hazard Calculations

Master Painter's Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-70E	Standard for Electrical Safety in the Workplace
NFPA-780	Standard for the Installation of Lightning Protection Systems

****END OF ITEM L-109****

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ITEM L-110 AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS

Item L-110 Airport Underground Electrical Duct Banks and Conduits is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 110-2.1 as follows:

110-2.1 GENERAL.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

Revise Section 110-3.7 as follows:

110-3.7 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include ~~[sodding] [topsoiling] [fertilizing] [liming] [~~ seeding ~~] [sprigging] [mulching]~~ shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

Revise Section 110-3.8 as follows:

110-3.8 OWNERSHIP OF REMOVED CABLE. ~~[~~ The Contractor shall remove all abandoned/unused conductors contained in conduits in which new conductors will be installed. No abandoned conductors shall be left in place at the completion of the job. All removed wire shall become the property of the Contractor and the Contractor shall be held responsible for removing the wire off airport property. The removal of existing conductors shall be considered incidental to the respective duct pay item and no separate payment will be made.

Revise Section 108-5.1 as follows:

BASIS OF PAYMENT

~~**110-5.1** Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal of existing duct banks and conduits as shown on the plans, furnishing all materials and for all preparation,~~

~~assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.~~

~~Payment will be made under:~~

~~Item L-110-5.1 [Concrete Encased] [Non-Encased] Electrical Duct Bank, [# and Size] - per linear foot (meter)~~

~~Item L-110-5.2 [Concrete Encased] [Non-Encased] Electrical Conduit, [# and Size] - per linear foot (meter)~~

110-5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal of existing duct banks and conduits as shown on the plans, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-110a	Install 1-2" SCH 40 PVC Conduit Direct Earth Buried (DEB) – per linear foot
Item L-110b	Install 1-2" SCH 40 PVC Conduit Concrete Encased (CE) in Existing Pavement – per linear foot
Item L-110c	Install 2-2" SCH 40 PVC Conduit Concrete Encased (CE) in Existing Pavement – per linear foot
Item L-110d	Install 1-2" SCH 40 HDPE Conduit Directionally Bored – per linear foot

ITEM L-110 AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS

DESCRIPTION

110-1.1 This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed per this specification at the locations and per the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits and removal of existing duct bank**s**. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

EQUIPMENT AND MATERIALS

110-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR

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b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the RPR. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the RPR and replaced with materials, that comply with these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3 ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

110-2.2 STEEL CONDUIT. Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a 10-mil thick coat of asphaltum sealer or shall have a factory-bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mils of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions. In lieu of PVC coated RGS, corrosion wrap tape shall be permitted to be used where RGS is in contact with direct earth."

110-2.3 PLASTIC CONDUIT. Plastic conduit and fittings-shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

a. Type I–Schedule 40 and Schedule 80 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

c. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

d. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

110-2.4 SPLIT CONDUIT. Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

110-2.5 CONDUIT SPACERS. Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads. They shall be designed to accept No. 4 reinforcing bars installed vertically.

110-2.6 CONCRETE. Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

110-2.7 PRECAST CONCRETE STRUCTURES. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program. Precast concrete structures shall conform to ASTM C478.

110-2.8 FLOWABLE BACKFILL. Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

110-2.9 DETECTABLE WARNING TAPE. Plastic, detectable, American Public Works Association (APWA) red (electrical power lines, cables, conduit and lighting cable), orange (telephone/fiber optic cabling) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.

CONSTRUCTION METHODS

110-3.1 GENERAL. The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The RPR shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches (50 mm) inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. Under pavement, the top of the duct bank shall not be less than 18 inches (0.5 m) below the subgrade; in other locations, the top of the duct bank or underground conduit shall be not less than 18 inches (0.5 m) below finished grade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch (6 mm) smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the RPR of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200-pound (90 kg) test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet (1.5 m).

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under

paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. Flowable backfill may alternatively be used

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the RPR. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet (60 cm).

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

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the RPR, the unsuitable material shall be removed per Item P-152 and replaced with suitable material. Additional duct bank supports shall be installed, as approved by the RPR.

