

CONTRACT FOR CONSTRUCTION

THIS CONTRACT FOR CONSTRUCTION (“Contract”) is made and entered into as of the date stated on the City’s signature page below (the **“Effective Date”**) by and between the **CITY AND COUNTY OF DENVER**, a municipal corporation of the State of Colorado acting on behalf of its Department of Aviation (the **“City”**), and **FLATIRON CONSTRUCTORS, INC.**, a Delaware corporation and authorized to do business in the State of Colorado (**“Contractor”**) (collectively the **“Parties”**).

WITNESSETH

WHEREAS, the City, for at least three (3) consecutive days, advertised that proposals would be received for furnishing all labor, tools, supplies, equipment, materials and everything necessary and required for the construction and installation of the work under Invitation for Bid No. 202473360-00, RW 17L - 35R Complex Pavement Rehabilitation and Electrical Upgrade - Package 2 (the **“Project”**) at Denver International Airport (**“DEN”**); and

WHEREAS, a bid in response to said advertisement have been received by the Chief Executive Officer of DEN (the **“CEO”**), who has recommended that a contract for the work be made and entered into with Contractor, which was the lowest, responsive, qualified bidder; and

WHEREAS, Contractor is qualified, willing, and able to perform the work in accordance with its proposal and the Contract Documents defined below;

NOW, THEREFORE, for and in consideration of the compensation to be paid by the City to Contractor and the other terms and conditions of this Contract, the Parties agree as follows:

1. CONTRACT DOCUMENTS:

It is agreed by the Parties that the instruments, drawings, and documents described below and whether attached to and bound with this Contract or not (the **“Contract Documents”**), are incorporated into the Contract by this reference, and are as fully a part of this Contract as if they were set out here verbatim and in full:

- Contract
- Notice to Proceed
- Form of Final Receipt
- Building Information Modeling (**“BIM”**) if applicable
- Change Directives
- Change Orders
- Exhibit A Federal Appendices
- Exhibit B City Equal Employment Opportunity Provisions
- Exhibit C Insurance Requirements
- Exhibit D Prevailing Wage Schedules
- Exhibit E Special Conditions
- Exhibit F Standard Specifications for Construction General Contract Conditions

(2011 Edition) (the “**Yellow Book**”) (“**General Conditions**”)
(Table of Contents attached as Exhibit F)

- Exhibit G Performance Bond
- Exhibit H Payment Bond
- Exhibit I Technical Specifications
- Exhibit J Contract Drawings
- Exhibit K Invitation for Bids and Contractor’s Response to Invitation for Bids

In the event of an irreconcilable conflict between a provision of Section 1 through 31 of this Contract document and any other provisions of the Contract Documents such that it is impossible to give effect to both, the order of precedence to determine which document shall control to resolve such conflict is as follows, in descending order:

1. Exhibit A Federal Appendices
2. Contract
3. Change Directives
4. Change Orders
5. Exhibit B City Equal Employment Opportunity Provisions
6. Exhibit E Special Conditions
7. Exhibit F Standard Specifications for Construction General Contract Conditions (2011 Edition) (the “**Yellow Book**”) (“**General Conditions**”)
(Table of Contents attached as Exhibit F)
8. Exhibit C Insurance Requirements
9. Exhibit D Prevailing Wage Schedules
10. Exhibit I Technical Specifications
11. Exhibit J Contract Drawings
12. Exhibit K Invitation for Bids and Contractor’s Response to Invitation for Bids
13. Exhibit G Performance Bond
14. Exhibit H Payment Bond
15. Notice to Proceed
16. Form of Final Receipt
17. Building Information Modeling (“**BIM**”) if applicable

The remaining order of precedence is established in General Conditions Title 4.

2. SCOPE OF WORK:

Contractor shall furnish all labor and tools, supplies, equipment, superintendence, materials, and everything necessary for and required to do, perform, and complete all of the work described, drawn, set forth, shown, and included in the Contract Documents (the “**Work**”).

3. TERM OF CONTRACT:

The Senior Vice President of Design, Engineering and Construction (the “**SVP**”) will issue a written notice to proceed to Contractor (the “**Notice to Proceed**”), and Contractor shall begin performing the Work required under this Contract within ten (10) days of such Notice to Proceed

(the “**Commencement Date**”). Contractor shall fully complete the Work in its entirety within 75 consecutive calendar days from the date of the Notice to Proceed (“**Contract Time**”). Contractor is not authorized to commence work prior to its receipt of the Notice to Proceed.

4. TERMS OF PAYMENT:

The City agrees to pay Contractor for the performance and completion of all of the Work as required by the Contract Documents, and Contractor agrees to accept as its full and only compensation therefor, a total amount of **Nine Million One Hundred Sixty Thousand Nine Hundred Twenty-Nine Dollars and No Cents (\$9,160,929.00)** (the “**Maximum Contract Amount**”). In no event will the City’s liability exceed the Maximum Contract Amount, as adjusted by duly authorized Change Orders in accordance with this Contract. The Parties specifically agree that any performance by Contractor hereunder shall not subject the City to any cost, charge, or fee not specified above.

5. VERIFIED STATEMENT OF CLAIMS:

Colorado Revised Statutes § 38-26-107 (“**C.R.S.**”) requires that, in the event any person or company files a verified statement of amounts due and unpaid in connection with a claim for labor and materials supplied on this Project, the City shall withhold from payments to Contractor sufficient funds to insure the payment of any such claims. Should the City be made a party to any lawsuit to enforce such unpaid claims or any lawsuit arising out of or relating to such withheld funds, Contractor agrees to pay to the City its costs and a reasonable attorney’s fee incurred in any such lawsuit. Because the City Attorney Staff does not bill the City for legal services on an hourly basis, Contractor agrees a reasonable fee shall be computed at the rate of two hundred dollars and no cents (\$200.00) per hour of City Attorney time.

6. DISPUTES:

All disputes arising under or related to this Contract shall be resolved by administrative hearing under the procedures described in *Exhibit F*, as modified by *Exhibit E*, if any, and the Denver Revised Municipal Code § 5-17 (“**D.R.M.C.**”) and all related rules and procedures, including but not limited to DEN Rule 250. The determination resulting from said administrative hearing shall be final, subject only to Contractor's right to appeal the determination under Colorado Rule of Civil Procedure, Rule 106.

7. DEFENSE AND INDEMNIFICATION:

A. To the fullest extent permitted by law, Contractor hereby agrees to defend, indemnify, reimburse and hold harmless City, its appointed and elected officials, agents and employees for, from and against all liabilities, claims, judgments, suits or demands for damages to persons or property arising out of, resulting from, or related to the work performed under this Contract that are due to the negligence or fault of the Contractor or the Contractor’s agents, representatives, subcontractors, or suppliers (“**Claims**”). This indemnity shall be interpreted in the broadest possible manner consistent with the applicable law to indemnify the City.

B. Contractor’s duty to defend and indemnify City shall arise at the time written notice

of the Claim is first provided to City regardless of whether suit has been filed and even if Contractor is not named as a Defendant.

C. Contractor will defend any and all Claims which may be brought or threatened against City and will pay on behalf of City any expenses incurred by reason of such Claims including, but not limited to, court costs and attorney fees incurred in defending and investigating such Claims or seeking to enforce this indemnity obligation, including but not limited to time expended by the City Attorney Staff, whose costs shall be computed at the rate specified in Section 5. Such payments on behalf of City shall be in addition to any other legal remedies available to City and shall not be considered City's exclusive remedy.

D. Insurance coverage requirements specified in this Contract shall in no way lessen or limit the liability of the Contractor under the terms of this indemnification obligation. The Contractor shall obtain, at its own expense, any additional insurance that it deems necessary for the City's protection.

E. This defense and indemnification obligation shall survive the expiration or termination of this Contract.

8. WAIVER OF C.R.S. § 13-20-801, ET SEQ.:

Notwithstanding any other provision of this Contract, Contractor specifically waives all of the provisions of C.R.S. §§ 13-20-801 *et seq.* as they may relate to Contractor's performance under this Contract.

9. LIQUIDATED DAMAGES:

If Contractor fails to achieve Substantial Completion of the Work within the Contract Time or fails to substantially complete the Work described in the Scope of Work within the time set forth in the Special Conditions, the City will suffer substantial damages, which damages would be difficult to accurately determine. The Parties hereto have considered the possible elements of damages and have agreed that the amount of liquidated damages for Contractor's failure to substantially complete the work within the Contract Time or to substantially complete the work described in Milestone Areas within the time set forth in the Special Conditions shall be as provided in the Special Conditions. If Contractor shall fail to pay such liquidated damages promptly upon demand therefor, the Surety on its Performance Bond and Payment Bond shall pay such damages. Also, the City may withhold all, or any part of, such liquidated damages from any payment due to Contractor. Additional provisions relating to liquidated damages are set forth in the Construction Contract General Conditions and Special Conditions.

10. INSURANCE REQUIREMENTS:

A. Contractor shall obtain and keep in force all of the minimum insurance coverage forms and amounts set forth in *Exhibit C* ("**Insurance Requirements**") during the entire Term of this Agreement, including any extensions of the Agreement or other extended period stipulations stated in *Exhibit C*. All certificates of insurance must be received and accepted by the City before any airport access or work commences.

B. Contractor shall ensure and document that all subcontractors performing services or providing goods hereunder procure and maintain insurance coverage that is appropriate to the primary business risks for their respective scopes of performance. At minimum, such insurance must conform to all applicable requirements of DEN Rules and Regulations Part 230 and all other applicable laws and regulations.

C. The City in no way warrants or represents the minimum limits contained herein are sufficient to protect Contractor from liabilities arising out of the performance of the terms and conditions of this Contract by Contractor, its agents, representatives, employees, or subcontractors. Contractor shall assess its own risks and maintain higher limits and/or broader coverage as it deems appropriate and/or prudent. Contractor is not relieved of any liability or other obligations assumed or undertaken pursuant to this Contract by reason of its failure to obtain or maintain insurance in sufficient amounts, duration, or types.

D. In no event shall the City be liable for any of the following: (i) business interruption or other consequential damages sustained by Contractor; (ii) damage, theft, or destruction of Contractor's inventory, or property of any kind; or (iii) damage, theft, or destruction of an automobile, whether or not insured.

E. The Parties understand and agree that the City, its elected and appointed officials, employees, agents and volunteers are relying on, and do not waive or intend to waive by any provisions of this Contract, the monetary limitations and any other rights, immunities and protections provided by the Colorado Governmental Immunity Act, C.R.S. §§ 24-10-101, *et seq.*, or otherwise available to the City, its elected and appointed officials, employees, agents and volunteers.

11. CONTRACT BINDING:

It is agreed that this Contract shall be binding on and inure to the benefit of the Parties hereto, their heirs, executors, administrators, assigns, and successors.

12. SEVERABILITY:

If any part, portion, or provision of this Contract shall be found or declared null, void, or unenforceable for any reason whatsoever by any court of competent jurisdiction or any governmental agency having authority thereover, only such part, portion, or provision shall be affected thereby and all other parts, portions, and provisions of this Contract shall remain in full force and effect.

13. ASSIGNMENT:

Contractor shall not assign, pledge or transfer its duties, obligations, and rights under this Contract, in whole or in part, without first obtaining the written consent of the CEO or their authorized representative. Any attempt by Contractor to assign or transfer its rights hereunder without such prior written consent shall, at the option of the CEO or their authorized representative, automatically terminate this Contract and all rights of Contractor hereunder.

14. APPROPRIATIONS:

Payment will be in accordance with the provisions of the Contract Documents, including Title 9 of the General Conditions, and will be made solely and exclusively from funds appropriated or otherwise lawfully made available for the purposes of this Contract from the Airport System Funds. The City has no obligation to make payments from any other fund or source or to make additional appropriations or allocations to such fund to satisfy such costs or other obligations.

15. APPROVALS:

In the event this Contract calls for the payment by the City of Five Million Dollars and no cents (\$5,000,000.00) or more, approval by the Denver City Council, acting by Resolution in accordance with Section 3.2.6 of the Charter of the City and County of Denver, is and shall be an express condition precedent to the lawful and binding execution and performance of this Contract.

16. JOINT VENTURE:

If Contractor is a Joint Venture, the partners to the Joint Venture shall be jointly and severally liable to the City for the performance of all duties and obligations of Contractor which are set forth in the Contract.

17. NO DISCRIMINATION IN EMPLOYMENT:

In connection with the performance of work under the Agreement, the Contractor may not refuse to hire, discharge, promote, demote, or discriminate in matters of compensation against any person otherwise qualified, solely because of race, color, religion, national origin, ethnicity, citizenship, immigration status, gender, age, sexual orientation, gender identity, gender expression, marital status, source of income, military status, protective hairstyle, or disability. The Contractor shall insert the foregoing provision in all subcontracts.

18. COORDINATION OF SERVICES:

Contractor agrees to perform its work under this Contract in accordance with the operational requirements of DEN, and all work and movement of personnel or equipment on areas included within the DEN site shall be subject to the regulations and restrictions established by the City or its authorized agents.

19. COMPLIANCE WITH ALL LAWS AND REGULATIONS:

A. Contractor and its subcontractor(s) shall perform all work under this Contract in compliance with all existing and future applicable laws, rules, regulations, and codes of the United States, and the State of Colorado and with the City Charter, ordinances, Executive Orders, and rules and regulations of the City.

B. Contractor shall perform all work in compliance with Executive Order 123 regarding Sustainability as may be directed by the City, including the requirement that all new City buildings and major renovations will be certified to the applicable LEED Gold Certification,

with the goal of achieving LEED Platinum where economically feasible. Contractor also shall comply with all applicable DEN design and construction standards, including the DEN Design Standards Manuals, which are incorporated herein by reference. Current versions can be found at: <https://business.flydenver.com/bizops/bizRequirements.asp>.

20. PREVAILING WAGE REQUIREMENTS:

A. In addition to the Davis-Bacon Requirements contained in *Exhibit A*, Contractor shall comply with, and agrees to be bound by, all requirements, conditions and determinations of the City regarding the Payment of Prevailing Wages Ordinance, D.R.M.C. §§20-76 through 20-79, contained in *Exhibit D*, including, but not limited to, the requirement that every covered worker working on a City-owned or leased building or on City-owned land shall be paid no less than the prevailing wages and fringe benefits in effect on the date the bid or request for proposal was advertised. In the event a request for bids, or a request for proposal, was not advertised, Contractor shall pay every covered worker no less than the prevailing wages and fringe benefits in effect on the date funds for the Contract were encumbered.

Date bid or proposal issuance was advertised April 19, 2024.

B. Prevailing wage and fringe rates will adjust on the yearly anniversary of the actual date of bid or proposal issuance, if applicable, or the date of the written encumbrance if no bid/proposal issuance date is applicable. Unless expressly provided for in this Contract, Contractor will receive no additional compensation for increases in prevailing wages or fringe rates.

C. Contractor shall provide the Auditor of the City and County of Denver with a list of all subcontractors providing any services under the Contract.

D. Contractor shall provide the Auditor with electronically-certified payroll records for all covered workers employed under the Contract in a manner specified by the Auditor.

E. Contractor shall prominently post at the work site the current prevailing wage and fringe rates. The posting must inform workers that any complaints regarding the payment of prevailing wages or fringe benefits may be submitted to the Denver Auditor by calling 720-913-5000 or emailing auditor@denvergov.org.

F. If Contractor fails to pay workers as required by the Prevailing Wage Ordinance, Contractor will not be paid until documentation of payment satisfactory to the Auditor has been provided. The Auditor may enforce the Prevailing Wage Ordinance in a manner provided by law, including the Prevailing Wage Ordinance. The City also may, by written notice, suspend or terminate work if Contractor fails to pay required wages and fringe rates.

21. CITY PROMPT PAYMENT:

A. The City will make monthly progress payments to the Contractor for all services performed under this Contract based upon the Contractor's monthly invoices or shall make payments as otherwise provided in this Agreement. The City's Prompt Payment Ordinance, D.R.M.C. §§ 20-107 to 20-118, applies to invoicing and payment under this Contract.

B. Final Payment to the Contractor shall not be made until after the Project is accepted, and all certificates of completion, record drawings, reproducible copies, and other deliverables are delivered to the City, and the Contract is otherwise fully performed by the Contractor. The City may, at the discretion of the SVP withhold reasonable amounts from billing and the entirety of the final payment until all such requirements are performed to the satisfaction of the SVP.

22. OWNERSHIP AND DELIVERABLES:

Upon payment to Contractor, all records, data, deliverables, and any other work product prepared by Contractor or any custom development work performed by Contractor for the purpose of performing this Contract on or before the day of the payment, whether a periodic or final payment, shall become the sole property of the City. Upon request by the City, or based on any schedule agreed to by Contractor and the City, Contractor shall provide the City with copies of the data/files that have been uploaded to any database maintained by or on behalf of Contractor or otherwise saved or maintained by Contractor as part of the services provided to the City under this Contract. All such data/files shall be provided to the City electronically in a format agreed to by the Parties. Contractor also agrees to allow the City to review any of the procedures Contractor uses in performing any work or other obligations under this Contract, and to make available for inspection any and all notes, documents, materials, and devices used in the preparation for or performance of any of the scope of work, for up to six (6) years after termination of this Contract. Upon written request from the City, Contractor shall deliver any information requested pursuant to this Section within ten (10) business days in the event a schedule or otherwise agreed-upon timeframe does not exist.

23. COLORADO OPEN RECORDS ACT:

A. Contractor acknowledges that the City is subject to the provisions of the Colorado Open Records Act (“**CORA**”), C.R.S. §§ 24-72-201 *et seq.*, and Contractor agrees that it will fully cooperate with the City in the event of a request or lawsuit arising under such act for the disclosure of any materials or information which Contractor asserts is confidential or otherwise exempt from disclosure. Any other provision of this Contract notwithstanding, all materials, records, and information provided by Contractor to the City shall be considered confidential by the City only to the extent provided in CORA, and Contractor agrees that any disclosure of information by the City consistent with the provisions of CORA shall result in no liability of the City.

B. In the event of a request to the City for disclosure of such information, time and circumstances permitting, the City will make a good faith effort to advise Contractor of such request in order to give Contractor the opportunity to object to the disclosure of any material Contractor may consider confidential, proprietary, or otherwise exempt from disclosure. In the event Contractor objects to disclosure, the City, in its sole and absolute discretion, may file an application to the Denver District Court for a determination of whether disclosure is required or exempted. In the event a lawsuit to compel disclosure is filed, the City may tender all such material to the court for judicial determination of the issue of disclosure. In both situations, Contractor agrees it will either waive any claim of privilege or confidentiality or intervene in such legal process to protect materials Contractor does not wish disclosed. Contractor agrees to defend, indemnify, and hold harmless the City, its officers, agents, and employees from any claim,

damages, expense, loss, or costs arising out of Contractor's objection to disclosure, including prompt reimbursement to the City of all reasonable attorney's fees, costs, and damages the City may incur directly or may be ordered to pay by such court, including but not limited to time expended by the City Attorney Staff, whose costs shall be computed at the rate specified in Section 5.

24. EXAMINATION OF RECORDS AND AUDITS:

A. Any authorized agent of the City, including the City Auditor or his or her representative, has the right to access and the right to examine, copy and retain copies, at City's election in paper or electronic form, any pertinent books, documents, papers and records related to Consultant's performance pursuant to this Agreement, provision of any goods or services to the City, and any other transactions related to this Agreement. Consultant shall cooperate with City representatives and City representatives shall be granted access to the foregoing documents and information during reasonable business hours and until the latter of three (3) years after the final payment under the Agreement or expiration of the applicable statute of limitations. When conducting an audit of this Agreement, the City Auditor shall be subject to government auditing standards issued by the United States Government Accountability Office by the Comptroller General of the United States, including with respect to disclosure of information acquired during the course of an audit. No examination of records and audit pursuant to this paragraph shall require Parties to make disclosures in violation of state or federal privacy laws. Parties shall at all times comply with D.R.M.C. § 20-276.

B. Additionally, Contractor agrees until the expiration of six (6) years after the final payment under this Contract, any duly authorized representative of the City, including the CEO or their representative, shall have the right to examine any pertinent books, documents, papers and records of Contractor related to Contractor's performance of this Contract, including communications or correspondence related to Contractor's performance, without regard to whether the work was paid for in whole or in part with federal funds or was otherwise related to a federal grant program.

C. In the event the City receives federal funds to be used toward the services performed under this Contract, the Federal Aviation Administration ("FAA"), the Comptroller General of the United States and any other duly authorized representatives shall have access to any books, documents, papers and records of Contractor which are directly pertinent to a specific grant program for the purpose of making audit, examination, excerpts and transcriptions. Contractor further agrees that such records will contain information concerning the hours and specific services performed along with the applicable federal project number.

25. COMPLIANCE WITH DENVER WAGE LAWS:

To the extent applicable to the Contractor's work hereunder, the Contractor shall comply with, and agrees to be bound by, all rules, regulations, requirements, conditions, and City determinations regarding the City's Minimum Wage and Civil Wage Theft Ordinances, D.R.M.C. § 58-1 through 58-26, including, but not limited to, the requirement that every covered worker shall be paid all earned wages under applicable state, federal, and city law in accordance with the foregoing

D.R.M.C. Sections. By executing this Agreement, the Contractor expressly acknowledges that the Contractor is aware of the requirements of the City's Minimum Wage and Civil Wage Theft Ordinances and that any failure by the Contractor, or any other individual or entity acting subject to this Agreement, to strictly comply with the foregoing D.R.M.C. Sections shall result in the penalties and other remedies authorized therein.

26. COMPLIANCE WITH DISADVANTAGED BUSINESS ENTERPRISE (DBE) REQUIREMENTS:

Contractor shall comply with Code of Federal Regulations ("C.F.R."), 49 C.F.R. Part 26 ("DBE Requirements"), as set forth in *Exhibit A* and administered by the Division of Small Business Opportunity. The Contractor is committed to, at a minimum, meet the participation goal of twenty and fourteen hundredth percent (20.14%) established for this Project, utilizing properly certified DBE subconsultants, subcontractors, suppliers, manufacturers, manufacturer's representatives or brokers.

27. SENSITIVE SECURITY INFORMATION:

Contractor acknowledges that, in the course of performing its work under this Contract, Contractor may be given access to Sensitive Security Information ("SSI"), as material is described in the Code of Federal Regulations, 49 C.F.R. Part 1520. Contractor specifically agrees to comply with all requirements of the applicable federal regulations, including but not limited to, 49 C.F.R. Parts 15 and 1520. Contractor understands any questions it may have regarding its obligations with respect to SSI must be referred to DEN's Security Office.

28. DEN SECURITY:

A. Contractor, its officers, authorized officials, employees, agents, subcontractors, and those under its control, shall comply with safety, operational, or security measures required of Contractor or the City by the FAA or Transportation Security Administration ("TSA"). If Contractor, its officers, authorized officials, employees, agents, subcontractors or those under its control, fail or refuse to comply with said measures and such non-compliance results in a monetary penalty being assessed against the City, then, in addition to any other remedies available to the City, Contractor shall fully reimburse the City any fines or penalties levied against the City, and any attorney fees or related costs paid by the City as a result of any such violation. Contractor must pay this amount within fifteen (15) days from the date of the invoice or written notice. Any fines and fees assessed by the FAA or TSA against the City due to the actions of Contractor and/or its agents will be deducted directly from the invoice for that billing period.

B. Contractor is responsible for compliance with Airport Security regulations and 49 C.F.R. Parts 1542 (Airport Security) and 14 C.F.R. Parts 139 (Airport Certification and Operations). Any and all violations pertaining to Parts 1542 and 139 resulting in a fine will be passed on to and borne by Contractor. The fee/fine will be deducted from the invoice at time of billing.

29. FEDERAL RIGHTS:

A. This Contract is subject and subordinate to the terms, reservations, restrictions and conditions of any existing or future contracts between the City and the United States, the execution of which has been or may be required as a condition precedent to the transfer of federal rights or property to the City for airport purposes, and the expenditure of federal funds for the extension, expansion or development of the Airport System.

(i) General Civil Rights: Contractor agrees to comply with pertinent statutes, Executive Orders and such rules as are promulgated to ensure that no person shall, on the grounds of race, creed, color, national origin, sex, age, or disability be excluded from participating in any activity conducted with or benefiting from Federal Assistance. This provision binds Contractor and subcontractors from the bid solicitation period through the completion of the Contract. This provision is in addition to that required of Title VI of the Civil Rights Act of 1964.

(ii) Federal Fair Labor Standards Act: This Contract incorporates by reference the provisions of 29 C.F.R. Part 201, the Federal Fair Labor Standards Act (“**FLSA**”), with the same force and effect as if given in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part-time workers. Contractor agrees to incorporate by reference the provisions of FLSA in all contracts and subcontracts resulting from this Contract. Contractor has full responsibility to monitor compliance to the referenced regulation. Contractor must address any claims or disputes arising from this requirement directly with the U.S. Department of Labor – Wage and Hour Division.

(iii) Occupational Safety and Health Act: This Contract incorporates by reference the requirements of 29 C.F.R. Part 1910 with the same force and effect as if given in full text. Contractor must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. Contractor retains full responsibility to monitor its compliance and any subcontractor’s compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (29 C.F.R. Part 1910). Contractor must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

(iv) Contractor covenants it will include the provisions of this section in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Federal Acts, Regulations and directives issued pursuant thereto. Contractor covenants it will take action with respect to any subcontract or procurement as the City or the FAA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, Contractor may request the City to enter into any litigation to protect the interests of the City. In addition, Contractor may request the United States to enter into the litigation to protect the interests of the United States.

30. CITY EXECUTION OF CONTRACT:

This Contract is expressly subject to, and shall become effective upon, the execution of all signatories of the City and, if required, the approval of Denver City Council. This Contract may be executed in two or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same.

31. ELECTRONIC SIGNATURES AND ELECTRONIC RECORDS:

The Contract, and any other documents requiring a signature hereunder, may be signed electronically by the City and/or Contractor in the manner specified by the City. The Parties agree not to deny the legal effect or enforceability of the Contract solely because it is in electronic form or because an electronic record was used in its formation. The Parties agree not to object to the admissibility of the Contract in the form of an electronic record, or a paper copy of an electronic document, or a paper copy of a document bearing an electronic signature, on the ground that it is an electronic record or electronic signature or that it is not in its original form or is not an original.

[SIGNATURE PAGES FOLLOW]

Contract Control Number: PLANE-202473360-00
Contractor Name: FLATIRON CONSTRUCTORS, INC.

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of:

SEAL

CITY AND COUNTY OF DENVER:

ATTEST:

By:

APPROVED AS TO FORM:

REGISTERED AND COUNTERSIGNED:

Attorney for the City and County of Denver


By:

By:

By:

Contract Control Number:
Contractor Name:

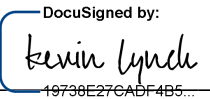
PLANE-202473360-00
FLATIRON CONSTRUCTORS, INC.

By:  _____
DF0C339A96D14DC

Name: Grant Johns
(please print)

Title: Vice President & District Manager
(please print)

ATTEST: [if required]

By:  _____
19738E27CADF4B5...

Name: Kevin Lynch
(please print)

Title: Division Finance Manager
(please print)

EXHIBIT A

AIP/FAA FUNDED CONSTRUCTION PROVISIONS

A.1.3 ACCESS TO RECORDS AND REPORTS

The Contractor must maintain an acceptable cost accounting system. The Contractor agrees to provide the Owner, the Federal Aviation Administration and the Comptroller General of the United States or any of their duly authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to the specific contract for the purpose of making audit, examination, excerpts and transcriptions. The Contractor agrees to maintain all books, records and reports required under this contract for a period of not less than three years after final payment is made and all pending matters are closed.

A.3.3 BREACH OF CONTRACT TERMS

Any violation or breach of terms of this contract on the part of the Contractor or its subcontractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this agreement.

To the extent provided in this Contract, Owner will provide Contractor written notice that describes the nature of the breach and corrective actions the Contractor must undertake in order to avoid termination of the contract. Owner reserves the right to withhold payments to Contractor until such time the Contractor corrects the breach or the Owner elects to terminate the contract. The Owner's notice will identify a specific date by which the Contractor must correct the breach. Owner may proceed with termination of the contract if the Contractor fails to correct the breach by the deadline indicated in the Owner's notice.

The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder are in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.

A.5.3.1 GENERAL CIVIL RIGHTS PROVISIONS

In all its activities within the scope of its airport program, the Contractor agrees to comply with pertinent statutes, Executive Orders, and such rules as identified in Title VI List of Pertinent Nondiscrimination Acts and Authorities to ensure that no person shall, on the grounds of race, color, national origin (including limited English proficiency), creed, sex (including sexual orientation and gender identity), age, or disability be excluded from participating in any activity conducted with or benefiting from Federal assistance.

This provision is in addition to that required by Title VI of the Civil Rights Act of 1964.

A.5.3.2 SPECIFIC CLAUSE THAT IS USED FOR GENERAL CONTRACT AGREEMENTS

The above provision binds the Contractor and subcontractors from the bid solicitation period through the completion of the contract.

A.6.4.1 TITLE VI LIST OF PERTINENT NONDISCRIMINATION ACTS AND AUTHORITIES

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “Contractor”) agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 USC § 2000d *et seq.*, 78 stat. 252) (prohibits discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination in Federally-Assisted programs of the Department of Transportation—Effectuation of Title VI of the Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 USC § 4601) (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973 (29 USC § 794 *et seq.*), as amended (prohibits discrimination on the basis of disability); and 49 CFR part 27 (Nondiscrimination on the Basis of Disability in Programs or Activities Receiving Federal Financial Assistance);
- The Age Discrimination Act of 1975, as amended (42 USC § 6101 *et seq.*) (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982 (49 USC § 47123), as amended (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987 (PL 100-259) (broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, the Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990 (42 USC § 12101, *et seq*) (prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities) as implemented by U.S. Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration’s Nondiscrimination statute (49 USC § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (ensures nondiscrimination against minority populations by discouraging programs, policies, and activities with disproportionately

high and adverse human health or environmental effects on minority and low-income populations);

- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs [70 Fed. Reg. 74087 (2005)];
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 USC § 1681, et seq).

A.6.4.2 COMPLIANCE WITH NONDISCRIMINATION REQUIREMENTS

During the performance of this contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “Contractor”), agrees as follows:

1. **Compliance with Regulations:** The Contractor (hereinafter includes consultants) will comply with the Title VI List of Pertinent Nondiscrimination Acts and Authorities, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. **Nondiscrimination:** The Contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, national origin (including limited English proficiency), creed, sex (including sexual orientation and gender identity), age, or disability in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Nondiscrimination Acts and Authorities, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.
3. **Solicitations for Subcontracts, including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the contractor’s obligations under this contract and the Nondiscrimination Acts and Authorities on the grounds of race, color, or national origin.
4. **Information and Reports:** The Contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Sponsor or the Federal Aviation

Administration to be pertinent to ascertain compliance with such Nondiscrimination Acts and Authorities and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the Contractor will so certify to the Sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.

5. **Sanctions for Noncompliance:** In the event of a Contractor's noncompliance with the non-discrimination provisions of this contract, the Sponsor will impose such contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:
 - a. Withholding payments to the Contractor under the contract until the Contractor complies; and/or
 - b. Cancelling, terminating, or suspending a contract, in whole or in part.

6. **Incorporation of Provisions:** The Contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations, and directives issued pursuant thereto. The Contractor will take action with respect to any subcontract or procurement as the Sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the Contractor may request the Sponsor to enter into any litigation to protect the interests of the Sponsor. In addition, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

A.7.3 CLEAN AIR AND WATER POLLUTION CONTROL

Contractor agrees to comply with all applicable standards, orders, and regulations issued pursuant to the Clean Air Act (42 USC §§ 7401-7671q) and the Federal Water Pollution Control Act as amended (33 USC §§ 1251-1387). The Contractor agrees to report any violation to the Owner immediately upon discovery. The Owner assumes responsibility for notifying the Environmental Protection Agency (EPA) and the Federal Aviation Administration.

Contractor must include this requirement in all subcontracts that exceed \$150,000.

A.8.3 CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

1. Overtime Requirements.

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, including watchmen and guards, in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; Liability for Unpaid Wages; Liquidated Damages.

In the event of any violation of the clause set forth in paragraph (1) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this clause, in the sum of \$29 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this clause.

3. Withholding for Unpaid Wages and Liquidated Damages.

The Federal Aviation Administration (FAA) or the Owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this clause.

4. Subcontractors.

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

A.9.3 COPELAND “ANTI-KICKBACK” ACT

Contractor must comply with the requirements of the Copeland “Anti-Kickback” Act (18 USC 874 and 40 USC 3145), as supplemented by Department of Labor regulation 29 CFR part 3. Contractor and subcontractors are prohibited from inducing, by any means, any person employed on the project to give up any part of the compensation to which the employee is entitled. The Contractor and each Subcontractor must submit to the Owner, a weekly statement on the wages paid to each employee performing on covered work during the prior week. Owner must report any violations of the Act to the Federal Aviation Administration.

A.10.3 DAVIS-BACON REQUIREMENTS

1. Minimum Wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalent thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can easily be seen by the workers.

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

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

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

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

(B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and

Hour Division, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

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

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

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

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

2. Withholding.

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

3. Payrolls and Basic Records.

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

(ii)(A) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant, Sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR § 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (*e.g.*, the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <https://www.dol.gov/agencies/whd/government-contracts/construction/payroll-certification> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker and shall provide them upon request to the Federal Aviation Administration if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit them to the applicant, Sponsor, or Owner, as the case may be, for transmission to the Federal Aviation Administration, the Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, Sponsor, or Owner).

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

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR § 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR § 5.5 (a)(3)(i), and that such information is correct and complete;

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

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

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

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

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

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not

be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR § 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination that provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate that is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

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

5. Compliance with Copeland Act Requirements.

The Contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

6. Subcontracts.

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

7. Contract Termination: Debarment.

A breach of the contract clauses in paragraph 1 through 10 of this section may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR § 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes Concerning Labor Standards.

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

10. Certification of Eligibility.

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

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

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

A.12.3.3 DBE PROGRAM

Disadvantaged Business Enterprise Requirements

- a) 49 C.F.R. Part 26 or 40 C.F.R. Part 30 (“DBE Requirements”) apply to this Agreement (or “Contract”). Contractor, its sub-consultants (or “subcontractors”) shall not discriminate on the basis of race, color, national origin, or sex in the performance of this Agreement. The Consultant shall carry out applicable DBE Requirements in the award and administration of federally assisted contracts. Failure by the Consultant to carry out these requirements is a material breach of this Agreement, which may result in the termination of this Agreement or such other remedy as the City deems appropriate as, which may include, but is not limited to:
1. Withholding monthly progress payments;
 2. Assessing sanctions;
 3. Liquidated damages; and/or
 4. Disqualifying the Contractor from future bidding as not responsible.

Consequently, Contractor must fully comply with the DBE Requirements in bidding and performing hereunder.

- b) The DBE Requirements provide for the adoption of a good faith goals program, to be administered by the Division of Small Business Opportunity (DSBO). As such, each proposer must comply with the terms and conditions of the DBE Requirements in submitting its proposal and, if awarded the Agreement, in performing all Work thereunder. A proposer’s failure to comply with the DBE Requirements, any Rules or Regulations promulgated pursuant thereto, or any additional requirements contained herein may render a proposal non-responsive and may constitute cause for rejection.
- c) In accordance with the DBE Requirements, the Contractor is committed to, at a minimum, meet the participation goal of twenty and fourteen hundredth percent (20.14%) established for this Project utilizing properly certified DBE subconsultants, subcontractors, suppliers, manufacturers, manufacturer’s representatives or brokers.
- d) The Contractor(s) are required to report participation in the Small Business Certification and Contract Management System also known as B2GNow. B2Gnow is the compliance monitoring system DSBO utilizes to implement these payment monitoring requirements. Prime Contractor(s), are required to confirm in B2Gnow payments received from the City and County of Denver monthly. This monthly requirement is known as an “audit” in B2GNow and will be referred to as such within the system and in any future communication received regarding such. You must inform subcontractors at all tiers of their responsibility to respond to audits. If certified subcontractors fail to confirm payments through the audits, participation for those payments will not count towards meeting the DBE commitment and will result in noncompliance action.

- e) By committing to working on this Agreement which is subjected to DBE Requirements, all DBE subconsultants, subcontractors, supplier, manufacturer, manufacturer's representative or broker must undergo a commercially useful function review ("CUF") or a DBE compliance review before their contract can be closed by DSBO. DBEs are required to fully cooperate with DSBO or its designee in the CUF and compliance review processes. The CUF review process will be initiated with a request for documents relating to contract performance and management of the actual work performed on the contract. The scope and intensity of each CUF review will depend on the specific facts and circumstances. The CUF review is purposed to verify the amount of DBE participation credit, to ensure that work is actually performed by the DBE consistent with the DBE Program requirements and/or to ensure that there is no activity engaged in by the DBE inconsistent with the intent and objectives of the DBE Program. The CUF review is formal and will be initiated with an orientation/explanation process and closed out with a briefing and determination. The DBE subcontractor may be subjected to an informal DBE compliance review by DSBO or its designee with or without notice. The informal compliance review will generally be conducted at the work site where the City observes and assesses the services/supplies being provided by the DBE.
- f) For all questions, concerns, and guidance pertaining to DBE Requirements for this Agreement, the Contractor or DBE/Non-DBE subcontractors are highly encouraged to consult the DBE Requirements or contact the DSBO designated Compliance Officer or DSBO representative at dsbo@denvergov.org.
- g) **Required Subcontract DBE Flow-Down Provisions for all Tiers.** While no subcontractor will be considered a third-party beneficiary to the Agreement between the City and the Contractor, the City considers subconsultants and subcontractors of every tier to be agents of the Contractor. Therefore, subconsultants and subcontractors of every tier will be held to all the requirements of the Agreement. With that understanding, the Contractor is well advised to conform all subcontracts to the requirements of the Agreement and make the Agreement available to all subconsultants and subcontractors. **At the very least, the Contractor must include the following provisions in their subcontracts with their DBE subcontractors as well as ensure that all tiered-subcontractors comply with and insert the provisions of the section into all-tiered subcontract agreements/purchase orders: 1. Non-Discrimination clause, 2. Contractor Prompt Payment, 3. Counting and Reporting, 4. Joint Check Utilization, 5. DBE Termination/Substitution/Reduction Of Scope From Contract, 6. Changes, Amendments, Modifications.**
- h) The Contractor will be required to submit to DSBO all DBE subcontracts within 30 days of execution. Throughout the Agreement if Contractor makes good faith efforts and engages or subcontracts with additional DBEs, Contractor must get approval from DSBO if the Contractor intends to count DBE participation from those additional DBEs. To count DBE participation toward the commitments made by the Contractor for DBE utilization, the DSBO must review DBE subcontract agreements and ensure that those additional DBEs are properly certified as a DBE(s) with the City and County of Denver or CDOT under the appropriate North American Industry Classification System ("NAICS") code that coincides with the scope of work that they will perform. Notwithstanding, DSBO shall also

request any appropriate documents it deems necessary. The Contractor shall ensure that this information flows down to all tiers of DBE subcontractors.

- i) **Flow-Down Provision: Non-Discrimination.** The Contractor, subconsultant or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this Agreement. The Contractor shall carry out applicable DBE Requirements. Failure by the Contractor to carry out these requirements is a material breach of this Agreement, which may result in the termination of this Agreement or such other remedy as the recipient deems appropriate, which may include, but is not limited to: (1) Withholding monthly progress payments; (2) Assessing sanctions; (3) Liquidated damages; and/or (4) Disqualifying the Contractor from future bidding as not responsible.
- j) **Flow-Down Provision: Contractor Prompt Payment of Subcontractors.** The Contractor shall:
 - i. Pay every subconsultant and subcontractor any invoiced and undisputed amounts for accepted and completed work within thirty (30) days of the Contractor's receipt of payment from the City and County of Denver. Any subcontractor, regardless of whether that subcontractor holds a city contract, may be required to make payments to subcontractors as set forth in this section.
 - ii. Retention
 - i. From the total of the amount determined to be payable on a partial payment, 5 percent of such total amount will be deducted and retained by the Owner for protection of the Owner's interests. Unless otherwise instructed by the Owner or provided in the Contract, the amount retained by the Owner will be in effect until the final payment is made as provided in the Contract.
 - ii. The Contractor is required to pay all subcontractors for satisfactory performance of their work no later than 7 days after the Contractor has received a payment for that work as provided in the Prompt Pay Ordinance, D.R.M.C. §§ 20-107 to 20-118. Contractor must provide the Owner evidence of prompt and full payment of retainage held by the prime Contractor to the subcontractor within 7 days after the subcontractor's work is satisfactorily completed and the retainage is paid. A subcontractor's work is satisfactorily completed when all the tasks called for in the subcontract have been accomplished and documented as required by the Owner. When the Owner has made an incremental acceptance of a portion of a prime contract, the work of a subcontractor covered by that acceptance is deemed to be satisfactorily completed for the purposes of completing final settlement of the Contract.
 - iii. Failure to comply with the payment requirements in this section may be grounds for the City withholding payment and considered a breach of this Agreement.

- iv. The payment requirements under this section shall apply to all subcontractors regardless of tier.
- k) **Flow-Down Provisions: Counting and Reporting.** In accordance with DBE Requirements, Firms identified to count toward DSBO's established participation goal must be certified by DSBO in that specified program and certified in the applicable NAICS code(s) to count toward the participation goal. In addition, Only the value of the work actually performed by the certified DBE will count toward the DBE participation goal.
- l) **Flow-Down Provision: Joint Check Utilization.** A joint check is a check issued by the Contractor to a DBE subcontractor and a material supplier or other third party. All joint check arrangements with DBE subs must be pre-approved by DSBO and must strictly adhere to the joint check requirements set forth in USDOT guidance regarding same. At a minimum, the request must be initiated by the DBE to remedy a financial hardship for a specific period of time. DSBO will closely monitor the use of joint checks to ensure that the independence of the DBE firm is not compromised. Joint check usage will not be approved merely for the convenience of the prime Contractor.
- m) **Flow-Down Provision: DBE Termination/Substitution/Reduction of Scope from Contract.** The Contractor must have good cause to remove/terminate/substitute/replace a DBE subcontractor and such removal/termination/substitution requires the consent and approval of City and County of Denver's DSBO. This section also includes reductions to the DBE scope of services and/or commitment values. No DBE subcontract agreement may contain a "termination for convenience" clause/provision because any termination for convenience provision/clause is contrary to the objectives of this part and the objectives of 49 CFR Part 26. To initiate the termination, substitution, removal, or replacement process with a DBE contractor/supplier (regardless of the tier), the Contractor or lower tier contractor/subcontractor must do the following:
 - i. Before transmitting to DSBO its request to terminate and/or substitute a DBE subcontractor, the Contractor must give notice in writing to the DBE subcontractor and notify City and County of Denver DSBO of such notice. The notice must include its request to terminate and/or substitute, replace and/or remove the DBE, the reason for the request and all documentation to support its claim. The Contractor must submit a copy of the notice and support documentation to DSBO at the time the original letter is sent to the DBE contractor.
 - ii. The Contractor must give the DBE subcontractor five (5) business days to respond to the notice and provide DSBO with reasons, if any, why it objects to the proposed termination of its DBE contract and why DSBO should not consent the Contractor's action;
 - iii. DSBO will then open a formal investigation inclusive of review of all documentation, conduct interviews and site visits, if necessary. The Contractor carries the burden of proof to demonstrate good cause for the termination and/or substitution;

- iv. If DSBO determines that the Contractor has good cause to terminate the DBE firm, the DSBO will provide written consent of DBE removal and the requirements to substitute work to another DBE firm. If DSBO finds that good cause does not exist to terminate the DBE firm, DSBO will provide a written denial of the request to terminate/replace the DBE subcontractor and will immediately request a corrective action plan from the Contractor. Please note that if a Contractor elects to terminate, substitute and or reduce the scope of work initially committed to a DBE without the approval or consent of the City and County of Denver DSBO, this constitutes a material breach of a contract, which may result in the termination of the contract or such other remedy as the recipient/City and County of Denver deems necessary as set forth under the DBE Requirements. These legal remedies may include but are not limited to: withholding monthly progress payments, assessing sanctions, liquidated damages, and/or disqualifying the Contractor from future bidding as nonresponsible.
- v. For purposes of good cause to remove, replace, or terminate a DBE the following circumstances should exist: (1) failure or refusal by the DBE subcontractor to execute a written contract without good cause, (2) failure or refusal by the DBE subcontractor to perform the work of its subcontract in a way consistent with normal industry practice and the Contractor has not acted in bad faith, (3) failure by the DBE subcontractor to meet the Contractor's reasonable bonding or insurance requirements, (4) insolvency, bankruptcy or credit unworthiness by the DBE subcontractor that creates a risk for the contract, (5) ineligibility by the DBE subcontractor to work on public works Program because of suspension or debarment proceedings, (6) a determination by City And County Of Denver that the DBE is not a responsible contractor, (7) voluntary withdrawal from the Program by written notification that has been verified, (8) ineligibility to receive DBE participation credit for the type of work to be performed, (9) other documented good cause that compels the replacement of the DBE.
- vi. When a DBE subcontractor is terminated with the approval of DSBO or fails to complete its work on the contract for any reason, prime contractors are required to make good faith efforts to find another DBE subcontractor to substitute for the original DBE.
- vii. Prime contractors must show that it took all necessary and reasonable steps to find another DBE to perform at least the same amount of work under the contract as the DBE that was terminated, to the extent needed to meet the contract goal DSBO has established for this Agreement and or commitments made by the Contractor for DBE utilization/participation. 49 CFR Part 26.53 shall serve as the criteria for evaluating compliance with the good faith efforts requirements. Additionally, bidders/proposers are required to solicit the support and assistance of the DSBO if they are unable to meet the DBE participation goal assigned to this contract.
- viii. The good faith efforts shall be documented by the Contractor. If the DSBO requests documentation under this provision, the Contractor shall submit the documentation to the DSBO Compliance Officer within 7 days, which may be extended for an

additional 7 days, if necessary, at the request of the Contractor, and DSBO shall provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated.

- ix. Contractor shall comply with Good Faith Efforts procedures as defined in the DBE Requirements. Contractor shall comply with this section of the DBE Requirements or any DBE program requirements and failure by the Contractor to carry out the requirements of this part as they administer this contract is a material breach of contract, which may result in the termination of the contract or such other remedy as the recipient deems necessary as set forth in the DBE Requirements. The legal remedies include but is not limited to: withholding monthly progress payments, assessing sanctions, liquidated damages, and/or disqualifying the Contractor from future bidding as non-responsible.
 - x. The Contractor shall ensure that DBE tiered subcontractors comply with this Section and insert the provisions of this Section into all DBE lower tiered subcontractor agreements, regardless of their certification status.
- n) **Flow-Down Provision: Changes, Amendments, Modifications.** The DBE Goal(s) shall apply to the performance/value of all obligations under this Agreement, including any Changes, Modifications, Amendments and Change Orders whether initiated by the Contractor or City and County of Denver.

A.13.3 TEXTING WHEN DRIVING

In accordance with Executive Order 13513, “Federal Leadership on Reducing Text Messaging While Driving”, (10/1/2009) and DOT Order 3902.10, “Text Messaging While Driving”, (12/30/2009), the Federal Aviation Administration encourages recipients of Federal grant funds to adopt and enforce safety policies that decrease crashes by distracted drivers, including policies to ban text messaging while driving when performing work related to a grant or subgrant.

In support of this initiative, the Owner encourages the Contractor to promote policies and initiatives for its employees and other work personnel that decrease crashes by distracted drivers, including policies that ban text messaging while driving motor vehicles while performing work activities associated with the project. The Contractor must include the substance of this clause in all sub-tier contracts exceeding \$10,000 that involve driving a motor vehicle in performance of work activities associated with the project.

A.16.3.1 EQUAL OPPORTUNITY CLAUSE

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

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

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

(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer, advising the labor union or workers' representative of the Contractor's commitments under this section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

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

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

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

(8) The Contractor will include the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions, including sanctions for noncompliance: *Provided*, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

A.19.3 PROHIBITION OF SEGREGATED FACILITIES

(a) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Employment Opportunity clause in this contract.

(b) "Segregated facilities," as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Employment Opportunity clause of this contract.

A.20.3 OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

All contracts and subcontracts that result from this solicitation incorporate by reference the requirements of 29 CFR Part 1910 with the same force and effect as if given in full text. The employer must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. The employer retains full responsibility to monitor its compliance and their subcontractor's compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (29 CFR Part 1910). The employer must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

A.21.3 PROCUREMENT OF RECOVERED MATERIALS

Contractor and subcontractor agree to comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, and the regulatory provisions of 40 CFR Part 247. In the performance of this contract and to the extent practicable, the Contractor and subcontractors are to use products containing the highest percentage of recovered materials for items designated by the Environmental Protection Agency (EPA) under 40 CFR Part 247 whenever:

- 1) The contract requires procurement of \$10,000 or more of a designated item during the fiscal year; or
- 2) The contractor has procured \$10,000 or more of a designated item using Federal funding during the previous fiscal year.

The list of EPA-designated items is available at www.epa.gov/smm/comprehensive-procurement-guidelines-construction-products.

Section 6002(c) establishes exceptions to the preference for recovery of EPA-designated products if the contractor can demonstrate the item is:

- a) Not reasonably available within a timeframe providing for compliance with the contract performance schedule;
- b) Fails to meet reasonable contract performance requirements; or
- c) Is only available at an unreasonable price.

A.23.3.2 SEISMIC SAFETY

The Contractor agrees to ensure that all work performed under this contract, including work performed by subcontractors, conforms to a building code standard that provides a level of seismic safety substantially equivalent to standards established by the National Earthquake Hazards Reduction Program (NEHRP). Local building codes that model their code after the current version of the International Building Code (IBC) meet the NEHRP equivalency level for seismic safety.

A.27.3 VETERAN'S PREFERENCE

In the employment of labor (excluding executive, administrative, and supervisory positions), the Contractor and all sub-tier contractors must give preference to covered veterans as defined within Title 49 United States Code Section 47112. Covered veterans include Vietnam-era veterans, Persian Gulf veterans, Afghanistan-Iraq war veterans, disabled veterans, and small business concerns (as defined by 15 USC § 632) owned and controlled by disabled veterans. This preference only applies when there are covered veterans readily available and qualified to perform the work to which the employment relates.

RULES AND REGULATIONS
REGARDING
EQUAL EMPLOYMENT OPPORTUNITY

Promulgated and adopted by the Executive Director of the Department of Transportation and Infrastructure pursuant to and by authority of Article III, Division 2, Chapter 28 of the Revised Municipal Code of the City and County of Denver, and for the purpose of insuring that contractors, subcontractors and suppliers soliciting and receiving compensation for contract work from or through the City and County of Denver provide equal opportunity in employment without regard to race, color, creed, sex, national origin, age, religion, marital status, political opinion or affiliation or mental or physical handicap and meet certain requirements for the hiring, training, promotion, and treatment during employment of members of ethnic groups subject to differential treatment, including persons of African descent (Black), Spanish-surnamed (Hispanic), Asian-American and American Indian Groups.

RULE I - DEFINITIONS

- A. "City" means the City and County of Denver.
- B. "Manager" shall mean the Executive Director of the Department of Transportation and Infrastructure for the City and County of Denver.
- C. "Contract" means a contract entered into with the City and County of Denver, financed in whole or in part by local resources or funds of the City and County of Denver, for the construction of any public building or prosecution or completion of any public work.
- D. "Contractor" means the original party to a contract with the City and County of Denver, also referred to as the "general" or "prime" contractor.
- E. "Director" means the Director of the Division of Small Business Opportunity.
- F. "Subcontractor" means any person, company, association, partnership, corporation, or other entity, which assumes by subordinate agreement some or all of the obligations of the general or prime contractor.
- G. The phrase "Bidding Specifications" as used in Article III, Division 2 of Chapter 28 of the Revised Municipal Code shall include BID CONDITION, INVITATION TO BID, and NOTICE OF PROPOSAL.
- H. "Affirmative Action Program" means a set of specific and result-oriented procedures or steps to which a contractor commits himself to apply every good faith effort to employ members of ethnic minority groups, to include persons of African descent (Black), Spanish surnamed (Hispanic), Asian-American, American Indians, and persons with mental or physical handicap.
- I. "Division of Small Business Opportunity" means the City agency established pursuant to Article III, Division 1 of Chapter 28 of the Denver Revised Municipal Code.

RULE II - NOTICE OF HEARING

When results of conciliation efforts are unsatisfactory to the Manager and he is informed in accordance with Article III, Division 2 of Chapter 28 of the Revised Municipal code that a contractor or subcontractor has apparently failed to meet affirmative action and equal employment opportunity requirements after a reasonable period of notice to correct deficiencies, the Manager will, prior to imposition of any sanctions, afford the general contractor a hearing in order to determine whether the contractor or his subcontractors have failed to comply with the affirmative action and equal employment opportunity requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code

or of the contract. Written notice of such hearing shall be delivered personally or sent by certified mail, return receipt requested, to the contractor and to any subcontractor involved, at least ten (10) days prior to the date scheduled for the hearing.

RULE III - HEARING

- A. Contractors will appear at hearings and may be represented by counsel, and may present testimony orally and other evidence.
- B. Hearings shall be conducted by one or more hearing examiners designated as such by the Manager.
- C. The Director of the Division of Small Business Opportunity may participate in hearings as a witness.
- D. Hearings shall be held at the place specified in the notice of hearing.
- E. All oral testimony shall be given under oath or affirmation and a record of such proceedings shall be made.
- F. All hearings shall be open to the public.
- G. The hearing officer shall make recommendations to the Manager who shall make a final decision.

REGULATIONS

REGULATION NO. 1 - ORDINANCE:

The Rules and Regulations of the Manager shall be inserted in the bidding specifications for every contract for which bidding is required.

REGULATION NO. 2 - EXEMPTIONS:

Each contract and subcontract, regardless of the dollar amount, shall be subject to affirmative action requirements unless specifically exempted in writing individually by the Manager. Exemptions apply only to "affirmative action" in equal employment opportunity, and are not to be construed as condonation in any manner of "discrimination" or "discriminatory practices" in employment because of race, color, creed, sex, age, national origin, religion, marital status, political opinion or mental or physical handicap.

REGULATION NO. 3 - DIRECTOR OF CONTRACT COMPLIANCE:

The Director of the Division of Small Business Opportunity shall perform the duties assigned to such official by Article III, Division 2 Chapter 28 of the Revised Municipal Code and by the Manager. (1) The Director of the Division of Small Business Opportunity or designated representatives shall inform bidders and contractors of affirmative action procedures, programs, and goals in accordance with the Ordinance at pre-bid and pre-construction conference; (2) make regular on-site inspections; (3) supply contractors and subcontractors with report forms to be completed by them when requested, and furnished to the Director of the Division of Small Business Opportunity; and (4) review payroll records, employment records and practices of general contractors and their subcontractors and suppliers during the performance of any contract. The Director of the Division of Small Business Opportunity shall promptly report apparent affirmative action deficiencies to the Manager.

REGULATION NO. 4 - GOALS AND TIMETABLES:

In general, goals and timetables should take into account anticipated vacancies and the availability of skills in the market place from which employees should be drawn. In addition, where discrimination in employment by a general contractor or any of his subcontractors is indicated, a corrective action program will take into account the need by the general contractor and his subcontractors to correct past discriminatory practices and reach goals of minority manpower utilization on a timely basis through such recruiting and advertising efforts as are necessary and appropriate.

REGULATION NO. 5 - AWARD OF CONTRACTS:

It shall be the responsibility of the Director of the Division of Small Business Opportunity to determine the affirmative action capability of bidders, contractors and subcontractors and to recommend to the Manager the award of contracts to those bidders, contractors and subcontractors and suppliers who demonstrate the ability and willingness to comply with the terms of their contract.

REGULATION NO. 6 - PUBLICATION AND DUPLICATION:

Copies of these Rules and Regulations as amended by the Manager from time to time, shall as soon as practicable and after Notice being published will be made a part of all City Contracts.

REGULATION NO. 7 - NOTICE TO PROCEED:

Prior to issuance of the Notice to Proceed a sign-off will be required of the Director of the Division of Small Business Opportunity or his designee.

REGULATION NO. 8 - CONTRACTS WITH SUBCONTRACTORS:

To the greatest extent possible, the contractor shall make a good faith effort to contract with minority contractors, subcontractors and suppliers for services and supplies by taking affirmative actions, which include but are not limited to the following:

1. Advertise invitations for subcontractor bids in minority community news media.
2. Contact minority contractor organizations for referral of prospective subcontractors.
3. Purchase materials and supplies from minority material suppliers.

REGULATION NO. 9 - AGENCY REFERRALS:

It shall be no excuse that the union with which the contractor or subcontractor has an agreement providing for referral, exclusive or otherwise, failed to refer minority employees.

REGULATION NO. 10 - CLAUSES:

The Manager shall include the appropriate clauses in every contract and the contractor shall cause to be inserted in every subcontract the appropriate clauses:

1. APPENDIX A: City and County of Denver Equal Opportunity Clause - ALL CONTRACTS funded only with City and County of Denver monies.
2. APPENDIX B: Equal Opportunity Clause (11246) - ALL FEDERAL ASSISTED.
3. APPENDIX C: Section 3 - Assurance of Compliance - HUD ASSISTED PROJECTS.
4. APPENDIX D: Section 3 - Clause - HUD ASSISTED PROJECTS.

All amendments to the appendices shall be included by reference.

REGULATION NO. 11 - SHOW CAUSE NOTICES:

When the Manager has reasonable cause to believe that a contractor has violated Article III, Division 2 of Chapter 28 of the Denver Revised Municipal Code, he may issue a notice requiring the contractor to show cause, within fifteen (15) days why enforcement procedures, or other appropriate action to insure compliance, should not be instituted.

REGULATION NO. 12 - BID CONDITIONS - AFFIRMATIVE ACTION REQUIREMENTS - EQUAL EMPLOYMENT OPPORTUNITY:

1. APPENDIX E: The Bid Conditions - Affirmative Action Requirements - Equal Employment Opportunity as amended and published by the U.S. Department of Labor Employment Standards Administration, Office of Federal Contract Compliance, shall be inserted verbatim for bidding specification for every non-exempt contract involving the use of Federal funds.
2. APPENDIX F: The Bid Conditions - Affirmative Action Requirements - Equal Employment Opportunity as published by the Department of Transportation and Infrastructure, City and County

of Denver, shall be inserted verbatim as bidding specifications for every non-exempt contract using City funds.

APPENDIX A

CITY AND COUNTY OF DENVER EQUAL OPPORTUNITY CLAUSE - ALL CONTRACTS

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap.
3. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided, advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. Each Contractor will comply with all provisions of Article III, Division 2 of Chapter 28 of the Revised Municipal Code, and the rules, regulations, and relevant orders of the Manager and the Director.
5. The Contractor will furnish all information and reports required by Article III, Division 2 of Chapter 28 of the Revised Municipal Code, and by rules, regulations and orders of the Manager and Director or pursuant thereto, and will permit access to his books, records, and accounts by the Manager, Director, or their designee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
6. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further City contracts in accordance with procedures authorized in Article III, Division 2, Chapter 28 of the Revised Municipal Code, or by rules, regulations, or order of the Manager.
7. The Contractor will include Regulation 12, Paragraph 2 and the provisions of paragraphs (1) through (6) in every subcontract of purchase order unless exempted by rules, regulations, or orders of the Manager issued pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, so that such provisions will be binding on each subcontractor or supplier. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance.

The applicant further agrees to be bound by the above equal opportunity clauses with respect to its own employment practices when it participates in City contracts. The Contractor agrees to assist and cooperate actively with the Manager and the Director in obtaining compliance of subcontractors and suppliers with the equal opportunity clause and the rules, regulations and relevant orders of the Manager, and will furnish the Manager and the Director such information as they may require for the supervision of compliance, and will otherwise assist the Manager and Director in the discharge of the City's primary responsibility for securing compliance. The Contractor further agrees to refrain from entering into any contract or contract modification subject to Article III, Division 2 of Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who has not demonstrated eligibility for, City contracts.

The Contractor will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the Manager and Director. In addition, the Contractor agrees that failure or refusal to comply with these undertakings the Manager may take any or all of the following actions:

- A. Cancellation, termination, or suspension in whole or in part of this contract.
- B. Refrain from extending any further assistance to the applicant under the program with respect to which the failure occurred until satisfactory assurance of future compliance has been received from such applicant.
- C. Refer the case to the City Attorney for appropriate legal proceedings.

SUBCONTRACTS: Each prime Contractor or Subcontractor shall include the equal opportunity clause in each of its subcontracts.

APPENDIX F

AFFIRMATIVE ACTION REQUIREMENTS

EQUAL EMPLOYMENT OPPORTUNITY

For All Non-Exempt Construction Contracts to Be Awarded by the
City and County of Denver, Department of Transportation and Infrastructure.

NOTICE

EACH BIDDER, CONTRACTOR OR SUBCONTRACTOR (HEREINAFTER THE CONTRACTOR) MUST FULLY COMPLY WITH THE REQUIREMENTS OF THESE BID CONDITIONS AS TO EACH CONSTRUCTION TRADE IT INTENDS TO USE ON THIS CONSTRUCTION CONTRACT, AND ALL OTHER CONSTRUCTION WORK (BOTH CITY AND NON-CITY) IN THE DENVER AREA DURING THE PERFORMANCE OF THIS CONTRACT OR SUBCONTRACT. THE CONTRACTOR COMMITS ITSELF TO THE GOALS FOR MINORITY MANPOWER UTILIZATION, AS APPLICABLE, AND ALL OTHER REQUIREMENTS, TERMS AND CONDITION OF THESE BID CONDITIONS BY SUBMITTING A PROPERLY SIGNED BID.

THE CONTRACTOR SHALL APPOINT A COMPANY EXECUTIVE TO ASSUME THE RESPONSIBILITY FOR THE IMPLEMENTATION OF THE REQUIREMENTS, TERMS AND CONDITIONS OF THESE BID CONDITIONS.

/s/ _____

Executive Director of Transportation and
Infrastructure
City and County of Denver

A. REQUIREMENTS - AN AFFIRMATIVE ACTION PLAN:

Contractors shall be subject to the provisions and requirements of these bid conditions including the goals and timetables for minority* and female utilization, and specific affirmative action steps set forth by the Office of Contract Compliance. The contractor's commitment to the goals for minority, and female utilization as required constitutes a commitment that it will make every good faith effort to meet such goals.

1. GOALS AND TIMETABLES:

The goals and timetables for minority and female participation, expressed in percentage terms for the contractor's aggregate workforce in each trade are as follows:

GOALS FOR MINORITY PARTICIPATION FOR EACH TRADE	GOALS FOR FEMALE PARTICIPATION FOR EACH TRADE
From January 1, 1982 to Until Further Notice	From January 1, 1982 to Until Further Notice
21.7% - 23.5%	6.9%

The goals for minority and female utilization above are expressed in terms of hours of training and employment as a proportion of the total number of hours to be worked by the contractor's aggregate workforce, which includes all supervisory personnel, in each trade, on all projects for the City and County of Denver during the performance of its contract (i.e., The period beginning with the first day of work on the City and County of Denver funded construction contract and ending with the last day of work).

The hours of minority and female employment and training must be substantially uniform throughout the length of the contract in each trade and minorities and females must be employed evenly on each of a contractor's projects. Therefore, the transfer of minority or female employees from contractor to contractor or from project to project for the purpose of meeting the contractor's goals shall be a violation of these Bid Conditions.

If the Contractor counts the nonworking hours of apprentices they must be employed by the Contractor during the training period; the Contractor must have made a commitment to employ apprentices at the completion of their training subject to the availability of employment opportunities; and the apprentices must be trained pursuant to training programs approved by the Bureau of Apprenticeship and Training.

- * "Minority" is defined as including, Blacks, Spanish Surname Americans, Asian Americans, and American Indians, and includes both men and minority women.

2. SPECIFIC AFFIRMATIVE ACTION STEPS:

No contractor shall be found to be in noncompliance solely on account of its failure to meet its goals, but will be given an opportunity to demonstrate that the contractor has instituted all the specific affirmative action steps specified and has made every good faith effort to make these steps work toward the attainment of its goals within the timetables, all to the purpose of expanding minority and female utilization in its aggregate workforce. A contractor, who fails to comply with its obligation under the Equal Opportunity Clause of its contract and fails to achieve its commitments to the goals for minority and female utilization has the burden of proving that it has engaged in an Affirmative Action Program directed at increasing minority and female utilization and that such efforts were at least as extensive and as specific as the following:

- a. The Contractor should have notified minority and female organizations when employment opportunities were available and should have maintained records of the organization's response.

- b. The Contractor should have maintained a file of the names and addresses of each minority and female referred to it by any individual or organization and what action was taken with respect to each such referred individual, and if the individual was not employed by the Contractor, the reasons. If such individual was sent to the union hiring hall for referral and not referred back by the union or if referred, not employed by the Contractor, the file should have documented this and their reasons.
- c. The Contractor should have promptly notified the Department of Transportation and Infrastructure, and the Division of Small Business Opportunity when the union or unions with which the Contractor has collective bargaining agreements did not refer to the contractor a minority or female sent by the contractor, or when the Contractor has other information that the union referral process has impeded efforts to meet its goals.
- d. The Contractor should have disseminated its EEO policy within its organization by including it in any employee handbook or policy manual; by publicizing it in company newspapers and annual reports and by advertising such policy at reasonable intervals in union publications. The EEO policy should be further disseminated by conducting staff meetings to explain and discuss the policy; by posting of the policy; and by review of the policy with minority and female employees.
- e. The Contractor should have disseminated its EEO policy externally by informing and discussing it with all recruitment sources; by advertising in news media, specifically including minority and female news media; and by notifying and discussing it with all subcontractors.
- f. The Contractor should have made both specific and reasonably recurrent written and oral recruitment efforts. Such efforts should have been directed at minority and female organizations, schools with substantial minority and female enrollment, and minority and female recruitment and training organizations within the Contractor's recruitment area.
- g. The Contractor should have evidence available for inspection that all tests and other selection techniques used to select from among candidates for hire, transfer, promotion, training, or retention are being used in a manner that does not violate the OFCCP Testing Guidelines in 41 CFR Part 60-3.
- h. The Contractor should have made sure that seniority practices and job classifications do not have a discriminatory effect.
- i. The Contractor should have made certain that all facilities are not segregated by race.
- j. The Contractor should have continually monitored all personnel activities to ensure that its EEO policy was being carried out including the evaluation of minority and female employees for promotional opportunities on a quarterly basis and the encouragement of such employees to seek those opportunities.
- k. The Contractor should have solicited bids for subcontracts from available minority and female subcontractors engaged in the trades covered by these Bid Conditions, including circulation of minority and female contractor associations.

NOTE:

The Director and the Division of Small Business Opportunity will provide technical assistance on questions pertaining to minority and female recruitment sources, minority and female community organizations, and minority and female news media upon receipt of a request for assistance from a contractor.

3. NON - DISCRIMINATION:

In no event may a contractor utilize the goals and affirmative action steps required in such a manner as to cause or result in discrimination against any person on account of race, color, religion, sex, marital status, national origin, age, mental or physical handicap, political opinion or affiliation.

4. COMPLIANCE AND ENFORCEMENT:

In all cases, the compliance of a contractor will be determined in accordance with its obligations under the terms of these Bid Conditions. All contractors performing or to perform work on projects subject to these Bid Conditions hereby agree to inform their subcontractors in writing of their respective obligations under the terms and requirements of these Bid Conditions, including the provisions relating to goals of minority and female employment and training.

B. CONTRACTORS SUBJECT TO THESE BID CONDITIONS:

In regard to these Bid Conditions, if the Contractor meets the goals set forth therein or can demonstrate that it has made every good faith effort to meet these goals, the Contractor shall be presumed to be in compliance with Article III, Division 2 of Chapter 28 of the Revised Municipal Code, the implementing regulations and its obligations under these Bid Conditions. In the event, no formal sanctions or proceedings leading toward sanctions shall be instituted unless the contracting or administering agency otherwise determines that the contractor is violating the Equal Opportunity Clause.

1. Where the Office of Contract Compliance finds that a contractor failed to comply with the requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code or the implementing regulations and the obligations under these Bid Conditions, and so informs the Manager, the Manager shall take such action and impose such sanctions, which include suspension, termination, cancellation, and debarment, as may be appropriate under the Ordinance and its regulations. When the Manager proceeds with such formal action it has the burden of proving that the Contractor has not met the goals contained in these Bid Conditions. The Contractor's failure to meet its goals shall shift to it the requirement to come forward with evidence to show that it has met the good faith requirements of these Bid Conditions.
2. The pendency of such proceedings shall be taken into consideration by the Department of Transportation and Infrastructure in determining whether such contractor can comply with the requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code, and is therefore a "responsible prospective contractor".
3. The Division of Small Business Opportunity shall review the Contractor's employment practices during the performance of the contract. If the Division of Small Business Opportunity determines that the Contractor's Affirmative Action Plan is no longer an acceptable program, the Director shall notify the Manager.

C. OBLIGATIONS APPLICABLE TO CONTRACTORS:

It shall be no excuse that the union with which the Contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority or female employees. Discrimination in referral for employment, even if pursuant to provisions of a collective bargaining agreement, is prohibited by the National Labor Relations Act, as amended, Title VI of the Civil Rights Act of 1964, as amended, and Article III, Division 2 of Chapter 28 of the Revised Municipal Code. It is the policy of the Department of Transportation and Infrastructure that contractors have a responsibility to provide equal employment opportunity, if they wish to participate in City and County of Denver contracts. To the extent they have delegated the responsibility for some of their employment practices to a labor organization and, as a result, are prevented from meeting their obligations pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, such Contractors cannot be considered to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, or its implementing rules and regulations.

D. GENERAL REQUIREMENTS:

Contractors are responsible for informing their subcontractors in writing regardless of tier, as to their respective obligations. Whenever a Contractor subcontracts a portion of work in any trade covered by these

Bid Conditions, it shall include these Bid Conditions in such subcontracts and each subcontractor shall be bound by these Bid Conditions to the full extent as if it were the prime contractor. The Contractor shall not, however, be held accountable for the failure of its subcontractors to fulfill their obligations under these Bid Conditions. However, the prime contractor shall give notice to the Director of any refusal or failure of any subcontractor to fulfill the obligations under these Bid Conditions. A subcontractor's failure to comply will be treated in the same manner as such failure by a prime contractor.

1. Contractors hereby agree to refrain from entering into any contract or contract modification subject to Article III, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who is determined not to be a "responsive" bidder for the City and County of Denver contracts pursuant to the Ordinance.
2. The Contractor shall carry out such sanctions and penalties for violation of these Bid Conditions and the Equal Opportunity Clause including suspension, termination and cancellation of existing subcontracts and debarment from future contracts as may be ordered by the Manager pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code and its implementing regulations.
3. Nothing herein is intended to relieve any contractor during the term of its contract from compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the Equal Opportunity Clause of its contract with respect to matters not covered in these Bid Conditions.
4. Contractors must keep such records and file such reports relating to the provisions of these Bid Conditions as shall be required by the Office of Contract Compliance.
5. Requests for exemptions from these Bid Conditions must be made in writing, with justification, to the Manager of the Department of Transportation and Infrastructure, 201 W. Colfax, Dept. 608, Denver, Colorado 80202, and shall be forwarded through and with the endorsement of the Director.

EXHIBIT C

CITY AND COUNTY OF DENVER INSURANCE REQUIREMENTS FOR DEPARTMENT OF AVIATION OWNER CONTROLLED INSURANCE PROGRAM (OCIP/ROCIP) PROJECT

NOTICE OF CHANGE TO ROCIP: DEN reserves the right to terminate or modify the DEN ROCIP or any portion thereof. Further, dependent on factors including, but not limited to, the official timing and duration of the ROCIP project for which services are provided under this Agreement, DEN may need to transition from one ROCIP program to another and introduce corresponding requirements for contractors. DEN will provide Contractor notice in accordance with the terms and conditions of this Agreement.

1. General Information

City and County of Denver and Denver International Airport (hereinafter referred to collectively as “DEN”) has arranged for certain construction activities at DEN to be insured under an Owner Controlled Insurance Program (OCIP) or a Rolling Owner Controlled Insurance Program (ROCIP) (hereinafter collectively referred to as “ROCIP”). A ROCIP is a single insurance program that insures DEN, the Contractor and subcontractors of any tier, and other designated parties (Enrolled Parties), for work performed at the Project Site. Certain trade contractors and subcontractors are ineligible for this program; see ROCIP Insurance Manual Section 4. Insurance requirements are determined based on the scope of work.

1.2 ROCIP Manuals

Below are links to access the current reference manuals related to DEN ROCIP. These manuals are part of the Contract Documents.

[ROCIP Insurance Manual](#)

[ROCIP Safety Manual](#)

[ROCIP Claims Guide](#)

2. Insurance Requirements for Non-ROCIP Contractors and Subcontractors (Ineligible Parties)

Contractor and subcontractors of any tier shall require all Ineligible Parties, as defined in ROCIP Insurance Manual Section 4 or confirmed as excluded by DEN, to provide and maintain insurance of the type and in limits as set forth in the Contractor Subcontract Agreement and such insurance shall include the minimum defined coverages and be evidenced to DEN as required in this Section 2.

2.1 Certificate Holder

Certificate(s) shall be issued to:	CITY AND COUNTY OF DENVER Denver International Airport 8500 Peña Boulevard, Suite 8810 Denver CO 80249 Attn: Risk Management
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2.2 Acceptable Certificate of Insurance Form and Submission Instructions

Please read these requirements carefully to ensure proper documentation and receipt of your certificate(s) of insurance.

- ACORD FORM (or equivalent) certificate is required.
- SUBMIT via emailed in pdf format to: contractadmininvoices@flydenver.com
- ELECTRONIC CERTIFICATES are required, hard copy documents will not be accepted.

- THIRD PARTY SOFTWARE may be implemented during the term of this Agreement to manage insurance compliance and documents with required use by Vendor of such system.
- REFERENCE on the certificate must include the DEN assigned Contract Number.

2.3 Coverage and Limits

2.3.1 Commercial General Liability

Contractor shall maintain insurance coverage including bodily injury, property damage, personal injury, advertising injury, independent contractors, and products and completed operations in minimum limits of \$1,000,000 each occurrence, \$2,000,000 products and completed operations aggregate; if policy contains a general aggregate, a minimum limit of \$2,000,000 annual aggregate must be maintained.

2.3.1.1 Coverage shall include Contractual Liability covering liability assumed under this Agreement (including defense costs assumed under contract) within the scope of coverages provided.

2.3.1.2 Coverage shall include Mobile Equipment Liability, if used to perform services under this Agreement.

2.3.2 Business Automobile Liability

Contractor shall maintain a minimum limit of \$1,000,000 combined single limit each occurrence for bodily injury and property damage for all owned, leased, hired and/or non-owned vehicles used in performing services under this Agreement.

2.3.2.1 If operating vehicles unescorted airside at DEN, a \$10,000,000 combined single limit each occurrence for bodily injury and property damage is required.

2.3.2.2 If Contractor does not have blanket coverage on all owned and operated vehicles and will require unescorted airside driving privileges, then a schedule of insured vehicles (including year, make, model and VIN number) must be submitted with the Certificate of Insurance.

2.3.2.3 If transporting waste, hazardous material, or regulated substances, Contractor shall carry a Broadened Pollution Endorsement and an MCS 90 endorsement on its policy.

2.3.2.4 If Contractor does not own any fleet vehicles and Contractor's owners, officers, directors, and/or employees use their personal vehicles to perform services under this Agreement, Contractor shall ensure that one or both of the following coverages are maintained as appropriate: (i) Personal Automobile Liability including a Business Use Endorsement by the vehicle owner and (ii) Non-Owned Auto Liability by the Contractor.

2.3.2.5 If Contractor will be completing all services to DEN under this Agreement remotely and not be driving to locations under direction of the City to perform services, this requirement is waived.

2.3.3 Workers' Compensation and Employer's Liability Insurance

Contractor shall maintain the coverage as required by statute for each work location and shall maintain Employer's Liability insurance with limits no less than \$1,000,000 per occurrence for each bodily injury claim, \$1,000,000 per occurrence for each bodily injury caused by disease claim, and \$1,000,000 aggregate for all bodily injuries caused by disease claims.

2.3.3.1 Colorado Workers' Compensation Act allows for certain, limited exemptions from Worker's Compensation insurance coverage requirements. It is the sole responsibility of the Contractor to determine their eligibility for providing this coverage, executing all required documentation with the State of Colorado, and obtaining all necessary approvals. Verification document(s) evidencing exemption status must be submitted with the Certificate of Insurance.

2.3.4 Professional Liability (Errors and Omissions) Insurance

Contractor shall maintain a minimum limit of \$1,000,000 each claim and policy aggregate, providing coverage for applicable services outlined in this Agreement. If there are no applicable professional services, this coverage will not be required.

The Contractor shall be responsible for conferring with DEN Risk Management on any subcontractors providing work to the Project to obtain a formal determination if this coverage will be required.

2.3.5 Contractor's Pollution Legal Liability

If required by DEN Risk Management for any specific Excluded Party based on their scope of work, Contractor shall maintain coverage for its work site operations that are conducted on DEN's premises including project management and site supervision duties with a limit no less than \$1,000,000 each occurrence and aggregate resulting from claims arising out of a pollution condition or site environmental condition resulting out of work site operations on DEN's premises.

2.3.5.1 Coverage shall include claims/losses for bodily injury, property damage including loss of use of damaged property, defense costs including costs and expenses incurred in the investigation, defense or settlement of claims, and cleanup cost for pollution conditions resulting from illicit abandonment, the discharge, dispersal, release, escape, migration or seepage of any solid, liquid, gaseous or thermal irritant, contaminant, or pollutant, including soil, silt, sedimentation, smoke, soot, vapors, fumes, acids, alkalis, chemicals, electromagnetic fields, hazardous substances, hazardous materials, waste materials, low level radioactive waste, mixed wastes, on, in, into, or upon land and structures thereupon, the atmosphere, surface water or groundwater on the DEN premises.

2.3.5.2 Work site means a location where covered operations are being performed, including real property rented or leased from DEN for the purpose of conducting Contractor's covered operations.

The Contractor shall be responsible for conferring with DEN Risk Management on any subcontractors providing work to the Project to obtain a formal determination if this coverage will be required.

2.3.6 Unmanned Aerial Vehicle (UAV) Liability

If Contractor desires to use drones in any aspect of its work on DEN premises, the following requirements must be met prior to commencing any drone operations:

2.3.6.1 Express written permission must be granted by DEN.

2.3.6.2 Express written permission must be granted by the Federal Aviation Administration (FAA).

2.3.6.3 Drone equipment must be properly registered with the FAA.

2.3.6.4 Drone operator(s) must be properly licensed by the FAA.

2.3.6.5 Contractor must maintain UAV Liability including flight coverage, personal and

advertising injury liability, and hired/non-owned UAV liability for its commercial drone operations with a limit no less than \$1,000,000 combined single limit each occurrence for bodily injury and property damage.

2.3.7 Excess/Umbrella Liability

Combination of primary and excess coverage may be used to achieve minimum required coverage limits. Excess/Umbrella policy(ies) must follow form of the primary policies with which they are related to provide the minimum limits and be verified as such on any submitted Certificate of Insurance.

2.4 Reference to Project and/or Contract

The DEN Project and/or Contract Number and project description shall be noted on the Certificate of Insurance.

2.5 Additional Insured

For all coverages required under this Agreement (excluding Workers' Compensation and Professional Liability, if required), Contractor's insurer(s) shall include the City and County of Denver, its elected and appointed officials, successors, agents, employees and volunteers as Additional Insureds by policy endorsement.

2.6 Waiver of Subrogation

For all coverages required under this Agreement (excluding Professional Liability, if required), Contractor's insurer(s) shall waive subrogation rights against the City and County of Denver, its elected and appointed officials, successors, agents, employees and volunteers by policy endorsement.

If Contractor will be completing all services to the City under this Agreement remotely and not be traveling to locations under direction of the City to perform services, this requirement is waived specific to Workers' Compensation coverage.

2.7 Notice of Material Change, Cancellation or Nonrenewal

Each certificate and related policy shall contain a valid provision requiring notification to the Certificate Holder in the event any of the required policies be canceled or non-renewed or reduction in required coverage before the expiration date thereof.

2.7.1 Such notice shall reference the DEN assigned contract number related to this Agreement.

2.7.2 Said notice shall be sent thirty (30) days prior to such cancellation, non-renewal or reduction in coverage unless due to non-payment of premiums for which notice shall be sent ten (10) days prior.

2.7.3 If such written notice is unavailable from the insurer or afforded as outlined above, Contractor and/or its insurance broker/agent shall provide written notice of cancellation, non-renewal and any reduction in coverage to the Certificate Holder within seven (7) business days of receiving such notice by its insurer(s) and include documentation of the formal notice received from its insurer(s) as verification. Contractor shall replace cancelled or nonrenewed policies with no lapse in coverage and provide an updated Certificate of Insurance to DEN.

2.7.4 In the event any general aggregate or other aggregate limits are reduced below the required minimum per occurrence limits, Contractor will procure, at its own expense, coverage at the requirement minimum per occurrence limits. If Contractor cannot replenish coverage within ten (10) calendar days, it must notify the City immediately.

2.8 Cooperation

Contractor agrees to fully cooperate in connection with any investigation or inquiry and accept any formally tendered claim related to this Agreement, whether received from the City or its representative. Contractor's failure to fully cooperate may, as determined in the City's sole discretion, provide cause for default under the Agreement. The City understands acceptance of a tendered claim does not constitute acceptance of liability.

2.9 Additional Provisions

- 2.9.1 Deductibles or any type of retention are the sole responsibility of the Contractor.
- 2.9.2 Defense costs shall be in addition to the limits of liability. If this provision is unavailable that limitation must be evidenced on the Certificate of Insurance.
- 2.9.3 Coverage required may not contain an exclusion related to operations on airport premises.
- 2.9.4 A severability of interests or separation of insureds provision (no insured vs. insured exclusion) is included under any policy requiring Additional Insured status.
- 2.9.5 A provision that coverage is primary and non-contributory with other coverage or self-insurance maintained by DEN, excluding Professional Liability and Workers' Compensation policies, if required.

- 2.9.6 The insurance requirements under this Agreement shall be the greater of (i) the minimum limits and coverage specified hereunder or (ii) the broader coverage and maximum limits of coverage of any insurance policy or proceeds available to the Contractor. It is agreed that the insurance requirements set forth herein shall not in any way act to reduce coverage that is broader or that includes higher limits than the minimums set forth in this Agreement.
- 2.9.7 All policies shall be written on an occurrence form when available and industry norm. If an occurrence form is unavailable and/or the industry norm, claims-made coverage may be accepted by DEN provided the retroactive date is on or before the Agreement Effective Date or the first date when any goods or services were provided to DEN, whichever is earlier, and continuous coverage will be maintained or an extended discovery period of three years beginning at the time work under this Agreement is completed or the Agreement is terminated, whichever is later.
- 2.9.8 Certificates of Insurance must specify the issuing companies, policy numbers and policy periods for each required form of coverage. The certificates for each insurance policy are to be signed by an authorized representative and must be submitted to the City at the time Contractor signed this Agreement.
- 2.9.9 The insurance shall be underwritten by an insurer licensed or authorized to do business in the State of Colorado and rated by A.M. Best Company as A- VIII or better.
- 2.9.10 Certificate of Insurance and Related Endorsements: The City's acceptance of a certificate of insurance or other proof of insurance that does not comply with all insurance requirements shall not act as a waiver of Contractor's breach of this Agreement or of any of the City's rights or remedies under this Agreement. All coverage requirements shall be enforced unless waived or otherwise modified in writing by DEN Risk Management. Contractor is solely responsible for ensuring all formal policy endorsements are issued by their insurers to support the requirements.
- 2.9.11 The City shall have the right to verify, at any time, all coverage, information, or representations, and the insured and its insurance representatives shall promptly and fully cooperate in any such audit the City may elect to undertake including provision of copies of insurance policies upon request. In the case of such audit, the City may be subject to a non-disclosure agreement and/or redactions of policy information unrelated to the required coverage and premium amounts.
- 2.9.12 No material changes, modifications, or interlineations to required insurance coverage shall be allowed without the review and written approval of DEN Risk Management.
- 2.9.13 Contractor shall be responsible for ensuring the City is provided updated Certificate(s) of prior to each policy renewal.
- 2.9.14 Contractor's failure to maintain required insurance shall be the basis for immediate suspension and cause for termination of this Agreement, at the City's sole discretion and without penalty to the City.

2.10 Part 230 and the DEN Airport Rules and Regulations

If the minimum insurance requirements set forth herein differ from the equivalent types of insurance requirements in Part 230 of the DEN Airport Rules and Regulations, the greater and broader insurance requirements shall supersede those lesser requirements, unless expressly excepted in writing by DEN Risk Management.

3. Insurance Requirements for ROCIP Enrolled Contractors and Subcontractors

3.1 Insurance Provided by the DEN ROCIP

DEN retains the right to have this Project insured under a ROCIP. ROCIP coverage shall provide: (i) Commercial General Liability, (ii) Workers' Compensation & Employer's Liability, (iii) Excess Liability, (iv) Contractor's Pollution Liability, and (v) Builder's Risk as outlined herein and as defined by the respective policies for each coverage, for the period from the start of Work through completion and final acceptance by DEN except as otherwise provided herein.

3.2 Enrollment Required

Parties performing labor or services at the Project Site are eligible to enroll in the DEN ROCIP, unless they are Ineligible Parties (as defined in ROCIP Insurance Manual Section 4). Participation is mandatory but not automatic. Parties eligible for enrollment shall follow the procedures and follow the instructions as provided in the DEN ROCIP Insurance Manual to enroll in the program. When the Contractor and subcontractors of any tier are properly enrolled, the DEN ROCIP Administrator will issue a Certificate of Insurance evidencing the coverages afforded to each Enrolled Party under the DEN ROCIP, prior to their commencing Work on the Project Site.

3.3 Exclusion of Contractor/Subcontractor Insurance Costs from Proposal and Bid Prices

Contractor shall exclude from Contractor's cost of work and ensure that each subcontractor of any tier exclude from their cost of work, normal costs for insurance for those coverages provided under the DEN ROCIP. As part of the enrollment process, Contractor and subcontractors shall provide policy declaration rate pages and deductible endorsements on the General Liability, Workers' Compensation, and Excess Liability policies as required in the DEN ROCIP Insurance Manual. The calculation of these costs will be determined by the ROCIP Program Administrator. The costs of DEN ROCIP coverage includes reductions in insurance premiums, all relevant taxes and assessments, markup on insurance premiums, and losses retained through large deductibles, self-insured retentions, or self-funded programs. Change orders shall also exclude the cost of ROCIP coverage.

Pre-employment substance abuse testing costs will be covered by DEN and should be removed from bid prices. Drug testing will be more thoroughly discussed in the ROCIP Safety Manual.

3.4 Insurance Premiums

DEN will pay the insurance premiums for the DEN ROCIP insurance policies. DEN is responsible for all adjustments to the premiums and will be the sole beneficiary of all dividends, retroactive adjustments, return premiums, and any other monies due through audits or otherwise. The Contractor assigns to DEN the right to receive all such adjustments and will require that each subcontractor of any tier assign to DEN all such adjustments. The Contractor and the subcontractors who are Enrolled Parties shall execute such further documentation as may be required by DEN to accomplish this assignment.

3.5 Off Site Operations Coverage Under ROCIP

The DEN ROCIP will provide certain insurance coverage for DEN, Contractor and Enrolled Parties, along with their Eligible Employees performing Work at the Project Site. Off-site operations shall be covered only if designated in writing by DEN and when all operations at such site are identified and solely dedicated to the Project. Contractors and subcontractors are responsible to notify the DEN ROCIP Administrator in writing, to request coverage for specified off-site operations. Coverage is not provided at the off-site location unless confirmed in writing by the DEN ROCIP Administrator.

3.6 DEN ROCIP Insurance Manual

As soon as practicable, the DEN ROCIP Insurance Manual will be sent to each Enrolled Party and will become a part of the Contract and Contractor's Subcontract with its subcontractor and its subcontractors' agreements with any lower-tier subcontractor. The DEN ROCIP Insurance Manual will contain the administrative and claim reporting procedures. Contractor agrees to and will require that its subcontractors of any tier to cooperate with the DEN ROCIP Administrator in providing all required information.

3.7 Conflicts

Descriptions of the DEN ROCIP coverages set forth in ROCIP Insurance Manual Section 4.6 are not intended to be complete or meant to alter or amend any provision of the DEN ROCIP insurance policies. The DEN ROCIP coverages, terms, conditions, and exclusions are set forth in full in their respective policy forms. In the event of a conflict or omission between the coverages provided in the DEN ROCIP insurance policies and the coverages summarized or described in the DEN ROCIP Insurance Manual, this Exhibit or elsewhere in the Contract Documents, the DEN ROCIP insurance policies shall govern. In the event of a conflict between the provisions of this Exhibit and the DEN ROCIP Insurance Manual, that does not involve any conflict with the provisions of the DEN ROCIP insurance policies, the provisions of this Exhibit shall govern.

3.8 ROCIP Insurance Coverage Provided to Enrolled Parties

3.8.1 Insurance Provided by DEN

Unless otherwise provided herein, prior to commencement of the Work, DEN, at its sole option and expense, shall secure and maintain at all times during the performance of this Contract the insurance specified below, insuring DEN, Enrolled Parties and such other persons or interests as DEN may designate with limits not less than those specified below for each coverage.

3.8.1.1 Workers' Compensation & Employer's Liability – On Site Only

DEN shall maintain the coverage as required by statute for the Project Site and shall maintain Employer's Liability insurance with limits no less than \$1,000,000 per occurrence for each bodily injury claim, \$1,000,000 per occurrence for each bodily injury caused by disease claim, and \$1,000,000 aggregate for all bodily injuries caused by disease claims.

3.8.1.2 Commercial General Liability – On Site Only

DEN shall maintain insurance coverage including bodily injury, property damage, personal injury, advertising injury, and products and completed operations in minimum limits as listed below:

Coverage	Limit
Annual General Aggregate (Per Project and Reinstates Annually)	\$4,000,000
Products/Completed Operations Aggregate (Per Project and Statute of Repose)	\$4,000,000
Total Products/Completed Operations Aggregate (Statute of Repose)	\$20,000,000
Personal / Advertising Injury Limit	\$2,000,000
Each Occurrence Limit	\$2,000,000
Fire Damage Legal Liability (any one fire)	\$ 300,000
Medical Payments (any one person)	\$ 10,000

3.8.1.3 Excess Liability Insurance

DEN shall maintain coverage following form with underlying policies of Commercial General Liability and Employer's Liability in minimum limits as listed below:

Coverage	Limit
Annual General Aggregate (Per Project and Reinstates Annually)	\$200,000,000
Products/Completed Operations Aggregate (Per Project)	\$20,000,000
Total Products/Completed Operations Aggregate (Policy Cap)	\$400,000,000
Each Occurrence Limit	\$200,000,000

DEN, in its sole discretion, may elect to provide higher limits, based on Project size. Excess Liability limits are shared by all Insured parties.

3.8.1.4 Contractor's Pollution Liability

DEN shall maintain coverage for bodily injury, property damage, or environmental damage caused by a pollution event resulting from covered operations, including completed operations, at the Project Site with a limit no less than \$10,000,000 each occurrence and aggregate. Coverage includes microbial matter and legionella pneumophila in any structure on land and the atmosphere contained with the structure. Products/Completed Operations coverage may extend for the statute of limitations/repose after final completion of the Project.

3.8.1.5 Builder's Risk Insurance

DEN shall maintain, Builder's Risk (and/or Installation Floater) in the amount of \$200,000,000 per occurrence subject to various sublimits (as defined in the Builders' Risk Policy). Such insurance shall end when the first of the following occurs: 1) DEN's interest in the Work ceases; 2) the policy expires or is cancelled; or 3) the Work is accepted by DEN.

Builder's Risk Insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss of damage including, theft, vandalism, malicious mischief, terrorism, rigging and hoisting for materials and equipment that are part of the Project, collapse, earthquake, flood, windstorm, falsework, testing and startup (as provided by the policy), temporary buildings and debris removal including demolition occasioned by enforcement of any applicable ordinance laws, and shall cover reasonable compensation for services and expenses required as a result of such insured loss.

This Builder's Risk Insurance shall cover portions of the Work stored off site, and also portions of the Work in transit.

DEN and Contractor shall waive all rights against (1) each other and any of their subcontractors of any tier, and all respective agents and employees, and (2) the architect, architect's consultants, separate contractors, if any, and any of their subcontractors of any tier, and all respective agents and employees, for damages caused by fire or other causes of loss to the extent covered by Builder's Risk Insurance obtained pursuant to this Section or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by DEN as fiduciary. DEN or Contractor, as appropriate, shall require of the architect, architect's consultants, separate contractors, and their subcontractors of any tier, and all respective agents and employees, by appropriate agreements, written where

legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

3.8.2 Claim Chargeback

A claim charge-back will be assessed, regardless of fault, for the amount of any loss payable under this program with the exception of Workers' Compensation and Excess Liability, up to a maximum of \$25,000 each loss. General Contractor may elect to pass no more than \$5,000 of this charge, each loss, through to any responsible subcontractor.

3.9 Other Insurance Provided By Enrolled Parties

At their own expense, the Enrolled Parties of all tiers must carry the following minimum coverage and limits and such insurance shall be evidenced to DEN and the DEN ROCIP Administrator as required in this Section 3.9.

3.9.1 Certificate Holder

Certificate(s) shall be issued to: CITY AND COUNTY OF DENVER
Denver International Airport
8500 Peña Boulevard, Suite 8810
Denver CO 80249
Attn: Risk Management

and

CITY AND COUNTY OF DENVER
Department of Aviation
c/o Marsh USA, Inc.
111 SW Columbia, Ste 500
Portland, OR 97201

3.9.2 Acceptable Certificate of Insurance Form and Submission Instructions

Please read these requirements carefully to ensure proper documentation and receipt of your certificate(s) of insurance.

- ACORD FORM (or equivalent) certificate is required.
- SUBMIT via emailed in pdf format to: contractadmininvoices@flydenver.com
and DenverAirport.ROCIP@marsh.com
- ELECTRONIC CERTIFICATES are required, hard copy documents will not be accepted.
- THIRD PARTY SOFTWARE may be implemented during the term of this Agreement to manage insurance compliance and documents with required use by Vendor of such system.
- REFERENCE on the certificate must include the DEN assigned Contract Number.

3.9.3 Other Insurance Requirements

Enrolled Contractors shall adhere to the same minimum insurance requirements as stated in Section 2 of this exhibit, with the following exceptions:

- Commercial General Liability coverage requirement is Off Site Only

- Workers' Compensation and Employer's Liability coverage requirement is Off Site Only
- Contractor's Pollution Legal Liability is not required

4. Contractor Warranties and Agreements

4.1 Accuracy of Contractor-provided Information

Contractor warrants that all information submitted to DEN or the DEN ROCIP Administrator is accurate and complete to the best of its knowledge. Contractor will notify DEN or the DEN ROCIP Administrator immediately in writing of any errors discovered during the performance of the Work.

4.2 Contractor Responsible to Review Coverage

Contractor acknowledges that all references to DEN ROCIP policy terms, conditions, and limits of liability in this document, as well as the DEN ROCIP Insurance Manual, are for reference only. Contractor and its subcontractors of any tier are responsible for conducting their own independent review and analysis of the DEN ROCIP insurance policies in formulating any opinion or belief as to the applicability of such coverage in the event of any loss or potential claim. Any type of insurance or increase of limits not described above, which the Contractor requires for its own protection or on account of statute, shall be its own responsibility and at its own expense.

4.3 Audit

Contractor agrees to make its records available for review and to cooperate with DEN, its insurers and insurance brokers, the City Auditor, and representatives of the aforesaid parties in the event of an audit. In the event that a DEN audit of Contractor's records, as permitted in the Contract or other DEN ROCIP documents, reveals a discrepancy in the insurance, payroll, safety, or any other information required to be provided to DEN or the DEN ROCIP Administrator, or reveals inclusion of costs for DEN ROCIP coverage or other coverage beyond what is described above in any payment for the Work, DEN will have the right to deduct from payments due Contractor all such insurance costs as well as all audit costs.