All excavation shall be unclassified and shall be considered incidental to Item L-110. Dewatering necessary for duct installation, and erosion per federal, state, and local requirements is incidental to Item L-110.
Unless otherwise specified, excavated materials that are deemed by the RPR to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the RPR and compacted per Item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

b. Trenching, etc., in cable areas shall then proceed with approval of the RPR, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

110-3.2 DUCT BANKS. Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches (0.5 m) below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (0.5 m) below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet (1 m) beyond the edges of the pavement or 3 feet (1 m) beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. The Contractor shall space the conduits not less than 3 inches (75 mm) apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches (75 mm) thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the RPR for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot (1.5-m) intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 to 6 inches (75 to 150 mm) wide tape, 8 inches (200 mm) minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch (75-mm) wide tape only for single conduit runs. Utilize the 6-inch (150-mm) wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches (600 mm) in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the RPR shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the RPR.

110-3.3 CONDUITS WITHOUT CONCRETE ENCASEMENT. Trenches for single-conduit lines shall be not less than 6 inches (150 mm) nor more than 12 inches (300 mm) wide. The trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches (100 mm) thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4-inch (6.3 mm) sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be used.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches (0.5 m) below the finished grade. Conduits outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches (60 cm) below the finished grade per National Electric Code (NEC), Table 300.5.

When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches (150 mm) apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3 inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches (150 mm) apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the RPR for review prior to use.

110-3.4 MARKERS. The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet (60 cm) square and 4 - 6 inches (100 - 150 mm) thick extending approximately one inch (25 mm) above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet (61 m) along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word "DUCT" or "CONDUIT" on each marker slab. Impression of letters shall be done in a manner, approved by the RPR, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the RPR. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the RPR. The letters shall be 4 inches (100 mm) high and 3 inches (75 mm) wide with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

110-3.5 BACKFILLING FOR CONDUITS. For conduits, 8 inches (200 mm) of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 except that material used for back fill shall be select material not larger than 4 inches (100 mm) in diameter.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the RPR.

110-3.6 BACKFILLING FOR DUCT BANKS. After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 "Excavation and Embankment" except that the material used for backfill shall be select material not larger than 4 inches (100 mm) in diameter. In addition to the requirements of Item P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet (76 m) of duct bank or one work period's construction, whichever is less.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the RPR.

110-3.7 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include ~~[sodding] [topsoiling] [fertilizing] [liming] [~~ seeding ~~] [sprigging] [mulching]~~ shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

110-3.8 OWNERSHIP OF REMOVED CABLE. The Contractor shall remove all abandoned/unused conductors contained in conduits in which new conductors will be installed. No abandoned conductors shall be left in place at the completion of the job. All removed wire shall become the property of the Contractor and the Contractor shall be held responsible for removing the wire off airport property. The removal of existing conductors shall be considered incidental to the respective duct pay item and no separate payment will be made.

METHOD OF MEASUREMENT

110-4.1 Underground conduits and duct banks shall be measured by the linear feet (meter) of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated material, and

restoration, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

BASIS OF PAYMENT

~~**110-5.1** Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal of existing duct banks and conduits as shown on the plans, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.~~

~~Payment will be made under:~~

~~Item L-110-5.1 [Concrete Encased] [Non-Encased] Electrical Duct Bank, [# and Size] - per linear foot (meter)~~

~~Item L-110-5.2 [Concrete Encased] [Non-Encased] Electrical Conduit, [# and Size] - per linear foot (meter)~~

110-5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal of existing duct banks and conduits as shown on the plans, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-110a	Install 1-2" SCH 40 PVC Conduit Direct Earth Buried (DEB) – per linear foot
Item L-110b	Install 1-2" SCH 40 PVC Conduit Concrete Encased (CE) in Existing Pavement – per linear foot
Item L-110c	Install 2-2" SCH 40 PVC Conduit Concrete Encased (CE) in Existing Pavement – per linear foot
Item L-110d	Install 1-2" SCH 40 HDPE Conduit Directionally Bored – per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circular (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

ASTM International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit - Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 1242	Electrical Intermediate Metal Conduit Steel
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

****END OF ITEM L-110****

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ITEM L-115 ELECTRICAL MANHOLES AND JUNCTION STRUCTURES

Item L-115 Electrical Manholes and Junction Structures is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 115-2.1 as follows:

115-2.1 GENERAL.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder]~~ [in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

Revise Section 115-2.3 as follows:

115-2.3 PRECAST CONCRETE STRUCTURES. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program. Provide precast concrete structures where shown on the plans.

Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand [100,000 lb aircraft] loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown on the plans.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the RPR shall be submitted by the Contractor to allow for a full evaluation by the RPR. The RPR shall review per the process defined in the General Provisions.

Revise Section 108-2.7 as follows:

115-2.7 FRAMES AND COVERS. The frames shall conform to one of the following requirements:

a.	ASTM A48	Gray iron castings
b.	ASTM A47	Malleable iron castings
c.	ASTM A27	Steel castings
d.	ASTM A283, Grade D	Structural steel for grates and frames
e.	ASTM A536	Ductile iron castings

f. ASTM A897 Austempered ductile iron castings

All castings specified shall withstand a maximum tire pressure of ~~[~~ 250 ~~]~~ psi and maximum load of ~~[~~ 100,000 ~~]~~ lbs.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word "ELECTRIC" or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent. No cable notches are required.

Each manhole shall be provided with a "DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" safety warning sign as detailed in the Contract Documents and in accordance with OSHA 1910.146 (c)(2).

Revise Section 115-2.12 as follows:

115-2.12 CABLE TRAYS. Cable trays shall be of ~~[~~ galvanized steel ~~] [plastic] [aluminum]~~. Cable trays shall be located as shown on the plans.

Revise Section 115-2.16 as follows:

115-2.16 GROUND RODS. Ground rods shall be one piece, ~~[solid stainless steel] [copper]~~ or ~~[~~ copper clad steel ~~]~~**.** The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 8 feet (2.4 m) long nor less than 5/8 inch (16 mm) in diameter.

Revise Section 115-4.1/4.2 as follows:

METHOD OF MEASUREMENT

115-4.1 Electrical manholes and junction structures shall be measured by each unit completed in place and accepted. The following items shall be included in the price of each unit: All required excavation and dewatering; sheeting and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turfing; all required connections; temporary cables and connections; and ground rod testing

~~**115-4.2** Manhole elevation adjustments shall be measured by the completed unit installed, in place, completed, and accepted. Separate measurement shall not be made for the various types and sizes.~~

Revise Section 115-5.1/5.2 as follows:

BASIS OF PAYMENT

~~**115-5.1** The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.~~

~~**115-5.2** Payment shall be made at the contract unit price for manhole elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the plans and to the satisfaction of the RPR.~~

~~Payment will be made under:~~

~~Item L-115-5.1 Electrical Manhole **[** size and type **]** - Per Each~~

~~Item L-115-5.2 Electrical Junction Structure **[** size and type **]** - Per Each~~

~~Item L-115-5.3 Existing Electrical Manhole/Junction Structure Elevation Adjustment **[** size and type **]** – Per Each~~

~~Item L-115-5.4 Electrical Handhole **[** Size and Type **]** –Per Each~~

115-5.1 The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item L-115a	Remove L-867 Junction Box, Complete – per each
Item L-115b	Install L-867E, Junction Box, Complete – per each

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ITEM L-115 ELECTRICAL MANHOLES AND JUNCTION STRUCTURES

DESCRIPTION

115-1.1 This item shall consist of electrical manholes and junction structures (hand holes, pull boxes, junction cans, etc.) installed per this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the RPR. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the RPR including removal of existing manholes and junction structures as shown on the plans.

EQUIPMENT AND MATERIALS

115-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the RPR.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

115-2.2 CONCRETE STRUCTURES. Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures. Cast-in-place concrete structures shall be as shown on the plans.

115-2.3 PRECAST CONCRETE STRUCTURES. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program. Provide precast concrete structures where shown on the plans.

Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand [100,000 lb aircraft] loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown on the plans.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the RPR shall be submitted by the Contractor to allow for a full evaluation by the RPR. The RPR shall review per the process defined in the General Provisions.

115-2.4 JUNCTION BOXES. Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a L-894 blank cover, gasket, and stainless steel hardware. All bolts, studs, nuts, lock washers, and other similar fasteners used for the light fixture assemblies must be fabricated from 316L (equivalent to EN 1.4404), 18-8, 410, or 416 stainless steel. If 18-8, 410, or 416 stainless steel is utilized it shall be passivated and be free from any discoloration. Covers shall be 3/8-inch (9-mm) thickness for L-867 and 3/4-inch (19-mm) thickness for L-868. All junction boxes shall be provided with both internal and external ground lugs.

115-2.5 MORTAR. The mortar shall be composed of one part of cement and two parts of mortar sand, by volume. The cement shall be per the requirements in ASTM C150, Type I. The sand shall be per the requirements in ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C206. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

115-2.6 CONCRETE. All concrete used in structures shall conform to the requirements of Item P-610, Concrete for Miscellaneous Structures.