4.4 Insurance Costs Removed

Contractor warrants that the costs for insurance as provided under the DEN ROCIP were not included in Contractor's bid or proposal for the Work, the Contract Price/Contract Sum, and will not be included in any change order or any request for payment for the Work or extra work.

5. Contractor Obligations

5.1 ROCIP Documents Shall be Provided to Subcontractor

Contractor shall furnish each bidding subcontractor, vendor, supplier, material dealer or other party a copy of this Exhibit, the DEN ROCIP Insurance Manual and the DEN ROCIP Safety Manual and shall incorporate the terms of this Exhibit in all contracts and agreements entered into for performance of any portion of the Work.

5.2 Timely Enrollment Required

Contractor shall enroll in the DEN ROCIP within five (5) business days following a request by DEN or the DEN ROCIP Administrator. Contractor shall notify each subcontractor of the process for enrolling in DEN ROCIP and confirm that enrollment is mandatory, but not automatic. Contractor shall assure that subcontractors of any tier shall not commence Work until verification of enrollment is confirmed by the DEN ROCIP Administrator by the issuance of a Certificate of Insurance to each individual Enrolled Party.

5.3 Compliance with Conditions

Contractor shall not violate any condition of the policies of insurance provided by DEN under the terms of this Exhibit, the DEN ROCIP Insurance Manual or the DEN ROCIP Safety Manual. All requirements imposed by the subject policies and to be performed by Contractor shall likewise be imposed on, assumed, and performed by each subcontractor of any tier.

5.4 Claims Cooperation

Contractor shall participate in claim reporting procedures. Contractor agrees to assist and cooperate in every manner possible in connection with the adjustment of all claims arising out of operations within the scope of the Work required by the Contract, and to cooperate with DEN's insurer(s) in all claims and demands which DEN's insurer(s) is called upon to adjust or to defend against. Contractor shall take all necessary action to assure that its subcontractors of any tier comply with any request for assistance and cooperation. This obligation includes, without limitation, providing light or modified duty for injured workers, appearing in mediation, arbitration, or court proceedings and/or participating in settlement meetings, as may be required.

5.5 Monthly Payroll Submission

All Enrolled Parties shall submit monthly payrolls and worker-hour reports to DEN and/or the DEN ROCIP Administrator via the DEN ROCIP Administrator's online reporting system as outlined in the DEN ROCIP Insurance Manual. The online reporting instructions will be provided to all Contractors at time of enrollment. Failure to submit these reports may result in funds being held or delayed from monthly progress payments. Payroll must be submitted online for each month, including zero (0) payroll, if applicable, until completion of the Work under each Contract and Subcontract. For subcontractors of any tier performing Work under multiple Subcontracts, a separate payroll report is required for each Subcontract under which Work is being performed.

5.6 Response to Information Requests

All insurance underwriting, payroll, rating or loss history information requested by DEN or the DEN ROCIP Administrator shall be provided by the Contractor within three (3) business days of request. Contractor agrees (and will require each subcontractor to agree) that DEN, DEN's insurers or its representative may audit the Contractor's records or records of subcontractors of any tier to confirm the accuracy of all insurance information provided including, without limitation, any such information that may have any effect on insurance resulting from changes in the Work. At all times during performance of the Contract and Subcontracts, the Contractor and subcontractors of any tier shall cooperate with DEN, the DEN ROCIP Administrator and DEN's insurers.

5.7 Responsibility for Safety

Notwithstanding the DEN ROCIP, the Contractor shall initiate, maintain, and supervise all safety precautions and programs in connection with the Work. Contractor is solely responsible, at no adjustment to the contract sum payable or contract time, for initiating, maintaining, and supervising all safety precautions and programs relating to the conduct of Work including, without limitation, any safety programs or procedures that are required by any applicable state or federal laws, rules or regulations, or under the terms of the DEN ROCIP Safety Manual.

5.8 Duty of Care

Nothing herein shall relieve the Enrolled Parties of their respective obligations to exercise due care in the performance of their duties in connection with the Work or to complete the Work in strict compliance with this Contract and subsequent subcontracts.

6. Notices and Costs

6.1 Limitations on DEN Provided Coverage and DEN Right to Purchase Other Coverage

DEN assumes no obligations to provide insurance other than that evidenced by the policies referred to in Section 3.8. DEN, however, reserves the right to furnish insurance coverage of various types and limits provided that such coverage shall not be less than that specified in Section 3.8 and the costs of such insurance shall be paid by DEN. Apart from the DEN ROCIP, DEN may at its option purchase additional insurance coverages that insure the Project that may not necessarily insure the Contractor or the subcontractors. Without limitation, examples of such coverage may include pollution liability, excess professional liability, and excess automobile liability insurance.

6.2 Contractors Responsible for Own Equipment

Contractor and subcontractors are solely responsible for loss or damage of all construction tools and other equipment whether owned, leased, rented, borrowed, or used on Work at the Project Site. If an individual Enrolled Party purchases insurance on their tools and equipment, such insurance shall contain a waiver of subrogation in favor of the City and County of Denver, its elected and appointed officials, agents, employees and volunteers and all other Enrolled Parties. If an individual Enrolled Party does not purchase such insurance, that Enrolled Party will hold harmless the City and County of Denver, its elected and appointed officials, agents, employees and volunteers and other Enrolled Parties for loss or damage to its tools and equipment.

6.3 No Release; No Waiver of Immunity

The provision of the DEN ROCIP shall in no way be interpreted as relieving Contractor or subcontractors of any tier of any responsibility or liability under the Contract Documents, the DEN ROCIP insurance policies or applicable laws including, without limitation, Contractor's and subcontractor's responsibilities relative to indemnification and their obligation to exercise due care in the performance of the Work and to complete the Work in strict compliance with the Contract Documents. The parties hereto understand and agree that the City and County of Denver, its elected and appointed officials, agents, employees and volunteers are relying on, and do not waive or intend to waive by any provisions of this agreement, the monetary limitations or any other rights, immunities and protections provided by the Colorado Governmental Immunity Act, §§ 24-10-101 to 120, C.R.S., or otherwise available to DEN, its officers, officials and employees.

6.4 DEN Right to Withhold Payments

In addition to any other rights of withholding that DEN may have under the Contract Documents, DEN has the right to withhold any payments otherwise due to Contractor in the event of a failure by Contractor or any subcontractor to comply with the requirements of this Exhibit, the DEN ROCIP Insurance Manual or the DEN ROCIP Safety Manual. DEN may withhold from any payment owing to Contractor the costs of DEN ROCIP coverages if included in a request for payment. Such withholding by DEN shall not be deemed to be a default under the Contract. DEN shall withhold from Contractor the costs of DEN ROCIP coverages attributable to an increase in an Enrolled Party's total payroll for the Work over the amount reported to DEN and/or the DEN ROCIP Administrator at time of enrollment.

6.5 DEN Remedies

Without limitation upon any of DEN's other rights or remedies, any failure of an Enrolled Party to comply with any provision of this Exhibit, the DEN ROCIP Insurance Manual, or the DEN ROCIP Safety Manual shall be deemed a material breach of the Contract, thereby entitling DEN, at its option, upon notice to Contractor, to (1) suspend performance by Contractor and/or the offending subcontractor, without any adjustment to Contract Sum Payable or Contract Time, until there is full compliance, or (2) terminate this Contract for cause.

6.6 Off Site Storage

Unless otherwise provided in the Contract Documents, the property insurance provided by DEN shall not cover portions of the Work stored off the Site without written approval of DEN. Contractor shall be responsible for reporting such property or work if ownership has been transferred to DEN. If ownership rests with the Contractor, Contractor shall be responsible for obtaining insurance to protect its interests.

6.7 Partial Occupancy

Partial occupancy or use shall not commence until DEN insurer(s) providing Builders Risk and/or Property Insurance have consented to such partial occupancy or use by endorsement or otherwise. DEN and the Contractor shall take reasonable steps to obtain consent of the insurer(s) and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

6.8 DEN Right to Exclude Parties from the DEN ROCIP

DEN reserves the right to exclude any subcontractor from the DEN ROCIP, before or after enrollment by the subcontractor. If DEN elects to exclude a subcontractor from the DEN ROCIP, the Contractor will be responsible for ensuring the insurance coverages outlined in the Contractor's Subcontract Agreement are provided to DEN or the DEN ROCIP Administrator before the subcontractor can begin or resume Work on the Project.

6.9 DEN's Right to Modify or Discontinue DEN ROCIP Coverages

If DEN determines that modification or discontinuation of the DEN ROCIP is in the best interest of DEN, the Contractor and subcontractor will receive sixty (60) days advance written notice to secure and maintain such insurance as is required to provide replacement coverage comparable to that provided under the DEN ROCIP. Provided that the foregoing is not the result of any failure by the Contractor or any subcontractor to comply with the requirements of the Contract Documents, the DEN ROCIP Insurance Manual or DEN ROCIP Safety Manual, the costs of such replacement insurance shall be deemed a cost of Work for which the Contractor shall be entitled to a Contract Adjustment, without any sum added thereto for Allowable Markup. The form, content, limits of liability, cost and the rating of the insurer(s) issuing such replacement coverage shall be subject to DEN's prior written approval.

7. Definitions

Certificate of Insurance:	A document providing evidence of coverage for a particular insurance policy or policies. This will include certificates issued to Enrolled Parties evidencing the coverage afforded under the DEN ROCIP and certificates issued to DEN evidencing additional coverage "Provided by Enrolled Parties"
DEN:	City and County of Denver and Denver International Airport
Contract:	The written agreement between DEN and Contractor describing the Work, contract terms and conditions, or a portion thereof; also includes a written agreement between a Contractor and any subcontractor as well as between subcontractors and their subcontractors of any tier.
Contractor Insurance Cost:	The costs of ROCIP coverage are defined as the amount of Contractor's and eligible Subcontractors' of every tier reduction in insurance costs due to participation in the DEN ROCIP.

Rolling Owner Controlled Insurance Program (ROCIP): A coordinated insurance program providing certain coverage, as defined herein, for DEN, Contractor and Enrolled Subcontractors, along with their Eligible Employees, performing Work at the Project Site.

Eligible Employees: Employees of the Contractor and Enrolled Subcontractors who are not excluded from the ROCIP under the “Excluded Parties” definition.

Enrolled Parties: The Contractor and those subcontractors that have submitted all necessary enrollment information and been accepted into the ROCIP as evidenced by the issuance of a Certificate of Insurance.

Ineligible/Excluded Parties: Parties not covered by the ROCIP because of ineligibility or DEN explicit exclusion. No insurance coverage provided by DEN under the ROCIP shall extend to the activities or products of the following:

- Any person or organization that fabricates or manufactures products, materials or supplies away from a Project Site with no direct onsite installation responsibility

Exception: The ROCIP Insurer may agree to extend General Liability coverage only if the General Contractor has a written contract with the off-site fabricator or manufacturer to provide the pre-fabricated product. To consider extending coverage, the Insurer requires 30 days advance written notice to the ROCIP Administrator with details of the work/product and a copy of the contract between the General Contractor and the off-site fabricator or manufacturer. Approval must be obtained from the Insurer before enrolling in the ROCIP for General Liability coverage only.

- Scaffolding contractors (erecting and dismantling scopes of work only)
- Hazardous materials remediation, removal, or transportation companies and their consultants
- Architects, engineers, surveyors and their consultants
- Truckers, haulers, material dealers, vendors, suppliers, and others who merely transport, pick up, deliver, or carry materials, personnel, parts or equipment or any other items or persons to or from a Project Site including companies providing supplemental services
- Contractors, subcontractors and subconsultants who do not work at a Project Site
- Employees of an Enrolled Party who either (i) do not work on-site or (ii) occasionally visit a Project Site to make deliveries, pick-up supplies or personnel, to perform supervisory or progress inspections, or for any other reason

- Temporary labor employees (individuals working directly for the Contractor and not procured through a third party such as a Professional Employer Organization)

Exception: The ROCIP Insurer typically will accept including employees working for a contractor, or employed by temporary staffing agencies or professional employer organizations, as long as those employer-entities are enrolled as subcontractors to supply supplemental workforce.

Insured: (liability policies)	DEN, Contractor and Enrolled Parties and their Eligible Employees and any other party named in the insurance policies.
Insurers:	Those insurance companies providing the DEN ROCIP coverage. The insurers will be identified on the issued Certificate of Insurance and in the DEN ROCIP Insurance Manual.
Net Bid:	Contractor bids with insurance costs removed because of the obligation of any Enrolled Party to delete insurance costs for coverage provided by the ROCIP from its bid and all change orders. Net bids are subject to verification by the Administrator through the providing of contractors' rate and declaration pages from their Insurance policies.
ROCIP Administrator:	The DEN ROCIP Administrator will be identified in the DEN ROCIP Insurance Manual.
ROCIP Insurance Manual:	A reference document provided to Contractor and subcontractors of all tiers, which summarizes the terms and provisions of the DEN ROCIP and provides information about requirements and compliance.
ROCIP Safety Manual:	A reference document provided to Contractor and subcontractors of all tiers which contains workplace safety requirements of all Enrolled Parties.
Off Site Work:	Work performed away from the Project Site.
Payroll:	For purposes of the ROCIP only, refers to Unburdened Straight Time Payroll per Workers Compensation Class Code.
Policy Owner:	City and County of Denver and Denver International Airport
Project:	The Project as defined in the contract documents and as described in the Declarations of the DEN ROCIP insurance policies.

Project Site: Means those areas designated in writing by DEN in a Contract document for performance of the Work and such additional areas as may be designated in writing by DEN for Contractors' use in performance of the Work. Subject to the ROCIP Insurer(s) written approval, the term "Project Site" shall also include: (1) field office sites, (2) property used for bonded storage of material for the Project approved by DEN, staging areas dedicated to the Project, and (4) areas where activities incidental to the Project are being performed by Contractor or subcontractors covered by the DEN ROCIP Worker's Compensation policy (if included), but excluding any permanent locations of any Enrolled Party.

Items 1 through 4 above must be approved by the ROCIP Insurer and listed on the DEN ROCIP insurance policies.

Subcontract: The written agreement between Contractor and subcontractor, or between subcontractor and a lower tier subcontractor, describing the Work, subcontract terms and conditions, or a portion thereof.

Subcontractor: Includes those persons, firms, joint venture entities, corporations, or other parties that enter into a Subcontract with Contractor to perform Work at the Project Site and any of these subcontractor's lower-tier subcontractors.

Work: Operations, as fully described in the Contract and Subcontract, performed at the Project Site.

City and County of Denver



TIMOTHY M. O'BRIEN, CPA
AUDITOR

201 West Colfax Avenue, #705 • Denver, Colorado 80202
(720) 913-5000 • Fax (720) 913-5253 • denvergov.org/auditor

TO: All Users of the City and County of Denver Prevailing Wage Schedules
FROM: Luis Osorio Jimenez, Prevailing Wage Administrator
DATE: January 8, 2024
SUBJECT: Latest Change to Prevailing Wage Schedules

The effective date for this publication will be, **Tuesday, January 9, 2024**, and applies to the City and County of Denver for **HIGHWAY CONSTRUCTION PROJECTS** (does not include residential construction consisting of single family homes and apartments up to and including 4 stories) in accordance with the Denver Revised Municipal Code, Section 20-76(c).

General Wage Decision No. CO 20240009
Superseded General Decision No. CO 20230009
Modification No. 0
Publication Date: 1/9/2024
(9 pages)

Unless otherwise specified in this document, apprentices shall be permitted only if they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor (DOL). The employer and the individual apprentice must be registered in a program which has received prior approval by the DOL. Any employer who employs an apprentice and is found to be in violation of this provision shall be required to pay said apprentice the full journeyman scale.

Attachments as listed above.

In accordance to the amendment of Section 20-76, Division 3, Article IV, Chapter 20 of the Denver Revised Municipal Code enacted on Aug 21st, 2023, the Prevailing Wage Administrator is authorized to approve and adjust all Davis Bacon classifications under \$18.29 to comply with the city's minimum wage.

| higher) for all hours
| spent performing on the
| contract in 2024.

|
| If the contract was awarded on | . Executive Order 13658
| or between January 1, 2015 and | generally applies to the
| January 29, 2022, and the | contract.
| contract is not renewed or | . The contractor must pay
all | covered workers at least
| extended on or after January | \$12.90 per hour (or the
| 30, 2022: | applicable wage rate
| listed | on this wage
| determination, | if it is higher) for all
| hours spent performing on
| that contract in 2024.

|
The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Caisson (smaller than Watson 2500 and similar), Loader (up to and including 6 cu. yd.).....\$ 33.14	14.20
(3)-Loader (under 6 cu. yd.) Denver County.....\$ 33.14	14.20
(3)-Motor Grader (blade- rough) Douglas County.....\$ 33.19	14.20
(4)-Crane (50 tons and under), Scraper (single bowl, under 40 cu. yd).....\$ 33.83	14.20
(4)-Loader (over 6 cu. yd) Denver County.....\$ 33.30	14.20
(5)-Drill Rig Caisson (Watson 2500 similar or larger), Crane (51-90 tons), Scraper (40 cu.yd and over),.....\$ 33.48	14.20
(5)-Motor Grader (blade- finish) Douglas County.....\$ 33.65	14.20
(6)-Crane (91-140 tons).....\$ 35.28	14.20

SUCO2011-004 09/15/2011

	Rates	Fringes
CARPENTER (Excludes Form Work)...	\$ 19.27	5.08
CEMENT MASON/CONCRETE FINISHER		
Denver.....	\$ 20.18	5.75
Douglas.....	\$ 18.75	3.00
ELECTRICIAN (Excludes Traffic Signal Installation).....	\$ 35.13	6.83
FENCE ERECTOR (Excludes Link/Cyclone Fence Erection).....	\$ 18.29 **	3.20
GUARDRAIL INSTALLER.....	\$ 18.29 **	3.20

HIGHWAY/PARKING LOT

STRIPING:Painter

Denver.....	\$ 18.29	**	3.21
Douglas.....	\$ 15.89	**	3.21

IRONWORKER, REINFORCING

(Excludes Guardrail

Installation).....	\$ 16.69	**	5.45
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IRONWORKER, STRUCTURAL

(Includes Link/Cyclone Fence

Erection, Excludes Guardrail

Installation).....	\$ 18.22		6.01
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LABORER

Asphalt Raker.....	\$ 16.29	**	4.25
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Asphalt Shoveler.....	\$ 21.21		4.25
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Asphalt Spreader.....	\$ 18.58		4.65
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Common or General

Denver.....	\$ 16.76	**	6.77
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Douglas.....	\$ 16.29	**	4.25
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Concrete Saw (Hand Held)....	\$ 16.29	**	6.14
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Landscape and Irrigation....	\$ 15.26	**	3.16
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Mason Tender-

Cement/Concrete

Denver.....	\$ 16.96	**	4.04
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Douglas.....	\$ 16.29	**	4.25
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Pipelayer

Denver.....	\$ 18.29	**	2.41
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Douglas.....	\$ 16.30	**	2.18
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Traffic Control (Flagger)....	\$ 18.29	**	3.05
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Traffic Control (Sets

Up/Moves Barrels, Cones,

Install Signs, Arrow

Boards and Place

Stationary Flags) (Excludes

Flaggers).....	\$ 18.29	**	3.22
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PAINTER (Spray Only).....	\$ 16.99	**	2.87
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POWER EQUIPMENT OPERATOR:

Asphalt Laydown

Denver.....	\$ 22.67		8.72
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Douglas.....	\$ 23.67		8.47
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Asphalt Paver		
Denver.....	\$ 24.97	6.13
Douglas.....	\$ 25.44	3.50
Asphalt Roller		
Denver.....	\$ 23.13	7.55
Douglas.....	\$ 23.63	6.43
Asphalt Spreader.....	\$ 22.67	8.72
Backhoe/Trackhoe		
Douglas.....	\$ 23.82	6.00
Bobcat/Skid Loader.....	\$ 18.29 **	4.28
Boom.....	\$ 22.67	8.72
Broom/Sweeper		
Denver.....	\$ 22.47	8.72
Douglas.....	\$ 22.96	8.22
Bulldozer.....	\$ 26.90	5.59
Concrete Pump.....	\$ 21.60	5.21
Drill		
Denver.....	\$ 20.48	4.71
Douglas.....	\$ 20.71	2.66
Forklift.....	\$ 15.91 **	4.68
Grader/Blade		
Denver.....	\$ 22.67	8.72
Guardrail/Post Driver.....	\$ 16.07 **	4.41
Loader (Front End)		
Douglas.....	\$ 21.67	8.22
Mechanic		
Denver.....	\$ 22.89	8.72
Douglas.....	\$ 23.88	8.22
Oiler		
Denver.....	\$ 23.73	8.41
Douglas.....	\$ 24.90	7.67
Roller/Compactor (Dirt and Grade Compaction)		
Denver.....	\$ 20.30	5.51
Douglas.....	\$ 22.78	4.86
Rotomill.....	\$ 16.22 **	4.41
Screed		
Denver.....	\$ 22.67	8.38
Douglas.....	\$ 29.99	1.40
Tractor.....	\$ 13.13 **	2.95
TRAFFIC SIGNALIZATION:		
Groundsman		
Denver.....	\$ 18.29	3.41

Douglas.....	\$ 18.67		7.17
TRUCK DRIVER			
Distributor			
Denver.....	\$ 18.29		5.82
Douglas.....	\$ 16.98	**	5.27
Dump Truck			
Denver.....	\$ 18.29	**	5.27
Douglas.....	\$ 16.39	**	5.27
Lowboy Truck.....	\$ 18.29		5.27
Mechanic.....	\$ 26.48		3.50
Multi-Purpose Specialty & Hoisting Truck			
Denver.....	\$ 18.29		3.17
Douglas.....	\$ 20.05		2.88
Pickup and Pilot Car			
Denver.....	\$ 18.29	**	3.77
Douglas.....	\$ 16.43	**	3.68
Semi/Trailer Truck.....	\$ 18.39		4.13
Truck Mounted Attenuator....	\$ 18.29	**	3.22
Water Truck			
Denver.....	\$ 26.27		5.27
Douglas.....	\$ 19.46		2.58

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

**Office of the Prevailing Wage
Administrator for Supplemental Rates
(Specific to Denver projects)
Revision Date 01-01-2024**

Classification		Base	Fringe
Guard Rail Installer		\$18.29	\$3.20
Highway Parking Lot Striping: Painter		\$18.29	\$3.21
Ironworker (Ornamental)		\$26.05	\$12.00
Laborer	Removal of Asbestos	\$21.03	\$8.55
Laborer (Landscape & Irrigation)		\$18.29	\$3.16
Laborer: Traffic Control (Flagger)		\$18.29	\$3.05
Laborer: Stationary Flags (excludes Flaggers)		\$18.29	\$3.22
Line Construction	Lineman, Gas Fitter/Welder	\$36.88	\$9.55
	Line Eq Operator/Line Truck Crew	\$25.74	\$8.09
Millwright		\$28.00	\$10.00
Pipefitter		\$30.45	\$12.85
Plumber		\$30.19	\$13.55
Power Equipment Operator (Tunnels Above and Below Ground, shafts and raises):	Group 1	\$25.12	\$10.81
	Group 2	\$25.47	\$10.85
	Group 3	\$25.57	\$10.86
	Group 4	\$25.82	\$10.88
	Group 5	\$25.97	\$10.90
	Group 6	\$26.12	\$10.91
	Group 7	\$26.37	\$10.94
Power Equipment Operator	Group 1	\$22.97	\$10.60
	Group 2	\$23.32	\$10.63
	Group 3	\$23.67	\$10.67
	Group 4	\$23.82	\$10.68
	Group 5	\$23.97	\$10.70
	Group 6	\$24.12	\$10.71
	Group 7	\$24.88	\$10.79
Truck Driver	Group 1	\$18.42	\$10.00
	Group 2	\$19.14	\$10.07
	Group 3	\$19.48	\$10.11
	Group 4	\$20.01	\$10.16
	Group 5	\$20.66	\$10.23
	Group 6	\$21.46	\$10.31
Truck Driver: Truck Mounted Attenuator		\$18.29	\$3.22

Go to <http://www.denvergov.org/Auditor> to view the Prevailing Wage Clarification Document for a list of complete classifications used

EXHIBIT E
SPECIAL CONDITIONS
202473360 – RW 17L-35R COMPLEX PAVEMENT REHABILITATION AND
ELECTRICAL UPGRADE – PACKAGE 2

SC-1 CONSTRUCTION CONTRACT GENERAL CONDITIONS

The Construction Contract General Conditions which constitute a part of the Contract Documents are set forth in a separately published document, entitled “City and County of Denver, Department of Aviation and Department of Public Works, Standard Specifications for Construction, General Contract Conditions,” 2011 Edition, the Table of Contents to which is bound herein (which may be informally referred to as the Yellow Book). The General Conditions book is available for purchase for \$12.00 per copy at the following locations during the business hours stated, Monday through Friday, excluding holidays:

Office of the Cashier
Wellington E. Webb Municipal Office Building, 2nd Floor
201 West Colfax Avenue
Denver, Colorado, USA 80202
7:30 a.m. to 4:30 p.m.

The General Conditions are also available on the City and County of Denver website at:

<https://www.denvergov.org/content/denvergov/en/contract-administration/contractor-resources/general-contract-conditions.html>

SC-2 DRAWINGS AND SPECIFICATIONS TO BE FURNISHED BY THE CITY

The City will provide the following Contract Documents to the Contractor in electronic format at no expense to the Contractor:

1. Division 1 Specifications 05/29/2024
2. Division 2 Specifications 05/29/2024
3. Construction Drawings 05/29/2024
4. Construction Safety and Phasing Plan 03/01/2024

Additional copies of the foregoing documents will be furnished to the Contractor at the Contractor’s expense. The Contractor will be responsible for supplying all subcontractors with copies of the Contract Documents at its expense.

If Sensitive Security Information (SSI) is provided to the Contractor, the Contractor shall be required to comply with Department of Aviation, Standard Policies and Procedures No. 6003, “Contractor Protection of Sensitive Security Information,” or its successor, and 49 C.F.R. § 1520, or its successor.

The City will not supply any copies of the General Contract Conditions to the Contractor at City expense.

SC-3 REVISIONS TO G.C. 201

The second sentence of General Condition 201 is amended to read: “The unit responsible for this management and control is the Airport Infrastructure Management Office under the supervision of the Senior Vice President for Maintenance and Airport Infrastructure Management.”

SC-4 CITY LINE OF AUTHORITY AND CONTACTS

In accordance with General Condition 214, the City’s line of authority for administration of this Contract is:

Chief Executive Officer (CEO). Executive Office, 9th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249. Any reference to the Manager of Aviation shall also mean Chief Executive Officer, Department of Aviation (CEO).

Executive Vice President – Chief Construction and Infrastructure Officer (EVP-CCIO) who reports to the CEO. Design, Engineering and Construction office, 9th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Senior Vice President – Design, Engineering and Construction (SVP-DEC) who reports to the COO. Design, Engineering and Construction office, 10th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Director of Infrastructure and Quality Assurance, reports to the SVP-DEC. The Project Manager reports to the Director of Infrastructure and Quality Assurance. Design, Engineering and Construction Division, 7th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249.

Project Manager, the City representative who has day to day administrative responsibility of this Contract, and who reports to the SVP-DEC. All notices, requests, pay applications (pursuant to G.C. 902), and other correspondence from the Contractor shall be sent to the assigned Project Manager unless otherwise provided in this Contract. The Project Manager for this Contract is: Kathryn Stevens, Design, Engineering and Construction Office, 7th Floor, Airport Office Building, 8500 Peña Boulevard, Denver, CO 80249, phone 303-342-2200.

The CEO may from time to time substitute a different City official as the designated “SVP-DEC” hereunder, and any such change will be effective upon the issuance of written notice to the Contractor which identifies the successor SVP-DEC. The SVP-DEC may from time to time change the assigned Project Manager, and any such change will be effective upon the issuance of written notice to the Contractor which identifies the successor Project Manager.

SC-5 CONTRACTOR PERFORMANCE; SUBCONTRACTING

With respect to General Condition 501, no more than sixty-five percent (65%) of the work may be subcontracted. If it is determined to be in the City’s best interest, this percentage may be

modified throughout the course of the project by the SVP-DEC.

SC-6 COOPERATION WITH OTHERS

The Technical Specifications describe the constraints on the physical work site areas. These descriptions are not exhaustive, and the Contractor is required to coordinate its activities and work as may be required to meet Federal Aviation Administration (FAA) or City requirements while performing work on DEN.

Without limiting the foregoing, the following contracts administered by the City involve or may involve work overlapping or adjoining the Work under this Contract and may be prosecuted concurrently with the Work performed under this Contract. There are no other adjoining or overlapping contracts which are not listed.

SC-7 PROSECUTION AND COMPLETION OF THE WORK:

The Work to be performed under the Contract is described in the Technical Specifications and Contract Drawings. The Contractor shall complete the Work within seventy-five (75) consecutive calendar days from Notice to Proceed.

The Work to be performed under the Contract may be divided into the Milestone Areas which are described in the Technical Specifications or Contract Drawings. The Contractor shall complete the work included within these areas within the number of days set forth by the Project Manager.

	<u>Milestone</u>	<u>Date of Completion (or, days from NTP)</u>
1.	Milestone 1 – Taxiway P	75 days from NTP
2.	Milestone 2 – Taxiway EC	75 days from NTP

SC-8 LIQUIDATED DAMAGES

If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, the Contractor shall be liable to the City for liquidated damages at the rate of Twenty-Five Thousand Dollars (\$25,000.00) per day until substantial completion is achieved.

	<u>Milestone</u>	<u>Liquidated Damages, Per Day</u>
1.	Milestone 1 – Taxiway P	\$25,000 per Calendar Day
2.	Milestone 2 – Taxiway EC	\$25,000 per Calendar Day

Section 9 of the Contract and General Condition 602 cover payment and withholding of liquidated damages.

SC-9 FACILITY SECURITY AND PERSONNEL ACCESS

The Contractor shall conduct all its activities at the Airport in compliance with the Airport security system rules and regulations, which are administered by the Airport Operations Division. The Contractor shall obtain the proper access authorizations for its employees, subcontractors, and

suppliers (i.e., Badges and Permits), and shall be responsible for such persons' compliance with all the Airport rules and regulations. A copy of the Contractors' section of the Airport Security rules and regulations are available for Contractor review at the Airport Access Services Office, Concourse A East Subcore, 4th Level. Persons regularly entering the construction areas must obtain personnel access badges from the Airport Access Services Office and must display badges, at all times, upon entering the construction, restricted and sterile areas of the airport. Any employee, subcontractor or supplier who violates such rules may be subject to revocation of his access authorization, including authorization for access to the construction site and all other restricted and sterile areas.

The security status of the Airport is subject to change without notice. These contract Special Conditions are applicable to the current security status of the Airport. Should the security status of the Airport change at any time during the term of this Contract, a written notice shall be issued to the Contractor detailing all applicable security modifications from the airport's current security status. The Contractor shall take **immediate steps** to comply with those security modifications as directed in the written notice.

If these security modifications involve any additional project cost, the Contractor shall submit a Contractor Change Request in accordance with the General Conditions for the additional cost. The Contractor Change Request shall outline in specific detail the effects of the security modifications on the Contractor's performance of the Contract and shall provide a detailed cost breakdown for each item for which the Contractor is requesting reimbursement.

The Contractor shall return to the City, at contract completion or termination, or upon demand by the City, all access keys issued to it by the City to all areas of the Airport. If the Contractor fails to return any such key or keys at contract completion or termination or upon demand by the City, the Contractor shall be liable to the City for all the City's costs, including the City's labor costs for employees, incurred in re-coring doors and any other work which is required to prevent compromise of the Airport security system. In order to collect such costs hereunder, the City may withhold funds in such amount from any amounts due and payable to the Contractor under this Contract.

The construction of all the Project / Task Items that involve the breaching of any airport perimeter security boundary or continued access to restricted access rooms or areas will require the posting of authorized contract security personnel to maintain required security controls. The Contractor's **Total Contract BID Amount** shall include the cost of providing security services to maintain control and supervision of any and all airport perimeter security boundary breaches and for the duration of work activities where access to restricted areas is required and until the airport perimeter security boundaries are reestablished.

When security boundaries are opened for any reason, the Contractor must maintain one hundred percent (100%) control and supervision for the entire time that the openings are present to prevent unauthorized access to the secure / restricted access areas.

THE IMPORTANCE OF THIS SPECIAL CONDITION CANNOT BE OVER-EMPHASIZED. SEVERE FINANCIAL PENALTIES AS WELL AS CONTRACT TERMINATION COULD RESULT IF AIRPORT PERIMETER SECURITY REQUIREMENTS ARE NOT STRICTLY FOLLOWED. THE REQUIREMENT TO PROVIDE ONE HUNDRED PERCENT (100%) CONTROL AND SUPERVISION OF BREACHES IN THE AIRPORT'S PERIMETER SECURITY BOUNDARY IS ABSOLUTE. AT NO TIME, DURING WORK AND NON-WORK HOURS SHALL ANY BREACHES IN THE AIRPORT'S SECURITY PERIMETER BE UNSUPERVISED AND / OR UNSECURED.

For off-hours of construction, the Contractor may choose to erect a temporary wall to close all perimeter openings. The wall construction shall be of sufficient materials and strength to prevent access to the airport's Sterile/Restricted Areas. The Contractor shall submit for review and approval, the details, and materials for the temporary closure of security perimeter breaches for review and approval.

The Contractor will provide contract security guard services to maintain supervision of these openings. The security services must provide coverage to allow for lunch breaks, comfort breaks etc. The security services **must** be obtained from the following contract security guard company:

Covenant Aviation Security, LLC
1112 W. Boughton Road
Suite 355
Bolingbrook, IL 60440

DEN Contact:
Covenant Management
720-222-4774

All security guards provided for this project must have a Denver Airport SIDA Badge.

The DEN Security Guard Contractor may change between the Bidding or Bid phase of this contract from Notice to Proceed to closure of all security perimeter breaches. The Contractor shall maintain a contractual relationship with the Security Guard Contractor holding the most current contract with Denver International Airport.

The Contractor shall continue to provide security of these areas until such time that the breaches in the airport's security perimeter have been permanently secured.

The Contractor shall submit a written security plan for approval to the Director of Airport Security prior to the start of construction on any work where a breach of the perimeter security boundaries is required.

SC-10 CONSTRUCTION ACCESS

The work site is located at Runway 17L-35R Complex. The Contractor shall have access to the work site via P Gates in vicinity of Access Gate 7, with all equipment and materials delivery routes

TBD. The Contractor is responsible for ensuring all of the Contractor's and Subcontractor's personnel have the ability to access and locate the areas of work where the scope is to be performed without additional escorting or supervision from DEN.

The City will not provide parking spaces for the Contractor's employees or subcontractor employees at the Airport. Arrangements for transportation and parking for all of its and its subcontractors' employees will be the responsibility of the Contractor. The Total Contract Bid Amount or Contract Amount shall include any and all costs associated with the Contractor's and subcontractors' employee parking. Information about parking facilities and charges is available from the Airport Parking Office. Refundable deposits are required for all parking passes.

Unless specifically required by the Contract Documents, the Contractor shall install no fences or other physical obstructions on or around any project work area without the approval of the City.

SC-11 VEHICLE PERMITTING

Vehicle access on the Airport Operation Area (AOA) is controlled by and requires permission from the Airport Access Services Office. The Contractor will need to operate vehicles on the AOA to perform the Work.

SC-12 VENDORS AND SUPPLIERS

The Contractor shall provide the Project Manager's office with a list of its equipment/material vendors and suppliers. Vendors or suppliers shall access the construction work areas via the Contractor's access route, described in SC-10 above. All delivery vehicles are subject to search.

SC-13 COMMUNICATION DEVICES

Any site communications devices, mobile communication devices or internet data devices used at DEN must be approved by DEN Technologies.

SC-14 USE, POSSESSION OR SALE OF ALCOHOL OR DRUGS

The Contractor and its officers, agents, and employees shall cooperate and comply with the provisions of Executive Order No. 94 and Attachment A thereto concerning the use, possession, or sale of alcohol or drugs. Violation of these provisions or refusal to cooperate with implementation of the policy can result in the City's barring the Contractor from City facilities or participating in City operations.

SC-15 ATTORNEYS' FEES

Colorado Revised Statutes 38-26-107 requires that in the event any person or company files a verified statement of amounts due and unpaid in connection with a claim for labor and materials supplied on this project, the City shall withhold from payments to the Contractor sufficient funds to insure the payment of any such claims. Should the City and County of Denver be made a party to any lawsuit to enforce such unpaid claims or any lawsuit arising out of or relating to such withheld funds, Contractor agrees to pay to the City its costs and a reasonable attorney's fee. Because the City Attorney Staff does not bill the City for legal services on an hourly basis, Contractor agrees a reasonable fee shall be computed at the rate of two hundred dollars (\$200)

per hour of City Attorney time.

SC-16 INSURANCE REQUIREMENTS

In accordance with the provisions of Title 16 of the General Conditions, the minimum insurance requirements for this contract are set forth in [Section II-14 of the Instructions to Bidders]. The Contractor specifically agrees to comply with each condition, requirement or specification set forth in the attachment for each required coverage during all periods when the required coverages are in effect.

Contractor and sub-contractors shall procure and maintain until all of their obligations have been discharged, including any warranty periods under this Contract are satisfied, required insurance against claims for injury to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the Contractor, his agents, representatives, employees or sub-contractors.

The insurance requirements herein are minimum requirements for this Contract and in no way limit the indemnity covenants contained in this Contract.

The City and County of Denver in no way warrants that the minimum limits contained herein are sufficient to protect the Contractor from liabilities that might arise out of the performance of the work under this Contract by the Contractor, his agents, representatives, employees, or sub-contractors. The Contractor shall assess its own risks as it deems appropriate and/or prudent, maintain higher limits and/or broader coverages. The Contractor is not relieved of any liability or other obligations assumed or pursuant to the Contract by reason of its failure to obtain or maintain insurance in sufficient amounts, duration, or types.

Contractor shall furnish the City and County of Denver with certificates of insurance (ACORD form or equivalent approved by CCD) as required by this Contract. The certificates for each insurance policy are to be signed by a person authorized by the insurer to bind coverage on its behalf.

All certificates and any required endorsements are to be received and approved by the City before work commences. Each insurance policy required by this Contract must be in effect at or prior to commencement of work under this Contract and remain in effect for the duration of the project. Failure to maintain the insurance policies as required by this Contract or to provide evidence of renewal is a material breach of the Contract. All insurance coverages for sub-contractors shall be subject to the minimum requirements identified in the Exhibit. All sub-contractors' certificates and endorsements shall be received and approved by the Contractor before work commences. The City reserves the right to request copies of these certificates at any time.

All certificates required by this Contract shall be sent directly to ContractAdminInvoices@flydenver.com. The City project/contract number and project description shall be noted on the certificate of insurance. The City reserves the right to require complete, certified copies of all insurance policies required by this Contract at any time.

The parties hereto understand and agree that the City and County of Denver, its officers, officials and employees, are relying on, and do not waive or intend to waive by any provisions of this Contract, the monetary limitations or any other rights, immunities and protections provided by the Colorado Governmental Immunity Act, §§ 24-10-101 - 120, C.R.S., or otherwise available to the City and County of Denver, its officers, officials and employees.

SC-18 ADDITIONAL AFFIRMATIVE ACTION REQUIREMENTS, FEDERAL PROVISIONS

This contract is subject and subordinate to the terms, reservations, restrictions, and conditions of any existing or future agreements between the City and the United States, the execution of which has been or may be required as a condition precedent to the transfer of federal rights or property to the City for airport purposes, and the expenditure of federal funds for airport purposes. The “Federal Requirements” section attached hereto is made a part of this Contract.

SC-19 ESTIMATED QUANTITIES OF UNIT PRICED ITEMS

The “total estimated quantity” of each unit price item as stated on the Bid schedules shall be the estimated quantity which is used to determine the percentage of change in such item for purposes of G.C. 1104.7.

SC-20 REVISIONS TO G.C. 1102

G.C. 1102.2 is amended by replacing the phrase “Change Request” in all its occurrences in such G.C. with the phrase “Change Notice.”

G.C. 1102.3 is amended by replacing the phrase “Field Order/Change Order Directive” in all its occurrences in such G.C. with the phrase “Change Order Directive.”

SC-21 LISTING OF ACCEPTABLE MANUFACTURERS

The Technical Specifications list “Acceptable Manufacturers” for certain products. Such listing identifies manufacturers of certain products which have been determined by a preliminary review to be able to meet the basic product and/or system technical requirements. The listing is not intended to provide a blanket endorsement or acceptance of the manufacturer’s specified products or product line. All products from listed manufacturers must meet the detailed requirements of the Technical Specifications. Products that do not meet all detailed Technical Specifications are not acceptable and will be rejected, regardless of whether the manufacturer was listed as “acceptable.” The Contractor is responsible for determining the acceptability of all products under the Technical Specifications prior to submission of products for approval.

SC-22 ACCESSIBLE PARKING SPACES, ACCESS AISLES AND ROUTES OF TRAVEL

If any Work is performed in or adjacent to parking facilities at the Airport, the Contractor is responsible for compliance with this SC-30. “Accessible” parking spaces and access aisles as used in this SC-30 mean parking spaces and access aisles which are accessible for, and reserved for use by, persons with disabilities. These parking spaces and access aisles are designed and built to standards established by federal regulations implementing the Americans with Disabilities Act of 1990 (ADA) and are marked by signage. “Accessible routes of travel” as used herein means routes through parking facilities which comply with ADA accessibility standards, including degree of

slope and absence of obstructions.

Accessible routes of travel and accessible parking spaces and access aisles must be kept free of obstructions and construction debris at all times. No accessible parking spaces or access aisles or accessible routes of travel shall be relocated, blocked, or rendered unusable unless the contractor has obtained specific advance approval in writing for such actions from the airport's ADA Compliance Officer.

When prosecution of the Work requires that accessible spaces be temporarily blocked, those accessible spaces and their access aisles shall be temporarily relocated to another location as close as possible to an accessible building entrance. Temporary signage that identifies these parking spaces and access aisles as reserved for the handicapped shall be installed, and the accessible route shall be clearly marked as required.

Before blocking or relocating accessible parking spaces or accessible routes of travel, the contractor must obtain written approval from the DEN ADA Compliance Officer, by submitting a completed request form, which will be provided to the Contractor by the Project Manager at the preconstruction meeting if it is not included as a standard form in Section 019990 of the Technical Specifications. The request shall include the location of alternative spaces and/or routes, and specifications of the temporary signage to be used. Work shall not proceed without this approval.

If a vehicle is parked in any accessible space which is either temporary or approved to be relocated, the contractor will not remove signage or take any other action which would allow the access aisle for such parking space to be blocked. Such actions must be postponed until the parking space is no longer occupied.

SC-23 SUBCONTRACTOR PAYMENTS AND SUBCONTRACTOR RELEASES – REQUIRED USE OF THE B2G CONTRACT MANAGEMENT SYSTEM

The Contractor is required to use the City B2G Contract Management System to report all subcontractor payments and shall adhere to the City's Procedure for Reporting Subcontractor Payments. It is the Contractor's obligation to ensure that complete subcontractor information is entered into the B2G System prior to submission of the first application for payment in order to avoid any delays in payment. The Contractor shall, prior to the submission of each subsequent invoice, ensure payments to subcontractors have been entered into the B2G System, including subcontractor confirmation of amount of payment received, for services performed during the prior billing period.

SC-24 PAYMENTS TO CONTRACTORS

The Contractor recognizes and agrees that applications for payment shall be submitted using the Textura® Payment Management System (PPM System), which will also be the payment mechanism to disburse payments to sub-contractors used on this Project. For more information, please refer to Division I, Technical Specifications.

The Contractor further agrees that, to the fullest possible within the TPM System, the City shall be entitled to all non-Confidential records, reports, data, and other information related to the project that are available to Contractor through the TPM System, including, but not limited to, information related to Contractor and subcontractor billings. To that end, Contractor agrees that it will activate any available settings within the TPM System that are necessary to grant the City access to such non-Confidential information related to the contract and the project. Applications for payment shall be based on the Contract Unit Prices or the approved Schedule of Values described in GC 903.1

In accordance with General Contract Condition 902, PAYMENT PROCEDURE, the party(ies) responsible for review of all Pay Applications shall be:

Agency/Firm

DEN Division CA

DEN Division PM

DEN Division Director

DEN Contract Procurement CA

CCD Denver Prevailing Wage

In accordance with General Contract Condition 906, APPLICATIONS FOR PAYMENT, each Application submitted shall include the following:

1. The estimate of Work completed shall be based on the approved schedule of values or unit prices, as applicable, and the percent of the Work complete.
2. Each Application for Payment shall include each and every independent subcontractor's payroll information including pay dates and pay amounts.
3. The Contractor shall also submit to the Auditor and other appropriate officials of the City in a timely fashion, information required by General Contract Condition 1004, REPORTING WAGES PAID.

In accordance with General Contract condition 907, RELEASES AND CONTRACTORS' CERTIFICATION OF PAYMENT, Applications for Payment must be accompanied by a completed Final Claim Release Form, as appropriate, from EACH subcontractor and supplier, **AND** the Contractor's Certification of Payment Form.

EXHIBIT F

City and County of Denver



D E N V E R
THE MILE HIGH CITY

**DEPARTMENT OF AVIATION
DEPARTMENT OF PUBLIC WORKS**

**STANDARD SPECIFICATIONS FOR
CONSTRUCTION
GENERAL CONTRACT CONDITIONS**

2011 Edition

Statement

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Bond Numbers:

Liberty - 015224413, Travelers - 107961256
 F&D/Zurich - 9430996, Federal - K41785822
 CNA - 30206124, BH - 47-SUR-300033-01-0828

XI. ATTACHMENT 6, PERFORMANCE AND PAYMENT BOND**PERFORMANCE BOND**

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned Flatiron Constructors, Inc. **[Bidder name]**, a corporation organized under the laws of the State of Delaware **[Bidder state]**, hereinafter referred to as the "Contractor" and SEE ATTACHMENT A **[Bond issuer]**, a corporation organized under the laws of the State of SEE ATTACHMENT A **[Bond company state]**, and authorized to transact business in the State of Colorado, hereinafter referred to as Surety, are held and firmly bound unto the CITY AND COUNTY OF DENVER, a municipal corporation of the State of Colorado, hereinafter referred to as the "CITY", in the penal sum of ^{Nine Million One Hundred Sixty Thousand} Nine Hundred Twenty-Nine and 00/100 Dollars **[Bid amount text]** Dollars (\$9,160,929.00 *****), lawful money of the United States of America, for the payment of which sum the Contractor and Surety bind themselves and their heirs, executors, administrators, successors and assigns, jointly and severally by these presents.

WHEREAS, the above Contractor has, as of the date of execution listed on the contract signature page, entered into a written contract with the City for furnishing all labor, materials, equipment, tools, superintendence, and other facilities and accessories for the construction of 202473360, RW 17L-35R Complex Pavement Rehabilitation and Electrical Upgrade-Package 2, Denver International Airport, in accordance with the Technical Specifications, Contract Drawings and all other Contract Documents therefor which are incorporated herein by reference and made a part hereof, and are herein referred to as the Contract.

NOW, THEREFORE, the condition of this performance bond is such that if the Contractor:

1. Promptly and faithfully observes, abides by, and performs each and every covenant, condition and part of said Contract, including, but not limited to, its warranty provisions, in the time and manner prescribed in the Contract, and
2. Pays the City all losses, damages (liquidated or actual, including, but not limited to, damages caused by delays in the performance of the Contract), expenses, costs and attorneys' fees, that the City sustains resulting from any breach or default by the Contractor under the Contract, then this bond is void; otherwise, it shall remain in full force and effect.

IN ADDITION, if said Contractor fails to duly pay for any labor, materials, team hire, sustenance, provisions, provender, or any other supplies used or consumed by said Contractor or its subcontractors in its performance of the work contracted to be done or fails to pay any person who supplies rental machinery, tools, or equipment, all amounts due as the result of the use of such machinery, tools, or equipment in the prosecution of the work, the Surety shall pay the same in an amount not exceeding the amount of this obligation, together with interest as provided by law.

PROVIDED FURTHER, that the said Surety, for value received, hereby stipulates, and agrees that any and all changes in the Contract or compliance or noncompliance with the formalities in the Contract for making such changes shall not affect the Surety's obligations under this bond and the Surety hereby waives notice of any such changes.

(End of Page)

IN WITNESS WHEREOF, said Contractor and said Surety have executed these presents as of this ____ day of _____, 2024.

Flatiron Constructors, Inc.

CONTRACTOR

Kevin Lynch
Kevin Lynch
DIVISIONAL FINANCE MANAGER

By: [Signature]
President GRANT JOHNS VICE PRESIDENT



SEE ATTACHMENT A

SURETY

By: SEE ATTACHMENT A
Attorney-in-Fact

(Accompany this bond with Attorney-in-Fact's authority from the Surety to execute bond, certified to include the date of the bond.)

ATTACHMENT A

BOND NUMBERS:	Liberty Bond No.:	015224413
	Travelers Bond No.:	107961256
	F&D/Zurich Bond No.:	9430996
	Federal Bond No.:	K41785822
	Continental Bond No.:	30206124
	Berkshire Bond No.:	47-SUR-300033-01-0828

Liberty Mutual Insurance Company, a Massachusetts Corporation
Travelers Casualty and Surety Company of America, a Connecticut corporation
Fidelity and Deposit Company of Maryland, a Illinois corporation
Zurich American Insurance Company, a New York corporation
Federal Insurance Company, an Indiana corporation
The Continental Insurance Company, a Pennsylvania Corporation
Berkshire Hathaway Specialty Insurance Company, a Nebraska Corporation

Liberty Mutual Insurance Company – A.M. Best Rating A XV
175 Berkeley Street, Boston, MA 02116

Mailing Address for Notices:

Attn: Surety Claims Department
1001 4th Ave., Ste 3800, Seattle, WA 98154
Bond No. 015224413

Travelers Casualty and Surety Company of America – A.M. Best Rating A++ XV
Construction Services, One Tower Square, Hartford, CT 06183
Bond No. 107961256

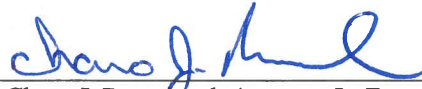
Fidelity and Deposit Company of Maryland
Zurich American Insurance Company - A.M. Best Rating A+ XV
1299 Zurich Way, 5th Floor, Schaumburg, IL 60196
Bond No. 9430996

Federal Insurance Company – A.M. Best Rating A++ XV
202B Hall's Mill Road, Whitehouse Station, NJ 08889
Bond No. K41785822

The Continental Insurance Company – A.M. Best Rating A XV
151 N Franklin Street, Chicago, IL 60606
Bond No. 30206124

Berkshire Hathaway Specialty Insurance Company – A.M. Best Rating A++ XV
1314 Douglas Street, Suite 1400, Omaha, NE 68102
Bond No. 47-SUR-300033-01-0828

By:



Charo J. Rosenond, Attorney-In-Fact

CORPORATE ACKNOWLEDGMENT

Form 152

STATE OF NEW JERSEY
COUNTY OF BERGEN

On this 29th day of May, 2024 before me personally came Charo J. Rosemond to me known, who, being by me duly sworn, did depose and say that she/he resides in Naugatuck, Connecticut that she/he is the ATTORNEY IN FACT of the LIBERTY MUTUAL INSURANCE COMPANY, TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, FIDELITY AND DEPOSIT COMPANY OF MARYLAND, ZURICH AMERICAN INSURANCE COMPANY, FEDERAL INSURANCE COMPANY, THE CONTINENTAL INSURANCE COMPANY, BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, the corporation described in and which executed the above instrument that she/he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that she/he signed her/his name thereto by like order.

(SEAL)

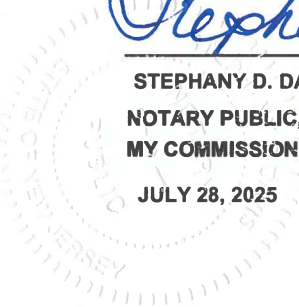


STEPHANY D. DAVIS

NOTARY PUBLIC, STATE OF NEW JERSEY

MY COMMISSION EXPIRES

JULY 28, 2025





This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: 8210087-974450

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, James Baldassare Jr, Sherryanne M. DePirro, Krista A. DiMezza, Michael Dugan, Charo J. Rosemond, Lisa M. Scavetta, Maria L. Spadaccini, John F. Surano, Nicholas F. Walsh

all of the city of Saddle Brook state of NJ each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 11th day of May, 2023.



Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: David M. Carey, Assistant Secretary

State of PENNSYLVANIA ss
County of MONTGOMERY

On this 11th day of May, 2023 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.



Commonwealth of Pennsylvania - Notary Seal
Teresa Pastella, Notary Public
Montgomery County
My commission expires March 28, 2025
Commission number 1126044
Member, Pennsylvania Association of Notaries

By: Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV - OFFICERS: Section 12. Power of Attorney.

Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII - Execution of Contracts: Section 5. Surety Bonds and Undertakings.

Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation - The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization - By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this ___ day of ___.



By: Renee C. Llewellyn, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

For bond and/or Power of Attorney (POA) verification inquiries, please call 610-832-8240 or email HOSUR@libertymutual.com.



Travelers Casualty and Surety Company of America
Travelers Casualty and Surety Company
St. Paul Fire and Marine Insurance Company

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Charo J Rosemond** of **SADDLE BROOK**, their true and lawful Attorney(s)-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this 21st day of April, 2021.



State of Connecticut

City of Hartford ss.

By: *Robert L. Raney*
Robert L. Raney, Senior Vice President

On this the 21st day of April, 2021, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of each of the Companies, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of said Companies by himself as a duly authorized officer.

IN WITNESS WHEREOF, I hereunto set my hand and official seal.

My Commission expires the 30th day of June, 2026



Anna P. Nowik
Anna P. Nowik, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of each of the Companies, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of each of the Companies, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this _____ day of _____



Kevin E. Hughes
Kevin E. Hughes, Assistant Secretary

To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.
Please refer to the above-named Attorney(s)-in-Fact and the details of the bond to which this Power of Attorney is attached.

**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by Robert D. Murray, Vice President, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint t Krista A. DIMEZZA, Charo J. ROSEMOND, John F. SURANO, Sherryanne M. DEPIRRO, Nicholas F. WALSH, Lisa M. SCAVETTA, James BALDASSARE, JR., Michael DUGAN, of Saddle Brook, New Jersey, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings**, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND, this 25th day of August, A.D. 2023.



**ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND**

By: *Robert D. Murray*
Vice President

By: *Dawn E. Brown*
Secretary

**State of Maryland
County of Baltimore**

On this 25th day of August, A.D. 2023, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, depose and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Genevieve M. Maison

**GENEVIEVE M. MAISON
NOTARY PUBLIC
BALTIMORE COUNTY, MD
My Commission Expires JANUARY 27, 2025**



Authenticity of this bond can be confirmed at bondvalidator.zurichna.com or 410-559-8790

EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify or revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF. I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this _____ day of _____, _____.



Thomas O. McClellan
Vice President

TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:

Zurich Surety Claims
1299 Zurich Way
Schaumburg, IL 60196-1056
reportsfclaims@zurichna.com
800-626-4577

Authenticity of this bond can be confirmed at bondvalidator.zurichna.com or 410-559-8790

CHUBB®

Power of Attorney

Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company
Westchester Fire Insurance Company | ACE American Insurance Company

Know All by These Presents, that FEDERAL INSURANCE COMPANY, an Indiana corporation, VIGILANT INSURANCE COMPANY, a New York corporation, PACIFIC INDEMNITY COMPANY, a Wisconsin corporation, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY corporations of the Commonwealth of Pennsylvania, do each hereby constitute and appoint James Baldassare Jr., Sherryanne M. DePirro, Krista A. DiMezza, Michael Dugan, Charo J. Rosemond, Lisa M. Scavetta, John F. Surano and Nicholas F. Walsh of Saddle Brook, New Jersey

each as their true and lawful Attorney-in-Fact to execute under such designation in their names and to affix their corporate seals to and deliver for and on their behalf as surety thereon or otherwise, bonds and undertakings and other writings obligatory in the nature thereof (other than bail bonds) given or executed in the course of business, and any instruments amending or altering the same, and consents to the modification or alteration of any instrument referred to in said bonds or obligations.

In Witness Whereof, said FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY have each executed and attested these presents and affixed their corporate seals on this 11th day of August 2023.

Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary

Stephen M. Haney

Stephen M. Haney, Vice President



STATE OF NEW JERSEY
County of Hunterdon

ss.

On this 11th day of August 2023 before me, a Notary Public of New Jersey, personally came Dawn M. Chloros and Stephen M. Haney, to me known to be Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros and Stephen M. Haney, being by me duly sworn, severally and each for herself and himself did depose and say that they are Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY and know the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that their signatures as such officers were duly affixed and subscribed by like authority.

Notarial Seal



Albert Contursi
NOTARY PUBLIC OF NEW JERSEY
No 50202369
Commission Expires August 22, 2027

Albert Contursi
Notary Public

CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016; WESTCHESTER FIRE INSURANCE COMPANY on December 11, 2006; and ACE AMERICAN INSURANCE COMPANY on March 20, 2009:

"RESOLVED, that the following authorizations relate to the execution, for and on behalf of the Company, of bonds, undertakings, recognizances, contracts and other written commitments of the Company entered into in the ordinary course of business (each a "Written Commitment"):

- (1) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise.
- (2) Each duly appointed attorney-in-fact of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise, to the extent that such action is authorized by the grant of powers provided for in such person's written appointment as such attorney-in-fact.
- (3) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to appoint in writing any person the attorney-in-fact of the Company with full power and authority to execute, for and on behalf of the Company, under the seal of the Company or otherwise, such Written Commitments of the Company as may be specified in such written appointment, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
- (4) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to delegate in writing to any other officer of the Company the authority to execute, for and on behalf of the Company, under the Company's seal or otherwise, such Written Commitments of the Company as are specified in such written delegation, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
- (5) The signature of any officer or other person executing any Written Commitment or appointment or delegation pursuant to this Resolution, and the seal of the Company, may be affixed by facsimile on such Written Commitment or written appointment or delegation.

FURTHER RESOLVED, that the foregoing Resolution shall not be deemed to be an exclusive statement of the powers and authority of officers, employees and other persons to act for and on behalf of the Company, and such Resolution shall not limit or otherwise affect the exercise of any such power or authority otherwise validly granted or vested."

I, Dawn M. Chloros, Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY (the "Companies") do hereby certify that

- (i) the foregoing Resolutions adopted by the Board of Directors of the Companies are true, correct and in full force and effect,
- (ii) the foregoing Power of Attorney is true, correct and in full force and effect.

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this _____ day of _____



Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary

IN THE EVENT YOU WISH TO VERIFY THE AUTHENTICITY OF THIS BOND OR NOTIFY US OF ANY OTHER MATTER, PLEASE CONTACT US AT:
Telephone (908) 903-3493 Fax (908) 903-3656 e-mail: surety@chubb.com

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That The Continental Insurance Company, a Pennsylvania insurance company, is a duly organized and existing insurance company having its principal office in the City of Chicago, and State of Illinois, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint

Michael Dugan, James Baldassare Jr, Sherryanne M DePirro, Nicholas F Walsh, Lisa M Scavetta, Krista A DiMezza, Charo J Rosemond, John F Surano, Individually

of Saddle Brook, NJ, its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts -

and to bind them thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the insurance company and all the acts of said Attorney, pursuant to the authority hereby given is hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the By-Law and Resolutions, printed on the reverse hereof, duly adopted, as indicated, by the Board of Directors of the insurance company.

In Witness Whereof, The Continental Insurance Company has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 20th day of July, 2023.



The Continental Insurance Company

Larry Kasten
Larry Kasten Vice President

State of South Dakota, County of Minnehaha, ss:

On this 20th day of July, 2023, before me personally came Larry Kasten to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is a Vice President of The Continental Insurance Company, a Pennsylvania insurance company, described in and which executed the above instrument; that he knows the seal of said insurance company; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said insurance company and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said insurance company.



My Commission Expires March 2, 2026

M. Bent
M. Bent Notary Public

CERTIFICATE

I, D. Johnson, Assistant Secretary of The Continental Insurance Company, a Pennsylvania insurance company, do hereby certify that the Power of Attorney herein above set forth is still in force, and further certify that the By-Law and Resolutions of the Board of Directors of the insurance company printed on the reverse hereof is still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said insurance company this _____ day of _____



The Continental Insurance Company

D. Johnson
D. Johnson Assistant Secretary

Form F6850-4-2023

Authorizing By-Laws and Resolutions

ADOPTED BY THE BOARD OF DIRECTORS OF THE CONTINENTAL INSURANCE COMPANY:

This Power of Attorney is made and executed pursuant to and by authority of the following resolutions duly adopted by the Board of Directors of the Company at a meeting held on May 10, 1995.

“RESOLVED: That any Senior or Group Vice President may authorize an officer to sign specific documents, agreements and instruments on behalf of the Company provided that the name of such authorized officer and a description of the documents, agreements or instruments that such officer may sign will be provided in writing by the Senior or Group Vice President to the Secretary of the Company prior to such execution becoming effective.

This Power of Attorney is signed by Larry Kasten, Vice President, who has been authorized pursuant to the above resolution to execute power of attorneys on behalf of The Continental Insurance Company.

This Power of Attorney is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 25th day of April, 2012.

“Whereas, the bylaws of the Company or specific resolution of the Board of Directors has authorized various officers (the “Authorized Officers”) to execute various policies, bonds, undertakings and other obligatory instruments of like nature; and

Whereas, from time to time, the signature of the Authorized Officers, in addition to being provided in original, hard copy format, may be provided via facsimile or otherwise in an electronic format (collectively, “Electronic Signatures”), Now therefore be it resolved: that the Electronic Signature of any Authorized Officer shall be valid and binding on the Company.”

This Power of Attorney may be signed by digital signature and sealed by a digital or otherwise electronic-formatted corporate seal under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 27th day of April, 2022:

“RESOLVED: That it is in the best interest of the Company to periodically ratify and confirm any corporate documents signed by digital signatures and to ratify and confirm the use of a digital or otherwise electronic-formatted corporate seal, each to be considered the act and deed of the Company.”



Power Of Attorney

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY
NATIONAL INDEMNITY COMPANY / NATIONAL LIABILITY & FIRE INSURANCE COMPANY

Know all men by these presents, that BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, a corporation existing under and by virtue of the laws of the State of Nebraska and having an office at One Lincoln Street, 23rd Floor, Boston, Massachusetts 02111, NATIONAL INDEMNITY COMPANY, a corporation existing under and by virtue of the laws of the State of Nebraska and having an office at 3024 Harney Street, Omaha, Nebraska 68131 and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, a corporation existing under and by virtue of the laws of the State of Connecticut and having an office at 100 First Stamford Place, Stamford, Connecticut 06902 (hereinafter collectively the "Companies"), pursuant to and by the authority granted as set forth herein, do hereby name, constitute and appoint: Charo J. Rosemond, Lisa M. Scavetta, Sherryanne M. DePirro, Nicholas F. Walsh, James Baldassare, Jr., Krista A. DiMezza, John F. Surano, Michael Dugan, 250 Pehle Avenue, Suite 311 of the city of Saddle Brook, State of New Jersey, their true and lawful attorney(s)-in-fact to make, execute, seal, acknowledge, and deliver, for and on their behalf as surety and as their act and deed, any and all undertakings, bonds, or other such writings obligatory in the nature thereof, in pursuance of these presents, the execution of which shall be as binding upon the Companies as if it has been duly signed and executed by their regularly elected officers in their own proper persons. This authority for the Attorney-in-Fact shall be limited to the execution of the attached bond(s) or other such writings obligatory in the nature thereof.

In witness whereof, this Power of Attorney has been subscribed by an authorized officer of the Companies, and the corporate seals of the Companies have been affixed hereto this date of August 24, 2023. This Power of Attorney is made and executed pursuant to and by authority of the Bylaws, Resolutions of the Board of Directors, and other Authorizations of BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, NATIONAL INDEMNITY COMPANY and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, which are in full force and effect, each reading as appears on the back page of this Power of Attorney, respectively. The following seals of the Companies and signatures by an authorized officer of the Company may be affixed by facsimile or digital format, which shall be deemed the equivalent of and constitute the written signature of such officer of the Companies and original seals of the Companies for all purposes regarding this Power of Attorney, including satisfaction of any signature and seal requirements on any and all undertakings, bonds, or other such writings obligatory in the nature thereof, to which this Power of Attorney applies.

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY,

[Signature of David Fields]

By: David Fields, Executive Vice President



NATIONAL INDEMNITY COMPANY, NATIONAL LIABILITY & FIRE INSURANCE COMPANY,

[Signature of David Fields]

By: David Fields, Vice President



NOTARY

State of Massachusetts, County of Suffolk, ss:

On this 24th day of August, 2023, before me appeared David Fields, Executive Vice President of BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY and Vice President of NATIONAL INDEMNITY COMPANY and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, who being duly sworn, says that his capacity is as designated above for such Companies; that he knows the corporate seals of the Companies; that the seals affixed to the foregoing instrument are such corporate seals; that they were affixed by order of the board of directors or other governing body of said Companies pursuant to its Bylaws, Resolutions and other Authorizations, and that he signed said instrument in that capacity of said Companies.

[Notary Seal]



[Signature of John C. Skinner]
Notary Public

I, Ralph Tortorella, the undersigned, Officer of BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, NATIONAL INDEMNITY COMPANY and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies which is in full force and effect and has not been revoked. IN TESTIMONY WHEREOF, see hereunto affixed the seals of said Companies this _____.



[Signature of Ralph Tortorella]

Ralph Tortorella, Officer

To verify the authenticity of this Power of Attorney please contact us at: BHSI Surety Department, Berkshire Hathaway Specialty Insurance Company, One Lincoln Street, 23rd Floor Boston, MA 02111 | (770) 625-2516 or by email at Jennifer.Porter@bhspecialty.com THIS POWER OF ATTORNEY IS VOID IF ALTERED To notify us of a claim please contact us on our 24-hour toll-free number at (855) 453-9675, via email at claimenquiries@bhspecialty.com, via fax to (617) 507-8259, or via mail.

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY (BYLAWS)

ARTICLE V.
CORPORATE ACTIONS

....
EXECUTION OF DOCUMENTS:

....
Section 6.(b) The President, any Vice President or the Secretary, shall have the power and authority:

- (1) To appoint Attorneys-in-fact, and to authorize them to execute on behalf of the Company bonds and other undertakings, and
- (2) To remove at any time any such Attorney-in-fact and revoke the authority given him.

NATIONAL INDEMNITY COMPANY (BY-LAWS)

Section 4. Officers, Agents, and Employees:

A. The officers shall be a President, one or more Vice Presidents, a Secretary, one or more Assistant Secretaries, a Treasurer, and one or more Assistant Treasurers none of whom shall be required to be shareholders or Directors and each of whom shall be elected annually by the Board of Directors at each annual meeting to serve a term of office of one year or until a successor has been elected and qualified, may serve successive terms of office, may be removed from office at any time for or without cause by a vote of a majority of the Board of Directors, and shall have such powers and rights and be charged with such duties and obligations as usually are vested in and pertain to such office or as may be directed from time to time by the Board of Directors; and the Board of Directors or the officers may from time to time appoint, discharge, engage, or remove such agents and employees as may be appropriate, convenient, or necessary to the affairs and business of the corporation.

NATIONAL INDEMNITY COMPANY (BOARD RESOLUTION ADOPTED AUGUST 6, 2014)

RESOLVED, That the President, any Vice President or the Secretary, shall have the power and authority to (1) appoint Attorneys-in-fact, and to authorize them to execute on behalf of this Company bonds and other undertakings and (2) remove at any time any such Attorney-in-fact and revoke the authority given.

NATIONAL LIABILITY & FIRE INSURANCE COMPANY (BY-LAWS)

ARTICLE IV

Officers

Section 1. Officers, Agents and Employees:

A. The officers shall be a president, one or more vice presidents, one or more assistant vice presidents, a secretary, one or more assistant secretaries, a treasurer, and one or more assistant treasurers, none of whom shall be required to be shareholders or directors, and each of whom shall be elected annually by the board of directors at each annual meeting to serve a term of office of one year or until a successor has been elected and qualified, may serve successive terms of office, may be removed from office at any time for or without cause by a vote of a majority of the board of directors. The president and secretary shall be different individuals. Election or appointment of an officer or agent shall not create contract rights. The officers of the Corporation shall have such powers and rights and be charged with such duties and obligations as usually are vested in and pertain to such office or as may be directed from time to time by the board of directors; and the board of directors or the officers may from time to time appoint, discharge, engage, or remove such agents and employees as may be appropriate, convenient, or necessary to the affairs and business of the Corporation.

NATIONAL LIABILITY & FIRE INSURANCE COMPANY (BOARD RESOLUTION ADOPTED AUGUST 6, 2014)

RESOLVED, That the President, any Vice President or the Secretary, shall have the power and authority to (1) appoint Attorneys-in-fact, and to authorize them to execute on behalf of this Company bonds and other undertakings and (2) remove at any time any such Attorney-in-fact and revoke the authority given.

Bond Numbers:

Liberty - 015224413, Travelers - 107961256
 F&D/Zurich - 9430996, Federal - K41785822
 CNA - 30206124, BH - 47-SUR-300033-01-0828

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned Flatiron Constructors, Inc.
[Bidder name], a corporation organized under the laws of the State of Delaware [Bidder state],
 hereinafter referred to as the "Contractor" and SEE ATTACHMENT A [Bonding company name], a
 corporation organized under the laws of the State of SEE ATTACHMENT A [Bonding company state], and
 authorized to transact business in the State of Colorado, hereinafter referred to as Surety, are held and firmly
 bound unto the CITY AND COUNTY OF DENVER, a municipal corporation of the State of Colorado, hereinafter
 referred to as the "CITY", in the penal sum of Nine Million One Hundred Sixty Thousand Nine Hundred Twenty-Nine and 00/100 Dollars
[Bid amount text] Dollars (\$ 9,160,929.00 *****), lawful money of the United States of America, for the
 payment of which sum the Contractor and Surety bind themselves and their heirs, executors, administrators,
 successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above Contractor has entered into a written contract with the City for furnishing all labor,
 materials, tools, superintendence, and other facilities and accessories for the construction of Contract No.
202473360 Denver International Airport, in accordance with the Technical Specifications,
 Contract Drawings and all other Contract Documents therefor which are incorporated herein by reference and
 made a part hereof, and are herein referred to as the Contract.

NOW, THEREFORE, the condition of this payment bond obligation is such that if the Contractor shall at all times
 promptly make payments of all amounts lawfully due to all persons supplying or furnishing it or its
 subcontractors with labor and materials, rental machinery, tools, or equipment, used or performed in the
 prosecution of work provided for in the above Contract and shall indemnify and save harmless the City to the
 extent of any and all payments in connection with the carrying out of such Contract which the City may be
 required to make under the law, then this obligation shall be null and void, otherwise, it shall remain in full force
 and effect;

PROVIDED FURTHER, that the said Surety, for value received, hereby stipulates, and agrees that any and all
 changes in the Contract, or compliance or noncompliance with the formalities in the Contract for making such
 changes shall not affect the Surety's obligations under this bond and the Surety hereby waives notice of any
 such changes.

[END OF PAGE]

IN WITNESS WHEREOF, said Contractor and said Surety have executed these presents as of this _____ day of _____, 2024.

Flatiron Constructors, Inc.

CONTRACTOR

Kevin Lynch
KEVIN LYNCH
DIVISIONAL FINANCE MANAGER

By: [Signature]
President GRANT JOHNS VICE PRESIDENT



SEE ATTACHMENT A

SURETY

By: SEE ATTACHMENT A

Attorney-in-Fact

(Accompany this bond with Attorney-in-Fact's authority from the Surety to execute bond, certified to include the date of the bond.)

ATTACHMENT A

BOND NUMBERS:	Liberty Bond No.:	015224413
	Travelers Bond No.:	107961256
	F&D/Zurich Bond No.:	9430996
	Federal Bond No.:	K41785822
	Continental Bond No.:	30206124
	Berkshire Bond No.:	47-SUR-300033-01-0828

Liberty Mutual Insurance Company, a Massachusetts Corporation
Travelers Casualty and Surety Company of America, a Connecticut corporation
Fidelity and Deposit Company of Maryland, a Illinois corporation
Zurich American Insurance Company, a New York corporation
Federal Insurance Company, an Indiana corporation
The Continental Insurance Company, a Pennsylvania Corporation
Berkshire Hathaway Specialty Insurance Company, a Nebraska Corporation

Liberty Mutual Insurance Company – A.M. Best Rating A XV
175 Berkeley Street, Boston, MA 02116

Mailing Address for Notices:
Attn: Surety Claims Department
1001 4th Ave., Ste 3800, Seattle, WA 98154
Bond No. 015224413


Travelers Casualty and Surety Company of America – A.M. Best Rating A++ XV
Construction Services, One Tower Square, Hartford, CT 06183
Bond No. 107961256

Fidelity and Deposit Company of Maryland
Zurich American Insurance Company - A.M. Best Rating A+ XV
1299 Zurich Way, 5th Floor, Schaumburg, IL 60196
Bond No. 9430996

Federal Insurance Company – A.M. Best Rating A++ XV
202B Hall's Mill Road, Whitehouse Station, NJ 08889
Bond No. K41785822

The Continental Insurance Company – A.M. Best Rating A XV
151 N Franklin Street, Chicago, IL 60606
Bond No. 30206124

Berkshire Hathaway Specialty Insurance Company – A.M. Best Rating A++ XV
1314 Douglas Street, Suite 1400, Omaha, NE 68102
Bond No. 47-SUR-300033-01-0828

By: 
Charo J. Rosemond, Attorney-In-Fact

CORPORATE ACKNOWLEDGMENT

Form 152

STATE OF NEW JERSEY
COUNTY OF BERGEN

On this 29th day of May, 2024 before me personally came Charo J. Rosemond to me known, who, being by me duly sworn, did depose and say that she/he resides in Naugatuck, Connecticut that she/he is the ATTORNEY IN FACT of the LIBERTY MUTUAL INSURANCE COMPANY, TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, FIDELITY AND DEPOSIT COMPANY OF MARYLAND, ZURICH AMERICAN INSURANCE COMPANY, FEDERAL INSURANCE COMPANY, THE CONTINENTAL INSURANCE COMPANY, BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, the corporation described in and which executed the above instrument that she/he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that she/he signed her/his name thereto by like order.

(SEAL)



Stephany D. Davis

STEPHANY D. DAVIS

NOTARY PUBLIC, STATE OF NEW JERSEY

MY COMMISSION EXPIRES

JULY 28, 2025



This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: 8210087-974450

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, James Baldassare Jr, Sherryanne M. DePirro, Krista A. DiMezza, Michael Dugan, Charo J. Rosemond, Lisa M. Scavetta, Maria L. Spadaccini, John F. Surano, Nicholas F. Walsh

all of the city of Saddle Brook state of NJ each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 11th day of May, 2023.



Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: David M. Carey
David M. Carey, Assistant Secretary

State of PENNSYLVANIA
County of MONTGOMERY ss

On this 11th day of May, 2023 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.



Commonwealth of Pennsylvania - Notary Seal
Teresa Pastella, Notary Public
Montgomery County
My commission expires March 28, 2025
Commission number 1126044
Member, Pennsylvania Association of Notaries

By: Teresa Pastella
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV - OFFICERS: Section 12. Power of Attorney.

Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII - Execution of Contracts: Section 5. Surety Bonds and Undertakings.

Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation - The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization - By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this ___ day of ___.



By: Renee C. Llewellyn
Renee C. Llewellyn, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

For bond and/or Power of Attorney (POA) verification inquiries, please call 610-832-8240 or email HOSUR@libertymutual.com.



Travelers Casualty and Surety Company of America
Travelers Casualty and Surety Company
St. Paul Fire and Marine Insurance Company

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Charo J Rosemond** of **SADDLE BROOK** their true and lawful Attorney(s)-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this 21st day of April, 2021.



State of Connecticut

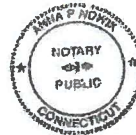
City of Hartford ss.

By:
Robert L. Raney, Senior Vice President

On this the 21st day of April, 2021, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of each of the Companies, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of said Companies by himself as a duly authorized officer.

IN WITNESS WHEREOF, I hereunto set my hand and official seal.

My Commission expires the 30th day of June, 2026



Anna P. Nowik, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of each of the Companies, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of each of the Companies, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this _____ day of _____



Kevin E. Hughes, Assistant Secretary

To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.
Please refer to the above-named Attorney(s)-in-Fact and the details of the bond to which this Power of Attorney is attached.

**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by Robert D. Murray, Vice President, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint Krista A. DIMEZZA, Charo J. ROSEMOND, John F. SURANO, Sherryanne M. DEPIRRO, Nicholas F. WALSH, Lisa M. SCAVETTA, James BALDASSARE, JR., Michael DUGAN, of Saddle Brook, New Jersey, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings**, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND, this 25th day of August, A.D. 2023.



ATTEST:
**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND**

By: *Robert D. Murray*
Vice President

By: *Dawn E. Brown*
Secretary

**State of Maryland
County of Baltimore**

On this 25th day of August, A.D. 2023, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, depose and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Genevieve M. Maison

**GENEVIEVE M. MAISON
NOTARY PUBLIC
BALTIMORE COUNTY, MD
My Commission Expires JANUARY 27, 2025**



Authenticity of this bond can be confirmed at bondvalidator.zurichna.com or 410-559-8790

EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify or revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this _____ day of _____, _____.



Thomas O. McClellan
Vice President

TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:

Zurich Surety Claims
1299 Zurich Way
Schaumburg, IL 60196-1056
reportsfclaims@zurichna.com
800-626-4577

Authenticity of this bond can be confirmed at bondvalidator.zurichna.com or 410-559-8790

CHUBB®

Power of Attorney

Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company

Westchester Fire Insurance Company | ACE American Insurance Company

Know All by These Presents, that FEDERAL INSURANCE COMPANY, an Indiana corporation, VIGILANT INSURANCE COMPANY, a New York corporation, PACIFIC INDEMNITY COMPANY, a Wisconsin corporation, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY corporations of the Commonwealth of Pennsylvania, do each hereby constitute and appoint James Baldassare Jr., Sherryanne M. DePirro, Krista A. DiMezza, Michael Dugan, Charo J. Rosemond, Lisa M. Scavetta, John F. Surano and Nicholas F. Walsh of Saddle Brook, New Jersey

each as their true and lawful Attorney-in-Fact to execute under such designation in their names and to affix their corporate seals to and deliver for and on their behalf as surety thereon or otherwise, bonds and undertakings and other writings obligatory in the nature thereof (other than bail bonds) given or executed in the course of business, and any instruments amending or altering the same, and consents to the modification or alteration of any instrument referred to in said bonds or obligations.

In Witness Whereof, said FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY have each executed and attested these presents and affixed their corporate seals on this 11th day of August 2023.

Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary

Stephen M. Haney

Stephen M. Haney, Vice President



STATE OF NEW JERSEY
County of Hunterdon

SS.

On this 11th day of August 2023 before me, a Notary Public of New Jersey, personally came Dawn M. Chloros and Stephen M. Haney, to me known to be Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros and Stephen M. Haney, being by me duly sworn, severally and each for herself and himself did depose and say that they are Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY and know the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that their signatures as such officers were duly affixed and subscribed by like authority.

Notarial Seal



Albert Contursi
NOTARY PUBLIC OF NEW JERSEY
No 50202369
Commission Expires August 22, 2027

Albert Contursi
Notary Public

CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016; WESTCHESTER FIRE INSURANCE COMPANY on December 11, 2006; and ACE AMERICAN INSURANCE COMPANY on March 20, 2009:

"RESOLVED, that the following authorizations relate to the execution, for and on behalf of the Company, of bonds, undertakings, recognizances, contracts and other written commitments of the Company entered into in the ordinary course of business (each a "Written Commitment"):

- (1) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise.
- (2) Each duly appointed attorney-in-fact of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise, to the extent that such action is authorized by the grant of powers provided for in such person's written appointment as such attorney-in-fact.
- (3) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to appoint in writing any person the attorney-in-fact of the Company with full power and authority to execute, for and on behalf of the Company, under the seal of the Company or otherwise, such Written Commitments of the Company as may be specified in such written appointment, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
- (4) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to delegate in writing to any other officer of the Company the authority to execute, for and on behalf of the Company, under the Company's seal or otherwise, such Written Commitments of the Company as are specified in such written delegation, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
- (5) The signature of any officer or other person executing any Written Commitment or appointment or delegation pursuant to this Resolution, and the seal of the Company, may be affixed by facsimile on such Written Commitment or written appointment or delegation.

FURTHER RESOLVED, that the foregoing Resolution shall not be deemed to be an exclusive statement of the powers and authority of officers, employees and other persons to act for and on behalf of the Company, and such Resolution shall not limit or otherwise affect the exercise of any such power or authority otherwise validly granted or vested."

I, Dawn M. Chloros, Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY (the "Companies") do hereby certify that

- (i) the foregoing Resolutions adopted by the Board of Directors of the Companies are true, correct and in full force and effect,
- (ii) the foregoing Power of Attorney is true, correct and in full force and effect.

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this _____ day of _____



Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary

IN THE EVENT YOU WISH TO VERIFY THE AUTHENTICITY OF THIS BOND OR NOTIFY US OF ANY OTHER MATTER, PLEASE CONTACT US AT:
Telephone (908) 903-3493 Fax (908) 903-3656 e-mail: surety@chubb.com

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That The Continental Insurance Company, a Pennsylvania insurance company, is a duly organized and existing insurance company having its principal office in the City of Chicago, and State of Illinois, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint

Michael Dugan, James Baldassare Jr, Sherryanne M DePirro, Nicholas F Walsh, Lisa M Scavetta, Krista A DiMezza, Charo J Rosemond, John F Surano, Individually

of Saddle Brook, NJ, its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts -

and to bind them thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the insurance company and all the acts of said Attorney, pursuant to the authority hereby given is hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the By-Law and Resolutions, printed on the reverse hereof, duly adopted, as indicated, by the Board of Directors of the insurance company.

In Witness Whereof, The Continental Insurance Company has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 20th day of July, 2023.



The Continental Insurance Company

Larry Kasten  Vice President

State of South Dakota, County of Minnehaha, ss:

On this 20th day of July, 2023, before me personally came Larry Kasten to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is a Vice President of The Continental Insurance Company, a Pennsylvania insurance company, described in and which executed the above instrument; that he knows the seal of said insurance company; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said insurance company and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said insurance company.



My Commission Expires March 2, 2026

M. Bent  Notary Public

CERTIFICATE

I, D. Johnson, Assistant Secretary of The Continental Insurance Company, a Pennsylvania insurance company, do hereby certify that the Power of Attorney herein above set forth is still in force, and further certify that the By-Law and Resolutions of the Board of Directors of the insurance company printed on the reverse hereof is still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said insurance company this _____ day of _____



The Continental Insurance Company

D. Johnson  Assistant Secretary

Form F6850-4-2023

Authorizing By-Laws and Resolutions

ADOPTED BY THE BOARD OF DIRECTORS OF THE CONTINENTAL INSURANCE COMPANY:

This Power of Attorney is made and executed pursuant to and by authority of the following resolutions duly adopted by the Board of Directors of the Company at a meeting held on May 10, 1995.

“RESOLVED: That any Senior or Group Vice President may authorize an officer to sign specific documents, agreements and instruments on behalf of the Company provided that the name of such authorized officer and a description of the documents, agreements or instruments that such officer may sign will be provided in writing by the Senior or Group Vice President to the Secretary of the Company prior to such execution becoming effective.

This Power of Attorney is signed by Larry Kasten, Vice President, who has been authorized pursuant to the above resolution to execute power of attorneys on behalf of The Continental Insurance Company.

This Power of Attorney is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 25th day of April, 2012.

“Whereas, the bylaws of the Company or specific resolution of the Board of Directors has authorized various officers (the “Authorized Officers”) to execute various policies, bonds, undertakings and other obligatory instruments of like nature; and

Whereas, from time to time, the signature of the Authorized Officers, in addition to being provided in original, hard copy format, may be provided via facsimile or otherwise in an electronic format (collectively, “Electronic Signatures”), Now therefore be it resolved: that the Electronic Signature of any Authorized Officer shall be valid and binding on the Company.”

This Power of Attorney may be signed by digital signature and sealed by a digital or otherwise electronic-formatted corporate seal under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 27th day of April, 2022:

“RESOLVED: That it is in the best interest of the Company to periodically ratify and confirm any corporate documents signed by digital signatures and to ratify and confirm the use of a digital or otherwise electronic-formatted corporate seal, each to be considered the act and deed of the Company.”



Power Of Attorney

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY
NATIONAL INDEMNITY COMPANY / NATIONAL LIABILITY & FIRE INSURANCE COMPANY

Know all men by these presents, that BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, a corporation existing under and by virtue of the laws of the State of Nebraska and having an office at One Lincoln Street, 23rd Floor, Boston, Massachusetts 02111, NATIONAL INDEMNITY COMPANY, a corporation existing under and by virtue of the laws of the State of Nebraska and having an office at 3024 Harney Street, Omaha, Nebraska 68131 and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, a corporation existing under and by virtue of the laws of the State of Connecticut and having an office at 100 First Stamford Place, Stamford, Connecticut 06902 (hereinafter collectively the "Companies"), pursuant to and by the authority granted as set forth herein, do hereby name, constitute and appoint: Charo J. Rosemond, Lisa M. Scavetta, Sherryanne M. DePirro, Nicholas F. Walsh, James Baldassare, Jr., Krista A. DiMezza, John F. Surano, Michael Dugan, 250 Pehle Avenue, Suite 311 of the city of Saddle Brook, State of New Jersey, their true and lawful attorney(s)-in-fact to make, execute, seal, acknowledge, and deliver, for and on their behalf as surety and as their act and deed, any and all undertakings, bonds, or other such writings obligatory in the nature thereof, in pursuance of these presents, the execution of which shall be as binding upon the Companies as if it has been duly signed and executed by their regularly elected officers in their own proper persons. This authority for the Attorney-in-Fact shall be limited to the execution of the attached bond(s) or other such writings obligatory in the nature thereof.

In witness whereof, this Power of Attorney has been subscribed by an authorized officer of the Companies, and the corporate seals of the Companies have been affixed hereto this date of August 24, 2023. This Power of Attorney is made and executed pursuant to and by authority of the Bylaws, Resolutions of the Board of Directors, and other Authorizations of BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, NATIONAL INDEMNITY COMPANY and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, which are in full force and effect, each reading as appears on the back page of this Power of Attorney, respectively. The following seals of the Companies and signatures by an authorized officer of the Company may be affixed by facsimile or digital format, which shall be deemed the equivalent of and constitute the written signature of such officer of the Companies and original seals of the Companies for all purposes regarding this Power of Attorney, including satisfaction of any signature and seal requirements on any and all undertakings, bonds, or other such writings obligatory in the nature thereof, to which this Power of Attorney applies.

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY,

[Signature of David Fields]

By: David Fields, Executive Vice President



NATIONAL INDEMNITY COMPANY, NATIONAL LIABILITY & FIRE INSURANCE COMPANY,

[Signature of David Fields]

By: David Fields, Vice President



NOTARY

State of Massachusetts, County of Suffolk, ss:

On this 24th day of August, 2023, before me appeared David Fields, Executive Vice President of BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY and Vice President of NATIONAL INDEMNITY COMPANY and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, who being duly sworn, says that his capacity is as designated above for such Companies; that he knows the corporate seals of the Companies; that the seals affixed to the foregoing instrument are such corporate seals; that they were affixed by order of the board of directors or other governing body of said Companies pursuant to its Bylaws, Resolutions and other Authorizations, and that he signed said instrument in that capacity of said Companies.

[Notary Seal]



[Signature of Notary Public]

Notary Public

I, Ralph Tortorella, the undersigned, Officer of BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY, NATIONAL INDEMNITY COMPANY and NATIONAL LIABILITY & FIRE INSURANCE COMPANY, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies which is in full force and effect and has not been revoked. IN TESTIMONY WHEREOF, see hereunto affixed the seals of said Companies this _____.



[Signature of Ralph Tortorella]

Ralph Tortorella, Officer

To verify the authenticity of this Power of Attorney please contact us at: BHSI Surety Department, Berkshire Hathaway Specialty Insurance Company, One Lincoln Street, 23rd Floor Boston, MA 02111 | (770) 625-2516 or by email at Jennifer.Porter@bhspecialty.com THIS POWER OF ATTORNEY IS VOID IF ALTERED To notify us of a claim please contact us on our 24-hour toll free number at (855) 453-9675, via email at claims@bhspecialty.com, via fax to (617) 507-8259, or via mail.

BERKSHIRE HATHAWAY SPECIALTY INSURANCE COMPANY (BYLAWS)

ARTICLE V.

CORPORATE ACTIONS

....

EXECUTION OF DOCUMENTS:

....

Section 6.(b) The President, any Vice President or the Secretary, shall have the power and authority:

- (1) To appoint Attorneys-in-fact, and to authorize them to execute on behalf of the Company bonds and other undertakings, and
- (2) To remove at any time any such Attorney-in-fact and revoke the authority given him.

NATIONAL INDEMNITY COMPANY (BY-LAWS)

Section 4. Officers, Agents, and Employees:

A. The officers shall be a President, one or more Vice Presidents, a Secretary, one or more Assistant Secretaries, a Treasurer, and one or more Assistant Treasurers none of whom shall be required to be shareholders or Directors and each of whom shall be elected annually by the Board of Directors at each annual meeting to serve a term of office of one year or until a successor has been elected and qualified, may serve successive terms of office, may be removed from office at any time for or without cause by a vote of a majority of the Board of Directors, and shall have such powers and rights and be charged with such duties and obligations as usually are vested in and pertain to such office or as may be directed from time to time by the Board of Directors; and the Board of Directors or the officers may from time to time appoint, discharge, engage, or remove such agents and employees as may be appropriate, convenient, or necessary to the affairs and business of the corporation.

NATIONAL INDEMNITY COMPANY (BOARD RESOLUTION ADOPTED AUGUST 6, 2014)

RESOLVED, That the President, any Vice President or the Secretary, shall have the power and authority to (1) appoint Attorneys-in-fact, and to authorize them to execute on behalf of this Company bonds and other undertakings and (2) remove at any time any such Attorney-in-fact and revoke the authority given.

NATIONAL LIABILITY & FIRE INSURANCE COMPANY (BY-LAWS)

ARTICLE IV

Officers

Section 1. Officers, Agents and Employees:

A. The officers shall be a president, one or more vice presidents, one or more assistant vice presidents, a secretary, one or more assistant secretaries, a treasurer, and one or more assistant treasurers, none of whom shall be required to be shareholders or directors, and each of whom shall be elected annually by the board of directors at each annual meeting to serve a term of office of one year or until a successor has been elected and qualified, may serve successive terms of office, may be removed from office at any time for or without cause by a vote of a majority of the board of directors. The president and secretary shall be different individuals. Election or appointment of an officer or agent shall not create contract rights. The officers of the Corporation shall have such powers and rights and be charged with such duties and obligations as usually are vested in and pertain to such office or as may be directed from time to time by the board of directors; and the board of directors or the officers may from time to time appoint, discharge, engage, or remove such agents and employees as may be appropriate, convenient, or necessary to the affairs and business of the Corporation.

NATIONAL LIABILITY & FIRE INSURANCE COMPANY (BOARD RESOLUTION ADOPTED AUGUST 6, 2014)

RESOLVED, That the President, any Vice President or the Secretary, shall have the power and authority to (1) appoint Attorneys-in-fact, and to authorize them to execute on behalf of this Company bonds and other undertakings and (2) remove at any time any such Attorney-in-fact and revoke the authority given.



**DENVER
INTERNATIONAL
AIRPORT**

PROJECT MANUAL

Runway 17L-35R Pavement Rehabilitation and Electrical Upgrades Package 2

**DESIGN CONTRACT NO. 202158114, TASK 7
CONSTRUCTION CONTRACT NO. 202473360**

PART I

GENERAL REQUIREMENTS

Issued for Construction, May 29, 2024

**CITY & COUNTY OF DENVER
DEPARTMENT OF AVIATION**

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**DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360**

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SECTION 011100 - SUMMARY OF WORK**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY AND DESCRIPTION

- A. The Work specified in this contract consists of furnishing all management, supervision, labor, materials, tools, equipment, services, testing and incidentals for the construction of the Work indicated in the contract documents including lump sum items and unit price items.
- B. The Work in this Contract may affect operations at DEN. The Contractor shall bid, plan and execute the Work to minimize disruption of operations and inconvenience to the public.
- C. Change Notice:
1. The Contractor will be required to submit a proposal for each Change Notice
 2. The Contractor shall submit a proposal for the complete scope of the Work within the specified duration identified by the Notice. Where there is no time requirement identified by the notice documents, the Contractor shall submit a proposal within 20 days of receiving the notice or as allowed in Title 11 - Changes in the Work, Contract Price, or Contract Time of the General Contract Conditions, 2011 Edition.
 3. The proposal could contain both competitive bid and estimated costs and shall adhere to the requirements of Title 11 of the General Contract Conditions.
 4. The Contractor shall not proceed on any change notice work until a change order is issued.
- D. Change Directives:
1. The DEN Project Manager may issue Change Directive(s) for a Scope of Work. The Contractor shall keep all Time and Material record for any Change Directive(s) issued until a final settlement for the task is settled and finalized in a Change Order.
 2. The Contractor shall keep records and approvals for all Time and Material impacts of a Change Directive until a final settlement is reached and fully executed by the DEN Project Manager.
 3. The Contractor may invoice for a Change Directive in accordance with Title 11 of the General Contract Conditions, 2011 Edition.

- E. Guaranteed Maximum Price (GMP): For Contracts assigned as GMP the Contractor shall follow the Special Conditions issued for the Contract.
- F. This Project will be administered using the current Project Management Information System (PMIS). The application will be supplied by DEN at no cost to the Contractor. DEN will provide PMIS training for up to two (2) of the contractor's personnel.
- G. The Contractor shall participate in a preconstruction coordination meeting and update the existing BIM Project Execution Plan or prepare a BIM Project Execution Plan if one does not exist based upon the DEN BIM Project Execution Plan (BXP) template included as provided by the DEN BIM group and the coordination meeting instructions.
- H. DEN utilizes several programs as part of the Asset Management System. Keeping accurate as-built record and operation and maintenance data are essential in the integrity and the validity of the airport operation. The Contractor is required to make every effort to keep the airport data informed, updated and accurate in the format required by DEN Project Manager:
1. The Contractor shall provide and implement BIM Project Execution Plan based on the DEN BIM Project Execution Plan. The Contractor shall employ or contract a consultant to provide all the requirements to produce the Project model in the latest edition of the AutoCAD Civil 3d
 2. The Contractor shall comply with all the requirements of DEN BIM Project Execution Plan and provide the data to DEN to produce the complete record of the BIM model of the Project
- I. Inspection Requirements:
1. Special Inspection and Testing required by the building official or the Engineer of Record in the Contract Documents or in the Statement of Special Inspections will be performed by DEN contracted Agencies.
 2. Contractor shall subcontract Qualified Material Testing Agency(s) to perform all necessary Quality Control, processing control and any additional Testing required by the Contract Documents.
 3. DEN Quality Assurance Manager may audit all material tests performed by the Contractor Quality Control at any time. Testing and Inspections for structural elements not identified as special inspection will be performed by the Contractor Quality Control Program and Contractor Material Testing Agency and audited and confirmed by DEN Quality Assurance Manager. DEN will perform 100% visual inspection on all weldments. DEN will perform Quality Assurance testing at a frequency of approximately 10% of the Quality Control test and inspection frequencies. The testing frequencies by DEN may escalate to higher percentages and the Contractor will be responsible for all costs associated with failing tests of the same pay item elements. The Contractor may not hire the DEN contracted or testing agency in any capacity on this Project.
- J. DEN Quality Assurance will perform all quality assurance pull and adhesion tests on all airfield joint sealants. Contractor shall perform all quality control tests for the same items.