115-2.7 FRAMES AND COVERS. The frames shall conform to one of the following requirements:

a.	ASTM A48	Gray iron castings
b.	ASTM A47	Malleable iron castings
c.	ASTM A27	Steel castings
d.	ASTM A283, Grade D	Structural steel for grates and frames
e.	ASTM A536	Ductile iron castings
f.	ASTM A897	Austempered ductile iron castings

All castings specified shall withstand a maximum tire pressure of [250] psi and maximum load of [100,000] lbs.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word "ELECTRIC" or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent. No cable notches are required.

Each manhole shall be provided with a "DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" safety warning sign as detailed in the Contract Documents and in accordance with OSHA 1910.146 (c)(2).

115-2.8 LADDERS. Ladders, if specified, shall be galvanized steel or as shown on the plans.

115-2.9 REINFORCING STEEL. All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

115-2.10 BEDDING/SPECIAL BACKFILL. Bedding or special backfill shall be as shown on the plans.

115-2.11 FLOWABLE BACKFILL. Flowable material used to backfill shall conform to the requirements of Item P-153, Controlled Low Strength Material.

115-2.12 CABLE TRAYS. Cable trays shall be of ~~[~~ galvanized steel ~~] [plastic] [aluminum]~~. Cable trays shall be located as shown on the plans.

115-2.13 PLASTIC CONDUIT. Plastic conduit shall comply with Item L-110, Airport Underground Electrical Duct Banks and Conduits.

115-2.14 CONDUIT TERMINATORS. Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

115-2.15 PULLING-IN IRONS. Pulling-in irons shall be manufactured with 7/8-inch (22 mm) diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2-inch (12 mm) diameter with an ultimate strength of 270,000 psi (1862 MPa)). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

115-2.16 GROUND RODS. Ground rods shall be one piece, copper clad steel**.** The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 8 feet (2.4 m) long nor less than 5/8 inch (16 mm) in diameter.

CONSTRUCTION METHODS

115-3.1 UNCLASSIFIED EXCAVATION. It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the RPR without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the RPR. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to Item L-115. Dewatering necessary for structure installation and erosion per federal, state, and local requirements is incidental to Item L-115.

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

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.
Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the RPR. Structures shall be placed after the RPR has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 inches (150 mm) of sand or a material approved by the RPR as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

115-3.2 CONCRETE STRUCTURES. Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the RPR before the concrete is placed.

115-3.3 PRECAST UNIT INSTALLATIONS. Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115-3.4 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES AND FITTINGS. All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the RPR and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written approval is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the RPR and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

115-3.5 INSTALLATION OF LADDERS. Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

115-3.6 REMOVAL OF SHEETING AND BRACING. In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than 6 inches (150 mm) of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The RPR may direct the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

115-3.7 BACKFILLING. After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches (150 mm). Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the RPR.

Backfill shall not be placed against any structure until approval is given by the RPR. In the case of concrete, such approval shall not be given until tests made by the laboratory under supervision of the RPR establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the RPR may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

115-3.8 CONNECTION OF DUCT BANKS. To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

115-3.9 GROUNDING. A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches (150 mm) above the floor. The ground rod shall be installed within one foot (30 cm) of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4-inch (100 mm) diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one foot (30 cm) above the floor of the structure and separate from other cables. No. 2 American wire gauge (AWG) bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus

shall be made by using connectors approved for direct burial in soil or concrete per UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

115-3.10 CLEANUP AND REPAIR. After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound per MIL-P-21035. Surfaces shall be prepared and compound applied per the manufacturer's recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

115-3.11 RESTORATION. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective Item L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

115-3.12 INSPECTION. Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test per American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

115-3.13 MANHOLE ELEVATION ADJUSTMENTS. The Contractor shall adjust the tops of existing manholes in areas designated in the Contract Documents to the new elevations shown. The Contractor shall be responsible for determining the exact height adjustment required to raise or lower the top of each manhole to the new elevations. The existing top elevation of each manhole to be adjusted shall be determined in the field and subtracted/added from the proposed top elevation.

The Contractor shall remove/extend the existing top section or ring and cover on the manhole structure or manhole access. The Contractor shall install precast concrete sections or grade rings of the required dimensions to adjust the manhole top to the new proposed elevation or shall cut the existing manhole walls to shorten the existing structure, as required by final grades. The Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.

The Contractor shall construct a concrete slab around the top of adjusted structures located in graded areas that are not to be paved. The concrete slab shall conform to the dimensions shown on the plans.

115-3.14 DUCT EXTENSION TO EXISTING DUCTS. Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts

together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

METHOD OF MEASUREMENT

115-4.1 Electrical manholes and junction structures shall be measured by each unit completed in place and accepted. The following items shall be included in the price of each unit: All required excavation and dewatering; sheeting and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turfing; all required connections; temporary cables and connections; and ground rod testing

~~**115-4.2** Manhole elevation adjustments shall be measured by the completed unit installed, in place, completed, and accepted. Separate measurement shall not be made for the various types and sizes.~~

BASIS OF PAYMENT

~~**115-5.1** The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.~~

~~**115-5.2** Payment shall be made at the contract unit price for manhole elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the plans and to the satisfaction of the RPR.~~

~~Payment will be made under:~~

~~Item L-115-5.1 Electrical Manhole **[** size and type **]** - Per Each~~

~~Item L-115-5.2 Electrical Junction Structure **[** size and type **]** - Per Each~~

~~Item L-115-5.3 Existing Electrical Manhole/Junction Structure Elevation Adjustment **[** size and type **]** Per Each~~

~~Item L-115-5.4 Electrical Handhole **[** Size and Type **]** –Per Each~~

115-5.1 The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item L-115a	Remove L-867 Junction Box, Complete – per each
Item L-115b	Install L-867E, Junction Box, Complete – per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Advisory Circular (AC)

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation)

ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C144	Standard Specification for Aggregate for Masonry Mortar

ASTM C150 Standard Specification for Portland Cement

ASTM C206 Standard Specification for Finishing Hydrated Lime

FAA Engineering Brief (EB)

EB #83 In Pavement Light Fixture Bolts

Mil Spec

MIL-P-21035 Paint High Zinc Dust Content, Galvanizing Repair

National Fire Protection Association (NFPA)

NFPA-70 National Electrical Code (NEC)

****END OF ITEM L-115****

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ITEM L-125 INSTALLATION OF AIRPORT LIGHTING SYSTEMS

Item L-125 Installation of Airport Lighting Systems is hereby amended with respect to the paragraphs and the sections sited below.

Revise Section 125-2.1 as follows:

125-2.1 GENERAL.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder]~~ in an electronic pdf file format, ~~[~~tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

All LED light fixtures, which the exception of obstruction lighting (AC 150/5345-43) must be warranted by the manufacturer for a minimum of 4 years after date of installation inclusive of all electronics. "Obstruction lighting warranty is set by the individual manufacturer**.**

Revise Section 125-2.6 as follows:

125-2.6 RETROREFLECTIVE MARKERS. ~~[~~ Retroreflective markers shall be type L-853 and shall conform to the requirements of AC 150/5345-39. ~~] [Not required.]~~

Revise Section 125-2.7 as follows:

125-2.7 RUNWAY AND TAXIWAY LIGHTS. Runway and taxiway lights shall conform to the requirements of AC 150/5345-46. Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.

~~Lights~~

~~Type~~	~~Class~~	~~Mode~~	~~Style~~	~~Option~~	~~Base~~	~~Filter~~	~~Transformer~~	~~Notes~~
~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~

Lights

Type	Class	Mode	Style	Option	Base	Filter	Transformer	Notes
L-861T	2	1	N/A	4	L-867	Blue	L-830 Size Per Manufacturer	LED
L-861	2	1	N/A	4	L-867	Per Plan	L-830 Size Per Manufacturer	LED
L-861E	2	1	N/A	4	L-867	Per Plan	L-830 Size Per Manufacturer	LED

Revise Section 125-2.8 as follows:

125-2.8 RUNWAY AND TAXIWAY SIGNS. Runway and Taxiway Guidance Signs should conform to the requirements of AC 150/5345-44.

~~**Signs**~~

~~Type~~	~~Size~~	~~Style~~	~~Class~~	~~Mode~~	~~Notes~~
~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~

Signs

Type	Size	Style	Class	Mode	Notes
L-858B/L/R/Y	**1**	**2/3**	**2**	**2**	**LED**

Revise Section 125-2.9 as follows:

125-2.9 RUNWAY END IDENTIFIER LIGHT (REIL). ~~[The REIL fixtures shall meet the requirements of AC 150/5345-51, Type [L-849V][L-849I], Style [A][B][C][D][E][F].][~~ Not required. ~~]~~

Revise Section 125-2.10 as follows:

125-2.10 PRECISION APPROACH PATH INDICATOR (PAPI). ~~[The light units for the PAPI shall meet the requirements of AC 150/5345-28, Type [L-880][L-881], Style [A][B], Class [I][II].][Not required.]~~
The light units for the PAPI shall meet the requirements of AC 150/5345-28, Type L-880, Style B, Class 1, LED.