- K. DEN Quality Assurance is required to submit a letter indicating that all Work performed on the project complies with all applicable codes. The Contractor shall make sure that all required test frequencies and all deficiencies has been corrected to comply with all applicable codes standards and the requirements of the Contract Documents.

1.3 WORK BY OTHERS AND FUTURE WORK

- A. Refer to Title 7 – Cooperation, Coordination and Rate of Progress of the General Contract Conditions, 2011 Edition

1.4 SITE CONDITIONS

- A. Refer to Title 14 – Site Conditions of the General Contract Conditions, 2011 Edition

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S DUTIES

- A. Refer to Title 3 – Contractor Performance and Services of the General Contract Conditions, 2011 Edition
- B. Execute the Work as specified and in a timely manner. Submit a schedule of Work that will be performed at times other than during the eight-hour working day of Monday through Friday, daylight hours. Submit this schedule five (5) working days prior to the beginning of Work to the DEN Project Manager for review and acceptance. Approval to work at night may be obtained after Contractor presents a written program outlining special precautions to be taken to control the extraordinary hazards presented by night work. That program shall include, but not limited to, supplementary lighting of work areas, availability of medical facilities, security precautions, and noise limitations.

3.2 COORDINATION

- A. Coordinate execution of the Work with those public utilities, governmental bodies, private utilities and other contractors performing work on and adjacent to the worksites. Eliminate or minimize delays in the Work and conflicts with those utilities, bodies, and contractors. Schedule governmental, private utility and public utility work that relies upon survey points, lines and grades established by the Contractor to occur immediately after those points, lines and grades have been established. Confirm coordination measures for each individual case with the DEN Project Manager in writing.
- B. In the coordination effort of work by others, the Contractor shall obtain and refer to equipment locations and other layouts, as available, to avoid interface problems.

- C. The City reserves the right to permit access to the site of the Work for the performance of work by other contractors and persons at such times that the City deems proper. The exercise of such reserved right shall in no way or to any extent relieve the Contractor from liability for loss and damage to the Work due to or resulting from its operations or from responsibility for complete execution of the Contract. The Contractor shall cooperate with other contractors and persons in all matters requiring common effort.

3.3 CONTRACTOR USE OF WORK SITE

- A. Confine work site operations to areas permitted by law, ordinances, permits, and the Contract.
- B. Consider the safety of the Work and that of the people and property on and adjacent to the work site when determining amount, location, movement, and use of materials and equipment on work site.
- C. Do not load work site with equipment and products that would interfere with the Work. Only equipment, tools, or materials required for this Work may be stored at the work site.
- D. Protect products, equipment, and materials stored on work site.
- E. Relocate stored products, equipment, and materials that interfere with operations of City, government bodies, public, and private utilities, and other contractors.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 011100

SECTION 011400 - WORK SEQUENCE AND CONSTRAINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 OTHER WORK

- A. Other concurrent construction contracts with which the Contractor must interface are described elsewhere in the Contract Documents. Refer to Section 013210 "Schedule" and the Special Conditions for specific work constraints and milestones.

1.3 WORK SEQUENCE

- A. The work sequence shall comply with Phasing, Sequencing, and Milestones as indicated in the Contract Documents and in accordance with the approved Construction Schedule developed by the Contractor. The schedule shall comply with requirements indicated in the Special Conditions and Section **011400** "Work Sequence and Constraints". The Construction Schedule is described in Section 013210 "Schedule".

1.4 WORK CONSTRAINTS

- A. Site Constraints:
1. Access to the Project shall be generally as indicated in the Contract Documents. Access shall be organized and planned by the Contractor to ensure no disruption of airline or DEN operations.
 2. Access to work sites will be strictly monitored and must comply with DEN Airport Operations and FAA Regulations. The Contractor shall provide monitoring and escorts as required by DEN Operations in the area of the Work.
 3. The Contractor's staging area will be as indicated in the Construction Documents.
 4. Contractor employee parking will not be allowed within the existing revenue control system. Parking facilities will be as indicated in the Construction Documents.
 5. The Contractor shall use the haul routes specified in the Construction Documents.

6. If required, the Contractor shall provide a bus and driver to transport the Contractor's employees between the designated employee parking area and the work sites. No separate payment will be made for this bus and driver. The cost shall be included in the bid item "Mobilization". The bus driver shall be provided at all times when Contractor employees are working on the Project.

B. System Interruptions:

1. DEN is a 24/7/365 facility. Construction activity that requires any system shutdown must be coordinated with the project manager and DEN AIM MCC.
2. The Shutdown cannot proceed unless all approver groups have approved the request. If any of the groups rejects the request, you may not proceed with the Shutdown. If a Shutdown is determined to be an emergency due to pending health issues or the risk of additional damage, this process may be bypassed. If the Shutdown is an emergency, proceed with the shutdown without the approvals. Approvals must be obtained as follows
 - a. Airfield Shutdowns must be submitted at least 72 hours prior to the shutdown start date.
 - b. All other Shutdowns must be submitted at least five (5) business days prior to the shutdown start date.
 - c. All Shutdown Requests must be submitted using the Shutdown Request form, which can be accessed via the Home page of the DEN intranet.

C. Airfield Operations at Denver International Airport:

1. Full airport and aircraft operations are underway adjacent to this Project. Contractors are required to become a Participant of the Airport Security Program and comply with 49 CFR Part 1542 Regulations, Security Directives, Denver Municipal Airport System Rules and Regulations.
 - a. If any Work contains requirements for Work activities or access through or in the secured area, reference Section 011420 "Security Requirements & Sensitive Security Information (SSI)" for requirements.
 - b. If not in a secured area, the Contractor personnel still must be badged; reference Section 011420 "Security Requirements & Sensitive Security Information (SSI)".

D. Conduct of persons using the Denver Municipal Airport system:

1. Contractor activities shall comply with Airport Operations and Regulation 130 "Operating Vehicles in the Secured Area " and Regulation 20 " Security" shall be followed at all times. These regulations are available from Airport Security at Denver International Airport.

E. Operational safety on airports during construction:

1. All Work shall be accomplished in accordance with FAA Advisory Circular AC150/5370-2G, "Operational Safety on Airports during Construction", FAR Part 139 and TSR Part 1542 except as herein modified.

F. Welding Equipment, Procedures and Constraints:

1. Natural gas-powered portable welders or inverter single- and three-phase electric portable welders are the only acceptable welding equipment to be used inside the building basement or tunnel areas. Acceptability of equipment other than the equipment noted above shall be at the sole discretion of the DEN Project Manager.
2. Welding activities inside buildings require submittal of a System Interruption Request (See paragraph "System Interruptions" above). Prior to welding in any area, the Contractor shall locate smoke detectors and shall request interruption of the fire alarm system. Subsequent to the interruption of the fire alarm system and prior to welding activities, the Contractor shall cover and protect smoke detectors until work is complete. Prior to expiration of each interruption of the system, the Contractor shall uncover the smoke detectors.
3. Electrical Service: The Contractor shall be responsible for verifying with the DEN Project Manager or representatives locations acceptable for accessing electrical power for welders and other electrical equipment feeders. The Contractor shall be responsible for all work and equipment required to install temporary or permanent electrical modifications for construction power and lighting.
 - a. Temporary Hook-up: In addition to the requirements of paragraph "Temporary Power and Lighting for Construction" below, comply with the following:
 - 1) Provide wiring sized to accommodate full load of welding equipment, accounting for voltage drop.
 - 2) Provide appropriate NEMA twist-lock or ANSI receptacle for welder hook-up.
 - 3) 480V, 3 phase, 3 pole, 4-wire twist lock ground line.
 - 4) NEMA L16-20 or ANSI C73.87.
 - b. The Contractor may not begin operation of the equipment prior to request for inspection by DEN representatives and acceptance of the installation.
 - c. Permanent installation of electrical branch circuiting for welding equipment shall be made in accordance with all Division 26 Specification Sections
4. Welding Practices: All standard safe welding practices must be followed, including but not limited to the following:
 - a. Flash protection for surrounding areas.
 - b. Contractor fire extinguisher in area.
 - c. One person in each welding area solely designated as fire watch for each welder.
 - d. Protect all equipment, cable trays and contents, etc., in area.
 - e. Use fire blankets and other appropriate materials to confine sparks and molten metal from the welding, cutting, and/or grinding activities.
 - f. All welders shall have been qualified through welding tests in accordance with applicable welding code, such as but not limited to AWS, ASME, API, within one year prior to welding taking place. Evidence of qualification shall be through Welding Performance Qualification Records (WPQR).

1. The Contractor shall have wireless communications in place prior to initiation of work in the tunnel or basements by use of cell phone and/or radio. Radio and cell phone coverage in the tunnels and basements varies in signal strength throughout the campus. An RF Application must be submitted for the Radio equipment intended for use at least 14 days prior to intended use. Include the following radio information:
 - a. Make
 - b. Model
 - c. Frequency
 - d. Effective Radiated Power (ERP)
2. Contractors must receive an approval letter from the RF Systems Manager prior to use of the radio equipment on the DEN campus.

K. Keys:

1. The Contractor shall be required to contact DEN Maintenance Control to procure keys for access to all rooms having locks in order to gain access. Keys may be checked out at the beginning of each work shift by the Contractor and shall be returned to DEN Maintenance Control at the end of each work shift

1.5 COORDINATION

- A. The Contractor will designate a contact person for coordination with the DEN Project Manager and airline tenants. The contact person shall have the authority to make decisions for the Contractor firm and shall have binding signatory power for changes in work. The contact person shall be on site at all times during work activity.
- B. No additional costs shall be considered for coordination activities throughout this project. The Contractor shall include in the Contractor's bid costs for coordination of all activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DUST/PROTECTION BARRIERS

- A. HVAC system containment. The Contractor shall submit to DEN Maintenance HVAC and Fire Alarm shutdown requests prior to modifications to the area of work for dust containment. The HVAC system shall be interrupted, re-routed, or blocked off to prevent dust from entering return or supply ducts.

- B. Debris and Protection Barriers: The Contractor shall construct code-approved and DEN-approved dust and debris barriers on both sides of walls and doors that are to be modified. Barriers shall be constructed to allow emergency ingress and egress to and from equipment and spaces. Barriers shall be constructed to allow continual uninterrupted function of building equipment and spaces.
 - 1. Return all removed door hardware to DEN. Label each hardware set correlating the door number of the original hardware set. Coordinate with the DEN Project Manager for storage and return of hardware.

3.2 EQUIPMENT

- A. Equipment: CNG-powered equipment is allowed within the buildings. No other fossil fuel equipment may be used within the buildings unless the equipment is directly vented to the building exterior.
- B. Electric: Electric powered equipment is acceptable in the Work area.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 011400

SECTION 011420 - SECURITY REQUIREMENTS & SENSITIVE SECURITY INFORMATION (SSI)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Each Contractor is required to become a "Participant" in the DEN Airport Security Program (ASP), and must remain in good standing in order to retain Airport Security privileges.
- B. All Contractor employees and all vehicles requiring access to the Secured Area, Sterile Area, and/or any other Controlled Areas shall be required to obtain the proper access authorizations for Airport ID badges and vehicle permits.

1.3 PARTICIPANT OF AIRPORT SECURITY PROGRAM

- A. Contractors are required to become a "Participant" of the ASP. In order to become a "Participant", your company must attend a Participant meeting within the Airport Security Office.
- B. The Contractor shall comply with all Denver Municipal Airport System Rules and Regulations and all Transportation Security Administration (TSA) regulations. Special emphasis should be paid to Denver Municipal Airport System Rules and Regulations Part 20 – Airport Security Rules and Regulations and Part 130 – Operating Vehicles In The Secured Area" and Part 35 – Operations Infraction Accountability Program". The Denver Municipal Airport System Rules and Regulations can be found on the flydenver.com website.
- C. The TSA has the authority to issue civil penalties for failure to adhere to their regulations.

- D. It is the responsibility of the Airport Security Office to ensure all fences and gates are secure. If a Contractor's operations necessitate the frequent use of a particular gate, the Contractor shall place, at the Contractor's expense, two (2) contract security guards at the gate that shall have been trained and certified by the Airport Operations Division to facilitate access to its Work. The Contractor assumes full responsibility for maintaining security once this is done. If the perimeter gate will be used as a haul route, the contractor must also place, at the Contractor's expense, Haul Route Monitors as dictated by the TSA approved Temporary Amendment. Any fines levied against the Airport as a result of the failure by the Contractor to provide adequate security shall be passed on to the Contractor.
1. If the Contractor provides guards or monitors, the Contractor must also supply a shelter for the guards/monitors. The shelter must meet the following requirements:
 - a. One 10 x 12 Tuff Shed or similar type structure with a window, 24-inch convex mirror mounted outside for vehicle inspection, sufficient HVAC capability, generator, light plant, and sanitary services, which are maintained by the Contractor.
- E. Contractors will be required at all times to have a supervisor or foreman at each work location in Secured, Sterile, and Controlled Areas.
- F. All Work shall be accomplished in accordance with the most current FAA Advisory Circular (AC) 150/5370-2, "Operational Safety on Airports during Construction", 49 Code of Federal Regulations (CFR) Part 1542 and 14 CFR Part 139 except as modified herein.
- G. All Work shall be accomplished in accordance with the most current TSA Security Directives applicable to DEN, except as modified herein.
- H. This Section intends to supplement, modify, change, delete from, or add to the most current FAA AC150/5370-2. Where any paragraph, subparagraph, or clause of the AC is modified or deleted by these supplements, the unaltered provisions of that paragraph, subparagraph, or clause shall remain in effect.

1.4 SENSITIVE SECURITY INFORMATION (SSI)

- A. If the Contract involves SSI information or procedures, the Contractor must contact the Assistant Director of Airport Security or designee, for disclosure information, as well as protocols that must be followed with SSI distribution.
- B. This Section governs the maintenance, safeguarding, and disclosure of records and information that the TSA has determined to be SSI as defined by 49 CFR Part 1520, "Protection of Sensitive Security Information". SSI is information that the TSA has determined to be detrimental to the security of Denver International Airport if disclosed to unauthorized persons. This is a process for the documentation, use, and recovery of SSI of a specific origin.

C. Applicability:

1. For all management staff, all authorized departments, all contractors, and subcontractors handling documents or materials containing SSI information.
2. Each person employed by, contracted to, or acting on behalf of the Department of Aviation at Denver International Airport is subject to the requirements of this Section.
3. SSI disclosure is limited to persons or entities under criteria identified in federal regulations, subject to strict "need-to-know" standard, and as otherwise determined by TSA or the Department of Homeland Security (DHS).

D. Except as otherwise provided in this Section, records containing SSI are not available for public inspection or copying. Denver International Airport will not release such records to persons without a need to know. Prime contractors will not release SSI records to any subcontractor without a need to know. An employee or contractor has a "need to know" SSI if access to the information is necessary for performance of his or her official duties.

E. Unauthorized disclosure of SSI is a Federal violation of 49 CFR Part 1520 and violation is grounds for a civil penalty and other enforcement action by DHS Security. In addition to the civil penalties, corrective action may include issuance of an order requiring retrieval of SSI to remedy unauthorized disclosure, an order to cease future unauthorized disclosure, and dismissal from the work site.

F. Except as otherwise provided in writing by the TSA in the interest of public safety or airport security, the following information and records containing such information constitute SSI:

1. Information that would be detrimental to the security of Denver International Airport and aviation transportation.
2. Any performance specification, including a description of devices and procedures used by Denver International Airport, for the detection of any weapon, explosive, incendiary, or destructive substance.
3. Any performance specification, including a description of devices and procedures, for any communications equipment used by Denver International Airport in carrying out any aviation transportation security requirements.
4. Details of any security inspection or investigation of an alleged violation of aviation transportation security requirements of Federal law that could reveal security vulnerability.
5. Specific details of aviation transportation security measures including those recommended by the Federal government.
6. The following information regarding security screening under aviation transportation security requirements of Federal law:
 - a. Procedures for screening of persons, property, checked baggage, U.S. mail, and cargo.
 - b. Information used by a passenger or property-screening program or system, including an automated screening system.
 - c. Detailed information, if determined by the TSA to be SSI, about the locations at which particular screening methods or equipment are used.

- d. Performance or test data from security equipment or screening systems.
 7. Identifying information of certain aviation transportation security personnel including lists of the names or other identifying information that identify persons as having unescorted access to a secure area of the airport.
 8. Critical aviation asset information identifying systems so vital to the airport that the incapacity or destruction of such assets would have a debilitating impact on aviation security.
 9. Any information involving the security of operational or administrative data systems identified by the Department of Transportation or DHS as critical to the safety or security of Denver International Airport.
 10. Solicited or unsolicited proposals, pursuant to a grant or contract, to perform work that relates to security measures.
- G. Restrictions on the Disclosure of SSI:
1. Employees and contractors working onsite have a duty to protect sensitive security information and must take reasonable steps to safeguard SSI in that person's possession from unauthorized disclosure. When a person is not in physical possession of SSI, the person must store it in a secure container such as a locked desk, a locked file cabinet, or in a locked room. SSI is to be disclosed only to persons having a need to know as stated in CFR 1520. Requests for SSI are to be referred to City Project Manager.
 2. Prior to receiving SSI records, contractors must sign the "Confidentiality and Non-Disclosure Agreement", Form PS-17, stating that SSI will be guarded from unauthorized persons, that records will be controlled while in use and secured when not in use, and that all SSI plans and records will be returned to the airport or destroyed following the completion of the Project.
 3. Return or destruction of SSI documents must be done in a timely manner and documented on the SSI Return or Destruction Compliance Form, Form PS-20. Companies under contract to the City must return or destroy all SSI material following the completion of the Work. Companies not selected during the bidding process must return or destroy all SSI material immediately following the announcement of bid results.
- H. If a record containing SSI is received that is not marked as specified in this Section below, the following steps must be taken:
1. Mark the record as specified in paragraph Part 1 of this Section.
 2. Inform the sender of the record that the record must be marked as specified in Part 1 of this Section.
- I. If a person becomes aware that SSI has been released to unauthorized persons, promptly inform the Communication Center Supervisor at 303-342-4020 and request to speak to the on-call Airport Security Coordinator
- J. Marking SSI:

1. In the case of paper records containing SSI, a covered person must mark the record by placing the PROTECTIVE MARKING conspicuously on the top, and the DISTRIBUTION LIMITATION STATEMENT on the bottom, of following parts of the document:
 - a. The outside of any front and back cover, including a binder cover or folder, if the document has a front and back cover.
 - b. Any title page
 - c. Each page of the document
2. Protective Marking:
 - a. SENSITIVE SECURITY INFORMATION
 - b. Distribution Limitation Statement:
 - c. WARNING: This record contains Sensitive Security Information that is controlled under 49 CFR parts 15 and 1520. No part of this record may be disclosed to persons without a "need to know", as defined in 49 CFR parts 15 and 1520, except with the written permission of the Administrator of the Transportation Security Administration or the Secretary of Transportation. Unauthorized release may result in civil penalty or other action. For U.S. government agencies, public disclosure is governed by 5 U.S.C. 552 and 49 CFR parts 15 and 1520
3. In the case of non-paper records that contain SSI, including motion picture films, videotape recordings, audio recording, and electronic and magnetic records, a covered person must clearly and conspicuously mark the records with the protective marking and the distribution limitation statement such that the viewer or listener is reasonably likely to see or hear them when obtaining access to the contents of the record.

K. Destruction of SSI:

1. When the employee or contractor no longer needs the SSI to carry out their work requirements, the SSI must be returned to the issuing entity or completely destroyed by burning or cross-shredding to preclude recognition or reconstruction of the information.
2. The Contractor shall comply with all the requirements of the Department of Aviation Standards and Procedures, Protection of Sensitive Security Information (SSI) No. 10003 Revised 08/01/15 regarding Contractor Protection of Sensitive Security Information (SSI).

1.5 MISCELLANEOUS

A. Dumpster Security Requirements:

1. The following procedures must be followed to provide maximum security with all construction projects in public areas unless an exception has been made by the Airport Security Coordinator (ASC) or designee:

- a. Roll-off dumpsters must have the ability to be covered (hard side) and locked when not in use.
 - b. When unlocked and in use, the Contractor shall provide an employee, or a subcontractor's employee, to stand by the dumpster to prevent unauthorized placement of prohibited items
2. If the Contractor is not able to have a roll-off dumpster with the ability to be locked, the dumpster shall be removed from the public area when the construction site is inactive.
- B. Contractor Fences (Not Perimeter Fence):
1. If required, the Contractor shall establish and maintain a secure (fenced) perimeter at its primary operations area to include its field offices, staging and storage areas, and maintenance facilities. The responsibility for security within its operations area shall rest solely with the Contractor. Entrance gates to operations areas shall be equipped with a combination of locks to include a lock provided by the City for its use in accessing emergency equipment, should that need arise. The location, size and other physical characteristics of the Contractor's operations area must be approved by the DEN Project Manager prior to its installation.
 2. Unless specifically required by the Contract Documents and with the exception of the fenced operations area described above, the Contractor shall install no fences or other physical obstructions on or around the Project work area without the written approval of the DEN Project Manager.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SUBMITTAL FOR AIRPORT ID BADGES

- A. By submitting information for the individual requesting or requiring an Airport ID badge that would permit unescorted access to the Sterile and/or Secured Areas must be fingerprinted and pass a Criminal History Records Check (CHRC) and Security Threat Assessment (STA). Passing a CHRC means the employee shall not have been convicted, given a deferred sentence, found not guilty by reason of insanity or have been arrested and are awaiting judicial proceedings of any felony charge during the ten (10) years before the date of the individual's application for unescorted access authority. For an individual to obtain driver authorization to drive within the Secured Area, the individual must have a valid driver license that allows them to drive their contractor vehicle.

- B. An employee requesting an Airport ID badge must resolve all pending or valid violations before being allowed to proceed in the airport ID badging process. If the employee no longer works for the company and is attempting to be employed by a different company, a management representative from the “new” company must attend the Violation Notice Hearing along with the employee.
- C. Airport ID Badges are obtained as follows:
1. The Contractor shall meet with the City Project Manager to review the procedures and required access points at DEN. The Contractor and the DEN Project Manager shall visit the site to verify the access points. Access points shall be listed and submitted by the Contractor to the DEN Project Manager for review and comment prior to Contractor’s application for badging.
 2. The Contractor shall designate an Authorized Signatory who must attend an annual class with Airport Security. The Authorized Signatory must be an employee of the Contractor, have a valid Denver International Airport ID badge. The Authorized Signatory will be authorized to sign for the Contractor on the Fingerprinting and Badge Application Form and will be the primary designation contact for Airport Security related business.
 3. The Contractor's Authorized Signatory shall schedule a Participant Meeting with the DEN Airport Security Office to review DEN security procedures and receive training on how to ensure that all Participants remain in compliance with Part 20 of the Denver Municipal Airport System Rules and Regulations. A second meeting will be scheduled for the Authorized Signatory to learn how to successfully complete the required forms for Airport ID badges and vehicle permits.
 4. A CHRC and STA are required for each employee requesting unescorted access to the Secure and/or Sterile Area. The employee will complete the Fingerprinting and Badge Application (two-sided form) and schedule an appointment with the Airport Security Office to have the form reviewed and to be fingerprinted. The Federal Bureau of Investigation will conduct the CHRC and will return the results to the Airport Security Office. For the fee for the Fingerprinting, please see the flydenver.com website. The Transportation Security Administration will process the STA and will return the results to the Airport Security Office.
 5. When the Authorized Signatory is notified by Airport Security that the CHRC and STA have cleared, the applicants must come to the Airport Security Office to receive regulated security and driver training. The training will take approximately one (1) hour for security training and approximately two (2) hours for security and driver training.
 6. All applicants must watch and pass all concepts of a computer based security training module for a Security Identification Display Area (SIDA) Airport ID badge. All individuals requesting driver authorization in the non-movement area must also view an interactive computer based driver training module and complete a test by passing all concepts. In addition, the individual must receive non-movement driver orientation training by the Contractor’s driver representative before being allowed to drive on the airfield. Non Movement Orientation training should be conducted annually.
 7. All Airport ID badges must be immediately terminated upon employee separation from the Contractor or when a need for DEN access no longer exists.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
011420
SECURITY REQUIREMENTS & SENSITIVE SECURITY
INFORMATION (SSI)

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

8. The Airport ID badges must be returned to the Airport Security Office prior to final payment. All Airport ID badges are issued with an annual expiration date. The expiration date is determined by the birthday of the Airport ID badge holder. Contractors shall notify the DEN Project Manager as soon as possible but in no case less than four (4) weeks in advance of any requirement to extend the Sponsorship status.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 011420

SECTION 011430 - VEHICLE AND EQUIPMENT PERMITTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Contractor shall comply with the Airport Security Program. Vehicle permits are required for all vehicles operating in the Secured Area. The DEN vehicle permit is required for vehicles operating in the Secured Area but limited to above grade, outdoor activity. Vehicles or machinery operating within buildings shall be required to acquire a DEN emissions permit as well as a DEN vehicle permit.
- B. Special emphasis should be paid to Denver Municipal Airport System Rules and Regulations Part 20 – Airport Security Rules and Regulations and Part 130 – Operating Vehicles In The Secured Area" and Part 35 – Operations Infraction Accountability Program". The Denver Municipal Airport System Rules and Regulations can be found on the flydenver.com website.
 - 1. All Work shall be accomplished in accordance with the most current FAA Advisory Circular (AC) 150/5370-2, "Operational Safety on Airports during Construction", 49 Code of Federal Regulations (CFR) Part 1542 and 14 CFR Part 139 except as modified herein.
 - 2. All Work shall be accomplished in accordance with the most current TSA Security Directives applicable to DEN, except as modified herein.
 - 3. Access to the runways, taxiways, and aprons shall be gained by the Contractor after establishing radio communications with Airport Operations through the DEN Inspector. No personnel or equipment will be allowed on the runways until radio contact has been made with Airport Operations and permission given.
 - 4. Access to the Movement Area will be limited in order to allow the maximum efficient movement of aircraft. As part of this limitation, the Contractor may be required to only use these areas late at night when there is less aircraft traffic
 - 5. Once admitted into the Secured Area, the Contractor shall proceed directly to the work location by way of a route assigned by Airport Security. At no time shall a Contractor or any of its personnel enter onto a taxiway, runway, or ramp without proper clearance from the Airport Operations Manager or Assistant Airport Operations Manager. Contractors or individuals violating these requirements for driving in the Secured Area may be subject to fines, suspension, or permanent revocation of their driver authorization and/or Airport ID badge privileges.

6. The Transportation Security Administration (TSA) requires that all operating airports be secured from the general public and has the authority to issue citations for violations of these requirements. It is the responsibility of the Airport to ensure all fences and gates are secure. If a Contractor's operations necessitate the frequent use of a particular gate, the Contractor shall place guards at the gate. Refer to 011420 – Security Requirements and SSI for details regarding the placement of guards.

C. General Safety Regulations When in Aircraft Operations Areas May Include the Following:

1. At all times, the Contractor shall coordinate its Work with the requirements of the Airport site and operations. All Work, movement of personnel, materials, supplies and equipment in areas used by aircraft shall be subject to regulations and restrictions established by the City. The Contractor shall take special precautions and be fully responsible for the prevention of damage to materials and equipment in the areas affected by the jet blast of taxiing aircraft. No work shall proceed until necessary protective devices are placed as required to protect the public, airport operations, property, and personnel from the hazards of the Work. The Contractor shall proceed with the Contractor's Work, including temporary work and storage of tools, machinery, and materials, to cause no interference with or hazards to the operation of the Airport.
2. Landings, takeoffs, and taxiing shall take precedence over all Contractors' operations. In the event that the Contractor is notified that an emergency landing or a takeoff is imminent, the Contractor shall stop all operations immediately, regardless of the sequence of events in progress and shall immediately evacuate the Contractor's personnel and equipment from the runway and taxiway areas as directed.
3. The Contractor shall remove its personnel and equipment to the distance specified below for the prevailing conditions:
 - a. For emergencies, the Contractor shall move all personnel and equipment as directed by Airport Operations or the DEN Project Manager.
 - b. At the end of a work day in areas where aircraft are operating, all equipment shall be moved to a location that is not less than 750 lineal feet measured from the near edge of the runway, taxiway or ramp area or to the location designated by the City.
4. If the Contractor is asked to leave part of its work site to allow aircraft operation, the Contractor shall clean the area to allow safe aircraft movement. Cleaning may include sweeping the area to prevent damage to aircraft.

D. Vehicle Permitting:

1. Refer to the Denver Municipal Airport System Rules and Regulations Part 20 – Airport Security Rules and Regulations and Part 130 – Operating Vehicles In The Secured Area" and Part 35 – Operations Infraction Accountability Program" for information regarding vehicle permitting. These Denver Municipal Airport System Rules and Regulations can be found on the flydenver.com website.
2. For additional information regarding permitting, the Contractor must contact DEN Security.

E. Equipment Permitting

1. Fossil fuel powered equipment to be used in the interior of buildings and/or in basement/tunnel areas shall require inspection by DEN Maintenance and the Denver Fire Department.
 - a. Only CNG fossil fuel powered equipment may be used; gasoline powered, propane powered, or diesel powered equipment will not be acceptable unless identified and operated per Section 011400 "Work Sequence and Constraints".

1.3 SUBMITTALS

- A. Refer to Section 03300 "Submittal Procedures" for submittal procedures
- B. Submit a copy of each vehicle permit and/or equipment and vehicle emissions permit a maximum of fourteen (14) days after receipt of permit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PERMITS

- A. Vehicle permits shall not be issued prior to Notice to Proceed. The Contractor may, at the Contractor's own risk, submit required information prior to Notice to Proceed to the following:
 1. Vehicle permit: DEN Project Manager or DEN Airport Security.
 2. Equipment and vehicle emissions permit. DEN Project Manager or DEN Maintenance Group.

3.2 SCHEDULE

- A. The Contractor shall allow in the Contractor's schedule five (5) days for DEN review of submittals for permits. Testing of equipment and review by the Denver Fire Department shall be scheduled by the Contractor. By submitting information for permits, the Contractor certifies that equipment and vehicles comply with Contract documents and with all City, state and federal regulations including but not limited to emissions, licensing and safety requirements.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
011430
VEHICLE AND EQUIPMENT PERMITTING

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 011430

SECTION 011810 - UTILITIES INTERFACE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Various utilities are located within the limits of work in the Project area. The owners of these utilities hereinafter noted may require that the Contractor is to work around their existing facilities until such alterations, relocation, or abandonment have been completed. All known existing utilities are shown; however, the Contractor shall verify and satisfy himself that there are no other existing utilities that may not be shown.
- B. The owners of known utilities within the project area and corresponding representatives include, but are not limited to:
1. Century Link Telephone
 2. DEN Telephone
 3. Xcel Energy Natural Gas
 4. Xcel Energy Elec. Services
 5. DEN Storm Water
 6. DEN Sanitary Sewer
 7. Denver Water Department
 8. Inland Technologies
 9. Fuel System (ASI)
 10. Premise Wiring System- DEN IT Section
 11. FAA Duct Bank
 12. Oil/Gas Wells
 13. DEN Electrical Department
 14. Fire Alarm System
 15. Paging System
- C. The location and establishment of each construction vehicle crossing shall be at sites mutually agreed upon in writing by the Contractor and the owner of the utility.
- D. At the locations where the Contractor needs to establish a construction vehicle crossing over any of the operating pipelines, the furnishing and placing of a crossing shall be by the Contractor. The crossing shall allow the normal operation of the pipeline at all times. Each crossing shall be adequately marked and signed for safe passage of vehicles over the crossing. Construction vehicles shall not be allowed to cross over operating pipelines at any place other than an established crossing.

- E. These utility locations are based upon information provided by the utility companies or previous construction contractors that were the basis for determining utility coordinates. The Contractor is responsible for confirming the accuracy of the provided coordinates.
- F. The Contractor shall control the Contractor's operations in order to avoid creating any obstacles for the utility owner's access for maintaining or operating their equipment.

1.3 REFERENCE DOCUMENTS

- A. Section 312323.33 "Flowable Backfill (Controlled Low-Strength Material)"

1.4 REGULATORY REQUIREMENTS

- A. The Contractor shall obtain and pay for all utility company permits, fees, and licenses necessary for the execution of this work. The Contractor shall give all notices and shall comply with all laws, ordinances, rules, and regulations of all authorities having jurisdiction.

1.5 QUALITY CONTROL

- A. When the Contractor performs any operations that will affect a utility owner, the Contractor shall give timely notice to the utility owner and the DEN Project Manager so that the Contractor's operations may be observed by the utility owner or their representative.

1.6 WORK INCLUDED

- A. The Work of this Section includes furnishing all materials, equipment, and labor necessary to provide utility crossings as required and as specified herein and subject to approval by the associated utility owner.
- B. North American Resources has a line passing through airport property. The Contractor shall contact the utility prior to beginning earthwork operations to ascertain any special requirements or conditions required to maintain and protect this service during construction activities.
- C. FAA Underground Duct lines: The FAA has duct lines passing under the site. The Contractor shall contact the FAA prior to beginning earthwork operations to ascertain any special requirements or conditions required to maintain this service during construction activities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Suitable cover material shall be in accordance with Colorado Department of Transportation Standard Specifications. Wet, soft, or frozen material, asphalt chunks, or other deleterious substances shall not be used for cover.
- B. Aggregate for road base material shall consist of clean, sound and durable particles of crushed stone, crushed gravel or crushed slag, shall be free from coatings of clay, silt and organic matter, and shall contain no clay balls. Material shall conform to the State of Colorado Standard Specifications for Road and Bridge Construction Class 6 aggregate base unless otherwise specified.
- C. The materials for the load distribution system on top of the cover shall conform to the specification of the American Institute of Steel Construction, the American Institute of Timber Construction, or the American Concrete Institute, as applicable, depending upon the system agreed upon between the Contractor and utility owner.
- D. Materials for the sleeving of the pipelines shall be purchased by the utility owner at the Contractor's expense.
- E. Comply with utility backfill requirements for the use of flowable backfill in Section 312323.33 "Flowable Backfill (Controlled Low-Strength Material)" and Division 26 and Division 33 requirements.

PART 3 - EXECUTION

3.1 NOTIFICATION OF UTILITIES FOR LOCATING AND POTHOLING

- A. The Contractor shall verify the location of all utilities prior to any operations including physically uncovering the utility to verify location as required by the utility owner.
- B. The Contractor shall notify the Utility Notification Center of Colorado at (303) 534-6700 or 811, as a minimum for location of utilities.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

TECHNICAL SPECIFICATIONS
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011810
UTILITIES INTERFACE

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PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 011810

SECTION 012510 - SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. All material and equipment substitutions must comply with Title 4, Article 406: Substitution of Materials and Equipment in the General Contract Conditions, 2011 Edition.
- B. The Work specified in this Section consists of submitting form CM-09, Request for Substitution for the approval of a different material, equipment, or process than is described in the Contract Documents.
- C. If the substitution changes the Scope of Work, Contract cost, or Contract time, a Change Order is required.
- D. As-built drawings and specifications must include all substitutions even if a Change Order is not issued.

1.3 REFERENCE DOCUMENTS

- A. Form CM-09, Request for Substitution
- B. Section 013300 "Submittal Procedures"
- C. Section 013325 "Shop and Working Drawings, Product Data and Samples"

1.4 QUALITY CONTROL

- A. The substitution shall provide as a minimum, the same performance as specified.

1.5 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. A completed Form CM-09 shall be submitted at least 60 days prior to when an order needs to be placed or a method needs to be changed.

- C. The submittal shall contain all the data required to be submitted for acceptance of the originally specified item or process, including, as appropriate:
1. Detailed product data sheets for the specified items and the substitution.
 2. Samples and shop drawings of the substitution.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SUBSTITUTION PROCESS

- A. Provide the information as required on Form CM-09.

3.2 SUBSTITUTION REQUEST

- A. The formal Request for Substitution will be evaluated by the DEN Project Manager and the Designer of Record based on the following criteria:
1. Compatibility with the rest of the project.
 2. Reliability, ease of use and maintenance.
 3. Both initial and long term cost.
 4. Schedule impact.
 5. The willingness of the Contractor to share equally in any cost savings.
 6. The ability of the item or process to meet all applicable governing regulations, rules, and laws along with funding agency requirements.
 7. The cost of evaluating the substitution.
- B. Based upon the above evaluation, the Sr. Director of AIM Development will make a final determination of what is in the best interest of the City and either approve, disapprove or approve as noted the requested substitution.

3.3 CONDITIONS

- A. As a condition for submitting a Request for Substitution the Contractor waives all rights to claim for extra cost or change in Contract time other than those outlined in the request and approved by the Deputy Manager of Aviation. The Contractor, by submitting a Request for Substitution, also accepts all liability for cost and scheduling impact on other contractors or the City due to the substitution.
- B. Included with the Request for Substitution shall be the following statement:
1. "The substitution being submitted is equal to or superior in all respects to the Contract-required item or process. All differences between the substitution and the Contract-required item or process are described in this request along with all required information, cost, and scheduling data."

- C. The statement shall be signed and dated by the Contractor's Superintendent.

- D. Replacement of Substitution Found to be Not Equal:. The Contractor shall be responsible for all aspects and conditions of the substitution that are not clearly identified in the substitution submittal, and shall be liable for the appearance, function, performance or other aspects of the substitution that are found not to be equal to the originally specified item.
 - 1. The Contractor shall incur all labor and costs associated with replacement of any substitution that is found to be not equal to the originally specified item or process and rejected by the DEN Project Manager.
 - 2. The replacement of any rejected substitution shall either be with the originally specified item or process, or a substitution approved by the DEN Project Manager

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

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END OF SECTION 012510

SECTION 012910 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions other Division 01 Specification Sections, and Related Requirements apply to this Section.

1.2 RELATED REQUIREMENTS

- A. The Work specified in this Section consists of preparing and submitting the Schedule of Values ("Schedule") as referenced in the General Conditions. Use the Project Specifications Table of Contents or Bid Tabs, if applicable, as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section. The Work also includes the preparing and submitting of updated copies of the Schedule if the Schedule is affected by change orders.
- B. A Schedule of Stored Material is a detailed cost breakdown for permanent materials that will be temporarily stored prior to their being installed and for which the Contractor seeks partial payments. The Schedule of Stored Material will be incorporated as a part of the Schedule of Values.
- C. Within 14 calendar days of issuance of the Notice to Proceed (NTP), the Contractor shall submit the Schedule of Values including the Schedule of Stored Material if applicable. The Schedule of Values and Schedule of Stored Material used to prepare the work/cost breakdown for the Schedule will be used for the Contractor's billings.
- D. Any Contract allowances shall be included in the Schedule. Expenditure of allowances shall be done using the Allowance Authorization form. Use of this form does not increase or decrease the Contract value.

1.3 RELATED DOCUMENTS

- A. Title 9 – Compensation of the General Contract Conditions, 2011 Edition
- B. Section 013300 "Submittal Procedures"
- C. Section 013325 "Shop and Working Drawings, Product Data and Samples".
- D. Form CM-89, Schedule of Values
- E. Form CM-91, Schedule of Values for Unit Price Contracts

1.4 SUBMITTALS

- A. The Schedule of Values shall be formally approved by the DEN Project Manager.
- B. The Schedule shall identify each item of work. Work items in the Schedule shall represent all Work and shall be referenced with the Technical Specifications section numbers, specification subparagraph, specification section title and the bid item number used for the Schedule of Prices and Quantities when applicable.
- C. Upon request by the City, the Contractor shall support values given with the data that will substantiate the correctness of the values.
- D. The Schedule will be utilized only as a basis for review of the Contractor's application for progress payment.

1.5 REVIEW AND RESUBMITTAL

- A. If review by the DEN Project Manager indicates that changes to the Schedule are required, the Contractor shall revise and resubmit the Schedule.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARING SCHEDULE OF VALUES

- A. Provide a breakdown of the Contract Price in enough detail to facilitate continued evaluation of Applications for Payment and progress reports.
- B. Breakdown of the items used in the Schedule shall include the following item costs. Ensure each item is complete:
 - 1. Delivered cost of product with applicable taxes paid.
 - 2. Total installation cost with overhead and profit.
 - 3. Breakdown costs of each lump sum item with a list of products and major operations for which the Contractor seeks to receive progress payments to recover the Contractor's costs for that bid item.
 - 4. Each unit price item as listed in the bid Schedule of Prices and Quantities shall list products and major operations for which the Contractor seeks to receive progress payments for that bid item.

3.2 PREPARING SCHEDULE OF STORED MATERIAL

- A. The Contractor shall submit with the Schedule an indication of whether products will be stored on or off the work site. The Schedule of Stored Material shall show all quantities and types of products that will be stored.

- B. Material allowances consist of only the net cost of the product, the cost of delivery and unloading at the storage site, the cost of applicable sales taxes, and all discounts.
- C. In no case will the cost paid for a permanent material be greater than 90 percent of the Contract price for the Work in which they are included.

3.3 PAYMENT FOR STORED MATERIALS

- A. Only materials that are described in the specifications and on the drawings will be considered permanent materials. Permanent materials are materials that will be left in the Work after the Contract is completed.
- B. Nothing in these specifications shall be interpreted as requiring the City to pay for stored materials. The DEN Project Manager shall decide on a case-by-case basis whether stored materials shall be paid for. No payment will be made for stored materials that have not been submitted and accepted.
- C. The Contractor must, at all times, store permanent materials in accordance with manufacturer's recommendations. Any material not properly stored will not be paid for. Amounts will be deducted from payments for any stored permanent material previously paid for and subsequently found to be improperly stored or not present, based upon a physical inventory of stored permanent material.
- D. Only the neat line quantity of material needed for the finished product may be paid for.
- E. All requests for stored permanent material payment must be accompanied by paid invoices clearly showing the quantity of permanent material, the type of permanent material and discounts or rebates and the net amount paid to the supplier along with a certificate stating that the permanent material is free of any liens or judgments preventing its use by the City.
- F. If the permanent material is stored outside the Denver area the Contractor must pay for the City representative's transportation and lodging to see the stored material as needed. Acceptable lodgings must, as a minimum, have a Mobil Travel Guide Rating Criteria® rating of Two-Star or the American Automobile Association Lodging Listing Requirements & Diamond Rating Guidelines® rating of Two Diamonds. The minimum transportation shall be by regularly scheduled commercial air carrier at coach rates. The DEN Project Manager will determine if an overnight stay is required.
- G. All permanent material stored off site, for which payment is being requested, must be insured and stored in bonded, insured warehouses. The Contractor shall provide proof of insurance for all material stored off site, and specific address and storage conditions of storage location.
- H. Any permanent material on which payment is requested must be in such a form that it cannot be used on work other than this Contract, or stored in a manner acceptable to the DEN Project Manager to ensure that the permanent material cannot be used on work other than this Contract.

3.4 ALLOWANCE AUTHORIZATION AND PAYMENT

- A. Contractor shall request written approval for expenditure of any Contract allowances PRIOR TO performing the Work involved. List work to be performed and estimated cost in the requesting correspondence.
- B. Original copies of all invoices and receipts must be submitted with the Allowance Authorization as part of the request for payment.
- C. Using the format provided by the City, the Contractor's request for payment of all Contract allowances shall be included in the Schedule of Values.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 012910

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations and coordination with other stakeholders and adjacent Contractors on the Project including,

1. Subcontractor's Acceptance Certification and Subcontractors List.
2. General Coordination Procedures.
3. Contract Administration Procedures.
4. Current Project Management Information Systems (PMIS)
5. Coordination drawings.
6. Current DEN Asset Management Systems
7. Requests for Information (RFIs).

- B. Related Requirements:

1. Section 011100, " Summary of Work" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
2. Section 011400 "Work Sequence and Constraints" for shutdown requests and coordinating with airport operational activities.
3. Section 011420 "Security Requirements and Sensitive Security Information (SSI)".
4. Section 013210 "Schedule" for preparing and submitting Contractor's Construction Schedule.
5. Section 013223 "Construction Layout, As-built and Quantity Surveys" for coordinating, survey activities and survey related record documents.
6. Section 013300 "Submittal Procedures. "
7. Section 013325 "Shop and Working Drawings, Product Data and Samples".
8. Section 017720 "Contract Closeout" for coordinating closeout of the Contract.
9. Section 017419 "Construction Waste Management and Recycling".
10. DEN Building Information Modeling (BIM) Design Standards Manual (DSM)

1.3 DEFINITIONS

- A. RFI: Request from the DEN Contractor DEN Project Manager seeking information required by or clarifications of the Contract Documents.

1.4 SUBMITTALS - SUBCONTRACTORS ACCEPTANCE CERTIFICATION AND
SUBCONTRACTORS LIST

- A. To comply with Section 502.2 in the General Contract Conditions, 2011 Edition, the Contractor must complete and submit form CM-02 Subcontractor Acceptance Certification for each Subcontractor working on the project. Additionally, the Contractor must prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.
- B. Provide emergency contacts list to the DEN Project Manager prior to any site activities. List must contain project name, number, location, company name and address, name and title of emergency contacts in order and time and assigned responsibilities. Keep list current and accurate at all times. Include any specific security arrangements or special projects requirements.
- C. Within two (2) days of Notice to Proceed, the Contractor shall submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identifying individuals and their duties and responsibilities listing addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Providing names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of the accepted list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination with other Contractors:
 - 1. For details on coordinating with other Contractors, refer to Article 701 Cooperation with Other Work Forces, Article 702 Coordination of the Work, and Article 703 Coordination of Public Contact in the General Contract Conditions, 2011 Edition.
- B. Minimum cooperation requirements with other contractors include the following, unless directed by the DEN Project Manager in writing:
 - 1. Regular meetings, minimum weekly.
 - 2. Construction schedule coordination.
 - 3. Staging area and access planning (to include employee shuttle routes).
 - 4. Deliveries.
 - 5. Traffic control.
 - 6. When and where required or specified, the Contractor shall develop appropriate coordination drawings for use by interfacing adjacent parties using the Denver International Airport site.
- C. The following is a list that includes, but is not limited to, all of the contractors that will be working in the area of the project limits:

D. Coordination with DEN entities shall include but is not limited to the following:

1. Coordinate with Owner Contracted Communication Contractor.
2. Coordinate with Utility Companies for utilities that are single sole source.
3. Coordinate with Airport Security and DEN Maintenance for all security related services.
4. Coordinate with DEN Life Safety Team for all issues related to fire alarm, fire protection systems in addition to compliance with all regulatory agencies.
5. Coordinate all shutdowns and system interruptions in accordance with section 011400 "Work Sequence and Constraints."

1.6 Contract Administration Procedures:

- A. This Project will be administered in part using the current Project Management Information System (PMIS). Any processes necessary to properly administer the Contract and not included in the list below shall be addressed as acceptable to the DEN Project Manager. DEN Project Manager may modify the list below in serialized correspondence without constituting a change to the Contract. Administrative tools and processes shall not in any form waive any contractual or legal requirements of the law or the Contract. The Contractor shall attend all coordination meetings with the DEN Project Manager and the DEN Project Control Administrators to arrange for staff training, and technical support to facilitate the execution of electronic data management and control.
- B. Project Management Information Systems (PMIS): Oracle Unifier Enterprise Project Portfolio Manager (EPPM), or the Oracle Primavera P6.
- C. All submittals, RFIs, Pay Applications, Correspondence, change requests, and pricing proposals and settlement agreements shall be recorded and submitted using the current PMIS:
1. The Contractor shall follow the specified PMIS Access Request Procedure and adhere to all user license conditions.
 2. The Contractor shall sign the Information Technology Agreement (ITA) to comply with the DEN computer system security requirements and any contractual obligation to the software and service providers for the current PMIS software
 3. DEN will train the Contractor's staff on the use of the PMIS.
 4. At a minimum, the Contractor shall provide computer hardware and software to meet the following requirements and to run the following programs, as required for the project:
 - a. Internet connectivity that provides the necessary high-speed connection to perform all activities indicated in this Contract.
 - b. Internet Explorer version 8 or higher.
 - c. Based on the project, a specific Java JRE application may be required, which can be downloaded from the Internet. If needed, the revision and update number will be provided at NTP.
 - d. Other files capability pre-approved by the DEN Project Manager or as required by the DEN BIM Execution Plan
 - e. Most current version of Revit, as per DEN requirements.

1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, BIM Design Standards Manual and BIM Project Execution Plan (BPPX), and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity. Coordination drawings will be the result of a Contractor driven Spatial Coordination effort as spelled out in the BPPX.
1. Field verify all existing dimensions and any as-built dimensions, whether built by the Contractor or others, necessary to produce accurate coordination and working drawings.
 2. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Models/Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Models/Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to DEN Project Manager indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Using software as in the BPPX, the Contractor shall coordinate these systems per floor or zone per BPPX, and as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

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3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes dimensioned from column centerlines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: DEN Project Manager will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If DEN Project Manager determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, DEN Project Manager will so inform Contractor, who shall make changes as directed and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings, unless approved otherwise by DEN Project Manager.
 2. File Preparation Format: Provided in the Project BIM Execution Plan operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files as required in the Project BIM Execution Plan.
 4. The submittal must be logged in accordance with the submittal procedure

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5. For Fire Protection system; provide shop drawing and design calculations as approved by the building department. Submit as-built drawings in format as outline in BXP.
 6. For all projects, receiving official variance from the BIM requirements not utilizing BIM, coordination drawings must be submitted in acceptable digital format shall be in an industry recognized 3D AutoCAD model.
 7. BIM File Incorporation: DEN Project Manager will incorporate Contractor's coordination drawing files into Building Information Model for Revit as established for Project.
 - a. Contractor shall lead three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect or other sub-consultants.
 8. DEN Project Manager will furnish Contractor one (1) set of digital data files of Models and/or Drawings for use in preparing coordination digital data files.
 - a. The Design consultants and Contractors and Sub Contractors acknowledge and represent the following Right Of Reliance regarding Electronic Models and/or Drawing deliverables:
 - 1) Models may be transferred for allowing the recipients to develop derivative models to develop the means and methods by which to construct the project.
 - 2) It must be clear that each party be able to rely on the fact that the model furnished by others "match the 2D Contract Documents or shop drawings in their equivalent state of development"
- 1.8 Coordination with DEN Asset Management System:
- A. The full intent is to produce comprehensive record documents integrating existing data in the form of digital files and models, reconciled to actual field conditions, modifications or additions facilities or components of existing facilities according to new Contract Documents, and to produce record documents that could be incorporated into DEN asset management system.
 - B. Utilize the BIM to link all necessary data content to the model and follow the BXP as collaboratively modified by the Contractor, Designer, and DEN BIM Administrators and approved by DEN Project Manager
 - C. Provide the following information through the execution of the Contract for all elements and element types that DEN has designated as assets. The information shall include but is not limited to:
 1. Project title, number, project manager contact information, contractor and subcontractor contact information
 2. Pertaining shop drawings
 3. Operational Manuals and safety information, MSDS and cut sheets, and any pertinent technical information.

4. Details of all components' maintenance procedures and requirements.
5. Details of all applicable warranties including but not limited to; warranty providers, manufacturers information, warranty start and finish dates, contacts , bonding company name, consent of surety,
6. Equipment location (by room number and location description or grid location format acceptable to DEN Project Manager, for civil projects), equipment make, model, serial number, and other asset information as outlined in the DEN BIM DSM
7. List of all spare parts including but not limited to; equipment make and model, location, submittal number or link, and suppliers reordering information
8. Commissioning results, acceptance criteria, test reports, and Tab reports

1.9 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI through the PMIS
 1. DEN Project Manager will distribute the RFIs to the proper entities.
 2. DEN Project Manager will coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's Work or work of subcontractors
- B. DEN Project Manager has the right to reject RFIs or those that do not contain proper information and required data to properly evaluate the request and respond in a timely manner.
- C. RFIs: Use PMIS to generate RFIs.
 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
 2. Attachments include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- D. For projects not using Unifier to create the RFI, the RFI must include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of DOR and DEN Project Manager.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- E. DEN Project Manager will review each RFI, determine action required, and respond. RFIs received by DEN Project Manager after 1:00 p.m. will be considered as received the following working day. Direct responses by any entity other than DEN Project Manager shall not be binding to the City and County of Denver. E-mails, and verbal conversations must be followed by an official RFI or proper contractual vehicle before it is considered for any additional compensation or time impact to the project terms and conditions.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of DEN Project Manager's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. DEN Project Manager's action may include a request for additional information, in which case DEN Project Manager's time for response will date from time of receipt of additional information.
 3. DEN Project Manager's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Title 11 - Changes In the Work, Contract Price, or Contract Time in the General Contract Conditions, 2011 Edition as amended by Special Conditions.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify DEN Project Manager in writing within five (5) days of receipt of the RFI response or the time required by Title 11 - Changes In the Work, Contract Price, or Contract Time in the General Contract Conditions, 2011 Edition
- F. RFI Log: For projects not utilizing the PMIS application, prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. The log shall include but not limited to the following data:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of DEN Project Manager.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.

7. Date DEN Project Manager's response was received.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT:

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT:

- A. No additional Payment will be made for compliance with the requirements of this section.

END OF SECTION 013100

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
013100
PROJECT MANAGEMENT AND COORDINATION

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

SECTION 013119 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section requires the Contractor's Project Manager, Superintendent, and Quality Control representative to attend meetings scheduled by the DEN Project Manager for the collection and dissemination of information related to the subject Contract.
- B. The DEN Project Manager will prepare the minutes of each meeting and distribute them to each of the participants.

1.3 REFERENCE DOCUMENTS

- A. Form CM-01, Preconstruction Meeting Agenda
- B. Form CM-62, Construction Meeting Agenda/Minutes

1.4 OTHER MEETINGS

- A. The Contractor shall attend all other project related meetings as directed by the DEN Project Manager.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MEETING

- A. A Preconstruction Meeting will be scheduled by the DEN Project Manager after the Contract has been signed by all parties. The purpose of this meeting is to introduce the City's Representatives to their counterparts in the Contractor's organization and to establish lines of communication between these representatives and outline some Contract requirements. The Contractor's key personnel shall attend this meeting.

- B. The DEN Project Manager will distribute a notice of this meeting, along with an agenda of the subjects to be addressed. Refer to form CM-01, Preconstruction Meeting Agenda.
- C. The DEN Project Manager will explain and discuss the responsibilities and authorities of the City, the Designer of Record, and the DEN Project Manager's organization.
- D. The Contractor shall introduce the Contractor's key personnel, subcontractors, and representatives and briefly describe each person's responsibilities.
- E. Explanations provided by the DEN Project Manager will not amend, supersede, or alter the terms or meaning of any Contract document, and the Contractor shall not claim reliance on such explanations as a defense to any breach or failure by the Contractor to perform as specified in the Contract.

3.2 CONSTRUCTION PROGRESS MEETINGS

- A. Progress meetings will be scheduled weekly and more often as necessary by the DEN Project Manager to promote the competent and timely execution of the Contract.
- B. The meetings will be held at the work site or at a location selected by the DEN Project Manager. Meetings will be chaired by the DEN Project Manager or the DEN Project Manager's representative.
- C. The Contractor's key personnel shall attend unless otherwise agreed by the DEN Project Manager.
- D. At a minimum, and as directed by the DEN Project Manager, the items detailed in CM-62, Construction Meeting Agenda/Minutes shall be addressed at each meeting. The items addressed in the meeting do not waive notification or submittal requirements as required elsewhere in the Contract.
- E. The DEN Project Manager will be responsible for publishing minutes of the meetings. Refer to form CM-62, Construction Agenda/Meeting Minutes.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment shall be made for work under this Section.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
013119
PROJECT MEETINGS

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
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- B. All payments for any Work done under this contract shall be in accordance with Title 9
- Compensation of the General Contract Conditions, 2011 Edition.

END OF SECTION 013119

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
013119
PROJECT MEETINGS

DENVER INTERNATIONAL AIRPORT
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SECTION 013210 - SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section describes the procedures and requirements for scheduling and documenting the progress of the project:

1. Preliminary Construction Schedule.
2. Initial Project Construction Schedule (IPS).
3. Monthly Progress Schedule update.
4. As-built Schedule.
5. Three-Week Look-Ahead Schedule.
6. Submittal Schedule.
7. Fabrication Schedule.
8. Material Delivery Schedules, cranes, special equipment and staging status.
9. Daily Superintendent/Foreman Reports
10. Daily Quality Control Reports
11. Special reports:
 - a. Weather impacts and mitigations.
 - b. Recovery Schedule and alternatives.

- B. Reference Documents

1. Article 1105 – Time Extensions in the General Contract Conditions, 2011 Edition.
2. Section 011100 "Summary of Work"
3. Section 011420 "Work Sequence and Constraints".
4. Section 012910 "Schedule of Values".
5. Section 013119 "Project Meetings"
6. Section 013300 "Submittal Procedures"

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a Construction Schedule consume time and resources:

- B. **Contract Time:** Total number of days provided in the Contract Documents from the Notice to Proceed to the date of Final Completion of the Work. Substantial Completion shall occur prior to Final Completion. Contract Time may be further defined and divided into phases by the Technical Specifications or Special Conditions. The Contract Documents may require completion on or before a certain specified date.
- C. **Cost Loading:** The allocation of the total contract value spread across each appropriate activity. All project costs, including those for stored materials, allowances and indirect costs shall be loaded into the schedule and shall be balanced to where no activity is unfunded.
- D. **Critical Activity:** An activity on the critical path that must start and finish on the planned early start and finish dates. Any delay in the start or finish of a critical activity will cause a delay to the project finish.
- E. **Critical Path Method (CPM):** A method of planning and scheduling a construction project where activities are arranged based upon defined relationships. Defined relationships determine when activities can be performed and the critical path for completing the Work.
- F. **Critical Path:** The longest chain of interdependent activities through the network sequence that establishes the shortest duration for completing the work and contains no float. The critical path shall be calculated as total float equal to but not less than zero days. Activities on the critical path have a total float of zero.
- G. **Data Date:** The date on which the schedule status is determined. For initial schedules, it is the project Notice to Proceed date. For schedule updates, it is the reporting period cut-off date. Updated schedules depict the actual status of the work started, on-going and/or completed within the reporting period. The data date is used to start the scheduling calculations for forward and backward passes.
- H. **Days:** Consecutive calendar days unless specifically designated otherwise and includes weekends, holidays or days of normal inclement weather.
- I. **Direct Man-hours:** Man-hours related only to the physical construction of the Work, i.e., drywall, carpeting, electrical, masonry, mechanical, etc.
- J. **Final Completion:** Occurs following Substantial Completion and when the Project Manager confirms in writing that the Contractor has completed the work in accordance with the contract, including completion of all punch list items, cleanup work and delivery of all required guarantees, warranties, licenses, releases and other required deliverables.
- K. **Free float:** The amount of time an activity can be delayed without adversely affecting the early start of its successor activity.
- L. **Indirect Man-hours:** Man-hours related to support of the physical construction of the Work, i.e., mobilization, cleanup, traffic control, temporary activities, badging, supervision and overhead, etc.

- M. Lag: The delay of a successor activity and represents time that must pass before the second activity can begin. There are no resources associated with a lag.
- N. Lead: The acceleration of a successor activity where it can begin in parallel with the predecessor activity. It compresses the total combined duration of both activities. The dependency must be discretionary and there is no physical limitation on completing Activity "A" before Activity "B" begins.
- O. Longest Path: The longest continuous path of activities through a project, which controls project early completion. It is possible for otherwise defined critical path activities to not be on the longest path and longest path activities to not show calculated critical float.
- P. Notice to Proceed: A notification letter from the Owner addressed to the contractor stating the date on which the contractor can begin project work. The NTP date marks the beginning of the Contract Time.
- Q. Predecessor Activity: An activity that comes before a dependent activity in the network sequence. It must either start or finish before a specified activity can begin.
- R. Resource Loading: A calculated value based on the actual worker's hours and costs, equipment and materials costs that are required to complete an activity. The value is allocated to the specific activities.
- S. Substantial Completion: The Work has progressed to the point that the City can beneficially occupy or utilize the Work for the purpose for which it is intended, and the Work complies with all applicable codes and regulations, including, if required, issuance of a certificate of occupancy, or certificate of suitability for use from the appropriate governmental agencies, as determined by the Manager in its sole discretion.
- T. Successor Activity: A dependent activity that logically comes after another activity in the network sequence.
- U. Total float: The amount of time that an activity in a network sequence can be delayed without causing a delay to subsequent activities and/or the completion date of the Work.
- V. Work Breakdown Structure (WBS): A hierarchical decomposition of the Work to be executed by the contractor. It shall allow for the roll-up and summarization to a predetermined level. The level of breakdown shall be agreed upon by the Contractor and the DEN Project Manager prior to the start of Work.

1.4 SUBMITTALS

- A. Submit for City acceptance the following in accordance with Section 013300 – Submittal Procedures:
1. Project Scheduler Qualifications
 2. Preliminary Project Construction Schedule

3. Initial Project Construction Schedule
4. Monthly Progress Update Schedules
5. Time Impact Analysis, when necessary
6. As-built Schedule

B. Scheduler/Scheduling Consultant Qualifications:

1. A professional with a minimum of two (2) years of experience with scheduling construction projects similar in size and scope of work as this project using Oracle Primavera P6 software.
2. The scheduler shall have a comprehensive knowledge of Critical Path Method (CPM) scheduling principles and application.
3. The scheduler shall also have the ability to produce reports and diagrams within 24 hours of the DEN Project Manager's request and be able to perform the below tasks, including, but not limited to, the following:
 - a. Create, maintain and update the project construction schedule.
 - b. Prepare monthly progress schedule updates, submit for review and incorporate the City's review comments into the schedule, if any.
 - c. Coordinate the participation of qualified personnel to assist in the development of the initial construction schedule and updating of the monthly progress schedule.
 - d. Develop a WBS to the appropriate level and be able to discuss verbally and in writing the applicability of the WBS.
 - e. Incorporate delivery dates for Owner-furnished products.
 - f. Incorporate submittal requirements, procedures and time required for review of submittals and resubmittals.
 - g. Incorporate requirements for tests and inspections by independent testing and inspecting agencies.
 - h. Incorporate time required for Project closeout and Owner start-up procedures, including commissioning activities.

1.5 COORDINATION

- A. Pre-scheduling Conference: Schedule conference at Pre-Construction meeting to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to setting up the Preliminary Project Construction Schedule and Initial Project Construction Schedule, including, but not limited to, the following:
1. Verify availability of qualified personnel needed to develop and update schedule.
 2. Review content and format for reports.
 3. Discuss constraints, including phasing, area separations, interim milestones, and partial Owner occupancy.
 4. Review delivery dates for Owner-furnished products.
 5. Review submittal requirements and procedures.
 6. Review time required for review of submittals and resubmittals.
 7. Review time required for Shutdown request and approval.
 8. Review requirements for tests and inspections by independent testing and inspecting agencies.

9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 10. Review procedures for updating schedule.
 11. Review requirements for content and input of direct man-hour resources in activities.
 12. Review requirements for cost loading of activities.
- B. Coordinate Initial Project Construction Schedule with the Schedule of Values.
- C. Work items in the Initial Construction Schedule shall be identified in a Work Breakdown Structure (WBS) format that corresponds with the areas, phasing or schedules of the project and the technical specifications.
- D. Secure time commitments for performing critical elements of the Work from entities involved.
- E. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SOFTWARE

- A. DEN Default Software:
1. DEN shall use Oracle Primavera P6, Release 18.7 for all City scheduling needs.
- B. Contractor Software:
1. Scheduling software used by the contractor shall be Oracle Primavera P6 Release 16 or higher.
 2. The software and any support agreements shall be purchased at the contractor's expense from a vendor of the contractor's choosing.
 3. The City will not provide training or support services for contractor purchased software.
- C. Oracle Primavera P6:
1. The following settings are mandatory and required in all schedule submissions to the City:
 - a. Activity codes shall be Project Level, not Global or EPS level.
 - b. Calendars shall be Project Level, not Global or Resource level.
 - c. Activity Duration Types shall be set to "Fixed Duration & Units".
 - d. Percent Complete Types shall be set to "Physical".
 - e. Time Period Admin. Preferences shall remain the default "8.0 hour/day, 40 hour/week, 172 hour/month, 2000 hour/year". Set Calendar Work Hours/Day to 8.0-hour days.

- f. Set Schedule Option for defining Critical Activities to "Total Float less than or equal to zero (0) hours/day".
- g. Set Schedule Option for defining progressed activities to "Retained Logic".
- h. Set up cost loading using single lump sum resource. The Price/Unit shall be \$1/hour, Default Units/Time shall be 8h/d", and settings "Auto Compute Actuals" and "Calculate Cost from Units" selected.
- i. Activity ID's shall not exceed 10 characters.
- j. Activity Names shall have the most defining and detailed description within the first 30 characters.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Prepare for acceptance all Project Schedules utilizing the Critical Path Method (CPM) of network calculation to generate all Project Schedules.
- B. Prepare each Project Schedule utilizing the Precedence Diagram Method (PDM).
- C. Show in the schedule, the proposed sequence to perform the work and dates contemplated for starting and completing the schedule activities.
- D. The scheduling of the entire project is required.
- E. Provide a schedule that is forward planning as well as a project monitoring tool
- F. Contractor management personnel shall actively participate in its development.
- G. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate project schedule.
- H. The contractor shall keep the subcontractors and suppliers informed of the Project Construction Schedule to enable the subcontractors to plan and perform their work properly.

3.2 COST LOADING

- A. Activity cost loading shall be reasonable and without front-end loading.
- B. Provide additional documentation to demonstrate reasonableness, if requested by the City.

3.3 WITHHOLDINGS / PAYMENT REJECTION

- A. Failure to meet the requirements of this Section may result in the disapproval of the schedules or updates and subsequent rejection of payment requests until requirements are met.

- B. If the DEN Project Manager directs schedule revisions and those revisions have not been included in subsequent Project Schedule revisions or updates, the DEN Project Manager may withhold 10 percent of pay request amount for each payment period until such revisions to the project schedule have been made.

3.4 PROJECT SCHEDULE DETAIL REQUIREMENTS

A. Level of Detail Required

1. Develop the Project Schedule as a Level 4 execution schedule.
2. Level of detail to address major milestones and to allow for satisfactory project planning and execution.
3. Failure to develop the Project Schedule to an appropriate level of detail will result in its disapproval.
4. The DEN Project Manager will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail

B. Activity Durations

1. Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods.
2. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days.

C. Procurement Activities

1. Include activities associated with the critical submittals and their approvals, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies.
2. Long lead procurement activities are those with an anticipated procurement sequence of over 30 calendar days.

D. Mandatory Tasks

1. Include the following tasks/activities in the preliminary and initial project schedules and all updates.
 - a. Notice to Proceed milestone activity.
 - b. Submission, review and acceptance of preconstruction submittals (individual activity for each).
 - c. Long procurement activities.
 - d. Submission and approval of testing activities, as needed by project.
 - e. Submission and approval of Operations & Maintenance (O&M) manuals.
 - f. Submission and approval of as-built drawings.
 - g. City Punch list walk-through.
 - h. Correction of Punch list items based on City Punch list walk-through.
 - i. Substantial Completion milestone activity.

E. Owner Activities

1. Show the City and other agency activities that could impact progress. These activities include, but are not limited to:
 - a. Approvals
 - b. Acceptance
 - c. Building Department Permits
 - d. Environmental Permit Approvals by State Regulators
 - e. Inspections
 - f. Utility Tie-Ins
 - g. Owner Furnished Equipment
 - h. NTP For Phasing Requirements.

- F. Workers Per Day
 1. Assign workers per day for the field construction and direct work activities, if directed by DEN Project Manager.
 2. Workers per day shall be the average number of workers expected each day to perform the task for the duration of the activity.

- G. Responsible Party Coding
 1. Assign responsibility for activities to the Prime Contractor, subcontractors, DEN or other agencies responsible for performing the activity.
 2. Activities cannot have more than one Responsibility Code.
 3. Examples of acceptable activity code values are:
 - a. DOR (Designer of Record)
 - b. ELEC (electrical subcontractor)
 - c. MECH (mechanical subcontractor)
 - d. PAVE (paving subcontractor)
 - e. DEN (Denver International Airport)

- H. Calendars
 1. Schedule activities on a calendar to which the activity logically belongs.
 2. Develop calendars to accommodate Contract-defined work periods, such as a 7-day calendar for City Acceptance activities, concrete cure times, etc.
 3. Develop the default calendar to match the physical work plan with non-work periods identified including weekends and holidays.
 4. Develop and assign seasonal calendars to seasonally affected activities.
 5. If an activity is weather-sensitive, assign it to a calendar showing non-work days on a monthly basis, with the non-work days selected at random across the weeks of the calendar:
 - a. The assignment of the non-work days should be over a 7-day week since weather records are compiled on 7-day weeks, which will cause some of the weather related non-work days to fall on weekends.
 - b. Monthly average rain and snow measurements can be obtained from the National Climatic Data Center for the Denver Metropolitan Area or any similar trusted resource.

I. Contract Milestones and Constraints

1. Milestone shall be used for significant project events including, but not limited to, project phasing, project start and end activities, and interim milestone and/or completion dates.
2. The use of artificial float constraints such as "zero free float" or "zero total float" are prohibited.
3. Mandatory constraints that ignore or affect network logic are prohibited.
4. No constrained dates are allowed in the schedule other than those specified herein. Submit additional constraints to DEN Project Manager for approval on a case-by-case basis.

J. Project Start Date Milestone

1. The first activity in the project schedule shall be a start milestone titled "NTP Issued" with a date equal to the date that NTP was issued to the contractor.

K. Project Finish Milestone

1. The last activity in the schedule shall be a finish milestone titled "Substantial Completion".
2. The project schedule shall be constrained to reflect the last day of the contract duration in such a way that if the schedule calculates an early finish, then the float calculation for "Substantial Completion" milestone reflects positive float.
3. If the project schedule calculates a late finish, then the "Substantial Completion" milestone float calculation reflects negative float.
4. The City is under no obligation to accelerate City activities to support a Contractor's early completion.

L. Interim Completion Dates and Constraints

1. Constrain contractually specified interim milestone completion dates to show negative float when the calculated last finish date of the last activity in that phase is later than the specified interim completion date.

M. Start Phase

1. Use a start milestone as the first activity for a project phase.
2. The start milestone shall be called "Start Phase X" where "X" refers to the phase of work.

N. End Phase

1. Use a finish milestone as the last activity for a project phase.
2. Call the finish milestone "End Phase X" where "X" refers to the phase of work.

O. Open Ended Logic

1. Only two (2) open ended activities are allowed: the first activity "NTP Issued" shall have no predecessor logic, and the last activity "Substantial Completion" shall have no successor logic.

P. Default Progress Data Disallowed

1. Actual Start and Finish dates shall not automatically update with default mechanisms included in the scheduling software.
2. Updating of the percent complete and the remaining duration of an activity shall be independent functions.
3. Disable program features that calculate one of these parameters from the other. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided in the Contractor Quality Control Reports.
4. Failure to document the AS and AF dates in the Daily Quality Control report will result in disapproval of the Contractor's schedule.

Q. Out-of-Sequence Progress

1. Activities that have been progressed before the preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis and subject to DEN Project Manager approval.
2. Propose logic corrections to eliminate Out-of-Sequence Progress.
3. Address Out-of-Sequence Progress and logic changes in the Narrative Report and in the periodic schedule update meetings.

R. Added and Deleted Activities

1. Do not delete activities from the project schedule or add new activities to the schedule without approval from the DEN Project Manager.
2. Activity ID and description changes are considered new activities and shall not be changed without approval from the City.

S. Original Durations

1. Activity Original Durations (OD) shall be reasonable to perform the work item. OD changes are prohibited unless justification is provided to and approved by the DEN Project Manager.

T. Leads, Lags, and Start to Finish Relationships

1. Lags shall be reasonable as determined by the DEN Project Controls and not used in place of realistic original durations, shall not be in place to artificially absorb float, or to replace proper schedule logic.
2. Leads (negative lags) and Start to Finish (SF) relationships are prohibited.

U. Retained Logic

1. Schedule calculations shall retain the logic between predecessors and successors ("retained logic" mode) even when the successor activity starts, and the predecessor activity has not finished (out-of-sequence progress).
2. Software features that, in effect, sever the tie between predecessor and successor activities when the successor has started, and the predecessor logic is not satisfied ("progress override") shall not be allowed.

V. Percent Complete

1. Update the percent complete for each activity started, based on the realistic assessment of earned value.
2. Activities which are complete, but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete to allow for proper schedule management.

W. Remaining Duration

1. Update the remaining duration for each activity based on the number of estimated work days necessary to complete the activity.
2. Remaining duration may not mathematically correlate with percentage found under Paragraph "Percent Complete", above.

X. Work Performed Under Adverse Weather Conditions

1. In accordance with the 2011 Denver General Contract Conditions (GCC) Section 305 Work Performed Under Adverse Weather Conditions, adverse weather conditions are those that are not abnormal weather conditions but that can, depending on the Work to be performed, cause defective Work.
2. High and low temperatures, excessive moisture or unusual drying conditions are examples. Reflect the number of anticipated adverse weather days allocated to a weather-sensitive activity in the activity's calendar.
3. These conditions must be recorded in the Contractor Daily QC Reports, notification of adverse weather shall be given within twenty-four (24) hours of occurrence to the DEN Project Manager for concurrence and the adverse weather day documented in order to be considered for a time extension adjustment.

Y. Time Extensions for Abnormal Weather Conditions

1. In accordance with the 2011 Denver General Conditions (GCC) Section 1105 Time Extensions, if abnormal weather conditions are the basis for a request to extend the Contract Time, such request will be documented by data substantiating that weather conditions were unusually severe for the period of time and could not have been reasonably anticipated.
2. To establish that the existence of abnormal weather, the Contractor must submit documentation that establishes that the weather conditions experienced fall outside of the extreme ranges of weather data published by the National Climatic Data Center for the Denver Metropolitan Area for the ten (10) year period immediately preceding the data of the Contract.
3. Regardless of actual weather conditions, any Day in which the Contractor is able to work eighty percent (80%) or more of its scheduled work force shall not be counted as an abnormal weather Day for purposes of calculating weather related time extensions.

Z. Early Completion Schedule and the Right to Finish Early

1. An Early Completion Schedule is an Initial Project Schedule that indicates the scope of the required contract work will be completed before the contractually required completion date.
2. An Initial Project Schedule indicating an Early Completion will not be accepted without being fully resource-loaded (including crew sizes and manhours) and without the DEN Project Manager agreeing that the schedule is reasonable and achievable.
3. The City is under no obligation to accelerate its own work items to ensure that the early completion is met nor is it responsible to modify incremental funding (if applicable) for the project to meet the Contractor's accelerated work.

3.5 PROJECT SCHEDULE SUBMISSIONS

A. General

1. Submit the electronic data files (.xer), reports, and network diagrams required for each submission as described in Article 1.4 SUBMITTALS.
2. If the Contractor fails or refuses to furnish the information and schedule updates as set forth, the Contractor will be deemed unresponsive and payment may be withheld as described in Article 3.3 WITHOLDINGS / PAYMENT REJECTION.
3. Review comments made by DEN Project Controls on the schedules do not relieve the Contractor from compliance with the Contract.
4. Provide the submissions as described below.

B. Preliminary Project Construction Schedule Submission

1. Within ten (10) days after the issuance of Notice to Proceed (NTP), submit the Preliminary Project Construction Schedule:
 - a. If contract time is greater than 120 calendar days, submit the Schedule defining the planned operations detailed, at a minimum, for the first sixty (60) calendar days of the project for acceptance.
 - b. If contract time is shorter than 120 calendar days, submit the Schedule defining the planned operations detailed for the full contract term for acceptance.
 - c. It shall be early start and late finish constrained and logically tied as specified.
2. The Preliminary Project Construction Schedule shall form the basis for the Initial Project Construction Schedule specified herein and shall include all the required plan and program preparations, submissions and approvals identified in the contract. For example, Quality Control Plan, Site-specific Safety Plan, and Environmental Protection Plan, etc.
3. The DEN Project Manager will respond within 14 days to the Preliminary Schedule submittal with either acceptance or direction to revise and resubmit.
4. In lieu of the Preliminary Project Construction Schedule, the Contractor may, at the Contractor's own discretion, submit the Initial Project Construction Schedule at the Preconstruction Meeting.

- a. If the Initial Project Construction Schedule is submitted in lieu of the Preliminary Project Construction Schedule, the DEN Project Manager will respond within thirty (30) days with acceptance or direction to revise and resubmit within ten (10) days.
5. Acceptance of Preliminary Project Construction Schedule will not constitute approval of Schedule of Values.
- C. Gantt Chart Schedule
1. Submit a time-scaled network diagram printout of the Preliminary Project Construction Schedule at the pre-construction meeting.
 2. Preparation
 - a. Indicate each significant construction activity separately.
 - b. Identify first workday of each week with a continuous vertical line.
 - c. Outline significant construction activities for the contract duration.
 - d. Include skeleton diagram for the remainder of the Work, when necessary.
 - e. For a project with contract time greater than 120 calendar days, the Preliminary Schedule shall show all significant Work tasks that occur in the first sixty (60) days including, but not limited to planning, mobilization, shop drawings and technical submittals and approval time, procurement, fabrication and construction.
 - f. For a project with contract time less than 120 calendar days, the Preliminary Schedule shall show all Work tasks that occurs during the contract time including, but not limited to planning, mobilization, shop drawings and technical submittals and approval time, procurement, fabrication and construction.
 - g. It shall identify work items or milestones that affect or are affected by City, other Contractor's work, utilities, and other third parties and it shall list major submittals required by the Contract.
- D. Narrative Report
1. For a project with contract time greater than 120 calendar days, the Preliminary Project Construction Schedule shall be accompanied by a narrative describing the Contractor's approach to mobilization, procurement, and construction during the first sixty (60) days.
 2. For a project with contract time less than 120 calendar days, the Preliminary Project Construction Schedule shall be accompanied by a narrative describing the Contractor's approach to mobilization, procurement, and construction during the contract time.
 3. The narrative shall elaborate based on durations, production rates, major equipment to be used, and shall identify all major assumptions used to develop the schedule.

3.6 Initial Project Construction Schedule Submission

A. General

1. Submit the Initial Project Construction Schedule for acceptance within thirty (30) days after issuance of NTP.
 2. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent the Work through the entire contract performance period.
 3. The DEN Project Manager will respond within 14 days with acceptance or direction to revise and resubmit.
 4. The acceptance of the schedule is for general conformity to the Contract requirements and shall not constitute any relief of any Contract requirements.
 5. Upon acceptance from the DEN Project Manager and DEN Project Controls, the Initial Project Construction Schedule shall become the Baseline Schedule for the duration of the project.
 6. The Baseline Project Construction Schedule may be changed when one or more of the following events occur:
 - a. When a Change Order significantly affects the contract completion date or sequence of work.
 - b. When the Contractor elects to change the sequence or duration of work items affecting the critical path resulting in a major change that requires DEN PM approval.
 - c. When the City directs a change that affects a milestone dates specified in the Special Conditions or alters the length of a critical path.
 7. Failure to include any work item required for performance of this Contract shall not excuse the Contractor from completing all Work within applicable completion dates, regardless of the City's acceptance of the schedule.
 8. Failure of the contractor to have an Initial Project Construction Schedule accepted by DEN Project Manager will be considered cause for withholding progress payment.
- B. Preparation:
1. Project Duration
 - a. Extend schedule from NTP date to Substantial Completion.
 - b. Contract completion date shall not be changed by submission of a schedule that shows an early or late completion date, unless specifically amended by Change Order.
 2. Activities
 - a. Treat each building floor or separate area as a separate numbered activity for each main element of the Work.
 - b. Prepare a list of all activities required to complete the Work and indicate the estimated time duration, sequence requirements, and relationships of each activity in relation to the other activities.
 3. Activity Duration:
 - a. Define activities so no construction activity is longer than twenty (20) days, unless specifically allowed by DEN Project Manager. Include estimated time frames for the following activities:

- 1) Preparation and processing of submittals.
- 2) Mobilization and demobilization.
- 3) Purchase of materials.
- 4) Delivery of materials.
- 5) Fabrication of materials
- 6) System shutdown request and approval
- 7) Utility/system interruptions
- 8) Installation of Work
- 9) Work by City, other contractors, utilities and other third parties that may affect or be affected by Contractor's activities.
- 10) Startup, Testing and Commissioning
- 11) Punch list and Final Completion.

4. Critical Path Activities:

- a. No more than twenty-five (25) percent of the activities may be on the critical path, unless approved IN WRITING by DEN Project Manager.
- b. Identify critical path activities, including those for interim completion dates.
- c. Scheduled start and completion dates shall be consistent with Contract milestone dates.

5. Procurement Activities:

- a. Include procurement activities for long lead items and major items as separate activities in schedule.
- b. Procurement cycle activities including, but are not limited to, submittals, approvals, purchasing, fabrication and delivery.
- c. May have a duration greater than twenty (20) calendar days and should represent the time to complete the procurement cycle as described above.

6. Submittal Review Time:

- a. Include review and re-submittal times indicated in Technical Specification 013300 "Submittal Procedures" in schedule unless time frame is reduced by approval of the DEN Project Manager.
- b. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.

7. Substantial Completion:

- a. Indicate date established for Substantial Completion.

8. Milestones:

- a. Include milestone indicated in the Contract Documents, including, but not limited to, NTP, Phasing Milestones and Substantial Completion.

9. Constraints:

- a. Include constraints and work restrictions indicated in the Contract Documents and show how the sequence of the Work is affected:

- 1) Phasing:
 - a) Arrange activities in schedule in Work Breakdown Structure (WBS) by Area, Phase or Bid Schedule.
 - b) Coordinate phasing and constraints with those established in Technical Specification Section 011400 "Work Sequence and Constraints".
- 2) Products Ordered in Advance:
 - a) Include separate activity for each product.
 - b) Include delivery date indicated in Technical Specification Section 011100 "Summary of Work".
 - c) Delivery dates indicated stipulate the earliest possible delivery data.
- 3) Owner-furnished Products:
 - a) Include separate activity for each product.
 - b) Include delivery date indicated in Technical Specification Section 011100 "Summary of Work".
 - c) Delivery dates indicated stipulate the earliest possible delivery date.

10. Resource Loading of Construction Schedule:

- a. Coordinate with DEN Project Controls and DEN Project Manager for the requirements.
- b. Activities shall be resource loaded with direct man-hours required to perform the physical construction of the project. Indirect man-hours shall not be included as resources to activities.

C. Schedule Narrative Report

1. The Initial Project Construction Schedule shall be accompanied by a narrative describing the Contractor's approach to mobilization, procurement, and construction for the project.
2. It shall elaborate on the original assumptions of estimated quantities and production rates, hours per shift, workdays per week, and types, number and capacities of major construction equipment to be used and whether the Contractor plans to work weekends.

3.7 MONTHLY PROGRESS CONSTRUCTION SCHEDULE UPDATES

- A. The Contractor shall submit a monthly progress schedule at the end of each month following the issuance of NTP.
- B. At the end of each month, the Contractor and DEN Project Manager shall agree on the progress of the work and the Contractor shall update the Construction Schedule accordingly.

- C. This review does not constitute an acceptance of the Monthly Progress Schedule update and shall not be used for the purpose of modifying the accepted Baseline Project Construction Schedule.
- D. Failure of the Contractor to have a Monthly Progress Construction Schedule accepted by the DEN Project Manager will be considered cause for withholding progress payment per Article 306 - Working Hours and Schedules and Article 909 - Additional Withholding of Progress Payments of the General Contract Conditions, 2011 Edition.
- E. The Contractor's monthly progress schedule shall include a written narrative describing the overall progress of the Work, provide a critical path analysis, explain the basis for determining construction logic, discuss significant problems with proposed corrective action, and how the status of major changes and any other changes are affecting the project schedule.
- F. Concurrent with making revision to the schedule, prepare a tabulated report showing the following and include in the narrative report:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations for remaining work activities only.
 5. Changes in critical path.
 6. Change in total float
 7. Changes in contract time.
- G. Minor revisions submitted at monthly progress review meeting are not considered as changes in this context.
- H. If after submitting a request for change to the Construction Schedule, the DEN Project Manager does not agree with the request, the DEN Project Manager will schedule a meeting with the Contractor to discuss the differences.
- I. If a settlement cannot be reached on the change in the Construction Schedule, or if the Contractor has failed to submit revisions to the network, the DEN Project Manager has the option of providing suggested logic or duration changes in all subsequent update schedules.
- J. The suggested logic and/or duration times will remain in effect until the change in the Construction Schedule is settled or until the logic and duration are superseded.
- 3.8 THREE WEEK LOOK-AHEAD SCHEDULE
- A. The Contractor shall provide the DEN Project Manager an electronic copy prior to and a minimum of four (4) hard copies of the Contractor's Three (3) Week Look-Ahead Schedule for review at the DEN Project Manager's weekly progress meeting.

- B. The schedule shall be generated from Primavera P6 in time-scaled network diagram bar chart format based on the approved accepted CPM Baseline Project Schedule and shall include dates of activities in progress, work to be completed within the period, percent complete of activities, and responsible subcontractor for the activities, testing activities, and anticipated dates of inspection by DEN and other agencies.

3.9 AS-BUILT CONSTRUCTION SCHEDULE:

- A. After all Contract Work items are complete, the contractor shall submit an as-built Project Construction Schedule that reflects the actual sequence of construction activities, includes all change order scope of work changes and shows actual start and finish dates for all work items and milestones for acceptance by the DEN Project Manager.
- B. The basis for the As-built Construction schedule will be the approved Monthly Progress Schedules.

3.10 RECOVERY SCHEDULE

- A. When a monthly progress schedule update indicates the Work is behind the current approved schedule, submit a separate Recovery Schedule indicating means by which Contractor intends to regain compliance with the schedule.
- B. No additional costs will be allowed if such expediting measures are necessary to meet the agreed completion date or dates except as provided elsewhere in the Contract Documents.
- C. If the early finish date for any work item or the substantial completion date does not fall within the Contract Duration, the sequence of work or duration shall be revised by the Contractor through concurrent operations, additional manpower, additional shifts or overtime, additional equipment, or alternative construction methods until the schedule produced indicates that all significant contract completion dates, occupancy dates and milestone dates will be met.
- D. Provide a narrative indicating changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- E. The narrative shall be submitted in accordance with Article 1105 – Time Extensions in the General Contract Conditions, 2011 Edition.

3.11 REQUEST FOR TIME EXTENSION

- A. General:
1. Provide a justification of delay to the DEN Project Manager, in accordance with the Contract provisions and clauses, for approval within 10 days of a delay occurring.

2. Prepare a time impact analysis for each DEN Change Directive, Change Notice and Contractor's Change Request to justify time extensions.
3. Added work by the City does not necessarily entitle Contractor to a Time Extension, unless the Contractor can prove that this new added scope impacts the current critical path without manipulating any of the logic and relationships in the most recent and approved schedule.
4. The City may reject any Time Extension Request that does not include a detailed and a clear time impact analysis that shows direct impact to the most current critical path along with a detailed productivity rate calculation to justify the requested time to execute such added work.
5. If the Contractor is granted an extension of time for completion of any milestone or contract completion date under the provisions of the Contract, the determination of the total number of extended days will be based upon the current analysis of the schedule and upon all data relevant to the extension. Such data shall be incorporated into the next monthly update of the schedule.
6. The Contractor acknowledges and agrees that delays in work items that, according to schedule analysis, do not affect any milestone dates or the Contract completion date shown on the CPM Network Schedule at the time of the delay will not be the basis for a Contract extension.

B. Justification of Delay

1. Provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify the schedule activities impacted.
2. Show that the event that caused the delay/impact was the responsibility of the City.
3. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion date or interim completion dates.
4. Multiple impacts shall be evaluated chronologically; each with its own justification of delay. With multiple impacts, consider concurrency of delay.
5. A time extension and the schedule fragment become part of the project schedule and future schedule updates upon approval by DEN Project Controls.

C. Time Impact Analysis (Prospective Analysis)

1. Prepare a time impact analysis for City approval based on industry standard AACE 52R-06. Use a copy of the last approved schedule prior to the first day of the impact or delay for the time impact analysis.
2. If DEN Project Controls determines the time frame between the last approved schedule and the first day of impact is too great, prepare an interim updated schedule to perform the time impact analysis.
3. Unless approved by the DEN Project Controls, no other changes will be incorporated into the schedule being used to justify the time impact.

D. Fragmentary Network (FragNet)

1. Prepare a proposed fragment for time impact analysis. The proposed fragment shall sequence new activities into the project schedule to demonstrate the influence of the delay or impact to the project's contractual dates.
2. Clearly show how the proposed fragment shall be tied into the project schedule, including the predecessors and successors to the fragment activities.

3. Obtain City approval of the proposed fragment before incorporating it into the project schedule.

E. Time Extension

1. Time extensions will not be granted until after the City has approved the Justification of Delay, including the time impact analysis.
2. No time extension will be granted unless the delay consumes the available Project Float and extends the projected finish date ("Substantial Completion" milestone) beyond the Contract Duration.
3. The time extension will be in calendar days.
4. Actual delays that the City determines are caused by the Contractor's own actions and result in a calculated schedule delay will not be a cause for an extension to the performance period, completion date, or interim milestone date.

F. Impact to Early Completion Schedule

1. No extended overhead will be paid for delay prior to the original Contract Substantial Completion date.

3.12 FAILURE TO ACHIEVE PROGRESS

A. General:

1. If the progress falls behind the approved baseline project schedule for reasons other than those that are excusable within the terms of the Contract, the City may require submittal of a written recovery plan for approval.
2. The plan shall detail how progress shall be recovered, including which activities will be accelerated by adding additional crews, longer work hours, extra work days, etc.

B. Artificially Improving Progress

1. Artificially improving progress by means such as, but not limited to, revising the schedule logic, modifying or adding constraints, shortening activity durations, or changing calendars in the project schedule is prohibited.
2. Indicate assumptions made and the basis for logic, constraint, duration, and calendar changes used in the creation of the recovery plan.
3. Additional resources, manpower, and daily and weekly work hour changes proposed shall be evident at the work site and documented in the daily report along with the Schedule Narrative Report.

C. Failure to Perform

1. Failure to perform work and maintain progress in accordance with the supplemental recovery plan may result in an interim and final unsatisfactory performance rating and/or may result in Non-Conformance Report for corrective action directed by DEN Project Controls pursuant to other Contract provisions.

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PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 013210

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SECTION 013223.11 – CONSTRUCTION LAYOUT AND AS-BUILT SURVEYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section covers Denver International Airport (DEN) procedures and accuracy requirements for survey services for construction layout, and as-built.
- B. Before commencing any field surveys on DEN property, the Contractor must coordinate a pre-survey preparation activities meeting. This meeting is to be arranged through the DEN Project Manager's Office with the attendance of the Contractor and the DEN Survey Section. The Contractor is responsible for obtaining DEN related survey guidance, Access to DEN survey network, Primary Control, projection parameters, and training materials from the DEN Survey at the pre-survey meeting and/or prior to beginning any survey work.
 - 1. Survey Project Checklist, provided as part of this Specification, must be reviewed at the pre-survey preparation activities meeting. (Refer to Article 1.11.)

1.3 REFERENCE DOCUMENTS:

- A. Section 013223.15 "Survey Information".
- B. Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples".
- C. Latest version of Federal Aviation Administration Advisory Circular 150/5300
- D. Latest Version of DEN BIM DSM (Design Standards Manual)
- E. Latest Version of Colorado Department of Transportation (CDOT) Survey Manual.
- F. Latest Version of Minimum Standard Detail Requirements for ALTA/ NSPS Land Title Survey

1.4 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for the submittal process.

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B. Survey Statement of Work (SSOW):

1. The Contractor must develop a complete SSOW and submit it to the DEN Project Manager. The SSOW is the Contractor's written description of the Contractor's methodology for surveying services that must be provided as part of the Project, including specific features that must be surveyed, action items, timelines necessary airport resources and general information.
2. SSOW must be submitted by the Contractor prior to commencement of any survey or layout work on the site.
3. The SSOW will be accepted by the DEN Project Manager.
4. Under no circumstances must the Contractor begin work until the SSOW has been accepted.

C. Survey and Quality Control Plan (SQCP):

1. The Contractor must develop a complete SQCP and submit it to the DEN Project Manager. The SQCP is the Contractor's written description detailing the Contractor's methodologies for data collection, data safeguarding and quality assurance. Provide insight on how the Contractor must completely check all data to ensure it is complete, reliable, and accurate. Identify data safeguards used to protect the sensitive and safety critical data. Utilize a checklist based quality control process with definable and repeatable standards for each element ensuring consistency of work between different personnel within an organization. Submit the plan in a non-editable PDF.
2. SQCP must be submitted by the Contractor prior to commencement of any survey or layout work on the site.
3. The SQCP will be accepted by the DEN Project Manager.
4. Under no circumstances must the Contractor begin work until the SQCP has been accepted.

D. Weekly Project Status Report:

1. Contractor must submit a project status report in compliance with FAA AC 150/5300-18B to the DEN Project Manager every Monday by 2:00 P.M. Mountain Time, from the date of the task order until the date of Substantial Completion
2. The Weekly Project Status Report must use format from AC 150/5300-18B

E. Final Project Survey Report:

1. The Final Project Survey Report, must use format from AC 150/5300-18B
2. Final Project Survey Report must be stamped and wet signed by a current Colorado Registered Professional Land Surveyor.

F. SURVEY DELIVERABLES:

1. Contractor must submit all of the following deliverables.
2. All raw files: GPS and Levels that is compatible with Trimble Business Center.
3. If combining x, y from GPS and z from Levels, provide field notes and data that shows where this data came from to verify values. The GPS point numbers must match to the Level descriptions.

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4. As-built or as-constructed survey submittals must need to be in both Portable Document Format (PDF) and in AutoCAD Civil 3D. Refer to current and criteria document for direction on PDF production.
5. All copies of original pages of field notes or electronic field notes must be in (PDF).
6. Scanned copies of all original field notebooks used for this Project must be submitted at the end of Contract.
7. All as-built points files must be in either CSV or TXT format.
8. All CAD drawings must be in current approved Autodesk Civil 3D format.
 - a. CAD layers are specified in DEN BIM Design Standards Manual
 - b. DEN must provide the Autodesk Civil 3D drawing template.
9. The as-built survey must follow the most recent Minimum Standard Detail Requirements for ALTA/ NSPS Land Title Survey for all sections, as far as they are applicable to the scope of work for the project and site in question.
10. Documentation in accordance with "Table A, Optional Survey Responsibilities and Specifications" (Refer to Article 1.11.) is filled out with the required content to be submitted.
11. Hard copy of all documentation stamped and wet signature by licensed PLS responsible for the work.

1.5 QUALITY REQUIREMENTS

- A. Contractor – Company contracted to perform survey work under the direct supervision of a Colorado Registered Professional Land Surveyor with current FAA "Idle Certification"
- B. Subsurface Utilities Engineering (SUE): Refer to Section 011810 "Utilities Interface" for information related to underground utilities.
- C. Surveying accuracies and tolerances in control surveys, construction layouts: See CDOT Survey Manual for acceptable tolerances.

1.6 DEN SITE SURVEY REQUIREMENTS

- A. A site survey, construction survey, or construction as-built survey providing horizontal location and level information of surface features and both above and below ground services and utilities must be completed. This must also be annotated with information (where applicable) relating to the size, direction of and material type.
 1. When collecting utilities, Contractor must be responsible to have all exposed and installed utilities surveyed prior to being covered. If Contractor fails to survey utilities, DEN Project Manager can have the Contractor uncover the utilities so they can be surveyed.
 2. Any temporary works that remain at the completion of the project must also be surveyed.

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3. FAA and DEN Survey codes must be provided by The DEN Project Manager via DEN Survey or Designee and must be used throughout the project by Contractor for as surveyed features.
4. The most current DEN Civil 3D template must be provided by The DEN Project Manager via the DEN BIM team. All DEN BIM requirements must be met.