Revise Section 125-2.11 as follows:

125-2.11 CIRCUIT SELECTOR CABINET. ~~The circuit selector cabinet shall meet the requirements of AC 150/5345-5, Type L-847, [one][two][three][four] circuit control [as indicated], Class [A, indoor][B, outdoor], Rating [1, for 6.6 amperes][2, for 20 amperes].~~ Not required.

Revise Section 125-2.12 as follows:

125-2.12 LIGHT BASE AND TRANSFORMER HOUSINGS. ~~Light Base and Transformer Housings should conform to the requirements of AC 150/5345-42. Light bases shall be Type [L-867] [L-868], Class [1A] [1B] [2A] [2B], Size [A] [B] [C] shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures~~.

Light Base and Transformer Housings should conform to the requirements of AC 150/5345-42. Light bases shall be Type L-867, Class 1A **or** 1B Size B shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures.

Revise Section 125-2.13 as follows:

125-2.13 ISOLATION TRANSFORMERS. Isolation Transformers shall be Type ~~[~~ L-830 ~~] [L-831]~~, size as required for each installation. Transformer shall conform to AC 150/5345-47.

Revise Section 125-4.1 as follows:

METHOD OF MEASUREMENT

125-4.1 ~~Reflective markers will be measured by the number installed as completed units in place, ready for operation, and accepted by the RPR~~. Runway and taxiway lights will be measured by the number of each type installed as completed units in place, ready for operation, and accepted by the RPR. Guidance signs will be measured by the number of each type and size installed as completed units, in place, ready for operation, and accepted by the RPR.~~Runway End Identifier Lights shall be measured by each system installed as a completed unit in place, ready for operation, and accepted by the RPR.~~

Precision Approach Path Indicator shall be measured by each system installed as a completed unit, in place, ready for operation, and accepted by the RPR. Abbreviated Precision Approach Path Indicator shall be measured by each system installed as a completed unit, in place, ready for operation, and accepted by the RPR.

BASIS OF PAYMENT

~~**125-5.1** Payment will be made at the Contract unit price for each complete runway or taxiway light, guidance sign, reflective marker, runway end identification light, precision approach path indicator, or abbreviated precision approach path indicator installed by the Contractor and accepted by the RPR. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete this item.~~

~~Payment will be made under:~~

~~[Item] [Description] – [each]~~

125-5.1 Payment will be made at the Contract unit price for each complete runway or taxiway light, guidance sign, ~~reflective marker, runway end identification light~~, precision approach path indicator, ~~or abbreviated precision approach path indicator~~ installed by the Contractor and accepted by the RPR. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete this item.

Payment will be made under:

Item L-125a	Remove Runway/Taxiway Edge Light in Soil, Complete – per each
Item L-125b	Remove Runway/Taxiway Edge Light in Existing Pavement, Complete – per each
Item L-125c	Install L-861 LED Runway Edge Light, Base Mounted, in Soil, Complete – per each
Item L-125d	Install L-861 LED Runway Edge Light, Base Mounted, in Existing Pavement, Complete – per each
Item L-125e	Install L-861E LED Runway Threshold Light, Base Mounted, in Existing Pavement, Complete – per each
Item L-125f	Install L-861T LED Taxiway Edge Light, Base Mounted, in Soil, Complete – per each
Item L-125g	Install L-861T LED Taxiway Edge Light, Base Mounted, in Existing Pavement, Complete – per each
Item L-125h	Remove L-858 Guidance Sign and Concrete Foundation, Complete – per each
Item L-125i	Install L-858 LED Guidance Sign, Size 1, 2 Module, Complete – per each
Item L-125j	Install L-858 LED Guidance Sign, Size 1, 3 Module, Complete – per each
Item L-125k	Install L-858 LED Guidance Sign, Size 1, 4 Module, Complete – per each
Item L-125l	Install L-858 LED Runway Distance Remaining Sign, Size 4, Complete – per each
Item L-125m	Remove VASI System, Complete – per each
Item L-125n	Install L-880 LED PAPI System, Complete – per each

ITEM L-125 INSTALLATION OF AIRPORT LIGHTING SYSTEMS

DESCRIPTION

125-1.1 This item shall consist of airport lighting systems furnished and installed in accordance with this specification, the referenced specifications, and the applicable advisory circulars (ACs). The systems shall be installed at the locations and in accordance with the dimensions, design, and details shown in the plans. This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the RPR.

EQUIPMENT AND MATERIALS

125-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified under the Airport Lighting Equipment Certification Program in accordance with AC 150/5345-53, current version. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not performs as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.

b. Manufacturer's certifications shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications and acceptable to the RPR. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the RPR and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

c. All materials and equipment used shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Clearly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be clearly made with arrows or circles (highlighting is not acceptable). The Contractor shall be responsible for delays in the project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be ~~[neatly bound in a properly sized 3-ring binder] [~~ in an electronic pdf file format, ~~]~~ tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

All LED light fixtures, which the exception of obstruction lighting (AC 150/5345-43) must be warranted by the manufacturer for a minimum of 4 years after date of installation inclusive of all electronics. "Obstruction lighting warranty is set by the individual manufacturer**.**

125-2.2 CONDUIT/DUCT. Conduit shall conform to Specification Item L-110 Airport Underground Electrical Duct Banks and Conduits.

125-2.3 CABLE AND COUNTERPOISE. Cable and Counterpoise shall conform to Item L-108 Underground Power Cable for Airports.

125-2.4 TAPE. Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 23 and 88 respectively, as manufactured by 3M Company or an approved equal.

125-2.5 CABLE CONNECTIONS. Cable Connections shall conform to Item L-108 Installation of Underground Cable for Airports.

125-2.6 RETROREFLECTIVE MARKERS. ~~[~~ Retroreflective markers shall be type L-853 and shall conform to the requirements of AC 150/5345-39. ~~] [Not required.]~~

125-2.7 RUNWAY AND TAXIWAY LIGHTS. Runway and taxiway lights shall conform to the requirements of AC 150/5345-46. Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.

~~Lights~~

~~Type~~	~~Class~~	~~Mode~~	~~Style~~	~~Option~~	~~Base~~	~~Filter~~	~~Transformer~~	~~Notes~~
~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~

Lights

Type	Class	Mode	Style	Option	Base	Filter	Transformer	Notes
L-861T	2	1	N/A	4	L-867	Blue	L-830 Size Per Manufacturer	LED
L-861	2	1	N/A	4	L-86	Per Plan	L-830 Size Per Manufacturer	LED
L-861E	2	1	N/A	4	L-867	Per Plan	L-830 Size Per Manufacturer	LED

125-2.8 RUNWAY AND TAXIWAY SIGNS. Runway and Taxiway Guidance Signs should conform to the requirements of AC 150/5345-44.

~~Signs~~

~~Type~~	~~Size~~	~~Style~~	~~Class~~	~~Mode~~	~~Notes~~
~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~	~~[___]~~

Signs

Type	Size	Style	Class	Mode	Notes
L-858B/L/R/Y	**1**	**2/3**	**2**	**2**	**LED**

125-2.9 RUNWAY END IDENTIFIER LIGHT (REIL). ~~[The REIL fixtures shall meet the requirements of AC 150/5345-51, Type [L-849V][L-849I], Style [A][B][C][D][E][F].][~~ Not required. ~~]~~

125-2.10 PRECISION APPROACH PATH INDICATOR (PAPI). ~~[The light units for the PAPI shall meet the requirements of AC 150/5345-28, Type [L-880][L-881], Style [A][B], Class [I][II].][Not required.]~~
The light units for the PAPI shall meet the requirements of AC 150/5345-28, Type L-880, Style B, Class 1, LED.

125-2.11 CIRCUIT SELECTOR CABINET. ~~The circuit selector cabinet shall meet the requirements of AC 150/5345-5, Type L-847, [one][two][three][four] circuit control [as indicated], Class [A, indoor][B, outdoor], Rating [1, for 6.6 amperes][2, for 20 amperes].~~ Not required.

125-2.12 LIGHT BASE AND TRANSFORMER HOUSINGS. ~~Light Base and Transformer Housings should conform to the requirements of AC 150/5345-42. Light bases shall be Type [L-867][L-868], Class [1A][1B][2A][2B], Size [A][B][C] shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures~~.
Light Base and Transformer Housings should conform to the requirements of AC 150/5345-42. Light bases shall be Type L-867, Class 1A **or** 1B Size B shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures.

125-2.13 ISOLATION TRANSFORMERS. Isolation Transformers shall be Type ~~[~~ L-830 ~~][L-831]~~, size as required for each installation. Transformer shall conform to AC 150/5345-47.