1.7 DEN ALIGNMENT MONUMENTATION

- A. Alignment monuments must be set at their corresponding coordinates as shown on the monumentation sheet of the Alignment Plans. When monumenting the Alignment, the Contractor must verify that the latest set of Alignment plans are being used. After the Alignment monument locations are staked in the field, any necessary utility locates should be called for prior to setting the monument.
- B. All Alignment monuments set must be established within the Minimum Horizontal Accuracy Tolerance as required in this chapter for a CDOT Class B – Secondary survey.
- C. Alignment monuments must be set at the locations as shown on the Alignment Plans, which include the following locations:
 1. 1. All angle points or changes of directions.
 2. 2. At the beginning and ending of curves.
 3. 3. At the points of change of direction or changes of radius of any boundary defined by circular arcs.
 4. 4. Not to exceed 1400 feet apart along any straight boundary line.
 5. 5. Any other points as approved by the Survey Coordinator due to field conditions encountered during setting of the Alignment monumentation.
- D. Alignment monuments must have a witness post installed within 2 ft and facing the monument, or as accepted by DEN Survey. For setting easement monuments, the witness post requirement may be waived by DEN Survey.
- E. Use Orange Carsonite witness post:
- F. All Alignment monument caps set in the field must be stamped with the following:
 1. 1. DEN Project Code number
 2. 2. Point number as shown on the Right of Way Plans
 3. 3. Colorado PLS number setting the monument
- G. All Alignment monuments set in the field must be shown on the Final set of Alignment Plans in accordance with the CDOT Right of Way Manual, Chapter 2 – ROW Plans. The Colorado PLS who is in responsible charge for setting the Alignment monuments must stamp her/his number on the monument cap, and must certify on the Alignment Plans to setting of the Alignment monuments in the field.

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- H. The Contractor in responsible charge of the Alignment Plans and the Contractor in responsible charge of setting the Alignment monuments in the field might not be the same individual. Therefore, care must be taken to ensure any monuments set in the field at locations different than that shown on the Alignment Plans are communicated to the Alignment plans section, and the final Alignment Plans are corrected to show these new monument locations and descriptions prior to submitting the plans to DEN Survey.
- I. Alignment monuments, witness posts, and monument box materials must be furnished by Contractor.

1.8 FEATURES TO BE RECORDED

- A. Surface and Above Ground Features: The survey of surface features must include, but is not limited to:
1. Structures and Surfaces – paths, driveways, retaining walls, slabs/paved areas, significant structural footings (plinths etc.), poles/ floodlighting.
 2. Drainage Structures – headwalls, open drains, grated drains, culverts.
 3. Roads – edge of pavement, curbs, shoulders, line-marking, bridges, road furniture (NOTE – the top back and bottom face of curb, and all water channels must be surveyed and recorded).
 4. Buildings – footprints, awnings, overhangs, columns, external fixtures (stairs, ramps, plant, etc.).
 5. Fences and Gates – AOA, security, general fencing, gates and handrails.
 6. Aircraft Pavements and Movement Area Structures – finished surfaces, pavement markings, airfield markers/signage/ navigational aids, PLB and other aeronautical infrastructure;
 7. Topographical Features – general topography, embankments, earthworks platforms and surcharge.
 8. Vegetation – gardens, significant trees (>0.2' trunk diameter, decorative shrubs), vegetation stands, riparian zones.
 9. Signage – road, airfield, parking, advertising, other general signage.
 10. Survey Marks – survey control points used, any settlement plates/ monitoring points placed during works.
 11. Airfield panel corner elevations must be derived from digital levels.
- B. Services and Utilities - Prior to any backfilling or covering, information on all underground services must be obtained and documented according to DEN's modified ASCE-SUE Standards, including but not limited to:
1. Electrical (LV and HV) – top of conduit every fifty feet including horizontal and vertical bends, cables and conduits, pits/ manholes and chambers, HV cable joints, earth points and earth mats, substations/ transformers and surrounding pad, pillars, cabinets and switchboards, top of conduits.
 2. Fuel Control – top of conduit every fifty feet including horizontal and vertical bends, cables and conduits, pits/ manholes and chambers, cabinets, emergency shut-off points.

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3. Communications - top of conduit every fifty feet including horizontal and vertical bends, fiber optic, microducts, comms cables and conduits, pits/ manholes and chambers, top of conduit casing/housing.
 4. Drainage – top of pipes at fifty-foot intervals and at every vertical and horizontal bend, inspection openings, pits/ manholes and chambers, roof water drainage (downpipes, small pits/ grates).
 5. Fuel – top of pipes every fifty feet including horizontal and vertical bends, all weld points with weld numbers documented in the point description and in the field notes, pits/ manholes and chambers, valves, hydrants, earth points, test points.
 6. Sewer (note whether gravity or force main) – top of pipes every fifty feet including horizontal and vertical bends, pipes, pipe inverts, pipe outflows, inspection openings, pits/ manholes and chambers, vent pipes, pump stations and associated components.
 7. Water (differentiate between potable and recycled) – top of pipes every fifty feet including horizontal and vertical bends, pits/ manholes and chambers, valves (and type), meters, taps, hydrants, tanks, pumps, irrigation control.
 8. Compressed Air – top of pipes every fifty feet including horizontal and vertical bends, hoses and other fixtures.
 9. Natural Gas / Petroleum– top of pipes every fifty feet including horizontal and vertical bends, valves, tanks, meters.
- C. Sufficient points must be recorded to ensure that the extremities of all surface features, structures and footings are clearly defined and all bends, intersections, and changes of gradient are accurately recorded. The distance between points of location should generally be about 50 feet and must not exceed 100 feet. All curves must be accurately defined using a minimum of three points (two tangent points and one midpoint).
- D. Where actual positions of linear features deviate from a straight line, sufficient additional points of location must be provided to define the deviation – horizontal and/or vertical change in directions.
- E. For systems, utilities, and features not identified herein, refer to PM for direction on capture requirements
- 1.9 SURVEY METHODOLOGY – SERVICES AND UNDERGROUND FEATURES
- A. Sufficient points must be recorded to ensure that the extremities of all pits, manholes, and any other features related to the service are clearly defined and all bends, joints, intersections, changes of gradient, and fittings on or along the service, pipe or conduit are accurately recorded. All curves must be accurately defined using a minimum of three points (two tangent points and one midpoint). Where actual positions of linear features deviate from a straight line, sufficient additional points of location must be provided to define the deviation – horizontal and/or vertical change of directions.
- B. The maximum distance between points of location along services must not exceed 50 feet. Horizontal and vertical locations must be surveyed on the top of the utility and must be labeled as “top”. Inverts measurements must also be taken in manholes and must be labeled.

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- C. The Contractor must record and annotate all services and utilities with information relating to the size, direction of and material type. The Contractor must record and clearly differentiate between the communication service providers and DEN and/or FAA communications infrastructure.
- D. The Contractor must record the size and orientation of all grates, pits and manholes. Grates and pits must be recorded using a minimum of three corner or edge points. Pit/manhole chambers only need to be located and where the extents of the chamber extend past the extremities of the pit at surface level. In all instances, any thrust blocks or concrete cover/ protection over services must be located, showing depth.

1.10 EXISTING FEATURES AND SERVICES

- A. Existing Services: where the existence of services and other features on the site of the Work and the Work exposes or interacts with these existing services, the Contractor must locate and record the details of all such features and services.
- B. Tunnel Boring: The Contractor must provide records (logs, profiles etc.) relating to all tunnel boring undertaken as part of the Project. Where appropriate this information must be incorporated into the as-built site survey. Where the contract drawings do not show the existence of certain utilities and features and the Work exposes or interacts with the utilities and features, these must be located and recorded by the Contractor.
- C. Services Alteration/ Abandonment / Demolition: Where existing infrastructure, building services and/or utilities are demolished or services realigned or abandoned this information must be reflected within the as-built site survey. A distinction must be made between services (or part services) which have been abandoned (but left in the ground) and those that have been physically removed.

1.11 SURVEY CHECK LIST

	Yes	No	N/A	Project Kickoff Phase
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor meet with DEN PM obtain the data standards and general requirements for data gathering?
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor meet with Airport Survey Office to obtain airport survey control points, projection parameters, and airport survey training materials?
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor provide Survey Statement of Work to DEN PM?
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor provide Geodetic Verification Survey to DEN PM?
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor provide Survey Control Plan to DEN PM?
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor provide Imagery Plan to DEN PM? (Only required if collecting aerial imagery)?
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did the FAA accept survey plans?
	Yes	No	N/A	Construction Phase (As-Built)
8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor perform field survey of project site to collect accurate as-built data?

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9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did the Contractor provide DEN PM with subsurface utility data?
10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Each week, did the Contractor provide DEN PM with Project Status Reports?
11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did the Contractor provide DEN PM with 25% as-built data in both CADD and GIS formats including all attribute information and metadata?
12a	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did DEN PM report 25% QA findings via email to Contractor?
12b	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If required, did the Contractor provide DEN PM with 50% as-built data in both CADD and GIS formats including all attribute information and metadata?
12c	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable, did DEN PM report 50% QA findings via email to Contractor?
12d	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If required, did the Contractor provide the DEN PM with 75% as-built data in both CADD and GIS formats including all attribute information and metadata?
12e	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable, did DEN PM report 75% QA findings via email to Contractor?
13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did the Contractor provide DEN PM with 100% as-built data in both CADD and GIS formats including all attribute information and metadata?
14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did Contractor provide DEN PM with a completed Final Survey Report?
15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did DEN PM report QA findings via email to Contractor?

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION LINES AND GRADES

- A. The Contractor must make surveys and layouts as necessary to delineate the Work. The Contractor must make the surveys for the proper performance of the Work. As a part of such surveys, the Contractor must furnish, establish, and maintain in good order survey control points that may be required for the completion of the Work subject to the approval of the DEN Project Manager as to their location, sufficiency and adequacy. However, such approval by the DEN Project Manager must not relieve the Contractor of responsibility for the accuracy of the Contractor's survey work.
- B. The DEN Project Manager must have the right to check surveys and layouts made by the Contractor prior to approving any of the Work. The Contractor must give advance notice of not less than forty-eight (48) hours to the DEN Project Manager to enable such checking prior to placing any work. The Contractor must furnish assistance as may be required for checking purposes when so requested by the DEN Project Manager.

CONSTRUCTION LAYOUT AND AS-BUILT SURVEYS

- C. The Contractor must furnish skilled labor, instrument platforms, ladders and such other temporary structures as may be necessary for making and maintaining points and lines in connection with the surveys required.
- D. The DEN Project Manager may draw the Contractor's attention to errors or omissions in lines or grades, but the failure to point out such errors or omissions must not give the Contractor any right or claim nor must in any way relieve the Contractor of obligations according to the terms of this Contract.
- E. The Contractor's instruments and other survey equipment must have current certification from manufacturer's representative Surveys must be performed under the direct supervision of a current Colorado Registered Licensed Land Contractor.
- F. Field Notes:
1. The Contractor must record surveys in field notebooks or as electronic field notes, whichever is more appropriate to the type of survey work.
 2. If the DEN Project Manager finds errors in the field notes DEN must have the Contractor correct and resubmit the notes. This review does not relieve the Contractor from the responsibility of maintaining accurate survey data. Whichever method of note-taking the Contractor starts with, the Contractor must use the same method throughout the Contract duration.
- G. The DEN Project Manager may at any time use line and grade points and markers established by the Contractor. The Contractor's surveys are a part of the Work and may be checked by the DEN Project Manager or the DEN Project Manager's representatives at any time.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. Construction As-Built Survey shall be per lump sum. This item shall include the layout, staking, and construction survey required for this project..

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. Construction As-Built Survey shall be per lump sum.

Payment shall be made under

013223a Construction As-built Survey

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
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CONSTRUCTION LAYOUT AND AS-BUILT SURVEYS

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END OF SECTION 013223.11

SECTION 013223.15 – SURVEY INFORMATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section covers Denver International Airport (DEN) procedures and accuracy requirements for survey control.
- B. Before commencing any field surveys on DEN property, the Contractor must coordinate a pre-survey preparation activities meeting. This meeting is to be arranged through the DEN Project Manager's Office with the attendance of the Contractor and the DEN Survey Section. The Contractor is responsible for obtaining DEN related survey guidance, Access to DEN survey network, Primary Control, projection parameters, and training materials from the DEN Survey at the pre-survey meeting and/or prior to beginning any survey work.
- C. Survey Project Checklist, provided after the end of this Section, will be reviewed at the pre-survey preparation activities meeting.

1.3 REFERENCE DOCUMENTS:

- A. Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples".
- B. Latest version of Federal Aviation Administration Advisory Circular 150/5300
- C. Latest Version of DEN BIM DSM (Design Standards Manual)
- D. Latest Version of Colorado Department of Transportation (CDOT) Survey Manual.
- E. Latest Version of Minimum Standard Detail Requirements for ALTA/ NSPS Land Title Survey

1.4 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for the submittal process.
- B. Survey Statement of Work (SSOW):

1. The Contractor must develop a complete SSOW in accordance with Specification Section 013223.11, "Construction Layout and As-Built Surveys".

C. Survey and Quality Control Plan (SQCP):

1. The Contractor must develop a complete SQCP in accordance with Specification Section 013223.11, "Construction Layout and As- Built Surveys".

1.5 QUALITY REQUIREMENTS

A. Equipment Calibration:

1. Equipment must be regularly checked, and calibrated for accuracy at the beginning of any survey project to ensure that the equipment is operating appropriately. Errors due to poorly maintained or malfunctioning equipment will not be accepted. If any equipment errors are found to exist they must be reported to the DEN Survey prior to the start of any surveying. These errors must be verified and eliminated prior to performing any survey work. For projects lasting longer than six (6) months, the checking, and calibration of equipment must be repeated. Furthermore, documentation must verify such equipment has met acceptable tolerances.
2. The Contractor must submit to the DEN Project Manager written proof that survey equipment has been checked and calibrated before commencing any survey work. If repairs are made, documentation of such repairs from an authorized equipment vendor must be submitted.

B. See CDOT Survey Manual for acceptable procedures for calibrating equipment electronic survey instruments adjustments, calibration, or repairs:

1. All electronic survey instruments must be repaired, adjusted, or calibrated only by an authorized equipment vendor or manufacturers service department.
2. A calibration check on all types of electronic survey instrumentation is essential to obtain and maintain the tolerances required for any DEN project. At the beginning of any DEN project, all survey equipment utilized to perform the survey must be calibrated by the surveyor in charge of the Project.
3. See CDOT Survey Manual for acceptable procedures for calibrating equipment.

C. Baseline Calibration Requirements:

1. See CDOT Survey Manual for the procedures to check the survey equipment and the method of reporting the findings to the DEN Project Manager and the DEN Survey Section.
2. The Contractor must submit to the DEN Project Manager written proof that survey equipment has been checked and calibrated before commencing any survey work. If repairs are made, documentation of such repairs from an authorized equipment vendor must be submitted.

1.6 SURVEY CONTROL

- A. DEN utilizes its own local coordinate system that is tied to the National Spatial Reference System (NSRS). The DEN Survey Section will provide the data required to use this coordinate system during the mandatory pre-survey preparation activities meeting. The DEN Survey Section will also provide coordinates for all Primary Control Points based upon the location of the Project.
- B. The coordinates of the Primary Airport Control Station (PACS) and Secondary Airport Control Station (SACS) were correct at the time of installation (or subsequent date listed on the plan) but may be subject to the effects of subsequent subsidence and/ or disturbance. Marks with any noticeable signs of disturbance, damage, or location out of tolerance must be reported so that they can be repaired and/ or noted on the control plan. In addition, any marks that have been or will be destroyed either before or during Works must be noted and mentioned in the Survey Statement of Work and the Survey and Quality Control Plan. If removed or destroyed, the Contractor will create a plan and must replace the PACS or SACS.
- C. DEN is based on the North American Vertical Datum of 1988 (NAVD 1988). Vertical Control and Bench Marks must be tied into this datum. DEN has existing established National Geodetic Survey (NGS) vertical stations around its property and these points must be used in all DEN projects. Project control points must be established by performing measurements with a digital level from at least two NGS vertical stations that are given by the DEN Survey Section. The benchmarks used to establish ties to the datum must be shown in the Contractor's notes and on the CSP.
- D. The Contractor will be provided survey control from the DEN Survey Section. If the nearest NGS Vertical Station is a considerable distance from the site, the Contractor may establish a Temporary Survey Control Point (TSCP) near the site. Appropriate survey procedures must be used to establish any additional TSCP. A minimum of 3 TSM must be established for the project. Each must be visible and tied to at least 2 separate TSCP or PACS and/or SACS. It is the Contractor's responsibility to verify the stability of the mark over the life of the project. Where unacceptable discrepancies in control marks due to land settlement, disturbance or from other factors are apparent, the Contractor must refer the matter to DEN Project Manager for resolution prior to the continuation of Work.
- E. Horizontal Control is based on a local coordinate system. The Contractor must establish reliable horizontal control that will last the duration of the Project. Where unacceptable discrepancies in control marks due to land settlement, disturbance or from other factors are apparent, the Contractor must refer the matter to DEN Project Manager for resolution prior to the commencement of Work. The horizontal control establishing ties to the datum must be shown in the Contractor's notes and on the CSP.
- F. Geodetic Verification Survey Instructions and Procedures:

1. The geodetic verification survey is created to insure the stable position of the DEN Primary control points that are used to reference the TSCP to the NSRS. Acceptable monuments will be identified by the DEN Survey Section and will be limited to monuments of the NSRS with permanent identifiers (PIDS) and published positions and elevations. Temporary design/construction control points established for such project will be referenced by direct measurement to at least two (2) separate NGS control stations.
 - a. The Contractor must recover each identified monument and determine its condition, stability, and suitability for the intended use. A location sketch and visibility diagram will be prepared for each station. A minimum of three (3) digital photographs, one of each type described in AC 150/5300-18B, Section 1.5.2.1, will be captured, captioned, and properly named. A recovery note will be filed with NGS if no current recovery is shown in the NSRS database.
 - b. After recovering the identified NSRS NGS control stations that are located on DEN property, the procedure to verify the control points are as follows:
 - 1) DEN has created its own Virtual Reference System (VRS) Network that will be used on all survey projects. This network will be known as DENVRS.
 - a) This system is comprised of hardware and software designed to facilitate real-time GPS/GNSS positioning based on a set of reference stations.
 - b) DEN has created a control network that incorporates fifteen (15) Primary Control Points tied together with the reference stations for the DENVRS,
 - c) This network, in turn, is tied to the National Spatial Reference System (NSRS).
 - d) DEN will be monitoring the stations on an annual basis and the primary control points on an annual basis and the primary control points on a quarterly basis.
 - 2) The Consultant is required to validate the DENVRS by observing at least two (2) Primary control points using a Fast Static method
 - a) Fast Static surveys allow for systematic errors to be resolved when high accuracy positions are required by collecting simultaneous data between stationary receivers for a shorter period of time than that of Static surveys. DEN will require an observation time of (15) minutes on all Primary control points. Each baseline between adjacent intervisible control points must be observed at least twice.
 - 3) The results must be reviewed and approved by the DEN Survey Office, allowing at least seventy-two (72) hours to review and either approve or reject the temporary control. All temporary control points **MUST BE** accepted before any design survey work can commence.

- 4) Obtain elevation checks either from GPS observations or from digital levels. The distances must agree within, plus or minus, three (± 3) cm; the difference in ellipsoidal height must agree within, plus or minus, four (± 4) cm, and the difference in orthometric height must agree within, plus or minus, five (± 5) cm. If the tolerances are not met the data must be recollected.
- 5) Provide the results or the comparisons as part of the observational data in a report to the DEN Project Manager to be reviewed and approved by the DEN Survey Section prior to the start of construction and include this approved report in the final report.
- 6) Submit a Recover Observe Report for the NGS horizontal control stations to the NGS. Refer to <https://www.ngs.noaa.gov/GPSonBM/Report.shtml> for the report format.

G. Limitations and Additional Information for NGS Control Stations and NGS Benchmarks:

1. The use of control monuments and projection parameters for construction layout other than those shown on the Contract Drawings or furnished by or approved by the DEN Survey Section is STRICTLY PROHIBITED. Use of other monuments is solely at the risk of the Contractor.
2. The DEN Survey Section will provide the Contractor with the projection parameters and any assistance in implementing the coordinate system. It is up to the Contractor to use the correct methodology in performing any survey task which must be submitted to the DEN Project Manager and reviewed during the pre-survey preparation activities meeting.
3. The DEN Project Manager will need all pertinent data from the Contractor to check and verify that the Contractor implemented the coordinate system correctly.

H. Modifications to AC 150/5300-18B, Section 2.6.10.1.1, Verification of Survey Marks:

1. DEN requires Contractor to verify the unmoved position and elevation of both the PACS and SACS for any airside projects and any two (2) DEN approved NGS control stations for any landside project.
2. The Contractor must follow the same verification procedure as stated in Section G above.

I. Reporting Damage or Errors of NGS Control Stations:

1. Report damaged or destroyed airport control points, bench marks, and section corner monuments promptly to the DEN Project Manager.
 - a. If section corner monuments are damaged or destroyed during construction activities, such points must be re-established pursuant to Laws of the State of Colorado Regulating the Practice of Land Surveying by a current Registered Professional Land Contractor in the State of Colorado.
 - b. If NGS control stations or NGS bench marks are damaged, moved, altered, or destroyed by the Contractor, DEN's cost of reestablishing such points must be borne by the Contractor.

- c. DEN will not be responsible for any increased costs or delays to the Contractor relating to reference points, airport control points, or bench marks which are damaged, moved, altered, or destroyed by the Contractor or its, suppliers, agents or employees or other Contractors working on the site.
2. Report alleged errors in NGS control stations or NGS bench marks promptly to the DEN Project Manager.
 - a. Discontinue use of NGS control stations or NGS bench marks alleged to be in error until the accuracy of points can be verified or as directed.
 - b. Claims for extra compensation for alteration or reconstruction allegedly due to errors in NGS control stations or NGS benchmarks will not be allowed unless original NGS control stations and NGS bench marks still exist or substantiating evidence proving error is furnished by the Contractor, and unless the Contractor has reported such errors to the DEN Project Manager as specified herein.

1.7 TEMPORARY SURVEY CONTROL

- A. The Contractor MUST set a minimum of either 'chiseled X' in concrete; a drill hole with lead and tack in concrete; a PK nail with shiner in asphalt or concrete or a 5/8" rebar with plastic cap in natural ground. An 'Inked X' set as a control point is UNACCEPTABLE.
- B. When a Contractor establishes TSCP for DEN survey work the Contractor MUST follow FAA guidelines. All TSCP must be referenced to the National Spatial Reference System (NSRS) using the NGS control stations provided by the DEN Survey Section. Temporary control may be necessary based on project site location. Below are the acceptable means to establish temporary geodetic control for DEN design or construction projects:
 1. Temporary control must be established under close cooperation with the DEN Survey Section following the procedures outlined in AC150/5300-16 "General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to National Geodetic Survey" only in the following cases:
 - a. Large airport construction projects that significantly changes the airport geometry and would trigger the need to acquire new Digital Stereo Imagery following AC 150/5300-17 "General Guidance and Specification for Aeronautical Survey Airport Imagery Acquisition and Submission to the National Geodetic Survey". Examples include a new runway and taxiway complex, significant modification of existing runway or taxiway system, development of new outboard deice pad complex or establishment of new mid airfield concourse and terminal complex. The size and complexity of the Project will dictate the need to acquire new digital stereo imagery for significant construction.
 - b. Construction that establishes a new ILS CAT II/III Operations.
 - c. New Instrument Development Procedure.

- d. New Airport Layout Plan Survey Update.
 - e. New Airport Obstruction Chart Update.
 - f. New Airport Mapping Database.
2. On DEN projects, the Contractor, may use TSCPs on their project site. These TSCP must be referenced to the nearest two (2) DEN primary control points and MUST BE referenced vertically to two (2) different NGS benchmarks. Also, all Contractors MUST obtain permission to establish TSCPs on DEN property by means of communicating with the DEN Survey Section.
 3. In addition, all vertical control MUST BE established only using a digital level unless otherwise authorized by the DEN Survey Section.
 4. Minimum Construction Horizontal and Vertical Accuracy Tolerance:
 - a. Adjustments:
 - 1) No adjustment of the survey field data will be permitted without the written consent of the DEN Project Manager. If it is determined that an adjustment is necessary, a weighted least squares adjustment method is recommended.
 - b. Primary NGS vertical stations values must be held unless the Contractor has determined that there is an issue with one of the values. If this is the case, the Contractor must notify the DEN Project Manager to determine which other Primary stations can be used.
 - c. Secondary Control Project Benchmark Minimum Vertical Accuracy Tolerance:
 - 1) Setting of secondary control benchmarks must meet the Minimum Vertical Accuracy Tolerance of the square root of the total horizontal distance of the level loop in miles multiplied by 0.035 feet.
 - 2) The results of this evaluation must be recorded in the field book for each differential level loop. At least two (2) established NGS benchmarks on the same datum must be used to verify that the starting mark has not been disturbed. If.
 5. Whether establishing TSCPs or not, the Contractor must set up a Pre-Survey Preparation Activity meeting with the DEN Project Manager to discuss Geodetic Control Verification, obtain pertinent survey data, and projection parameters before the commencement of any survey work.
 6. If TSCPs are needed, the Contractor can set and collect temporary control while performing as outlined in Part 1 of this Section. Once the data is collected the Contractor is required to submit all pertinent data to the DEN Project Manager. This data must include all GPS raw data in a Trimble format with an Excel spreadsheet that displays the comparison from each observation of the NGS control stations. The comparison must include showing the delta northings, delta eastings, and delta elevations for each redundant pair of control points Contractor Only the redundant values of the TSCPs should be averaged. The results must be reviewed and accepted by the DEN Project Manager, allowing at least seventy-two (72) hours to review and either approve or reject the temporary control. All TSCPs MUST BE approved before any survey work can commence.

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PART 2 - Products (Not Used)

PART 3 - Execution (Not Used)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 013223.15

SECTION 013223.19 QUANTITY SURVEYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section covers Denver International Airport DEN procedures and accuracy requirements for survey services for construction layout, as-built and quantity surveys.
- B. Before commencing any field surveys on DEN property, the Contractor must coordinate a pre-survey preparation activities meeting. This meeting is to be arranged through the DEN Project Manager's Office with the attendance of the Contractor, the Contractor's surveyor, and the DEN Survey Section. The Contractor is responsible for obtaining DEN related survey guidance, primary control stations, projection parameters and training materials from the DEN Survey Section prior to beginning any survey work.
- C. Reference Contract General Conditions.

1.3 REFERENCE DOCUMENTS:

- A. Section 013326 "Survey Control".
- B. Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples".
- C. Latest version of Federal Aviation Administration Advisory Circular 150/5300
- D. Latest Version of DEN BIM DSM (Design Standards Manual)
- E. Latest Version of Colorado Department of Transportation (CDOT) Survey Manual.
- F. Latest Version of Minimum Standard Detail Requirements for ALTA/ NSPS Land Title Survey

1.4 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for the submittal process.
- B. Weekly Project Status Report:

1. Contractor must submit a project status report in compliance with FAA AC 150/5300-18B to the DEN Project Manager every Monday by 2:00 P.M. Mountain Time, from the date of the task order until the date of Substantial Completion
2. The Weekly Project Status Report must use format from AC 150/5300-18B

C. Final Project Survey Report:

1. The Final Project Survey Report, must use format from AC 150/5300-18B
2. Final Project Survey Report must be stamped and wet signed by a current Colorado Registered Professional Land Surveyor.

1.5 QUALITY REQUIREMENTS

A. Equipment Calibration:

1. Equipment must be regularly checked, and calibrated for accuracy at the beginning of any survey project to ensure that the equipment is operating appropriately. Errors due to poorly maintained or malfunctioning equipment will not be accepted. If any equipment errors are found to exist they must be reported to the DEN Survey prior to the start of any surveying. These errors must be verified and eliminated prior to performing any survey work. For projects lasting longer than six (6) months, the checking, and calibration of equipment must be repeated. Furthermore, documentation must verify such equipment has met acceptable tolerances.
2. The Contractor must submit to the DEN Project Manager written proof that survey equipment has been checked and calibrated before commencing any survey work. If repairs are made, documentation of such repairs from an authorized equipment vendor must be submitted.

B. See CDOT Survey Manual for acceptable procedures for calibrating equipment electronic survey instruments adjustments, calibration, or repairs:

1. All electronic survey instruments must be repaired, adjusted, or calibrated only by an authorized equipment vendor or manufacturers service department.
2. A calibration check on all types of electronic survey instrumentation is essential to obtain and maintain the tolerances required for any DEN project. At the beginning of any DEN project, all survey equipment utilized to perform the survey must be calibrated by the surveyor in charge of the Project.
3. See CDOT Survey Manual for acceptable procedures for calibrating equipment.

C. Baseline Calibration Requirements:

1. See CDOT Survey Manual for the procedures to check the survey equipment and the method of reporting the findings to the DEN Project Manager and the DEN Survey Section.
2. The Contractor must submit to the DEN Project Manager written proof that survey equipment has been checked and calibrated before commencing any survey work. If repairs are made, documentation of such repairs from an authorized equipment vendor must be submitted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 QUANTITY SURVEYS FOR PAYMENT

- A. When the specifications or the DEN Project Manager require items in the Schedule of Prices and Quantities to be measured by surveying methods, the Contractor must perform the surveys.
- B. All such surveys, including control surveys run for establishing the measurement reference lines, must be performed in the presence of the DEN Project Manager or the DEN Project Manager's representative who will witness the surveying operation and who will acknowledge receipt of the field notes or keep duplicate field notes, at the DEN Project Manager's option.
- C. The Contractor must reduce the field notes and calculate final quantities for payment purposes. The note reductions and calculations must be given to the DEN Project Manager.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement must be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section must be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 013223.19

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QUANTITY SURVEYS

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final Completion construction photographs.
 - 4. Preconstruction video recordings.
 - 5. Periodic construction video recordings.
 - 6. Web-based construction photographic documentation.

1.3 REFERENCE DOCUMENTS:

- A. Section 013300 "Submittal Procedures"
- B. Section 017720 "Contract Closeout"
- C. Section 017900 "Demonstration and Training"
- D. Section 024116 "Structure Demolition"
- E. Section 024119 "Selective Demolition"
- F. Section 311000 "Site Clearing"

1.4 ALTERNATES

- A. Refer to Section 012300 "Alternates"

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor will document construction progress using these general specifications listed below. Contractor will coordinate with the DEN Project Manager on the specific media requirements for documentation prior to commencing construction.
- A. Qualification Data: For photographer.

- B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- C. Digital Photographs: Submit image files within three (3) days of taking photographs.
1. Digital Camera: Minimum sensor resolution of 10 megapixels.
 2. File Format: Minimum 3200 by 2400 pixels, in unaltered .RAW original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Project title and Project number.
 - b. Name and contact information for photographer.
 - c. Name of DEN Project Manager.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - 1) Include work order number or change order number if applicable.
 - g. Unique sequential identifier keyed to accompanying key plan.
 - h. Photograph number.
- D. Section Deleted
- E. Video Recordings: Submit video recordings within seven (7) days of recording.
1. Submit video recordings in an electronic format acceptable to DEN Project Manager. Recordings shall be high-resolution 4k with a minimum framerate of 60Hz
 2. Identification: With each submittal, provide the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of DEN Project Manager.
 - d. Name of Contractor.
 - e. Date video recording was recorded.
 - f. Description and key plan of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Weather conditions at time of recording.

1.6 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

- B. Web-Based Photographic Documentation Service Provider: A firm specializing in providing photographic equipment, Web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project for not less than three years.

1.7 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to City and County of Denver for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 10 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.
- B. Digital Video Recordings: Provide high-resolution 4k with a minimum framerate of 60Hz in electronic format acceptable to DEN Project Manager.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to show clearly the Work. Photographs with blurry or out-of-focus areas will not be accepted.
1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software. Provide commercial quality, digital color photographs in PDF format. PDF file shall be security-free, bookmarked by date with all photos rotated to the correct orientation. Identify the following information on each photograph on the lower right corner.
1. Subject description (include work order number or change order number if applicable)
 2. Station point of camera and direction of view. Include letter size diagram of project indicating Station point
 3. Date and time each photo was taken
 4. Name of Contractor.

5. Photograph number
 6. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to DEN Project Manager.
- D. Preconstruction Photographs: Before [starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by DEN Project Manager.
1. Flag construction limits before taking construction photographs.
 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
 5. Haul route, laydown yard, and other locations as directed by DEN Project Manager.
- E. Periodic Construction Photographs: Take 20 photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. DEN Project Manager-Directed Construction Photographs: From time to time, DEN Project Manager will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
1. Frequency: Take photographs monthly, coinciding with the cutoff date associated with each Application for Payment.
 2. Vantage Points: Following suggestions by DEN Project Manager and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
- H. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. DEN Project Manager will inform photographer of desired vantage points.
1. Do not include date stamp.

- I. Additional Photographs: DEN Project Manager may request photographs in addition to periodic photographs specified. Additional photographs shall be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice shall be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. DEN's request for special publicity photographs.

3.2 CONSTRUCTION VIDEO RECORDINGS

- A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.
- B. Recording: Mount camera on tripod before starting recording unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
- C. Narration: Describe scenes on video recording by [audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
1. Confirm date and time at beginning and end of recording.
 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
- D. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, as directed by DEN Project Manager.
1. Flag construction limits before recording construction video recordings.
 2. Show existing conditions adjacent to Project site before starting the Work.
 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
 4. Show protection efforts by Contractor.

- E. Periodic Construction Video Recordings: Record video recording monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be 30 minutes(s).
- F. Time-Lapse Sequence Construction Video Recordings: Record video recording to show status of construction and progress.
1. Frequency: During each of the following construction phases, set up video recorder to automatically record one frame of video recording every five (5) minutes, from same vantage point each time, to create a time-lapse sequence of 30 minutes in length as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during daylight construction work hours.
 3. Vantage Points: Following suggestions by DEN Project Manager [and Contractor], photographer shall select vantage points.

3.3 SECTION WAS DELETED.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section summarizes the requirements for the submittal of documents to the DEN Project Manager that are defined in these Specifications. It also describes the procedures for "supplemental" submittals.
- B. The Contractor must follow all the requirements of the procedures and the product details and keep all the submittals current and approved prior to any placement of work.

1.3 SUBMITTAL SCHEDULE

- A. The Contractor shall provide a submittal schedule within 14 days after Notice to Proceed. The Submittal Schedule shall be directly related to the CPM schedule, shall identify all the submittals, and shall include the following information for each submittal item
 1. Specification section, Contract article, or special condition.
 2. Specification Subparagraph.
 3. Item description.
 4. Date the submittal shall be submitted.
 5. Name of subcontractor or supplier.
- B. The submittal schedule shall be kept current by the Contractor and submitted with the progress payment requests.
- C. For large files that cannot be loaded or e-mailed through the electronic Project Manager application (Unifier), submit the files on a CD, DVD, or USB flash drive media.

1.4 ELECTRONIC SUBMITTALS

- A. Before the initiation of the submittal process, coordinate and insure that all submittals comply and follow the requirements of the DEN Building Information Modeling (BIM) Design Standards Manual (DSM) and the DEN BIM PXP.

- B. Submit request for progress payment applications utilizing TEXTURA software as instructed by DEN Project Manager.
- C. Submit Subcontractor's Contract information required by the City and County of Denver Small Business Office as instructed by DEN Project Manager.
- D. Submit original electronic copies of all City and County of Denver Development Department/ Building Inspection Department Approved drawings including all approvals of Deferred Submittals; including but not limited to shoring plans, Fire Protection distribution plans, and structural shop drawings to DEN Project Manager as Informational Submittals. The lack of approval of the Denver Development Services on any document shall be basis for rejection of Work and non-compliance.
1. NOTE: Only original copies shall be accepted. Scans will not be accepted.
- E. Submit electronically scanned copies of all documents required by Chapter 17 "Special Inspection and Testing" of the International Building Code 2009 as amended by City and County of Denver 2011. Keep scale and clarify dimension where electronic copies are not as originally scaled and dimensioned.
- F. All submittals shall be delivered to the DEN Project Manager utilizing the Primavera Construction Manager program (PCM) as attachments and as separate file when files are too large to attach or of an electronic media that is not supported by PCM or Utilizing the EPPM Unifier software uploaded to the share drive Unifier's project site when directed by DEN Project Manager.
1. Acceptable electronic formats
- a. Print document format (pdf) shall have no security and bookmark every applicable submittal. All pages shall be completely legible and oriented to correct reading view.
2. Formats are acceptable only with written permission of the DEN Project Manager or required by the BIM PXP. For files in any of the following formats, the corresponding stringency will apply:
- a. Microsoft Office 2007 or newer. All files shall be fully compatible with Microsoft Office 2007.
- 1) AutoCAD files shall be self-contained with no external x-references.
- b. BIM files shall conform to the standards and formats outlined in the BIM PXP and DEN BIM DSM.
- c. Other files pre-approved by the DEN Project Manager.

1.5 INITIAL SUBMITTAL

- A. Each submittal document shall include a title block showing the following information:
1. Date of submittal and revision dates.

2. Contract title and number.
 3. The names of Contractor, subcontractor, supplier, manufacturer and when applicable, the seal and signature of an Engineer registered in the State of Colorado, for the involved discipline.
 4. Identification of product by either description, model number, style number or lot number.
 5. Subject identification by Contract Drawing or specification reference.
- B. On each submitted drawing, include a blank space on each sheet, three inches by four inches, in the lower right corner, just above the title block, in which the DEN Project Manager or the Designer of Record may indicate the action taken.
- C. Make submissions sufficiently in advance so that the DEN Project Manager Review may be completed not less than 30 days before Work represented by those submittals is scheduled to be performed.
- D. Allow a minimum cycle of 30 days for review of each submittal by the DEN Project Manager.
- E. Accompany submittal documents with DEN transmittal form CM-30, Submittal, which shall contain the following information:
1. Contractor's name, address and telephone number.
 2. Submittal number and date.
 3. Contract title and number.
 4. Supplier's, manufacturer's, or subcontractor's name, address and telephone number.
 5. Identification of variations from Contract Documents.
 6. Contractor's stamp and signature certifying the Contractor's review.
 7. Identification of submittal:
 - a. If the submittal is being made on a General Condition or Special Condition, reference the General or Special Condition number the first two digits of the specification section shall be 00XXXX.
 - b. If the submittal is being made under a specification section, reference the specification number, paragraph number, and subparagraph number.
 - c. If the submittal is being made under a drawing, reference the drawing(s) number and sub-number.
- F. The Contractor shall describe, at the time of submission, variations from the Contract documents in writing, separate from the submittal document. If the DEN Project Manager approves any such variations, an appropriate Contract change order shall be issued, except that if the variation is minor and does not involve a change in price or in time of performance, a modification need not be issued. If a submission contains variations and the variation column is not marked on the transmittal form, it will not be considered for review and acceptance. Along with marking the transmittal as a variation, a description must be included which outlines all the differences including maintenance and utility services along with any cost savings from an item not containing the variation.

- G. Changes in accepted submittal documents will not be permitted unless those changes have been accepted, in writing, by the DEN Project Manager.
- H. The form and quality of submittal documents shall comply with Section 013325 "Shop and Working Drawings, Product Data, and Samples."

1.6 SUPPLEMENTAL SUBMITTALS

- A. Supplemental submittal documents initiated by the Contractor for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals with the appropriate primary transmittal referenced.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. The Contractor shall review all submittal documents, stamp, and sign as reviewed and approved as complying with Contract Documents prior to submission to the DEN Project Manager. Submittal documents that are submitted to the DEN Project Manager **THAT HAVE NOT BEEN REVIEWED BY THE CONTRACTOR** will not be reviewed and will be returned to the Contractor. Contractor is responsible for any delays in the Project due to improperly reviewed, stamped, and signed submittals.
- B. The Owner review period will be limited to ten (10) business days from the time complete submittal documents have been submitted.
- C. The Contractor is responsible to obtain all approvals for all deferred submittals, shop drawings, and significant changes from the CCD Development Service Department.
- D. All submittals must delineate any deviation from the intended design and must submit request for substitution to address any significant variation. Refer to Title 4, Article 405 – Shop Drawings, Product Data, and Samples, and Article 406 – Substitution of Materials and Equipment of the General Contract Conditions, 2011 Edition.

3.2 REVIEW BY DEN PROJECT MANAGER

- A. Submittal documents will be reviewed by the DEN Project Manager, the DEN Project Manager Team, and/or the DOR for conformance to requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. The DEN Project Manager will withhold approval of submittals that depend on other submittals not yet submitted. Review and acceptance will not relieve the Contractor from the Contractor's responsibility for accuracy of submittals, for conformity of submittal document to requirements of Contract Drawings and specifications, for compatibility of described product with contiguous products and the rest of the system, or for protection and completion of the Contract in accordance with the Contract Drawings and specifications.
- B. The City, the DOR, and/or the DEN Project Manager will review the submittal documents for general conformance with the Contract Documents and mark the Action Code, sign, and date the transmittal.
- C. The Action Codes have the following meanings:
1. Accepted (ACC)
 - a. The submittal conforms to the respective requirements of the contract documents.
 2. Accepted as Noted (AAN)
 - a. The submittal conforms to the respective requirements of the Contract Documents after changes are made in accordance with reviewer's comments. AAN submittals do not need to be resubmitted.
 3. Revise and Resubmit (R&R)
 - a. The submittal is unacceptable and must be revised and resubmitted.
 4. Rejected (REJ)
 - a. The submittal is not approved and a new submittal in accordance with the Contract Documents must be prepared and submitted.
 5. For Information Only (FIO)
 - a. An item is received by the DEN Project Manager but is not reviewed.

3.3 CONTRACTOR'S RESPONSIBILITIES

- A. Coordinate each submittal document with the requirements of the Work. Place particular emphasis upon ensuring that each submittal of one trade is compatible with other submittals of that trade and submittals of other trades including producing as needed drawings showing the relationship of the Work of different trades.

- B. Contractor's responsibility for errors and omissions in submittal documents and associated calculations is not relieved by the DEN Project Manager's review, correction, and acceptance of submittals.
- C. Contractor's liability to the City, in case of variations in the submittal document from the requirements of the Contract Documents, is not relieved by the DEN Project Manager's review and acceptance of submittals containing variations unless the DEN Project Manager expressly approves the deviation in writing, in which the DEN Project Manager describes the variation.
- D. The Contractor shall maintain a file of all approved submittal documents at the work site. The complete file of approved submittal documents shall be turned over to the DEN Project Manager with the as-built documents at the end of the job.
- E. Schedule impact due to resubmittal requirements is the responsibility of the Contractor.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 013300

SECTION 013325 - SHOP AND WORKING DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section consists of preparing and submitting shop and working drawings, product data, samples, and record documents required by other specifications Sections.
1. The Contractor shall submit all shop drawings, working drawings, product data, and samples, as defined in the General Conditions, to the DEN Project Manager in accordance with the requirements in the technical specifications. The DEN Project Manager will return one (1) copy of the shop drawings, working drawings and product data to the Contractor with a written transmittal.
- B. The Contractor shall not submit as shop drawings, copies or reproductions of drawings issued to the Contractor by DEN.
- C. Related Requirements
1. Section 013300 "Submittal Procedures
 2. Section 012510 "Substitutions"
 3. Section 017720 "Contract Closeout"

1.3 SUBMITTALS

- A. All submittals shall be delivered to the DEN Project Manager in electronic format. All submittals must be of a consistent format (all PDF). No combination of electronic file types will be allowed unless required by a specific specification section.
1. Acceptable electronic formats: Comply with the electronic file formats approved by DEN Building Information Modeling (BIM) Design Standards Manual If any of the files are in any of the formats listed below then the version of the software shall be no less than identified below:
 - a. Adobe Acrobat 8.0 or newer. All files shall be fully compatible with Adobe Acrobat 8.0.
 - b. Microsoft Office 2007 or newer. All files shall be fully compatible with Microsoft Office 2007.

- c. AutoDesk AutoCAD 2007 or newer. All files shall be fully compatible with AutoDesk AutoCAD 2007.
 - d. AutoCAD files shall be self-contained with no external x-references.
 - e. BIM format outlined in the BIM Project Execution Plan (PXP)
 - f. Other files pre-approved by the DEN Project Manager.
2. Adobe Acrobat Requirements:
- a. Drawings shall have security set to "No Security." Commenting, printing, adding photos, form fields and document signing must be allowed.
 - b. PDF submittals shall be one continuous file or Portfolio. No external links are allowed.
 - c. All individual components of submittals shall be bookmarked inside the PDF file.
 - d. All original documents shall be directly converted from the original electronic format to PDF. Scanning of files shall only be allowed by the DEN Project Manager when the original electronic information is not obtainable.
 - e. Failure to comply with these requirements will result in a return of file to the Contractor for immediate revision.
3. Electronic files submitted shall correspond with DEN File Control Numbering System available from the DEN Project Manager.

B. Quantities

1. One (1) electronic submittal in Unifier containing electronic files of each shop or working drawing.
2. One (1) electronic submittal in Unifier containing electronic files of manufacturer's standard schematic drawings.
3. One (1) electronic submittal in Unifier containing electronic files of manufacturer's calculations and manufacturer's standard data.
4. One (1) electronic submittal in Unifier containing electronic files of manufacturer's printed installation, erection, application, and placing instructions.
5. Nine (9) samples of each item specified in the various specification sections, unless otherwise specified.
6. One electronic submittal in Unifier containing electronic files of inspection, test reports, and certificates of compliance.
7. Note: If manufacturer's printed information is in color, all copies of submittals must be in color.

C. Review:

1. Submittal review comments by the DEN Project Manager will be in electronic form and incorporated into the electronic submittal file.
2. Resubmittals of electronic documents shall modify the original electronic file with new information and include the DEN Project Manager's comments with appropriate responses and additional information.

1.4 CHANGES

- A. Changes in products for which shop or working drawings, product data or samples have been submitted will not be permitted unless those changes have been accepted and approved in writing by the Deputy Manager of Aviation as provided in Section 012510 "Substitutions."

1.5 QUALITY CONTROL

- A. Shop drawings and record documents shall be prepared to the standards of quality outlined in the specifications, DSM and BIM PXP, prepared and printed from Revit and checked in the spatial coordination format specified in the BIM PXP.
- B. Refer to DEN BIM DSM for other requirements that may be applicable to this Article.

PART 2 - PRODUCTS.

2.1 SHOP AND WORKING DRAWINGS

- A. Prepare shop and working drawings in an electronic format that is current and approved by DEN to a scale large enough to easily depict and annotate each of the various items.
- B. Comply per other BIM requirements for Shop and Working Drawings as established in the DEN BIM DSM.
- C. Include the following as they apply to the subject:
1. Contract title, work order, and number.
 2. Respective Contract drawing numbers.
 3. Applicable specification section numbers.
 4. Relation to adjacent structure or materials.
 5. Field dimensions clearly identified as such.
 6. Applicable standards such as ASTM or Federal Specification number, FAA, AASHTO, and pertinent authority specifications or standards.
 7. Identification of deviations from the Contract Drawings and specifications.
 8. Drawing name, number, and revision.
 9. Contractor's stamp, initialed or signed, certifying:
 - a. Verification of field measurements.
 - b. Review of submittals for compliance with Contract requirements.
 - c. Compatibility of the Work shown thereon with that of affected trades.
 10. Blank space on each sheet per Technical Specifications Section 013300 "Submittal Procedures."

- D. Drawings of equipment and other items that contain multiple parts shall include exploded views showing the relationship of parts and the description of the parts into the smallest units that may be purchased or serviced.
- E. Comply with all submittal requirements of Section 013300 "Submittal Procedures."

2.2 PRODUCT DATA

- A. Modify manufacturer's standard and/or schematic drawings to delete information that is not applicable to the Contract. Supplement standard information with additional information applicable to this Contract.
- B. Modify manufacturer's standard(s), diagrams, schedules, performance charts, illustrations, calculations, and other descriptive data to delete information that is not applicable to the Contract. Indicate dimensions, clearances, performance characteristics, and capacities. Include with the submittal electrical, plumbing, HVAC, and any other diagrams, as applicable.
- C. Modify erection, application, and placing instructions to delete information that is not applicable to the Contract or work order.
- D. Include the following:
 - 1. Contract title, work order, and number.
 - 2. Respective Contract drawing numbers.
 - 3. Applicable Contract technical specification section numbers.
 - 4. Applicable standards such as ASTM or Federal Specification number, FAA, AASHTO and pertinent authority specifications or standards.
 - 5. Identification of deviations from the Contract Drawings and specifications.
 - 6. Contractor's stamp, initialed or signed, certifying:
 - a. Dimensional compatibility of the product with the space in which it is intended to be used.
 - b. Review of submittals for compliance with Contract requirements.
 - c. Compatibility of the product with other products with which it is to perform or which will be next to it.
 - d. The products electrical, plumbing, control and HVAC requirements conform to Contract Documents and the necessary utilities are provided for in the Contract Documents.

- E. Comply with all submittal requirements of Section 013300 "Submittal Procedures."

2.3 SAMPLES

- A. Submit samples of sizes and quantities to clearly illustrate full color range and functional characteristics of products and materials including attachment devices.

- B. Erect field samples and mockups at the work site as specified in specification Sections and at locations acceptable to the DEN Project Manager. All field samples shall be erected in a location that will be readily visible throughout the life of the Contract to allow comparison of the Work as it progresses to the field sample. Field samples and mockups may be incorporated into the Work at Contractor's risk if approved by DEN Project Manager.
- C. The Contractor shall verify, through appropriate inspections and tests, that the samples submitted meet the specifications and shall provide inspection and test data with the samples. The review and comments on the sample shall not relieve the Contractor of the Contractor's responsibility for completion of the Contract.
- D. Show the following information:
1. Contract title and number.
 2. Respective Contract drawing numbers.
 3. Applicable technical specification section numbers.
 4. Applicable standards such as ASTM or Federal Specification number.
 5. Identification of deviations from the Contract Drawings and specifications
 6. Contractor's stamp, initialed or signed, certifying:
 - a. Dimensional compatibility of the product with the space in which it is intended to be used
 - b. Review of submittals for compliance with Contract requirements
 - c. Compatibility of the product with other products with which it is to perform or which will be next to it
 7. If multiple samples are submitted and the DEN Project Manager is requested to make a choice, each sample shall have a unique identification number attached to it so the returned transmittal can state the identification number of the accepted sample and the Contractor will know which one it is.
- E. Comply with all submittal requirements of Section 013300 "Submittal Procedures."

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

- A. Verify field measurements, catalog numbers, and similar data.
- B. The Contractor shall not start work for which submittals are required until a transmittal has been received by the Contractor marked with the Action Code ACCEPTED or ACCEPTED AS NOTED by the DEN Project Manager.
- C. Before making submittals, ensure that the products will be available in the quantities and at the times required by the Contract.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
013325
SHOP AND WORKING DRAWINGS, PRODUCT DATA, AND
SAMPLES

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

- D. Submit final, corrected, electronic copies of Contract and shop and working drawings showing the Work as actually installed, placed, erected, and applied. Refer to Section 017720 "Contract Closeout."

3.2 REVIEW BY THE DEN PROJECT MANAGER

- A. One (1) electronic copy of the marked-up shop and working drawing and one (1) electronic copy of the product data will be returned to the Contractor by the DEN Project Manager. Only the transmittal form appropriately marked with the Action Code and comments, if any, will be returned on sample submittals.
- B. Contractor's responsibility for errors and omissions in submittals for compatibility will not be reduced, waived or otherwise limited by the review and acceptance of submittals by the DEN Project Manager.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. .

END OF SECTION 013325

SECTION 013520 - CONSTRUCTION SAFETY - AIRSIDE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work specified in this Section includes construction safety precautions and programs by the Contractor for airside, and the basis for reviews by the DEN Project Manager.
- B. Related Specification Sections:
 - 1. Section 011420 "Security Requirements and Sensitive Security Information".
 - 2. Section 011430 "Vehicle and Equipment Permitting".
 - 3. Section 011810 "Utilities Interface".
 - 4. Section 013510 "Construction Safety".
- C. For projects enrolled under DEN Rolling Owner Controlled Insurance Program (ROCIP) reference the Contract Special Conditions for all safety requirements.
- D. For projects enrolled under DEN Owner Controlled Insurance Program (OCIP) reference the Contract Special Conditions for all safety requirements.

1.3 RESPONSIBILITY

- A. The Contractor is responsible for the health and safety of the Contractor's personnel, agents, subcontractors and their personnel, and other persons on the worksite, for the protection and preservation of the Work and all materials and equipment to be incorporated therein, and for the worksite and the area surrounding the worksite. The Contractor shall take all necessary and reasonable precautions and actions to protect all such persons and property.
- B. This Section shall be interpreted in its broadest sense for the protection of persons and property by the Contractor and no action or omission by the DEN Project Manager or the DEN Project Manager's authorized representatives shall relieve the Contractor of any of its obligations and duties hereunder.

1.4 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for the submittal process. The Contractor's Operational Safety Plan shall be submitted and approved under the general Contract prior to commencing any Work. If a Task Order or Change Order is issued where the Work is not covered by the approved Contractor's Operational Safety Plan, then a revision to the Safety Plan specific for the Work in the Task Order shall be resubmitted for approval.
1. No progress payment shall be approved until the Contractor's Operational Safety Plan has been accepted by the DEN Project Manager.
- B. Scope: The Contractor's Operational Safety Plan shall be developed and submitted by the contractor for the DEN Project Manager's review and approval. The Operational Safety Plan shall be developed according to the guidelines and requirements provided in FAA AC No. 150/5370-2G "Operational Safety on Airports During Construction" and will describe how the Contractor will comply with the requirements of the Construction Safety and Phasing Plan (CSPP). The Operational Safety Plan shall cover the actions of not only the construction personnel and equipment, but the actions of inspection personnel and airport staff for the duration of construction activities.
- C. Definitions:
1. Approach Surface: A surface longitudinally centered on the extended runway centerline and extending outward and upward from either a runway threshold or 200 feet behind a threshold. This surface is needed to define where unobstructed airspace above the runway begins.
 2. Notice To Airmen (NOTAM): A notice to the flying public (airmen) through FAA's NOTAM system. Normally initiated by message to the nearest FAA Flight Service Station. Issuance of the NOTAM will be coordinated through the DEN Project Manager and DEN Operations.
 3. Object Free Area: A two-dimensional ground area surrounding runways, taxiways, and taxi lanes that is clear of objects, except for objects whose location is fixed by function.
 4. Safety Area (see AC 150/5300-13B): A defined surface adjacent to runways, taxiways and taxi lanes prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot or excursion from the paved surface. Each safety area must be cleared and graded and have no potentially hazardous ruts, humps, depressions or other surface variations. Each safety area must be drained by grading or storm sewers to prevent water accumulation. East safety area must be capable under dry conditions of supporting snow removal and aircraft rescue and firefighting equipment and or supporting the occasional passage of aircraft without causing any damage to the aircraft. No objects may be located in any safety area, except for objects that need to be located in a safety area because of their function. These objects must be constructed, to the extent practical, on frangibly mounted structures of the lowest practical height, with the frangible point no higher than three (3) inches above grade.

- D. Policy: Aviation safety is a primary consideration during airport construction. These activities shall be planned and scheduled to minimize disruption of normal aircraft activities. If the clearances and restrictions described in this plan cannot be maintained while construction is underway, action will be taken by the Contractor to perform Work at night or during periods of minimal aircraft activity.
- E. Safety Impacts: The Contractor shall take all necessary steps and precautions to mitigate the impact of hazardous conditions as they may relate to the Work. Potentially hazardous conditions which may occur during airport construction include, but are not limited to, the following:
1. Trenches, holes, or excavations on or adjacent to any active runway, taxiway, taxi lane, apron, or related safety areas.
 2. Unmarked/unlighted holes or excavations on or adjacent to any active runway, taxiway, taxi lane, apron, or related safety areas.
 3. Mounds or piles of earth, construction material, temporary structures, or other objects on or in the vicinity of any active runway, taxiway, taxi lane, apron or related safety, approach, or departure areas.
 4. Pavement drop-offs that would cause, if crossed at normal operating speeds, damage to aircraft that normally use the airport. The maximum drop-off is 3 inches per FAA AC 150/5300-13B.
 5. Vehicles or equipment (whether operating or idle) on any active runway, taxiway, taxi lane, apron or related safety, approach, or departure areas.
 6. Vehicles, equipment, excavations, stockpiles, or other materials that could impinge upon NAVAID-critical areas and degrade or otherwise interfere with electronic NAVAIDS or interfere with visual NAVAIDS facilities.
 7. Unmarked utility, NAVAIDS, weather service, runway lighting, underground power, or signal cables that could be damaged during construction.
 8. Objects or activities anywhere on or in the vicinity of an airport which would be distracting, confusing, or alarming to pilots during aircraft operations.
 9. Unflagged/unlighted low visibility items such as tall cranes, backhoes, scrapers, dump trucks, rollers, compactors, dozers and the ilk, in the vicinity of an active runway, taxiway, taxi lane, apron or related safety, approach, or departure areas.
 10. Dirt, debris, or other transient accumulations that temporarily obscure pavement markings or pavement edges, or derogate the visibility of runway or taxiway markings or lighting or of construction and maintenance areas.
 11. Trash or other materials with foreign object damage (FOD) potential, whether on runways, taxiways, taxi lanes, aprons or in related safety areas.
 12. Failure to control vehicle, human and large animal access to, and nonessential nonaeronautical activities on, open aircraft movement areas.
 13. Failure to maintain radio communication between construction vehicles and air traffic control or other on-field communications facilities.
 14. Construction activities or material which could hamper Aircraft Rescue and Fire Fighting (ARFF) vehicle access from ARFF stations to all parts of the runway/taxiway system, runway approach and departure areas, or aircraft parking locations.
 15. Inadequate fencing or other marking to separate construction areas from open aircraft operating areas.
 16. Bird attractions such as edibles (food scraps, etc.), trees, brush, other trash, grass/crop seeding, or ponded water on or near the airport.

F. Safety Requirements:

1. General:

- a. During performance of this Contract, the airport runways, taxiways, taxi lanes, and aircraft parking aprons shall remain in use by aircraft to the maximum extent possible, consistent with continual safety. Aircraft use of areas near the Contractor's Work will be controlled to minimize disturbance to the Contractor's operation. However, AIRCRAFT HAVE THE RIGHT OF WAY AT ALL TIMES. The Contractor shall not allow employees, subcontractors, suppliers, or any unauthorized persons to enter or remain in any airport area that would be hazardous to persons or to aircraft operations.
- b. Contractor personnel, airport staff and field inspectors directly involved in on-airport construction shall:
 - 1) Be aware of the types of conditions, safety problems, and/or hazards identified each day at the airport. To insure that all personnel are aware, daily meetings between management and supervisory personnel and their employees shall be scheduled prior to any work commencing on the shift.
 - 2) Inspect daily all work and/or storage areas for which the Contractor is responsible to be aware of current conditions.
 - 3) Promptly take all steps needed to remedy any unsafe or potentially unsafe condition. Coordinate with the DEN Project Manager to insure immediate corrective action is undertaken
- c. Before commencement of construction activity the Contractor, through coordination with the DEN Project Manager and DEN Operations, shall give notice using the NOTAM system of construction on the airfield. In addition, a NOTAM shall be issued for the completion of construction on the airfield.

2. Construction Area Marking: Temporary lighting, barricades, flagging, and flashers are required as shown on the plans and per FAA AC 150/5370-2G Chapter 2 Section 2.18 through 2.21 Flag lines, traffic cones, flashers, edge lights, and/or signs shall be used as necessary:

- a. To clearly separate all construction from other parts of an air operations area
- b. To identify isolated hazards, such as open manholes, excavations, areas under repair, stockpiled material, waste areas, etc.
- c. Vehicle and pedestrian access routes used for airport construction shall be controlled to prevent any unauthorized entry of persons, vehicles, or animals.
- d. Vehicle parking areas for Contractor employees shall be designated in advance to minimize traffic in open/active aircraft movement areas.

3. Cables and Utilities:

- a. Special attention shall be given to preventing unscheduled interruption of utility services and facilities. The location of all cables and utilities shall be identified prior to construction activities.
 - b. There shall be coordination among the Contractor, the DEN Project Manager, DEN Operations, the FAA, the National Weather Service, utility companies, and any other appropriate entity or organization. NAVAIDS, weather service facilities, electric cables, and other utilities must be fully protected during the entire construction time.
 - c. Power, communication, and control cables leading to and from any FAA NAVAIDS, weather service, and other facilities will be marked in the field by the appropriate individuals as identified in Section 011810 "Utilities Interface" for the information of the Contractor before any work in their general vicinity is started. Thereafter, through the entire duration of construction, utilities shall be protected from any possible damage.
 - d. At the intersection of expansion joints and centerline lighting circuits on taxiways and runways, the electrical conduit may be within the 21" portion of the Portland cement concrete pavement. Coordination with the DEN Project Manager's representative and the DEN Electrical Department is of utmost importance for both the scheduling of an outage and the removal of conductors while cutting the joint.
4. Vehicle and Employee Identification:
- a. Contractor vehicles and equipment shall be flagged for high daytime visibility and if appropriate, lighted for nighttime operations. Vehicles that are not marked and lighted shall be escorted by a vehicle that is equipped with appropriate marking and lighting devices. Marking and lighting shall be in conformance with FAA AC 150/5210-5D, current edition, or as outlined in Section 011430 "Vehicle and Equipment Permitting" of the Contract Documents.
 - b. The Contractor will be required to conform to the specific requirements as outlined in Section 011420 "Security Requirements and Sensitive Security Information (SSI)" of the Contract documents.
5. Radio Communications:
- a. The Contractor's construction superintendent and flag personnel shall be required to coordinate directly with the DEN Project Manager or designated Representative. Only the DEN Project Manager or designated Representative shall monitor transceiver radios tuned to the frequency for communications with DEN Operations and B Tower Control. Radios shall be used to obtain the proper clearance concerning the movement of equipment, trucks, etc., on the airfield. Further, any unusual occurrences in the flight pattern of approaching or departing aircraft shall be acknowledged by all concerned so that operation of the airport and the construction work can be safely carried on at all times.
6. Haul Routes Crossing Active Aircraft Operation Areas:

- a. The Contractor shall provide a minimum of one (1) broom truck to continuously clean the surface of the active taxiway, taxi lane or apron of any foreign object damage (FOD) or other objectionable debris that may result from hauling activities. Additional broom trucks may be required to expedite the cleanup process. Opening the taxiway, taxi lane, or apron to aircraft operations shall only be approved after a visual inspection of the pavement surface by the DEN Airfield Operations Manager.
- b. The Contractor shall not work within the minimum of the following: 160 ft. of the centerline of an active taxiway, 310 ft. of the centerline of an active runway, or the minimum requirements of the FOD or Safety Zone unless otherwise noted in the Contract Documents and as approved in writing by the DEN Project Manager.
- c. All construction equipment and vehicles shall be flagged for high daytime visibility and if appropriate, lighted for nighttime operations. Vehicles that are not marked and lighted shall be escorted by a vehicle that is equipped with appropriate marking and lighting devices. Marking and lighting shall be in conformance with FAA AC 150/5210-5D, current edition.
- d. All Contractor and Subcontractor employees must be aware of the types of safety problems and hazards associated with aircraft operations and construction activities.

PART 2 - PRODUCTS

2.1 Contractor's Operational Safety Plan

- A. The Contractor shall provide six (6) copies of the Contractor's Operational Safety Plan to the DEN Project Manager for review at least ten (10) calendar days before on-site construction begins. The Contractor's program must meet, as a minimum, all applicable federal, state and local government requirements, and the following:
 1. The Contractor shall provide the following information for acceptance by the DEN Project Manager prior to the commencement of construction activities. The Operational Safety Plan must address all aspects listed below. If an item is not applicable, then this must be noted in the plan.
 - a. Name of the Contractor's safety representative.
 - b. If the Contractor is running multiple shifts or working more than (40) hours per week, the name of an assistant safety representative who can act in the absence of the site safety representative.
 - c. Twenty-four (24) hours per day emergency phone numbers of Contractor site management to be used in case of injury or accident. Provide at least four contacts.
 - d. Means of protecting employees working in trenches and excavations, including sloping and shielding.

- 1) Soil classification will be considered as Type C when designing protective systems, unless the Contractor can prove to the satisfaction of DEN that the soil classification is otherwise. Soil classification change request shall be provided to the DEN Project Manager in writing. The decision of the DEN Project Manager will be provided to the Contractor in writing.
- e. The Contractor shall show how material shall be stored beside the excavation. Stored material shall include the excavated and backfilled material
- f. Injury and accident handling, including samples of the reporting form.
- g. How personnel will be handled who are unable to safely perform their duties, including how the Contractor will determine whether personnel are unable to safely perform duties. This may include the Contractor's disciplinary process and employee's physical capabilities to perform the work safely.
- h. How and when equipment will be checked to see that it is safe, that all safety guards are in place, and that the equipment is being used for its designed purpose and within its rated capacity.
- i. How and when all electric devices will be checked for proper grounding and insulation. Describe the methods that will be used to lock out electric systems that should not be energized.
- j. How trash and human organic waste will be disposed of.
- k. How snow and ice will be removed by the Contractor in the project area.
- l. How concrete forms will be anchored to ensure their stability, including calculations showing that the forms will safely hold the maximum construction loads.
- m. How flammable materials will be stored and handled, and how any spills will be cleaned up and removed for disposal.
- n. What system will be used to prevent fires and, if fires do occur, who will be trained to fight them. In addition, what firefighting equipment will the Contractor have available and how will this equipment's condition be monitored.
- o. How materials will be received, unloaded, stored, moved, and disposed of.
- p. How personnel working above ground level will be protected from falling.
- q. How people working beneath the construction work will be protected.
- r. What will be done to protect personnel in case of severe weather.
- s. How adequate lighting will be provided and monitored.
- t. How air quality will be monitored to ensure that chemical exposures are below current, established OSHA Permissible Exposure Limits. How personnel will be protected if these limits are exceeded.
- u. How the safety of work platforms, man lifts, material lifts, ladders, shoring, scaffolding, etc., will be ensured relating to load capacity and the protection of personnel using or working around them.
- v. The type of personal protective equipment that will be used to protect personnel from hazards.
- w. The type of safety training that will be provided to personnel to inform them of safe work procedures.
- x. How daily audits and inspections will be performed to ensure compliance with the Contractor's Operational Safety Plan and current, applicable OSHA regulations.

- y. Procedures to ensure that welding and other hot work is performed safely.
 - 1) A hot work permit from the Denver Fire Department (DFD) will be required for all welding, soldering, cutting, and brazing and or other processes required by DFD on the project. Contractor will comply with all of the provisions in the permit.
- z. How compressed gases will be safely stored, handled, and used.
- aa. Methods to ensure that personnel safely enter, work in, and exit confined spaces.
 - 1) All confined spaces on DEN property are considered permit required. A permit must be obtained from the DFD before Contractor personnel may enter a confined space. Contractors will comply with all provisions and requirements of this permit.
- bb. How the hazards of chemicals will be communicated to personnel, including the use of material safety data sheets and chemical labels.
- cc. Methods to ensure that forklifts and other powered industrial trucks are operated in a safe manner.
- dd. How an effective hearing conservation program will be used to protect personnel from high noise levels and prevent hearing loss.
- ee. How personnel will be protected from the effects of jet blast.
- ff. How hazards will be identified and corrected when reported.

2.2 DEN PROJECT MANAGER'S REVIEW

- A. Prior to the start of any work by contractor or subcontractor personnel, the Contractor shall provide the DEN Project Manager with a list of its personnel, subcontractor's personnel and other personnel the Contractor has requested to work at Denver International Airport, who have signified in writing that they have been briefed on, or have read and understand, the Contractor's Operational Safety Plan.

PART 3 - EXECUTION

3.1 IMPLEMENT CONTRACTOR'S OPERATIONAL SAFETY PLAN

- A. Implement the approved Contractor's Operational Safety Plan as described in Part 1 and Part 2 of this Section and in Section 011100 "Summary of Work."
- B. If the Contractor experiences lost time or an injury rate greater than 75 percent of the national average for all construction, the Contractor shall notify the DEN Project Manager, audit its safety procedures, and submit a plan to reduce its rates.

- C. If at any time the lost time or injury rates experienced by the Contractor are 150 percent or more of the national average for construction, the Contractor shall notify the DEN Project Manager and immediately hire an independent safety professional who shall audit the Contractor's procedures and operations and make a report of changes that the Contractor should implement to reduce the rate including changing personnel.
1. The report shall be submitted to the DEN Project Manager.
 2. The Contractor shall immediately begin implementing the recommendations of the independent safety professional.
 3. A weekly report shall be submitted by the Contractor to the DEN Project Manager on the status of the implementation of the recommendations.
 4. Failure to comply with these requirements is a basis to withhold a portion of progress payments.

3.2 ROLLING OWNER CONTROLLED INSURANCE PROGRAM (ROCIP)

- A. Implement Rolling Owner Controlled Insurance Program (ROCIP) as provided in the Project Manual issued for bid or proposal

3.3 OWNER CONTROLLED INSURANCE PROGRAM (OCIP)

- A. Implement Owner Controlled Insurance Program (OCIP) as provided in the Project Manual issued for bid or proposal

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 013520

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CONSTRUCTION SAFETY - AIRSIDE

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SECTION 014100 - REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section identifies primary compliance with the State, City and County of Denver's regulatory requirements including:
 - 1. City and County of Denver / Department of Aviation.
 - 2. Colorado Department of Public Health and Environment.
 - 3. City and County of Denver Development Services, including the Department of Public Works and Division of Wastewater Management.
 - 4. The standards that govern design and construction projects at Denver International Airport.
- B. Construction shall be based on the latest edition of the referenced codes including additions and revisions thereto that are in effect at the time of Project bidding or Task Order pricing or GMP established whichever is latest, and as specifically related.

1.3 RELATED SECTIONS

- A. Section 015719 "Temporary Environmental Controls" for environmental and related permitting requirements.

1.4 BUILDING CODE

- A. All design and construction work shall be governed by the Building Code for the City and County of Denver, latest edition. This is based upon the International Building Code of the International Code Council with Denver Amendments to this code. Appendix N of the Denver Amendments addresses Construction of Airport Buildings and Structures.
 - 1. This Contract shall be based on the most current published version of the ICC series as Amended by The City and County of Denver.

1.5 DENVER BUILDING DEPARTMENT

- A. For review and approval of all construction documents for compliance to the Denver building code:

1.6 DENVER FIRE DEPARTMENT

- A. For review and approval of plans for compliance with the Denver Fire Department's requirements as they apply to the Denver International Airport:

Denver Fire Department
745 West Colfax Avenue
Denver, Colorado 80204
Telephone 720-913-3474

- B. The Contractor is advised that the Denver Fire Department – Fire Prevention Bureau requires permitting for the following activities as they apply to the scope of work. The Contractor is responsible for obtaining the appropriate permits necessary to complete the work. All costs associated with this permitting and policy compliance shall be the responsibility of the Contractor. The policies all reference the International Fire Code (IFC).

1. “Hot work”, which is defined as the operation of any equipment or tool that creates sparks, hot slag, or radiant or convective heat as a result of the work. This includes, but is not limited to, welding, cutting, brazing, or soldering.
2. Use and storage of compressed gas for both temporary storage and permanent facility installation. This includes, but is not limited to, flammable gas (excluding propane-LPG), oxidizer (including oxygen), and inert and/or simple asphyxiates.
3. Tank installation, which includes aboveground storage tanks (AST) and underground storage tanks (UST) for both temporary tanks and permanent facility installations.

- C. In addition to the above permits, the Denver Fire Department may require other permits that are associated with the specific work in the Contract Documents. Policies provided by the Denver Fire Department are meant to provide basic information for the most common conditions and situations. In any given occupancy, many other Uniform Fire Code requirements may be enforced. These should be addressed with the Denver Fire Department before construction begins and during construction with premise inspection(s).

1. The Fire Prevention Bureau web site is denfpb@denvergov.org

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PERMITS AND CERTIFICATIONS

- A. The Contractor shall maintain records on site of all permits acquired by federal, state, and local agencies. Posting of permits shall conform to requirements of the respective agencies.

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- B. At the completion of any inspection by other agencies, the Contractor shall forward copies of the status of the inspection and copies of any approved or "signed-off" inspections by the respective agencies to the DEN Project Manager.

- C. At the time of request for Substantial Completion, the Contractor shall forward to the DEN Project Manager all permits approved by the respective agencies.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 014100

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SECTION 014210 - REFERENCED MATERIAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 REFERENCED MATERIAL

- A. City and County of Denver, Department of Aviation, Standard Specification for Construction, General Contract Conditions
- B. The following documents may be available for examination at the Owner's offices unless otherwise noted. The referenced material and documents are not part of the Contract Documents unless otherwise specified.
 - 1. Environmental Impact Statement (EIS).
 - 2. Geotechnical Reports:
 - a. Borings, other field and laboratory explorations, and investigations have been made to indicate subsurface materials at particular locations. Explorations and investigations conducted by designers and their subconsultants are solely for the purpose of study and design.
 - b. The subsurface exploration and investigation information is presented or made available to indicate some of the conditions that may be encountered during construction and is offered as supplementary information only. Geotechnical information presented in the referenced material represents the opinion of soils consultants as to the character of the materials encountered. Subsurface information was directly obtained only at the specified location and necessarily indicates subsurface conditions only at the respective plan location, depths penetrated and only at the time of the exploration.
 - c. Neither the City nor the Designers assume any responsibility whatever in respect to the sufficiency or accuracy of borings made, or of the logs of test borings, or of other investigations, or of the interpretations made thereof, and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations are representative of those existing throughout such area, or any part thereof, or that unforeseen developments may not occur. It is expressly understood that the making of deductions, interpretations, and conclusions from all of the accessible factual information, including the nature of the materials to be excavated, the difficulties of doing other work affected by the geology, groundwater elevations and other subsurface conditions at the site of the Work are the Contractor's sole responsibility.

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- d. Information derived from inspection of logs of borings, topographic maps, technical memorandum, reports, or plans showing information of the subsurface of site conditions will not relieve the Contractor from any risk or from properly examining the site and making such additional investigations as the Contractor may elect or from properly fulfilling all the terms of the Contract Documents.
- 3. Available Conceptual Utility and Drainage Reports.
- 4. DEN Building Information Modeling (BIM) Design Standards Manual (DSM)
- 5. Woolpert, Inc. Report - "A Low Distortion Projection for Denver International Airport (DEN)", dated 12/10/2010.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 014210

SECTION 014220 - ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 REFERENCE LIST

- A. Documents published by the following agencies may be referenced within these Contract Documents to define the quality of materials, equipment, workmanship, and other features of Work. Unless otherwise stated, the reference documents shall be of the latest edition as of the date of the Advertisement for Bids.
- B. Wherever used in the Contract Documents, the following abbreviations will have the meanings listed:

Abbreviation	Definition
AALA	American Association of Laboratory Accreditation
AAN	American Association of Nurserymen
AAO	Affirmative Action Officer
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
AFI	Air-Filter Institute
AGTS	Automated Ground Transportation System
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
APEN	Air Pollution Emission Notes
APWA	American Public Works Association
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWPA	American Wood Preserver's Association

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Abbreviation	Definition
AWS	American Welding Society
AWWA	American Water Works Association
BID	Building Inspection Division, Department of Public Works
BIM	Building Information Modeling
CAR	Corrective Action Report
CCD	City and County of Denver
CCR	Contractor Change Request
CCRL	Cement Concrete Reference Laboratory
CD	Change Directive
CDOH	Colorado Department of Highways or Colorado Department of Health
CDOT	Colorado Department of Transportation
CMEC	Concrete Materials Engineering Council
CN	Change Notice
CO	Change Order
COE	Corps of Engineers
CPM	Critical Path Method
CR	Change Request
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DEN	Denver International Airport
DFD	Denver Fire Department
DOT	United States Department of Transportation
DOR	Designer of Record
DWB	Denver Water Board
EEO	Equal Employment Officer or Equal Employment Opportunity
EIA	Electronics Industry Association
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FHWA	Federal Highway Administration
FM	Factory Mutual Association
FS	Federal Specifications (U.S. General Services Administration)
GCC	General Contract Conditions
GIS	Geographic Information Systems
GMP -	Guaranteed Maximum Price
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code (published by ICC)
IBR	Institute of Boiler and Radiator Manufacturer's
ICBO	International Conference of Building Officials
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMC	International Mechanical Code (published by ICBO)
IPC	International Plumbing Code (published by ICBO)
ISA	Instrument Society of America
ITA	Independent Testing Agency

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Abbreviation	Definition
MIL	Military Specifications (Naval Publications and Forms Center)
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
MUTCD	Manual of Uniform Traffic Control Devices
NAAB	National Association of Air Balance
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards (now called National Institute of Standards and Technology)
NEC	National Electric Code (NFPA 70)
NECA	National Electric Contractors Association
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NFC	National Fire Code (as published by NFPA)
NFPA	National Fire Protection Association
NICET	National Institute for the Certification of Engineering Technologies
NIST	National Institute of Standards and Technology
NGS	National Geological Survey
NLMA	National Lumber Manufacturers Association
NOAA	National Oceanic and Atmospheric Administration
NRMCA	National Ready Mix Concrete Association
NTP	Notice to Proceed
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDM	Precedent Diagram Method
PS	Product Standard of NIST (U.S. Department of Commerce)
PM	Project Manager
PMT	Project Management Team
PXP	Project Execution Plan
QA	Quality Assurance
QC	Quality Control
RFI	Request for Information
RTD	Regional Transportation District
SC	Special Contract Condition
SDI	Steel Door Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SSPWC	Standard Specifications for Public Works Construction
TCP	Traffic Control Plan
TSA	Transportation Security Administration
UL	Underwriters Laboratories, Inc.
USC	United States Code
WBS	Work Breakdown Schedule

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 014220

SECTION 014225 - REFERENCE STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section contains a summary of industry-accepted and recognized standards published by trade associations, government, and institutional organizations that are referred to in the various Sections of these specifications or elsewhere in the Contract Documents.
- B. Standards listed herein are included in the Contract Documents by this reference and become a part of the Contract Documents to the same extent as though included in their entirety unless specific limitations are noted in the individual specifications Sections.
- C. Listings of reference standards include name and address of the organization publishing the standard, and the full name and designator of each of the standards referenced herein.
- D. If a publication date or edition number is listed with the reference standard, that publication date or edition number shall apply. Otherwise, the publication date or edition number in effect at the Contract date shall apply.
- E. Inclusion of reference standards herein does not make the DEN Project Manager an agent of the publishing agency, nor does it obligate the DEN Project Manager to perform inspections required by or to enforce rules or regulations contained in the reference standards.

1.3 SCHEDULE OF REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO), 444 North Capitol Street, NW, Suite 249, Washington, DC 20090:
 - 1. AASHTO M 36—Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
 - 2. AASHTO M216—Standard Specification for Lime for Soil Stabilization.
 - 3. AASHTO T26—Standard Method of Test for Water to be Used in Concrete.
 - 4. AASHTO T84—Specific Gravity and Absorption of Fine Aggregate.
 - 5. AASHTO T85—Specific Gravity and Absorption of Coarse Aggregate.
 - 6. AASHTO T103—Soundness of Aggregates by Freezing and Thawing
 - 7. AASHTO T219—Standard Methods of Testing Lime for Chemical Constituents and Particle Sizes.

- B. American Concrete Institute (ACI) 38800 Country Club Drive, Farmington Hills, MI 48331
1. ACI 211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 2. ACI 301—Specifications for Structural Concrete for Buildings.
 3. ACI 304—Recommended Practices for Measuring, Mixing, Transporting and Placing Concrete.
 4. ACI 304.2R—Placing Concrete by Pumping Methods.
 5. ACI 305R—Hot Weather Concreting.
 6. ACI 306R—Cold Weather Concreting.
 7. ACI 318—Building Codes Requirements for Structural Concrete
 - a. Reference to ACI 318 may be limited to more stringent requirements of local building code.
- C. American Society for Testing and Materials (ASTM), International 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428:
1. ASTM A 27—Mild to Medium Strength Carbon - Steel Casting for General Application.
 2. ASTM A 36—Structural Steel.
 3. ASTM A 47—Malleable Iron Castings.
 4. ASTM A 82—Specification for Steel Wire, Plain, for Concrete Reinforcement: Replaced by A1064
 5. ASTM A 123—Hot-dip Galvanizing.
 6. ASTM A 184—Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 7. ASTM A 185—Specifications for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement: Replaced by A1064
 8. ASTM A 283—Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
 9. ASTM A 615—Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 10. ASTM A 706—Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
 11. ASTM C 25—Method for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime.
 12. ASTM C29—Unit Weight and Voids in Aggregate
 13. ASTM C 31—Methods of Making and Curing Concrete Test Specimens in the Field.
 14. ASTM C 33—Specification for Concrete Aggregates.
 15. ASTM C 39—Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 16. ASTM C 42—Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 17. ASTM C 76—Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 18. ASTM C 88—Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 19. ASTM C 94—Specification for Ready Mixed Concrete.
 20. ASTM C 109—Compressive Strength of Hydraulic Cement Mortars

21. ASTM C 110—Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone.
22. ASTM C 117—Materials Finer than 75 mm (No. 200) Sieve in Mineral Aggregates by Washing.
23. ASTM C 131—Resistance of Abrasions of Small Size Coarse Aggregate by Use of the Los Angeles Machine.
24. ASTM C 136—Method for Sieve Analysis of Fine and Coarse Aggregates.
25. ASTM C 138—Unit Weight, Yield, and Air Content of Concrete.
26. ASTM C 143—Test Method for Slump of Hydraulic – Cement Concrete
27. ASTM C 150—Specification for Portland Cement
28. ASTM C 171—Specification for Sheet Material for Curing Concrete.
29. ASTM C 172—Method of Sampling Fresh Concrete.
30. ASTM C 173—Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
31. ASTM C 231—Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
32. ASTM C 260—Specification for Air Entraining Admixture for Concrete.
33. ASTM C 309—Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
34. ASTM C 443—Joints for Concrete Pipe and Manholes, using Rubber Gasket
35. ASTM C 494—Specification for Chemical Admixtures for Concrete.
36. ASTM C 595—Blend Hydraulic Cements.
37. ASTM C 618—Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete
38. ASTM C 655—Reinforced Concrete D Load Culvert, Storm Drain, and Sewer Pipe.
39. ASTM C 789—Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers: Replaced by C1433
40. ASTM C 803—Test Method for Penetration Resistance of Hardened Concrete.
41. ASTM C 805—Test Method for Rebound Number of Hardened Concrete.
42. ASTM C 977—Specification for Quicklime and Hydrated Lime for Soil Stabilization.
43. ASTM D 75—Sampling Aggregate.
44. ASTM D 422—Test Method for Particle Size Analysis of Soils.
45. ASTM D 516-88—Standard Test Method for Sulfate Ions in Water.
46. ASTM D 693—Crushed Stone, Crushed Slag and Crushed Gravel for Dryer Water-Bound Macadam Base Courses and Bituminous Macadam Base and Surface Courses of Pavements: Withdrawn
47. ASTM D 698—Laboratory Compaction Characteristics of Soil using Standard Effort
48. ASTM D 751—Test Method for Coated Fabrics
49. ASTM D 1556—Test Method for Density of Soil in Place by the Sand-Cone Method.
50. ASTM D 1557—Laboratory Compaction Characteristics of Soil using Modified Effort
51. ASTM D 1682—Ultraviolet Resistance Grab Tensile Strength Grab Tensile Elongation Toughness: Replaced by D5034 and D5035
52. ASTM D 1751—Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
53. ASTM D 1752—Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

54. ASTM D 2167–Test Method for Density of Soil in Place by the Rubber-Balloon Method.
 55. ASTM D 2216–Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.
 56. ASTM D -79 Hydroxypropyl Methylcellulose
 57. ASTM D 2419–Sand Equivalent Value of Soils and Fine Aggregate.
 58. ASTM D 2487–Test Method for Classification of Soils for Engineering Purposes.
 59. ASTM D 2922—Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Method: Replaced by D6938
 60. ASTM D 3017—Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth): Replaced by D6938
 61. ASTM D 3665–Random Sampling of Paving Materials.
 62. ASTM D 4253–Test Method for Maximum Index Density of Soils Using Vibratory Table.
 63. ASTM D 4318–Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 64. ASTM D 4397–Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications.
 65. ASTM D 4546–Test Method for One-Dimensional Swell or Settlement Potential of Cohesive Soils.
 66. ASTM E 329–Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
 67. ASTM F 477–Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 68. ASTM F 758–Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport and Similar Drainage.
- D. American Welding Society (AWS), 550 NW LeJeune Road, Miami, FL 33135 AWS Code for Welding in Building Construction (Structural Welding Code).
- E. Concrete Reinforcing Steel Institute (CRSI) 933 N. Plum Grove Road, Schaumburg, IL 60195, (312) 490-1700:
1. Manual of Standard Practice.
- F. Colorado Department of Transportation (CDOT) Division of Administration, Office of Bid Plans, 4201 E. Arkansas Avenue, Denver, CO 80222:
1. Standard Specifications for Road and Bridge Construction (latest edition) Colorado Standard Plans, M&S Standards.
- G. Federal Highway Administration (FHWA) Superintendent of Documents, US Government Printing Office, Washington DC, 20402:
1. Manual of Uniform Traffic Control Devices (latest edition).

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REFERENCE STANDARDS

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
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PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 014225

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
014225
REFERENCE STANDARDS

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
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SECTION 014230 - DEFINITIONS AND CONVENTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section contains a list of definitions of words or phrases and grammatical or contextual conventions commonly used in these Contract Documents.

1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. Alphabetical Listing of Definitions:
 - 1. As indicated: Shown on the drawings by graphic indication, notes, or schedules, or written in the specifications or elsewhere in the Contract Documents.
 - 2. As directed, as approved, as requested: Unless otherwise indicated, these terms imply "by the DEN Project Manager" and require that an instruction be obtained by the Contractor from the DEN Project Manager.
 - 3. Concealed: Embedded in masonry, concrete, or other construction; installed in furred spaces; within double partitions or hung ceilings; in trenches; in crawl spaces or in enclosures.
 - 4. Ensure: To make certain in a way that eliminates the possibility of error.
 - 5. Exposed: Not installed underground or "concealed" as defined above.
 - 6. Furnish or Provide: To supply, install and connect complete and ready for safe and regular operation of particular work unless specifically otherwise noted.
 - 7. Indicated, Shown, or Noted: As depicted on drawings or specifications.
 - 8. Install: To erect, mount and connect complete with related accessories.
 - 9. Or equal, or approved equal: Refers to products which, in the opinion of the DEN Project Manager, are similar in all respects to products specified by proprietary brand name. Refer to Section 012510 "Substitutions" for procedures for submittal of proposed substitutions.
 - 10. Rework: To repair existing items or work required to be removed and replaced in order to accomplish the Work in accordance with the Contract Documents.
 - 11. Related Work: Includes, but not necessarily limited to, mentioned work associated with, or affected by, the Work specified.
 - 12. Reviewed, Satisfactory, Accepted, or Directed: Assumes by or to the DEN Project Manager.
 - 13. Similar, or Equal: Same in materials, weight, size, design, construction, capacity, performance, and efficiency of specified product.

14. **Supply:** To purchase, procure, acquire and deliver complete with related accessories.
15. **Unless Otherwise Indicated and Unless Otherwise Noted:** General note to perform work as indicated or shown on drawings or in specifications unless specifically directed otherwise elsewhere in the Contract Documents; may be abbreviated "U.O.N.", "U.O.I.", or "U.N.O."

C. **BIM Model Definitions:**

1. **Building Information Model (BIM):** BIM is a digital representation of the physical and functional characteristics of the Project and is referred as a Model(s), which term may be used to describe a Model Element, a single Model or technology used to create the Model.
2. **Design Model:** A Model that has reached the stage of completion that would customarily be expressed by an architect or engineer in two-dimensional Construction Documents.
3. **Construction Model:** The equivalent of shop drawing and other information useful to construction. A model that consists of data imported from a "Design Model or", if none exist, from a designer's "Construction Document".
4. **Federated Model:** Distinct component models "linked" together in such a manner that the linked data sources so not lose the indent or integrity by being so linked.
5. **Level of Development (LOD):** LoD describes the level of completeness to which a Model Element is developed.
6. **Model Element:** Is a portion of the BIM representing a component system or assembly within a building or building site.
7. **Model Element Author:** The party responsible for developing the content of a specific Model Element to the LoD for a particular phase of the Project.

1.4 **BIM REFERENCE STANDARDS**

- A. Refer to the DEN BIM Design Standard Manual (DSM) for the proposed minimum requirements of the BIM Execution Plan. The execution plan shall be further developed jointly with DEN and the Contractor to specifically address the administrative steps necessary to provide comprehensive BIM system before during and after construction.

1.5 **CONVENTIONS**

A. **Specifications Format:**

1. In order to standardize the location of information in the Contract Documents, the specifications generally are organized in one or more of the following formats:
 - a. The "MASTERFORMAT" 2011 Edition published by the Construction Specifications Institute.
 - b. The Standard Specifications for Road and Bridge Construction published by CDOT.
 - c. The alphanumeric system as published by the FAA.

B. **Organization of Drawings and Specifications:**

1. Organization of the specifications into divisions and sections, and arrangement or numbering of drawings is intended solely for the convenience of the Contractor in the Contractor's responsibilities to divide the Work among subcontractors or to establish the extent of work to be performed by any trade.
2. Neither the City nor the DEN Project Manager assume any liability arising out of jurisdictional issues or claims advanced by trade organizations or other interested parties based on the arrangement or organization of drawings or specifications.

C. Gender and Number:

1. For convenience and uniformity, parties to the Contract, including the City, Contractor, and DEN Project Manager, and their subcontractors, suppliers, installers, consultants or other interested parties are referred to throughout the Contract Documents as if masculine in gender and singular in number. Such reference is not intended to limit the meaning of the Contract Documents to the masculine gender or singular number.

D. Singular vs. Plural:

1. Materials, products, equipment, or other items of work referred to in the singular shall be construed as plural where applicable by the intent of the Contract Documents and shall not limit quantities to be provided by the Contractor.

E. Imperative Mood:

1. Specifications and notes on the drawings or elsewhere in the Contract Documents are generally written in the imperative mood as instructions to the Contractor, whether the Contractor is specifically addressed or not.

F. References to Subcontractors or Trades

1. References to subcontractors, trades or other entities, which are not parties to the Contract, shall be construed as meaning the Contractor whose responsibility it shall be to divide the Work among subcontractors or trades. Such references are used as a matter of convention, and are not intended to preclude or direct the Contractor's responsibility to divide the Work.

G. Abbreviations

1. A list of abbreviations used in the Contract Documents is included in Technical Specifications Section 014220 "Abbreviations and Symbols"; an abridged list of abbreviations used on the drawings is included with the drawings.
2. Abbreviations are believed to be those in general use in the construction industry. Contact the DEN Project Manager for clarification of abbreviations for which the meaning is not clear.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 014230

SECTION 014320 - DEN QUALITY ASSURANCE FOR FAA FUNDED PROJECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Title 17 – Inspection and Defects in the General Contract Conditions, 2011 Edition.
- C. ASTM standard practices and specifications testing including, but not limited to, the following:
 - 1. ASTM C 1077: Standard Practices for Laboratory Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
 - 2. ASTM D 3666: Road & Paving Materials
 - 3. ASTM D 3740: Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
 - 4. ASTM E 329: Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction
 - 5. ASTM E 543: Determining the Qualifications of Nondestructive Testing Agencies.
- D. Other:
 - 1. Standard testing practices for other disciplines.

1.2 SUMMARY

- A. This Section identifies Denver International Airport (DEN) inspection activities to be performed by inspectors employed by DEN and working under the direction of the DEN Project Manager.

1.3 QUALITY ASSURANCE

- A. Inspection and tests, conducted by persons or agencies other than the Contractor, shall not in any way relieve the Contractor of the Contractor's responsibility and obligation to meet all requirements of Contract Documents and the referenced standards.
- B. The inspection and approval of Work by other agencies above does not constitute inspection or acceptance of Work required by DEN. The Contract Documents may contain requirements more stringent than Denver Building Inspection Division or other code agency requirements. The City will perform all acceptance testing.

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- C. The Contractor will employ the services of a Material Testing Agency in conformance with Section 014525 "Material Testing Agency" to perform acceptance testing on all earthwork and earthwork related work items. DEN Quality Assurance (QA) program will monitor all tests performed by the Contractor's Material Testing Agency and must be present on site during all acceptance testing and inspections.
- D. The City will employ the services of a Testing Agency (TA), which will perform all acceptance testing.
- E. Laboratory and field testing requirements to be conducted by the TA for materials and construction on this project are included in the appropriate Contract Documents. Where the Contract Documents reference the CDOT Standard Specifications for Road and Bridge Construction, the references shall also mean CDOT Field Materials Manual for schedule of tests unless otherwise stated. As a minimum, the TA described in this Section shall perform all applicable tests including the sampling and acceptance testing. In the event of such a conflict between the schedule and a specification in the Contract Documents, the more comprehensive testing shall govern unless otherwise noted.
- F. Inspections and tests conducted by the TA shall not in any way relieve the Contractor of the Contractor's responsibility and obligation to meet the requirements of all Contract Documents and referenced standards. Employment of the City's TA does not relieve the Contractor of providing the required Quality Control program.
- G. When inspections or tests by the TA prove that the item or material does not meet all applicable specifications and requirements, the cost incurred for the re-testing or re-inspection shall be borne by the Contractor.
- H. Samples will only be considered if taken at random.
- I. The Contractor is obligated to correct any item deemed deficient at no additional cost to the City.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION (Not Used)****PART 4 - MEASUREMENT****4.1 METHOD OF MEASUREMENT**

- A. No separate measurement will be made for work under this Section.

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01 GENERAL REQUIREMENTS
014320
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PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 014320

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SECTION 014520 - CONTRACTOR QUALITY CONTROL PROGRAM - FAA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Contractor shall establish, provide and maintain an effective Quality Control Program that details the methods and procedures that will be taken to ensure that all materials and completed construction required by this Contract conform to Contract Documents and any other requirements, whether manufactured by the Contractor or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified herein and elsewhere in the Contract Documents, the Contractor shall assume full responsibility for accomplishing the stated purpose.

1.3 LEVEL OF CONTROL

- A. The intent of this Section is to explain the Contractor's need to establish a necessary level of control that will:
 - 1. Adequately provide for the production of acceptable quality materials.
 - 2. Provide sufficient information to ensure both the Contractor and the DEN Project Manager that the Contract requirements are being met.
 - 3. Allow the Contractor as much latitude as possible to develop the Contractor's own standards of control.

1.4 REQUIREMENTS

- A. The Contractor shall be prepared to discuss at the Preconstruction Conference, the Contractor's understanding of the quality control requirements. A written Quality Control Plan shall be submitted to the DEN Project Manager no later than ten (10) days after the Notice to Proceed. The Contractor shall not begin any construction, production or off-site fabrication of materials to be incorporated into the completed work until the Quality Control Plan has been reviewed and approved by the DEN Project Manager. No partial payment will be made for work or materials subject to specific quality control requirements until the Quality Control Plan has been reviewed and approved by the DEN Project Manager.

- B. The quality control requirements contained in this Section and elsewhere in the Contract Documents are in addition to and separate from the acceptance testing requirements. Certain acceptance testing requirements as noted in the specifications are also the responsibility of the Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 QUALITY CONTROL PROGRAM

- A. General Description: The Contractor shall establish a Quality Control Program to perform inspection and testing of all items of Work required by the Contract Documents, including those performed by subcontractors. This Quality Control Program shall ensure conformance to applicable specifications and plans with respect to materials, workmanship, construction, finish, and functional performance. The Quality Control Program shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the Contract Documents in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of quality control.
- B. Quality Control Plan: The following Quality Control Plan shall be submitted within ten (10) days of receiving the Administrative Notice to Proceed (NTP) in a MS Word or MS Excel format that can easily be incorporated into the FAA Construction Management Plan. The Contractor shall describe the Quality Control Program in a written plan. The Quality Control Plan shall provide a general description of minimum quality control monitoring required to be performed for each specification division until Final Acceptance by DEN.
1. The Quality Control Plan shall address and establish controls and documentation to ensure that only items or materials that have been accepted through successful inspection are used or installed. Identification and traceability of construction materials shall be provided throughout all inspections, test activities and records. For stored items, provisions shall be made for the control of the item/material identification, consistent with the expected duration and type of storage.
 2. The Quality Control Plan shall describe the methodology of monitoring, testing and exercising of all equipment, valves and/or assemblies to ensure the Work installed is in proper working order.
 3. In addition, the Quality Control Plan shall be organized to address, as a minimum, the following items:
 - a. Quality control organization and personnel.
 - b. Inspection requirements.
 - c. Quality control testing plan.
 - d. Documentation of quality control activities.