INSTALLATION

125-3.1 INSTALLATION. The Contractor shall furnish, install, connect and test all equipment, accessories, conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport lighting system as specified here and shown in the plans.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and state and local code agencies having jurisdiction.

The Contractor shall install the specified equipment in accordance with the applicable advisory circulars and the details shown on the plans.

125-3.2 TESTING. All lights shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include operating the constant current regulator in each step not less than 10 times at the beginning and end of the 24-hour test. The fixtures shall illuminate properly during each portion of the test.

125-3.3 SHIPPING AND STORAGE. Equipment shall be shipped in suitable packing material to prevent damage during shipping. Store and maintain equipment and materials in areas protected from weather and physical damage. Any equipment and materials, in the opinion of the RPR, damaged during construction or storage shall be replaced by the Contractor at no additional cost to the owner. Painted or galvanized surfaces that are damaged shall be repaired in accordance with the manufacturer's recommendations.

125-3.4 ELEVATED AND IN-PAVEMENT LIGHTS. Water, debris, and other foreign substances shall be removed prior to installing fixture base and light.

A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixtures shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. The outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set.

METHOD OF MEASUREMENT

125-4.1 ~~Reflective markers will be measured by the number installed as completed units in place, ready for operation, and accepted by the RPR~~. Runway and taxiway lights will be measured by the number of each type installed as completed units in place, ready for operation, and accepted by the RPR. Guidance signs will be measured by the number of each type and size installed as completed units, in place, ready for operation, and accepted by the RPR.~~Runway End Identifier Lights shall be measured by each system installed as a completed unit in place, ready for operation, and accepted by the RPR.~~

Precision Approach Path Indicator shall be measured by each system installed as a completed unit, in place, ready for operation, and accepted by the RPR. Abbreviated Precision Approach Path Indicator shall be measured by each system installed as a completed unit, in place, ready for operation, and accepted by the RPR.

BASIS OF PAYMENT

~~**125-5.1** Payment will be made at the Contract unit price for each complete runway or taxiway light, guidance sign, reflective marker, runway end identification light, precision approach path indicator, or abbreviated precision approach path indicator installed by the Contractor and accepted by the RPR. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete this item.~~

~~Payment will be made under:~~

~~[Item] [Description] – [each]~~

125-5.1 Payment will be made at the Contract unit price for each complete runway or taxiway light, guidance sign, ~~reflective marker, runway end identification light~~, precision approach path indicator, ~~or abbreviated precision approach path indicator~~ installed by the Contractor and accepted by the RPR. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete this item.

Payment will be made under:

Item L-125a Remove Runway/Taxiway Edge Light in Soil, Complete – per each

Item L-125b Remove Runway/Taxiway Edge Light in Existing Pavement, Complete – per each

Item L-125c Install L-861 LED Runway Edge Light, Base Mounted, in Soil, Complete – per each

Item L-125d Install L-861 LED Runway Edge Light, Base Mounted, in Existing Pavement, Complete – per each

Item L-125e	Install L-861E LED Runway Threshold Light, Base Mounted, in Existing Pavement, Complete – per each
Item L-125f	Install L-861T LED Taxiway Edge Light, Base Mounted, in Soil, Complete – per each
Item L-125g	Install L-861T LED Taxiway Edge Light, Base Mounted, in Existing Pavement, Complete – per each
Item L-125h	Remove L-858 Guidance Sign and Concrete Foundation, Complete – per each
Item L-125i	Install L-858 LED Guidance Sign, Size 1, 2 Module, Complete – per each
Item L-125j	Install L-858 LED Guidance Sign, Size 1, 3 Module, Complete – per each
Item L-125k	Install L-858 LED Guidance Sign, Size 1, 4 Module, Complete – per each
Item L-125l	Install L-858 LED Runway Distance Remaining Sign, Size 4, Complete – per each
Item L-125m	Remove VASI System, Complete – per each
Item L-125n	Install L-880 LED PAPI System, Complete – per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-18	Standards for Airport Sign Systems
AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-28	Precision Approach Path Indicator (PAPI) Systems
AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers

AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-44	Specification for Runway and Taxiway Signs
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-51	Specification for Discharge-Type Flashing Light Equipment
AC 150/5345-53	Airport Lighting Equipment Certification Program

Engineering Brief (EB)

EB No. 67	Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures

****END OF ITEM L-125****