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- e. Requirements for corrective action when quality control and/or acceptance criteria are not met.
 - f. Testing Agencies Certifications, personnel certifications, equipment lists, test forms, report samples and forms, frequency of tests, specification references, and specification standards.
 - g. Acceptance tests required and methods of quality control for each activity included in the Contract Documents.
4. The Contractor is encouraged to add any additional elements to the Quality Control Plan that he/she deems necessary to adequately control all production and/or construction processes required by this Contract.

3.2 QUALITY CONTROL ORGANIZATION

- A. The Contractor's Quality Control Program shall be implemented by the establishment of a separate quality control organization. An organizational chart shall be developed to show all quality control personnel and how these personnel integrate with other management/production and construction functions and personnel.
1. The organizational chart shall identify all quality control staff by name and function and shall indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item or work. If necessary, different technicians can be utilized for specific inspection and testing functions for different items of work. All personnel used for implementation of all or part of the Quality Control Program shall be subject to the qualification requirements of this Section. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.
- B. The quality control organization shall consist of the following minimum personnel:
1. Quality Control Manager:
 - a. The Quality Control Program shall be administrated by a Quality Control Manager. The Quality Control Manager shall be a full-time employee of the Contractor or a consultant engaged by the Contractor. The Quality Control Manager shall have a minimum of five (5) years of experience in airport and/or highway construction and shall have had prior quality control experience on a project of comparable size and scope as this Contract.
 - b. Additional qualifications for the Quality Control Manager shall include the following requirements:
 - 1) A licensed professional engineer with a minimum of five (5) years of airport or highway grading and drainage paving, field and laboratory testing, and quality control experience acceptable to the DEN Project Manager, or,

- 2) A technician certified at Level III or IV by the National Institute for Certification in Engineering Technologies (NICET) for Construction Materials, Highway Materials, Highway Construction or five (5) years of highway and/or airport paving experience in all fields of work included in the scope of work and acceptable to the DEN Project Manager.
 - 3) Submit the following documentation to the DEN Project Manager for review:
 - a) A current resume including the individual's experience and qualifications.
 - b) Copy of current PE registration and/or all applicable certifications.
 - c) Four (4) references for work on projects completed within past five (5) years, including names, current organization, and telephone numbers.
 - c. The Quality Control Manager shall have full authority to institute any and all actions necessary for the successful implementation of the Quality Control Program to ensure compliance with the Contract Documents. The Quality Control Manager shall report directly to a responsible officer of the construction firm. The Quality Control Manager shall be on-site for a minimum of forty (40) hours per week during all production and shall be released from full-time duties only after written permission from the DEN Project Manager.
2. Electrical Quality Control Manager: Depending on the project's scope of work, the Contractor shall provide a dedicated, full-time Electrical Quality Control Manager. The Electrical Quality Control Manager shall have no other responsibilities other than overall electrical quality control. The Electrical Quality Control Manager shall be a master electrician with a minimum of five (5) years electrical airfield construction experience at a commercial carrier airport. The Electrical Quality Control Manager shall be a Certified Senior Technician.
- a. The Quality Control personnel:
 - 1) Shall be familiar with and prove proficiency in all aspects of inspections and testing he/she is supervising.
 - 2) Shall not perform any testing or inspection he/she is not certified to perform.
 - 3) Shall be subject to the approval of DEN Project Manager.
 - 4) Shall not report or be part of the production team on the Project.
3. Quality Control Inspection Technicians: A sufficient number of Quality Control Inspection Technicians necessary to adequately implement the Quality Control Program shall be provided by the Contractor. The Quality Control Inspection Technicians shall have the authority to bring the Work into conformance with Contract requirements including stopping non-conforming work in progress. A document signed by an officer of the Contractor shall convey and acknowledge the Inspector's authority. Inspection personnel shall be engineers, engineering technicians, or experienced craftsman with the following qualifications:

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- a. Engineer-in-training with minimum two (2) years of airport/highway grading experience acceptable to the DEN Project Manager.
 - b. An individual with 3 years of highway and/or airport grading experience acceptable to the DEN Project Manager, with a Bachelor of Science degree in Civil Engineering, Civil Engineering, Technology or Construction.
 - c. The Quality Control personnel:
 - 1) Shall be familiar and prove proficiency in all aspects of inspections and testing he or she is supervising.
 - 2) Shall not perform any inspection he/she is not certified to perform.
 - 3) Shall be subject to the approval of DEN Project Manager.
 - 4) Shall not report or be part of the production team on the Project.
 - d. The Quality Control Inspection Technicians shall report directly to the Quality Control Manager and shall perform the following functions:
 - 1) Inspection of all materials, construction, plant and equipment for conformance to the Technical Specifications, and as required by Article 3.3 below
 - 2) Performance of all quality control tests as required by the Technical Specifications and Article 3.4 of this Section.
- C. If the DEN Project Manager determines that the Quality Control Manager or any of the Quality Control Manager's authorized support personnel are not effectively enforcing or performing the Quality Control requirements specified in the Contract, the DEN Project Manager will, in writing, require the Contractor to remove and replace such personnel from the Project at no cost to the City. No further work will be performed by the Contractor until an acceptable replacement for the replaced personnel is approved by the DEN Project Manager.
- D. Staffing Levels: The Contractor shall provide sufficient qualified quality control personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the Work, separate plant and field testing technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The Quality Control Plan shall state where different technicians will be required for different work elements. Should the DEN Project Manager determine that staffing levels are not sufficient to ensure compliance with the Quality Control Plan and Contract Documents, the Quality Control Manager shall take steps to bring staffing levels to an acceptable level.
- E. Suppliers and Subcontractors: The Quality Control Plan shall include a list of suppliers and subcontractors. The list shall include items to be supplied by each supplier and/or subcontractor and shall identify work to be performed by each subcontractor. The list shall be updated and submitted as required.

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- F. Emergency Contact Information: Provide the name, company, title, work phone number, home phone number, and other means of contact for at least four (4) individuals. The individuals can be associated with production and/or quality control. The Emergency Contact list shall be revised in the event there is any change in any of the information and forwarded to the DEN Project Manager and DEN Maintenance Control (303-342-2800). The Emergency Contact list shall also include the project number, title and date of issue.

3.3 INSPECTION REQUIREMENTS.

- A. The Contractor shall utilize the following six-point inspection plan to ensure the conformance of the Work performed by the Contractor meets the requirements of the Contract Documents, the referenced codes and standards and the approved submittals:
1. Pework coordination: Prior to the start of construction work on the Contract and prior to the start of work under each separate specification section and prior to the start of work where a change in a construction operation is contemplated by the Contractor and prior to a new subcontractor starting work, a coordination meeting will be held with the Contractor's Quality Control Manager, Project Manager, Superintendent, Foreman, Safety representative, Quality Control Inspector(s), MTA representative, and the DEN Project Manager, DEN Inspector(s), and DEN Quality Assurance Laboratory representative. Supervisory, Safety, and Quality Control representatives of all applicable subcontractors will also attend. The Contractor's Quality Control Manager will chair the meeting and shall distribute the proposed meeting agenda 48 hours prior to the meeting. Upon completion of the meeting, minutes including any revisions to the agenda shall be distributed within twenty-four (24) hours.
 2. The purpose of the coordination meeting is to ensure that the Contractor's personnel have no misunderstandings regarding their safety and quality procedures as well as the technical requirements of the Contract. The following items shall be submitted to the DEN Project Manager no less than seventy-two (72) hours prior to the meeting and shall be presented and reviewed by the Contractor at the meeting held no less than forty-eight (48) hours prior to start of work:
 - a. Contract requirements and specifications.
 - b. Shop drawings, certifications, submittals and as-built drawings that apply.
 - c. Testing and inspection program and procedures.
 - d. Contractor's Quality Control Program.
 - e. Familiarity and proficiency of the Contractor's and subcontractor's workforce to perform the operation to required workmanship standards including certifications of installers.
 - f. Safety and environmental precautions to be observed.
 - g. Any other preparatory steps dependent upon the particular operation.
 - h. The Contractor's means and methods for performing the Work.

3. Initial Inspection: Upon completion of a representative sample of a given feature of the Work and no later than two (2) weeks after the start of a new or changed operation, the DEN Project Manager or the DEN Project Manager's designated representative will meet with the Contractor's Quality Control representative and applicable subcontractor's supervisor and their Quality Control representatives to check the following items, as a minimum:
 - a. Workmanship to established quality standards.
 - b. Conformance to Contract Documents and the accepted shop drawings.
 - c. Adequacy of materials and articles utilized.
 - d. Results of inspection and testing methods.
 - e. Adequacy of as-built drawings maintained daily.
 - f. Once accepted, the representative sample will become the physical baseline by which ongoing work is compared for quality and acceptability. To the maximum practical extent, approved representative samples of work elements shall remain visible until all work in the appropriate category is complete. Acceptance of a sample does not waive or alter any Contract requirements or show acceptance of any deviation from the Contract not approved in writing by the DEN Project Manager. The Contractor's Quality Control representative shall chair, prepare and distribute minutes of Quality Control meetings. Meeting minutes shall be distributed within twenty-four (24) hours of the meeting.
4. Follow-up Inspection: The Contractor's Quality Control representative will monitor the Work to review the continuing conformance of the Work to the workmanship standards established during the preparatory and initial inspections.
5. Completion Inspection: Forty-eight (48) hours prior to the completion of an item or segment of work and prior to covering up any work, the Contractor will notify the DEN Project Manager who will verify that the segment of work is substantially complete, all inspections and tests have been completed and the results are acceptable. The purpose of this inspection is to allow further corrective work upon, or integral to, the completed segment of work. **THIS IS NOT AN ACCEPTANCE INSPECTION.** If any items are determined to be deficient, need correction or are non-conforming, a deficiency list will be prepared and issued to the respective Contractor for correction, repair or replacement of any deficient or non-conforming items. The DEN Project Manager and Contractor's Quality Control representative will verify the correction of the deficient and/or non-conforming items prior to the start of the next operation.
6. Pre-Final Acceptance Inspection: Prior to requesting a Pre-final Acceptance Inspection by DEN, all work and operational systems to be inspected shall be satisfactorily completed and tested by the Contractor. The Contractor's written request for this inspection shall be made seventy-two (72) hours in advance. With the request shall come a list of any known deficiencies (punch list) and the time frame in which they will be corrected. If the list is too large or contains too many significant items, in the opinion of the DEN Project Manager, no inspection will be held due to the incompleteness of the Work.

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- a. The DEN Project Manager will schedule the Pre-final Acceptance Inspection and will add to the punch list deficient items discovered during the inspection. If during the inspection the list becomes too large or too many significant items are on the list, the inspection will be canceled. After the inspection is completed, the deficiency list will be transmitted to the Contractor for correction of the deficient items.
7. Final Acceptance Inspection: After the Contractor has completed all items on the deficiency list (generated from the Pre-final Acceptance Inspection) he/she shall request a Final Acceptance Inspection. The request shall be made in writing at least seventy-two (72) hours in advance of the inspection. All areas must be cleaned and ready for turnover prior to this inspection. The DEN Project Manager, the design consultant, a representative of the funding agency, if applicable, and other interested parties will inspect the subject Work to ensure that all deficiencies have been satisfactorily attended to and that no new deficiencies have appeared and that all systems are completely functional. Any outstanding or additional deficient items will be noted and handled per the requirements of the Pre-final Acceptance Inspection noted above until the Work is acceptable to the DEN Project Manager.

3.4 QUALITY CONTROL TESTING PLAN.

- A. As a part of the overall Quality Control Program, the Contractor shall implement a Quality Control Testing Plan as required by the specifications. The testing plan shall include the minimum tests and test frequencies required by each item in the Contract Documents as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes.
- B. The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:
 1. Specification item number (e.g., P-401).
 2. Item description (e.g., Plan Mix Bituminous Pavements).
 3. Test type (e.g., gradation, grade, asphalt content).
 4. Test standard (e.g., ASTM or AASHTO test number, as applicable).
 5. Test frequency (e.g., as required by specifications or minimum frequency when requirements are not stated).
 6. Responsibility (e.g., plant technician).
 7. Control requirements (e.g., target, permissible deviations).
- C. The testing plan shall contain a statistically based procedure of random sampling for acquiring test samples in accordance with ASTM D 3665. The DEN Project Manager shall be provided the opportunity to witness quality control sampling and testing.
- D. All quality control test results shall be documented by the Contractor as required by this Section.

3.5 DOCUMENTATION.

- A. The Contractor shall maintain current quality control records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, results of inspections or tests, nature of defects, deviations, causes for rejection, etc., proposed remedial action, and corrective actions taken.
- B. These records must cover both conforming and defective or deficient features and must include a statement that all supplies and materials incorporated in the Work are in full compliance with the terms of the Contract. Legible copies of these records shall be furnished to the DEN Project Manager daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the Contractor's Program Manager.
- C. Specific Contractor quality control records required for the Contract shall include, but are not necessarily limited to, the following records:
1. Certificates of compliance shall be submitted minimum thirty (30) days prior to the product's incorporation into the Work.
 2. Quality Control Charts for materials shall be established as required by the individual specification sections.
 3. Daily Foreman Report: The Foreman shall report daily construction activities using the Daily Foreman Report form QCP-1 as included in Specification Section 019990 "Standard Forms". The reports shall be completed in their entirety and shall as a minimum include the following:
 - a. Daily activities.
 - b. Quantities of material placed and completed.
 - c. Weather.
 - d. Safety issues.
 - e. Personnel.
 - f. Equipment on site with time used.
 - g. Equipment under repair.
 - h. Work delays.
 - i. Possible delays.
 - j. Materials delivered.
 - k. The reports shall be signed by the responsible foreman and Contractor Superintendent. The DEN Project Manager shall be provided a copy of each daily construction report on the work day following the day of record.
 4. Daily Quality Control Inspection Reports: Each Contractor Quality Control Inspection Technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on forms QCP-2 and QCP-2-2 included in Section 019990 "Standard Forms". The reports shall be completed in their entirety, shall provide factual evidence that continuous quality control inspections have been performed and shall, as a minimum, include the following:
 - a. Technical Specification item number and description.
 - b. Compliance with approved submittals.
 - c. Proper storage of materials and equipment.

CONTRACTOR QUALITY CONTROL PROGRAM - FAA

- d. Adherence to plans and specifications.
 - e. Review of quality control tests.
 - f. Compliance of quality control testing frequencies.
 - g. Identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, remedial or corrective actions taken or proposed.
 - h. The reports shall be signed by the responsible Quality Control Inspection Technician and the Program Manager. The DEN Project Manager shall be provided a copy of each report on the workday following the day of record.
5. Test Reports: The Contractor shall be responsible for establishing a system which will record all quality control test results. Daily test reports shall document the following information:
- a. Technical Specification item number and description.
 - b. Test designation.
 - c. Location.
 - d. Date of test.
 - e. Control requirements.
 - f. Test results.
 - g. Causes for rejection.
 - h. Recommended remedial actions.
 - i. Retests.
 - j. Fresh concrete properties tests and in-place moisture-density tests shall be reported in legible draft form to the DEN Inspector immediately at the test site. Any failing test shall be reported separately to a DEN Inspector or the DEN Project Manager within two (2) hours after the discovery.
 - k. Test results from each day's work period shall be transmitted to the DEN Project Manager on the next work day. These initial daily test reports shall be signed by the responsible Quality Control Technician and the Program Manager.
 - l. Typed final laboratory and field tests shall be provided to the DEN Project Manager as specified in paragraph 3.5.D "Weekly Summary Reports" below.

D. Weekly Summary Reports:

1. Typed final laboratory and field test reports summarizing the activities and results for the quality control tests and inspections for each week shall be prepared by the ITA and submitted to the DEN Project Manager. The weekly summary report shall meet the requirements of Section 014525 "Material Testing Agency" and be submitted within two (2) weeks from the end of the reporting period. At a minimum, the weekly summary report shall identify all test types, test locations, testers, test results, worksheets showing all calculations used, specifications, whether the test passed or failed, quantity of materials placed and the number of tests performed for each material, the material supplier, installer, and Contractor. Retests shall be identified in a fashion that easily correlates to the failing test. Any failed tests that have not been corrected when the report is published shall be highlighted and noted in the cover letter of the report. A current Correction Action Report (CAR) log shall also be included in the weekly summary report.

3.6 CORRECTIVE ACTION REQUIREMENTS

- A. The Quality Control Plan shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process under control. The requirements for corrective action shall include both general requirements for operation of the Quality Control Program as a whole, and for individual items of work contained in the specifications.
- B. The Quality Control Plan shall detail how the results of quality control inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a process is out of control and the type of correction to be taken to regain process control.
- C. When applicable or required by the specifications, the Contractor shall establish and utilize statistical quality control charts for individual quality control tests. The requirements for corrective action shall be linked to the control charts.

3.7 SURVEILLANCE BY THE DEN PROJECT MANAGER

- A. All items of material and equipment shall be subject to surveillance by the DEN Project Manager at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate quality control system in conformance with the requirements detailed herein and the applicable Contract Documents. In addition, all items of materials, equipment and work in place shall be subject to surveillance by the DEN Project Manager at the site for the same purpose.
- B. Surveillance by the DEN Project Manager does not relieve the Contractor of performing quality control inspections of either on-site or off-site Contractor's or subcontractor's work.

3.8 NONCOMPLIANCE

- A. The DEN Project Manager will notify the Contractor of any noncompliance with any of the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered by the DEN Project Manager or the DEN Project Manager's authorized representative to the Contractor or the Contractor's authorized representative at the site of the work, shall be considered sufficient notice.
- B. In cases where quality control activities do not comply with either the Contractor's Quality Control Program or the Contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, as determined by the DEN Project Manager, the DEN Project Manager may:
 - 1. Order the Contractor to replace ineffective or unqualified quality control personnel or subcontractors
 - 2. Order the Contractor to stop operations until appropriate corrective actions are taken.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 014520

SECTION 014525 - MATERIAL TESTING AGENCY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Contractor shall employ the services of a Material Testing Agency; hereafter referred to as the Contractor Testing Agency (CTA). This Section identifies the requirements for the Contractor to employ a Material Testing Agency and identifies the required activities of the Material Testing Agency.
- B. Laboratory and field-testing requirements to be conducted by the CTA for materials and construction methods used on this project are included in the appropriate technical specifications. Where the Specifications reference the CDOT Standard Specifications for Road and Bridge Construction, the references shall also mean CDOT Field Materials Manual for schedule of tests unless otherwise stated. As a minimum, the CTA described in this Section shall perform all applicable tests listed in the manual including the independent assurance sampling and testing. In the event of such a conflict between the schedule and a specification in these technical provisions, the more comprehensive testing shall govern unless otherwise noted.
- C. Inspections and tests conducted by the CTA shall not in any way relieve the Contractor of the Contractor's responsibility and obligation to meet all specifications and referenced standards. Employment of the CTA does not relieve the Contractor of providing the required Quality Control program.
- D. When inspections or tests by the CTA prove that the item or material does not meet all applicable specifications and requirements, the cost incurred for the re-testing or re-inspection shall be borne by the Contractor as per this Section.
- E. Samples will only be considered if taken at random. The Contractor shall permit representatives of the City to witness the selection of samples. Inspection or tests of items or materials that fail shall be sufficient cause to terminate further inspections/tests of the same brand, make or source of that product.
- F. The Contractor is obligated to correct any item deemed deficient at no additional cost to DEN.

1.3 SUBMITTALS

- A. All submittals shall comply with requirements of Sections 013300 "Submittal Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal requirements.

1.4 CONTRACTOR SUBMITTAL OF PROPOSED TESTING AGENCIES

- A. The Contractor shall employ the services of a CTA that has been accredited by AASHTO or CCRL or an approved equal to perform the tests required in the Contract. The CTA may also provide technicians to perform the required inspections. However, inspection and testing cannot be performed simultaneously by the same technician. The Contractor shall receive written acceptance from the DEN Project Manager of the CTA prior to any permanent work being installed or tested.
- B. The Contractor shall not submit for acceptance to the DEN Project Manager any testing agency or laboratory utilized in the design or construction document preparation or presently employed by DEN as part of DEN Quality Assurance, Material Testing, or special inspection agencies.
- C. For consideration of acceptance, the Contractor shall submit to the DEN Project Manager the following items received from the CTA:
1. Affidavit of current accreditation from a national certification and/or accreditation programs.
 2. Evidence that the CTA Laboratory is accredited to perform the testing required in the Contract Documents.
 3. Resumes and evidence of professional engineer registration and licensing in the State of Colorado for the personnel reviewing and signing test reports.
 4. Resumes and current certifications verifying that CTA management and supervisory personnel, laboratory staff, field testing technicians, and inspecting technicians are qualified in accordance with ASTM C 1077, D 3666, D 3740, and E 329 requirements to perform the Work. NICET, ACI, WAQTC, LabCAT, CDOT, NRMCA, PCA, AWS, ASNT certifications or a degree in a related engineering field with construction field experience that can demonstrate qualifications. A list summarizing all management, supervisory, laboratory, field testing, and inspection personnel assigned to the Project including the testing and/or inspection each individual will be performing, certifications held by each individual, and the expiration date of each certification.
 5. A matrix indicating each technical specification section, paragraph, quantity and type of sampling and/or testing required.
 6. Copies of all laboratory, field testing, and inspection report forms.

1.5 SUBMITTAL OF REPORTS

- A. Test results shall be submitted by the Contractor to the DEN Project Manager after completion of inspections/tests by the CTA and prior to incorporation of the items into the Work unless the test or inspection must be done during or after installation.

- B. All field test results including but not limited to fresh concrete properties and in-place moisture-density shall be reported in legible draft form to the DEN Inspector immediately at the test site. Any failing test shall be reported separately to the DEN Inspector or DEN Project Manager. The draft test results shall also be attached to the Daily Quality Control Inspection Report (reference Section 014510 "Contractor Quality Control") and transmitted to the DEN Project Manager the next workday.
- C. Typed test reports shall be provided to the DEN Project Manager as specified in the "Weekly Reports" Article in this Section. The test reports shall be numbered sequentially in chronological order. Individual tests shall be numbered sequentially. The reports and tests shall also be organized per specification section. All test results must be reviewed and signed by a registered licensed engineer in the State of Colorado. The signature represents that the test procedures used are in strict conformance with the applicable testing standard, the calculated data are true and accurate, the tools and equipment used were in calibration, the sample was not contaminated and the persons running the test were qualified.
- D. Reports of inspections and test activities are record documents and shall be maintained in a manner that provides integrity of item identification, acceptability, and traceability. Reports shall identify the following:
1. Contractor's name.
 2. DEN Contract number and title.
 3. Material Testing Agency name.
 4. Name of items inspected/tested including a physical description and, as applicable, model and make.
 5. Quantity of items.
 6. Inspection/test procedure used. If national standards are used, any deviation from these standards.
 7. Date the sample was taken and the date the test was made.
- E. Location (by coordinates, building grid or station number and elevation) of where tests and/or samplings were performed including environmental condition where applicable. Include plan drawing indicating location of test, lot size and location and work item sampled or tested.
1. Name of inspector/tester.
 2. In the event the testing or sampling is a re-test or re-sampling, reference the previous respective testing or sampling report.
 3. Specified requirements in the Contract that the item must meet. Include reference to technical specification section and paragraphs.
 4. Acceptability.
 5. Deviations/nonconformance.
 6. Evaluation of results.
 7. All information required for the specific test as specified in the applicable ASTM standard.
 8. Signature of authorized evaluator.

1.6 WEEKLY SUMMARY REPORTS

- A. The CTA and Quality Control Manager shall prepare and submit to the DEN Project Manager a weekly summary report each week, which summarizes by specification section all work activities and results for the quality control tests and inspections conducted during that period. The weekly summary report shall be submitted within two (2) weeks from the end of the reporting period. At a minimum, the weekly summary report shall identify all inspections, test types, test locations, testers, test results, specifications, whether the test passed or failed, quantity of materials placed and the number of tests performed for each material, and the material supplier, installer and Contractor. Re-tests shall be identified in a fashion that easily correlates to the failing test. Any failed tests that have not been corrected when the report is published shall be highlighted and noted in the cover letter of the report.
- B. The weekly report shall be submitted per Sections 013000 and 013350 requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REMOVAL OF NONCONFORMING MATERIAL

- A. The Contractor is obligated to correct or remove nonconforming materials, whether in place or not. If necessary, the DEN Project Manager will send written notification to the Contractor to correct or remove the defective materials from the project. If the Contractor fails to respond, the DEN Project Manager may order correction, removal, and/or replacement of defective materials by others, in which case the Contractor shall bear all costs incurred by such actions.

3.2 PERFORMANCE

- A. If the DEN Project Manager determines that the CTA or its personnel are not effectively enforcing or performing the testing and documentation requirements specified in the Contract, the DEN Project Manager will require, in writing, the Contractor to remove and replace CTA or such personnel at no cost to DEN.

3.3 CONTROL OF MEASURING AND TEST EQUIPMENT

- A. The CTA shall select measuring and test equipment in such a manner as to provide proper type, range, accuracy, calibration, and tolerance for determining compliance with specified requirements. Measuring and test devices shall be calibrated, adjusted and maintained at prescribed intervals prior to use based upon equipment stability and other conditions affecting measurement. Provisions shall be made for the proper handling and storage of equipment. Calibration shall be accomplished using certified standards that have a known traceable relationship to the National Institute of Standards and Technology. Every calibrated measuring and test device shall show the current status, date of last calibration and the due date for the next calibration. Calibration records shall be maintained onsite as quality records and shall be made available for inspection upon the DEN Project Manager's request.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under the Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.
- B. Refer to Title 17 - Inspection and Defects of the General Contract Conditions, 2011 Edition, for guidance on payment methods.

END OF SECTION 014525

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
014525
MATERIAL TESTING AGENCY

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

SECTION 014545 - SPECIAL INSPECTION AGENCY AND OWNER TESTING AGENCIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Special Inspection Statement issued as part of the application for building permit for the specific task or project.

1.2 SUMMARY

- A. The City will employ the services of Special Inspection Agencies (SIA). This Section identifies the requirements for the Contractor to coordinate, facilitate, and support DEN and its agents and consultants to fulfill the requirements of Special Inspection.
 - 1. Any additional tests deemed necessary by the Building Official, Engineer of Record, Special Inspector or DEN Project Manager to assure these agencies that all material and work on the Project meet the requirements of the Contract and all applicable codes and regulations.
 - 2. Minimum Laboratory and field testing requirements to be conducted by the SIA for materials and construction on this Project are included in the Table at the end of this Section.
 - 3. All caissons and piers drilling on this Project shall be continuously inspected by Special Inspection Agency hired by DEN directly or through the Engineer of Record or its sub-consultants.
 - 4. The Contractor shall not perform any work that could cover work or material that has not passed the requirement of special inspection or require the presence of the special inspector to meet the requirements of continuous or periodic inspection.
 - 5. It is the responsibility of the Contractor to plan, coordinate all testing requirements on the project to assure no delays are occurring due to the lack of inspection or testing.
 - 6. The Contractor must allow sufficient time in the schedule to perform all required inspection and testing.
 - 7. All rework due to nonconformance, failing tests or rework to test covered work prior to proper inspection and testing shall be borne by the Contractor.
 - 8. All re-inspections and re-testing costs due to non-conformances or failing tests or revisiting to test covered or incomplete work shall be borne by the Contractor at a cost of \$100 per hour in addition to all direct and indirect costs associated with testing.
 - 9. Periodic welding inspection shall include the minimum of fitting inspection and final inspection at all times.

10. Inspections and tests conducted by the SIA shall not relieve in any way the Contractor of the Contractor's responsibility and obligation to meet all specifications and referenced standards. Employment of the SIA does not relieve the Contractor of providing the required Quality Control program.
11. When inspections or tests by the SIA prove that the item or material does not meet all applicable specifications and requirements, the cost incurred for the re-testing or re-inspection shall be borne by the Contractor. Reference Article 5.1 of this Section.
12. Samples will only be considered if taken at random. The Contractor shall permit representatives of the City to witness the selection of samples. Inspection or tests of items or materials that fail shall be sufficient cause to terminate further inspections/tests of the same brand, make or source of that product.
13. The Contractor is obligated to correct any item deemed deficient at no additional cost to DEN.

1.3 SUBMITTALS

- A. All submittals shall comply with requirements of Section 013300 "Submittals" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal requirements.

1.4 CONTRACTOR SUBMITTAL OF PROPOSED CONTRACTOR'S TESTING AGENCIES

- A. Projects requiring Special Inspection where the Contractor is utilizing certified shop to produce material. DEN requires that testing be performed to satisfy the certification be no less than the following: All material and workmanship meets the requirements of a Contractor Material Testing Agency.
- B. The Contractor shall employ the services of a Testing Agency for process control and acceptance by the subcontractors and suppliers or material delivery for Contractor convenience or contractual obligations with others.
- C. The Contractor's Testing Agency must be accredited agency to perform any test required to be submitted for compliance with a Contract requirement or for use of data by DEN agencies for any official use, for examples and not to grant any obligation on the DEN Project Management Team, any payment reduction factor calculation. Any dispute or requirement to recalibrate testing equipment or machine, proof of compliance of material that was installed in contrary to manufacturer recommendation, any apparent defect due to adverse weather, improper installation, incomplete material record.
- D. Contractor's testing agency must be a qualified entity that has performed testing on similar jobs in size and complexity and has been accredited by AASHTO or CCRL or an approved equal to perform the tests required in the Contract. The CTA may also provide technicians to perform the required inspections. However, inspection and testing cannot be performed simultaneously by the same technician.

- E. The Contractor shall not submit for acceptance to the DEN Project Manager any testing agency or laboratory utilized in the design or construction document preparation or presently employed by DEN as part of DEN Quality Assurance.
- F. For consideration of acceptance, the Contractor shall submit to the DEN Project Manager the following items received from the CTA:
1. Affidavit of current accreditation from a national certification and/or accreditation program.
 2. Evidence that the CTA Laboratory is accredited to perform the testing required in the Contract Documents.
 3. Resumes and evidence of professional engineer registration and licensing in the State of Colorado for the personnel reviewing and signing test reports.
 4. Resumes and current certifications verifying that SIA management and supervisory personnel, laboratory staff, field testing technicians, and inspecting technicians are qualified in accordance with ASTM C 1077, D 3666, D 3740, and E 329 requirements to perform the Work. NICET, ACI, WAQTC, LabCAT, CDOT, NRMCA, PCA, AWS, ASNT certifications, or a degree in a related engineering field with construction field experience can demonstrate qualifications. A list summarizing all management, supervisory, laboratory, field testing, and inspection personnel assigned to the Project including the testing and/or inspection each individual will be performing, certifications held by each individual, and the expiration date of each certification.
 5. A matrix indicating each technical specification section, paragraph, quantity and type of sampling and/or testing required.
 6. Copies of all laboratory, field testing, and inspection report forms.

1.5 SUBMITTAL OF REPORTS

- A. Test results shall be submitted by the Special Inspector and/or DEN Testing Agency to the DEN Project Manager after completion of inspections/tests by the SIA/OTA and prior to incorporation of the items into the Work unless the test or inspection must be done during or after installation.
- B. All field test results including but not limited to fresh concrete properties and in-place moisture-density shall be reported in legible draft form to the DEN/PMT Inspection and the Contractor Quality Control Manager immediately at the test site. Any failing test shall be reported separately to the DEN/PMT Inspector or DEN Project Manager within two (2) hours after the discovery.
- C. The Contractor's Quality Control Manager or his/her Authorized representative must keep track and official record of all tests passed, failed, or defected. The Contractor shall be fully responsible to show passing tests of all required elements. The lack of any passing test record of any required element does not waive the requirement to of testing or inspection as required by the Contract Documents and the IBC. The Contractor shall bear all costs associated with recovering missing tests including but not limited to the cost of the cost of disassembling, testing or inspecting, reassembling, and any indirect time or cost impacts of a missing required test or inspection.

- D. Typed test reports shall be provided by the testing agency to the DEN Project Manager as specified in Part 1 of this Section Weekly Summary Reports. The test reports shall be numbered sequentially in chronological order. Individual tests shall be numbered sequentially. The reports and tests shall also be organized per specification section. All test results must be reviewed and signed by a registered licensed engineer in the State of Colorado. The signature represents that the test procedures used are in strict conformance with the applicable testing standard, the calculated data are true and accurate, the tools and equipment used were in calibration, the sample was not contaminated and the persons running the test were qualified.
- E. A plan of work and administrative procedure shall be established to assure that all test and inspections frequency required are performed and all defects are tracked and retested and re-inspected to meet all applicable specifications, codes, and standards.
- F. The Contractor shall track all tests performed on the daily reports and shall submit a statement for each phase of the Work showing all elements of Quality have been completed and all defects are addressed or scheduled to be addressed prior to covering the Work.
- G. Reports of inspections and test activities are record documents and shall be maintained in a manner that provides integrity of item identification, acceptability, and traceability. Reports shall identify the following:
1. Contractor's name.
 2. DEN Contract number and title.
 3. Testing Agency name.
 4. Name of items inspected/tested including a physical description and, as applicable, model and make.
 5. Quantity of items.
 6. Inspection/test procedure used. If national standards are used, any deviation from these standards.
 7. Date the sample was taken and the date the test was made.
 8. Location, by coordinates, building grid or station number, of where tests and/or samplings were performed including environmental condition where applicable. Include plan drawing indicating location of test and work item sampled or tested.
 9. Name of inspector/tester.
 10. In the event the testing or sampling is a re-test or re-sampling, reference the previous respective testing or sampling report.
 11. Specified requirements in the Contract that the item must meet. Include reference to technical specification section and paragraphs.
 12. Acceptability.
 13. Deviations/nonconformance.
 14. Corrective action.
 15. Evaluation of results.
 16. All information required for the specific test as specified in the applicable ASTM standard.
 17. Signature of authorized evaluator.

1.6 WEEKLY SUMMARY REPORTS

- A. The SIA/OTA shall prepare and submit to the DEN Project Manager a weekly summary report each week that summarizes by specification section all work activities and results for the quality control tests and inspections conducted during that period.
- B. The weekly summary report shall be submitted within two (2) weeks from the end of the reporting period. At a minimum, the weekly summary report shall identify all inspections, test types, test locations, testers, test results, specifications, whether the test passed or failed, quantity of materials placed and the number of tests performed for each material, and the material supplier, installer and Contractor.
- C. Re-tests shall be identified in a fashion that easily correlates to the failing test. Any failed tests that have not been corrected when the report is published shall be highlighted and noted in the cover letter of the report. The SIA shall identify costs of re-testing or additional site visits required due to scheduling changes by the Contractor. A current Corrective Action Report log (CAR) shall also be included in the weekly summary report.
- D. The weekly report shall be submitted per Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CORRECTION OR REMOVAL OF NONCONFORMING MATERIAL

- A. The Contractor is obligated to correct or remove nonconforming materials, whether in place or not. If necessary, the DEN Project Manager will send written notification to the Contractor to correct or remove the defective materials from the Project. If the Contractor fails to respond, the DEN Project Manager may order correction, removal, and/or replacement of defective materials by others, in which case the Contractor shall bear all costs incurred by such actions.

3.2 PERFORMANCE

- A. If the DEN Project Manager determines that the SIA or its personnel are not effectively enforcing or performing the testing and documentation requirements specified in the Contract, the DEN Project Manager will, state in writing, the requirement for the Contractor to remove and replace SIA or such personnel at no cost to DEN.

3.3 CONTROL OF MEASURING AND TEST EQUIPMENT

- A. The SIA shall select measuring and test equipment in such a manner as to provide proper type, range, accuracy, calibration, and tolerance for determining compliance with specified requirements. Measuring and test devices shall be calibrated, adjusted and maintained at prescribed intervals prior to use based upon equipment stability and other conditions affecting measurement.
- B. Provisions shall be made for the proper handling and storage of equipment. Calibration shall be accomplished using certified standards that have a known traceable relationship to the National Institute of Standards and Technology. Every calibrated measuring and test device shall show the current status, date of last calibration and the due date for the next calibration. Calibration records shall be maintained onsite as quality records and shall be made available for inspection upon the DEN Project Manager's request.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for Work under the Section. DEN Project Management Team staff will track all costs and remark the conditions and track all associated impacts for credits to the City. The contractor record of the same is only valid if signed by the DEN Project Manager or authorized representative.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for Work under this Section.
- B. Refer to Title 17 - Inspection and Defects in the General Contract Conditions, 2011 Edition, for guidance on payment methods.

END OF SECTION 014545

SECTION 015210 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 312319 "Dewatering" for disposal of ground water at Project site.
 - 3. Section 321216 "Asphalt Paving" for construction and maintenance of asphalt pavement for temporary roads and paved areas.
 - 4. Section 321313 "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 DESCRIPTION

- A. The Work specified in this Section consists of furnishing, installing, operating, maintaining, and removing temporary construction barriers, enclosures, and field facilities including the Contractor's construction offices, staging areas, yards, storage areas, electrical power, telephone, water, fire protection, and sanitary service.
- B. Construction Offices, Construction Yards and Storage Areas:
 - 1. The Contractor's offices, construction yards laydown and storage areas shall be located as shown on the Contract Drawings and/or as designated by the DEN Project Manager. All construction offices, staging areas, and material storage areas are to occur within these areas.
 - 2. Any activity that is expected to result in disturbance of the ground surface equal to or greater than one acre or part of a larger project that is expected to disturb equal to or greater than one acre, is required to be identified in their Erosion Control permit. These areas include, but are not limited to, laydowns, borrow areas, stockpiles, and storage areas regardless of the location.
 - 3. All areas of ground disturbance are required to be stabilized in accordance with State, local, and airport rules and regulations prior to permit termination and/or closure of the Contract.

4. The Contractor shall restore any area on DEN property that becomes contaminated as a result of its operations in accordance with Airport Rule and Regulation 180. Restoration shall be either to applicable standards under Federal and State law or to such other levels as may be required by the Manager of Aviation, at the Manager's sole discretion.
5. All temporary facility sites must be inspected prior to Contract closeout.
 - a. The DEN Project Manager or authorized representative shall conduct an inspection of contractor areas used during the life of the project. These areas include but are not limited to, staging areas, laydown areas, borrow areas, and contractor yards and offices.
6. The DEN Project Manager will ensure these areas have been properly stabilized in accordance with DEN Rules and Regulations and required permits. Site must be restored to the condition in which the City initially provided to the Contractor. A representative from DEN Environmental Services shall be present during the final walk through.
7. Contractor materials shall be managed in accordance with all applicable Environmental Regulations.
8. Temporary facilities which the Contractor desires to locate in secondary laydown and staging areas adjacent to the Work or within the project limits are subject to approval by the DEN Project Manager. If approved, these areas must also be included as part of their erosion control permit.
9. Access to and security of the Contractor's construction offices, yard, temporary facilities, and storage areas shall be as shown on the Contract Drawings or as specified in the Contract Special Conditions.
10. Contractor Field Office:
 - a. The Contractor shall acquire all necessary permits for installation and construction work related to the Contractor's field office and fencing.
 - b. The Contractor shall provide, as part of the Contractor's on-site field office, a conference room for weekly meetings. Minimum size to accommodate fifteen (15) people with the currently approved schedule posted on a wall. The conference room shall have [network connection with a monitor] and one (1) available telephone.
 - c. Jack the mobile office unit off its wheels and provide support. Enclose the underside of the trailer with weatherproof skirting.
 - d. Install tie downs in compliance with all applicable codes.
 - e. Provide access to the field office and easily accessible space for parking six (6) full size passenger automobiles as a minimum. Grade the field office site, access roadway, and parking area for drainage, and surface with gravel paving or crushed stone.
 - f. Water and sewer lines to the field office, if installed, shall be installed so they will not freeze.
11. All Contractor Storage Yards must be fenced. Submit fencing plan and typical details to DEN Project Manager at least seven (7) days before planned execution for review and acceptance.
12. In accordance with Denver Fire Department Requirements, all Temporary Facilities shall have signage that lists the following information:

- a. Company Name
- b. Contact Telephone Number
- c. Facility Address

C. Electrical Service

1. Provide lighting and power for field offices, storage facilities and other construction facilities and areas.
2. Provide power centers for electrically operated and controlled construction facilities including tools, equipment, testing equipment, interior construction lighting, heating, cooling and ventilation equipment.
3. Provide night security lighting at secured areas within construction limits at offices, storage facilities, temporary facilities and excavated areas.
4. Provide battery operated or equivalent emergency lighting facilities at construction areas where normal light failures would cause employees to be subjected to hazardous conditions. Test such facilities monthly and maintain a record of these tests for the DEN Project Manager's review.
5. Contractor shall bear all costs of temporary electric service permits, fees, and deposits required by the governing authorities, and connection charges and temporary easements including installation, maintenance, and removal of equipment.

D. Telephone/Communications Service:

1. The Contractor shall furnish, install, and maintain at least two (2) telephones in the Contractor's main field office. These phones shall be manned at all times by the Contractor's personnel or by an answering machine when personnel are not in the field office.
2. Comply with requirements of Division 26 Sections.

E. Water Service:

1. The Contractor shall make all connections and extensions required and shall make use of water in direct support of the Work. The Contractor shall install an approved Water Department tap at the City's water source prior to obtaining any water. The Contractor shall arrange and pay for its supply/distribution system from the City's point of connection. The location and alignment of the Contractor's temporary supply/distribution system must be approved by the DEN Project Manager prior to its installation. The Contractor shall leave in place all above ground and underground water distribution facilities unless otherwise directed by the DEN Project Manager.
2. The Contractor shall not use in place fire hydrants or standpipes as sources for construction water or potable water.
3. Comply with requirements of Division 22 Sections.

F. Fire Protection:

1. Furnish, install, and maintain temporary portable fire protection equipment throughout the construction period at all buildings (including the project site), maintenance shops, and fuel storage on all large construction equipment and at the location of any flammable materials or construction materials.

2. Comply with requirements of Division 21 Sections.

G. Sanitary Service:

1. Furnish, install, and maintain temporary sanitary facilities and services throughout the construction period.
2. Ensure that separate or single user toilets shall be provided to ensure privacy between the sexes.
3. Provide general washing facilities adequate for the number of employees.
4. Provide special washing facilities adequate for the number of employees engaged in the application of paints, coating, and other volatile or hazardous materials.

1.4 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. Submit a shop drawing within five (5) days of the Notice to Proceed that shows the following:
 1. Temporary facilities equipment and materials (include manufacturer's literature).
 2. Details and layout of temporary installations including fences, roads, parking, buildings, storage areas, signage, and drainage plans.
 3. Lighting plan showing temporary lighting facilities, electrical service panel location, electrical circuit diagram, and anticipated light level on the working roadway, pathway, or construction surface.
 4. As-built description of any temporary underground utilities referenced to the Airport grid and benchmark system within five (5) days of completion of the installation.
 5. Copies of all permits for all temporary facilities.

1.5 QUALITY CONTROL

- A. Provide products for, and the execution of, the Work of this Section that will satisfy the requirements of all applicable codes. Provide products that satisfy the requirements of the applicable codes.

PART 2 - PRODUCTS

2.1 ELECTRICAL SERVICE

- A. Provide temporary power and lighting equipment consisting of fixtures, transformers, panel boards, groundings, lamps, switches, poles, conduits and wiring sized and capable of continuous service and having adequate capacity to ensure a complete operating system. Comply with NEMA and Division 26 requirements.

2.2 TELEPHONE/COMMUNICATIONS SERVICE

- A. Provide equipment that is compatible with that of the current DEN service provider and the telephone exchange to which the Contractor connects.

2.3 POTABLE WATER SERVICE

- A. Provide sanitary materials and equipment that satisfies the requirements of codes and regulations pertaining to temporary water systems. Bottled products may be used if those products comply with codes. Clearly label portable containers having a dispensing tap and used only for drinking water. Provide single service disposable cups and a sanitary container for dispensing cups. A trash receptacle shall be provided and maintained beside each portable water supply.
- B. If paints, coatings and other volatile or hazardous materials injurious to humans will be applied as part of the Contract, provide washing facilities with warm water of approximately 120 degrees F.

2.4 FIRE PROTECTION

- A. Fire extinguishers shall be UL rated and shall comply with the International Fire Code with City of Denver amendments.

2.5 SANITARY SERVICE

- A. Provide materials and equipment adequate for the intended purposes, which will neither create unsanitary conditions nor violate the codes applicable to temporary sanitary facilities. Enclosures for toilet and washing facilities shall be weatherproof, sight proof, ventilated and sturdy, and shall be maintained in clean conditions.
- B. Provide portable type toilet facilities that satisfy the requirements of OSHA.
- C. Provide washing facilities as needed. Furnish soap, single-service paper towels, towel dispenser, and towel receptacle.

PART 3 - EXECUTION

3.1 ELECTRICAL SERVICE

- A. The approximate location of primary power lines is shown on the Construction Drawings. The Contractor shall locate electrical service where it will not interfere with equipment, storage spaces, traffic, and prosecution of the Work or the work of others. Installation shall present a neat and orderly appearance and shall be structurally sound. Maintain service in a manner that will ensure continuous electrical service and safe working conditions.
- B. Comply with requirements of Division 26 Sections.

3.2 TELEPHONE/COMMUNICATION SERVICE

- A. Install temporary telephone service in a neat and orderly manner, and make structurally and electrically sound to ensure continuous service. Modify, relocate, and extend, as work progress requires. Place conduit and cable where those products will not interfere with traffic, work areas, materials, handling equipment, storage areas, and the work of other contractors. Service lines may be aerial.

3.3 WATER SERVICE

- A. Install the systems in a neat and orderly manner. Make them structurally and mechanically sound. Provide continuous service. Modify, relocate, and extend the systems as the Work progresses.
- B. Comply with requirements of Division 22 Sections.
- C. Locate systems where they will be convenient to work stations, sanitary facilities, and first aid station but will not interfere with traffic, work areas, materials handling equipment, storage areas, or the work of other contractors.
- D. Provide sanitary bubbler drinking fountains if potable water service is available. Disinfect water piping before using for the potable water service.
- E. Install vacuum breakers, backflow preventers, and similar devices in a manner and location that will prevent temporary water from returning to the water mains.
- F. Do not incorporate any part of temporary water distribution system into the permanent water distribution system.

3.4 FIRE PROTECTION

- A. Install products in conformance with the requirements of the applicable Denver Fire Department and OSHA regulations.
 - 1. Provide functional, approved fire extinguishers that are clearly identified for fire and an accessible supply of water during the period of construction. These fire extinguishers shall remain in place until permanent fire protection systems are functional.
- B. Instruct construction personnel as to location and use of temporary fire protection equipment.
- C. Comply with requirements of Division 21 Sections.

3.5 SANITARY SERVICE

- A. Place temporary sanitary and washing facilities in a neat and orderly manner within the limits of the Work and convenient to the workstations. Make these facilities structurally and mechanically sound. Modify, relocate, and extend the facilities as required by progress of the Work.
- B. Service toilets at those time intervals that will minimize the accumulation of wastes and prevent creation of unsanitary conditions, but not less than once a week.
- C. The waste from the sanitary and wash facilities shall be disposed of in accordance with all applicable rules, regulations, and laws and with the least environmental impact.

3.6 FENCING

- A. Contact all utility service companies prior to planning fence location and post locations for certification of current utilities. Locate pothole posts planned within five (5) feet of known utilities.

3.7 SIGNAGE

- A. Contractor shall not provide any signage for temporary facilities without prior approval from the DEN Project Manager.

3.8 REMOVAL

- A. The Contractor shall locate all temporary facilities including the underground utilities so they can be completely removed without damaging permanent work or the work site of other contractors.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section.

END OF SECTION 015210

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
015210
TEMPORARY FACILITIES

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

SECTION 015525 - TRAFFIC CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section consists of furnishing plans and designs for traffic control and haul routes, implementing these plans with all necessary personnel and equipment. Installation may require but not be limited to signage, cones, flaggers, signal lights, lighting and temporary roads.
- B. All Work must be in conformance with the "Manual of Uniform Traffic Control Devices for Streets and Highways" (MUTCD) and CDOT Standard Plans regarding traffic control.
- C. The Contractor must coordinate the Contractor's proposed traffic control needs with the needs of other contractors on the airport construction site in writing through the DEN Project Manager.
- D. Refer to Article 805 – Protection of Street and Road System in the General Contract Conditions, 2011 Edition.

1.3 QUALITY CONTROL

- A. Temporary signal work shall conform to CDOT Standard Plans and the current version of the CDOT Standard Specifications.
- B. Designate a qualified person to inspect and test traffic control devices daily and to ascertain that those devices are continuously operating, serviceable, in place, and clean.
- C. Provide certified personnel who will be responsible for design, implementation, and inspection of traffic control needs.

1.4 SUBMITTALS

- A. Refer to Technical Specifications Sections 013300 "Submittals" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.

- B. Submit a Traffic Control Plan (TCP) that includes, at a minimum, the following list of items for approval before starting Work. Submit an updated TCP when necessary to modify traffic operation or undertake a construction activity that creates a different traffic pattern:
1. Traffic blockade and reductions anticipated to be caused by construction operations.
 2. Temporary detours.
 3. A Method of Handling Traffic (MHT) must be submitted and approved by the DEN Project Manager, which at a minimum will show and describe proposed location, dates, hours, and duration of detours, vehicular traffic routing, and management, traffic control devices for implementing detours and details of barricades.
- C. Submit Haul Route Plan for both on- and off-site hauls. The Haul Route Plan shall be submitted 30 days prior to hauling any permanent material. The Plan shall be updated as the Contractor's plans change.
- D. Specific Traffic Considerations: The DEN Project Manager may require the Contractor to revise the Traffic Control Plan to address traffic considerations not included in the Contractor's plan.
- E. Shutdown requests for any impact to traffic must be submitted for approval a minimum of five days before the intended shutdown. These requests will be made through the DEN Project Manager.

PART 2 - PRODUCTS

2.1 TRAFFIC CONTROL DEVICES

- A. Devices including signs, delineators, striping, barriers, barricades, and high-level warning devices shall conform to the latest revision of the MUTCD and the latest revision of the Colorado Department of Transportation Standard Plans.

PART 3 - EXECUTION

3.1 TEMPORARY TRAFFIC CONTROL DEVICES

- A. Place temporary control devices in a manner that allows for the smooth flow of traffic at the posted speed limit, limiting hazards or abrupt changes in direction.
- B. Place traffic cones or delineators as directed by the MUTCD. Operate warning lights between sunset and sunrise.
- C. Place control devices so that approaching traffic is alerted to hazards and variances to normal traffic patterns.
- D. Clean and repair damaged devices or replace them with new devices as required.

3.2 TEMPORARY TRAFFIC STRIPING AND PAVEMENT MARKINGS

- A. Full-compliance striping is required at all times per the MUTCD.
- B. Temporary signs must be replaced with permanent signing within three days per the MUTCD.

3.3 FLAGGERS

- A. Furnish flaggers where required for safety and by the MHT.

3.4 CONSTRUCTION VEHICULAR TRAFFIC

- A. Restrict construction vehicles to approved haul routes.
- B. Haul routes on the airfield must be approved by Security.

3.5 CONTROLLING VEHICULAR AND PEDESTRIAN FLOW ADJACENT TO WORK SITE

- A. Ensure that construction operations will not impede normal traffic. Where work is in the area of pedestrian or occupant activity, the Contractor shall detail a plan for managing pedestrian traffic safely. Refer to Title 8 - Protection of Persons and Property, Section 801.1 in the General Contract Conditions, 2011 Edition.

3.6 SIGNS

- A. Refer to Title 8, Article 802 - Protective Devices and Safety Precautions in the General Contract Conditions, 2011 Edition.
 - 1. The Contractor must contact the DEN Project Manager a minimum of five (5) working days in advance of construction for installation, relocation, or removal of regulatory parking signs.
- B. Coordinate and pay any expense associated with the furnishing and installation of all parking regulatory signs, such as "No Stopping Any Time," etc., at the work site.
- C. Furnish and install any necessary advance detour or guidance signing.
- D. Authorize, modify, and install regulatory parking controls and vehicle turn restrictions.
- E. Implement those traffic control modifications outside of the traffic control zone that are necessary to manage diverted traffic.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. Measurement for Flagger shall be made per hour. This shall include all associated costs with providing the flaggers. The quantity to be measured for flagging will be the total number of actual flagging hours that are used in place and actively flagging. Payment will not be made for time spent by flaggers to set up and take down construction traffic control devices or for 'break flaggers' not actively flagging and shall instead be incidental to this work item
- B. Measurement for Gate Guard shall be made per hour. This shall include all associated costs with providing the Gate Guards.
- C. Measurement for Gate Guard Shack shall include the installation, maintenance, and removal of the guard shack at Gate(s) shown on the Contract Drawings including all required incidental items described in the Contract Drawings.
- D. Measurement for Traffic Control shall be per lump sum. This item shall include installation, maintenance, re-positioning (as required by phase or the DEN Project Manager) and removal upon completion; of the low profile barricades (with lights), tubular barricades, temporary haul routes and temporary signage, temporary pavement markings, gates, and any other item associated with providing traffic control for the project.

PART 5 - PAYMENT

5.1 PAYMENT

- A. Payment for Flagger will be made at the contract unit price per hour.
- B. Payment for Gate Guard will be made at the contract unit price per hour.
- C. Payment for Gate Guard shack will be made at the contract unit price per lump sum. This price will include the installation, maintenance, and removal of the guard shack at Gate G7 including all required incidental items described in the Contract Drawings.
- D. Payment for Traffic Control shall be per lump sum. This item shall include installation, maintenance, re-positioning (as required by phase or the DEN Project Manager) and removal upon completion; of the low profile barricades (with lights), tubular barricades, temporary haul routes and temporary signage, temporary pavement markings, gates, and any other item associated with providing traffic control for the project.

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01 GENERAL REQUIREMENTS
015525
TRAFFIC CONTROL

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Payment Shall Be Made Under:

015525a	Flagger	Per Hour
015525b	Gate Guard	Per Hour
015525c	Gate Guard Shack	Per Lump Sum
015525d	Traffic Control	Per Lump Sum

END OF SECTION 015525

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
015525
TRAFFIC CONTROL

DENVER INTERNATIONAL AIRPORT
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SECTION 015719**TEMPORARY ENVIRONMENTAL CONTROLS****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Specifications Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Title 8 - Protection of Persons and Property in the General Contract Conditions, 2011 Edition, specifically the following articles:
 - 1. Article 806 - Protection of Drainage Ways
 - 2. Article 807 - Protection of Environment
 - 3. Article 808 - Hazardous and Explosive Materials or Substances
 - 4. Article 809 - Archaeological and Historical Discoveries
- C. Denver Municipal Airport System Rules and Regulations, Part 180-Environmental Management.
- D. DEN Environmental Management System (EMS)

1.02 SUMMARY

- A. The Work specified in this Section consists of identifying, and avoiding or mitigating adverse environmental impacts to air, water, soil, and other natural resources caused by construction activities.
 - 1. The Contractor, in conducting any activity on airport property or in conducting work for an airport project not on airport property, shall comply with all applicable airport, local, state, and federal rules, regulations, statutes, laws, and orders.
 - 2. Work shall not commence on any project until all FAA approvals have been received, applicable permits have been issued and signed by permittee, and all inspection requirements have been satisfied in accordance with State and local permitting requirements.

1.03 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. Within ten (10) days after Notice to Proceed on a task order, the Contractor shall submit the following if applicable, unless waived by the DEN Project Manager:
 - 1. Submittals pertaining to water quality management:
 - a. Construction Activities Stormwater Discharge Permit
 - 1) City and County of Denver
 - a) Sewer Use & Drainage Permit (SUDP)
 - b) Construction Activities Stormwater Discharge Permit (CASDP)
 - 2) Colorado Department of Public Health and Environment (CDPHE) Colorado Discharge Permit System (CDPS) Authorization to Discharge (Contractor need not submit a copy of the general permit or the general permit rationale)
 - a) CDPS General Permit for Stormwater Discharges Associated with

TECHNICAL SPECIFICATIONS
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- Construction Activities
- b) CDPS General Permit for Associated with Non-Extractive Industrial Activity
 - c) CDPS General Permit for Construction Dewatering Discharges (Prior to obtaining a CDPS General Permit for Construction Dewatering Discharges permit, the Contractor shall submit a draft permit application and the final permit application for DEN review and approval PRIOR to submittal to CDPHE. The Contractor need not submit a copy of the general permit or the general permit rationale.
- 3) Upon request the contractor shall provide the following documentation
 - a) Stormwater Management Plan (SWMP)
 - b) CASDP Inactivation Request
 - c) CDPS Notice of Termination
 - d) Permit Transfer Application
 - e) Modification Application
 - f) Discharge Monitoring Reports (DMRs)
 - g) A copy of the well permit from the state Division of Water Resources for every new well that diverts or for the monitoring of groundwater. (A draft copy of the Notice of Intent for any borehole structure filed with the state Division of Water Resources).
 - h) Section 404 related permitting (Prior to obtaining a permit issued by the US Army Corps of Engineers, the contractor shall submit a draft copy of the application and coordinate with efforts DEN Environmental Services).
 - 4) Revisions or amendments to the CASMP by the Contractor: At the completion of the Project, after final stabilization has been achieved and accepted in accordance with CASDP requirements, the Contractor shall submit a copy of the CASDP Inactivation Request.
2. Submittals pertaining to sewage holding tanks associated with buildings and trailers: For purposes of this Section, the generic term “sewage holding tank” means “onsite wastewater treatment system (OWTS),” “individual sewage disposal system (ISDS),” “privy vault”, “septic tank”, or “septic system”:
 - a. Draft copy of the permit application for a sewage holding tank.
 - b. Copy of the Sewer Use & Drainage Permit issued by the Denver Department of Public Works.
 - c. Copy of the OWTS permit issued by the Denver Department of Environmental Health.
 3. Submittals pertaining to air quality management:
 - a. Copy of any permit issued by the CDPHE Air Pollution Control Division (APCD)
 4. Submittals pertaining to storage tanks and containers:
 - a. Copy of the approved application issued by the State of Colorado, Department of Labor and Employment, Division of Oil and Public Safety, for installation of petroleum, or other regulated substances, storage tanks located on airport property and used for the Project.
 - b. Copy of permits issued by the Denver Fire Department for storage tank installations, storage tank removals, and hazardous materials use/storage.
 - c. Copy of Spill Prevention, Control, and Countermeasure (SPCC) Plan for petroleum storage tanks and containers with capacity of 55 gallons of oil or greater located on airport property and used for the Project.
 5. Copies of any other plans, permits, permit applications, correspondence with regulatory agencies, including violations, waste manifests, results of laboratory analyses, or other environmental documentation required for the Project not previously identified herein.

1.04 RELATED DOCUMENTS

- A. Code of Federal Regulations (CFR) Publications, including, but not limited to, the following:
 - 1. 33 CFR 323 - Permits for discharges of dredged or fill materials into waters of the United States.
 - 2. 40 CFR - Protection of Environment.
 - 3. 49 CFR 171-180 Hazardous Materials Transportation Regulations.
- B. Colorado Revised Statutes, including, but not limited to, the following:
 - 1. Water Quality Control, Title 25, Article 8.
 - 2. Air Quality Control, Title 25, Article 7.
 - 3. Hazardous Waste, Title 25, Article 15.
 - 4. Noise Abatement, Title 25, Article 12.
 - 5. Petroleum Storage Tanks, Title 8, Article 20.5.
 - 6. Liquefied Petroleum Gas (LPG) Storage Tanks, Title 8, Article 20, Part 4.
 - 7. Solid waste regulations.
- C. City and County of Denver Executive Orders, including, but not limited to, the following:
 - 1. Executive Order No. 115 - Required Use of Denver-Arapahoe Disposal Site (Landfill).
 - 2. Executive Order No. 123 - Office of Sustainability and Citywide Sustainability Policy.
 - 3. Denver Revised Municipal Code, Title II, Sections 48-44 and 48-93 - Solid Waste.
 - 4. Denver Revised Municipal Code, Title II, Section 4-43 – Idling Restriction.
- D. City and County of Denver Construction Activities Stormwater Manual.
- E. Any other applicable rules, regulations, ordinances, and guidance must be followed as applicable.
- F. Refer to Section 013300 "Submittal Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- G. Refer to Section 017419 "Construction Waste Management" for waste management requirements

PART 2 - PRODUCTS**2.01 PRODUCTS**

- A. Products required for the Work shall meet all Environmental Requirements.
- B. At a minimum, products for erosion and sediment control must conform to the technical requirements contained in the City and County of Denver "Construction Activities Stormwater Manual" and the current version of the "Mile High Flood District's Urban Storm Drainage Criteria Manual, Volume 3: Best Management Practices".

PART 3 - EXECUTION**3.01 AIR POLLUTION CONTROLS**

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- A. The Contractor shall use appropriate control measures to comply with applicable air quality permit requirements. Additionally, the Contractor must be aware of the following procedures and techniques while conducting construction activities on DEN property. NOTE: Application of dust control measures should be discussed and outlined in the Dust Control Plan.
1. Apply water as needed to the construction site haul roads, disturbed surface areas and public access roads as needed to suppress dust. The use of chemical stabilizer can be requested by the Contractor. The type of stabilizer to be used and locations of use must be included in the Dust Control Plan, which must be approved by the DEN Project Manager prior to application.
 2. The Contractor shall suspend all earthmoving activities if wind speed exceeds 30 mph. For purposes of this Section, the generic term “earthmoving” means clearing, grubbing, excavation, topsoil removal, backfilling, embankment work, grading, trenching, drilling, and installation of borings. Contractors are expected to check wind speeds with the airport’s ramp tower to demonstrate compliance with this requirement. In addition, the Project may be shut down if two of three of the Runway Visual Range (RVR) instruments read visibility of 2,400 feet or less. The instruments are used by FAA Control Tower personnel to ensure safe aircraft operations. Costs for shutdowns due to wind velocities or RVR readings shall not be grounds for delay or extra cost claims.
- B. Burning of materials is strictly prohibited on DEN property.

3.02 WATER POLLUTION CONTROLS

- A. The Contractor shall conduct construction activities in accordance with all applicable permit requirements. In addition, the Contractor shall comply with the following procedures and requirements while conducting activities on DEN property:
1. Water encountered during construction cannot be discharged to the stormwater system or placed onto the ground surface without a permit AND prior written approval by the DEN Project Manager. If groundwater or stormwater is anticipated to be encountered and the Contractor desires to discharge it to the stormwater system or onto the ground surface, then the Contractor must obtain an appropriate CDPS discharge permit in advance of the discharge unless this activity is specifically authorized under the CDPS Construction Stormwater Permit.
 2. If water is encountered and the Contractor desires to discharge these waters to the sanitary sewer system, then the Contractor must obtain approval from DEN Environmental Services in advance of the discharge.
 3. The Contractor shall ensure that stormwater that comes in contact with storage areas does not become impacted and discharged to the stormwater sewer system or to an impervious surface. Furthermore, any materials in storage areas shall not be stored directly on the ground.
 4. The Contractor shall not operate any valves, sluice gates or other drainage appurtenances related to any DEN sewer system without the prior approval of both the DEN Project Manager and DEN Environmental Services. Any violation of this directive may result in the payment of a financial penalty by the Contractor if the State of Colorado assesses such a penalty.

3.03 EROSION CONTROL AND SEDIMENTATION CONTROL

- A. This Work consists of constructing, installing, maintaining and removing, if required, temporary and permanent control measures during the life of the Contract (and possibly afterward) until the Contractor achieves final stabilization of the site to prevent or minimize erosion, sedimentation, and pollution of any state waters in accordance with all

Environmental Requirements.

- B. The Contractor is responsible for compliance with all requirements in accordance with the CASDP, the City and County of Denver Construction Activities Stormwater Manual, the approved CASMP, and CDPS-issued permits.
- C. Temporary facilities, including but not limited to storage areas, laydowns, borrow areas, and contractor offices and work yards, shall be managed in accordance with Section 015210 "Temporary Facilities".
- D. Clean soil fill may be stockpiled in any area that has been previously approved and signed off by the DEN Section Manager of Construction, Design and Planning, and Environmental Services. Soil stockpiles are considered a potential pollutant source and must be addressed in the CASMP and/or SWMP.
- E. Make immediately available, upon the DEN Project Managers request, all labor, material, and equipment judged appropriate by the DEN Project Manager to maintain suitable erosion and sediment control features. These actions requested by the DEN Project Manager take precedence over all other aspects of project construction that have need of the same labor, material and equipment, except those aspects required to prevent loss of life or severe property damage.

3.04 CONSTRUCTION OF CONTROL MEASURES FOR EROSION AND SEDIMENTATION

- A. The Contractor must install control measures in accordance with the most recent version of the "Mile High Flood District's Urban Storm Drainage Criteria Manual, Volume 3: Best Management Practices and the City and County of Denver Construction Activities Stormwater Manual".
 - 1. Deviations from these two documents are allowed with written consent from the City and County of Denver CASDP Inspector.

3.05 STORAGE OF OIL, FUELS, OR HAZARDOUS SUBSTANCES

- A. The Contractor shall prevent oil or other hazardous substances, as defined in federal and state regulations, from entering the ground, drainage or local bodies of water, and shall provide containment, diversionary structures, or equipment to prevent discharged oil from reaching a watercourse and take immediate action to contain and clean up any spill of oily substances, petroleum products, or hazardous substances. The Contractor shall provide one or more of the following preventive systems at each petroleum storage site:
 - 1. Dikes, berms, or retaining walls capable of containing at least 100% of the volume of the largest single tank and equipped with sufficient freeboard to contain precipitation events. The secondary containment must be "sufficiently impermeable" to prevent a release to the environment.
 - 2. Culverting, curbing, guttering, or other similar structures capable of containing at least 100% of the volume of the largest single tank and freeboarding from precipitation.
- B. The provision of such preventive systems shall be subject to acceptance by the DEN Project Manager prior to tank installation and shall follow the SPCC regulations (40 CFR Part 112).
- C. Prior to bringing any containers of 55-gallon or above capacity onto DEN property for storage of oil, fuel, or other petroleum substances, the Contractor may be required to prepare an SPCC Plan that conforms to 40 CFR Part 112. The plan must include a certification either from a Professional Engineer or self-certification, if applicable, as well as management approval from the legally responsible Contractor representative.

3.06 SPILL RESPONSE AND NOTIFICATION

- A. The Contractor is responsible for all spills that may result from its activities. For ANY suspected or confirmed release or spill of oil, fuel, solid waste, hazardous waste, unknown materials, lavatory waste, or miscellaneous chemicals, etc., that occurs as the result of the Contractor's activities on DEN property, the Contractor is required to take immediate action to mitigate the release or spill and report it to the DEN Project Manager and to the DEN Communications Center at (303) 342-4200.
- B. The Contractor is responsible for notifying the appropriate regulatory agency in the event suspected and/or confirmed releases are identified, in accordance with regulatory requirements.

3.07 SITE REMEDIATION AND RESTORATION

- A. The Contractor shall be required to perform any necessary site assessment and remediation activities required by applicable regulatory agency.
- B. During routine construction activities, the Contractor is required to manage soils using typical construction techniques. The Contractor must differentiate between soils and wastes, including contaminated soils versus clean soils, and determine those materials that can remain on DEN property and those that must be transported off site for disposal.
- C. During all construction activities that require the management of soils, the Contractor must notify the DEN Project Manager and DEN Environmental Services (ES) that soils being managed may be impacted by industrial activities conducted at the airport. "Process knowledge" pertaining to previous use and/or impact for the locations under construction can be used to determine whether impacted soils are probable. Also, common indices such as soil staining and odor can be used as a determination for the probable condition. If probable contamination conditions are suspected, the Contractor will notify the DEN Project Manager and DEN ES immediately. At that time, which may be before the Work is initiated where indicative conditions exist, all work will cease until a sampling and analysis approach is determined and implemented by the proper responder.
- D. If the site conditions warrant based on evidence of spillage or contamination, process knowledge, and/or visual or olfactory observations, the Contractor may be required to conduct sampling and analysis to confirm that no remedial action is required. Prior to conducting any removal activities, the Contractor must provide a Scope of Work to the DEN Project Manager describing the proposed site assessment activities.
- E. The impacted project will modify its operation to include a segregation area where probable impacted soils can be placed, stored, and sampled for characterization. Should the soil materials be determined to exceed the applicable standards, the DEN Project Manager, in conjunction with DEN ES, will be responsible for the proper disposal of these materials. Materials that are determined to contain contamination levels below the applicable standards can be considered clean soils and placed back into the excavation or reused elsewhere on DEN property. In accordance with Part 3 of this Section, materials removed that are suitable for recycling will be placed within areas designated on DEN to store these materials.
- F. The Contractor shall restore any area on the Airport that becomes contaminated as a result of its operations. Restoration shall be either to applicable standards under federal and state law or to such other levels as may be required by the Manager of Aviation, at the Manager's sole discretion. Such restoration shall be completed at the earliest possible time, and the Contractor's restoration shall be subject to inspection and approval by the Manager of Aviation or duly authorized representative. See DEN Rules & Regulations - Part 180.

PART 4 - MEASUREMENT

4.01 METHOD OF MEASUREMENT

- A. Measurement for Temporary Erosion Control shall be considered lump sum. There shall be no separate measurement for work associated with any temporary erosion control measures implemented during the life of the contract required to satisfy all local, State, and Federal stormwater permitting. The contractor shall prepare and submit a Schedule of Values to the DEN Project Manager for his/her approval prior to initial installation of any control measures.

PART 5 - PAYMENT

5.01 METHOD OF PAYMENT

- A. Payment for Erosion Control – Temporary Erosion Control will be made at the contract unit price per lump sum for work completed and accepted in place as described in the Schedule of Values. This price will be full compensation for furnishing all materials, all labor, equipment, tools, and incidentals necessary to complete this item, including the removal and disposal of such items in accordance with the contract documents and specifications
- B. The Contractor shall be responsible for payment of all fees associated with review of environmental permit applications and processing of environmental permits.

Payment Shall Be Made Under:

015719a	Temporary Erosion Control	Per Lump Sum
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TECHNICAL SPECIFICATIONS
DIVISION 01 – GENERAL REQUIREMENTS
SECTION 015719 - TEMPORARY ENVIRONMENTAL CONTROLS

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS
CONST. CONTRACT NO. 202473360

END OF SECTION 015719

SECTION 015810 - TEMPORARY SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the following:
1. Construction signage visible to the public.
 2. Temporary directional, informational, or regulatory signage.
- B. Related Requirements:
1. Section 015210 "Temporary Facilities" for requirements for temporary facilities.

1.3 SUBMITTALS

- A. Submit temporary sign finishes, materials and paint, etc., for review and approval by DEN Project Manager prior to any fabrication.

1.4 QUALITY CONTROL

- A. Construction and other temporary signage visible to the public must be commercial grade quality, professionally fabricated, and installed based on the location of the sign. The Contractor is responsible to maintain this signage until it is no longer needed, and to remove signage from the site.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Interior signs that are visible and not physically accessible to the public may be made of rigid board, such as "Gator Board", with vinyl messages. All edges must be finished and all fasteners concealed.
- B. Interior signs that are visible and physically accessible by the public must be vandal-proof. Acceptable examples of vandal-proof signs are messages applied second surface with concealed tamperproof fasteners.

-
- C. Exterior signs must be vandal-proof and fabricated of weatherproof materials.

PART 3 - EXECUTION

3.1 HARDWARE

- A. Interior Signs: Attach with suitable adhesive and/or tape which may be removed without damage to finishes.
- B. Exterior Signs: Must be secured to withstand site conditions and varying weather conditions.

3.2 SIGN FINISHES, MATERIALS, AND PAINT

- A. Provide temporary signage to reflect permanent sign design and/or as directed by the DEN Signage Design Project Manager. Submit temporary sign finishes, materials and paint, etc., for review and approval prior to any fabrication.

3.3 MAINTENANCE

- A. The Contractor shall maintain temporary signage until it is no longer needed, as determined by DEN Project Manager.

3.4 REMOVAL

- A. The Contractor shall remove all temporary signs, and clean and refurbish affected areas to their original, or intended, condition.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
1. Section 012510 "Substitutions" for requests for substitutions.
 2. Section 014225 "Reference Standards" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number, title, and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 2. DEN Project manager's Action: If necessary, DEN Project Manager will request additional information or documentation for evaluation within one week of receipt of a comparable product request. DEN Project Manager will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if DEN Project Manager does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, DEN Project Manager will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Refer to Title 18 - Warranties, Guarantees and Corrective Work of the General Contract Conditions, 2011 Edition.
- B. Submittal Time: Comply with requirements in Section 017720 "Contract Closeout."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged, and unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," DEN Project Manager will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

C. Visual Matching Specification: Where Specifications require "match DEN Project Manager's sample", provide a product that complies with requirements and matches DEN Project Manager's sample. DEN Project Manager's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012510 "Substitutions" for proposal of product.

- D. Visual Selection Specification: Where Specifications include the phrase "as selected by DEN Project Manager from manufacturer's full range" or similar phrase, select a product that complies with requirements. DEN Project Manager will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: DEN Project Manager will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, DEN Project Manager may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

2.3 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to DEN Project Manager for the visual and functional performance of in-place materials.

PART 3 - EXECUTION (Not Used)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
016000
PRODUCT REQUIREMENTS

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 016000

SECTION 016610 - STORAGE AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section consists of providing storage and protection of the materials, products and supplies which are to be incorporated into the construction and indicating such storage areas on the working drawings with the location and dates when such areas will be available for each purpose.
- B. Related Requirements:
 - 1. Section 015210 "Temporary Facilities" for requirements for temporary facilities.

1.3 SUBMITTALS

- A. Refer to Technical Specifications Sections 013300 "Submittal Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures. Submit concurrently with submittals required in Section 013223 "Construction Layout, As-built and Quantity Surveys".
- B. Submit working drawings showing locations of storage areas not indicated on the Contract Drawings.
- C. Submit descriptions of proposed methods and locations for storing and protecting products.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials required for the storage and protection of the items specified shall be durable, weatherproof and either factory finished or painted to present an appearance acceptable to the DEN Project Manager and the City. Storage facilities shall be uniform in appearance with similar materials used to the maximum extent possible.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS OF EXECUTION

- A. Palletize materials, products, and supplies that are to be incorporated into the construction and stored off the ground. Material and equipment shall be stored only in those areas that are indicated as storage areas on the Contract Drawings and on the reviewed and accepted working drawings.
1. Store these items in a manner which will prevent damage and which will facilitate inspection.
 2. Leave seals, tags, and labels intact and legible.
 3. Maintain access to products to allow inspection.
 4. Protect products that would be affected by adverse environmental conditions.
- B. Periodically inspect stored products to ensure that products are being stored as stipulated and that they are free from damage and deterioration.
1. Any damaged or deteriorated materials must be replaced immediately to avoid delays in the project schedule.
- C. Do not remove items from storage until they are to be incorporated into the Work.
- D. The Contractor shall ensure that all protective wrappings and coverings are secure and ballasted to prevent any items from deterioration and/or subsequent dislodgment. All items on the work site that are subject to becoming windborne shall be ballasted or anchored.

3.2 HANDLING AND TRANSPORTATION

- A. Handling:
1. Avoid bending, scraping, or overstressing products. Protect projecting parts by blocking with wood, by providing bracing or by other approved methods.
 2. Protect products from soiling and moisture by wrapping or by other approved means.
 3. Package small parts in containers such as boxes, crates, or barrels to avoid dispersal and loss. Firmly secure an itemized list and description of contents to each container.
- B. Transportation:
1. Conduct the loading, transporting, unloading, and storage of products so that they are kept clean and free from damage.

3.3 STORAGE

- A. Store items in a manner that shall prevent damage to the DEN's property. Do not store hydraulic fluids, gasoline, liquid petroleum, gases, explosives, diesel fuel, and other flammables in excavations. Petroleum products and chemicals must be stored in closed containers within secondary containment.
- B. Provide sheltered weather-tight or heated weather-tight storage as required for products subject to weather damage.
- C. Provide blocking, platforms or skids for products subject to damage by contact with the ground.
- D. All material shall be stored according to the manufacturer's recommendations. Any material that has to be stored within specified temperature or humidity ranges shall have a 24-hour continuously written recording made of the applicable condition. Should the recording show that the material was not stored within the recommended ranges the material shall be considered defective and in nonconformance. If a certification from the manufacturer's engineering design representative is provided stating that the actual variations are acceptable and will in no way harm the material or affect warranties, then the deficiency will be considered corrected.
- E. Store hazardous material separately, with all material marked with a label showing the hazard and how to treat exposure to the material. Store incompatible materials separately.
- F. Extra materials that are left over at the completion of the Work shall be removed from the Project site by the Contractor unless they are required to be delivered to DEN as per Contract Document requirements for maintenance stock.

3.4 LABELS

- A. Storage cabinets and sheds that will contain flammable substances and explosive substances shall be labeled "FLAMMABLE - KEEP FIRE AWAY" and "NO SMOKING" with conspicuous, bold lettering and conforming to OSHA requirements. Flammable substances shall be stored in flammable storage cabinets that conform to OSHA requirements.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
016610
STORAGE AND PROTECTION

DENVER INTERNATIONAL AIRPORT
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PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. The cost of the Work described in this Section shall be included in the applicable unit price item, work order, or lump sum bid item.
- B. Reference Section 012910 "Schedule of Values" for additional requirements for the possible payment of stored material.

END OF SECTION 016610

SECTION 017330 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.3 Refer to Article 316, Cutting and Patching the Work in the General Contract Conditions, 2011 Edition

1.4 SUMMARY

1.5 Section Includes:

- A. Project information.
- B. Work covered by Contract Documents.
- C. Phased construction.
- D. Work by DEN.
- E. Work under separate contracts.
- F. Future work.
- G. Purchase contracts.
- H. DEN-furnished products.
- I. Contractor-furnished, DEN-installed products.
- J. Access to site.
- K. Coordination with occupants.
- L. Work restrictions.
- M. Specification and drawing conventions.
- N. Miscellaneous provisions.

1.6 Related Requirements:

- A. Section 015210 "Temporary Facilities" for limitations and procedures governing temporary use of DEN's facilities.
- B. Section 015719 "Temporary Environmental Controls" for environmental control requirements.
- C. Section 024119 "Selective Demolition" for selective demolition of structures and other elements.
- D. Section 099123 "Interior Painting" for interior painting of areas of cutting and patching.

1.7 DEFINITIONS

1.8 Cutting: Removal of existing construction to permit installation of or to perform other Work.

1.9 Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.10 SUBMITTALS

1.11 Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.

1.12 Cutting and Patching Proposal: Submit a proposal describing procedures at least thirty (30) calendar days before the time cutting and patching will be performed, requesting approval to proceed. Obtain approval of cutting and patching proposal by DEN Project Manager before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work. The proposal shall include at least the following information:

- A. Identification of the Contract and the Contractor's name.
- B. Description of proposed work:
 - 1. Scope of cutting, patching, alteration, or excavation.
 - 2. The necessity for cutting or alteration.
 - 3. Drawing showing location of the requested cutting or alteration, along with radar or x-ray report.
 - 4. Trades that will execute the work.
 - 5. Products proposed to be used.
 - 6. Extent of refinishing to be done.
 - 7. Alternatives to cutting and patching.

- C. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
- D. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted and proposed dates of interruption of service. Additionally, verify and locate anything in or behind the area prior to cutting.
- E. Proposed Dust Control and Noise Control Measures: Submit a statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- F. Effect on the work and other surrounding work or on structural or weatherproof integrity of Project.
- G. Written concurrence of each contractor or entity whose work will be affected.
- H. Cost proposal, when applicable.

1.13 QUALITY CONTROL

1.14 Operational Elements: Do not cut and patch ANY operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance, decreased operational life or safety unless approved by the DEN Project Manager. Operations elements may include, but are not limited to the following:

- A. Primary operational systems and equipment.
- B. Air or smoke barriers.
- C. Fire protection systems.
- D. Control systems.
- E. Communication systems.
- F. Conveying systems.
- G. Electrical wiring systems.
- H. Operating systems of special construction as described in Divisions 13 and 26.
- I. HVAC systems.

1.15 Miscellaneous Elements: Do not cut and patch ANY of the following elements or related components in a manner that could change their load-carrying capacity, that

results in reducing their capacity to perform as intended, or those results in increased maintenance, decreased operational life or safety unless approved by the DEN Project Manager. Miscellaneous elements may include, but are not limited to the following:

- A. Water, moisture, or vapor barriers.
 - B. Membranes and flashings.
 - C. Exterior curtain wall construction.
 - D. Equipment supports.
 - E. Piping, ductwork, vessels and equipment.
 - F. Noise control and vibration control elements and systems.
 - G. Stud walls.
 - H. Roofing system
- 1.16 Visual Elements: Do not cut and patch ANY construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would reduce, in DEN's sole opinion, the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactorily manner.
- A. If possible, retain the original installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage the original installer or fabricator, engage another recognized, experienced, and specialized firm as approved by the DEN Project Manager. Visual elements may include, but are not limited to:
 - 1. Stonework and stone masonry.
 - 2. Ornamental metal.
 - 3. Matched-veneer woodwork.
 - 4. Preformed metal panels.
 - 5. Firestopping.
 - 6. Window wall systems.
 - 7. Terrazzo.
 - 8. Flooring.
 - 9. Wall coverings and finishes.
 - 10. HVAC enclosures, cabinets, or covers.

1.17 Cutting and Patching Conference: Before proceeding, meet at the Project site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.18 WARRANTY

1.19 Existing Warranties: Remove, replace, patch and repair materials and surfaces cut or damaged during cutting and patching operations by methods and with materials so as not to void existing warranties.

A. All effort shall be made to engage the original installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage the original installer or fabricator, engage another recognized, experienced and specialized firm as approved by the DEN Project Manager:

1. Processed concrete finishes.
2. Stonework and stone masonry.
3. Ornamental metal.
4. Matched-veneer woodwork.
5. Preformed metal panels.
6. Firestopping.
7. Window wall systems.
8. Terrazzo.
9. Flooring.
10. Wall coverings and finishes.
11. HVAC enclosures, cabinets, or covers.

1.20 MATERIALS

1.21 General: All patching material shall be of the type specified for the material being patched. Comply with requirements specified in other specifications Sections.

1.22 Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually and texturally match existing adjacent surfaces to the fullest extent possible.

A. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials as approved by the DEN Project Manager.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

- A. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers. Provide additional substrates or materials if required to achieve desired final results of patching work.
- B. Immediately notify the DEN Project Manager, in writing, of unsuitable, unsafe, or unsatisfactory conditions.
- C. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
- D. Proceed with patching only after construction operations requiring cutting are complete and inspected by the DEN Project Manager.

3.3 PREPARATION

3.4 Temporary Support: Provide temporary support of Work to be cut to ensure structural value or integrity.

3.5 Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

3.6 Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.7 Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid or minimize interruption of services to occupied areas. Do not interrupt services in without approval from the appropriate authority. Refer to the appropriate Shutdown specification/procedures for applicable services.

3.8 POLLUTION CONTROLS

3.9 Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations. Reference Section 015719 "Temporary Environmental Controls" for requirements.

- A. Do not use water when it may damage existing construction or create hazardous or objectionable conditions such as ice, flooding, and pollution.
- B. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosures. Vacuum carpeted areas. Professionally clean carpeted areas if required.
- C. For outdoor concrete saw cutting operations, slurry waste must be vacuumed up immediately to prevent migration off-site to pervious surfaces, surface waters or drains.

3.10 Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

- A. Concrete slurry waste must be disposed of properly in accordance with applicable airport, local and state rules and regulations.

- 3.11 Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to the condition existing before selective demolition operations began.
- 3.12 PERFORMANCE
- 3.13 General: Employ skilled workers to perform cutting and patching. Execute cutting and demolition by methods that will prevent damage to other work and will provide a proper surface to receive patching.
- A. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
 - B. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerance, and finishes.
 - C. Restore work that has been cut or removed; install new products to provide complete work in accordance with requirements of the Contract Documents.
 - D. Fit work airtight and fire safe to pipes, sleeves, ducts, conduit, and other penetrations through surfaces as required by the Contract Documents.
- 3.14 Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and other similar operations, including excavation, using methods least likely to damage elements retained to adjoining construction. If possible, review proposed procedures with original installer and comply with original installer's written recommendations.
- A. In general, use ground fault hand or small power tools designed (to short if metal is hit) for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - B. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - C. Concrete: Use a cutting machine such as an abrasive saw or a diamond-core drill.
 - D. Proceed with patching after construction operations requiring cutting are complete.
- 3.15 Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other specification Sections.
- A. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

- B. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing. For continuous surfaces, refinish entire unit to the nearest break line. For an assembly, refinish entire unit.

- C. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Where patching occurs on a painted surface, apply primer and intermediate paint coats over the patch and apply the final coat over the entire unbroken surface containing the patch. Provide additional coats until the patch blends with adjacent surfaces.

- D. Ceilings: Patch, repair or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

- 3.16 Fire Rated Construction: Where rated elements are cut, reconstruct to approved designs to provide original fire rating.
- 3.17 CORE DRILLING
- 3.18 The Contractor shall execute a minimum of x-rays or ground penetrating radar (GPR) at each location planned for core drilling prior to submittal to the DEN Project Manager and to utility representatives for approval for core drilling. The request for approval shall be submitted a minimum seven (7) days before Core Drilling. The request for approval shall indicate on the x-ray or radar information regarding alternate locations or core drilling to avoid structural members and any embedded conduit. Embedded conduit may be metallic or plastic. The x-ray or radar system shall be capable of detecting both types of conduit.
- 3.19 Core drilled "cores" and the core-drilled opening shall be inspected by DEN Project Manager Representatives prior to installation of any systems in new openings.

PART 4 - MEASUREMENT

- 4.1 METHOD OF MEASUREMENT
- 4.2 No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

- 5.1 METHOD OF PAYMENT
- 5.2 No separate payment will be made for work under this Section.

END OF SECTION 017330

SECTION 017419**CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section describes the requirements for the disposal, recovery, reuse or recycling of **non-hazardous** and **non-asbestos** containing construction and demolition waste for LEED, Envision and other projects. Note that LEED and Envision projects may have additional requirements.
- B. Waste materials shall be managed in accordance with all local, state, and federal regulations.
- C. Related Requirements:
1. Section 013300 "Submittal Procedures" for submittal procedures.
 2. Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
 3. Section 015719 "Temporary Environmental Controls" for environmental control procedures.
 4. Section 018113.16 "Sustainable Design Requirements" for Envision Requirements.
 5. P-159 Concrete and Asphalt Crushing

1.3 SECTION 016610 "STORAGE AND PROTECTION" FOR REQUIREMENTS RELATED TO MATERIALS STORAGE AND PROTECTION.DEFINITIONS

- A. Solid Waste: means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, air pollution control facility, or other discarded material; including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations, commercial operations or community activities. Solid waste does not include any solid or dissolved materials in domestic sewage, or agricultural wastes, or solid or dissolved materials in irrigation return flows, or industrial discharges which are point sources subject to permits under the provisions of the "Colorado Water Quality Control Act", Title 25, Article 8, CRS or materials handled at facilities licensed pursuant to the provisions on "Radiation Control Act" in Title 25, Article 11, CRS. Solid waste does not include:
1. Materials handled at facilities licensed pursuant to the provisions on radiation control in Article 11 of Title 25, C.R.S.
 2. Excluded scrap metal that is being recycled.
 3. Shredded circuit boards that are being recycled.
- B. Salvaged Materials: Defined as materials that exist on the site that can be reused, either on site or by another entity
- C. Recyclable Materials: Defined as materials that exist on site or are generated during the

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construction process that can be recycled and/or remanufactured into another material. Recyclable waste includes, but is not limited to, the following:

1. Concrete.
 2. Asphalt
 3. Ferrous and non-ferrous metals.
 4. Untreated wood, engineered wood.
 5. Gypsum wallboard.
 6. Corrugated cardboard, paper goods.
 7. Plastic.
 8. Glass, insulation.
 9. Carpet.
 10. Paints, fabric.
 11. Rubber.
 12. Stone and brick.
- D. Hazardous Waste: Per 6 CCR 1007-3, those substances and materials defined or classified as such by the Hazardous Waste Commission pursuant to 25-15-302, C.R.S., as amended. Also, see hazardous waste definition per 40 CFR 261.3.
- E. Asbestos Containing Materials: Per 5 CCR 1001-10: Regulation No. 8, The Control of Hazardous Air Pollutants, Part B The Control of Asbestos- material containing more than 1% asbestos

1.4 SUBMITTALS

- A. Prior to the start of construction activities, the Contractor shall submit a list of materials and products used with Safety Data Sheets (SDS). Examples include chemicals, solvents, fuels, building materials, etc.
1. An electronic copy or link to the SDS for all materials and products used, if applicable.
 2. Identify storage methods for materials, including measures to segregate incompatible materials.
- B. Prior to the start of any waste generating activities, the Contractor shall submit a Waste Management Plan to the DEN Project Manager and DEN Environmental Services. Minimum Waste Management Plan requirements include the following:
1. A list of all waste streams generated by the project
 - a. For each construction activity, the Contractor shall identify the waste stream that will be generated, waste handling and transportation method, disposal method, and identify the disposal facility utilized.
 - b. If the Contractor anticipates generation of hazardous waste, the Contractor shall provide its EPA Generator Identification Number.
 2. Pollution Prevention Measures
 - a. Describe best practices that will reduce waste. For example, waste reduction measures, requiring vendors to deliver materials in reusable packaging, etc.
 3. Waste Management Plan Training.
 4. Storage of materials.
 5. Spill response and Training

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- C. Approval of Contractor's Waste Management Plan does not relieve the contractor of responsibility for compliance with applicable environmental regulations.
1. The contractor shall maintain a record of the amounts of construction and demolition waste generated, recycled, reused, salvaged, or disposed of, in pounds for review. The Contractor shall submit at the end of the project a summary of these records. The summary should include at a minimum the type of waste, quantity, method of disposal, date and location of disposal, and calculation of the waste diversion rate.

Waste diversion rate is calculated as the amount of material (in tons) diverted from landfill or incineration divided by the total material generated. Diverted materials can include all material that is recycled, composted, chipped, or in any way used in a higher and better use than landfilling or incineration.

PRODUCTS**1.5 DOCUMENTS**

- A. A list of all materials and products used. Examples include chemicals, solvents, fuels, curing compounds, etc.
1. An electronic copy or link to SDSs for all materials and products used.
 2. Identify storage methods, including measures to segregate incompatible materials.
 3. Refer to the Waste Management Plan

PART 2 - EXECUTION**2.1 REQUIREMENTS**

- A. The Contractor shall not wash down equipment in such a manner as to flush grease, oils, detergents, and other contaminants onto the project site or onto airport property unless the waste is properly contained, treated, and disposed of.
- B. DEN maintains two dry concrete and asphalt recycling yards used for the accumulation and crushing of asphalt and concrete. The South Yard is located on 71st Ave just east of Jackson Gap Street. The North Yard is located on the south side of 110th, west of Queensburg Street.
- C. Concrete washwater cannot be discharged to surface waters or to storm sewer systems. Colorado Discharge Permit System (CDPS) coverage conditionally authorizes discharges to the ground of concrete wash water from washing of tools and concrete mixer chutes when appropriate best management practices (BMPs) are implemented.
1. A bermed containment area that allows discharge water to infiltrate or evaporate;
 - a. Alternatives to bermed containment areas include portable concrete washout bins, and industrial washout containment systems where the accumulated waste is removed from the site and disposed of properly.
 2. Use of the washout site should be temporary (less than one year);
 3. The washout site should not be located in an area where shallow groundwater may be present, such as near natural drainages, springs, or wetlands
 4. Upon termination of the washout site, accumulated solid waste, which includes concrete waste and contaminated soils, must be removed from the site and disposed of properly.
- D. Rejected loads and/or other wet concrete or asphalt materials are PROHIBITED on DEN

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property. These materials must be returned to the facility of origination or other permitted facility for proper disposal.

- E. Concrete slurry generated from sawcutting activities is accepted at the DEN North and South Concrete and Asphalt Recycle Yards at designated areas only. Prior notification and approval is required.
- F. Any wastewater generated from construction activities may not be disposed of anywhere on DEN property, except as allowed by any permit (e.g. dewatering permit). These materials must be properly disposed of offsite.
- G. Soil or water that is determined to be contaminated with materials not formally designated as hazardous must have specific waste management practices identified and included in the Waste Management Plan. This includes but is not limited to petroleum products and per- and polyfluoroalkyl substances (PFAS).
- H. Unknown or questionable materials encountered during construction activities must be immediately reported to the DEN Communications Center at (303) 342-4200 and the DEN Project Manager.

PART 3 - MEASUREMENT**3.1 METHOD OF MEASUREMENT**

- A. No separate measurement shall be made for work under this Section.

PART 4 - PAYMENT**4.1 METHOD OF PAYMENT**

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 017419

SECTION 017420 - CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this section consists of maintaining a clean, orderly, hazard free work site during construction, and final cleaning for the City's Final Acceptance. Failure to maintain the work site will be grounds for withholding monthly payments until corrected to the satisfaction of the DEN Project Manager.
- B. Refer to Article 325, Cleanup During Construction in the General Contract Conditions, 2011 Edition

1.3 JOB CONDITIONS

A. Safety Requirements

1. Maintain the work site in a neat, orderly, and hazard-free manner in conformance with all federal, state, and local rules, codes, regulations, and orders, including all OSHA requirements, until Final Acceptance of the Work. Keep catwalks, underground structures, work site walks, sidewalks, roadways, and streets, along with public and private walkways adjacent to the work site, free from hazards caused by construction activities. Inspect those facilities regularly for hazardous conditions caused by construction activities.

B. Hazards Control:

1. Store waste materials in properly labeled waste containers. This includes solid wastes, hazardous wastes, universal wastes, etc.
2. Store volatile wastes in covered metal containers and remove those wastes from work site daily.
3. Do not accumulate wastes that create hazardous conditions.
4. If volatile and noxious substances are being used in spaces that are not naturally ventilated adequately, provide artificial ventilation.
5. Hazard controls shall conform to the applicable federal, state, and local rules and regulations.
6. Provide appropriate waste receptacles in all areas in which employees are working. Waste receptacles shall be kept covered at all times. All materials on site shall be anchored and covered to prevent any objects from becoming wind-borne.

C. Access:

1. Maintain the work site to permit access by other City contractors as required and to allow access by emergency personnel.

1.4 SUBMITTALS

A. Washing Plan: The Contractor shall prepare a plan describing the specific procedures and materials to be utilized for any equipment, vehicle, etc., washing activities. The plan must be submitted to the DEN Project Manager and approved by the DEN Project Manager and Environmental Services.

1. Outdoor washing at DEN is not allowed unless the materials will be collected or managed in a manner to ensure that they will not enter the municipally owned separate storm sewer system (MS4). The materials can only be disposed at a location pre-approved by DEN Environmental Services (refer to DEN SWMP). Failure to comply with this requirement would result in the discharge of non-stormwater.
 - a. Outdoor wash materials that contain soaps or other cleaning chemicals must be collected and disposed of off site
2. Indoor washing must be conducted in accordance with the Best Management Practices (BMPs) detailed in the DEN SWMP. Refer to Section 015719 "Environmental Controls". In addition, all indoor washing must be conducted in a manner that ensures that there are no prohibited discharges to the sanitary sewer system.
 - a. All wash-water that will be disposed of into the sanitary sewer must comply with City and County Denver rules and regulations pertaining to prohibited discharges.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

- A. Utilize the type of cleaning materials recommended by the manufacturer for the surfaces to be cleaned.
- B. Maintain current Safety Data Sheets (SDS) on site for all chemicals. DEN Environmental Services must approve the chemicals used prior to discharge to the sanitary sewer system.
- C. Ensure proper disposal of all wastes generated from the use of these materials. The Contractor must ensure compliance with all environmental regulations. No wastes can be disposed of on DEN property.

PART 3 - EXECUTION

3.1 INTERIM CLEANING

- A. Clean the work site every shift/workday for the duration of the construction Contract. Maintain structures, grounds, storage areas and other areas of work site, including public and private properties immediately adjacent to work site, free from accumulations of waste materials caused by construction operations. Place waste materials in covered metal containers. All hard concrete, steel, wood, and finished walking surfaces shall be swept clean daily.
- B. Remove or secure loose material on open decks and on other exposed surfaces at the end of each workday or more often in a manner that will maintain the work site hazard free. Secure material in a manner that will prevent dislodgment by wind and other forces.
- C. Sprinkle waste materials with water or acceptable chemical palliative to prevent blowing of dust.
- D. Promptly empty waste containers when they become full and legally dispose of the contents at dumping areas off the City's property.
- E. Control the handling of waste materials. Do not permit materials to be dropped or thrown from structures.
- F. Immediately remove spillage of construction related materials from haul routes, work site, private property, public rights of way, or on the Denver International Airport site.
- G. Clean only when dust and other contaminants will not precipitate upon newly painted surfaces.
- H. Cleaning shall be done in accordance with manufacturer's recommendation.
- I. Cleaning shall be done in a manner and using such materials as to not damage the Work.
- J. Clean areas prior to painting or applying adhesive.
- K. Clean all heating and cooling systems prior to operations. If the Contractor is allowed to use the heating and cooling system, it shall be cleaned prior to testing.
- L. Clean all areas that will be concealed prior to concealment.
- M. Dispose of all fluids according to the approved Washing Plan.

3.2 FINAL CLEANING

- A. Refer to Article, Clean-up Upon Completion in the General Contract Conditions, 2011 Edition. Additionally, the Contractor, shall at a minimum, complete the following:

1. Inspect interior and exterior surfaces, including concealed spaces, in preparation for completion and acceptance.
2. Remove dirt, dust, litter, corrosion, solvents, discursive paint, stains, and extraneous markings.
3. Remove surplus materials, except those materials intended for maintenance.
4. Remove all tools, appliances, equipment, and temporary facilities used in the construction.
5. Remove detachable labels and tags. File them with the manufacturer's specifications for that specific material for the City's records.
6. Repair damaged materials to the specified finish or remove and replace.
7. After all trades have completed their work and just before Final Acceptance, all catch basins, manholes, drains, strainers and filters shall be cleaned; roadway, driveways, floors, steps and walks shall be swept. Interior building areas shall be vacuum cleaned and mopped.
8. Final cleanup applies to all areas, whether previously occupied and operational or not.
9. Dispose of all fluids according to the approved Washing Plan.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 017420

SECTION 017515 - SYSTEM STARTUP, TESTING AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete startup, testing, and operator training services to ensure operability of all systems supplied.
- B. Coordinate all start-up and testing with DEN Commissioning Authority or DEN Asset Management through the DEN Project Manager.

1.3 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures. Submit the following:
 - 1. Test procedures.
 - 2. Test reports.
 - 3. Training outline.
- B. Submit Qualification Data: For instructor.
- C. Attendance Record: For each training module submit the following:
 - 1. Module title
 - 2. Module description
 - 3. Length of instruction time
 - 4. Participant names
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

SYSTEM STARTUP, TESTING AND TRAINING

- B. Instructor Qualifications: A factory-authorized service representative, experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required. Recordings shall be high-resolution 4k with a minimum framerate of 60Hz
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 014510 "Contractor Quality Control". Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructor's personnel, audiovisual equipment, and facilities needed to avoid delays. Ensure that students are notified at least 14 [insert other] days prior to the start of instruction.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with DEN's operations. Adjust schedule as required to minimize disrupting DEN's operations and to ensure availability of DEN's personnel. As required, include multiple classed to accommodate various shifts
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by DEN Project Manager.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FIELD TESTS AND ADJUSTMENTS

- A. All electrical and mechanical equipment including the interfaces with control systems and the communication system, and all alarm and operating modes for each piece of equipment, shall be tested by the Contractor to the satisfaction of the DEN Project Manager before any facility is put into operation. Tests shall be as specified herein and shall be made to determine whether the equipment has been properly assembled, aligned and connected. Any changes, adjustments, or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the Work.
1. At least thirty (30) days before the time allowed in the construction schedule for commencing startup and testing procedures, the Contractor shall submit to the DEN Project Manager six (6) copies of the detailed procedures the Contractor proposes for testing and startup of all electrical and mechanical equipment. These procedures are submitted for review and acceptance by DEN.
 2. The Contractor's startup and testing procedures shall include detailed descriptions of all pre-operational hardware, electrical, mechanical and instrumentation used for testing work.
 - a. Each control device, item of electrical, mechanical and instrumentation equipment, and all control circuits shall be considered in the testing procedures which shall be designed in a logical sequence to ensure that all equipment has been properly serviced, aligned, connected, wired, calibrated and adjusted prior to operation.
 - b. Motors shall be tested in accordance with ANSI/IEEE Publication 112. The Contractor is advised that failure to observe these precautions may place the acceptability of the subject equipment in question, and the Contractor may either be required to demonstrate that the equipment has not been damaged, or replace it as determined by the DEN Project Manager.
 3. Testing procedures shall be designed to duplicate as nearly as possible all conditions of operations and shall be carefully selected to ensure that the equipment is not damaged. All filters shall be in place during startup and testing.
 - a. Once the DEN Project Manager has accepted the testing procedures, the Contractor shall provide checkout, alignment, adjustment and calibration signoff forms for each item of equipment and each system that will be used.
 - b. The Contractor and the DEN Project Manager shall use the signoff forms in the field jointly to ensure that each item of electrical, mechanical and instrumentation equipment and each system has been properly installed and tested. The Contractor shall cooperate with project-wide systems contractors where startup and testing is to be conducted concurrently.

SYSTEM STARTUP, TESTING AND TRAINING

4. Any special equipment needed to test equipment shall be provided by the Contractor to the City at no cost for a period of thirty (30) days during startup.
- B. Before starting up the equipment, the Contractor shall properly service it and other items, which normally require service in accordance with the maintenance instructions. The Contractor shall be responsible for lubrication and maintenance of equipment and replacement filters throughout the entire equipment "break-in" period described by the manufacturer.
1. The Contractor shall be responsible for the startup, adjustment, preliminary maintenance, and checkout of all equipment and instrumentation. All systems shall be carefully checked for conformance with the design criteria.
 2. If any equipment or system does not operate as specified in the Contract, the Contractor shall immediately replace or repair components until it operates properly.
 3. The Contractor shall submit a test report to the DEN Project Manager within thirty (30) days after completion of the system startup period.

3.2 SYSTEMS STARTUP AND TESTING

- A. The Contractor shall be responsible for a 30-day startup period during which time all hardware, electrical and mechanical equipment, communications, alarm systems, and associated devices shall be energized and operated under local and automatic controls. The Contractor shall be present during the startup period with adequate labor and support personnel to adjust equipment and troubleshoot system failures that might arise.
- B. When a piece of electrical or mechanical equipment is found to be in conflict with specific criteria, an experienced representative of the manufacturer shall adjust the item.
- C. If adjustments fail to correct the operation of a piece of equipment or fixture, the Contractor shall remove the equipment or fixture from the Project site and replace it with a workable replacement that meets the specification requirements.
- D. The 30-day startup period shall commence thirty (30) days prior to the Contract completion date and shall be completed prior to final payment. If, during the startup, any system fails to operate in accordance with Contract requirements, the failure shall be corrected and the startup period shall begin again.
1. At the end of the startup period, all filters shall be replaced with new ones.
 2. The City may provide, at its option, a Commissioning Representative to observe or participate in the startup and testing of any system. The Contractor shall coordinate with the Commissioning Representative relating to scheduling, reporting, forms, methods, and procedures of the startup and testing.

3.3 FINAL INSTRUCTIONS AND OPERATION TRAINING

- A. After startup and testing is completed, the Contractor shall demonstrate to the City's personnel the proper manner of operating the equipment, programming messages, making adjustments, responding to alarms and emergency signals, and maintaining the system.
- B. The Contractor shall provide on-the-job training by a suitably qualified instructor to designated personnel and shall instruct them in the operation and maintenance of the systems. In the event qualified instructors on the Contractor's staff are not available, the Contractor shall arrange with the equipment manufacturer for such instruction at no additional cost to the City.
- C. The Contractor shall provide a minimum of eight (8) hours of operator training to the Airport per shift. Classes shall accommodate up to five (5) people at a time with up to two (2) separate courses (one for each shift).
- D. The Contractor shall provide a syllabus to the DEN Project Manager at least seven (7) calendar days prior to the start of each course that outlines topics to be covered, the proposed time allotted to each topic, and the target audience of the training session (technical, casual operator, overview, etc.). The Contractor shall not commence any training courses until the syllabus has been reviewed and approved by the DEN Project Manager.
- E. The Contractor shall video record all training sessions and provide to the DEN Project Manager. The Contractor shall provide video recordings in format as required in Section 017900 "Demonstration and Training".
- F. The Contractor shall provide an annotated syllabus to the DEN Project Manager that indicates topics contained on each tape.
- G. The contractor shall provide instruction for obtaining live help for questions relating operation and troubleshooting

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.
- B. No contractual item requiring startup or testing will be paid until the conditions of this Section are completely satisfied.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
017515
SYSTEM STARTUP, TESTING AND TRAINING

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

END OF SECTION 017515

SECTION 017720 - CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Special Sections, apply to this Section.

1.2 SUMMARY

- A. Work specified in this Section includes procedures required prior to Final Acceptance of the Work in addition to those specified in Title 20 – Final Completion and Acceptance of The Work in the General Contract Conditions, 2011 Edition, and Technical Specification Section 017840 "Contract Record Documents".

- B. This Section also includes procedures and penalties to ensure prompt completion of the Project Closeout.

- C. Related Sections:

- 1. Title 20 of the General Contract Conditions, 2011 Edition..
- 2. Section 017840 "Contract Record Documents" for required record documents.
- 3. Form CM-75, Closeout Checklist

- D. SUBMITTALS

- 1. Submit written Certification to the DEN Project Manager that, in the opinion of the Contractor, the Work is complete.
- 2. Submit final survey within 60 days after issuance of Substantial Completion.
 - a. Progress submittal and review of content will be performed as scheduled sequence of work is completed.
- 3. Submit a Final Statement of Accounting to the DEN Project Manager.
- 4. Submit Asset Data within 60 days after issuance of Substantial Completion.
 - a. Progress submittal and review of content will be performed every two weeks in a data progress meeting hosted by DEN

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION FOR FINAL INSPECTION

- A. Before requesting inspection for Final Acceptance of the Work by the City, the Contractor shall inspect, clean, and repair the Work as required.

- B. The Contractor shall ensure that all items on the Closeout Checklist have been addressed and accepted by the DEN Project Manager.

3.2 FINAL INSPECTION

- A. The Contractor shall submit written certification to the DEN Project Manager when, in the opinion of the Contractor, the Work is complete. Such communication shall certify that:
1. The Work has been inspected by the Contractor for conformance with the Contract Documents.
 2. The Work has been completed in conformance with the Contract Documents, including all punchlist items.
 3. The Work is ready for final inspection by the City.
 4. All as-built documents have been submitted and accepted.
 5. All damaged or destroyed real, personal, public, or private property impacted by the Work has been repaired or replaced.
 6. All Warranties and Bonds have been completed, executed, submitted, and accepted.
 7. All personnel badges and vehicle permits have been returned to DEN Airport Security.
- B. The DEN Project Manager will inspect the Work in accordance with the Section 2002.1 of the City and County of Denver's Department of Aviation's General Contract Conditions.
- C. If the DEN Project Manager finds incomplete or defective Work:
1. The DEN Project Manager may, at the DEN Project Manager's sole discretion, either terminate the inspection, or prepare a punchlist and notify the Contractor in writing, listing the incomplete or defective Work.
 2. The Contractor shall take immediate steps to remedy all identified deficiencies and resubmit a written certification to the DEN Project Manager that Work is complete.
 3. The DEN Project Manager will then re-inspect the Work.

3.3 REINSPECTION FEES

- A. Should the DEN Project Manager be required to perform re-inspections of the Work due to the Contractor prematurely claiming the status of the Work to be complete:
1. The Contractor shall compensate the City for such additional services at the rate of \$125.00 per man-hour, with a minimum charge of \$250.00.
 2. The City shall deduct the amount of such compensation from the final payment to the Contractor.

3.4 FINAL SURVEY FEES

- A. The Contractor shall complete and submit the final survey within 60 days after issuance of Substantial Completion. If the Contractor fails to complete and submit the final survey within this time frame it is understood that DEN will arrange for a qualified surveying company to complete this work at the Contractor's expense. All costs associated with DEN arranging for and completing the final survey will be deducted from the final payment including compensation due the City for the DEN Project Manager's time to manage this work.
1. The DEN Project Manager's rate of compensation shall be set at \$150.00 per man-hour.
 2. Survey submittals needing to be revised may extend the 60-day time frame at the DEN Project Manager's discretion.
 3. Costs, including the DEN Project Manager's, for the review of the resubmitted survey shall be deducted from the final payment.

3.5 LATE CLOSEOUT FEES

- A. Within 100 days after issuance of substantial completion, all documentation required by this Contract to achieve Project Closeout shall be submitted. Failure to submit all required documentation shall result in fees to compensate the City for project management work while the project remains open.
1. Fees at the rate of \$450 per day.
 2. The resubmittal of required documents may extend the 100-day time frame at the DEN Project Manager's discretion.

3.6 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a Final Statement of Accounting to the DEN Project Manager.
- B. The Final Statement of Accounting shall reflect all adjustments to the Contract amount and shall include the following:
1. The original Contract Value.
 2. Additions and deductions resulting from the following:
 - a. Approved Change Orders.
 - b. Allowances.
 - c. Final quantities for unit price items, including required backup for the quantities.
 - d. Deductions for corrected work.
 - e. Penalties.
 - f. Deductions for liquidated damages.
 - g. Deductions for re-inspection payments.
 - h. Other adjustments.
 3. Total Contract Value, as adjusted.

4. Previous payments.
5. Sum remaining due.

- C. If required, the DEN Project Manager will prepare a final Change Order, reflecting the approved adjustments to the Contract Value that were not included in previously issued Change Orders.

3.7 FINAL APPLICATION FOR PAYMENT

- A. The Contractor shall submit the final application for payment in accordance with the procedures and requirements detailed in Article 2003, Final Settlement in the General Contract Conditions, 2011 Edition.

3.8 ASSET DATA

- A. The Contractor shall submit Asset Data on the provided spreadsheets for the following scope items:

1. Airfield Lighting.
2. Airport Signs.
3. CCTV Cameras.
4. Electric Panels.
5. Lighting Circuit.

- B. Asset Data that is required includes:

1. Manufacturer
2. Model
3. Serial Number
4. Purchase Price
5. Install Date
6. Warranty End Date
7. Vendor
8. Barcode
9. Expected Life

The Asset Data shall be provided in a spreadsheet format. The spreadsheets for the scope items listed above will be provided to the contractor prior to construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
017720
CONTRACT CLOSEOUT

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
017720
CONTRACT CLOSEOUT

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

END OF SECTION 017720

SECTION 017825 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section consists of preparing and submitting operation and maintenance data for mechanical, electrical, and other specified equipment/products.
- B. Coordinate all the requirements of the required data with DEN Asset Management.

1.3 SUBMITTALS

- A. Refer to Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.
- B. All submittals must be provided in electronic data as indicated by the DEN Building Information Modeling (BIM) Design Standards Manual (DSM) and as required by the DEN BIM and DEN Asset Management groups.
- C. Submit one (1) electronic copy and three (3) bound hard copies of the proposed Operation and Maintenance Data Manual not less than 30 days prior to acceptance tests and final inspection.
 - 1. The submitted copies shall provide the Information following the MasterFormat standard. Equipment/Data shall be organized using Section formatting within the 50 MasterFormat Divisions.
- D. Submit one (1) electronic copy and three (3) bound hard copies of Operation and Maintenance Data Manual within ten days after commissioning is complete. These copies shall incorporate any comments made on the previous submittals, along with final readings on all settings and gauges taken while the system is in fully satisfactory operation.

1.4 CONTINUOUS UPDATING PROGRAM

- A. Furnish to DEN AIM Asset Management one (1) electronic copy of the Contractor's letter indicating that suppliers have been notified to provide updated operation and maintenance data, service bulletins, and other information pertinent to the equipment, as it becomes available.

PART 2 - PRODUCTS

- A. The following products are the requirements of hard copies:
1. Paper size: 8-½ inches x 11 inches.
 2. Paper: White bond, at least 20-pound weight.
 3. Text: Typewritten.
 4. Printed data: Manufacturer's catalog cuts, brochures, operation, and maintenance data. Clear reproductions thereof will be acceptable. If this data is in color, all final manuals must contain color data.
 5. Drawings: 8½ inches x 11 inches, bound with the text. Larger drawings are acceptable provided they are folded to fit into a pocket inside the rear cover of the manual. Reinforce edges of large drawings.
 6. Prints of drawings: Black ink on white paper, sharp in detail and suitable for making reproductions.
 7. Flysheets: Separate each portion of the manual with colored, neatly prepared flysheets briefly describing the contents of the ensuing portion.
 8. Covers: Provide 40 to 50 mil, clear plastic, front and plain back covers for each manual. The front covers shall contain the information required in paragraph 3.2 below.
 9. Bindings: Conceal the binding mechanism inside the manual. Lockable 3-ring binders shall be provided.
 10. Training Videos: Provide in digital electronic format as per current DEN requirements.
 - a. Refer to Section 017900 - Demonstration and Training for video requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Assemble each operation and maintenance manual using the manufacturer's latest standard commercial data, and include all additional information that is unique to the Project.

3.2 COVER

- A. Include the following information on the front cover and on the inside cover sheet:
1. Operation and maintenance instructions.
 2. Title of structure or facility.
 3. Title and number of Contract.
 4. Contractor's name and address.
 5. General subject of the manual.

3.3 CONTENTS OF THE MANUAL

- A. Table of Contents, which references, at a minimum, three heading levels.
- B. Index of Equipment/Data with entries for equipment type and MasterFormat Division and Section.
- C. A Master Index that contains index entries for all submitted Operation and Maintenance Data Manuals.
 - 1. Equipment/Data shall be indexed by equipment type and MasterFormat Division and Section.
 - 2. Name, address, and telephone numbers of Contractor, suppliers and installers along with the manufacturer's order number and description of the order.
 - 3. Name, address, and telephone numbers of manufacturer's nearest service representatives.
 - 4. Name, address, and telephone number of nearest parts vendor and service agency.
 - 5. Copy of guaranties and warranties issued to, and executed in the name of, the City.
 - 6. Anticipated date the City assumes responsibility for maintenance.
 - 7. Description of system and component parts including theory of operation.
 - 8. Pre operation check or inspection list.
 - 9. Procedures for starting, operating, and stopping equipment.
 - 10. Post operation check or shutdown list.
 - 11. Inspection and adjustment procedures.
 - 12. Troubleshooting and fault isolation procedures for on-site level of repair.
 - 13. Emergency operating instructions.
 - 14. Accepted test data.
 - 15. Maintenance schedules and procedures.
 - 16. Test procedures to verify the adequacy of repairs.
 - 17. One (1) copy of each wiring diagram.
 - 18. One (1) copy of each piping diagram.
 - 19. Location where all measurements are to be made.
 - 20. One (1) copy of each duct diagram.
 - 21. One (1) copy of control diagram.
 - 22. One (1) copy of each accepted shop drawing.
 - 23. One (1) copy of software programs imputable or changeable on site.
 - 24. Ordering information.
 - 25. Training course material used to train DEN staff, including slides and other presentation material.
 - 26. Provide the following information, unless the item is covered in the Manufacturer's Operation and Manual:
 - a. Manufacturer's parts list with catalog names, numbers, and illustrations.
 - b. A list of components that are replaceable by the City.
 - c. An exploded view of each piece of the equipment with part designations.
 - d. List of manufacturer's recommended spare parts, current prices, and recommended quantities for two years of operation.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
017825
OPERATION AND MAINTENANCE DATA

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- e. List of special tools and test equipment required for the operation, maintenance, adjustment, testing and repair of the equipment, instruments and components.
- f. Scale and corrosion control procedures.
- g. Disassembly and re-assembly instructions.
- h. Troubleshooting and repair instructions.
- i. Calibration procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 017825

SECTION 017835 - WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section consists of preparing and submitting warranties and bonds required by the Contract and these Specifications.

1.3 SUBMITTALS

- A. Refer to Technical Specifications Section 013300 "Submittal Procedures" and Section 013325 "Shop and Working Drawings, Product Data and Samples" for submittal procedures.

- 1. All warranties shall be executed specifically to the City.
- 2. Photocopies or reproductions of stock manufacturer's warranties will not be accepted, although electronic copies are acceptable when the manufacturer's warranty is contained in the O&M manual.

- B. Submit samples of warranties and bonds for review by the City prior to execution of Work. Do not submit final warranties until sample warranties have been approved by the City.

- 1. Submit the warranties and bonds required by the Contract Documents.
- 2. Prepare and submit a list of all warranties and bonds on the following forms:

- a. CM-10: Contractor Warranty
- b. CM-11: Contractor/Sub-Contractor Warranty

- C. Submit executed warranties and bonds

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 WARRANTIES AND BONDS

- A. Submit executed warranties and bonds required by the Contract Documents, as detailed in Title 15 - Performance and Payment Bonds and Title 18 - Warranties, Guarantees, and Corrective Work in the General Contract Conditions, 2011 Edition.

1. Prepare and submit a list of all warranties and bonds on the following forms:
 - a. CM-10, Contractor Warranty
 - b. CM-11, Contractor/Sub-Contractor Warranty

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 017835

SECTION 017840 - CONTRACT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work specified in this Section consists of maintaining, marking, recording, and submitting Contract record documents that include shop drawings, warranties, Contract Documents, and contractor records.
- B. Refer to DEN Building Information Modeling (BIM) Design Standards Manual (DSM) and Approved BIM execution for data format and file types acceptable for different type of data.
- C. Related Requirements:
 - 1. Section 013100 "Project Management and Coordination".
 - 2. Section 013223 "Construction Layout, As-built and Quantity Surveys".
 - 3. Section 013300 "Submittal Procedures".
 - 4. Section 013325 "Shop and Working Drawings, Product Data and Samples".
 - 5. Section 017720 "Contract Closeout".
 - 6. Section 017825 "Operation and Maintenance Data".

1.3 SUBMITTALS

- A. Each submittal of record documents shall contain the following information:
 - 1. Date.
 - 2. Project title and numbers.
 - 3. Contractor's name and address.
 - 4. Title and number of each record document.
 - 5. Certification that each document as submitted is complete and accurate.
 - 6. Signature of the Contractor or the Contractor's authorized representative.
- B. At the completion of this Contract, deliver all record documents including the following:
 - 1. As-built shop drawings, diagrams, illustrations, schedules, charts, brochures and other similar data.
 - 2. Warranties, guarantees, and bonds.
 - 3. Contract Documents.
 - 4. Contractor records.

- C. As-built Contract Drawings shall be submitted with each monthly progress payment application, and a complete set shall be submitted prior to final payment.
1. The Contractor shall provide a single electronic copy of each Contract drawing sheet which has been used to produce work during the payment period or work that payment is being requested on, which records the current as-built conditions of work, including the posting of any change orders or change directives not shown on the Contract Documents at the time of Contract signing.
 - a. The Contractor must show as-built work completed through the payment application date including but not limited to utilities, empty conduit, conduit for actual electrical lines, plumbing, HVAC, location of anchor bolts and support points for use by others.
 - b. The Contractor shall be liable for any costs incurred by the City or a third party due to errors or lack of information provided on the as-built drawings.
 - c. All markings on drawings shall be legible to identify the portion of work completed.
 - d. For projects utilizing BIM system by the Contractor or a consultant of the Contractor, all data formats shall be compatible and as approved by the BIM execution plan as required in the DEN BIM DSM.

1.4 QUALITY CONTROL

- A. Submit electronically scanned copies of all documents required by Chapter 17 "Special Inspection and Testing" of the International Building Code 2009 as amended by City and County of Denver 2011. Keep scale and clarify dimension where electronic copies are not as originally scaled and dimensioned.
- B. For projects utilizing BIM for Revit, follow approved BIM execution plan and DEN BIM DSM for record documents, formats, and quality control and assurance procedures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 MAINTENANCE OF DOCUMENTS

- A. The Contractor must follow all the procedures established in the Contract Documents and DEN BIM DSM.
- B. The Contractor shall maintain at the work site on a current basis one (1) record copy of all drawings, specifications, addenda, change orders, approved shop drawings, working drawings, product data and samples in good order and marked currently to record all changes made during construction.
- C. Maintain at the field office one copy of the following record documents:

1. Contract Documents:

- a. Contract Drawings with all clarifications, requests for information, directives, changes, and as-built conditions clearly posted.
- b. Contract Specifications with all clarifications, requests for information, changes, directives and record of manufacturer actually used along with product trade name.
- c. Reference Standards in accordance with Section 014225 "Referenced Standards".
- d. Affirmative Action Plan and documents.
- e. One (1) set of drawings to record the following:
 - 1) Horizontal and vertical location of underground utilities affected by the Work.
 - 2) Location of internal utilities; include valves, controls, conduit, duct work, switches, pressure reducers, size reducers, transitions, crosses, tees, filters, motors, heaters, dampers, regulators, safety devices, sensors, access doors and appurtenances that are concealed in the construction shall be shown with dimensions given from a visible and recognizable reference to the item being located in all three dimensions. The drawings shall also reference the applicable submittal for the item being located.
 - 3) Field changes of dimensions and details including as-built elevations and location (station and offset).
 - 4) Details not on original Contract Drawings but obtained through requests for information or by other communications with the City.

2. Contractor Records:

- a. Daily Quality Control Reports.
- b. Certificates of compliance for materials used in construction.
- c. Completed inspection list.
- d. Inspection and test reports.
- e. Test procedures.
- f. Qualification of personnel.
- g. Approved submittals.
- h. Material and equipment storage records.
- i. Safety Plan
- j. Erosion, sediment, hazardous and quality plans.
- k. Hazardous material records.
- l. First report of injuries.

3.2 RECORDINGS

- A. Label each document page or article "PROJECT RECORD" in two-inch high letters.
- B. Keep record documents current daily.
- C. Legibly mark copies of the Contract Drawings to record actual construction.

D. Legibly mark up each Section of the specifications and Contract Drawings to record:

1. Manufacturer, trade name, catalog number and supplier of each product and item actually installed
2. Changes made by change orders, requests for information, substitutions, and variations approved by submittals.

3.3 DOCUMENT MAINTENANCE

- A. Follow all the required processes of the approved BIM Execution Plan as approved by DEN for this specific project or in formats acceptable to DEN BIM management system.
- B. Do not use record documents for construction purposes.
- C. Make documents available for inspection by the DEN Project Manager and any others having jurisdiction.

3.4 MONTHLY REVIEW

- A. Prior to any application for payment, the DEN Project Manager or the DEN Project Manager's designated representative will inspect the record documents to ensure that they are being maintained and contain the most current correct data with particular attention to as-built drawings.
- B. If, during the inspection, the DEN Project Manager determines that the documents are not being maintained and kept current as to as-built conditions, an amount may be withheld from the payment request and deducted from the Contract value to cover the City's cost of collecting and recording the as-built Contract data. This cost will be determined based on \$100.00 per man-hour of effort.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 017840

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing City's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructor's names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two (2) copies within seven (7) days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.

- b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
2. Closed Caption: Videos shall contain a visible text version of all speech provided in the recording.
 3. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 4. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 5. At completion of training, submit complete training manual(s) for City's use prepared and bound in format matching operation and maintenance manuals and in PDF electronic file format.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A professional instructor/trainer who is experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 014510 "Contractor Quality Control". Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructor's personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with City's operations. Adjust schedule as required to minimize disrupting City's operations and to ensure availability of City's personnel.
 - 1. Include multiple classes to accommodate various shifts, as necessary.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by DEN Project Manager.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.

- g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:

- a. Diagnosis instructions.
- b. Repair instructions.
- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017825 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and City for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct City's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Contractor will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. City will furnish an instructor to describe City's operational philosophy.
 3. DEN Project Manager will furnish Contractor with names and positions of DEN participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with City, through DEN Project Manager, with at a minimum of thirty (30) days advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written or a demonstration performance-based test.

- F. Cleanup: Collect used and leftover educational materials and give to City. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Recordings: Submit video recordings in an electronic format acceptable to DEN Project Manager [by posting to Project Web site]. Recordings shall be high-resolution 4k with a minimum framerate of 60Hz
1. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 2. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.

- E. Narration: Describe scenes on video recording by [audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.
1. Closed Caption: Videos shall contain a visible text version of all speech provided in the recording.
 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Failure of Video Recordings: If video recordings submitted by Contractor do not comply with Project requirements, or have audio and/or video problems, Contractor will be required to repeat training and video recording in compliance with this Section in order to re-create the training video.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 017900

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
017900
DEMONSTRATION AND TRAINING

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2020
CONST. CONTRACT NO. 202473360

SECTION 018113.16- SUSTAINABLE CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Sustainability Questionnaire
- C. Additional documents and tools related to the successful achievement of required Envision credit criteria may be provided during the Envision Construction Kick-off Meeting, attended by the DEN Project Manager, Engineer, and the Contractor.

1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with Project's strategy to pursue an award for sustainability from the Institute for Sustainable Infrastructure (ISI) using the Envision framework. The project's Envision pursuit strategy is based on guidance provided by Envision Sustainable Infrastructure Framework Guidance Manual Version 3 and requires participation by the Contractor to meet the specific Envision credit criteria
 - 1. Contractor must, through the completion of the Sustainability Questionnaire, acknowledge and commit to the Project Sustainability Commitment Statement and support, to the extent possible through construction, additional Project Sustainability Goals.
 - a. Project Sustainability Commitment Statement: As a key member of the Project, we are committed to strategically considering the long-term economic, social, and environmental impacts of the activities associated with the design, construction, operation, and maintenance of the Runway 17L-35R Package 2 Rehabilitation Project. We will work collaboratively to implement sustainable solutions that prioritize improvements in health, safety, and access for all stakeholders; reduce energy use and greenhouse gas (GHG) emissions; maximize diversion of waste materials or resources from landfills; identify methods for reuse of materials (including recycled content and waste byproducts); minimize impacts to local and national operations; and engage DEN stakeholders in improving the long-term operation and maintenance of the project site.
 - b. Project Sustainability Goals: 1) Improve resource management for DEN runway rehabilitation projects.
 - 2. Contractor is committed to revisiting the Project Sustainability Commitment Statement through construction; supporting, to the extent possible through construction, the achievement of additional Project Sustainability Goals; monitoring the Contractor's

performance towards achieving Envision credits required by the Contractor; and fulfilling all Envision requirements as agreed upon by the Engineer, Contractor, and DEN.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from the Engineer, DEN Project Manager, and potentially ISI regarding Envision credit criteria that are the responsibility of the Contractor, or that depend on the Contractor's participation until ISI has made its determination on the level of award to be received by the Project's Envision verification application. Responses to such requests shall be documented as informational submittals.
- B. Contractor's project team shall include at least one (1) certified Envision Sustainability Specialist, ENV SP, who will monitor the Contractor's adherence to the Project Sustainability Commitment Statement and progress towards Project Sustainability Goals as well as manage the production, organization, and delivery of action submittals as need for Envision credits required by the Contractor.
- C. Contractor will attend an 1) Envision Construction Kick-off Meeting and 2) Envision Construction Closeout Meeting with Engineer and DEN Project Manager, each assumed to be virtual and 1-hour long, to discuss in greater detail the Envision credits required by the Contractor, operational procedures for Action Submittals, recommended achievement strategies for Envision credits required by the Contractor, and any other relevant topics concerning the Project's Envision pursuit strategy.

1.4 ACTION SUBMITTALS

- A. Contractor shall include in their proposal a credentialed Envision Sustainability Professional (ENV SP) to coordinate the Envision action submittals.
- B. Envision submittals are in addition to other submittals. If the submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated Envision requirements.
- C. The Project's Envision pursuit strategy includes the achievement of up to 166 points by the Contractor using the guidance provided by Envision Sustainable Infrastructure Framework Guidance Manual Version 3. A preliminary list of Envision credits that make up the 166 points is provided in Section I below. During the Envision Construction Kick-off Meeting, the Contractor will work with the Engineer and DEN Project Manager required to confirm the list of Envision credit criteria required by the Contractor during the Project.
- D. According to the guidance provided by Envision Sustainable Infrastructure Framework Guidance Manual Version 3, the Contractor will identify and implement compliance strategies in order to meet each Envision credit criteria required by the Contractor.
- E. Envision credits required by the Contractor may require additional participation from the Engineer and/or DEN Project Manager and are to be discussed during the Envision Construction Kickoff Meeting.
- F. The Contractor will provide Envision Documentation Submittals to the Engineer and DEN Project Manager, according to requirements to be determined at the Envision Construction Kickoff Meeting. A preliminary list of required Envision Documentation Submittals is provided in Section I below. The Engineer and DEN Project Manager will be responsible for the preparation and submission of the final Envision verification application.
- G. The format and method for delivery of Envision Documentation Submittals is to be agreed upon by Contractor, Engineer, and DEN Project Manager during the Envision

Construction Kick-off Meeting. Failure to comply with the agreed upon format and method may result in the rejection of such submittals.

- H. Additional resources related to the successful achievement of required Envision credit criteria may be provided to the Contractor during the Envision Construction Kick-off Meeting, attended by the DEN Project Manager, Engineer, and the Contractor. These resources may include but are not limited to: Credit Worksheets, Construction Waste Tracking Tool, and lists of recommended strategies. The Contractor may use alternative resources, so long as they meet the same purposes as the resources provided, pending approval by Engineer and DEN Project Manager.
- I. Contractor working with Envision SP to identify compliance strategies to meet the points that are needed to support the Project obtaining an ENVISION 'Verified' level of award verification based on the ISI's "Sustainable Infrastructure Framework Guidance Manual, v3." A preliminary list of Envision credits as well as a preliminary list of related Envision Documentation Submittals is provided below. This list is subject to change, pending confirmation by the Contractor, Engineer, and DEN Project Manager.
- a. Credit QL1.3: Improve Construction Safety (Project Target: Conserving, 14 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Construction Site Specific Safety Plan (SSSP) and related policies or procedures to meet all DEN ROCIP, construction general safety, and security requirements.
 - iii. Documentation of construction safety training programs, site safety inspections, and safety communications.
 - iv. Materials related to any health and/or wellness programs provided to Contractor's employees and subcontractors and the communication of such program(s) to employees and subcontractors.
 - b. Credit QL1.6: Minimize Construction Impacts (Project Target: Conserving, 8 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. a. Documentation demonstrating implementation of CSPP strategies to mitigate all four (4) construction impacts (i.e., intrusive lighting, vehicle and pedestrian wayfinding/safety, noise and vibration, site access for operations).
 - iii. Documentation from weekly CSPP Contractor progress meetings, including records that feedback mechanisms are in place with project stakeholders.
 - c. Credit LD1.1 Provide Effective Leadership and Commitment (Conserving Level of Achievement, 18 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Completed Sustainability Questionnaire
 - iii. Records of efforts to monitor Contractor's and any Subcontractor's performance of required Envision credit criteria and continued support of the Project Sustainability Commitment and Project Sustainability Goals

(meeting minutes, progress reports, or similar).

- d. Credit LD1.4: Pursue Byproduct Synergies (Project Target: Superior, 12 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation of efforts to identify existing components and fixtures fit for reuse within or outside of the Project
 - iii. Documentation of efforts to salvage, preserve, and store components and fixtures fit for reuse
 - iv. Documentation of efforts to identify a 3rd party use for salvaged components and fixtures
 - v. Documentation of successful hand off salvaged components and fixtures to a 3rd party

- e. Credit LD2.1 Establish a Sustainability Management Plan (Project Target: Conserving, 18 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation of processes to achieve the Project Sustainability Goals including development of a Construction Sustainability Action Plan to meet Envision credits required by Contractor
 - iii. Documentation showing tracking and implementation of the Construction Sustainability Action Plan during construction (meeting minutes, tracking tools, etc.)
 - iv. Documentation showing the evaluation of progress and change management processes to continually improve performance toward Envision requirements and Project Sustainability Goals (i.e., change orders, meeting minutes)
 - v. Documentation of team communication of Project Sustainability Commitment and Project Sustainability Goals (i.e., construction plans, daily job briefings, job site training/orientation)

- f. Credit LD2.3: Plan for Long-Term Monitoring & Maintenance (Project Target: Conserving, 12 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor was met
 - ii. Documentation of strategies implemented to reduce negative impacts of long-term operations and maintenance, and
 - iii. Records of training and/or communication of long-term operations and maintenance plans and/or procedures to DEN as part of project close-out.

- g. Credit RA1.1: Support Sustainable Procurement Practices (Project Target: Improved, 3 points)
 - i. Credit worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation and calculations demonstrating the percentage of project materials that meet the requirements of the Contractor's Sustainable Procurement Policy, including evidence of disclosure information from the

manufacturer

or

supplier.

- h. Credit RA1.2: Use Recycled Materials (Project Target: Conserving, 16 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation and calculations demonstrating the Project has used at least 50% recycled material.

- i. Credit RA 1.4: Reduce Construction Waste (Project Target: Conserving, 16 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Construction Waste Management Plan
 - iii. Documentation of additional waste reduction strategies implemented by Contractor.
 - iv. Waste management records and calculations demonstrating a 95% total waste diversion rate.

- j. Credit RA 1.5: Balance Earthwork On-Site (Project Target: Conserving, 8 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met.
 - ii. Total volumes of cut and fill.

- k. Credit RA 2.2: Reduce Construction Energy Consumption (Project Target: Superior, 8 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation of identification, selection, and implementation of four (4) construction energy reduction strategies, subject to review by DEN.
 - iii. Calculations and documentation showing the implementation of such strategies have reduced construction energy consumption.

- l. Credit RA 3.3: Reduce Construction Water Consumption (Project Target: Enhanced, 3 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation of identification, selection, and implementation of three (3) construction water reduction strategies, subject to review by DEN.
 - iii. Calculations and documentation demonstrating the implementation of such strategies have resulted in a reduction in construction potable water consumption.

- m. CR 1.1: Reduce Net Embodied Carbon (Project Target: Improved, 5 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Calculations, supporting data, and documentation identifying which materials are primary contributors to net embodied carbon

- iii. Calculations and supporting documentation demonstrating at least a 5% reduction in total embodied carbon of the materials selected for the Project
 - n. Credit NW 2.3 – Reduce Pesticide and Fertilizer Impacts (Project Target: Conserving, 9 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met.
 - ii. Documentation to demonstrate that no pesticides or fertilizers were used on the Project.
 - o. Credit NW 2.4: Protect Surface and Groundwater Quality (Project Target: Superior, 9 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor was met
 - ii. Spill Prevention, Control, and Countermeasures Plan (SPCC) for project site, including staging areas and batch plant.
 - iii. Site inspection records of stormwater management and spill controls measures
 - p. Credit NW 3.4: Control Invasive Species (Project Target: Improved, 6 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation of implementation of Construction Management Plan as it pertains to this credit and the control of infestations during construction
 - iii. Documentation of identified invasive species on the project site
 - q. Credit NW 3.5 Protect Soil Health (Project Target: Enhanced, 3 points)
 - i. Credit Worksheet completed to the targeted level of achievement, demonstrating how all credit criteria required by the Contractor were met
 - ii. Documentation of efforts to restore disturbed soils after construction.
- J. Should the Contractor identify any Envision credit requirements unattainable, they shall contact Engineer immediately with documentation evidencing unattainability of such target. Together, the two shall identify alternative credit requirements to support the Project's Envision pursuit strategy, subject to final approval by DEN Project Manager.

1.5 INFORMATIONAL SUBMITTALS

- A. Sustainability Questionnaire: Provide completed questionnaire prior to the start of construction.
- B. Sustainable Procurement Policy: Contractor shall provide a Sustainable Procurement Policy by which purchasing decisions will be made for the Project. The Policy shall meet the standards provided in the Envision Sustainable Infrastructure Framework Guidance Manual Version 3.

- C. Envision Action Plans: Provide preliminary submittals within 30 days of the date established for commencement of the Work indicating plans for how Envision credit requirements will be met by the Contractor.
- D. Envision Progress Reports: Concurrent with each Application for Payment, the Contractor must submit Envision Progress Reports including 1) actual construction and purchasing activities related to Envision Action Submittals and 2) summary of progress made on Construction Sustainability Action Plan. Contractor shall provide a draft Envision Progress Report template to the Engineer and DEN Project Manager for approval prior to start of construction.
- E. Responses to questions and comments from Engineer, DEN Project Manager, and/or ISI.

1.6 QUALITY ASSURANCE

- A. Envision Sustainability Professional (ENV SP): Engage an experienced ENV SP to coordinate Envision requirements and sign off on the submittals.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to achieve Envision credits required by the Contractor required in this Section. Although other Sections may specify some requirements that contribute to Envision credits, the Contractor shall determine additional materials and procedures necessary to achieve Envision credits indicated.

PART 3 – EXECUTION

3.1 MEASUREMENT AND VERIFICATION

- A. Implement measurement and verification plan consistent with Envision Sustainable Infrastructure Framework Guidance Manual Version 3 to achieve Envision credits required by the Contractor in this Section.

PART 4 – MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. Envision Requirements shall be on an hourly basis. This shall include all administrative requirements, action submittals, information submittals, and quality assurance required by this specification necessary to achieve Envision credits required by Contractor.

PART 5 – PAYMENT

5.1 METHOD OF PAYMENT

- A. Payment for Envision Requirements shall be made at the contract unit price per hour for all requirements necessary to achieve Envision credits required by the Contractor in this section.

Payment Shall Be Made Under:

018113a	Envision Requirements	Per Hour
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END OF SECTION 018113.16

SUSTAINABILITY QUESTIONNAIRE

Company Name:
Date:
Contract Number:

This questionnaire is to be completed by the project team and included before construction start. Positive answers require the submission of supporting documentation in the form of web links and/or attachments.

Company Information- Prime Consultant: Information from subconsultant(s) is not requested.

1. To what extent has your company received third-party recognition or certifications related to sustainability? *(e.g., signatory to the UN Global Compact, listed on the CDP Climate Performance Leadership Index, listed on the Jantzi Social Index, listed on the Dow Jones Sustainability Index, BCorp certification, JUST Label, etc.)*

Supporting documentation: *(web link and/or title of relevant attachment)*

2. To what extent is your company committed to organizational sustainability principles and policies? Please provide relevant links and/or attachments to support. *(e.g., Global Reporting Initiative, corporate GHG emissions reduction targets, corporate energy reduction targets, corporate waste reduction targets).*

Supporting documentation: *(web link and/or title of relevant attachment)*

3. Have any past or ongoing projects, or significant initiatives undertaken, received recognition for improved sustainable performance? Please provide relevant links and/or attachments to support. *(e.g., project write-ups, awards, or third-party recognition received for sustainable performance, efforts or initiatives to train and/or credential staff in sustainability)*

Supporting documentation: *(web link and/or title of relevant attachment)*

Project Team

1. Name of project team's credentialed Envision Sustainability Professional (ENV SP):
2. Credential expiration date:

Supporting documentation: Copy of ENV SP Certificate to be attached.

Project Sustainability Commitment

Sustainability Commitment Statement:

The Project Team is committed to strategically considering the long-term economic, social, and environmental impacts of the activities associated with the design, construction, operation, and maintenance of the Runway 17L-35R Package 2 rehabilitation project. We will work collaboratively to implement sustainable solutions that prioritize improvements in health, safety, and access for all stakeholders; reduce energy use and greenhouse gas (GHG) emissions; maximize diversion of waste materials or resources from landfills; identify methods for reuse of materials (including recycled content and waste byproducts); minimize impacts to local and national operations; and engage DEN stakeholders in improving the long-term operation and maintenance of the project site.

Additional Project Sustainability Goal:

1. Improve resource management for DEN runway rehabilitation projects.

_____ (Company) acknowledges the project's Sustainability Commitment Statement and Project Sustainability Goal. As a member of the project team, _____ (Company) will support the upholding of the statement and achievement of goals.

Signature:
Name, Title:

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Basis of Design (BOD) documentation included by reference for information only.
- C. Specification Sections:
 - 1. Section 013100 – Project Management and Coordination
 - 2. Section 013119 – Project Meetings
 - 3. Section 013300 – Submittal Procedures
 - 4. Section 014510 – Contractor Quality Control

1.2 SUMMARY

- A. Scope
 - 1. Commissioning requirements common to all Sections
 - 2. Systems and equipment functional performance testing
 - 3. Validation of proper and thorough installation of systems and equipment
 - 4. Equipment performance verification
 - 5. Documentation of tests, procedures, and observations.
 - 6. Review of DEN Training agency.
- B. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- C. Related Sections
- D. Related Sections

1.3 DEFINITIONS

- A. Acceptance Phase: The phase of the project when the facility and its systems and equipment are inspected, tested, verified, and documented; and when most of the Functional Performance Testing and formal training occurs. This will generally occur after the Construction Phase is complete (start-up and checks have been accomplished). The Acceptance Phase typically begins with Substantial Completion and ends with Final I Completion.

GENERAL COMMISSIONING REQUIREMENTS

- B. Commissioning Authority (CA or CxA): The Party retained by DEN who will oversee the Commissioning process as well as develop and stipulate many of the Commissioning requirements. They will also manage the Commissioning process, and ensure and validate that systems and equipment are designed, installed, and tested to meet DEN's requirements.
- C. Commissioning Contact (CxC): Individuals, appointed by the installing contractor, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action.
- D. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- E. Construction Phase: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subcontractors complete the installation, complete start-up documentation, submit operation and maintenance information, establish trends, and perform any other applicable requirements to get systems started. Contractor and Vendors may also conduct equipment specific training. The Construction Phase will generally end upon Substantial Completion.
- F. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the General Contractor, subcontractors, or vendors as inferred by its usage.
- G. Deficiency: A condition in the installation or function of a component, piece of equipment or system that does not comply with the Contract Documents, i.e., does not perform properly or is not complying with the design intent.
- H. Energy Management Control System (EMCS): The computer-based heating, ventilation, and air-conditioning (HVAC) control system.
- I. Factory Authorized Representative: An individual fully trained on the equipment and certified by the manufacturer to perform the respective task.
- J. Factory Testing: Testing of equipment off-site at the manufacturer's facility. The testing may be witnessed by the members of the project team.
- K. Functional Performance Testing (FPT): The detailed and thorough testing of building systems and their interactions with building components and other building systems.
- L. Issue Log: This list is maintained and updated by the Commissioning Authority that includes all Issue items that relate to Commissioning activities and site observations requiring contractor action or response.
- M. Maximum Failure Limit: The maximum percentage of a test population that is permitted to fail before the test is considered a failure and subject to correction and retesting. Where test sampling is used, the Maximum Failure Limit shall be the maximum percentage of a test sample that is permitted to fail before an entirely new sample must be selected for testing.

- N. Operation and Maintenance (O&M) Documentation: Contractor-developed documentation designed to address the needs of facilities personnel and customized for the context of the specific facility and installation. This includes manufacturer's literature (including O&M manuals, parts lists, troubleshooting guides, etc.), Contractor-developed instructions for start-up and shut-down, control sequences, and other installation-specific information.
- O. Pre-Start Up: Preliminary testing accomplished during a scheduled system outage to verify system functionality prior to placing the system/equipment into preliminary service.
- P. Start-Up: Refers to the quality control process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the Start-Up Checklist, energizes the device, verifies that it is in proper working order and ready for dynamic testing, including Start-Up Tests.
- Q. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- R. Test, Adjust, and Balance (TAB): Refers to the test, adjust, and balance process or the Testing, Adjusting, and Balancing Contractor.

1.4 ACTION SUBMITTALS

A. General requirements:

1. Provide individual checklists and procedures for each system or component.
2. Develop individual checklists and procedures for each tagged piece of equipment. General procedures developed for multiple pieces of equipment, including similar equipment, are not acceptable.
3. Procedures and checklists for specified phases of commissioning (e.g. Pre-startup, startup, functional performance testing) must be submitted and approved prior to commencement of the related activity.

B. CxA submittals:

1. Commissioning plan.
2. Pre-functional checklists: For each system or component.
3. Startup procedures: For each system or component.
4. Startup checklists: For each system or component.
5. Completed startup checklists: For each system or component.
6. Functional Test Procedures: For each system or component.
7. Functional Test Checklists: For each system or component.
8. Formal acceptance recommendation for each component or system tested, following successful completion of testing.

C. Contractor submittals:

1. Completed pre-functional checklists: For each system or component.
2. Completed startup checklists: For each system or component.
3. Completed functional test checklists: For each system or component.

1.5 INFORMATIONAL SUBMITTALS

A. CxA submittals:

1. Qualifications: For CxA and testing technicians.
2. Test equipment calibration certificates.
3. Preliminary Commissioning Report, including the following:
 - a. Compiled test results.
 - b. Updated Issues Log.
 - c. Updated Checklist log.
4. Final Commissioning Report, including the following:
 - a. Compiled test results.
 - b. Seasonal test results.
 - c. Warranty walkthrough results.
 - d. Completed issues log.
 - e. Completed checklist log.

1.6 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Contractor shall appoint a CxC.
2. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by DEN Project Manager:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. DEN will engage the CxA under a separate contract.
2. Representatives of DEN Sustainability, DEN Project Manager Representative, and DEN Maintenance personnel.
3. Architect and engineering design professionals.

1.7 DEN'S RESPONSIBILITIES

- A. Assign DEN Sustainability and Operations Maintenance personnel and schedule them to participate in commissioning team activities.
- B. Coordinate activities specified in paragraph below with DOR and Architect-Consultant agreements.

- C. Provide the BoD documentation, prepared by DOR, and approved by DEN, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.8 EACH CONTRACTOR'S RESPONSIBILITIES

- A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Include Commissioning requirements in price and plan for work.
2. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
3. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
4. Attend commissioning team meetings held on a weekly basis and progressing to weekly meetings as construction project nears completion.
5. Integrate and coordinate commissioning process activities with construction schedule.
6. Review and accept construction pre-functional checklists provided by the CxA prior to commencing functional testing.
7. Complete electronic construction checklists as Work is completed and provide to the DEN Project Manager after each checklist has been completed.
8. Review and accept commissioning process functional test procedures provided by the Commissioning Authority.
9. Designate a CxC from each major subcontractor with activities related to commissioning. These CxCs are to be the primary contacts for Commissioning activities.
10. Contractor shall incorporate the Commissioning process into the construction schedule, outlining generic Commissioning tasks with precedents or prerequisites to each task. These tasks will apply to many systems and the Contractor shall incorporate as such. Examples of enumerated tasks include, but are not limited to:
 - a. Contractor preparation of the Training Plan
 - b. Testing Agency activities
 - c. Contractor documentation of pipe pressure testing, flushing, and cleaning of applicable systems
 - d. Documentation of the Start-Up Procedures for equipment and systems
 - e. TAB of applicable system
 - f. Preparation of the O&M Manual content
 - g. FPT and Acceptance
 - h. Observation Period and System Optimization
 - i. Occupant or other Regulatory Agency testing or approval process

11. Assist the CxA in preparation for the specific FPT procedures. Contractors, subcontractors, and vendors shall review the FPTs to ensure feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests. Damage caused to equipment performed in accordance with the approved procedures that is the result of malfunctioning equipment or contract deficiencies, shall be the responsibility of the Contractor.
 12. Record start-up and testing procedures.
 13. Demonstrate the operation of all systems as specified.
 - a. Operate systems, with assistance of DEN Maintenance, under direction of the CxA during FPT's and other acceptance testing.
- B. Acceptance Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Acceptance Phase.
1. Work in conjunction with CxA in FPT and shall include, but not limited to the following:
 - a. Operate and Manipulate systems and equipment to facilitate testing (as dictated in this section, relevant technical sections and the Commissioning Plan).
 - b. Operate and Manipulate EMCS and other control systems to facilitate FPT (as dictated in this section, relevant technical sections and the Commissioning Plan).
 2. Correct any work not in accordance with Contract Documents.
 3. Maintain record documentation and update and resubmit it after Functional Completion.
 4. Compensate DEN for additional CxA fees and expenses incurred to retest equipment and systems following testing failures.
 5. Monitor systems, equipment, and areas throughout the Transition Period. Log and diagnose all alarms during this period. Maintain trends and logs of all critical parameters. Forward the logs and trends on a weekly basis throughout all Transition Periods.
- C. Warranty Period: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Warranty Period.
1. Provide warranty service
 2. Conduct EMCS Sequence Training
 3. Respond to and document Warranty issues
 4. Correct any deficiencies identified throughout the Warranty Period
 5. Update record documentation to reflect any changes made throughout the Warranty Period and resubmit final Record Drawings and data records at the close of the Warranty period

1.9 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team through the entire project.

- B. Provide and update construction phase commissioning plans.
- C. Convene commissioning team meetings to discuss commissioning activities and current issues and resolutions.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Review all pertinent equipment submittals, shop drawings, and O&M documentation.
- F. Verify the execution of commissioning process activities. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the DPR. When a requirement is not met, the CxA will report the failure in the Issues Log.
- G. Prepare and maintain the Issues Log.
- H. Prepare and maintain completed construction checklist log.
- I. Organize and lead the functional, seasonal, any LEED required tests, and 10-month Warranty review in the presence of the contractor, DEN Maintenance, and DEN PM assigned personnel.
- J. Witness systems, assemblies, equipment, and component startup.
- K. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

1.10 ISSUES LOG

- A. CxA shall maintain an Issues Log (required information, identified deficiencies, work required, etc.) that relates to Commissioning. Each item shall be tracked with the initiator, the parties responsible, due date, the date of closure, and a description of the resolution. Each item shall be categorized for sorting and tracking and for documentation on applicable forms.
- B. CxA will provide this list to the DEN Project Manager during regular project meetings as appropriate to keep all parties informed.
- C. All parties indicated as responsible for an action item shall respond to the DEN Project Manager. Responses are due within 10 days of action items being identified to the team.

1.11 PRE-START UP

- A. PREREQUISITES

1. All equipment, components, and devices applicable to the Pre-Start Up must be installed, and the Pre-Start Up must be documented and approved. This includes installation, identification labeling, insulation, and all other requirements for placing systems into dynamic operation.

B. COMMON ELEMENTS

1. Required submittal documentation shall be present and located convenient to testing area.
2. Contractor shall submit the completed Pre-Start Up Procedures at least 10 days prior to the start of Functional testing. CxA shall review the Pre-Start Up Procedure documentation at the beginning of Start Up. Contractor shall demonstrate to DEN Project Manager, DEN Maintenance and DEN Sustainability that access is sufficient to perform required maintenance.
3. System and equipment configurations shall be compared against the contract documents.

1.12 INSTRUMENTATION

- A. All test instruments described in this section shall be acceptable for any portion of the commissioning process herein described.
- B. All instruments shall conform to the standards specified in the most recent edition of "NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" regarding accuracy and calibration status. Current calibration certificates must be available to the CxA if requested.
- C. Test instrument accuracy and resolution must match or exceed that of the system component being verified or calibrated.
- D. Test instruments must be used within guidelines as recommended by instrument manufacturer. All measuring methods must be appropriate to the instrument application and measurements must be repeatable under equivalent conditions.
- E. Standard Testing Instrumentation: Standard instrumentation normally used for performance assessment and diagnosis shall be provided by testing entity. These include, but are not limited to:
 1. Electronic Manometer (for Air and Flow Hood)
 2. Electronic Manometer (for Water)
 3. Temperature Instruments
 4. [Pressure instruments]
 5. Humidity Instruments
 6. CO2 Instrument
 7. Sound Meter
 8. Electronic Multimeter
 9. Tachometer
 10. Ultrasonic Flow Meter
 11. Others as required

1.13 START-UP

A. Prerequisites

1. All equipment, components, and devices applicable to the FPT must be started, and the Start-Up must be documented and approved. This includes completion of Start-Up Procedures, pressure testing (of equipment, duct and piping), flushing/cleaning, identification labeling, insulation, and all other requirements for placing systems into dynamic operation.
2. Unless specifically agreed to by DEN and CxA, all support systems shall be complete prior to FPT.
3. The CxA shall determine the optimal sequence of testing.

B. Common Elements

1. Required submittal documentation shall be present and located convenient to testing area. Validate that all required documentation has been submitted and [complete] per the contract requirements.
2. Contractor shall provide the completed Start-Up Procedures at the time of testing. CxA shall review the Start-Up Procedure documentation and spot-check at the beginning of FPT.

C. Procedure

1. Purpose:
 - a. Verify adherence to, and documentation of, quality control processes involved with preparing systems and equipment for operation.
 - b. These procedures shall be performed on all installed systems and equipment and no sampling strategy is used for the start-up process.
 - c. The Commissioning process requires all Parties to collaborate to establish the optimal standard of care for starting systems and equipment.
 - d. After the procedures are established, the Contractor performs them and documents them with the Start-up Procedures that are developed by the Contractor.
2. Start-Up Procedures: The content of these Start-Up Procedures shall provide the minimally acceptable content in accordance with the OEM field quality control requirements. Generic refers to the fact that the protocols may be created before the shop drawings are finalized. These procedures and protocols will normally be common across different manufacturers.
3. Content of Start-Up Procedures: Start-Up Procedures shall generally include the following for each item of equipment or system (as applicable):
 - a. Project-specific designation, location, and service.
 - b. Indication of the Party performing and documenting the Start-Up Procedure.
 - c. Clear explanation of the inspection, test, measurement, and outcome with a Pass/Fail indication and a record of measure parameters.
 - d. A Start-up Checklist item indicating that proper maintenance clearances have been maintained.

GENERAL COMMISSIONING REQUIREMENTS

4. Recording and Documentation of Factory Start-Up: Manufacturer's start-up protocols shall be executed and forms shall be completed by a qualified/authorized technician.
5. Recording and Documentation of non-Factory Start-Up: The start-up tests and checklists shall be completed by a qualified technician.
6. Commissioning Authority Review: CxA will review and spot-check procedures during FPT.
7. Documentation Completion: The individual executing the start-up must complete the start-up and pre-functional documentation for any given equipment and acknowledge acceptability with the indication of who did the associated task.
8. Sampling and Final Submission: All (100% of) systems are started and documented per the approved procedures and NO sampling strategy is used. Completed Start-up and pre-functional checklists for all pieces of equipment associated with independent systems shall be submitted to CxA prior to any associated FPT. Any outstanding item shall be clearly indicated and an associated Action Item must be entered to track resolution.
9. DEN Access: Contractor shall allow access by DEN representatives to inspect the equipment and ensure its proper operation.

1.14 TEST, ADJUST, AND BALANCE

- A. CxA shall review TAB reports.
- B. The CxA shall select up to 10% of the readings from the Balancing Reports and verify performance readings. Readings selected by the CxA may include:
 1. Supply air diffuser readings (both minimum and maximum readings for variable air volume boxes).
 2. Main and branch supply duct traverse readings.
 3. Outside/return air flow readings.
 4. Exhaust airflow readings.
 5. Water flow readings.
 6. Ampere readings.
 7. Water pressure drop readings through coils, heat exchangers, and other hydronic elements.
- C. For all readings, a deviation of more than 10% between the verification reading and reported data shall be considered as failing the FPT. The maximum failure rate for the sample is 10%.
- D. If greater than 10% of sample readings have failed, the TAB contractor shall justify all noted failures or rebalance and re-document the system.

1.15 FUNCTIONAL PERFORMANCE TESTING

- A. Objectives and Scope
 1. Demonstrate that each system is operating according to the documented design intent and Contract Documents.

GENERAL COMMISSIONING REQUIREMENTS

2. Bring all commissioned systems from a state of substantial completion to full dynamic operation.
3. Identify and correct performance deficiencies.
4. Operate each system through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, normal and emergency power, fire alarm, part-and full-load) where there is a specified system response.
5. Verify each sequence in the sequences of operation as required.
6. Verify responses to abnormal operational modes and conditions, such as power failure, freeze conditions, no flow, equipment failure, etc.

B. Development of Test Procedures

1. CxA shall develop specific [and custom] test procedures to verify and document proper operation of each piece of equipment and system.
2. CxA shall develop fill-in forms for use during FPT, based on the test procedures.
3. Not less than 14 days prior to execution of FPT, CxA shall submit completed test procedures to the DEN Project Manager to review the tests for feasibility, safety, equipment and warranty protection, and scope.
4. EMCS trends shall have been established as required in the documents. These shall generally be reviewed prior to or during FPT.
5. Capacities and adjusted/balanced conditions as applicable shall be subject to review.
6. Sequencing Verification: For applicable systems and equipment, all modes of operation shall be verified for proper sequencing.
7. System and equipment configurations shall be compared against the contract documents.
8. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe, and stable operation.

C. Scheduling:

1. Contractor shall notify the CxA and the DEN Project Manager that systems are ready for testing, to schedule FPT.
2. To the extent practical, tests shall be scheduled to allow efficient and contiguous testing of inter-related systems and equipment.

D. Phasing:

1. Non-interdependent segments of the project testing may be phased.
2. Phasing of FPT for this project shall be coordinated between the CxA, Contractor, and the DEN Project Manager as the project progresses.

E. Participation:

1. CxA shall witness and document FPTs performed by the contractor after Start-Up Procedure documentation of systems and equipment has been reviewed and accepted.

GENERAL COMMISSIONING REQUIREMENTS

2. Contractor shall perform the FPTs as described, with manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders, specialty test equipment, safety equipment), and on-the-spot remediation of minor identified deficiencies whenever possible.
3. Required participating Parties shall be indicated in the test plan for each individual FPT.
4. Required participating parties shall be available on-site throughout the testing of any given system for which they are required participants.
5. CxA shall coordinate effectively with the individual Contractors throughout FPT and minimize their required involvement.

F. Completeness:

1. All systems must be completed and ready for FPT at the time of the test.
2. All start up, factory authorized field testing, independent testing agency tests, and TAB procedures must be complete and the control systems must be tested and operational for the respective system or component.

G. Test Documentation:

1. CxA shall witness and document the tests.
2. CxA shall record all test results on the forms developed for the testing.
3. CxA shall 'Pass' or 'Fail' the testing and record the date and time of the test.
4. Deficiencies shall be clearly indicated when the test is failed.
5. When all related testing is completed successfully, CxA shall recommend acceptance of the system or component.
6. In the case of specialized testing, CxA shall witness and review the testing reports prepared by the Contractor.

H. Acceptance Criteria

1. The Acceptance Criteria shall be as follows unless specifically indicated within applicable individual specification sections or test procedures.
 - a. Accuracy/repeatability on sensing devices will be as specified for the device. CxA and TAB will use calibrated gauges for independent validation of sensing devices.
 - b. HVAC sequence-related criteria will be as specified in the documents.

I. Deficiencies

1. CxA shall record the results of each functional test. All deficiencies or non-conformance issues shall be brought to Contractor's attention immediately, noted in the Issues Log, and reported to the DEN Project Manager within 72 hours.
 - a. Corrections of identified minor deficiencies may be made during the tests where feasible. In such cases, the deficiency will be noted on the FPT documents.
 - b. Deficiencies with potential schedule or cost impacts shall be reported to the DEN Project Manager within 24 hours of discovery.

2. Contractor shall correct all identified deficiencies as directed by the DEN Project Manager.
 - a. CxA shall maintain Contractor's response to each deficiency in the Issues Log.
 - b. Contractor shall correct each deficiency, and notify CxA upon completion by completing an action item response.
 - c. Contractor shall schedule repeat testing and ensure CxA is available to observe.
 3. Disputes:
 - a. Contractor shall notify the DEN Project Manager and CxA immediately if the responsibility or nature of any identified deficiency is in dispute.
 - b. The CxA shall document as a disputed deficiency in the Issues Log.
 - c. The Contractor shall negotiate a resolution to the dispute with the DEN Project Manager.
 - d. Upon resolution, CxA shall update the Issues Log to reflect the status of the deficiency
- J. Sampling Percentage:
1. Sampling percentage shall be as indicated in the test plan.
 2. Where no sampling percentage is indicated, the implied sampling percentage is 100% and all units shall be tested.
- K. Maximum Failure Limit:
1. Maximum Failure Limit shall be as indicated in the test plan.
 2. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.
 3. If no Maximum Failure Limit is indicated, the implied failure limit is 0% and all tested samples must pass.
 4. Where sample tests involve multiple systems (i.e., checking strainers on different hydronic systems), the Maximum Failure Limit will apply per system.
 5. The responsible Contractors shall reimburse DEN for the CxA's cost of that sample test, and redo the start-up and TAB for the applicable devices/systems.
 6. All work necessitated by sample failures shall be at no cost to DEN.
- L. Manufacturer's Defects:
1. If 10% of identical pieces of equipment fail to perform to the Contract Documents (mechanically or substantively) due to a manufacturing defect, all identical units may be considered unacceptable by the DEN Project Manager.
 2. For the purposes of defining 'identical equipment' for this Section, size or capacity alone does not constitute a difference.
 3. In case of failure due to manufacturer's defects, the Contractor shall provide DEN with the following:
 - a. Manufacturer's response in writing as to the cause of the failure and proposed resolution.

- b. Manufacturer shall implement their proposed resolution on a representative sample of the product.
- c. The DEN Project Manager will determine whether a replacement of all identical units or a repair is acceptable.
- d. Upon acceptance, the Contractor shall replace or repair all identical items at their expense and shall extend the warranty accordingly (if the original equipment warranty had begun).
- e. Manufacturer shall pay the costs of all retesting necessitated by the failure.

1.16 CLOSEOUT

A. Commissioning Report

1. A final summary report by the CxA shall be provided to the DEN Project Manager, focusing on evaluating commissioning process issues and identifying areas where the process could be improved.
2. Include all acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., compiled in appendices, and provided with the summary report.
3. Pre-Start Up verification, Start Up checklists, TAB, functional tests, and monitoring reports shall not be included the final report, but shall be submitted as part of the Commissioning Record in the O&M manuals.

B. Logs

1. CxA shall submit an updated Issues Log and all Issues Logs upon substantial completion of the project.

C. Acceptance

1. CxA shall recommend acceptance of each test in writing to the DEN Project Manager.
2. The CxA shall note each satisfactorily demonstrated function on the test documentation.
3. Tests shall be considered accepted only upon formal acceptance by the DEN Project Manager.

D. Training

1. The Contractor shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
2. The CxA shall witness the content and adequacy of the training of DEN personnel for commissioned equipment. Any issues shall be noted in the Issues Log and reported immediately to the DEN Project Manager.

E. Operation and Maintenance Manual and Record Drawing Review

1. Prior to substantial completion, the CxA shall review the O&M manuals, documentation, and redlined as-built drawings for systems that were commissioned to verify compliance with the Specifications.

2. The CxA shall review completed record drawings and document any discrepancies in the Issues Log.

1.17 WARRANTY PERIOD

A. Warranty Walkthrough

1. General Requirements

- a. Contractor and CxA, as directed by the DEN Project Manager, shall participate in an on-site walkthrough to review the condition of the project prior to expiration of the Contractor's warranty (the "warranty walkthrough").
- b. The warranty walkthrough shall occur not less than nine (9) months following substantial completion, and not more than eleven (11) months following substantial completion.
- c. Any deficiencies identified during the warranty walkthrough shall be identified and tracked using the Issues Log, and shall be provided in writing to the DEN Project Manager.

2. Required Attendees:

- a. Installing Contractor, and subcontractor representatives.
- b. TAB Contractor.
- c. CxA.
- d. DEN Project Manager, or authorized representative.
- e. DEN Asset Manager, or authorized representative.
- f. <insert attendees>.

3. Contractor's Responsibilities

- a. Contractor shall provide personnel at the warranty walkthrough as necessary to facilitate operation of equipment and testing procedures. Confirm with the DEN Project Manager a full list of attendees with their contact information not less than (4) weeks prior to scheduled warranty walkthrough. Required attendees shall include:
 - 1) Contractor's Project Manager.
 - 2) Manufacturer's representative(s) for commissioned equipment.
 - 3) Electrical Subcontractor.
 - 4) Mechanical Subcontractor.
 - 5) Others, as required by the DEN project Manager.
 - 6) <insert attendees>.
- b. Contractor, or designated subcontractor or manufacturer's representative under direction of Contractor, shall operate equipment during the warranty walkthrough as directed by the DEN Project Manager.

4. CxA's Responsibilities

GENERAL COMMISSIONING REQUIREMENTS

- a. CxA, under direction from the DEN Project Manager and DEN Asset Management, shall facilitate the inspection and verification of all commissioned systems as part of the on-site warranty walkthrough.
- b. CxA shall perform visual inspection of equipment to document any warranty-related defects or damage.
- c. CxA shall perform basic functional verification of equipment to affirm the equipment is operating in compliance with Contract Documents.
- d. The CxA shall document any deficiencies found during the warranty walkthrough in the Issues Log and notify the DEN Project Manager.
- e. Required documentation:
 - 1) Not less than (4) weeks prior to the scheduled warranty walkthrough, submit a warranty inspection checklist, including:
 - a) A section for each individual piece of equipment.
 - b) Expected attendees and responsibilities.
 - c) Fields or checkboxes for each individual inspection procedure or measurement as directed by the DEN Project Manager.
 - 2) CxA shall provide the approved warranty inspection checklist for use on-site at the warranty walkthrough.
 - 3) CxA shall provide the current Issues Log for use on-site at the warranty walkthrough.
 - 4) CxA shall provide an updated Issues Log to the DEN Project Manager following completion of the warranty walkthrough.

B. Seasonal Testing

1. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract.
2. The CxA shall coordinate this activity with the DEN Project Manager and the Contractor.
3. Tests will be executed, documented and deficiencies corrected by the appropriate parties, with DEN maintenance staff and the CxA witnessing.
4. Any final adjustments to the O&M manuals and Record Drawings due to the testing will be made by the responsible parties.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION (Not Used)****PART 4 - MEASUREMENT****4.1 METHOD OF MEASUREMENT**

- A. No separate measurement shall be made for work under this Section.

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
019113
GENERAL COMMISSIONING REQUIREMENTS

DENVER INTERNATIONAL AIRPORT
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PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. .

END OF SECTION 019113

TECHNICAL SPECIFICATIONS
01 GENERAL REQUIREMENTS
019113
GENERAL COMMISSIONING REQUIREMENTS

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DENVER
INTERNATIONAL
AIRPORT

PROJECT MANUAL

Runway 17L-35R Pavement Rehabilitation and Electrical Upgrades Package 2

DESIGN CONTRACT NO. 202158114, TASK 7
CONST. CONTRACT NO. 202473360

PART II

TECHNICAL SPECIFICATIONS

Issued for Construction, May 29, 2024

CITY & COUNTY OF DENVER
DEPARTMENT OF AVIATION

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Part 1 – General Contract Provisions

Section 10 Definition of Terms

When the following terms are used in these specifications, in the contract, or in any documents or other instruments pertaining to construction where these specifications govern, the intent and meaning shall be defined as follows:

Paragraph Number	Term	Definition
10-01	AASHTO	The American Association of State Highway and Transportation Officials.
10-02	Access Road	The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public roadway.
10-03	Advertisement	A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.
10-04	Airport	Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft; an appurtenant area used or intended to be used for airport buildings or other airport facilities or rights of way; airport buildings and facilities located in any of these areas, and a heliport.
10-05	Airport Improvement Program (AIP)	A grant-in-aid program, administered by the Federal Aviation Administration (FAA).
10-06	Air Operations Area (AOA)	The term air operations area (AOA) shall mean any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.
10-07	Apron	Area where aircraft are parked, unloaded or loaded, fueled and/or serviced.
10-08	ASTM International (ASTM)	Formerly known as the American Society for Testing and Materials (ASTM).
10-09	Award	The Owner's notice to the successful bidder of the acceptance of the submitted bid.

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Paragraph Number	Term	Definition
10-10	Bidder	Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.
10-11	Building Area	An area on the airport to be used, considered, or intended to be used for airport buildings or other airport facilities or rights-of-way together with all airport buildings and facilities located thereon.
10-12	Calendar Day	Every day shown on the calendar.
10-13	Certificate of Analysis (COA)	The COA is the manufacturer's Certificate of Compliance (COC) including all applicable test results required by the specifications.
10-14	Certificate of Compliance (COC)	The manufacturer's certification stating that materials or assemblies furnished fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer's authorized representative.
10-15	Change Order	A written order to the Contractor covering changes in the plans, specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for work within the scope of the contract and necessary to complete the project.
10-16	Contract	A written agreement between the Owner and the Contractor that establishes the obligations of the parties including but not limited to performance of work, furnishing of labor, equipment and materials and the basis of payment. The awarded contract includes but may not be limited to: Advertisement, Contract form, Proposal, Performance bond, payment bond, General provisions, certifications and representations, Technical Specifications, Plans, Supplemental Provisions, standards incorporated by reference and issued addenda.
10-17	Contract Item (Pay Item)	A specific unit of work for which a price is provided in the contract.
10-18	Contract Time	The number of calendar days or working days, stated in the proposal, allowed for completion of the contract, including authorized time extensions. If a calendar date of completion is stated in the proposal, in lieu of a number of calendar or working days, the contract shall be completed by that date.

Paragraph Number	Term	Definition
10-19	Contractor	The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the work contracted and for the payment of all legal debts pertaining to the work who acts directly or through lawful agents or employees to complete the contract work.
10-20	Contractors Quality Control (QC) Facilities	The Contractor's QC facilities in accordance with the Contractor Quality Control Program (CQCP).
10-21	Contractor Quality Control Program (CQCP)	Details the methods and procedures that will be taken to assure that all materials and completed construction required by the contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors.
10-22	Control Strip	A demonstration by the Contractor that the materials, equipment, and construction processes results in a product meeting the requirements of the specification.
10-23	Construction Safety and Phasing Plan (CSPP)	The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications.
10-24	Drainage System	The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.
10-25	Engineer	The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for engineering, inspection, and/or observation of the contract work and acting directly or through an authorized representative.
10-26	Equipment	All machinery, together with the necessary supplies for upkeep and maintenance; and all tools and apparatus necessary for the proper construction and acceptable completion of the work.
10-27	Extra Work	An item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which is found by the Owner's Engineer or DEN Project Manager to be necessary to complete the work within the intended scope of the contract as previously modified.

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Paragraph Number	Term	Definition
10-28	FAA	The Federal Aviation Administration. When used to designate a person, FAA shall mean the Administrator or their duly authorized representative.
10-29	Federal Specifications	The federal specifications and standards, commercial item descriptions, and supplements, amendments, and indices prepared and issued by the General Services Administration.
10-30	Force Account	<p>a. Contract Force Account - A method of payment that addresses extra work performed by the Contractor on a time and material basis.</p> <p>b. Owner Force Account - Work performed for the project by the Owner's employees.</p>
10-31	Intention of Terms	<p>Whenever, in these specifications or on the plans, the words “directed,” “required,” “permitted,” “ordered,” “designated,” “prescribed,” or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer and/or DEN Project Manager is intended; and similarly, the words “approved,” “acceptable,” “satisfactory,” or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer and/or DEN Project Manager, subject in each case to the final determination of the Owner.</p> <p>Any reference to a specific requirement of a numbered paragraph of the contract specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such specific reference.</p>
10-32	Lighting	A system of fixtures providing or controlling the light sources used on or near the airport or within the airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the airport surface.
10-33	Major and Minor Contract Items	A major contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 20% of the total amount of the award contract. All other items shall be considered minor contract items.
10-34	Materials	Any substance specified for use in the construction of the contract work.

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Paragraph Number	Term	Definition
10-35	Modification of Standards (MOS)	Any deviation from standard specifications applicable to material and construction methods in accordance with FAA Order 5300.1.
10-36	Notice to Proceed (NTP)	A written notice to the Contractor to begin the actual contract work on a previously agreed to date. If applicable, the Notice to Proceed shall state the date on which the contract time begins.
10-37	Owner	The term “Owner” shall mean the party of the first part or the contracting agency signatory to the contract. Where the term “Owner” is capitalized in this document, it shall mean airport Sponsor only. The Owner for this project is <u>the City and County of Denver</u> .
10-38	Passenger Facility Charge (PFC)	Per 14 Code of Federal Regulations (CFR) Part 158 and 49 United States Code (USC) § 40117, a PFC is a charge imposed by a public agency on passengers enplaned at a commercial service airport it controls.
10-39	Pavement Structure	The combined surface course, base course(s), and subbase course(s), if any, considered as a single unit.
10-40	Payment bond	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will pay in full all bills and accounts for materials and labor used in the construction of the work.
10-41	Performance bond	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.
10-42	Plans	The official drawings or exact reproductions which show the location, character, dimensions and details of the airport and the work to be done and which are to be considered as a part of the contract, supplementary to the specifications. Plans may also be referred to as 'contract drawings.'
10-43	Project	The agreed scope of work for accomplishing specific airport development with respect to a particular airport.
10-44	Proposal	The written offer of the bidder (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications.

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Paragraph Number	Term	Definition
10-45	Proposal guaranty	The security furnished with a proposal to guarantee that the bidder will enter into a contract if their own proposal is accepted by the Owner.
10-46	Quality Assurance (QA)	Owner’s responsibility to assure that construction work completed complies with specifications for payment.
10-47	Quality Control (QC)	Contractor’s responsibility to control material(s) and construction processes to complete construction in accordance with project specifications.
10-48	Quality Assurance (QA) Inspector	An authorized representative of the Engineer and/or DEN Project Manager assigned to make all necessary inspections, observations, tests, and/or observation of tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.
10-49	Quality Assurance (QA) Laboratory	The official quality assurance testing laboratories of the Owner or such other laboratories as may be designated by the Engineer or DEN Project Manager. May also be referred to as Engineer’s, Owner’s, or QA Laboratory.
10-50	Resident Project Representative (RPR)	The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for all necessary inspections, observations, tests, and/or observations of tests of the contract work performed or being performed, or of the materials furnished or being furnished by the Contractor, and acting directly or through an authorized representative.
10-51	Runway	The area on the airport prepared for the landing and takeoff of aircraft.
10-52	Runway Safety Area (RSA)	A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft. See the construction safety and phasing plan (CSPP) for limits of the RSA.
10-53	Safety Plan Compliance Document (SPCD)	Details how the Contractor will comply with the CSPP.
10-54	Specifications	A part of the contract containing the written directions and requirements for completing the contract work. Standards for specifying materials or testing which are cited in the contract specifications by reference shall have the same force and effect as if included in the contract physically.

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Paragraph Number	Term	Definition
10-55	Sponsor	A Sponsor is defined in 49 USC § 47102(24) as a public agency that submits to the FAA for an AIP grant; or a private Owner of a public-use airport that submits to the FAA an application for an AIP grant for the airport.
10-56	Structures	Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein.
10-57	Subgrade	The soil that forms the pavement foundation.
10-58	Superintendent	The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the DEN Project Manager, and who shall supervise and direct the construction.
10-59	Supplemental Agreement	A written agreement between the Contractor and the Owner that establishes the basis of payment and contract time adjustment, if any, for the work affected by the supplemental agreement. A supplemental agreement is required if: (1) in scope work would increase or decrease the total amount of the awarded contract by more than 25%; (2) in scope work would increase or decrease the total of any major contract item by more than 25%; (3) work that is not within the scope of the originally awarded contract; or (4) adding or deleting of a major contract item.
10-60	Surety	The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds that are furnished to the Owner by the Contractor.
10-61	Taxilane	A taxiway designed for low speed movement of aircraft between aircraft parking areas and terminal areas.
10-62	Taxiway	The portion of the air operations area of an airport that has been designated by competent airport authority for movement of aircraft to and from the airport's runways, aircraft parking areas, and terminal areas.
10-63	Taxiway/Taxilane Safety Area (TSA)	A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft. See the construction safety and phasing plan (CSPP) for limits of the TSA.

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Paragraph Number	Term	Definition
10-64	Work	The furnishing of all labor, materials, tools, equipment, and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the contract, plans, and specifications.
10-65	Working day	A working day shall be any day other than a legal holiday, Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least six (6) hours toward completion of the contract. When work is suspended for causes beyond the Contractor's control, it will not be counted as a working day. Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work will be considered as working days.
10-66	Owner Defined terms	DEN Project Manager. The Individual duly authorized by the owner to be responsible for engineering inspection of the contract work and acting directly or through an authorized representative. For the purposes of this project, the terms DEN Project Manager and Resident Project Representative (RPR) shall be interchangeable.

6

END OF SECTION 10

7

Section 20 Proposal Requirements and Conditions

8 **20-01 Advertisement (Notice to Bidders).** This project has been advertised on the DEN Contract
9 Procurement Website. <http://business.flydenver.com/bizops/bids.asp>.

10 **20-02 Qualification of bidders.** Each bidder shall submit evidence of competency and evidence of financial
11 responsibility to perform the work to the Owner at the time of bid opening.

12 Evidence of competency, unless otherwise specified, shall consist of statements covering the bidder's past
13 experience on similar work, and a list of equipment and a list of key personnel that would be available for the
14 work.

15 Each bidder shall furnish the Owner satisfactory evidence of their financial responsibility. Evidence of financial
16 responsibility, unless otherwise specified, shall consist of a confidential statement or report of the bidder's
17 financial resources and liabilities as of the last calendar year or the bidder's last fiscal year. Such statements or
18 reports shall be certified by a public accountant. At the time of submitting such financial statements or reports,
19 the bidder shall further certify whether their financial responsibility is approximately the same as stated or
20 reported by the public accountant. If the bidder's financial responsibility has changed, the bidder shall qualify
21 the public accountant's statement or report to reflect the bidder's true financial condition at the time such
22 qualified statement or report is submitted to the Owner.

23 Unless otherwise specified, a bidder may submit evidence that they are prequalified with the State Highway
24 Division and are on the current "bidder's list" of the state in which the proposed work is located. Evidence of
25 State Highway Division prequalification may be submitted as evidence of financial responsibility in lieu of the
26 certified statements or reports specified above.

27 **20-03 Contents of proposal forms.** The Owner's proposal forms state the location and description of the
28 proposed construction; the place, date, and time of opening of the proposals; and the estimated quantities of
29 the various items of work to be performed and materials to be furnished for which unit bid prices are asked.
30 The proposal form states the time in which the work must be completed, and the amount of the proposal
31 guaranty that must accompany the proposal. The Owner will accept only those Proposals properly executed on
32 physical forms or electronic forms provided by the Owner. Bidder actions that may cause the Owner to deem
33 a proposal irregular are given in paragraph 20-09 *Irregular proposals*.

34 Mobilization is limited to 5 percent of the total project cost.

35 A prebid conference is required on this project to discuss as a minimum, the following items: material
36 requirements; submittals; Quality Control/Quality Assurance requirements; the construction safety and phasing
37 plan including airport access and staging areas; and unique airfield paving construction requirements. See
38 project advertisement for date prebid.

39 **20-04 Issuance of proposal forms.** The Owner reserves the right to refuse to issue a proposal form to a
40 prospective bidder if the bidder is in default for any of the following reasons:

41 a. Failure to comply with any prequalification regulations of the Owner, if such regulations are cited, or
42 otherwise included, in the proposal as a requirement for bidding.

43 b. Failure to pay, or satisfactorily settle, all bills due for labor and materials on former contracts in force
44 with the Owner at the time the Owner issues the proposal to a prospective bidder.

45 c. Documented record of Contractor default under previous contracts with the Owner.

46 d. Documented record of unsatisfactory work on previous contracts with the Owner.

47 **20-05 Interpretation of estimated proposal quantities.** An estimate of quantities of work to be done and
48 materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations

49 and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the
50 contract. The Owner does not expressly, or by implication, agree that the actual quantities involved will
51 correspond exactly therewith; nor shall the bidder plead misunderstanding or deception because of such
52 estimates of quantities, or of the character, location, or other conditions pertaining to the work. Payment to the
53 Contractor will be made only for the actual quantities of work performed or materials furnished in accordance
54 with the plans and specifications. It is understood that the quantities may be increased or decreased as provided
55 in the Section 40, paragraph 40-02, Alteration of Work and Quantities, without in any way invalidating the unit
56 bid prices.

57 **20-06 Examination of plans, specifications, and site.** The bidder is expected to carefully examine the site
58 of the proposed work, the proposal, plans, specifications, and contract forms. Bidders shall satisfy themselves
59 to the character, quality, and quantities of work to be performed, materials to be furnished, and to the
60 requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the
61 bidder has made such examination and is satisfied to the conditions to be encountered in performing the work
62 and the requirements of the proposed contract, plans, and specifications.

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

70 **20-07 Preparation of proposal.** The bidder shall submit their proposal on the forms furnished by the Owner.
71 All blank spaces in the proposal forms, unless explicitly stated otherwise, must be correctly filled in where
72 indicated for each and every item for which a quantity is given. The bidder shall state the price (written in ink
73 or typed) both in words and numerals which they propose for each pay item furnished in the proposal. In case
74 of conflict between words and numerals, the words, unless obviously incorrect, shall govern.

75 The bidder shall correctly sign the proposal in ink. If the proposal is made by an individual, their name and
76 post office address must be shown. If made by a partnership, the name and post office address of each member
77 of the partnership must be shown. If made by a corporation, the person signing the proposal shall give the
78 name of the state where the corporation was chartered and the name, titles, and business address of the
79 president, secretary, and the treasurer. Anyone signing a proposal as an agent shall file evidence of their
80 authority to do so and that the signature is binding upon the firm or corporation.

81 **20-08 Responsive and responsible bidder.** A responsive bid conforms to all significant terms and conditions
82 contained in the Owner's invitation for bid. It is the Owner's responsibility to decide if the exceptions taken by
83 a bidder to the solicitation are material or not and the extent of deviation it is willing to accept.

84 A responsible bidder has the ability to perform successfully under the terms and conditions of a proposed
85 procurement, as defined in 2 CFR § 200.318(h). This includes such matters as Contractor integrity, compliance
86 with public policy, record of past performance, and financial and technical resources.

87 **20-09 Irregular proposals.** Proposals shall be considered irregular for the following reasons:

88 **a.** If the proposal is on a form other than that furnished by the Owner, or if the Owner's form is altered,
89 or if any part of the proposal form is detached.

90 **b.** If there are unauthorized additions, conditional or alternate pay items, or irregularities of any kind that
91 make the proposal incomplete, indefinite, or otherwise ambiguous.

92 **c.** If the proposal does not contain a unit price for each pay item listed in the proposal, except in the case
93 of authorized alternate pay items, for which the bidder is not required to furnish a unit price.

94 **d.** If the proposal contains unit prices that are obviously unbalanced.

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95 e. If the proposal is not accompanied by the proposal guaranty specified by the Owner.

96 f. If the applicable Disadvantaged Business Enterprise information is incomplete.

97 The Owner reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver
98 is in the best interest of the Owner and conforms to local laws and ordinances pertaining to the letting of
99 construction contracts.

100 **20-10 Bid guarantee.** Each separate proposal shall be accompanied by a bid bond, certified check, or other
101 specified acceptable collateral, in the amount specified in the proposal form. Such bond, check, or collateral,
102 shall be made payable to the Owner.

103 **20-11 Delivery of proposal.** Each proposal shall be submitted to <https://www.bidnetdirect.com>. No proposal
104 will be considered unless received as specified in the advertisement or as modified by Addendum before the
105 time specified for opening all bids. Proposals received after the bid opening time shall be rejected and not
106 opened.

107 **20-12 Withdrawal or revision of proposals.** A bidder may withdraw or revise (by withdrawal of one proposal
108 and submission of another) a proposal provided that the bidder's request for withdrawal is received by the
109 Owner on <https://www.bidnetdirect.com> before the time specified for opening bids. Revised proposals must
110 be received before the time specified for opening all bids.

111 **20-13 Public opening of proposals.** Proposals shall be opened, and read, publicly at the time and place
112 specified in the advertisement. Bidders, their authorized agents, and other interested persons are invited to
113 attend. Proposals that have been withdrawn (by written or telegraphic request) or received after the time
114 specified for opening bids shall be returned to the bidder unopened.

115 **20-14 Disqualification of bidders.** A bidder shall be considered disqualified for any of the following reasons:

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

118 b. Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as
119 bidders for any future work of the Owner until any such participating bidder has been reinstated by the Owner
120 as a qualified bidder.

121 c. If the bidder is considered to be in "default" for any reason specified in paragraph 20-04, *Issuance of*
122 *Proposal Forms*, of this section.

123 **20-15 Discrepancies and Omissions.** A Bidder who discovers discrepancies or omissions with the project
124 bid documents shall immediately notify the Owner's Engineer of the matter. A bidder that has doubt as to the
125 true meaning of a project requirement may submit to the Owner's Engineer a written request for interpretation
126 no later than 7 days prior to bid opening.

127 Any interpretation of the project bid documents by the Owner's Engineer will be by written addendum issued
128 by the Owner. The Owner will not consider any instructions, clarifications or interpretations of the bidding
129 documents in any manner other than written addendum.

130 **END OF SECTION 20**

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131 **Section 30 Award and Execution of Contract**

132 **30-01 Consideration of proposals.** After the proposals are publicly opened and read, they will be compared
133 on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the
134 proposal by the unit bid prices. If a bidder's proposal contains a discrepancy between unit bid prices written in
135 words and unit bid prices written in numbers, the unit bid price written in words shall govern.

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

138 a. If the proposal is irregular as specified in Section 20, paragraph 20-09, *Irregular Proposals*.

139 b. If the bidder is disqualified for any of the reasons specified Section 20, paragraph 20-14, *Disqualification*
140 *of Bidders*.

141 In addition, until the award of a contract is made, the Owner reserves the right to reject any or all proposals,
142 waive technicalities, if such waiver is in the best interest of the Owner and is in conformance with applicable
143 state and local laws or regulations pertaining to the letting of construction contracts; advertise for new
144 proposals; or proceed with the work otherwise. All such actions shall promote the Owner's best interests.

145 **30-02 Award of contract.** The award of a contract, if it is to be awarded, shall be made within **120** calendar
146 days of the date specified for publicly opening proposals, unless otherwise specified herein.

147 If the Owner elects to proceed with an award of contract, the Owner will make award to the responsible bidder
148 whose bid, conforming with all the material terms and conditions of the bid documents, is the lowest in price.

149 **30-03 Cancellation of award.** The Owner reserves the right to cancel the award without liability to the bidder,
150 except return of proposal guaranty, at any time before a contract has been fully executed by all parties and is
151 approved by the Owner in accordance with paragraph 30-07 *Approval of Contract*.

152 **30-04 Return of proposal guaranty.** All proposal guaranties, except those of the two lowest bidders, will be
153 returned immediately after the Owner has made a comparison of bids as specified in the paragraph 30-01,
154 *Consideration of Proposals*. Proposal guaranties of the two lowest bidders will be retained by the Owner until such
155 time as an award is made, at which time, the unsuccessful bidder's proposal guaranty will be returned. The
156 successful bidder's proposal guaranty will be returned as soon as the Owner receives the contract bonds as
157 specified in paragraph 30-05, *Requirements of Contract Bonds*.

158 **30-05 Requirements of contract bonds.** At the time of the execution of the contract, the successful bidder
159 shall furnish the Owner a surety bond or bonds that have been fully executed by the bidder and the surety
160 guaranteeing the performance of the work and the payment of all legal debts that may be incurred by reason of
161 the Contractor's performance of the work. The surety and the form of the bond or bonds shall be acceptable
162 to the Owner. Unless otherwise specified in this subsection, the surety bond or bonds shall be in a sum equal
163 to the full amount of the contract.

164 **30-06 Execution of contract.** The successful bidder shall sign (execute) the necessary agreements for entering
165 into the contract and return the signed contract to the Owner, along with the fully executed surety bond or
166 bonds specified in paragraph 30-05, *Requirements of Contract Bonds*, of this section, within 15 calendar days from
167 the date mailed or otherwise delivered to the successful bidder.

168 **30-07 Approval of contract.** Upon receipt of the contract and contract bond or bonds that have been executed
169 by the successful bidder, the Owner shall complete the execution of the contract in accordance with local laws
170 or ordinances, and return the fully executed contract to the Contractor. Delivery of the fully executed contract
171 to the Contractor shall constitute the Owner's approval to be bound by the successful bidder's proposal and
172 the terms of the contract.

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173 **30-08 Failure to execute contract.** Failure of the successful bidder to execute the contract and furnish an
174 acceptable surety bond or bonds within the period specified in paragraph 30-06, *Execution of Contract*, of this
175 section shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty,
176 but as liquidated damages to the Owner.

177
END OF SECTION 30

178

Section 40 Scope of Work

179 **40-01 Intent of contract.** The intent of the contract is to provide for construction and completion, in every
180 detail, of the work described. It is further intended that the Contractor shall furnish all labor, materials,
181 equipment, tools, transportation, and supplies required to complete the work in accordance with the plans,
182 specifications, and terms of the contract.

183 **40-02 Alteration of work and quantities.** The Owner reserves the right to make such changes in quantities
184 and work as may be necessary or desirable to complete, in a satisfactory manner, the original intended work.
185 Unless otherwise specified in the Contract, the Owner's Engineer or DEN Project Manager shall be and is
186 hereby authorized to make, in writing, such in-scope alterations in the work and variation of quantities as may
187 be necessary to complete the work, provided such action does not represent a significant change in the character
188 of the work.

189 For purpose of this section, a significant change in character of work means: any change that is outside the
190 current contract scope of work; any change (increase or decrease) in the total contract cost by more than 25%;
191 or any change in the total cost of a major contract item by more than 25%.

192 Work alterations and quantity variances that do not meet the definition of significant change in character of
193 work shall not invalidate the contract nor release the surety. Contractor agrees to accept payment for such
194 work alterations and quantity variances in accordance with Section 90, paragraph 90-03, *Compensation for Altered*
195 *Quantities*.

196 Should the value of altered work or quantity variance meet the criteria for significant change in character of
197 work, such altered work and quantity variance shall be covered by a supplemental agreement. Supplemental
198 agreements shall also require consent of the Contractor's surety and separate performance and payment bonds.
199 If the Owner and the Contractor are unable to agree on a unit adjustment for any contract item that requires a
200 supplemental agreement, the Owner reserves the right to terminate the contract with respect to the item and
201 make other arrangements for its completion.

202 **40-03 Omitted items.** The Owner, the Owner's Engineer or the DEN Project Manager may provide written
203 notice to the Contractor to omit from the work any contract item that does not meet the definition of major
204 contract item. Major contract items may be omitted by a supplemental agreement. Such omission of contract
205 items shall not invalidate any other contract provision or requirement.

206 Should a contract item be omitted or otherwise ordered to be non-performed, the Contractor shall be paid for
207 all work performed toward completion of such item prior to the date of the order to omit such item. Payment
208 for work performed shall be in accordance with Section 90, paragraph 90-04, *Payment for Omitted Items*.

209 **40-04 Extra work.** Should acceptable completion of the contract require the Contractor to perform an item of
210 work not provided for in the awarded contract as previously modified by change order or supplemental
211 agreement, Owner may issue a Change Order to cover the necessary extra work. Change orders for extra work
212 shall contain agreed unit prices for performing the change order work in accordance with the requirements
213 specified in the order, and shall contain any adjustment to the contract time that, in the DEN Project Manager's
214 opinion, is necessary for completion of the extra work.

215 When determined by the DEN Project Manager to be in the Owner's best interest, the DEN Project Manager
216 may order the Contractor to proceed with extra work as provided in Section 90, paragraph 90-05, *Payment for*
217 *Extra Work*. Extra work that is necessary for acceptable completion of the project, but is not within the general
218 scope of the work covered by the original contract shall be covered by a supplemental agreement as defined in
219 Section 10, paragraph 10-59, *Supplemental Agreement*.

220 If extra work is essential to maintaining the project critical path, DEN Project Manager may order the
221 Contractor to commence the extra work under a Time and Material contract method. Once sufficient detail is

222 available to establish the level of effort necessary for the extra work, the Owner shall initiate a change order or
223 supplemental agreement to cover the extra work.

224 Any claim for payment of extra work that is not covered by written agreement (change order or supplemental
225 agreement) shall be rejected by the Owner.

226 **40-05 Maintenance of traffic.** It is the explicit intention of the contract that the safety of aircraft, as well as
227 the Contractor's equipment and personnel, is the most important consideration. The Contractor shall maintain
228 traffic in the manner detailed in the Construction Safety and Phasing Plan (CSPP).

229 **a.** It is understood and agreed that the Contractor shall provide for the free and unobstructed movement
230 of aircraft in the air operations areas (AOAs) of the airport with respect to their own operations and the
231 operations of all subcontractors as specified in Section 80, paragraph 80-04, *Limitation of Operations*. It is further
232 understood and agreed that the Contractor shall provide for the uninterrupted operation of visual and electronic
233 signals (including power supplies thereto) used in the guidance of aircraft while operating to, from, and upon
234 the airport as specified in Section 70, paragraph 70-15, *Contractor's Responsibility for Utility Service and Facilities of*
235 *Others*.

236 **b.** With respect to their own operations and the operations of all subcontractors, the Contractor shall provide
237 marking, lighting, and other acceptable means of identifying personnel, equipment, vehicles, storage areas, and
238 any work area or condition that may be hazardous to the operation of aircraft, fire-rescue equipment, or
239 maintenance vehicles at the airport in accordance with the construction safety and phasing plan (CSPP) and the
240 safety plan compliance document (SPCD).

241 **c.** When the contract requires the maintenance of an existing road, street, or highway during the
242 Contractor's performance of work that is otherwise provided for in the contract, plans, and specifications, the
243 Contractor shall keep the road, street, or highway open to all traffic and shall provide maintenance as may be
244 required to accommodate traffic. The Contractor, at their expense, shall be responsible for the repair to equal
245 or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel.
246 The Contractor shall furnish, erect, and maintain barricades, warning signs, flag person, and other traffic control
247 devices in reasonable conformity with the Manual on Uniform Traffic Control Devices (MUTCD)
248 (<http://mutcd.fhwa.dot.gov/>), unless otherwise specified. The Contractor shall also construct and maintain in
249 a safe condition any temporary connections necessary for ingress to and egress from abutting property or
250 intersecting roads, streets or highways.

251 **40-06 Removal of existing structures.** All existing structures encountered within the established lines, grades,
252 or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified
253 to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place.
254 The cost of removing such existing structures shall not be measured or paid for directly, but shall be included
255 in the various contract items.

256 Should the Contractor encounter an existing structure (above or below ground) in the work for which the
257 disposition is not indicated on the plans, the DEN Project Manager shall be notified prior to disturbing such
258 structure. The disposition of existing structures so encountered shall be immediately determined by the DEN
259 Project Manager in accordance with the provisions of the contract.

260 Except as provided in Section 40, paragraph 40-07, *Rights in and Use of Materials Found in the Work*, it is intended
261 that all existing materials or structures that may be encountered (within the lines, grades, or grading sections
262 established for completion of the work) shall be used in the work as otherwise provided for in the contract and
263 shall remain the property of the Owner when so used in the work.

264

265 **40-07 Rights in and use of materials found in the work.** Should the Contractor encounter any material such
266 as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or

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267 grading sections, the use of which is intended by the terms of the contract to be embankment, the Contractor
268 may at their own option either:

269 a. Use such material in another contract item, providing such use is approved by the DEN Project Manager
270 and is in conformance with the contract specifications applicable to such use; or,

271 b. Remove such material from the site, upon written approval of the DEN Project Manager; or

272 c. Use such material for the Contractor's own temporary construction on site; or,

273 d. Use such material as intended by the terms of the contract.

274 Should the Contractor wish to exercise option a., b., or c., the Contractor shall request the DEN Project
275 Manager's approval in advance of such use.

276 Should the DEN Project Manager approve the Contractor's request to exercise option a., b., or c., the
277 Contractor shall be paid for the excavation or removal of such material at the applicable contract price. The
278 Contractor shall replace, at their expense, such removed or excavated material with an agreed equal volume of
279 material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that such
280 replacement material is needed to complete the contract work. The Contractor shall not be charged for use of
281 such material used in the work or removed from the site.

282 Should the DEN Project Manager approve the Contractor's exercise of option a., the Contractor shall be paid,
283 at the applicable contract price, for furnishing and installing such material in accordance with requirements of
284 the contract item in which the material is used.

285 It is understood and agreed that the Contractor shall make no claim for delays by reason of their own exercise
286 of option a., b., or c.

287 The Contractor shall not excavate, remove, or otherwise disturb any material, structure, or part of a structure
288 which is located outside the lines, grades, or grading sections established for the work, except where such
289 excavation or removal is provided for in the contract, plans, or specifications.

290

291 **40-08 Final cleanup.** Upon completion of the work and before acceptance and final payment will be made,
292 the Contractor shall remove from the site all machinery, equipment, surplus and discarded materials, rubbish,
293 temporary structures, and stumps or portions of trees. The Contractor shall cut all brush and woods within the
294 limits indicated and shall leave the site in a neat and presentable condition. Material cleared from the site and
295 deposited on adjacent property will not be considered as having been disposed of satisfactorily, unless the
296 Contractor has obtained the written permission of the property Owner.

297

END OF SECTION 40

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Section 50 Control of Work

300 **50-01 Authority of the DEN Project Manager.** The DEN Project Manager has final authority regarding the
301 interpretation of project specification requirements. The DEN Project Manager shall determine acceptability
302 of the quality of materials furnished, method of performance of work performed, and the manner and rate of
303 performance of the work. The DEN Project Manager does not have the authority to accept work that does not
304 conform to specification requirements.

305 **50-02 Conformity with plans and specifications.** All work and all materials furnished shall be in reasonably
306 close conformity with the lines, grades, grading sections, cross-sections, dimensions, material requirements, and
307 testing requirements that are specified (including specified tolerances) in the contract, plans, or specifications.

308 If the DEN Project Manager finds the materials furnished, work performed, or the finished product not within
309 reasonably close conformity with the plans and specifications, but that the portion of the work affected will, in
310 their opinion, result in a finished product having a level of safety, economy, durability, and workmanship
311 acceptable to the Owner, the DEN Project Manager will advise the Owner of their determination that the
312 affected work be accepted and remain in place. The DEN Project Manager will document the determination
313 and recommend to the Owner a basis of acceptance that will provide for an adjustment in the contract price
314 for the affected portion of the work. Changes in the contract price must be covered by contract change order
315 or supplemental agreement as applicable.

316 If the DEN Project Manager finds the materials furnished, work performed, or the finished product are not in
317 reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished
318 product, the affected work or materials shall be removed and replaced or otherwise corrected by and at the
319 expense of the Contractor in accordance with the DEN Project Manager's written orders.

320 The term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to
321 complete the work in accordance with the contract, plans, and specifications. The term shall not be construed
322 as waiving the DEN Project Manager's responsibility to insist on strict compliance with the requirements of
323 the contract, plans, and specifications during the Contractor's execution of the work, when, in the DEN Project
324 Manager's opinion, such compliance is essential to provide an acceptable finished portion of the work.

325 The term "reasonably close conformity" is also intended to provide the DEN Project Manager with the
326 authority, after consultation with the Sponsor and FAA, to use sound engineering judgment in their
327 determinations to accept work that is not in strict conformity, but will provide a finished product equal to or
328 better than that required by the requirements of the contract, plans and specifications.

329 The DEN Project Manager will not be responsible for the Contractor's means, methods, techniques, sequences,
330 or procedures of construction or the safety precautions incident thereto.

331 **50-03 Coordination of contract, plans, and specifications.** The contract, plans, specifications, and all
332 referenced standards cited are essential parts of the contract requirements. If electronic files are provided and
333 used on the project and there is a conflict between the electronic files and hard copy plans, the hard copy plans
334 shall govern. A requirement occurring in one is as binding as though occurring in all. They are intended to be
335 complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions
336 will govern over scaled dimensions; contract technical specifications shall govern over contract general
337 provisions, plans, cited standards for materials or testing, and cited advisory circulars (ACs); contract general
338 provisions shall govern over plans, cited standards for materials or testing, and cited ACs; plans shall govern
339 over cited standards for materials or testing and cited ACs. If any paragraphs contained in the Special Provisions
340 conflict with General Provisions or Technical Specifications, the Special Provisions shall govern.

341 From time to time, discrepancies within cited testing standards occur due to the timing of the change, edits,
342 and/or replacement of the standards. If the Contractor discovers any apparent discrepancy within standard test

343 methods, the Contractor shall immediately ask the DEN Project Manager for an interpretation and decision,
344 and such decision shall be final.

345 The Contractor shall not take advantage of any apparent error or omission on the plans or specifications. In
346 the event the Contractor discovers any apparent error or discrepancy, Contractor shall immediately notify the
347 Owner or the designated representative in writing requesting their written interpretation and decision.

348 **50-04 List of Special Provisions.** Not Used

349 **50-05 Cooperation of Contractor.** The Contractor shall be supplied with an electronic PDF of the plans and
350 specifications. The Contractor shall have available on the construction site at all times one hardcopy each of
351 the plans and specifications. Additional hard copies of plans and specifications may be obtained by the
352 Contractor for the cost of reproduction.

353 The Contractor shall give constant attention to the work to facilitate the progress thereof, and shall cooperate
354 with the DEN Project Manager and their inspectors and with other Contractors in every way possible. The
355 Contractor shall have a competent superintendent on the work at all times who is fully authorized as their agent
356 on the work. The superintendent shall be capable of reading and thoroughly understanding the plans and
357 specifications and shall receive and fulfill instructions from the DEN Project Manager or their authorized
358 representative.

359 **50-06 Cooperation between Contractors.** The Owner reserves the right to contract for and perform other
360 or additional work on or near the work covered by this contract.

361 When separate contracts are let within the limits of any one project, each Contractor shall conduct the work
362 not to interfere with or hinder the progress of completion of the work being performed by other Contractors.
363 Contractors working on the same project shall cooperate with each other as directed.

364 Each Contractor involved shall assume all liability, financial or otherwise, in connection with their own contract
365 and shall protect and hold harmless the Owner from any and all damages or claims that may arise because of
366 inconvenience, delays, or loss experienced because of the presence and operations of other Contractors working
367 within the limits of the same project.

368 The Contractor shall arrange their work and shall place and dispose of the materials being used to not interfere
369 with the operations of the other Contractors within the limits of the same project. The Contractor shall join
370 their work with that of the others in an acceptable manner and shall perform it in proper sequence to that of
371 the others.

372 **50-07 Construction layout and stakes.** The Engineer/DEN Project Manager shall establish necessary
373 horizontal and vertical control. The establishment of Survey Control and/or reestablishment of survey control
374 shall be by a State Licensed Land Surveyor. Contractor is responsible for preserving integrity of horizontal and
375 vertical controls established by Engineer/DEN Project Manager. In case of negligence on the part of the
376 Contractor or their employees, resulting in the destruction of any horizontal and vertical control, the resulting
377 costs will be deducted as a liquidated damage against the Contractor.

378 Prior to the start of construction, the Contractor will check all control points for horizontal and vertical accuracy
379 and certify in writing to the DEN Project Manager that the Contractor concurs with survey control established
380 for the project. All lines, grades and measurements from control points necessary for the proper execution and
381 control of the work on this project will be provided to the DEN Project Manager. The Contractor is responsible
382 to establish all layout required for the construction of the project.

383 Copies of survey notes will be provided to the DEN Project Manager for each area of construction and for
384 each placement of material as specified to allow the DEN Project Manager to make periodic checks for
385 conformance with plan grades, alignments and grade tolerances required by the applicable material
386 specifications. Surveys will be provided to the DEN Project Manager prior to commencing work items that
387 cover or disturb the survey staking. Survey(s) and notes shall be provided in the following format(s): electronic
388 and hardcopy.)

389 Laser, GPS, String line, or other automatic control shall be checked with temporary control as necessary. In the
390 case of error, on the part of the Contractor, their surveyor, employees or subcontractors, resulting in established
391 grades, alignment or grade tolerances that do not concur with those specified or shown on the plans, the
392 Contractor is solely responsible for correction, removal, replacement and all associated costs at no additional
393 cost to the Owner.

394 No direct payment will be made, unless otherwise specified in contract documents, for this labor, materials, or
395 other expenses. The cost shall be included in the price of the bid for the various items of the Contract.

396 **50-08 Authority and duties of Quality Assurance (QA) inspectors.** QA inspectors shall be authorized to
397 inspect all work done and all material furnished. Such QA inspection may extend to all or any part of the work
398 and to the preparation, fabrication, or manufacture of the materials to be used. QA inspectors are not
399 authorized to revoke, alter, or waive any provision of the contract. QA inspectors are not authorized to issue
400 instructions contrary to the plans and specifications or to act as foreman for the Contractor.

401 QA Inspectors are authorized to notify the Contractor or their representatives of any failure of the work or
402 materials to conform to the requirements of the contract, plans, or specifications and to reject such
403 nonconforming materials in question until such issues can be referred to the DEN Project Manager for a
404 decision.

405 **50-09 Inspection of the work.** All materials and each part or detail of the work shall be subject to inspection.
406 The DEN Project Manager shall be allowed access to all parts of the work and shall be furnished with such
407 information and assistance by the Contractor as is required to make a complete and detailed inspection.

408 If the DEN Project Manager requests it, the Contractor, at any time before acceptance of the work, shall
409 remove or uncover such portions of the finished work as may be directed. After examination, the Contractor
410 shall restore said portions of the work to the standard required by the specifications. Should the work thus
411 exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or
412 making good of the parts removed will be paid for as extra work; but should the work so exposed or examined
413 prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the
414 parts removed will be at the Contractor's expense.

415 Provide advance written notice to the DEN Project Manager of work the Contractor plans to perform each
416 week and each day. Any work done or materials used without written notice and allowing opportunity for
417 inspection by the DEN Project Manager may be ordered removed and replaced at the Contractor's expense.

418 Should the contract work include relocation, adjustment, or any other modification to existing facilities, not the
419 property of the (contract) Owner, authorized representatives of the Owners of such facilities shall have the
420 right to inspect such work. Such inspection shall in no sense make any facility owner a party to the contract,
421 and shall in no way interfere with the rights of the parties to this contract.

422 **50-10 Removal of unacceptable and unauthorized work.** All work that does not conform to the
423 requirements of the contract, plans, and specifications will be considered unacceptable, unless otherwise
424 determined acceptable by the DEN Project Manager as provided in paragraph 50-02, *Conformity with Plans and*
425 *Specifications*.

426 Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through
427 carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed
428 immediately and replaced in an acceptable manner in accordance with the provisions of Section 70, paragraph
429 70-14, *Contractor's Responsibility for Work*.

430 No removal work made under provision of this paragraph shall be done without lines and grades having been
431 established by the DEN Project Manager. Work done contrary to the instructions of the DEN Project Manager,
432 work done beyond the lines shown on the plans or as established by the DEN Project Manager, except as
433 herein specified, or any extra work done without authority, will be considered as unauthorized and will not be

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434 paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the
435 Contractor's expense.

436 Upon failure on the part of the Contractor to comply with any order of the DEN Project Manager made under
437 the provisions of this subsection, the DEN Project Manager will have authority to cause unacceptable work to
438 be remedied or removed and replaced; and unauthorized work to be removed and recover the resulting costs
439 as a liquidated damage against the Contractor.

440 **50-11 Load restrictions.** The Contractor shall comply with all legal load restrictions in the hauling of materials
441 on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for
442 damage that may result from the moving of material or equipment.

443 The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type
444 of construction will not be permitted. Hauling of materials over the base course or surface course under
445 construction shall be limited as directed. No loads will be permitted on a concrete pavement, base, or structure
446 before the expiration of the curing period. The Contractor, at their own expense, shall be responsible for the
447 repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment
448 and personnel.

449 **50-12 Maintenance during construction.** The Contractor shall maintain the work during construction and
450 until the work is accepted. Maintenance shall constitute continuous and effective work prosecuted day by day,
451 with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

452 In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the
453 Contractor shall maintain the previous course or subgrade during all construction operations.

454 All costs of maintenance work during construction and before the project is accepted shall be included in the
455 unit prices bid on the various contract items, and the Contractor will not be paid an additional amount for such
456 work.

457 **50-13 Failure to maintain the work.** Should the Contractor at any time fail to maintain the work as provided
458 in paragraph 50-12, *Maintenance during Construction*, the DEN Project Manager shall immediately notify the
459 Contractor of such noncompliance. Such notification shall specify a reasonable time within which the
460 Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give
461 due consideration to the exigency that exists.

462 Should the Contractor fail to respond to the DEN Project Manager's notification, the Owner may suspend any
463 work necessary for the Owner to correct such unsatisfactory maintenance condition, depending on the exigency
464 that exists. Any maintenance cost incurred by the Owner, shall be recovered as a liquidated damage against the
465 Contractor.

466 **50-14 Partial acceptance.** If at any time during the execution of the project the Contractor substantially
467 completes a usable unit or portion of the work, the occupancy of which will benefit the Owner, the Contractor
468 may request the DEN Project Manager to make final inspection of that unit. If the DEN Project Manager finds
469 upon inspection that the unit has been satisfactorily completed in compliance with the contract, the DEN
470 Project Manager may accept it as being complete, and the Contractor may be relieved of further responsibility
471 for that unit. Such partial acceptance and beneficial occupancy by the Owner shall not void or alter any
472 provision of the contract.

473 **50-15 Final acceptance.** Upon due notice from the Contractor of presumptive completion of the entire
474 project, the DEN Project Manager and Owner will make an inspection. If all construction provided for and
475 contemplated by the contract is found to be complete in accordance with the contract, plans, and specifications,
476 such inspection shall constitute the final inspection. The DEN Project Manager shall notify the Contractor in
477 writing of final acceptance as of the date of the final inspection.

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478 If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the DEN Project
479 Manager will notify the Contractor and the Contractor shall correct the unsatisfactory work. Upon correction
480 of the work, another inspection will be made which shall constitute the final inspection, provided the work has
481 been satisfactorily completed. In such event, the DEN Project Manager will make the final acceptance and
482 notify the Contractor in writing of this acceptance as of the date of final inspection.

483 **50-16 Claims for adjustment and disputes.** If for any reason the Contractor deems that additional
484 compensation is due for work or materials not clearly provided for in the contract, plans, or specifications or
485 previously authorized as extra work, the Contractor shall notify the DEN Project Manager in writing of their
486 intention to claim such additional compensation before the Contractor begins the work on which the
487 Contractor bases the claim. If such notification is not given or the DEN Project Manager is not afforded proper
488 opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby
489 agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that
490 the DEN Project Manager has kept account of the cost of the work shall not in any way be construed as proving
491 or substantiating the validity of the claim. When the work on which the claim for additional compensation is
492 based has been completed, the Contractor shall, within 10 calendar days, submit a written claim to the DEN
493 Project Manager who will present it to the Owner for consideration in accordance with local laws or ordinances.

494 Nothing in this subsection shall be construed as a waiver of the Contractor's right to dispute final payment
495 based on differences in measurements or computations.

496 **END OF SECTION 50**

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Section 60 Control of Materials

527 **60-01 Source of supply and quality requirements.** The materials used in the work shall conform to the
528 requirements of the contract, plans, and specifications. Unless otherwise specified, such materials that are
529 manufactured or processed shall be new (as compared to used or reprocessed).

530 In order to expedite the inspection and testing of materials, the Contractor shall furnish documentation to the
531 DEN Project Manager as to the origin, composition, and manufacture of all materials to be used in the work.
532 Documentation shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of
533 such materials.

534 At the DEN Project Manager's option, materials may be approved at the source of supply before delivery. If it
535 is found after trial that sources of supply for previously approved materials do not produce specified products,
536 the Contractor shall furnish materials from other sources.

537 The Contractor shall furnish airport lighting equipment that meets the requirements of the specifications; and
538 is listed in AC 150/5345-53, *Airport Lighting Equipment Certification Program* and *Addendum*, that is in effect on the
539 date of advertisement.

540 **60-02 Samples, tests, and cited specifications.** All materials used in the work shall be inspected, tested, and
541 approved by the DEN Project Manager before incorporation in the work unless otherwise designated. Any
542 work in which untested materials are used without approval or written permission of the DEN Project Manager
543 shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be
544 paid for and, if directed by the DEN Project Manager, shall be removed at the Contractor's expense.

545 Unless otherwise designated, quality assurance tests will be made by and at the expense of the Owner in
546 accordance with the cited standard methods of ASTM, American Association of State Highway and
547 Transportation Officials (AASHTO), federal specifications, Commercial Item Descriptions, and all other cited
548 methods, which are current on the date of advertisement for bids.

549 The testing organizations performing on-site quality assurance field tests shall have copies of all referenced
550 standards on the construction site for use by all technicians and other personnel. Unless otherwise designated,
551 samples for quality assurance will be taken by a qualified representative of the DEN Project Manager. All
552 materials being used are subject to inspection, test, or rejection at any time prior to or during incorporation into
553 the work. Copies of all tests will be furnished to the Contractor's representative at their request after review
554 and approval of the DEN Project Manager.

555 A copy of all Contractor QC test data shall be provided to the DEN Project Manager daily, along with printed
556 reports, in an approved format, on a weekly basis. After completion of the project, and prior to final payment,
557 the Contractor shall submit a final report to the DEN Project Manager showing all test data reports, plus an
558 analysis of all results showing ranges, averages, and corrective action taken on all failing tests.

559 The Contractor shall employ a Quality Control (QC) testing organization to perform all Contractor required
560 QC tests in accordance with Item C-100 Contractor Quality Control Program (CQCP).

561 **60-03 Certification of compliance/analysis (COC/COA).** The DEN Project Manager may permit the use,
562 prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's COC
563 stating that such materials or assemblies fully comply with the requirements of the contract. The certificate shall
564 be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be
565 accompanied by a certificate of compliance in which the lot is clearly identified. The COA is the manufacturer's
566 COC and includes all applicable test results.

567 Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time
568 and if found not to be in conformity with contract requirements will be subject to rejection whether in place
569 or not.

- 570 The form and distribution of certificates of compliance shall be as approved by the DEN Project Manager.
- 571 When a material or assembly is specified by “brand name or equal” and the Contractor elects to furnish the
572 specified “or equal,” the Contractor shall be required to furnish the manufacturer’s certificate of compliance
573 for each lot of such material or assembly delivered to the work. Such certificate of compliance shall clearly
574 identify each lot delivered and shall certify as to:
- 575 a. Conformance to the specified performance, testing, quality or dimensional requirements; and,
 - 576 b. Suitability of the material or assembly for the use intended in the contract work.
- 577 The DEN Project Manager shall be the sole judge as to whether the proposed “or equal” is suitable for use in
578 the work.
- 579 The DEN Project Manager reserves the right to refuse permission for use of materials or assemblies on the
580 basis of certificates of compliance.
- 581 **60-04 Plant inspection.** The DEN Project Manager or their authorized representative may inspect, at its
582 source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from
583 time to time for the purpose of determining compliance with specified manufacturing methods or materials to
584 be used in the work and to obtain samples required for acceptance of the material or assembly.
- 585 Should the DEN Project Manager conduct plant inspections, the following conditions shall exist:
- 586 a. The DEN Project Manager shall have the cooperation and assistance of the Contractor and the producer
587 with whom the Contractor has contracted for materials.
 - 588 b. The DEN Project Manager shall have full entry at all reasonable times to such parts of the plant that
589 concern the manufacture or production of the materials being furnished.
 - 590 c. If required by the DEN Project Manager, the Contractor shall arrange for adequate office or working
591 space that may be reasonably needed for conducting plant inspections. Place office or working space in a
592 convenient location with respect to the plant.
- 593 It is understood and agreed that the Owner shall have the right to retest any material that has been tested and
594 approved at the source of supply after it has been delivered to the site. The DEN Project Manager shall have
595 the right to reject only material which, when retested, does not meet the requirements of the contract, plans, or
596 specifications.
- 597 **60-05 Engineer/ DEN Project Manager field office.** An Engineer/DEN Project Manager field office is not
598 required.
- 599 **60-06 Storage of materials.** Materials shall be stored to assure the preservation of their quality and fitness for
600 the work. Stored materials, even though approved before storage, may again be inspected prior to their use in
601 the work. Stored materials shall be located to facilitate their prompt inspection. The Contractor shall coordinate
602 the storage of all materials with the DEN Project Manager. Materials to be stored on airport property shall not
603 create an obstruction to air navigation nor shall they interfere with the free and unobstructed movement of
604 aircraft. Unless otherwise shown on the plans and/or CSPP, the storage of materials and the location of the
605 Contractor’s plant and parked equipment or vehicles shall be as directed by the DEN Project Manager. Private
606 property shall not be used for storage purposes without written permission of the Owner or lessee of such
607 property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on
608 private property. Upon request, the Contractor shall furnish the DEN Project Manager a copy of the property
609 Owner’s permission.
- 610 All storage sites on private or airport property shall be restored to their original condition by the Contractor at
611 their expense, except as otherwise agreed to (in writing) by the Owner or lessee of the property.

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612 **60-07 Unacceptable materials.** Any material or assembly that does not conform to the requirements of the
613 contract, plans, or specifications shall be considered unacceptable and shall be rejected. The Contractor shall
614 remove any rejected material or assembly from the site of the work, unless otherwise instructed by the DEN
615 Project Manager.

616 Rejected material or assembly, the defects of which have been corrected by the Contractor, shall not be returned
617 to the site of the work until such time as the DEN Project Manager has approved its use in the work.

618 **60-08 Owner furnished materials.** The Contractor shall furnish all materials required to complete the work,
619 except those specified, if any, to be furnished by the Owner. Owner-furnished materials shall be made available
620 to the Contractor at the location specified.

621 All costs of handling, transportation from the specified location to the site of work, storage, and installing
622 Owner-furnished materials shall be included in the unit price bid for the contract item in which such Owner-
623 furnished material is used.

624 After any Owner-furnished material has been delivered to the location specified, the Contractor shall be
625 responsible for any demurrage, damage, loss, or other deficiencies that may occur during the Contractor's
626 handling, storage, or use of such Owner-furnished material. The Owner will deduct from any monies due or to
627 become due the Contractor any cost incurred by the Owner in making good such loss due to the Contractor's
628 handling, storage, or use of Owner-furnished materials.

629 **END OF SECTION 60**

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Section 70 Legal Regulations and Responsibility to Public

658 **70-01 Laws to be observed.** The Contractor shall keep fully informed of all federal and state laws, all local
659 laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or
660 authority, which in any manner affect those engaged or employed on the work, or which in any way affect the
661 conduct of the work. The Contractor shall at all times observe and comply with all such laws, ordinances,
662 regulations, orders, and decrees; and shall protect and indemnify the Owner and all their officers, agents, or
663 servants against any claim or liability arising from or based on the violation of any such law, ordinance,
664 regulation, order, or decree, whether by the Contractor or the Contractor's employees.

665 **70-02 Permits, licenses, and taxes.** The Contractor shall procure all permits and licenses, pay all charges,
666 fees, and taxes, and give all notices necessary and incidental to the due and lawful execution of the work.

667 **70-03 Patented devices, materials, and processes.** If the Contractor is required or desires to use any design,
668 device, material, or process covered by letters of patent or copyright, the Contractor shall provide for such use
669 by suitable legal agreement with the Patentee or Owner. The Contractor and the surety shall indemnify and
670 hold harmless the Owner, any third party, or political subdivision from any and all claims for infringement by
671 reason of the use of any such patented design, device, material or process, or any trademark or copyright, and
672 shall indemnify the Owner for any costs, expenses, and damages which it may be obliged to pay by reason of
673 an infringement, at any time during the execution or after the completion of the work.

674 **70-04 Restoration of surfaces disturbed by others.** The Owner reserves the right to authorize the
675 construction, reconstruction, or maintenance of any public or private utility service, FAA or National Oceanic
676 and Atmospheric Administration (NOAA) facility, or a utility service of another government agency at any time
677 during the progress of the work. To the extent that such construction, reconstruction, or maintenance has been
678 coordinated with the Owner, such authorized work (by others) must be shown on the plans and is indicated as
679 follows:

680 See section 011810, Utilities Interface, subsection 1.2B for a listing of the applicable utility owners.

681 Except as listed above, the Contractor shall not permit any individual, firm, or corporation to excavate or
682 otherwise disturb such utility services or facilities located within the limits of the work without the written
683 permission of the DEN Project Manager.

684 Should the Owner of public or private utility service, FAA, or NOAA facility, or a utility service of another
685 government agency be authorized to construct, reconstruct, or maintain such utility service or facility during
686 the progress of the work, the Contractor shall cooperate with such Owners by arranging and performing the
687 work in this contract to facilitate such construction, reconstruction or maintenance by others whether or not
688 such work by others is listed above. When ordered as extra work by the DEN Project Manager, the Contractor
689 shall make all necessary repairs to the work which are due to such authorized work by others, unless otherwise
690 provided for in the contract, plans, or specifications. It is understood and agreed that the Contractor shall not
691 be entitled to make any claim for damages due to such authorized work by others or for any delay to the work
692 resulting from such authorized work.

693 **70-05 Federal Participation.** The United States Government has agreed to reimburse the Owner for some
694 portion of the contract costs. The contract work is subject to the inspection and approval of duly authorized
695 representatives of the FAA Administrator. No requirement of this contract shall be construed as making the
696 United States a party to the contract nor will any such requirement interfere, in any way, with the rights of either
697 party to the contract.

698 **70-06 Sanitary, health, and safety provisions.** The Contractor's worksite and facilities shall comply with
699 applicable federal, state, and local requirements for health, safety and sanitary provisions.

700 **70-07 Public convenience and safety.** The Contractor shall control their operations and those of their
701 subcontractors and all suppliers, to assure the least inconvenience to the traveling public. Under all
702 circumstances, safety shall be the most important consideration.

703 The Contractor shall maintain the free and unobstructed movement of aircraft and vehicular traffic with respect
704 to their own operations and those of their own subcontractors and all suppliers in accordance with Section 40,
705 paragraph 40-05, *Maintenance of Traffic*, and shall limit such operations for the convenience and safety of the
706 traveling public as specified in Section 80, paragraph 80-04, *Limitation of Operations*.

707 The Contractor shall remove or control debris and rubbish resulting from its work operations at frequent
708 intervals, and upon the order of the DEN Project Manager. If the DEN Project Manager determines the
709 existence of Contractor debris in the work site represents a hazard to airport operations and the Contractor is
710 unable to respond in a prompt and reasonable manner, the DEN Project Manager reserves the right to assign
711 the task of debris removal to a third party and recover the resulting costs as a liquidated damage against the
712 Contractor.

713 **70-08 Construction Safety and Phasing Plan (CSPP).** The Contractor shall complete the work in
714 accordance with the approved Construction Safety and Phasing Plan (CSPP) developed in accordance with AC
715 150/5370-2, Operational Safety on Airports During Construction. The CSPP is on sheet(s) G-040 thru G-052,
716 and G-090 of the project plans.

717 70-09 Use of explosives. **The use of explosives is not permitted on this project.**

718 **70-10 Protection and restoration of property and landscape.** The Contractor shall be responsible for the
719 preservation of all public and private property, and shall protect carefully from disturbance or damage all land
720 monuments and property markers until the Engineer/DEN Project Manager has witnessed or otherwise
721 referenced their location and shall not move them until directed.

722 The Contractor shall be responsible for all damage or injury to property of any character, during the execution
723 of the work, resulting from any act, omission, neglect, or misconduct in manner or method of executing the
724 work, or at any time due to defective work or materials, and said responsibility shall not be released until the
725 project has been completed and accepted.

726 When or where any direct or indirect damage or injury is done to public or private property by or on account
727 of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the non-
728 execution thereof by the Contractor, the Contractor shall restore, at their expense, such property to a condition
729 similar or equal to that existing before such damage or injury was done, by repairing, or otherwise restoring as
730 may be directed, or the Contractor shall make good such damage or injury in an acceptable manner.

731 **70-11 Responsibility for damage claims.** The Contractor shall indemnify and hold harmless the
732 Engineer/DEN Project Manager and the Owner and their officers, agents, and employees from all suits,
733 actions, or claims, of any character, brought because of any injuries or damage received or sustained by any
734 person, persons, or property on account of the operations of the Contractor; or on account of or in
735 consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing
736 the work; or because of any act or omission, neglect, or misconduct of said Contractor; or because of any claims
737 or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or
738 amounts arising or recovered under the “Workmen’s Compensation Act,” or any other law, ordinance, order,
739 or decree. Money due the Contractor under and by virtue of their own contract considered necessary by the
740 Owner for such purpose may be retained for the use of the Owner or, in case no money is due, their own surety
741 may be held until such suits, actions, or claims for injuries or damages shall have been settled and suitable
742 evidence to that effect furnished to the Owner, except that money due the Contractor will not be withheld
743 when the Contractor produces satisfactory evidence that he or she is adequately protected by public liability
744 and property damage insurance.

745 **70-12 Third party beneficiary clause.** It is specifically agreed between the parties executing the contract that
746 it is not intended by any of the provisions of any part of the contract to create for the public or any member
747 thereof, a third-party beneficiary or to authorize anyone not a party to the contract to maintain a suit for
748 personal injuries or property damage pursuant to the terms or provisions of the contract.

749 **70-13 Opening sections of the work to traffic.** If it is necessary for the Contractor to complete portions of
750 the contract work for the beneficial occupancy of the Owner prior to completion of the entire contract, such
751 “phasing” of the work must be specified below and indicated on the approved Construction Safety and Phasing
752 Plan (CSPP) and the project plans. When so specified, the Contractor shall complete such portions of the work
753 on or before the date specified or as otherwise specified.

754 Refer to the phasing plans of the construction drawings.

755 Upon completion of any portion of work listed above, such portion shall be accepted by the Owner in
756 accordance with Section 50, paragraph 50-14, *Partial Acceptance*.

757 No portion of the work may be opened by the Contractor until directed by the Owner in writing. Should it
758 become necessary to open a portion of the work to traffic on a temporary or intermittent basis, such openings
759 shall be made when, in the opinion of the DEN Project Manager, such portion of the work is in an acceptable
760 condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in
761 the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any
762 provision of the contract. Any damage to the portion of the work so opened that is not attributable to traffic
763 which is permitted by the Owner shall be repaired by the Contractor at their expense.

764 The Contractor shall make their own estimate of the inherent difficulties involved in completing the work under
765 the conditions herein described and shall not claim any added compensation by reason of delay or increased
766 cost due to opening a portion of the contract work.

767 The Contractor must conform to safety standards contained AC 150/5370-2 and the approved CSPP.

768 Contractor shall refer to the plans, specifications, and the approved CSPP to identify barricade requirements,
769 temporary and/or permanent markings, airfield lighting, guidance signs and other safety requirements prior to
770 opening up sections of work to traffic.

771 **70-14 Contractor’s responsibility for work.** Until the DEN Project Manager’s final written acceptance of the
772 entire completed work, excepting only those portions of the work accepted in accordance with Section 50,
773 paragraph 50-14, *Partial Acceptance*, the Contractor shall have the charge and care thereof and shall take every
774 precaution against injury or damage to any part due to the action of the elements or from any other cause,
775 whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair,
776 restore, and make good all injuries or damages to any portion of the work occasioned by any of the above
777 causes before final acceptance and shall bear the expense thereof except damage to the work due to
778 unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including
779 but not restricted to acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic
780 phenomenon of nature, or acts of the public enemy or of government authorities.

781 If the work is suspended for any cause whatever, the Contractor shall be responsible for the work and shall
782 take such precautions necessary to prevent damage to the work. The Contractor shall provide for normal
783 drainage and shall erect necessary temporary structures, signs, or other facilities at their own expense. During
784 such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable
785 growing condition all living material in newly established planting, seeding, and sodding furnished under the
786 contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth
787 against injury.

788 **70-15 Contractor’s responsibility for utility service and facilities of others.** As provided in paragraph 70-
789 04, *Restoration of Surfaces Disturbed by Others*, the Contractor shall cooperate with the owner of any public or
790 private utility service, FAA or NOAA, or a utility service of another government agency that may be authorized

791 by the Owner to construct, reconstruct or maintain such utility services or facilities during the progress of the
792 work. In addition, the Contractor shall control their operations to prevent the unscheduled interruption of such
793 utility services and facilities.

794 To the extent that such public or private utility services, FAA, or NOAA facilities, or utility services of another
795 governmental agency are known to exist within the limits of the contract work, the approximate locations have
796 been indicated on the plans and/or in the contract documents.

797 It is understood and agreed that the Owner does not guarantee the accuracy or the completeness of the location
798 information relating to existing utility services, facilities, or structures that may be shown on the plans or
799 encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of
800 the responsibility to protect such existing features from damage or unscheduled interruption of service.

801 It is further understood and agreed that the Contractor shall, upon execution of the contract, notify the Owners
802 of all utility services or other facilities of their plan of operations. Such notification shall be in writing addressed
803 to “The Person to Contact” as provided in this paragraph and paragraph 70-04, *Restoration of Surfaces Disturbed*
804 *By Others*. A copy of each notification shall be given to the DEN Project Manager.

805 In addition to the general written notification provided, it shall be the responsibility of the Contractor to keep
806 such individual Owners advised of changes in their plan of operations that would affect such Owners.

807 Prior to beginning the work in the general vicinity of an existing utility service or facility, the Contractor shall
808 again notify each such Owner of their plan of operation. If, in the Contractor’s opinion, the Owner’s assistance
809 is needed to locate the utility service or facility or the presence of a representative of the Owner is desirable to
810 observe the work, such advice should be included in the notification. Such notification shall be given by the
811 most expeditious means to reach the utility owner’s “Person to Contact” no later than two normal business
812 days prior to the Contractor’s commencement of operations in such general vicinity. The Contractor shall
813 furnish a written summary of the notification to the DEN Project Manager.

814 The Contractor’s failure to give the two days’ notice shall be cause for the Owner to suspend the Contractor’s
815 operations in the general vicinity of a utility service or facility.

816 Where the outside limits of an underground utility service have been located and staked on the ground, the
817 Contractor shall be required to use hand excavation methods within 3 feet (1 m) of such outside limits at such
818 points as may be required to ensure protection from damage due to the Contractor’s operations.

819 Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise,
820 the Contractor shall immediately notify the proper authority and the DEN Project Manager and shall take all
821 reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall
822 cooperate with the utility service or facility owner and the DEN Project Manager continuously until such
823 damage has been repaired and service restored to the satisfaction of the utility or facility owner.

824 The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to
825 their operations whether due to negligence or accident. The Owner reserves the right to deduct such costs from
826 any monies due or which may become due the Contractor, or their own surety.

827 **70-15.1 FAA facilities and cable runs.** The Contractor is hereby advised that the construction limits of the
828 project include existing facilities and buried cable runs that are owned, operated and maintained by the FAA.
829 The Contractor, during the execution of the project work, shall comply with the following:

830 **a.** The Contractor shall permit FAA maintenance personnel the right of access to the project work site for
831 purposes of inspecting and maintaining all existing FAA owned facilities.

832 **b.** The Contractor shall provide notice to the FAA Air Traffic Organization (ATO)/Technical
833 Operations/System Support Center (SSC) Point-of-Contact through the DEN Project Manager a minimum of
834 seven (7) calendar days prior to commencement of construction activities in order to permit sufficient time to
835 locate and mark existing buried cables and to schedule any required facility outages.

836 c. If execution of the project work requires a facility outage, the Contractor shall contact the FAA Point-
837 of-Contact a minimum of 72 hours prior to the time of the required outage.

838 d. Any damage to FAA cables, access roads, or FAA facilities during construction caused by the
839 Contractor's equipment or personnel whether by negligence or accident will require the Contractor to repair or
840 replace the damaged cables, access road, or FAA facilities to FAA requirements. The Contractor shall not bear
841 the cost to repair damage to underground facilities or utilities improperly located by the FAA.

842 e. If the project work requires the cutting or splicing of FAA owned cables, the FAA Point-of-Contact
843 shall be contacted a minimum of 72 hours prior to the time the cable work commences. The FAA reserves the
844 right to have a FAA representative on site to observe the splicing of the cables as a condition of acceptance.
845 All cable splices are to be accomplished in accordance with FAA specifications and require approval by the
846 FAA Point-of-Contact as a condition of acceptance by the Owner. The Contractor is hereby advised that FAA
847 restricts the location of where splices may be installed. If a cable splice is required in a location that is not
848 permitted by FAA, the Contractor shall furnish and install a sufficient length of new cable that eliminates the
849 need for any splice.

850 **70-16 Furnishing rights-of-way.** The Owner will be responsible for furnishing all rights-of-way upon which
851 the work is to be constructed in advance of the Contractor's operations.

852 **70-17 Personal liability of public officials.** In carrying out any of the contract provisions or in exercising any
853 power or authority granted by this contract, there shall be no liability upon the Engineer, DEN Project Manager,
854 their authorized representatives, or any officials of the Owner either personally or as an official of the Owner.
855 It is understood that in such matters they act solely as agents and representatives of the Owner.

856 **70-18 No waiver of legal rights.** Upon completion of the work, the Owner will expeditiously make final
857 inspection and notify the Contractor of final acceptance. Such final acceptance, however, shall not preclude or
858 stop the Owner from correcting any measurement, estimate, or certificate made before or after completion of
859 the work, nor shall the Owner be precluded or stopped from recovering from the Contractor or their surety,
860 or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill their
861 obligations under the contract. A waiver on the part of the Owner of any breach of any part of the contract
862 shall not be held to be a waiver of any other or subsequent breach.

863 The Contractor, without prejudice to the terms of the contract, shall be liable to the Owner for latent defects,
864 fraud, or such gross mistakes as may amount to fraud, or as regards the Owner's rights under any warranty or
865 guaranty.

866 **70-19 Environmental protection.** The Contractor shall comply with all federal, state, and local laws and
867 regulations controlling pollution of the environment. The Contractor shall take necessary precautions to
868 prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, asphalts, chemicals, or other harmful
869 materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

870 **70-20 Archaeological and historical findings.** Unless otherwise specified in this subsection, the Contractor
871 is advised that the site of the work is not within any property, district, or site, and does not contain any building,
872 structure, or object listed in the current National Register of Historic Places published by the United States
873 Department of Interior.

874 Should the Contractor encounter, during their operations, any building, part of a building, structure, or object
875 that is incongruous with its surroundings, the Contractor shall immediately cease operations in that location
876 and notify the DEN Project Manager. The DEN Project Manager will immediately investigate the Contractor's
877 finding and the Owner will direct the Contractor to either resume operations or to suspend operations as
878 directed.

879 Should the Owner order suspension of the Contractor's operations in order to protect an archaeological or
880 historical finding, or order the Contractor to perform extra work, such shall be covered by an appropriate
881 contract change order or supplemental agreement as provided in Section 40, paragraph 40-04, *Extra Work*, and

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882 Section 90, paragraph 90-05, *Payment for Extra Work*. If appropriate, the contract change order or supplemental
883 agreement shall include an extension of contract time in accordance with Section 80, paragraph 80-07,
884 *Determination and Extension of Contract Time*.

885

886 **70-21 Insurance Requirements.** Refer to DEN Project Requirements.

887

888

END OF SECTION 70

889 **Section 80 Execution and Progress**

890 **80-01 Subletting of contract.** The Owner will not recognize any subcontractor on the work. The Contractor
891 shall at all times when work is in progress be represented either in person, by a qualified superintendent, or by
892 other designated, qualified representative who is duly authorized to receive and execute orders of the DEN
893 Project Manager.

894 The Contractor shall perform, with his organization, an amount of work equal to at least 35 percent of the total
895 contract cost.

896 Should the Contractor elect to assign their contract, said assignment shall be concurred in by the surety, shall
897 be presented for the consideration and approval of the Owner, and shall be consummated only on the written
898 approval of the Owner.

899 **The Contractor shall provide copies of all subcontracts to the DEN Project Manager 14 days prior to**
900 **being utilized on the project. As a minimum, the information shall include the following:**

- 901 a. Subcontractor's legal company name.
902 b. Subcontractor's legal company address, including County name.
903 c. Principal contact person's name, telephone and fax number.
904 d. Complete narrative description, and dollar value of the work to be performed by the
905 subcontractor.
906 e. Copies of required insurance certificates in accordance with the specifications.
907 f. Minority/ non-minority status.

908 **80-02 Notice to proceed (NTP).** The Owners notice to proceed will state the date on which contract time
909 commences. The Contractor is expected to commence project operations within 10 days of the NTP date.
910 The Contractor shall notify the DEN Project Manager at least 24 hours in advance of the time contract
911 operations begins. The Contractor shall not commence any actual operations prior to the date on which the
912 notice to proceed is issued by the Owner.

913 **80-03 Execution and progress.** Unless otherwise specified, the Contractor shall submit their coordinated
914 construction schedule showing all work activities for the DEN Project Manager's review and acceptance at
915 least 10 days prior to the start of work. The Contractor's progress schedule, once accepted by the DEN Project
916 Manager, will represent the Contractor's baseline plan to accomplish the project in accordance with the terms
917 and conditions of the Contract. The DEN Project Manager will compare actual Contractor progress against
918 the baseline schedule to determine that status of the Contractor's performance. The Contractor shall provide
919 sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the
920 plans and specifications within the time set forth in the proposal.

921 If the Contractor falls significantly behind the submitted schedule, the Contractor shall, upon the DEN Project
922 Manager's request, submit a revised schedule for completion of the work within the contract time and modify
923 their operations to provide such additional materials, equipment, and labor necessary to meet the revised
924 schedule. Should the execution of the work be discontinued for any reason, the Contractor shall notify the
925 DEN Project Manager at least 24 hours in advance of resuming operations.

926 The Contractor shall not commence any actual construction prior to the date on which the NTP is issued by
927 the Owner.

928 The project schedule shall be prepared as a network diagram in Critical Path Method (CPM), Program
929 Evaluation and Review Technique (PERT), or other format, or as otherwise specified. It shall include

930 information on the sequence of work activities, milestone dates, and activity duration. The schedule shall show
931 all work items identified in the project proposal for each work area and shall include the project start date and
932 end date.

933 The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule
934 on a twice monthly basis, or as otherwise specified in the contract. Submission of the work schedule shall not
935 relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply
936 with the requirements of the contract.

937 **80-04 Limitation of operations.** The Contractor shall control their operations and the operations of their
938 subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the air
939 operations areas (AOA) of the airport.

940 When the work requires the Contractor to conduct their operations within an AOA of the airport, the work
941 shall be coordinated with airport operations (through the DEN Project Manager) at least 48 hours prior to
942 commencement of such work. The Contractor shall not close an AOA until so authorized by the DEN Project
943 Manager and until the necessary temporary marking, signage and associated lighting is in place as provided in
944 Section 70, paragraph 70-08, *Construction Safety and Phasing Plan (CSPP)*.

945 When the contract work requires the Contractor to work within an AOA of the airport on an intermittent basis
946 (intermittent opening and closing of the AOA), the Contractor shall maintain constant communications as
947 specified; immediately obey all instructions to vacate the AOA; and immediately obey all instructions to resume
948 work in such AOA. Failure to maintain the specified communications or to obey instructions shall be cause for
949 suspension of the Contractor's operations in the AOA until satisfactory conditions are provided. The areas of
950 the AOA identified in the Construction Safety Phasing Plan (CSPP) and as listed below, cannot be closed to
951 operating aircraft to permit the Contractor's operations on a continuous basis and will therefore be closed to
952 aircraft operations intermittently as follows:

953 Refer to the Milestone sheets of the Construction Drawings

954 The Contractor shall be required to conform to safety standards contained in AC 150/5370-2, Operational
955 Safety on Airports During Construction and the approved CSPP.

956 **80-04.1 Operational safety on airport during construction.** All Contractors' operations shall be conducted
957 in accordance with the approved project Construction Safety and Phasing Plan (CSPP) and the Safety Plan
958 Compliance Document (SPCD) and the provisions set forth within the current version of AC 150/5370-2,
959 Operational Safety on Airports During Construction. The CSPP included within the contract documents
960 conveys minimum requirements for operational safety on the airport during construction activities. The
961 Contractor shall prepare and submit a SPCD that details how it proposes to comply with the requirements
962 presented within the CSPP.

963 The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity.
964 The Contractor shall conduct routine checks to assure compliance with the safety plan measures.

965 The Contractor is responsible to the Owner for the conduct of all subcontractors it employs on the project.
966 The Contractor shall assure that all subcontractors are made aware of the requirements of the CSPP and SPCD
967 and that they implement and maintain all necessary measures.

968 No deviation or modifications may be made to the approved CSPP and SPCD unless approved in writing by
969 the Owner. The necessary coordination actions to review Contractor proposed modifications to an approved
970 CSPP or approved SPCD can require a significant amount of time.

971

972 **80-05 Character of workers, methods, and equipment.** The Contractor shall, at all times, employ sufficient
973 labor and equipment for prosecuting the work to full completion in the manner and time required by the
974 contract, plans, and specifications.

975 All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers
976 engaged in special work or skilled work shall have sufficient experience in such work and in the operation of
977 the equipment required to perform the work satisfactorily.

978 Any person employed by the Contractor or by any subcontractor who violates any operational regulations or
979 operational safety requirements and, in the opinion of the DEN Project Manager, does not perform his work
980 in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the DEN Project
981 Manager, be removed immediately by the Contractor or subcontractor employing such person, and shall not
982 be employed again in any portion of the work without approval of the DEN Project Manager.

983 Should the Contractor fail to remove such person or persons, or fail to furnish suitable and sufficient personnel
984 for the proper execution of the work, the DEN Project Manager may suspend the work by written notice until
985 compliance with such orders.

986 All equipment that is proposed to be used on the work shall be of sufficient size and in such mechanical
987 condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used
988 on any portion of the work shall not cause injury to previously completed work, adjacent property, or existing
989 airport facilities due to its use.

990 When the methods and equipment to be used by the Contractor in accomplishing the work are not prescribed
991 in the contract, the Contractor is free to use any methods or equipment that will accomplish the work in
992 conformity with the requirements of the contract, plans, and specifications.

993 When the contract specifies the use of certain methods and equipment, such methods and equipment shall be
994 used unless otherwise authorized by the DEN Project Manager. If the Contractor desires to use a method or
995 type of equipment other than specified in the contract, the Contractor may request authority from the DEN
996 Project Manager to do so. The request shall be in writing and shall include a full description of the methods
997 and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on
998 the condition that the Contractor will be fully responsible for producing work in conformity with contract
999 requirements. If, after trial use of the substituted methods or equipment, the DEN Project Manager determines
1000 that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the
1001 substitute method or equipment and shall complete the remaining work with the specified methods and
1002 equipment. The Contractor shall remove any deficient work and replace it with work of specified quality, or
1003 take such other corrective action as the DEN Project Manager may direct. No change will be made in basis of
1004 payment for the contract items involved nor in contract time as a result of authorizing a change in methods or
1005 equipment under this paragraph.

1006 **80-06 Temporary suspension of the work.** The Owner shall have the authority to suspend the work wholly,
1007 or in part, for such period or periods the Owner may deem necessary, due to unsuitable weather, or other
1008 conditions considered unfavorable for the execution of the work, or for such time necessary due to the failure
1009 on the part of the Contractor to carry out orders given or perform any or all provisions of the contract.

1010 In the event that the Contractor is ordered by the Owner, in writing, to suspend work for some unforeseen
1011 cause not otherwise provided for in the contract and over which the Contractor has no control, the Contractor
1012 may be reimbursed for actual money expended on the work during the period of shutdown. No allowance will
1013 be made for anticipated profits. The period of shutdown shall be computed from the effective date of the
1014 written order to suspend work to the effective date of the written order to resume the work. Claims for such
1015 compensation shall be filed with the DEN Project Manager within the time period stated in the DEN Project
1016 Manager's order to resume work. The Contractor shall submit with their own claim information substantiating
1017 the amount shown on the claim. The DEN Project Manager will forward the Contractor's claim to the Owner
1018 for consideration in accordance with local laws or ordinances. No provision of this article shall be construed as
1019 entitling the Contractor to compensation for delays due to inclement weather or for any other delay provided
1020 for in the contract, plans, or specifications.

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1021 If it becomes necessary to suspend work for an indefinite period, the Contractor shall store all materials in such
1022 manner that they will not become an obstruction nor become damaged in any way. The Contractor shall take
1023 every precaution to prevent damage or deterioration of the work performed and provide for normal drainage
1024 of the work. The Contractor shall erect temporary structures where necessary to provide for traffic on, to, or
1025 from the airport.

1026 **80-07 Determination and extension of contract time.** The number of calendar days be stated in the proposal
1027 and contract and shall be known as the Contract Time.

1028 If the contract time requires extension for reasons beyond the Contractor's control, it shall be adjusted as
1029 follows:

1030 **80-07.1 Contract time based on calendar days.** Contract Time based on calendar days shall consist of the
1031 number of calendar days stated in the contract counting from the effective date of the Notice to Proceed and
1032 including all Saturdays, Sundays, holidays, and non-work days. All calendar days elapsing between the effective
1033 dates of the Owner's orders to suspend and resume all work, due to causes not the fault of the Contractor, shall
1034 be excluded.

1035 At the time of final payment, the contract time shall be increased in the same proportion as the cost of the
1036 actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such
1037 increase in the contract time shall not consider either cost of work or the extension of contract time that has
1038 been covered by a change order or supplemental agreement. Charges against the contract time will cease as of
1039 the date of final acceptance.

1040 **80-08 Failure to complete on time.** For each calendar day or working day, as specified in the contract, that
1041 any work remains uncompleted after the contract time (including all extensions and adjustments as provided in
1042 paragraph 80-07, *Determination and Extension of Contract Time*) the sum specified in the contract and proposal as
1043 liquidated damages (LD) will be deducted from any money due or to become due the Contractor or their own
1044 surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a
1045 reasonable portion of damages including but not limited to additional engineering services that will be incurred
1046 by the Owner should the Contractor fail to complete the work in the time provided in their contract.

1047

Schedule	Liquidated Damages Cost	Allowed Construction Time
Milestone 1	\$25,000/Day	75 Calendar Days
Milestone 2	\$25,000/Day	75 Calendar Days

1048

1049

1050 The maximum construction time allowed for the overall project is 75 calendar days. Permitting the Contractor
1051 to continue and finish the work or any part of it after the time fixed for its completion, or after the date to
1052 which the time for completion may have been extended, will in no way operate as a wavier on the part of the
1053 Owner of any of its rights under the contract.

1054 **80-09 Default and termination of contract.** The Contractor shall be considered in default of their contract
1055 and such default will be considered as cause for the Owner to terminate the contract for any of the following
1056 reasons, if the Contractor:

1057 a. Fails to begin the work under the contract within the time specified in the Notice to Proceed, or

1058 b. Fails to perform the work or fails to provide sufficient workers, equipment and/or materials to assure
1059 completion of work in accordance with the terms of the contract, or

1060 c. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work
 1061 as may be rejected as unacceptable and unsuitable, or

1062 d. Discontinues the execution of the work, or

1063 e. Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

1064 f. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

1065 g. Allows any final judgment to stand against the Contractor unsatisfied for a period of 10 days, or

1066 h. Makes an assignment for the benefit of creditors, or

1067 i. For any other cause whatsoever, fails to carry on the work in an acceptable manner.

1068 Should the Owner consider the Contractor in default of the contract for any reason above, the Owner shall
 1069 immediately give written notice to the Contractor and the Contractor's surety as to the reasons for considering
 1070 the Contractor in default and the Owner's intentions to terminate the contract.

1071 If the Contractor or surety, within a period of 10 days after such notice, does not proceed in accordance
 1072 therewith, then the Owner will, upon written notification from the DEN Project Manager of the facts of such
 1073 delay, neglect, or default and the Contractor's failure to comply with such notice, have full power and authority
 1074 without violating the contract, to take the execution of the work out of the hands of the Contractor. The Owner
 1075 may appropriate or use any or all materials and equipment that have been mobilized for use in the work and
 1076 are acceptable and may enter into an agreement for the completion of said contract according to the terms and
 1077 provisions thereof, or use such other methods as in the opinion of the DEN Project Manager will be required
 1078 for the completion of said contract in an acceptable manner.

1079 All costs and charges incurred by the Owner, together with the cost of completing the work under contract,
 1080 will be deducted from any monies due or which may become due the Contractor. If such expense exceeds the
 1081 sum which would have been payable under the contract, then the Contractor and the surety shall be liable and
 1082 shall pay to the Owner the amount of such excess.

1083 **80-10 Termination for national emergencies.** The Owner shall terminate the contract or portion thereof by
 1084 written notice when the Contractor is prevented from proceeding with the construction contract as a direct
 1085 result of an Executive Order of the President with respect to the execution of war or in the interest of national
 1086 defense.

1087 When the contract, or any portion thereof, is terminated before completion of all items of work in the contract,
 1088 payment will be made for the actual number of units or items of work completed at the contract price or as
 1089 mutually agreed for items of work partially completed or not started. No claims or loss of anticipated profits
 1090 shall be considered.

1091 Reimbursement for organization of the work, and other overhead expenses, (when not otherwise included in
 1092 the contract) and moving equipment and materials to and from the job will be considered, the intent being that
 1093 an equitable settlement will be made with the Contractor.

1094 Acceptable materials, obtained or ordered by the Contractor for the work and that are not incorporated in the
 1095 work shall, at the option of the Contractor, be purchased from the Contractor at actual cost as shown by
 1096 receipted bills and actual cost records at such points of delivery as may be designated by the DEN Project
 1097 Manager.

1098 Termination of the contract or a portion thereof shall neither relieve the Contractor of their responsibilities for
 1099 the completed work nor shall it relieve their surety of its obligation for and concerning any just claim arising
 1100 out of the work performed.

1101 **80-11 Work area, storage area and sequence of operations.** The Contractor shall obtain approval from the
 1102 DEN Project Manager prior to beginning any work in all areas of the airport. No operating runway, taxiway,

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1103 or air operations area (AOA) shall be crossed, entered, or obstructed while it is operational. The Contractor
1104 shall plan and coordinate work in accordance with the approved CSPP and SPCD.

1105 **END OF SECTION 80**

1106

Section 90 Measurement and Payment

1107 **90-01 Measurement of quantities.** All work completed under the contract will be measured by the DEN
 1108 Project Manager, or their authorized representatives, using United States Customary Units of Measurement.

1109 The method of measurement and computations to be used in determination of quantities of material furnished
 1110 and of work performed under the contract will be those methods generally recognized as conforming to good
 1111 engineering practice.

1112 Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and
 1113 no deductions will be made for individual fixtures (or leave-outs) having an area of 9 square feet (0.8 square
 1114 meters) or less. Unless otherwise specified, transverse measurements for area computations will be the neat
 1115 dimensions shown on the plans or ordered in writing by the DEN Project Manager.

1116 Unless otherwise specified, all contract items which are measured by the linear foot such as electrical ducts,
 1117 conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon
 1118 which such items are placed.

1119 The term “lump sum” when used as an item of payment will mean complete payment for the work described
 1120 in the contract. When a complete structure or structural unit (in effect, “lump sum” work) is specified as the
 1121 unit of measurement, the unit will be construed to include all necessary fittings and accessories.

1122 When requested by the Contractor and approved by the DEN Project Manager in writing, material specified to
 1123 be measured by the cubic yard (cubic meter) may be weighed, and such weights will be converted to cubic yards
 1124 (cubic meters) for payment purposes. Factors for conversion from weight measurement to volume
 1125 measurement will be determined by the DEN Project Manager and shall be agreed to by the Contractor before
 1126 such method of measurement of pay quantities is used.

1127 Measurement and Payment Terms

Term	Description
Excavation and Embankment Volume	In computing volumes of excavation, the average end area method will be used unless otherwise specified.
Measurement and Proportion by Weight	The term “ton” will mean the short ton consisting of 2,000 pounds (907 kg) avoirdupois. All materials that are measured or proportioned by weights shall be weighed on accurate, independently certified scales by competent, qualified personnel at locations designated by the DEN Project Manager. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the DEN Project Manager directs, and each truck shall bear a plainly legible identification mark.
Measurement by Volume	Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable for the materials hauled, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level

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Term	Description
	capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.
Asphalt Material	Asphalt materials will be measured by the gallon (liter) or ton (kg). When measured by volume, such volumes will be measured at 60°F (16°C) or will be corrected to the volume at 60°F (16°C) using ASTM D1250 for asphalts. Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work. When asphalt materials are shipped by truck or transport, net certified weights by volume, subject to correction for loss or foaming, will be used for computing quantities.
Cement	Cement will be measured by the ton (kg) or hundredweight (km).
Structure	Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.
Timber	Timber will be measured by the thousand feet board measure (MFBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.
Plates and Sheets	The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fraction of inch.
Miscellaneous Items	When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.
Scales	<p>Scales must be tested for accuracy and serviced before use. Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.</p> <p>Scales shall be accurate within 0.5% of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the DEN Project Manager before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed 0.1% of the nominal rated capacity of the scale, but not less than one pound (454 grams). The use of spring balances will not be permitted.</p> <p>In the event inspection reveals the scales have been “overweighing” (indicating more than correct weight) they will be immediately adjusted. All materials</p>

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Term	Description
	<p>received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of 0.5%.</p> <p>In the event inspection reveals the scales have been under-weighting (indicating less than correct weight), they shall be immediately adjusted. No additional payment to the Contractor will be allowed for materials previously weighed and recorded.</p> <p>Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the DEN Project Manager can safely and conveniently view them.</p> <p>Scale installations shall have available ten standard 50-pound (2.3 km) weights for testing the weighing equipment or suitable weights and devices for other approved equipment.</p> <p>All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in this subsection, for the weighing of materials for proportioning or payment, shall be included in the unit contract prices for the various items of the project.</p>
Rental Equipment	<p>Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the work. Special equipment ordered in connection with extra work will be measured as agreed in the change order or supplemental agreement authorizing such work as provided in paragraph 90-05 <i>Payment for Extra Work</i>.</p>
Pay Quantities	<p>When the estimated quantities for a specific portion of the work are designated as the pay quantities in the contract, they shall be the final quantities for which payment for such specific portion of the work will be made, unless the dimensions of said portions of the work shown on the plans are revised by the DEN Project Manager. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.</p>

1128 **90-02 Scope of payment.** The Contractor shall receive and accept compensation provided for in the contract
1129 as full payment for furnishing all materials, for performing all work under the contract in a complete and
1130 acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of
1131 the work or the execution thereof, subject to the provisions of Section 70, paragraph 70-18, *No Waiver of Legal*
1132 *Rights*.

1133 When the “basis of payment” subsection of a technical specification requires that the contract price (price bid)
1134 include compensation for certain work or material essential to the item, this same work or material will not also
1135 be measured for payment under any other contract item which may appear elsewhere in the contract, plans, or
1136 specifications.

1137 **90-03 Compensation for altered quantities.** When the accepted quantities of work vary from the quantities
1138 in the proposal, the Contractor shall accept as payment in full, so far as contract items are concerned, payment
1139 at the original contract price for the accepted quantities of work actually completed and accepted. No allowance,
1140 except as provided for in Section 40, paragraph 40-02, *Alteration of Work and Quantities*, will be made for any
1141 increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the

1142 Contractor which results directly from such alterations or indirectly from their own unbalanced allocation of
1143 overhead and profit among the contract items, or from any other cause.

1144 **90-04 Payment for omitted items.** As specified in Section 40, paragraph 40-03, *Omitted Items*, the DEN Project
1145 Manager shall have the right to omit from the work (order nonperformance) any contract item, except major
1146 contract items, in the best interest of the Owner.

1147 Should the DEN Project Manager omit or order nonperformance of a contract item or portion of such item
1148 from the work, the Contractor shall accept payment in full at the contract prices for any work actually completed
1149 and acceptable prior to the DEN Project Manager's order to omit or non-perform such contract item.

1150 Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the DEN Project
1151 Manager's order will be paid for at the actual cost to the Contractor and shall thereupon become the property
1152 of the Owner.

1153 In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs
1154 incurred for the purpose of performing the omitted contract item prior to the date of the DEN Project
1155 Manager's order. Such additional costs incurred by the Contractor must be directly related to the deleted
1156 contract item and shall be supported by certified statements by the Contractor as to the nature the amount of
1157 such costs.

1158 **90-05 Payment for extra work.** Extra work, performed in accordance with Section 40, paragraph 40-04, *Extra*
1159 *Work*, will be paid for at the contract prices or agreed prices specified in the change order or supplemental
1160 agreement authorizing the extra work.

1161 **90-06 Partial payments.** Partial payments will be made to the Contractor at least once each month as the work
1162 progresses. Said payments will be based upon estimates, prepared by the DEN Project Manager, of the value
1163 of the work performed and materials complete and in place, in accordance with the contract, plans, and
1164 specifications. Such partial payments may also include the delivered actual cost of those materials stockpiled
1165 and stored in accordance with paragraph 90-07, *Payment for Materials on Hand*. No partial payment will be made
1166 when the amount due to the Contractor since the last estimate amounts to less than five hundred dollars.

1167 a. From the total of the amount determined to be payable on a partial payment, 10% percent of
1168 such total amount will be deducted and retained by the Owner for protection of the Owner's
1169 interests. Unless otherwise instructed by the Owner, the amount retained by the Owner will
1170 be in effect until the final payment is made except as follows:

1171 (1) Contractor may request release of retainage on work that has been partially accepted
1172 by the Owner in accordance with Section 50-14. Contractor must provide a certified
1173 invoice to the RPR that supports the value of retainage held by the Owner for partially
1174 accepted work.

1175 (2) In lieu of retainage, the Contractor may exercise at its option the establishment of an
1176 escrow account per paragraph 90-08.

1177 b. The Contractor is required to pay all subcontractors for satisfactory performance of their
1178 contracts no later than 30 days after the Contractor has received a partial payment. Contractor
1179 must provide the Owner evidence of prompt and full payment of retainage held by the prime
1180 Contractor to the subcontractor within 30 days after the subcontractor's work is satisfactorily
1181 completed. A subcontractor's work is satisfactorily completed when all the tasks called for in
1182 the subcontract have been accomplished and documented as required by the Owner. When
1183 the Owner has made an incremental acceptance of a portion of a prime contract, the work of
1184 a subcontractor covered by that acceptance is deemed to be satisfactorily completed.

1185 c. When at least 95% of the work has been completed to the satisfaction of the RPR, the RPR
1186 shall, at the Owner's discretion and with the consent of the surety, prepare estimates of both
1187 the contract value and the cost of the remaining work to be done. The Owner may retain an

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1188 amount not less than twice the contract value or estimated cost, whichever is greater, of the
1189 work remaining to be done. The remainder, less all previous payments and deductions, will
1190 then be certified for payment to the Contractor.

1191 It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based
1192 on quantities of work in excess of those provided in the proposal or covered by approved change orders or
1193 supplemental agreements, except when such excess quantities have been determined by the DEN Project
1194 Manager to be a part of the final quantity for the item of work in question.

1195 No partial payment shall bind the Owner to the acceptance of any materials or work in place as to quality or
1196 quantity. All partial payments are subject to correction at the time of final payment as provided in paragraph
1197 90-09, *Acceptance and Final Payment*.

1198 The Contractor shall deliver to the Owner a complete release of all claims for labor and material arising out of
1199 this contract before the final payment is made. If any subcontractor or supplier fails to furnish such a release
1200 in full, the Contractor may furnish a bond or other collateral satisfactory to the Owner to indemnify the Owner
1201 against any potential lien or other such claim. The bond or collateral shall include all costs, expenses, and
1202 attorney fees the Owner may be compelled to pay in discharging any such lien or claim.

1203

1204 **90-07 Payment for materials on hand.** Partial payments may be made to the extent of the delivered cost of
1205 materials to be incorporated in the work, provided that such materials meet the requirements of the contract,
1206 plans, and specifications and are delivered to acceptable sites on the airport property or at other sites in the
1207 vicinity that are acceptable to the Owner. Such delivered costs of stored or stockpiled materials may be included
1208 in the next partial payment after the following conditions are met:

1209 a. The material has been stored or stockpiled in a manner acceptable to the DEN Project Manager at or
1210 on an approved site.

1211 b. The Contractor has furnished the DEN Project Manager with acceptable evidence of the quantity and
1212 quality of such stored or stockpiled materials.

1213 c. The Contractor has furnished the DEN Project Manager with satisfactory evidence that the material and
1214 transportation costs have been paid.

1215 d. The Contractor has furnished the Owner legal title (free of liens or encumbrances of any kind) to the
1216 material stored or stockpiled.

1217 e. The Contractor has furnished the Owner evidence that the material stored or stockpiled is insured against
1218 loss by damage to or disappearance of such materials at any time prior to use in the work.

1219 It is understood and agreed that the transfer of title and the Owner's payment for such stored or stockpiled
1220 materials shall in no way relieve the Contractor of their responsibility for furnishing and placing such materials
1221 in accordance with the requirements of the contract, plans, and specifications.

1222 In no case will the amount of partial payments for materials on hand exceed the contract price for such materials
1223 or the contract price for the contract item in which the material is intended to be used.

1224 No partial payment will be made for stored or stockpiled living or perishable plant materials.

1225 The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in
1226 accordance with the provisions of this paragraph.

1227 **90-08 Payment of withheld funds.** At the Contractor's option, if an Owner withholds retainage in accordance
1228 with the methods described in paragraph 90-06 *Partial Payments*, the Contractor may request that the Owner
1229 deposit the retainage into an escrow account. The Owner's deposit of retainage into an escrow account is
1230 subject to the following conditions:

1231 a. The Contractor shall bear all expenses of establishing and maintaining an escrow account and escrow
1232 agreement acceptable to the Owner.

1233 b. The Contractor shall deposit to and maintain in such escrow only those securities or bank certificates of
1234 deposit as are acceptable to the Owner and having a value not less than the retainage that would otherwise be
1235 withheld from partial payment.

1236 c. The Contractor shall enter into an escrow agreement satisfactory to the Owner.

1237 d. The Contractor shall obtain the written consent of the surety to such agreement.

1238 **90-09 Acceptance and final payment.** When the contract work has been accepted in accordance with the
1239 requirements of Section 50, paragraph 50-15, *Final Acceptance*, the DEN Project Manager will prepare the final
1240 estimate of the items of work actually performed. The Contractor shall approve the DEN Project Manager's
1241 final estimate or advise the DEN Project Manager of the Contractor's objections to the final estimate which
1242 are based on disputes in measurements or computations of the final quantities to be paid under the contract as
1243 amended by change order or supplemental agreement. The Contractor and the DEN Project Manager shall
1244 resolve all disputes (if any) in the measurement and computation of final quantities to be paid within 30 calendar
1245 days of the Contractor's receipt of the DEN Project Manager's final estimate. If, after such 30-day period, a
1246 dispute still exists, the Contractor may approve the DEN Project Manager's estimate under protest of the
1247 quantities in dispute, and such disputed quantities shall be considered by the Owner as a claim in accordance
1248 with Section 50, paragraph 50-16, *Claims for Adjustment and Disputes*.

1249 After the Contractor has approved, or approved under protest, the DEN Project Manager's final estimate, and
1250 after the DEN Project Manager's receipt of the project closeout documentation required in paragraph 90-11,
1251 *Contractor Final Project Documentation*, final payment will be processed based on the entire sum, or the undisputed
1252 sum in case of approval under protest, determined to be due the Contractor less all previous payments and all
1253 amounts to be deducted under the provisions of the contract. All prior partial estimates and payments shall be
1254 subject to correction in the final estimate and payment.

1255 If the Contractor has filed a claim for additional compensation under the provisions of Section 50, paragraph
1256 50-16, *Claims for Adjustments and Disputes*, or under the provisions of this paragraph, such claims will be
1257 considered by the Owner in accordance with local laws or ordinances. Upon final adjudication of such claims,
1258 any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final
1259 estimate.

1260 **90-10 Construction warranty.**

1261 a. In addition to any other warranties in this contract, the Contractor warrants that work performed under
1262 this contract conforms to the contract requirements and is free of any defect in equipment, material,
1263 workmanship, or design furnished, or performed by the Contractor or any subcontractor or supplier at any tier.

1264 b. This warranty shall continue for a period of one year from the date of final acceptance of the work,
1265 except as noted. If the Owner takes possession of any part of the work before final acceptance, this warranty
1266 shall continue for a period of one year from the date the Owner takes possession. However, this will not relieve
1267 the Contractor from corrective items required by the final acceptance of the project work. Light Emitting Diode
1268 emitting diode (LED) light fixtures with the exception of obstruction lighting, must be warranted by the
1269 manufacturer for a minimum of four (4) years after date of installation inclusive of all electronics.

1270 c. The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In
1271 addition, the Contractor shall remedy at the Contractor's expense any damage to Owner real or personal
1272 property, when that damage is the result of the Contractor's failure to conform to contract requirements; or
1273 any defect of equipment, material, workmanship, or design furnished by the Contractor.

1274 d. The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The
1275 Contractor's warranty with respect to work repaired or replaced will run for one year from the date of repair or
1276 replacement.

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- 1277 e. The Owner will notify the Contractor, in writing, within seven (7) days after the discovery of any failure,
1278 defect, or damage.
- 1279 f. If the Contractor fails to remedy any failure, defect, or damage within 14 days after receipt of notice, the
1280 Owner shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the
1281 Contractor's expense.
- 1282 g. With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for
1283 work performed and materials furnished under this contract, the Contractor shall: (1) Obtain all warranties that
1284 would be given in normal commercial practice; (2) Require all warranties to be executed, in writing, for the
1285 benefit of the Owner, as directed by the Owner, and (3) Enforce all warranties for the benefit of the Owner.
- 1286 h. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.
- 1287 **90-11 Contractor Final Project Documentation.** Approval of final payment to the Contractor is contingent
1288 upon completion and submittal of the items listed below. The final payment will not be approved until the
1289 DEN Project Manager approves the Contractor's final submittal. The Contractor shall:
- 1290 a. Provide two (2) copies of all manufacturers warranties specified for materials, equipment, and
1291 installations.
- 1292 b. Provide weekly payroll records (not previously received) from the general Contractor and all
1293 subcontractors.
- 1294 c. Complete final cleanup in accordance with Section 40, paragraph 40-08, *Final Cleanup*.
- 1295 d. Complete all punch list items identified during the Final Inspection.
- 1296 e. Provide complete release of all claims for labor and material arising out of the Contract.
- 1297 f. Provide a certified statement signed by the subcontractors, indicating actual amounts paid to the
1298 Disadvantaged Business Enterprise (DBE) subcontractors and/or suppliers associated with the project.
- 1299 g. When applicable per state requirements, return copies of sales tax completion forms.
- 1300 h. Manufacturer's certifications for all items incorporated in the work.
- 1301 i. All required record drawings, as-built drawings or as-constructed drawings.
- 1302 j. Project Operation and Maintenance (O&M) Manual(s).
- 1303 k. Security for Construction Warranty.
- 1304 l. Equipment commissioning documentation submitted, if required.
- 1305 m. Refer to the Division 1 specification 017720 Contract Closeout for additional closeout requirements.

1306 **END OF SECTION 90**

1307

Part 2 – General Construction Items

1308 **100-1 General.** Quality is more than test results. Quality is the combination of proper materials, testing,
1309 workmanship, equipment, inspection, and documentation of the project. Establishing and maintaining a culture
1310 of quality is key to achieving a quality project. The Contractor shall establish, provide, and maintain an effective
1311 Contractor Quality Control Program (CQCP) that details the methods and procedures that will be taken to
1312 assure that all materials and completed construction required by this contract conform to contract plans,
1313 technical specifications and other requirements, whether manufactured by the Contractor, or procured from
1314 subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified
1315 here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for
1316 accomplishing the stated purpose.

1317 The Contractor shall establish a CQCP that will:

- 1318 a. Provide qualified personnel to develop and implement the CQCP.
- 1319 b. Provide for the production of acceptable quality materials.
- 1320 c. Provide sufficient information to assure that the specification requirements can be met.
- 1321 d. Document the CQCP process.

1322 The Contractor shall not begin any construction or production of materials to be incorporated into the
1323 completed work until the CQCP has been reviewed and approved by the DEN Project Manager. No partial
1324 payment will be made for materials subject to specific quality control (QC) requirements until the CQCP has
1325 been reviewed and approved.

1326 The QC requirements contained in this section and elsewhere in the contract technical specifications are in
1327 addition to and separate from the quality assurance (QA) testing requirements. QA testing requirements are the
1328 responsibility of the DEN Project Manager or Contractor as specified in the specifications.

1329 A Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, DEN Project Manager,
1330 Contractor, subcontractors, testing laboratories, and Owner's representative must be held prior to start of
1331 construction. The QC/QA workshop will be facilitated by the Contractor. The Contractor shall coordinate
1332 with the Airport and the DEN Project Manager on time and location of the QC/QA workshop. Items to be
1333 addressed, at a minimum, will include:

- 1334 a. Review of the CQCP including submittals, QC Testing, Action & Suspension Limits for Production,
1335 Corrective Action Plans, Distribution of QC reports, and Control Charts.
- 1336 b. Discussion of the QA program.
- 1337 c. Discussion of the QC and QA Organization and authority including coordination and information
1338 exchange between QC and QA.
- 1339 d. Establish regular meetings to discuss control of materials, methods and testing.
- 1340 e. Establishment of the overall QC culture.

1341 **100-2 Description of program.**

1342 a. **General description.** The Contractor shall establish a CQCP to perform QC inspection and testing of
1343 all items of work required by the technical specifications, including those performed by subcontractors. The
1344 CQCP shall ensure conformance to applicable specifications and plans with respect to materials, off-site
1345 fabrication, workmanship, construction, finish, and functional performance. The CQCP shall be effective for
1346 control of all construction work performed under this Contract and shall specifically include surveillance and

1347 tests required by the technical specifications, in addition to other requirements of this section and any other
1348 activities deemed necessary by the Contractor to establish an effective level of QC.

1349 **b. Contractor Quality Control Program (CQCP).** The Contractor shall describe the CQCP in a written
1350 document that shall be reviewed and approved by the DEN Project Manager prior to the start of any
1351 production, construction, or off-site fabrication. The written CQCP shall be submitted to the DEN Project
1352 Manager for review and approval at least 10 calendar days before the CQCP Workshop. The Contractor's
1353 CQCP and QC testing laboratory must be approved in writing by the DEN Project Manager prior to the Notice
1354 to Proceed (NTP).

1355 The CQCP shall be organized to address, as a minimum, the following:

- 1356 1. QC organization and resumes of key staff
- 1357 2. Project progress schedule
- 1358 3. Submittals schedule
- 1359 4. Inspection requirements
- 1360 5. QC testing plan
- 1361 6. Documentation of QC activities and distribution of QC reports
- 1362 7. Requirements for corrective action when QC and/or QA acceptance criteria are not met
- 1363 8. Material quality and construction means and methods. Address all elements applicable to the
1364 project that affect the quality of the pavement structure including subgrade, subbase, base, and
1365 surface course. Some elements that must be addressed include, but is not limited to mix design,
1366 aggregate grading, stockpile management, mixing and transporting, placing and finishing, quality
1367 control testing and inspection, smoothness, laydown plan, equipment, and temperature
1368 management plan.

1369 The Contractor must add any additional elements to the CQCP that is necessary to adequately control all
1370 production and/or construction processes required by this contract.

1371 **100-3 CQCP organization.** The CQCP shall be implemented by the establishment of a QC organization. An
1372 organizational chart shall be developed to show all QC personnel, their authority, and how these personnel
1373 integrate with other management/production and construction functions and personnel.

1374 The organizational chart shall identify all QC staff by name and function, and shall indicate the total staff
1375 required to implement all elements of the CQCP, including inspection and testing for each item of work. If
1376 necessary, different technicians can be used for specific inspection and testing functions for different items of
1377 work. If an outside organization or independent testing laboratory is used for implementation of all or part of
1378 the CQCP, the personnel assigned shall be subject to the qualification requirements of paragraphs 100-03a and
1379 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are
1380 provided by an outside organization.

1381 The QC organization shall, as a minimum, consist of the following personnel:

1382 **a. Program Administrator.** The Contractor Quality Control Program Administrator (CQCPA) must be
1383 a full-time on-site employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA must
1384 have a minimum of five (5) years of experience in QC pavement construction with prior QC experience on a
1385 project of comparable size and scope as the contract.

1386 Included in the five (5) years of paving/QC experience, the CQCPA must meet at least one of the following
1387 requirements:

- 1388 (1) Professional Engineer with one (1) year of airport paving experience.
- 1389 (2) Engineer-in-training with two (2) years of airport paving experience.

1390 (3) National Institute for Certification in Engineering Technologies (NICET) Civil Engineering
1391 Technology Level IV with three (3) years of airport paving experience.

1392 (4) An individual with four (4) years of airport paving experience, with a Bachelor of Science Degree
1393 in Civil Engineering, Civil Engineering Technology or Construction.

1394 The CQCPA must have full authority to institute any and all actions necessary for the successful
1395 implementation of the CQCP to ensure compliance with the contract plans and technical specifications. The
1396 CQCPA authority must include the ability to immediately stop production until materials and/or processes are
1397 in compliance with contract specifications. The CQCPA must report directly to a principal officer of the
1398 construction firm. The CQCPA may supervise the Quality Control Program on more than one project provided
1399 that person can be at the job site within two (2) hours after being notified of a problem.

1400 **b. QC technicians.** A sufficient number of QC technicians necessary to adequately implement the CQCP
1401 must be provided. These personnel must be either Engineers, engineering technicians, or experienced craftsman
1402 with qualifications in the appropriate field equivalent to NICET Level II in Civil Engineering Technology or
1403 higher, and shall have a minimum of two (2) years of experience in their area of expertise.

1404 The QC technicians must report directly to the CQCPA and shall perform the following functions:

1405 (1) Inspection of all materials, construction, plant, and equipment for conformance to the technical
1406 specifications, and as required by paragraph 100-6.

1407 (2) Performance of all QC tests as required by the technical specifications and paragraph 100-8.

1408 (3) Performance of tests for the DEN Project Manager when required by the technical specifications.

1409 Certification at an equivalent level of qualification and experience by a state or nationally recognized
1410 organization will be acceptable in lieu of NICET certification.

1411 **c. Staffing levels.** The Contractor shall provide sufficient qualified QC personnel to monitor each work
1412 activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant
1413 and field technicians shall be provided at each plant and field placement location. The scheduling and
1414 coordinating of all inspection and testing must match the type and pace of work activity. The CQCP shall state
1415 where different technicians will be required for different work elements.

1416 **100-4 Project progress schedule.** Critical QC activities must be shown on the project schedule as required by
1417 Section 80, paragraph 80-03, *Execution and Progress*.

1418 **100-5 Submittals schedule.** The Contractor shall submit a detailed listing of all submittals (for example, mix
1419 designs, material certifications) and shop drawings required by the technical specifications. The listing can be
1420 developed in a spreadsheet format and shall include as a minimum:

1421 a. Specification item number

1422 b. Item description

1423 c. Description of submittal

1424 d. Specification paragraph requiring submittal

1425 e. Scheduled date of submittal

1426 **100-6 Inspection requirements.** QC inspection functions shall be organized to provide inspections for all
1427 definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified
1428 by paragraph 100-9.

1429 Inspections shall be performed as needed to ensure continuing compliance with contract requirements until
1430 completion of the particular feature of work. Inspections shall include the following minimum requirements:

1431 a. During plant operation for material production, QC test results and periodic inspections shall be used
1432 to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to

1433 meet the approved mix design and other requirements of the technical specifications. All equipment used in
 1434 proportioning and mixing shall be inspected to ensure its proper operating condition. The CQCP shall detail
 1435 how these and other QC functions will be accomplished and used.

1436 **b.** During field operations, QC test results and periodic inspections shall be used to ensure the quality of
 1437 all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to
 1438 ensure its proper operating condition and to ensure that all such operations are in conformance to the technical
 1439 specifications and are within the plan dimensions, lines, grades, and tolerances specified. The CQCP shall
 1440 document how these and other QC functions will be accomplished and used.

1441 **100-7 Contractor QC testing facility.**

1442 **a.** For projects that include Item P-401, Item P-403, and Item P-404, the Contractor shall ensure facilities,
 1443 including all necessary equipment, materials, and current reference standards, are provided that meet
 1444 requirements in the following paragraphs of ASTM D3666, *Standard Specification for Minimum Requirements for*
 1445 *Agencies Testing and Inspecting Road and Paving Materials*:

- 1446 • 8.1.3 Equipment Calibration and Checks;
- 1447 • 8.1.9 Equipment Calibration, Standardization, and Check Records;
- 1448 • 8.1.12 Test Methods and Procedures

1449 **b.** For projects that include P-501, the Contractor shall ensure facilities, including all necessary equipment,
 1450 materials, and current reference standards, are provided that meet requirements in the following paragraphs of
 1451 ASTM C1077, *Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in*
 1452 *Construction and Criteria for Testing Agency Evaluation*:

- 1453 • 7 Test Methods and Procedures
- 1454 • 8 Facilities, Equipment, and Supplemental Procedures

1455 **100-8 QC testing plan.** As a part of the overall CQCP, the Contractor shall implement a QC testing plan, as
 1456 required by the technical specifications. The testing plan shall include the minimum tests and test frequencies
 1457 required by each technical specification Item, as well as any additional QC tests that the Contractor deems
 1458 necessary to adequately control production and/or construction processes.

1459 The QC testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

- 1460 **a.** Specification item number (e.g., P-401)
- 1461 **b.** Item description (e.g., Hot Mix Asphalt Pavements)
- 1462 **c.** Test type (e.g., gradation, grade, asphalt content)
- 1463 **d.** Test standard (e.g., ASTM or American Association of State Highway and Transportation Officials
 1464 (AASHTO) test number, as applicable)
- 1465 **e.** Test frequency (e.g., as required by technical specifications or minimum frequency when requirements
 1466 are not stated)
- 1467 **f.** Responsibility (e.g., plant technician)
- 1468 **g.** Control requirements (e.g., target, permissible deviations)

1469 The QC testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples
 1470 in accordance with ASTM D3665. The DEN Project Manager shall be provided the opportunity to witness QC
 1471 sampling and testing.

1472 All QC test results shall be documented by the Contractor as required by paragraph 100-9.

1473 **100-9 Documentation.** The Contractor shall maintain current QC records of all inspections and tests
 1474 performed. These records shall include factual evidence that the required QC inspections or tests have been
 1475 performed, including type and number of inspections or tests involved; results of inspections or tests; nature
 1476 of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

1477 These records must cover both conforming and defective or deficient features, and must include a statement
 1478 that all supplies and materials incorporated in the work are in full compliance with the terms of the contract.
 1479 Legible copies of these records shall be furnished to the DEN Project Manager daily. The records shall cover
 1480 all work placed subsequent to the previously furnished records and shall be verified and signed by the CQCPA.

1481 Contractor QC records required for the contract shall include, but are not necessarily limited to, the following
 1482 records:

1483 **a. Daily inspection reports.** Each Contractor QC technician shall maintain a daily log of all inspections
 1484 performed for both Contractor and subcontractor operations. These technician's daily reports shall provide
 1485 factual evidence that continuous QC inspections have been performed and shall, as a minimum, include the
 1486 following:

- 1487 (1) Technical specification item number and description
- 1488 (2) Compliance with approved submittals
- 1489 (3) Proper storage of materials and equipment
- 1490 (4) Proper operation of all equipment
- 1491 (5) Adherence to plans and technical specifications
- 1492 (6) Summary of any necessary corrective actions
- 1493 (7) Safety inspection.
- 1494 (8) Photographs and/or video

1495 The daily inspection reports shall identify all QC inspections and QC tests conducted, results of inspections,
 1496 location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

1497 The daily inspection reports shall be signed by the responsible QC technician and the CQCPA. The DEN
 1498 Project Manager shall be provided at least one copy of each daily inspection report on the work day following
 1499 the day of record. When QC inspection and test results are recorded and transmitted electronically, the results
 1500 must be archived.

1501 **b. Daily test reports.** The Contractor shall be responsible for establishing a system that will record all QC
 1502 test results. Daily test reports shall document the following information:

- 1503 (1) Technical specification item number and description
- 1504 (2) Test designation
- 1505 (3) Location
- 1506 (4) Date of test
- 1507 (5) Control requirements
- 1508 (6) Test results
- 1509 (7) Causes for rejection
- 1510 (8) Recommended remedial actions
- 1511 (9) Retests

1512 Test results from each day's work period shall be submitted to the DEN Project Manager prior to the start of
 1513 the next day's work period. When required by the technical specifications, the Contractor shall maintain
 1514 statistical QC charts. When QC daily test results are recorded and transmitted electronically, the results must
 1515 be archived.

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1516 **100-10 Corrective action requirements.** The CQCP shall indicate the appropriate action to be taken when a
1517 process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to
1518 bring the process into control. The requirements for corrective action shall include both general requirements
1519 for operation of the CQCP as a whole, and for individual items of work contained in the technical specifications.

1520 The CQCP shall detail how the results of QC inspections and tests will be used for determining the need for
1521 corrective action and shall contain clear rules to gauge when a process is out of control and the type of
1522 correction to be taken to regain process control.

1523 When applicable or required by the technical specifications, the Contractor shall establish and use statistical
1524 QC charts for individual QC tests. The requirements for corrective action shall be linked to the control charts.

1525 **100-11 Inspection and/or observations by the DEN Project Manager.** All items of material and equipment
1526 are subject to inspection and/or observation by the DEN Project Manager at the point of production,
1527 manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an
1528 adequate QC system in conformance with the requirements detailed here and the applicable technical
1529 specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to
1530 inspection and/or observation by the DEN Project Manager at the site for the same purpose.

1531 Inspection and/or observations by the DEN Project Manager does not relieve the Contractor of performing
1532 QC inspections of either on-site or off-site Contractor's or subcontractor's work.

1533 **100-12 Noncompliance.**

1534 a. The DEN Project Manager will provide written notice to the Contractor of any noncompliance with
1535 their CQCP. After receipt of such notice, the Contractor must take corrective action.

1536 b. When QC activities do not comply with either the CQCP or the contract provisions or when the
1537 Contractor fails to properly operate and maintain an effective CQCP, and no effective corrective actions have
1538 been taken after notification of non-compliance, the DEN Project Manager will recommend the Owner take
1539 the following actions:

1540 (1) Order the Contractor to replace ineffective or unqualified QC personnel or subcontractors and/or

1541 (2) Order the Contractor to stop operations until appropriate corrective actions are taken.

1542 METHOD OF MEASUREMENT

100-13 Basis of measurement and payment. [Not Used] [Contractor Quality Control Program (CQCP) is
for the personnel, tests, facilities and documentation required to implement the CQCP. The CQCP will be
paid as a lump sum with the following schedule of partial payments:]

1543 a. With first pay request, 25% with approval of CQCP and completion of the Quality Control (QC)/Quality
1544 Assurance (QA) workshop.

1545 b. When 25% or more of the original contract is earned, an additional 25%.

1546 c. When 50% or more of the original contract is earned, an additional 20%.

1547 d. When 75% or more of the original contract is earned, an additional 20%

1548 e. After final inspection and acceptance of project, the final 10%.

1549 BASIS OF PAYMENT

1550 **100-14 Payment will be made under:**

Item C-100a Contractor Quality Control Program (CQCP) – Per Lump Sum

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1551 **REFERENCES**

1552 The publications listed below form a part of this specification to the extent referenced. The publications are
1553 referred to within the text by the basic designation only.

National Institute for Certification in Engineering Technologies (NICET)

ASTM International (ASTM)

- | | | |
|------|------------|--|
| 1554 | ASTM C1077 | Standard Practice for Agencies Testing Concrete and Concrete Aggregates |
| 1555 | | for Use in Construction and Criteria for Testing Agency Evaluation |
| 1556 | ASTM D3665 | Standard Practice for Random Sampling of Construction Materials |
| 1557 | ASTM D3666 | Standard Specification for Minimum Requirements for Agencies Testing and |
| 1558 | | Inspecting Road and Paving Materials |

1559 **END OF ITEM C-100**

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Item C-105 Mobilization

1571 **105-1 Description.** This item of work shall consist of, but is not limited to, work and operations necessary for
 1572 the movement of personnel, equipment, material and supplies to and from the project site for work on the
 1573 project except as provided in the contract as separate pay items.

1574 **105-2 Mobilization limit.** Mobilization shall be limited to 5 percent of the total project cost.

1575 **105-3 Posted notices.** Prior to commencement of construction activities, the Contractor must post the
 1576 following documents in a prominent and accessible place where they may be easily viewed by all employees of
 1577 the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal
 1578 Employment Opportunity (EEO) Poster “Equal Employment Opportunity is the Law” in accordance with the
 1579 Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage
 1580 Poster (WH 1321) - DOL “Notice to All Employees” Poster; and Applicable Davis-Bacon Wage Rate
 1581 Determination. These notices must remain posted until final acceptance of the work by the Owner.

1582 **105-4 Engineer/DEN Project Manager field office.** An Engineer/DEN Project Manager field office is not
 1583 required.

1584

METHOD OF MEASUREMENT

1585 **105-5 Basis of measurement and payment.** Based upon the contract lump sum price for “Mobilization”
 1586 partial payments will be allowed as follows:

1587 a. With first pay request, 25%.

1588 b. When 25% or more of the original contract is earned, an additional 25%.

1589 c. When 50% or more of the original contract is earned, an additional 40%.

1590 d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required
 1591 by Section 90, paragraph 90-11, *Contractor Final Project Documentation*, the final 10%.

1592

BASIS OF PAYMENT

1593 **105-6 Payment will be made under:**

1594 Item C-105a Mobilization – Per Lump Sum

1595

REFERENCES

1596 The publications listed below form a part of this specification to the extent referenced. The publications are
 1597 referred to within the text by the basic designation only.

1598 Office of Federal Contract Compliance Programs (OFCCP)

1599 Executive Order 11246, as amended

1600 EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

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1601 United States Department of Labor, Wage and Hour Division (WHD)

1602 WH 1321 – Employee Rights under the Davis-Bacon Act Poster

1603 **END OF ITEM C-105**

1604 Item C-110 Method of Estimating Percentage of Material Within Specification Limits
 1605 (PWL)

1606 **110-1 General.** When the specifications provide for acceptance of material based on the method of estimating
 1607 percentage of material within specification limits (PWL), the PWL will be determined in accordance with this
 1608 section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot
 1609 that is within specification limits. The PWL is computed using the sample average (\bar{X}) and sample standard
 1610 deviation (S_n) of the specified number (n) of sublots for the lot and the specification tolerance limits, L for
 1611 lower and U for upper, for the particular acceptance parameter. From these values, the respective Quality index,
 1612 Q_L for Lower Quality Index and/or Q_U for Upper Quality Index, is computed and the PWL for the lot for the
 1613 specified n is determined from Table 1. All specification limits specified in the technical sections shall be
 1614 absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

1615 There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of
 1616 production material (the population) is sampled and tested. This uncertainty exists because all portions of the
 1617 production material have the same probability to be randomly sampled. The Contractor's risk is the probability
 1618 that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Owner's
 1619 risk is the probability that material produced at the rejectable quality level is accepted.

1620 It is the intent of this section to inform the Contractor that, in order to consistently offset the Contractor's risk
 1621 for material evaluated, production quality (using population average and population standard deviation) must
 1622 be maintained at the acceptable quality specified or higher. In all cases, it is the responsibility of the Contractor
 1623 to produce at quality levels that will meet the specified acceptance criteria when sampled and tested at the
 1624 frequencies specified.

1625 **110-2 Method for computing PWL.** The computational sequence for computing PWL is as follows:

1626 a. Divide the lot into n sublots in accordance with the acceptance requirements of the specification.

1627 b. Locate the random sampling position within the subplot in accordance with the requirements of the
 1628 specification.

1629 c. Make a measurement at each location, or take a test portion and make the measurement on the test
 1630 portion in accordance with the testing requirements of the specification.

1631 d. Find the sample average (\bar{X}) for all subplot test values within the lot by using the following formula:

1632
$$\bar{X} = (x_1 + x_2 + x_3 + \dots + x_n) / n$$

1633 Where: \bar{X} = Sample average of all subplot test values within a lot

1634 x_1, x_2, \dots, x_n = Individual subplot test values

1635 n = Number of subplot test values

1636 e. Find the sample standard deviation (S_n) by use of the following formula:

1637
$$S_n = [(d_1^2 + d_2^2 + d_3^2 + \dots + d_n^2) / (n-1)]^{1/2}$$

1638 Where: S_n = Sample standard deviation of the number of subplot test values in the set

1639 d_1, d_2, \dots, d_n = Deviations of the individual subplot test values x_1, x_2, \dots from the average value \bar{X}

1640 that is: $d_1 = (x_1 - \bar{X}), d_2 = (x_2 - \bar{X}) \dots d_n = (x_n - \bar{X})$

1641 n = Number of subplot test values

1642 **f.** For single sided specification limits (i.e., L only), compute the Lower Quality Index Q_L by use of the
 1643 following formula:

1644 $Q_L = (X - L) / S_n$

1645 Where: L = specification lower tolerance limit

1646 Estimate the percentage of material within limits (PWL) by entering Table 1 with Q_L , using the column
 1647 appropriate to the total number (n) of measurements. If the value of Q_L falls between values shown on the
 1648 table, use the next higher value of PWL.

1649 **g.** For double-sided specification limits (i.e., L and U), compute the Quality Indexes Q_L and Q_U by use of
 1650 the following formulas:

1651 $Q_L = (X - L) / S_n$

1652 and

1653 $Q_U = (U - X) / S_n$

1654 Where: L and U = specification lower and upper tolerance limits

1655 Estimate the percentage of material between the lower (L) and upper (U) tolerance limits (PWL) by entering
 1656 Table 1 separately with Q_L and Q_U , using the column appropriate to the total number (n) of measurements,
 1657 and determining the percent of material above P_L and percent of material below P_U for each tolerance limit. If
 1658 the values of Q_L fall between values shown on the table, use the next higher value of P_L or P_U . Determine the
 1659 PWL by use of the following formula:

1660 $PWL = (P_U + P_L) - 100$

1661 Where: P_L = percent within lower specification limit

1662 P_U = percent within upper specification limit

1663 EXAMPLE OF PWL CALCULATION

1664 **Project:** Example Project

1665 **Test Item:** Item P-401, Lot A.

1666 A. PWL Determination for Mat Density.

1667 1. Density of four random cores taken from Lot A.

1668 A-1 = 96.60

1669 A-2 = 97.55

1670 A-3 = 99.30

1671 A-4 = 98.35

1672 n = 4

1673 2. Calculate average density for the lot.

1674 $X = (x_1 + x_2 + x_3 + \dots + x_n) / n$

1675 $X = (96.60 + 97.55 + 99.30 + 98.35) / 4$

1676 $X = 97.95\%$ density

- 1677 3. Calculate the standard deviation for the lot.
- 1678
$$S_n = [((96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2) / (4 - 1)]^{1/2}$$
- 1679
$$S_n = [(1.82 + 0.16 + 1.82 + 0.16) / 3]^{1/2}$$
- 1680
$$S_n = 1.15$$
- 1681 4. Calculate the Lower Quality Index Q_L for the lot. (L=96.3)
- 1682
$$Q_L = (X - L) / S_n$$
- 1683
$$Q_L = (97.95 - 96.30) / 1.15$$
- 1684
$$Q_L = 1.4348$$
- 1685 5. Determine PWL by entering Table 1 with $Q_L = 1.44$ and $n = 4$.
- 1686
$$PWL = 98$$
- 1687 **B. PWL Determination for Air Voids.**
- 1688 1. Air Voids of four random samples taken from Lot A.
- 1689
$$A-1 = 5.00$$
- 1690
$$A-2 = 3.74$$
- 1691
$$A-3 = 2.30$$
- 1692
$$A-4 = 3.25$$
- 1693 2. Calculate the average air voids for the lot.
- 1694
$$X = (x_1 + x_2 + x_3 + \dots + x_n) / n$$
- 1695
$$X = (5.00 + 3.74 + 2.30 + 3.25) / 4$$
- 1696
$$X = 3.57\%$$
- 1697 3. Calculate the standard deviation S_n for the lot.
- 1698
$$S_n = [((3.57 - 5.00)^2 + (3.57 - 3.74)^2 + (3.57 - 2.30)^2 + (3.57 - 3.25)^2) / (4 - 1)]^{1/2}$$
- 1699
$$S_n = [(2.04 + 0.03 + 1.62 + 0.10) / 3]^{1/2}$$
- 1700
$$S_n = 1.12$$
- 1701 4. Calculate the Lower Quality Index Q_L for the lot. (L= 2.0)
- 1702
$$Q_L = (X - L) / S_n$$
- 1703
$$Q_L = (3.57 - 2.00) / 1.12$$
- 1704
$$Q_L = 1.3992$$
- 1705 5. Determine P_L by entering Table 1 with $Q_L = 1.41$ and $n = 4$.
- 1706
$$P_L = 97$$
- 1707 6. Calculate the Upper Quality Index Q_U for the lot. (U= 5.0)
- 1708
$$Q_U = (U - X) / S_n$$
- 1709
$$Q_U = (5.00 - 3.57) / 1.12$$
- 1710
$$Q_U = 1.2702$$
- 1711 7. Determine P_U by entering Table 1 with $Q_U = 1.29$ and $n = 4$.
- 1712
$$P_U = 93$$
- 1713 8. Calculate Air Voids PWL

1714 $PWL = (P_L + P_U) - 100$

1715 $PWL = (97 + 93) - 100 = 90$

1716 **EXAMPLE OF OUTLIER CALCULATION (REFERENCE ASTM E178)**

1717 **Project:** Example Project

1718 **Test Item:** Item P-401, Lot A.

1719 **A. Outlier Determination for Mat Density.**

1720 1. Density of four random cores taken from Lot A arranged in descending order.

1721 $A-3 = 99.30$

1722 $A-4 = 98.35$

1723 $A-2 = 97.55$

1724 $A-1 = 96.60$

1725 2. From ASTM E178, Table 1, for $n=4$ an upper 5% significance level, the critical value for test criterion
1726 $= 1.463$.

1727 3. Use average density, standard deviation, and test criterion value to evaluate density measurements.

1728 a. For measurements greater than the average:

1729 If $(\text{measurement} - \text{average}) / (\text{standard deviation})$ is less than test criterion,
1730 then the measurement is not considered an outlier.

1731 For A-3, check if $(99.30 - 97.95) / 1.15$ is greater than 1.463.

1732 Since 1.174 is less than 1.463, the value is not an outlier.

1733 b. For measurements less than the average:

1734 If $(\text{average} - \text{measurement}) / (\text{standard deviation})$ is less than test criterion,
1735 then the measurement is not considered an outlier.

1736 For A-1, check if $(97.95 - 96.60) / 1.15$ is greater than 1.463.

1737 Since 1.435 is less than 1.463, the value is not an outlier.

1738 **Note:** In this example, a measurement would be considered an outlier if the density were:

1739 Greater than $(97.95 + 1.463 \times 1.15) = 99.63\%$

1740 OR

1741 less than $(97.95 - 1.463 \times 1.15) = 96.27\%$.

1742 **Table 1. Table for Estimating Percent of Lot Within Limits (PWL)**

Percent Within Limits (P_L and P_U)	Positive Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4717	1.4829	1.4914
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265

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Percent Within Limits (P_L and P_U)	Positive Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653
87	1.0597	1.1100	1.1173	1.1192	1.1199	1.1204	1.1208	1.1212
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990
83	0.9939	0.9900	0.9785	0.9715	0.9671	0.9643	0.9624	0.9610
82	0.9749	0.9600	0.9452	0.9367	0.9315	0.9281	0.9258	0.9241
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686
70	0.6787	0.6000	0.5719	0.5582	0.5504	0.5454	0.5419	0.5394
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537
66	0.5563	0.4800	0.4545	0.4424	0.4355	0.4310	0.4280	0.4257
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4030	0.4001	0.3980
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1588	0.1575	0.1566
55	0.1806	0.1500	0.1406	0.1363	0.1338	0.1322	0.1312	0.1304
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1049	0.1042
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0793	0.0786	0.0781
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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Percent Within Limits (P_L and P_U)	Negative Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
49	-0.0363	-0.0300	-0.0281	-0.0272	-0.0267	-0.0264	-0.0262	-0.0260
48	-0.0725	-0.0600	-0.0562	-0.0544	-0.0534	-0.0528	-0.0524	-0.0521
47	-0.1087	-0.0900	-0.0843	-0.0817	-0.0802	-0.0793	-0.0786	-0.0781
46	-0.1447	-0.1200	-0.1125	-0.1090	-0.1070	-0.1057	-0.1049	-0.1042
45	-0.1806	-0.1500	-0.1406	-0.1363	-0.1338	-0.1322	-0.1312	-0.1304
44	-0.2164	-0.1800	-0.1688	-0.1636	-0.1607	-0.1588	-0.1575	-0.1566
43	-0.2519	-0.2100	-0.1971	-0.1911	-0.1877	-0.1855	-0.1840	-0.1829
42	-0.2872	-0.2400	-0.2254	-0.2186	-0.2147	-0.2122	-0.2105	-0.2093
41	-0.3222	-0.2700	-0.2537	-0.2461	-0.2418	-0.2391	-0.2372	-0.2358
40	-0.3568	-0.3000	-0.2822	-0.2738	-0.2691	-0.2660	-0.2639	-0.2624
39	-0.3911	-0.3300	-0.3107	-0.3016	-0.2964	-0.2931	-0.2908	-0.2892
38	-0.4251	-0.3600	-0.3392	-0.3295	-0.3239	-0.3203	-0.3179	-0.3161
37	-0.4586	-0.3900	-0.3679	-0.3575	-0.3515	-0.3477	-0.3451	-0.3432
36	-0.4916	-0.4200	-0.3967	-0.3856	-0.3793	-0.3753	-0.3725	-0.3705
35	-0.5242	-0.4500	-0.4255	-0.4139	-0.4073	-0.4030	-0.4001	-0.3980
34	-0.5563	-0.4800	-0.4545	-0.4424	-0.4355	-0.4310	-0.4280	-0.4257
33	-0.5878	-0.5100	-0.4836	-0.4710	-0.4638	-0.4592	-0.4560	-0.4537
32	-0.6187	-0.5400	-0.5129	-0.4999	-0.4924	-0.4877	-0.4844	-0.4820
31	-0.6490	-0.5700	-0.5423	-0.5290	-0.5213	-0.5164	-0.5130	-0.5105
30	-0.6787	-0.6000	-0.5719	-0.5582	-0.5504	-0.5454	-0.5419	-0.5394
29	-0.7077	-0.6300	-0.6016	-0.5878	-0.5798	-0.5747	-0.5712	-0.5686
28	-0.7360	-0.6600	-0.6316	-0.6176	-0.6095	-0.6044	-0.6008	-0.5982
27	-0.7636	-0.6900	-0.6617	-0.6477	-0.6396	-0.6344	-0.6308	-0.6282
26	-0.7904	-0.7200	-0.6921	-0.6781	-0.6701	-0.6649	-0.6613	-0.6587
25	-0.8165	-0.7500	-0.7226	-0.7089	-0.7009	-0.6958	-0.6922	-0.6896
24	-0.8417	-0.7800	-0.7535	-0.7401	-0.7322	-0.7271	-0.7236	-0.7211
23	-0.8662	-0.8100	-0.7846	-0.7716	-0.7640	-0.7590	-0.7556	-0.7531
22	-0.8897	-0.8400	-0.8160	-0.8036	-0.7962	-0.7915	-0.7882	-0.7858
21	-0.9124	-0.8700	-0.8478	-0.8360	-0.8291	-0.8245	-0.8214	-0.8192
20	-0.9342	-0.9000	-0.8799	-0.8690	-0.8625	-0.8583	-0.8554	-0.8533
19	-0.9550	-0.9300	-0.9123	-0.9025	-0.8966	-0.8928	-0.8901	-0.8882
18	-0.9749	-0.9600	-0.9452	-0.9367	-0.9315	-0.9281	-0.9258	-0.9241
17	-0.9939	-0.9900	-0.9785	-0.9715	-0.9671	-0.9643	-0.9624	-0.9610
16	-1.0119	-1.0200	-1.0124	-1.0071	-1.0037	-1.0015	-1.0000	-0.9990
15	-1.0288	-1.0500	-1.0467	-1.0435	-1.0413	-1.0399	-1.0389	-1.0382
14	-1.0448	-1.0800	-1.0817	-1.0808	-1.0800	-1.0794	-1.0791	-1.0789
13	-1.0597	-1.1100	-1.1173	-1.1192	-1.1199	-1.1204	-1.1208	-1.1212
12	-1.0736	-1.1400	-1.1537	-1.1587	-1.1613	-1.1630	-1.1643	-1.1653
11	-1.0864	-1.1700	-1.1909	-1.1995	-1.2043	-1.2075	-1.2098	-1.2115
10	-1.0982	-1.2000	-1.2290	-1.2419	-1.2492	-1.2541	-1.2576	-1.2602
9	-1.1089	-1.2300	-1.2683	-1.2860	-1.2964	-1.3032	-1.3081	-1.3118
8	-1.1184	-1.2600	-1.3088	-1.3323	-1.3461	-1.3554	-1.3620	-1.3670
7	-1.1269	-1.2900	-1.3508	-1.3810	-1.3991	-1.4112	-1.4199	-1.4265
6	-1.1342	-1.3200	-1.3946	-1.4329	-1.4561	-1.4717	-1.4829	-1.4914
5	-1.1405	-1.3500	-1.4407	-1.4887	-1.5181	-1.5381	-1.5525	-1.5635

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Percent Within Limits (P_L and P_U)	Negative Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
4	-1.1456	-1.3800	-1.4897	-1.5497	-1.5871	-1.6127	-1.6313	-1.6454
3	-1.1496	-1.4100	-1.5427	-1.6181	-1.6661	-1.6993	-1.7235	-1.7420
2	-1.1524	-1.4400	-1.6016	-1.6982	-1.7612	-1.8053	-1.8379	-1.8630
1	-1.1541	-1.4700	-1.6714	-1.8008	-1.8888	-1.9520	-1.9994	-2.0362

1744

REFERENCES

1745 The publications listed below form a part of this specification to the extent referenced. The publications are
 1746 referred to within the text by the basic designation only.

1747 ASTM International (ASTM)

1748 ASTM E178 Standard Practice for Dealing with Outlying Observations

1749

END OF ITEM C-110

1750

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ITEM P-101 PREPARATION/REMOVAL OF EXISTING PAVEMENTS

DESCRIPTION

101-1.1 This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

EQUIPMENT AND MATERIALS

101-2.1 All equipment and materials shall be specified here and in the following paragraphs or approved by the DEN Project Manager. The equipment shall not cause damage to the pavement to remain in place.

CONSTRUCTION

101-3.1 REMOVAL OF EXISTING PAVEMENT.

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

- a. Concrete pavement removal.** Full depth saw cuts shall be made perpendicular to the slab surface. When it is necessary to remove existing concrete pavement and leave adjacent concrete in place the joint between the removal area and adjoining pavement to stay in place shall first be cut full depth with a standard diamond-type concrete saw. Next, a full depth saw cut shall be made parallel to the joint at least 24 inches from the joint and at least 12 inches from the end of any dowels. All pavements between this last saw cut and the joint line shall be carefully broken up and removed using hand-held jackhammers, 30 lb. or less, or the approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to remain in place. The joint face shall be sawed or otherwise trimmed so that there is no abrupt offset in any direction greater than 1/2-inch and no gradual offset greater than 1 inch when tested in a horizontal direction with a 12 ft. straightedge. Sawcutting depth may vary nominally and no extra payment will be allotted for varying depths.

The Contractor shall remove the remaining portion of concrete pavement slab by lifting and placing directly into haul trucks. The Contractor will not be allowed to use hydraulic rams on excavators that may damage the cement treated base below the pavement to be removed.

An alternative removal method may be accepted by the DEN Project Manager if the Contractor can demonstrate to the DEN Project Manager successful removal without damage to adjacent concrete or base material below. If during subsequent removals it is found the method is causing damage to the adjacent panels or base material below, the Contractor's method shall be rejected by the DEN Project Manager and the DEN Project Manager shall direct the Contractor to begin using the method above.

45 The Contractor's removal operation shall not cause damage to cables, utility ducts, pipelines, or
46 drainage structures under the pavement. Concrete slabs that are damaged by under breaking shall
47 be removed. Any damage shall be repaired at the Contractor's expense.

48 i. **Edge Repair.** The edge of existing concrete pavement against which new pavement abuts
49 shall be protected from damage at all times. Areas which are damaged during construction
50 shall be repaired at no cost to the Owner; repair of previously existing damage areas will be
51 paid for as listed in the bid schedule.

52 1) **Spall Repair.** Spalls shall be repaired where indicated and where directed. Repair
53 materials and procedures shall be completed as required in specification P-501.

54 2) **Underbreak Repair.** Any under breaking of slabs that are to remain in-place shall
55 result in the entire slab removal and replacement at the Contractor's expense to the
56 next joint.

57 3) **Underlying Material.** The underlying material adjacent to the edge of and under the
58 existing pavement which is to remain in place shall be protected from damage or
59 disturbance during removal operations and until placement of new concrete, and shall
60 be shaped as shown on the drawings or as directed. Sufficient material shall be kept
61 in place outside the joint line to prevent disturbance (or sloughing) of material under
62 the pavement which is to remain in place. Any material under the portion of the
63 concrete pavement to remain in place which is disturbed or loses its compaction, t
64 shall be carefully removed and replaced with concrete. The underlying material
65 outside the joint line shall be thoroughly compacted and moist when new concrete is
66 placed. If the disturbed material causes under breaking of concrete panels that are to
67 remain in-place, it shall result in the entire slab removal and replacement at the
68 Contractor's expense to the next joint.

69 b. **Asphalt pavement removal by Milling.** This item shall consist of milling existing bituminous
70 concrete pavement to allow for placement of sufficient thickness of bituminous concrete overlay
71 for pavement repairs or construction on the runway or taxiway shoulders.

72
73 The vertical edges of the milled surface shall be sawcut to expose a clean true vertical edge to pave
74 against.

75 All operations shall be carefully controlled to prevent damage to the asphalt pavement and to the
76 underlying material to remain in place.

77 Stairstep milling is required for the runway and taxiway shoulder widening interface. This item
78 shall consist of multiple passes as required to establish the "stairstep", as shown on the plans.

79 c. **Full Depth Asphalt Pavement Removal.**

80
81 This item shall consist of sawcutting and full depth milling of existing bituminous concrete
82 pavement (including Asphalt Treated Permeable Base (ATPB)) to allow for replacement of P-501
83 slabs along the edges adjacent to asphalt shoulders or the installation of the new pavement section
84 adjacent to existing pavement. A standard diamond-type concrete saw shall be used to make the
85 sawcut the full depth of the asphalt pavement (including ATPB). The pavement shall be removed

86 so the joint for each layer of pavement replacement is offset 1 foot from the joint in the preceding
87 layer. This does not apply if the removed pavement is to be replaced with concrete or soil.

88 The edge of existing bituminous concrete pavement against which new pavement abuts shall be
89 protected from damage at all times. Areas which are damaged during construction shall be repaired
90 at no cost to the Owner.

91 All operations shall be carefully controlled to prevent damage to the asphalt pavement and to the
92 underlying material to remain in place.

93 **101-3.2 PREPARATION OF JOINTS AND CRACKS PRIOR TO OVERLAY/SURFACE**
94 **TREATMENT.** Remove all vegetation and debris from cracks to a minimum depth of 1 inch (25 mm). If
95 extensive vegetation exists, treat the specific area with a concentrated solution of a water-based herbicide
96 approved by the DEN Project Manager. Fill all cracks greater than 1/4 inch (6 mm) wide) with a crack sealant
97 per ASTM D6690. The crack sealant, preparation, and application shall be compatible with the surface
98 treatment/overlay to be used. To minimize contamination of the asphalt with the crack sealant, underfill the
99 crack sealant a minimum of 1/8 inch (3 mm), not to exceed 1/4 inch (6 mm). Any excess joint or crack sealer
100 shall be removed from the pavement surface.

101
103 **101-3.3 REMOVAL OF FOREIGN SUBSTANCES/CONTAMINATES PRIOR TO REMARKING .**
104 Removal of foreign substances/contaminates from existing pavement that will affect the bond of the new
105 treatment shall consist of removal of rubber, fuel spills, oil, crack sealer, at least 90% of paint, and other foreign
106 substances from the surface of the pavement. Areas that require removal are designated on the plans and as
107 directed by the DEN Project Manager in the field during construction.

108
109 High-pressure water may be used. If chemicals are used, they shall comply with the state's environmental
110 protection regulations. Removal methods used shall not cause major damage to the pavement, or to any
111 structure or utility within or adjacent to the work area. Major damage is defined as changing the properties of
112 the pavement, removal of asphalt causing the aggregate to ravel, or removing pavement over 1/8 inch (3 mm)
113 deep. If it is deemed by the DEN Project Manager that damage to the existing pavement is caused by
114 operational error, such as permitting the application method to dwell in one location for too long, the
115 Contractor shall repair the damaged area without compensation and as directed by the DEN Project Manager.

116
117 The water blasting equipment shall be truck mounted and shall be capable of water pressures of 2,000 to 40,000
118 psi. The equipment shall be capable of adjusting the pressure to accomplish paint or cure removal without
119 damaging the paving surface. The equipment shall be capable of following a straight line and be maneuverable
120 to accommodate various pavement markings. The spray width needs to be able to accommodate lines 6" and
121 wider. If water blasting is used to remove lines on active airfield pavements, a vacuum system will be provided
122 to allow for timely repainting and the prevention of any debris being ingested into propellers or turbine engines
123 once the water blasting equipment has exited the active pavements.

124
125 Removal of foreign substances shall not proceed until approved by the DEN Project Manager. Water used for
126 high-pressure water equipment shall be provided by the Contractor at the Contractor's expense. No material
127 shall be deposited on the pavement. All wastes shall be disposed of in areas indicated in this specification or
128 shown on the plans and disposed off-site legally.

129
130 **101-3.4 CONCRETE SPALL OR FAILED ASPHALTIC CONCRETE PRAVEMENT REPAIR.**

131
132 **a. Spall Repair.** Spalls shall be repaired where indicated and where directed. Repair materials and
133 procedures shall be completed as required in specification P-501.

134
135 **101-3.5 COLD MILLING.** Milling shall be performed with a power-operated milling machine or grinder,
136 capable of producing a uniform finished surface. The vertical edges of the milled surface shall be sawcut to
137 expose a clean true vertical edge to pave against. The milling machine or grinder shall operate without tearing
138 or gouging the underlying surface. The milling machine or grinder shall be equipped with grade and slope
139 controls, and a positive means of dust control. All millings shall be removed and disposed in areas designated
140 on the plans. If the Contractor mills or grinds deeper or wider than the plans specify, the Contractor shall
141 replace the material removed with new material at the Contractor's Expense.

142
143 **a. Patching.** The milling machine shall be capable of cutting a vertical edge without chipping or
144 spalling the edges of the remaining pavement and it shall have a positive method of controlling
145 the depth of cut. The DEN Project Manager shall layout the area to be milled with a straightedge
146 in increments of 1-foot (30 cm) widths. The area to be milled shall cover only the failed area. Any
147 excessive area that is milled because the Contractor doesn't have the appropriate milling machine,
148 or areas that are damaged because of his negligence, shall be repaired by the Contractor at the
149 Contractor's Expense.

150
151 **b. Profiling, grade correction, or surface correction.** The milling machine shall have a minimum
152 width of 5 feet and it shall be equipped with electronic grade control devices that will cut the
153 surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch
154 (+0 mm and -6mm) of the specified grade. The machine must cut vertical edges and have a
155 positive method of dust control. The machine must have the ability to remove the millings or
156 cuttings from the pavement and load them into a truck. All millings shall be removed and disposed
157 of in areas designated on the plans.

158
159 **c. Clean-up.** The Contractor shall sweep the milled surface daily and immediately after the milling
160 until all residual materials are removed from the pavement surface. Prior to paving, the Contractor
161 shall wet down the milled pavement and thoroughly sweep and/or blow the surface to remove
162 loose residual material. Waste materials shall be collected and removed from the pavement surface
163 and adjacent areas by sweeping or vacuuming. Waste materials shall be removed and disposed in
164 areas designated on the plans.

165
166 **101-3.6. PREPARATION OF ASPHALT PAVEMENT SURFACES PRIOR TO SURFACE**
167 **TREATMENT.** Existing asphalt pavements to be treated with a surface treatment shall be prepared as
168 follows:

169
170 **a.** Patch asphalt pavement surfaces that have been softened by petroleum derivatives or have failed
171 due to any other cause. Remove damaged pavement to the full depth of the damage and replace
172 with new asphalt pavement similar to that of the existing pavement in accordance with paragraph
173 101-3.4b.

174
175 **b.** Repair joints and cracks in accordance with paragraph 101-3.2.

176
177 **c.** Remove oil or grease that has not penetrated the asphalt pavement by scrubbing with a detergent
178 and washing thoroughly with clean water. After cleaning, treat these areas with an oil spot primer.

179
180 **101-3.7 MAINTENANCE.** The Contractor shall perform all maintenance work necessary to keep the
181 pavement in a satisfactory condition until the full section is complete and accepted by the DEN Project
182 Manager. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained

183 at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be
184 performed at the Contractor's expense.

185
186 **101-3.8 PREPARATION OF JOINTS IN REIGID PAVEMENT PRIOR TO RESEALING.** Prior to
187 application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound,
188 moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the DEN Project
189 Manager, that the method used cleans the joint and does not damage the joint.

190
191 **101-3.8.1 REMOVAL OF EXISTING JOINT SEALANT.** All existing joint sealants will be removed by
192 plowing or use of hand tools. Any remaining sealant and or debris will be removed by use of wire brushes or
193 other tools as necessary. Resaw joints removing no more than 1/16 inch (2 mm) from each joint face.
194 Immediately after sawing, flush out joint with water and other tools as necessary to completely remove the
195 slurry.

196
197 **101-3.8.2 CLEANING PRIOR TO SEALING.** Immediately before sealing, joints shall be cleaned by
198 removing any remaining laitance and other foreign material. Allow sufficient time to dry out joints prior to
199 sealing. Joint surfaces will be surface-dry prior to installation of sealant.

200
201 **101-3.8.3 JOINT SEALANT.** Joint material and installation will be in accordance with Item P-605 and Item
202 P-604.

203
204 **101-3.9 PREPARATION OF CRACKS IN FLEXIBLE PAVEMENT PRIOR TO SEALING.** Prior to
205 application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound,
206 moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the DEN Project
207 Manager, that the method used cleans the cracks and does not damage the pavement.

208
209 **101-3.9.1 PREPARATION OF CRACK.** Widen crack with router or random crack saw by removing a
210 minimum of 1/16 inch (2 mm) from each side of crack. Immediately before sealing, cracks will be blown out
211 with a hot air lance combined with oil and water-free compressed air.

212
213 **101-3.9.2 REMOVAL OF EXISTING CRACK SEALANT.** Existing sealants will be removed by routing
214 or random crack saw. Following routing or sawing any remaining debris will be removed by use of a hot lance
215 combined with oil and water-free compressed air.

216
217 **101-3.9.3 CRACK SEALANT.** Crack sealant material and installation will be in accordance with Item P-605.

218
219 **101-3.9.4 REMOVAL OF PIPE AND OTHER BURIED STRUCTURES.**

220
221 **a. Removal of Existing Pipe Material.**
222 Contractor is responsible to contact the owner as to the status of the pipeline. If pipelines have
223 been abandoned in-place by the pipeline owners, the pipelines may not have been purged or
224 cleaned and may contain petroleum products. The contractor shall exercise extreme care in
225 removing these facilities and is responsible for removing the pipe including any remaining
226 contents, irrespective of the current pipe conditions. The Contractor should also expect to find
227 other pipelines, etc. which have been abandoned by unknown owners during the 15 to 20-year life
228 of the oil and gas fields. Contract documents indicate the general location of known pipelines and
229 developed utilities. All pipelines shown on the drawings shall be located by Contractor by
230 potholing to verify location, depth, and usage. The Contractor shall remove all utility pipes and
231 lines included in the earthwork contract area in accordance with these specifications. All buried
232 pipelines, utilities, buried tanks, and any other structures within the construction area of all

233 runways, taxiways and aprons extending to 10 feet outside the limits of construction and not less
 234 than 15 feet below the finished grade level shall be removed. The Contractor shall notify oil and
 235 gas facility owners and the DEN Project Manager in writing 30 days in advance of requiring work
 236 in areas currently occupied by oil and gas wells and buried pipelines.

237 Piping a minimum of 15 feet below finished grade elevations or plan excavation may be left in
 238 place or removed and salvaged at the discretion of the Contractor. The ends of any pipelines left
 239 in place shall have the ends capped prior to burial, according to applicable Federal Department of
 240 Transportation Regulations. Any piping which is left in place shall be surveyed and the coordinates
 241 of the ends of the abandoned pipe (or other items left in place) shall be provided to the DEN
 242 Project Manager and included on the "as-built" drawings.

243 **b. Removal of Inlets/Manholes.** Where indicated on the plans or as directed by the DEN Project
 244 Manager, inlets and/or manholes shall be removed and legally disposed of off-site in a timely
 245 fashion after removal. Excavations after removal shall be backfilled with material equal or better
 246 in quality than adjacent embankment. When under paved areas must be compacted to 95% of
 247 ASTM D1557 , when outside of paved areas must be compacted to 95% of ASTM D698.

248 **c. Removal of Electrical.**
 249 The Contractor shall remove all abandoned cable, cable identified to be removed,
 250 ductwork, base cans including concrete encasement and all light fixtures, signs and duct
 251 markers within the construction limits of taxiway and runway pavements to be removed,
 252 widened or constructed, or as shown on the Drawings. Protect existing airfield lighting
 253 fixtures and base plates from damage and deliver them to the Airport for storage as
 254 directed by the DEN Project Manager. Discard all base cans, conduit, transformers and
 255 cable off-site. The Electrical Contractor shall provide written documentation to the DEN
 256 Project Manager that electrical cable has been removed prior to slab sawcutting and
 257 demolition.
 258

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260

261

METHOD OF MEASUREMENT

262 **101-4.1 REMOVE CONCRETE PAVEMENT – 17” NON-REINFORCED.** Measurement
 263 for payment of Removal of 17-inch non-reinforced concrete pavement shall be made per square yard based
 264 on the area shown on the plans. Any pavement removed outside the designed limits of removal because the
 265 pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement
 266 for payment. The thickness of the existing material to be removed is approximate only and the Contractor
 267 will not be reimbursed for areas that may be thicker than shown on the plans. Removal of pavement shall
 268 include all sawcutting, excavation, hauling to recycle yard for crushing and any necessary disposal of material
 269 or waste material, and disposal (including disposal fees) of pavement necessary to facilitate removal.

270 **101-4.2 REMOVE CONCRETE PAVEMENT – 17” REINFORCED.** Measurement for
 271 payment of Removal of 17-inch reinforced concrete pavement shall be made per square yard based on the
 272 area shown on the plans. Any pavement removed outside the designed limits of removal because the
 273 pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement
 274 for payment. The thickness of the existing material to be removed is approximate only and the Contractor
 275 will not be reimbursed for areas that may be thicker than shown on the plans. Removal of pavement shall
 276 include all sawcutting, excavation, hauling to recycle yard for crushing and any necessary disposal of material
 277 or waste material, and disposal (including disposal fees) of pavement necessary to facilitate removal.

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278 **101-4.3 REMOVE CONCRETE PAVEMENT – 21” NON-REINFORCED.** Measurement for
279 payment of Removal of 21-inch non-reinforced concrete pavement shall be made per square yard based on the
280 area shown on the plans. Any pavement removed outside the designed limits of removal because the pavement
281 was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment.
282 The thickness of the existing material to be removed is approximate only and the Contractor will not be
283 reimbursed for areas that may be thicker than shown on the plans. Removal of pavement shall include all
284 sawcutting, excavation, hauling to recycle yard for crushing and any necessary disposal of material or waste
285 material, and disposal (including disposal fees) of pavement necessary to facilitate removal.

286 **101-4.4 FULL DEPTH ASPHALT PAVEMENT REMOVAL.** Measurement for payment of full
287 depth asphalt pavement removal shall be made per square yard based on the area shown on the plans. Any
288 pavement removed outside the designated limits of removal because the pavement was damaged by negligence
289 on the part of the Contractor shall not be included in the measurement for payment. The thickness of the
290 existing material to be removed is approximate only and the Contractor will not be reimbursed for areas that
291 may be thicker than shown on the plans. Removal of pavement shall include all sawcutting, excavation, hauling
292 millings to recycle yard and any necessary disposal of material or waste material, and disposal (including disposal
293 fees) of pavement necessary to facilitate removal.

294 **101-4.5 REMOVE RPU PAD COMPLETE.** Measurement for payment of removal of RPU pad
295 complete shall be made per lump sum of the RPU pad removed based on the locations shown on the plans.
296 The RPU Pad removal shall be in accordance with the specifications, and accepted by the DEN Project
297 Manager.

298 **101-4.6 GRIND CONCRETE TREATED BASE COURSE (0 TO 1 INCH).** Measurement
299 for payment of grinding concrete treated base course shall be made per square yard based on the area shown
300 on the plans. Any pavement removed outside the preapproved limits of removal because the pavement was
301 damaged by negligence on the part of the Contractor shall not be included in the measurement for payment.
302 Grinding of concrete treated base course shall include all sawcutting, hauling and disposal (including disposal
303 fees) of pavement necessary to facilitate removal.

304 **101-4.7 ROUTE SEAL.** Measurement for payment of route seal shall be made per linear foot based
305 on the locations shown on the plans. Route seal shall be in accordance with the specifications, and accepted
306 by the DEN Project Manager

307 **101-4.8 PAVEMENT MARKING REMOVAL.** Measurement for payment of pavement
308 marking removal shall be made per square feet based on the locations shown on the plans, regardless
309 of the method or number of methods required to remove the markings. Pavement marking removal
310 shall be in accordance with the specifications, and accepted by the DEN Project Manager. Multiple
311 operations to remove the same marking will not be measured separately.

312

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316 **101-5.1 REMOVE CONCRETE PAVEMENT – 17” NON-REINFORCED.**

317 Payment shall be made at the contract unit price per square yard of pavement material removed and disposal
318 of removed material off-site. This price shall be full compensation for furnishing all materials, and for all
319 labor, equipment, tools, and incidentals necessary to complete the item.

BASIS OF PAYMENT

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320 **101-5.2 REMOVE CONCRETE PAVEMENT – 17” REINFORCED.** Payment shall
 321 be made at the contract unit price per square yard of pavement material removed and disposal of removed
 322 material off-site. This price shall be full compensation for furnishing all materials, and for all labor, equipment,
 323 tools, and incidentals necessary to complete the item.

324 **101-5.3 REMOVE CONCRETE PAVEMENT – 21” NON-REINFORCED.** Payment
 325 shall be made at the contract unit price per square yard of pavement material removed and disposal of removed
 326 material off-site. This price shall be full compensation for furnishing all materials, and for all labor, equipment,
 327 tools, and incidentals necessary to complete the item.

328 **101-5.4 FULL DEPTH ASPHALT PAVEMENT REMOVAL.** Payment shall be made
 329 at the contract unit price per square yard for pavement material removed and disposal of removed material off-
 330 site. This price shall be full compensation for furnishing all materials, and for all labor, equipment, tools, and
 331 incidentals necessary to complete the item.

332 **101-5.5 REMOVE RPU PAD COMPLETE.** Payment shall be made at the contract unit price per lump
 333 sum for the removal and proper disposal offsite of the Abandoned Concrete RPU Pad, the Abandoned L-867
 334 Base Can, and two Ground Rod Test Pits and ground rods, concrete or flow fill encountered during removal,
 335 import placement and compaction of fill material, and any labor, materials, or equipment needed to complete
 336 the work, and incidentals necessary to complete the item.

337
 338 **101-5.6 GRIND CONCRETE TREATED BASE COURSE (0 TO 1 INCH).** Payment shall be made
 339 at the contract unit price per square yard for pavement material removed and disposal of removed material
 340 off-site. This price shall be full compensation for furnishing all materials, and for all labor, equipment, tools,
 341 and incidentals necessary to complete the item.

342 **101-5.7 ROUTE SEAL .** Payment shall be made at the contract unit price per linear foot
 343 for route seal. This price shall be full compensation for furnishing all materials, and labor, equipment,
 344 tools, and incidentals necessary to complete the item.

345 **101-5.8 PAVEMENT MARKING REMOVAL.** Payment shall be made at the contract
 346 unit price per square feet for pavement marking removal. This price shall be full compensation for furnishing
 347 all materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

348 Payment will be made under:

349	P-101a	Remove Portland Cement Concrete Pavement (Non-Reinforced, 17") – Per Square
350		Yard
351	P-101b	Remove Portland Cement Concrete Pavement (Reinforced, 17")– Per Square Yard
352	P-101c	Remove Portland Cement Concrete Pavement (Non-Reinforced, 21")– Per Square
353		Yard
354	P-101d	Full Depth Asphalt Pavement Removal– Per Square Yard
355	P-101e	Remove RPU Pad Complete – Per Lump Sum
356	P-101f	Grind Concrete Treated Base Course (0" to 1")– Per Square Yard
357	P-101g	Route Seal – Per Linear Foot
358	P-101h	Pavement Marking Removal– Per Square Feet

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359 P-101i Pavement Marking Removal (MMA) – Per Square Feet

360

361

REFERENCES

362

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

365

366 Advisory Circulars (AC)

367 AC 150/5380-6

Guidelines and Procedures for Maintenance of Airport Pavements.

368 ASTM International (ASTM)

369 ASTM D6690

Standard Specification for Joint and Crack Sealants, Hot Applied, for
Concrete and Asphalt Pavements

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****END OF ITEM P-101****

ITEM P-151 CLEARING AND GRUBBING

DESCRIPTION

151-1.1 This item shall consist of clearing or clearing and grubbing, including the disposal of materials, for all areas within the limits designated on the plans or as required by the DEN Project Manager. The designated areas shall be cleared and grubbed of six (6) inches of topsoil and vegetation prior to beginning any excavation or embankment operations. In addition, the Contractor shall clear, grub and strip an area 10 feet beyond the top of cut slopes and the toe of fill slopes.

- a. **Clearing** shall consist of the cutting and removal of all trees, stumps, brush, logs, hedges, the removal of fences and other loose or projecting material from the designated areas. The grubbing of stumps and roots will not be required.
- b. **Clearing and grubbing** shall consist of clearing the surface of the ground of the designated areas of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the DEN Project Manager is unsuitable for the foundation of strips, pavements, or other required structures, including the grubbing of stumps, roots, matted roots, foundations, and the disposal from the project of all spoil materials resulting from clearing and grubbing.
- c. **Tree Removal.** Tree Removal shall consist of the cutting and removal of isolated single trees or isolated groups of trees, and the grubbing of stumps and roots. The removal of all the trees of this classification shall be in accordance with the requirements for the particular area being cleared.

CONSTRUCTION METHODS

151-2.1 GENERAL. The areas denoted on the plans to be cleared or cleared and grubbed shall be staked on the ground by the Contractor as indicated on the plans. The Contractor shall employ a Land Surveyor registered in the State of Colorado for the surveying work required. The clearing and grubbing shall be done at a satisfactory distance in advance of the grading operations.

The removal of existing structures and utilities required to permit orderly progress of work shall be accomplished by local agencies, unless otherwise shown on the plans. Whenever a telephone pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated, the Contractor shall advise the DEN Project Manager who will notify the proper local authority or owner to secure prompt action.

151-2.1.1 DISPOSAL. All materials removed by clearing or by clearing and grubbing shall be disposed of outside the Airport's limits at the Contractor's responsibility, except when otherwise directed by the DEN Project Manager. As far as practicable, waste concrete and masonry shall be placed on slopes of embankments or channels. When embankments are constructed of such material, this material shall be placed in accordance with requirements for formation of embankments. Any broken concrete or masonry that cannot be used in construction and all other materials not considered suitable for use elsewhere, shall be disposed of by the Contractor. In no case, shall any discarded materials be left in windrows or piles adjacent to or within the airport limits. The manner and location of disposal of materials shall be subject to the approval of the DEN Project Manager and shall not create an unsightly or objectionable view. When the Contractor is required to locate a

50 disposal area outside the airport property limits, the Contractor shall obtain and file with the DEN Project
51 Manager permission in writing from the property owner for the use of private property for this purpose.
52

53 All hazardous waste materials shall be disposed of off site in accordance with Division 1 Technical Specification
54 Section 015719, Temporary Environmental Controls. The Contractor shall furnish the DEN Project Manager
55 a written statement from the disposal site facility which confirms that the waste material is allowed at the
56 disposal site in accordance with all pertinent Federal, State, and local rules, regulations, and ordinances. All
57 other waste material shall be disposed of as specified under Section P-152 Excavation and Embankment.
58

59 **151-2.1.2 BLASTING.** Blasting shall not be allowed.
60

61 **151-2.2 CLEARING.** The Contractor shall clear the staked or indicated area of all materials as indicated on
62 the plans. Trees unavoidably falling outside the specified clearing limits must be cut up, removed, and disposed
63 of in a satisfactory manner. To minimize damage to trees that are to be left standing, trees shall be felled toward
64 the center of the area being cleared. The Contractor shall preserve and protect from injury all trees not to be
65 removed. The trees, stumps, and brush shall be cut flush with the original ground surface. The grubbing of
66 stumps and roots will not be required.
67

68 Fences shall be removed and disposed of as directed by the DEN Project Manager . Fence wire shall be neatly
69 rolled and the wire and posts stored on the airport if they are to be used again, or stored at a location designated
70 by the DEN Project Manager if the fence is to remain the property of a local owner or authority.
71

72 **151-2.3 CLEARING AND GRUBBING.** In areas designated to be cleared and grubbed, all stumps, roots,
73 buried logs, brush, grass, and other unsatisfactory materials as indicated on the plans, shall be removed, except
74 where embankments exceeding 3-1/2 feet (105 cm) in depth will be constructed outside of paved areas. For
75 embankments constructed outside of paved areas, all unsatisfactory materials shall be removed, but sound trees,
76 stumps, and brush can be cut off flush with the original ground and allowed to remain. Tap roots and other
77 projections over 1-1/2 inches (38 mm) in diameter shall be grubbed out to a depth of at least 18 inches (0.5 m)
78 below the finished subgrade or slope elevation.
79

80 Any buildings and miscellaneous structures that are shown on the plans to be removed shall be demolished or
81 removed, and all materials shall be disposed of by removal from the site. The cost of removal is incidental to
82 this item. The remaining or existing foundations, wells, cesspools, and like structures shall be destroyed by
83 breaking down the materials of which the foundations, wells, cesspools, etc., are built to a depth at least 2 feet
84 (60 cm) below the existing surrounding ground. Any broken concrete, blocks, or other objectionable material
85 that cannot be used in backfill shall be removed and disposed of at the Contractor's expense. The holes or
86 openings shall be backfilled with acceptable material and properly compacted.
87

88 All holes in embankment areas remaining after the grubbing operation shall have the sides of the holes flattened
89 to facilitate filling with acceptable material and compacting as required in Item P-152. The same procedure shall
90 be applied to all holes remaining after grubbing in areas where the depth of holes exceeds the depth of the
91 proposed excavation.
92

93 METHOD OF MEASUREMENT

94
95 **151-3.2** The quantities of clearing and grubbing shall not be measured or paid for separately but will be
96 considered incidental to the project. The work under this item shall be considered subsidiary to other items of
97 work.
98

99

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BASIS OF PAYMENT

151-4.1 151-4.1 Clearing and grubbing shall be considered incidental to the project. No payment shall be made for clearing and grubbing

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****END OF ITEM P-151****

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.
- 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 m³) will be classified as "rock excavation."

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 DEN Project Manager.

152-1.4 SELECT EMBANKMENT. Select Embankment shall consist of material as described below. There are 2 zones of Select Embankment Material:

- a. Lower Select Embankment: the lower 4.5 feet (1.4 m) under airfield concrete pavement and 1 foot (0.3 m) below airfield asphalt shoulders.
- b. Upper Select Embankment: the upper 1.5 feet (.45 m).
- c. The upper 1 foot (300 mm) of the Upper Select Embankment will be cement treated.

Lower Select Embankment material shall consist of existing in-place and/or imported select fill, including moisture conditioning of the existing suitable on-site and/or imported select fill. Moisture conditioning of the existing suitable select fill shall be performed for the full depth of the embankment section. This will require over-excavation of existing soils using a maximum 8 inch (200 mm) lift thickness, and tested for classification (including gradation and Atterberg limits), and swell-consolidation.

Lower Select Embankment materials shall be free of unsuitable materials, including claystone, contain 100% passing the 3 inch (75 mm) sieve, less than 90% passing the No. 200 sieve, have a maximum Liquid Limit of 45, a maximum Plasticity Index of 30, and less than 3% swell potential at a loading of 200 pounds per square foot. The swell sample shall be remolded to 95% of the maximum dry density at optimum moisture as determined by ASTM D 698 for initial acceptance of the proposed Lower Select Embankment Material.

The lower and upper select embankment materials should be properly moisture conditioned and compacted in accordance with the specifications.

51 Upper Select embankment material shall be obtained from the borrow area indicated in the plans and shall
 52 meet the requirements of the specification.
 53

54 **d. Cement Treated Upper Select Embankment.** The Upper Select Embankment material, of
 55 which the upper 1 foot (300 mm) will be cement-treated, shall be an imported material free of
 56 unsuitable materials, with 100% passing the 1-inch sieve, no more than 45% retained on a No. 4
 57 sieve, less than 50% passing the No. 200 sieve, a maximum Plasticity Index of 15, a maximum
 58 water soluble sulfates content of 0.5%, and less than 3% swell potential at a loading of 200
 59 pounds per square foot. The swell sample shall be remolded to 95% of the maximum dry
 60 density at optimum moisture as determined by ASTM D 698 for initial acceptance of the
 61 proposed Upper Select Embankment material.
 62

63 Quality control tests of the upper zone select material shall be taken prior to the importing
 64 process for verification that the material meets the requirements for upper select embankment.
 65 Test results shall be provided to the DEN Project Manager for approval. If the material does not
 66 meet the requirements of upper select embankment, the material shall not be used. The quality
 67 control testing shall consist of the following:
 68

- 69 1. Soil classification, gradation, Atterberg limits, and soluble sulfates every 2,000 cubic yards.
- 70 2. Swell test every 5,000 cubic yards.

71
 72
 73 **152-1.5 MATERIAL CLASSIFICATION.** Non-cohesive soils, for the purposes of determining
 74 compaction control, are those with a plasticity index of less than 3 when tested in accordance with ASTM D
 75 4318. Any other material shall be considered cohesive.
 76

77 CONSTRUCTION METHODS

78
 79
 80 **152-2.1 GENERAL.** Before beginning excavation, grading, and embankment operations in any area, the area
 81 shall be cleared or cleared and grubbed in accordance with Item P-151.
 82

83 The suitability of material to be placed in embankments shall be subject to approval by the DEN Project
 84 Manager. All unsuitable material shall be disposed of in waste areas as shown on the plans. All waste areas
 85 shall be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas
 86 shall be specified on the plans or approved by the DEN Project Manager.
 87

88 When the Contractor's excavating operations encounter artifacts of historical or archaeological significance,
 89 the operations shall be temporarily discontinued and the DEN Project Manager notified per Section 70,
 90 paragraph 70-20. At the direction of the DEN Project Manager, the Contractor shall excavate the site in such
 91 a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid
 92 for as extra work.
 93

94 Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling
 95 or other Contractor activities shall be scarified and disked to a depth of 4 inches (100 mm), to loosen and
 96 pulverize the soil. Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not
 97 be permitted in the top 6 inches (150 mm) of the subgrade.
 98

99 If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar
 100 underground structures, the Contractor shall be responsible for and shall take all necessary precautions to

101 preserve them or provide temporary services. When such facilities are encountered, the Contractor shall
102 notify the DEN Project Manager, who shall arrange for their removal if necessary. The Contractor, at their
103 own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may
104 result from any of the Contractor's operations during the period of the contract.
105

106 **a. Blasting.** Blasting shall not be allowed.
107

108 **152-2.2 EXCAVATION.** No excavation shall be started until the work has been staked out by the
109 Contractor and the DEN Project Manager has obtained from the Contractor, the survey notes of the
110 elevations and measurements of the ground surface. The Contractor and DEN Project Manager shall agree
111 that the original ground lines shown on the original topographic mapping are accurate, or agree to any
112 adjustments made to the original ground lines.
113

114 Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces were
115 used to develop the design plans.
116

117 Volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and
118 generating Triangle Volume Reports. Electronic copies of DTM files and a paper copy of the original
119 topographic map will be issued to the successful bidder.
120

121 Volumetric quantities were calculated using design cross sections which were created for this project using the
122 DTM files of the applicable design surfaces and generating End Area Volume Reports. Paper copies of
123 design cross sections and a paper copy of the original topographic map will be issued to the successful bidder.
124

125 Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot
126 elevations shown on the topographic map, were developed by computer interpolation from those spot
127 elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground
128 surface by verifying spot elevations at the same locations where original field survey data was obtained as
129 indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual
130 ground surface at any particular location may differ somewhat from the interpolated surface shown on the
131 design cross sections or obtained from the DTM's. Contractor's verification of original ground surface,
132 however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be
133 made to the original ground surface unless the Contractor demonstrates that spot elevations shown are
134 incorrect. For this purpose, spot elevations which are within 0.1 foot (30 mm) of the stated elevations for
135 ground surfaces, or within 0.04 foot (12 mm) for hard surfaces (pavements, buildings, foundations, structures,
136 etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of
137 the original ground surface. If Contractor's verification identifies discrepancies in the topographic map,
138 Contractor shall notify the DEN Project Manager in writing at least two weeks before disturbance of existing
139 grade to allow sufficient time to verify the submitted information and make adjustments to the design cross
140 sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of
141 the accuracy of the original elevations shown on the topographic map for that area.
142

143 All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future
144 use in areas designated on the plans or by the DEN Project Manager. All suitable excavated material shall be
145 used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable
146 material shall be disposed of as shown on the plans.
147

148 The grade shall be maintained so that the surface is well drained at all times.
149

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

154

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

162

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

175

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

183

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

190

191 **e. Hazardous Materials.** Some material (equipment, debris, soil, wastes, etc.) may be affected by
192 hazardous constituents, chemicals or compounds used during oil and gas production, residential
193 development, public improvement construction or agricultural use. Material contaminated or
194 potentially contaminated with hazardous constituents, chemicals or compounds shall be assessed
195 by the contractor regarding the hazardous characteristic(s) of each material. The assessment will
196 be made in accordance with requirements specified by the Colorado Department of Public
197 Health and Environment (CDPHE) and the Colorado Department of Natural Resources - Oil
198 and Gas Conservation Commission (OGCC). The Contractor shall notify the DEN Project

199 Manager Engineer in writing immediately upon discovery or suspicion of the existence of such
200 hazardous material.
201

202 **152-2.3 Borrow excavation.** Borrow areas within the airport property are indicated on the plans. Borrow
203 excavation shall be made only at these designated locations and within the horizontal and vertical limits as
204 staked or as directed by the DEN Project Manager. All unsuitable material shall be disposed of by the
205 Contractor as shown on the plans. All borrow pits shall be opened to expose the various strata of acceptable
206 material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable
207 condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant.
208

209 **152-2.4 DRAINAGE EXCAVATION.** Drainage excavation shall consist of excavating drainage ditches
210 including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be
211 performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent
212 excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall
213 be placed in designated waste areas or as directed by the DEN Project Manager. All necessary work shall be
214 performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed
215 on the project to the required cross-section and shall keep them free of debris or obstructions until the
216 project is accepted.
217

218 **152-2.5 PREPARATION OF CUT AREAS OR AREAS WHERE EXISTING PAVEMENT HAS**
219 **BEEN REMOVED.** In those areas on which a subbase or base course is to be placed, the top 12 inches of
220 subgrade shall be compacted to not less than 95% of the maximum density as determined by ASTM D698.
221 As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3
222 as determined by ASTM D4318.
223

224 **152-2.6 PREPARATION OF EMBANKMENT AREA.** All sod and vegetative matter shall be removed
225 from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by
226 plowing or scarifying to a minimum depth of 12 inches (150 mm) and shall then be compacted per paragraph
227 152-2.10.
228

229 Sloped surfaces steeper than one (1) vertical to four (4) horizontal with embankments higher than 6 feet, shall
230 be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When
231 the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall
232 be scarified to a depth of 12 inches (300 mm) and compacted as specified for the adjacent fill.
233

234 No direct payment shall be made for the work performed under this section. The necessary clearing and
235 grubbing and the quantity of excavation removed will be paid for under the respective items of work.
236

237 **152-2.7 CONTROL STRIP.** The first half-day of construction of subgrade and/or embankment shall be
238 considered as a control strip for the Contractor to demonstrate, in the presence of the DEN Project Manager,
239 that the materials, equipment, and construction processes meet the requirements of this specification. The
240 sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The
241 maximum compacted thickness may be increased to a maximum of 12 inches (300 mm) upon the
242 Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the
243 specified density. The DEN Project Manager must witness this demonstration and approve the lift thickness
244 prior to full production.
245

246 Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and
247 replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted
248 by the DEN Project Manager. The Contractor shall use the same equipment, materials, and construction

249 methods for the remainder of construction, unless adjustments made by the Contractor are approved in
250 advance by the DEN Project Manager.

251
252 **152-2.8 FORMATION OF EMBANKMENTS.** The material shall be constructed in lifts as established in
253 the control strip, but not less than 6 inches (150 mm) nor more than 12 inches (300 mm) of compacted
254 thickness.

255
256 When more than one lift is required to establish the layer thickness shown on the plans, the construction
257 procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify
258 that compaction requirements have been met. The Contractor shall rework, re-compact and retest any
259 material placed which does not meet the specifications.

260
261 The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the
262 DEN Project Manager. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall
263 not be incorporated or buried in the embankment.

264
265 Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain,
266 freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the
267 embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces
268 that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to
269 provide surface drainage at all times.

270
271 The material in each lift shall be within $\pm 2\%$ of optimum moisture content before rolling to obtain the
272 prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform
273 moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or
274 manipulation alone to increase the rate of evaporation.

275
276 The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture
277 content to achieve the specified embankment density.

278
279 The DEN Project Manager will take samples of excavated materials which will be used in embankment for
280 testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM D698.
281 A new Proctor shall be developed for each soil type based on visual classification.

282
283 Density tests will be taken by the DEN Project Manager for every 100 square yards of compacted
284 embankment for each lift which is required to be compacted, or other appropriate frequencies as determined
285 by the DEN Project Manager.

286
287 If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow AASHTO T-180
288 Annex Correction of maximum dry density and optimum moisture for oversized particles.

289
290 Rolling operations shall be continued until the embankment is compacted to not less than 95% of the
291 maximum density as determined by ASTM D698. Under all areas to be paved, the embankments shall be
292 compacted to a depth of 12 inches and to a density of not less than 95 percent of the maximum density as
293 determined by ASTM D698. As used in this specification, "non-cohesive" shall mean those soils having a
294 plasticity index (PI) of less than 3 as determined by ASTM D4318.

295
296 On all areas outside of the pavement areas, no compaction will be required on the top 6 inches which shall be
297 prepared for a seedbed in accordance with Item T-905.

298

299 The in-place field density shall be determined in accordance with ASTM D1556 or ASTM 6938 using
300 Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture
301 content of the material. The machine shall be calibrated in accordance with ASTM D6938.
302

303 The **DEN Project Manager** shall perform all density tests for acceptance. If the specified density is not
304 attained, the area represented by the test or as designated by the DEN Project Manager shall be reworked
305 and/or re-compacted and additional random tests made. This procedure shall be followed until the specified
306 density is reached.
307

308 Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is
309 obtained.
310

311 During construction of the embankment, the Contractor shall route all construction equipment evenly over
312 the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of
313 the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the
314 finished pavement grade line.
315

316 When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at
317 approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the
318 embankment and the subgrade material shall be incorporated under the future paved areas. Stones,
319 fragmentary rock, and recycled pavement larger than 4 inches (100 mm) in their greatest dimensions will not
320 be allowed in the top 12 inches (300 mm) of the subgrade. Rockfill shall be brought up in lifts as specified or
321 as directed by the DEN Project Manager and the finer material shall be used to fill the voids forming a dense,
322 compact mass. Rock, cement concrete pavement, asphalt pavement, and other embankment material shall not
323 be disposed of except at places and in the manner designated on the plans or by the DEN Project Manager.
324

325 When the excavated material consists predominantly of rock fragments of such size that the material cannot
326 be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the
327 pieces, such material may be placed in the embankment as directed in lifts not exceeding 2 feet (60 cm) in
328 thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer
329 fragments of rock. The lift shall not be constructed above an elevation 4 feet (1.2 m) below the finished
330 subgrade.
331

332 **152-2.9 PROOF ROLLING.** The purpose of proof rolling the subgrade is to identify any weak areas in the
333 subgrade and not for compaction of the subgrade. After compaction is completed, the subgrade area shall be
334 proof rolled with a 20 ton (18.1 metric ton) Tandem axle Dual Wheel Dump Truck loaded to the legal limit
335 with tires inflated to 80/100/150 psi (0.551 MPa/0.689 MPa/1.034 MPa) in the presence of the DEN Project
336 Manager. Apply a minimum coverage as specified by the DEN Project Manager, under pavement areas. A
337 coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that
338 deflect more than 1 inch (25 mm) or show permanent deformation greater than 1 inch (25 mm) shall be
339 removed and replaced with suitable material or reworked to conform to the moisture content and
340 compaction requirements in accordance with these specifications. Removal and replacement of soft areas is
341 incidental to this item.
342

343 **152-2.10 COMPACTION REQUIREMENTS.** The subgrade under areas to be paved shall be compacted
344 to a depth of 12 inches and to a density of not less than 95 percent of the maximum dry density as
345 determined by ASTM D698. The subgrade in areas outside the limits of the pavement areas shall be
346 compacted to a depth of 12 inches and to a density of not less than 95 percent of the maximum density as
347 determined by ASTM D698.
348

349 The material to be compacted shall be within $\pm 2\%$ of optimum moisture content before being rolled to
350 obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent
351 retained on the $\frac{3}{4}$ inch (19.0 mm) sieve, follow the methods in ASTM D698, or procedures in AASHTO
352 T180 Annex for correction of maximum dry density and optimum moisture for oversized particles. Tests for
353 moisture content and compaction will be taken at a minimum of 100 S.Y. of subgrade. All quality assurance
354 testing shall be done by the DEN Project Manager for acceptance determination.
355

356 The in-place field density shall be determined in accordance with ASTM D1556, or ASTM D6938 using
357 Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture
358 content of the material. The machine shall be calibrated in accordance with ASTM D6938 within 12 months
359 prior to its use on this contract. The gage shall be field standardized daily.
360

361 Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.
362

363 If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional
364 random tests made. This procedure shall be followed until the specified density is reached.
365

366 All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the
367 plans or as directed by the DEN Project Manager and the finished subgrade shall be maintained.
368

369 **152-2.11 FINISHING AND PROTECTION OF SUBGRADE.** Finishing and protection of the subgrade
370 is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain
371 readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading,
372 rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the
373 lines and grades shown on the plans. All ruts or rough places that develop in the completed subgrade shall be
374 graded, re-compacted, and retested. The Contractor shall protect the subgrade from damage and limit hauling
375 over the finished subgrade to only traffic essential for construction purposes.
376

377 The Contractor shall maintain the completed course in satisfactory condition throughout placement of
378 subsequent layers. No subbase, base, or surface course shall be placed on the subgrade until the subgrade
379 has been accepted by the DEN Project Manager.
380

381 **152-2.12 HAUL.** All hauling will be considered a necessary and incidental part of the work. The Contractor
382 shall include the cost in the contract unit price for the pay of items of work involved. No payment will be
383 made separately or directly for hauling on any part of the work.
384

385 The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the
386 subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling
387 operations shall be repaired at the Contractor's expense.
388

389 The Contractor shall be responsible for providing, maintaining and removing any haul roads or routes within
390 or outside of the work area, and shall return the affected areas to their former condition, unless otherwise
391 authorized in writing by the Owner. No separate payment will be made for any work or materials associated
392 with providing, maintaining and removing haul roads or routes.
393

394 **152-2.13 SURFACE TOLERANCES.** In those areas on which a subbase or base course is to be placed, the
395 surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required
396 smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm),
397 reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved
398 by the DEN Project Manager. The Contractor shall perform all final smoothness and grade checks in the

399 presence of the DEN Project Manager. Any deviation in surface tolerances shall be corrected by the
400 Contractor at the Contractor's expense.

- 401
- 402 a. **Smoothness.** The finished surface shall not vary more than +/- 1/2 inch (12 mm) when tested
403 with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The
404 straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m)
405 straightedge for the full length of each line on a 50-foot (15-m) grid.
- 406
- 407 b. **Grade.** The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/-
408 0.05 feet (15 mm) of the specified grade.
- 409

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

413

414 **152-2.14 TOPSOIL.** When topsoil is specified or required as shown on the plans or under Item T-905, it
415 shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item
416 T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished
417 construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on
418 the plans and the approved CSPP, and shall not be placed on areas that subsequently will require any
419 excavation or embankment fill. If, in the judgment of the DEN Project Manager, it is practical to place the
420 salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without
421 stockpiling or further re-handling.

422

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

426

427 **152-2.15 RESTORING BORROW AREAS.** The Contractor shall, upon completion of his borrow
428 excavation activities, prepare the borrow sites for planting by performing the following work:

429

- 430 a. Remove and bury all rock over 6" in dimension in accordance with rock disposal methods as
431 noted under Section 3.02 Excavation P-152.
- 432
- 433 b. Grade all sites to drain as indicated in these specifications and drawings.
- 434
- 435 c. Remove all trash and other foreign objects so that the areas can be reused for farming purposes.
- 436
- 437 d. Rip the borrow area site in a manner as approved by the DEN Project Manager. After the area is
438 ripped to the 18 inch (450 mm) depth, the area ripped shall be treated on the surface to reduce
439 excessive surface roughness or cloddiness and produce an area suitable for future seeding.
440 Treatment may include discing, harrowing, cultipacking or other means as approved by the DEN
441 Project Manager. In areas where rock is the predominant surface remaining, the Contractor may
442 spread 18 inches (450 mm) of acceptable material over the rock areas as approved by the DEN
443 Project Manager at no additional cost to the City.
- 444

445 All work required to prepare the borrow area for planting as designated under this section shall be considered
446 as incidental work.

447

448

TECHNICAL SPECIFICATIONS
 DIVISION 2-AIRFIELD STANDARDS
 ITEM P-152 EXCAVATION, SUBGRADE, AND EMBANKMENT
 AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
 RUNWAY 17L-35R PAVEMENT REHABILITATION
 AND ELECTRICAL UPGRADES PACKAGE 2
 CONST. CONTRACT NO. 202473360

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METHOD OF MEASUREMENT

152-3.1 There shall be no direct measurement or payment for Embankment in place. The work under this item shall be considered subsidiary to other items of work.

BASIS OF PAYMENT

152-4.1 For Embankment in place shall be considered incidental to the project. No payment shall be made for Embankment in Place.

CONTRACTOR QUALITY CONTROL TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Lower Select Embankment P-152-1.4c	Classification, gradation, Atterberg limits, swell consolidation	shall be free of unsuitable materials, including claystone, contain 100% passing the 3 inch (75 mm) sieve, less than 90% passing the No. 200 sieve, have a maximum Liquid Limit of 45, a maximum Plasticity Index of 30, and less than 3% swell potential at a loading of 200 pounds per square foot.	Prior to placement	One per material type
Cement Treated Upper Select Embankment Upper Zone P-152-1.4d	Soil classification, gradation, Atterberg limits, soluble sulfates, swell test. ASTM D 698	free of unsuitable materials, with 100% passing the 1-inch sieve, no more than 45% retained on a No. 4 sieve, less than 50% passing the No. 200 sieve, a maximum Plasticity Index of 15, a maximum water soluble sulfates content of 0.5%, and less than 3% swell potential at a loading of 200 pounds per square foot.	Prior to importing	Soil classification, gradation, Atterberg limits, and soluble sulfates every 2,000 Cubic Yards Swell test every 5,000 cubic yards
Excavation Spot Elevation P-152-2.2	Survey	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.)	Next following Workday	as required by plans and/or specifications
Density of Preparation of Cut Areas or Areas where Existing Pavement Has Been Removed P-152-2.5	ASTM D698 ASTM D4318	not less than 95% of the maximum density	At time of test	100 square yards of compacted subgrade
Density/Moisture Formation of	ASTM D698	95% of the maximum density $\pm 2\%$ of optimum moisture	At time of test	100 square yards of compacted

TECHNICAL SPECIFICATIONS

DIVISION 2-AIRFIELD STANDARDS

ITEM P-152 EXCAVATION, SUBGRADE, AND EMBANKMENT

AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT

RUNWAY 17L-35R PAVEMENT REHABILITATION

AND ELECTRICAL UPGRADES PACKAGE 2

CONST. CONTRACT NO. 202473360

Embankments P-152-2.8		content before rolling		embankment
Density/Moisture Subgrade Under Paved Areas P-152-2.10	ASTM D698	95 percent of the maximum dry density $\pm 2\%$ of optimum moisture content before being rolled	At time of test	100 square yards. of subgrade
Density/Moisture Subgrade Outside of Pavement Areas P-152-2.10	ASTM D698	not less than 95 percent of the maximum density $\pm 2\%$ of optimum moisture content before being rolled	At time of Test	100 square yards. of subgrade

463

464

465

QUALITY ASSURANCE SAMPLING AND TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Lower Select Embankment P-152-1.4c	Classification, gradation, Atterberg limits, swell consolidation.	shall be free of unsuitable materials, including claystone, contain 100% passing the 3 inch (75 mm) sieve, less than 90% passing the No. 200 sieve, have a maximum Liquid Limit of 45, a maximum Plasticity Index of 30, and less than 3% swell potential at a loading of 200 pounds per square foot.	Prior to placement	One per material type
Cement Treated Upper Select Embankment Upper Zone P-152-1.4d	Soil classification, gradation, Atterberg limits, soluble sulfates, swell test. ASTM D 698	free of unsuitable materials, with 100% passing the 1-inch sieve, no more than 45% retained on a No. 4 sieve, less than 50% passing the No. 200 sieve, a maximum Plasticity Index of 15, a maximum water soluble sulfates content of 0.5%, and less than 3% swell potential at a loading of 200 pounds per square foot.	Prior to importing	Soil classification, gradation, Atterberg limits, and soluble sulfates every 2,000 Cubic Yards Swell test every 5,000 cubic yards
Excavation Spot Elevation P-152-2.2	Survey	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.)	Next following Workday	as required by plans and/or specifications
Density of Preparation of Cut Areas or Areas where Existing Pavement Has Been Removed P-152-2.5	ASTM D698 ASTM D4318	not less than 95% of the maximum density	At time of test	100 square yards of compacted subgrade
Density/Moisture	ASTM D698	95% of the maximum density	At time of	100 square yards

TECHNICAL SPECIFICATIONS

DIVISION 2-AIRFIELD STANDARDS

ITEM P-152 EXCAVATION, SUBGRADE, AND EMBANKMENT

AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT

RUNWAY 17L-35R PAVEMENT REHABILITATION

AND ELECTRICAL UPGRADES PACKAGE 2

CONST. CONTRACT NO. 202473360

Formation of Embankments P-152-2.8		$\pm 2\%$ of optimum moisture content before rolling	test	of compacted embankment
Density/Moisture Subgrade Under Paved Areas P-152-2.10	ASTM D698	95 percent of the maximum dry density $\pm 2\%$ of optimum moisture content before being rolled	At time of test	100 square yards. of subgrade
Density/Moisture Subgrade Outside of Pavement Areas P-152-2.10	ASTM D698	not less than 95 percent of the maximum density $\pm 2\%$ of optimum moisture content before being rolled	At time of Test	100 square yards. of subgrade

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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/ft³ (600 kN-m/m³))

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/ft³ (2700 kN-m/m³))

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****

Item P-153 Controlled Low-Strength Material (CLSM) 3721

DESCRIPTION

153-1.1 This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches or at other locations shown on the plans or as directed by the DEN Project Manager.

MATERIALS

153-2.1 Materials.

- a. **Cement.** Cement shall conform to the requirements of ASTM C150 Type I/II or ASTM C595 Type IP(HS)(MH), or IL(HS)(MH).
- b. **Fly ash.** Fly ash shall conform to ASTM C618, Class C or F.
- c. **Fine aggregate (sand).** Fine aggregate shall conform to the requirements of ASTM C33 except for aggregate gradation. Any aggregate gradation which produces the specified performance characteristics of the CLSM and meets the following requirements, will be accepted.

Sieve Size	Percent Passing by weight
3/4 inch (19.0 mm)	100
No. 200 (75 µm)	0 - 12

- d. **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.
- e. The CLSM used in the construction of Item L-110, Duct Bank, shall have Red Color added.

MIX DESIGN

153-3.1 Proportions. The Contractor shall submit, to the DEN Project Manager, a mix design including the proportions and source of aggregate, fly ash, cement, water, and approved admixtures. No CLSM mixture shall be produced for payment until the DEN Project Manager has given written approval of the proportions. The proportions shall be prepared by a laboratory and shall remain in effect for the duration of the project. The proportions shall establish a single percentage or weight for aggregate, fly ash, cement, water, and any admixtures proposed. Laboratory costs are incidental to this item.

- a. **Compressive strength.** CLSM shall be designed to achieve a 28-day compressive strength of 100 to 300 psi when tested in accordance with ASTM D4832, with no significant strength gain after 28 days.
- b. **Consistency.** Design CLSM to achieve a consistency that will produce an approximate 8-inch (200 mm) diameter circular-type spread without segregation. CLSM consistency shall be determined per ASTM D6103.

CONSTRUCTION METHODS

153-4.1 Placement.

- a. **Placement.** CLSM may be placed by any reasonable means from the mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed so structures or pipes are not displaced from their final position and intrusion of CLSM into unwanted areas is avoided. The material shall be brought up uniformly to the fill line shown on the plans or as directed by the DEN Project Manager. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one lift, the base lift shall be free of surface water and loose foreign material prior to placement of the next lift.
- b. **Contractor Quality Control.** The Contractor shall collect all batch tickets to verify the CLSM delivered to the project conforms to the mix design. The Contractor shall verify daily that the CLSM is consistent with 153-3.1a and 153-3.1b. Adjustments shall be made as necessary to the proportions and materials as needed. The Contractor shall provide all batch tickets to the DEN Project Manager.
- c. **Limitations of placement.** CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35°F (2°C) and rising. Mixing and placement shall stop when the air temperature is 40°F (4°C) and falling or when the anticipated air or ground temperature will be 35°F (2°C) or less in the 24-hour period following proposed placement. At the time of placement, CLSM shall have a temperature of at least 40°F (4°C).

153-4.2 Curing and protection

- a. **Curing.** The air in contact with the CLSM shall be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32°F (0°C), the material may be rejected by the DEN Project Manager if damage to the material is observed.
- b. **Protection.** The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 psi (105 kPa) is obtained. The Contractor shall be responsible for providing evidence to the DEN Project Manager that the material has reached the desired strength. Acceptable evidence shall be based upon compressive tests made in accordance with paragraph 153-3.1a.

153-4.3 Quality Assurance (QA) Acceptance. CLSM QA acceptance shall be based upon batch tickets provided by the Contractor to the DEN Project Manager to confirm that the delivered material conforms to the mix design.

METHOD OF MEASUREMENT

153-5.1 Measurement.

No separate measurement for payment shall be made for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

TECHNICAL SPECIFICATIONS

DIVISION 2-AIRFIELD STANDARDS

ITEM P-153 CONTROLLED LOW-STRENGTH MATERIAL (CLSM)

AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT

RUNWAY 17L-35R PAVEMENT REHABILITATION

AND ELECTRICAL UPGRADES PACKAGE 2

CONST. CONTRACT NO. 202473360

BASIS OF PAYMENT

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153-6.1 Payment.

No payment will be made separately or directly for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

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Payment will be made under:

No pay items.

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QUALITY ASSURANCE SAMPLING AND TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Batch Ticket Verification P-153-4.3	—	---	At time of placement	Each Truck

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CONTRACTOR QUALITY CONTROL TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Compressive Strength P-153-3.1a	ASTM D4382	100psi-300psi	28 days	—
Consistency P-153-3.1b	ASTM D6103	8-inch diameter circular-type spread without segregation	—	—
Batch Ticket Verification P-153-4.1b	—	---	At time of placement	Each Truck

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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.

117

ASTM International (ASTM)

ASTM C33 Standard Specification for Concrete Aggregates

ASTM C150 Standard Specification for Portland Cement

ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C595 Standard Specification for Blended Hydraulic Cements

ASTM D4832 Standard Test Method for Preparation and Testing of Controlled Low-Strength Material (CLSM) Test Cylinders

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TECHNICAL SPECIFICATIONS

DENVER INTERNATIONAL AIRPORT

DIVISION 2-AIRFIELD STANDARDS

RUNWAY 17L-35R PAVEMENT REHABILITATION

ITEM P-153 CONTROLLED LOW-STRENGTH MATERIAL (CLSM)

AND ELECTRICAL UPGRADES PACKAGE 2

AC 150/5370-10H

CONST. CONTRACT NO. 202473360

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****END OF ITEM P-153****

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ITEM P-159 CONCRETE AND ASPHALT CRUSHING

DESCRIPTION

159-1.1 This item shall consist of providing all equipment, labor, and utilities necessary to crush and stockpile concrete and asphalt rubble removed from the project at the South Airfield Recycle Yard, as shown on the project drawings. The following recycled materials will be produced by this contract:

- a. CDOT, Class 6 Aggregate Base Course
- b. Additional size and quantity of material as directed by the DEN Project Manager or DEN Quality Assurance Recycling Yard Inspector.

159-1.2 RELATED SECTIONS.

- a. Section 014510 – Contractor Quality Control
- b. Section 014525 – Independent Testing Agency

159-1.3 SUBMITTALS. (REFER TO SECTION 013300)

- a. Gradation Test Reports

PRODUCTS

159-2.1 CLASS 6, CRUSHED AGGREGATE MATERIALS. Aggregate base shall be material that has been crushed and screened to meet the gradation for CDOT, Class 6 material, as follows:

Sieve Size	% By Weight Passing Square Mesh Sieves
¾ inch	100
No. 4	30-65
No. 8	25-55
No. 200	3-12

Due to the quantity of fine material resulting from crushing concrete, the No. 200 material will be acceptable up to a maximum of 18%.

EXECUTION

159-3.1 STOCKPILING. Removed materials shall be crushed and stockpiled at the South Airfield Recycling Yard as directed by the DEN Quality Assurance Recycling Yard Inspector. Place stockpiles of differing materials (asphalt or concrete) in locations on the site such that the separate materials will be readily accessible by users (Materials produced by this contract may be removed by users while crushing operations are in progress) or as directed by the DEN Quality Assurance Recycling Yard Inspector. Separate differing materials with dividers or stockpile apart to prevent mixing. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials. Stockpile materials with stacking conveyors so as to minimize the footprint of each stockpile. The contractor will supply a conveyor at the discharge from the crusher that is equipped with a calibrated weight scale.

30 If additional space is needed for crushing operations, the project's staging area can be used provided all
 31 materials are removed from the project's staging area prior to demobilization of the staging area, unless
 32 approved otherwise by the DEN Project Manager.

33 Ensure that all concrete reinforcing, dowel bars, joint sealant, fiber board, and electrical equipment of any
 34 nature are segregated from all stockpiles for disposal. All reinforcing metal, or any nature removed from
 35 the concrete rubble during crushing operations shall be separated from finished materials for later
 36 disposal or recycling by the contractor.

37 **159-3.2 SITE CLEAN UP.** At the completion of crushing and screening operations, grade site
 38 surface to prevent freestanding surface water. Remove all steel reinforcing from the site and dispose of it
 39 at either a steel recycling facility or at a state permitted landfill. Remove, and dispose offsite of any excess
 40 minus 200 sieve material which may have been generated by the crushing and screening work. Remove
 41 any materials used for environmental protection, except that silt fences down grade from stockpiles shall
 42 be left in place.

43 **159-3.3 TESTING.** Class 6 aggregate base course, either concrete or asphalt, will be tested by
 44 an independent testing agency following the first 1000 tons of each material produced. A sieve analysis
 45 shall be performed by the contractor's Independent Testing Agency, and results forwarded to the DEN
 46 Project Manager for approval. Following initial approval, additional sieve analyses shall be performed for
 47 each additional 5000 tons of material produced. Re-ports of each test shall be forwarded to the DEN
 48 Project Manager.

49 METHOD OF MEASUREMENT

50 **159-4.1** Measurement for Concrete Crushing shall be by the number of tons of material using
 51 the scale at the recycle yard.

52 BASIS OF PAYMENT

53 **159-5.1** Payment shall be made at the contract unit price per ton for Concrete Crushing. The
 54 price shall be full compensation for furnishing all materials, for all preparation and placing the materials,
 55 and for all labor, equipment, tools, and incidentals necessary to complete the item. The quantity produced
 56 of each type of material will be directed by the DEN Project Manager or DEN Quality Assurance
 57 Recycling Yard Inspector.

58 Item P-159a Concrete Crushing – per ton

59 TESTING REQUIREMENTS

60 ASTM D75 Practice for Sampling Aggregates
 61 ASTM C117 Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
 62 ASTM C136 Method for Sieve Analysis of Fine and Coarse Aggregates
 63 ASTM C702 Practice for Reducing Samples of Aggregates to Testing Size

64 END OF ITEM P-159

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ITEM P-160 WATERING

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DESCRIPTION

3 **160-1.1** This work shall consist of obtaining, conveying, and applying water for compaction of
4 embankments and subgrades; for concrete; haul road; for dust control; and for any other purposes in
5 accordance with the requirements of the Contract Documents or as designated by the DEN Project
6 Manager.

7

MATERIALS

8 **160-2.1 WATER QUALITY.** Water required for construction use shall be clean and free from
9 sewage, oil, acid, strong alkalis, organic material, and other substances injurious to the finished product.
10 Water obtained from the City supplied source is acceptable for use as construction water. If the
11 Contractor provides an alternative source for water supply, water of questionable quality shall be tested in
12 accordance with ASTM C1602. All alternative supply sources shall be subject to approval by the DEN
13 Project Manager.

14 **160-2.2 CITY SUPPLIED WATER SOURCE.** The City shall make available a source of
15 construction water from the water line close to the existing Contractor Staging Area location shown on
16 the Drawings. There is not an unlimited supply of water available and the Contractor will be held
17 responsible for misuse of water. The tap size shall be limited to 1-1/2 inches.

18 It shall be the Contractor's responsibility to contact the Denver Water Department (DWD) and the DEN
19 Project Manager and arrange for connection to the above referenced waterline, to include installation of
20 meter. The Contractor's connection plan, its distribution system, and its filling operations must be
21 coordinated with, submitted to, and approved by the DWD prior to installation. All costs associated with
22 waterline connections and distribution shall be included in the unit prices bid for the applicable items of
23 construction.

24 **160-2.3 POTABLE WATER.** Potable water may be hauled in and stored by the Contractor.

25

CONSTRUCTION METHODS

26 **160-3.1 TRANSPORT OF WATER.** The Contractor may transport water overland to an
27 approved temporary storage facility, or construct temporary supply piping to his primary use point. The
28 approximate location and alignment of the Contractor's temporary supply/distribution system must be
29 approved by the DEN Project Manager in writing prior to its installation and must be removed by the
30 Contractor upon completion of work. Potential contamination of existing domestic water system shall be
31 held as the responsibility of the contractor.

32 **160-3.2 EQUIPMENT.** The water equipment shall be of capacity and designed to assure
33 uniform application of water in the amounts required.

34 **160-3.3 PERMITS.** The Contractor shall obtain the required DWD permit(s) relative to
35 tapping the water line and/or the use of said water.

36

37

METHOD OF MEASUREMENT

38

160-4.1 There shall be no direct measurement or payment for watering. The work under this
39 item shall be considered subsidiary to other items of work.

40

BASIS OF PAYMENT

41

160-5.1 Watering shall be considered incidental to the project. No payment shall be made for
42 watering.

43

TESTING REQUIREMENTS

44

ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic
45 Cement Concrete

46

END OF ITEM P-160

Item P-403 Asphalt Mix Pavement Base, Leveling, or Surface Course

DESCRIPTION

403-1.1 This item shall consist of pavement courses composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

MATERIALS

403-2.1 AGGREGATE. Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. Coarse aggregate is the material retained on the No. 4 (4.75 mm) sieve. Fine aggregate is the material passing the No. 4 (4.75 mm) sieve.

a. Coarse aggregate. Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. Coarse aggregate material requirements are given in the table below.

COARSE AGGREGATE MATERIAL REQUIREMENTS

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum for surface, asphalt binder, and leveling course Loss: 50% maximum for base course	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	1.0% maximum	ASTM C142
Percentage of Fractured Particles	For pavements designed for aircraft gross weights of 60,000 pounds (27200 kg) or more: Minimum 75% by weight of particles with at least two fractured faces and 85% with at least one fractured face ¹	ASTM D5821
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles with a value of 5:1 ²	ASTM D4791
Bulk density of slag ³	Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)	ASTM C29.

¹ The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

² A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

³ Only required if slag is specified.

26 **b. Fine aggregate.** Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles
 27 produced by crushing stone, slag, or gravel and shall be free from coatings of clay, silt, or other objectionable
 28 matter. Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to
 29 improve the workability of the mix. Fine aggregate material requirements are listed in the table below.

FINE AGGREGATE MATERIAL REQUIREMENTS

Material Test	Requirement	Standard
Liquid limit	25 maximum	ASTM D4318
Plasticity Index	4 maximum	ASTM D4318
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	1.0% maximum	ASTM C142
Sand equivalent	45 minimum	ASTM D2419
Natural Sand	0 to 15% maximum by weight of total aggregate	ASTM D1073

32 **c. Sampling.** ASTM D75 shall be used in sampling coarse and fine aggregate, and ASTM C183 shall be used
 33 in sampling mineral filler.
 34

35 **403-2.2 MINERAL FILLER.** Mineral filler (baghouse fines) may be added in addition to material naturally
 36 present in the aggregate. Mineral filler shall meet the requirements of ASTM D242.
 37

MINERAL FILLER REQUIREMENTS

Material Test	Requirement	Standard
Plasticity Index	4 maximum	ASTM D4318

41 **403-2.3 ASPHALT BINDER.** Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) 64-
 42 22.
 43
 44

ASPHALT BINDER PG PLUS TEST REQUIREMENTS

Material Test	Requirement	Standard
Elastic Recovery	75% minimum	ASTM D6084 ¹

47 ¹ Follow procedure B on RTFO aged binder.
 48
 49

50
51 **403-2.4 ANTI-STRIPPING AGENT.** Any anti-stripping agent or additive (anti-strip) shall be heat stable
52 and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material
53 of the Department of Transportation of the State in which the project is located.
54

55 **COMPOSITION**

56 **403-3.1 COMPOSITION OF MIXTURE.** The asphalt plant mix shall be composed of a mixture of well-
57 graded aggregate, filler and anti-strip agent if required, and asphalt binder. The several aggregate fractions
58 shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture
59 meets the grading requirements of the job mix formula (JMF).
60

61 **403-3.2 JOB MIX FORMULA (JMF) LABORATORY.** The laboratory used to develop the JMF shall
62 possess a current certificate of accreditation, listing D3666 from a national accrediting authority and all test
63 methods required for developing the JMF, and listed on the accrediting authority's website. A copy of the
64 laboratory's current accreditation and accredited test methods shall be submitted to the DEN Project
65 Manager prior to start of construction.
66

67 **403-3.3 JOB MIX FORMULA (JMF).** No asphalt mixture shall be placed until an acceptable mix design
68 has been submitted to the DEN Project Manager for review and accepted in writing. The DEN Project
69 Manager's review shall not relieve the Contractor of the responsibility to select and proportion the materials
70 to comply with this section.
71

72 When the project requires asphalt mixtures of differing aggregate gradations and/or binders, a separate JMF
73 shall be submitted for each mix. Add anti-stripping agent to meet tensile strength requirements.
74

75 The JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 403-3.2.
76 The asphalt mixture shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design
77 Manual, 7th Edition. Samples shall be prepared and compacted using the gyratory compactor in accordance
78 with ASTM D6925.
79

80 Should a change in sources of materials be made, a new JMF must be submitted to the DEN Project Manager
81 for review and accepted in writing before the new material is used. After the initial production JMF has been
82 approved by the DEN Project Manager and a new or modified JMF is required for whatever reason, the
83 subsequent cost of the new or modified JMF, including a new control strip when required by the DEN
84 Project Manager, will be borne by the Contractor.
85

86 The DEN Project Manager may request samples at any time for testing, prior to and during production, to
87 verify the quality of the materials and to ensure conformance with the applicable specifications.
88

89 The JMF shall be submitted in writing by the Contractor at least 30 days prior to the start of paving
90 operations. The JMF shall be developed within the same construction season using aggregates proposed for
91 project use.
92

93 The submitted JMF shall be dated, and stamped or sealed by the responsible professional Engineer of the
94 laboratory and shall include the following items as a minimum:

- 95 • Manufacturer's Certificate of Analysis (COA) for the asphalt binder used in the JMF in accordance
96 with paragraph 403-2.3. Certificate of asphalt performance grade is with modifier already added, if

- 97 used and must indicate compliance with ASTM D6373. For plant modified asphalt binder, certified
98 test report indicating grade certification of modified asphalt binder.
- 99 • Manufacturer's Certificate of Analysis (COA) for the anti-stripping agent if used in the JMF in
100 accordance with paragraph 403-2.4.
- 101 • Certified material test reports for the course and fine aggregate and mineral filler in accordance with
102 paragraphs 403-2.1 and 403-2.2.
- 103 • Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin;
104 percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the
105 JMF.
- 106 • Specific Gravity and absorption of each course and fine aggregate.
- 107 • Percent natural sand.
- 108 • Percent fractured faces.
- 109 • Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
- 110 • Percent of asphalt.
- 111 • Number of blows or gyrations.
- 112 • Laboratory mixing and compaction temperatures.
- 113 • Supplier recommended mixing and compaction temperatures.
- 114 • Plot of the combined gradation on the 0.45 power gradation curve.
- 115 • Graphical plots of air voids, voids in the mineral aggregate (VMA), and unit weight versus asphalt
116 content. To achieve minimum VMA during production, the mix design needs to account for
117 material breakdown during production.
- 118 • Tensile Strength Ratio (TSR).
- 119 • Type and amount of Anti-strip agent when used.
- 120 • Asphalt Pavement Analyzer (APA) results.
- 121 • Date the JMF was developed. Mix designs that are not dated or which are from a prior construction
122 season shall not be accepted.

123

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TABLE 1. ASPHALT DESIGN CRITERIA

Test Property	Value	Test Method
Number of blows/gyrations	75	
Air voids (%)	3.5	ASTM D3203
Percent voids in mineral aggregate (VMA), minimum	See Table 2	ASTM D6995
TSR ¹	not less than 80 at a saturation of 70-80%	ASTM D4867

128 1

129 1 Test specimens for TSR shall be compacted at 7 ± 1.0 % air voids. In areas subject to freeze-thaw, use
 130 freeze-thaw conditioning in lieu of moisture conditioning per ASTM D4867.

131 2 AASHTO T340 at 100 psi hose pressure at 64°C test temperature may be used in the interim. If this
 132 method is used the required Value shall be less than 5 mm @ 8000 passes

133 3 Where APA not available, use Hamburg wheel test (AASHTO T 324) 10 mm@ 20,000 passes at 50°C.

134 The mineral aggregate shall be of such size that the percentage composition by weight, as determined by
 135 laboratory sieves, will conform to the gradation or gradations specified in Table 2 when tested in accordance
 136 with ASTM C136 and ASTM C117.

137 The gradations in Table 2 represent the limits that shall determine the suitability of aggregate for use from the
 138 sources of supply, be well graded from coarse to fine and shall not vary from the low limit on one sieve to the
 139 high limit on the adjacent sieve, or vice versa.

140 **TABLE 2. AGGREGATE - ASPHALT PAVEMENTS**

141

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25.0 mm)	--
3/4 inch (19.0 mm)	100
1/2 inch (12.5 mm)	90-100
3/8 inch (9.5 mm)	72-88
No. 4 (4.75 mm)	53-73
No. 8 (2.36 mm)	38-60
No. 16 (1.18 mm)	26-48
No. 30 (600 µm)	18-38
No. 50 (300 µm)	11-27
No. 100 (150 µm)	6-18
No. 200 (75 µm)	3-6
Voids in Mineral Aggregate (VMA)¹	15
Asphalt Percent:	
Stone or gravel	5.0-7.5
Slag	6.5-9.5
Recommended Minimum Construction Lift Thickness	

142 ¹To achieve minimum VMA during production, the mix design needs to account for material
 143 breakdown during production.

144
145 The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing
146 the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the
147 Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

149
150 **403-3.4 RECLAIMED ASPHALT PAVEMENT (RAP).** RAP shall not be used.

151
152 **403-3.5 CONTROL STRIP.** Full production shall not begin until an acceptable control strip has been
153 constructed and accepted in writing by the DEN Project Manager. The Contractor shall prepare and place a
154 quantity of asphalt according to the JMF. The underlying grade or pavement structure upon which the
155 control strip is to be constructed shall be the same as the remainder of the course represented by the control
156 strip.

157 The Contractor will not be allowed to place the control strip until the Contractor quality control program
158 (CQCP), showing conformance with the requirements of paragraph 403-5.1, has been accepted, in writing, by
159 the DEN Project Manager.

160 The control strip will consist of at least 250 tons (227 metric tons) or 1/2 subplot, whichever is greater. The
161 control strip shall be placed in two lanes of the same width and depth to be used in production with a
162 longitudinal cold joint. The cold joint must be cut back in accordance with paragraph 403-4.13 using the
163 same procedure that will be used during production. The cold joint for the control strip will be an exposed
164 construction joint at least four (4) hours old or when the mat has cooled to less than 160°F (71°C). The
165 equipment used in construction of the control strip shall be the same type, configuration and weight to be
166 used on the project.

167 The control strip shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in
168 paragraph 403-6.1 and 403-6.2.

169 The control strip will be considered acceptable by the DEN Project Manager if the gradation, asphalt content,
170 and VMA are within the action limits specified in paragraph 403-5.5a; and Mat density greater than or equal
171 to 94%, air voids 3.5% +/- 1%, and joint density greater than or equal to 92%.

172 If the control strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures,
173 and/or rolling procedures shall be made and another control strip shall be placed. Unacceptable control strips
174 shall be removed at the Contractor's expense.

175 The control strip will be considered one lot for payment based upon the average of a minimum of 3
176 samples(no sublots required for control strip). Payment will only be made for an acceptable control strip in
177 accordance with paragraph 403-8.1.

178 CONSTRUCTION METHODS

179
180 **403-4.1 WEATHER LIMITATIONS.** The asphalt shall not be placed upon a wet surface or when the
181 surface temperature of the underlying course is less than specified in Table 4. The temperature requirements
182 may be waived by the DEN Project Manager, if requested; however, all other requirements including
183 compaction shall be met.

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TABLE 4. SURFACE TEMPERATURE LIMITATIONS OF UNDERLYING COURSE

Mat Thickness	Base Temperature (Minimum)	
	Degrees F	Degrees C
3 inches (7.5 cm) or greater	40	4
Greater than 2 inches (50 mm) but less than 3 inches (7.5 cm)	45	7

188

189

190 **403-4.2 ASPHALT PLANT.** Plants used for the preparation of asphalt shall conform to the requirements
 191 of American Association of State Highway and Transportation Officials (AASHTO) M156 including the
 192 following items:

193 **a. Inspection of plant.** The DEN Project Manager, or DEN Project Manager's authorized
 194 representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment;
 195 inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the
 196 temperatures maintained in the preparation of the mixtures.

197 **b. Storage bins and surge bins.** The asphalt mixture stored in storage and/or surge bins shall meet the
 198 same requirements as asphalt mixture loaded directly into trucks. Asphalt mixture shall not be stored in
 199 storage and/or surge bins for a period greater than twelve (12) hours. If the DEN Project Manager
 200 determines there is an excessive heat loss, segregation or oxidation of the asphalt mixture due to temporary
 201 storage, temporary storage shall not be allowed.

202

203 **403-4.3 AGGREGATE STOCKPILE MANAGEMENT.** Aggregate stockpiles shall be constructed in
 204 such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different
 205 sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have
 206 become segregated or mixed with earth or foreign material shall not be used.
 207 A continuous supply of materials shall be provided to the work to ensure continuous placement.

208

209 **403-4.4 HAULING EQUIPMENT.** Trucks used for hauling asphalt shall have tight, clean, and smooth
 210 metal beds. To prevent the asphalt from sticking to the truck beds, the truck beds shall be lightly coated with
 211 a minimum amount of paraffin oil, lime solution, or other material approved by the DEN Project Manager.
 212 Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect
 213 the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at
 214 the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

215

216 **403-4.4.1 MATERIAL TRANSFER VEHICLE (MTV).** A material transfer vehicle is not required.

217

218 **403-4.5 ASPHALT PAVERS.** Asphalt pavers shall be self-propelled with an activated heated screed,
 219 capable of spreading and finishing courses of asphalt that will meet the specified thickness, smoothness, and
 220 grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely
 221 affecting the finished surface. The asphalt paver shall be equipped with a control system capable of
 222 automatically maintaining the specified screed grade and elevation.

223 If the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes
 224 in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment
 225 shall be discontinued.

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The paver shall be capable of paving to a minimum width specified in paragraph 401-4.11.

403-4.6 ROLLERS. The number, type, and weight of rollers shall be sufficient to compact the asphalt to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, capable of operating at slow speeds to avoid displacement of the asphalt. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

403-4.6.1 DENSITY DEVICE. The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall also supply a qualified technician during all paving operations to calibrate the density gauge and obtain accurate density readings for all new asphalt. These densities shall be supplied to the DEN Project Manager upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

403-4.7 PREPARATION OF ASPHALT BINDER. The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of the unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325°F (160°C) when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F (175°C) when added to the aggregate.

403-4.8 PREPARATION OF MINERAL AGGREGATE. The aggregate for the asphalt shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F (175°C) when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

403-4.9 PREPARATION OF ASPHALT MIXTURE. The aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt upon discharge shall not exceed 0.5%.

403-4.10 APPLICATION OF PRIME AND TACK COAT. Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris.

274 A tack coat shall be applied in accordance with Item P-603 to all vertical and horizontal asphalt and concrete
275 surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

276
277 **403-4.11 LAYDOWN PLAN, TRANSPORTING, PLACING, AND FINISHING.** Prior to the
278 placement of the asphalt, the Contractor shall prepare a laydown plan with the sequence of paving lanes and
279 width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and
280 estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The
281 laydown plan and any modifications shall be approved by the DEN Project Manager.

282
283 Deliveries shall be scheduled so that placing and compacting of asphalt is uniform with minimum stopping
284 and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has
285 been compacted, as specified, and allowed to cool to approximately ambient temperature. The Contractor, at
286 their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.
287 Contractor shall survey each lift of asphalt surface course and certify to DEN Project Manager that every lot
288 of each lift meets the grade tolerances of paragraph 401-6.2e before the next lift can be placed.

289
290 Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and
291 laitance removed. Apply a tack coat in accordance with P-603 before new asphalt material is placed against it.
292 The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the
293 asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one way
294 slope unless shown otherwise on the laydown plan as accepted by the DEN Project Manager. The asphalt
295 mix shall be placed in consecutive adjacent lanes having a minimum width of 5 feet except where edge lanes
296 require less width to complete the area. Additional screed sections attached to widen the paver to meet the
297 minimum lane width requirements must include additional auger sections to move the asphalt mixture
298 uniformly along the screed extension.

299
300 The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at
301 least 1 foot (30 cm); however, the joint in the surface top course shall be at the centerline of crowned
302 pavements. Transverse joints in one course shall be offset by at least 10 feet (3 m) from transverse joints in
303 the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet (3 m). On areas
304 where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment
305 impractical, the asphalt may be spread and luted by hand tools.

306
307 The DEN Project Manager may at any time, reject any batch of asphalt, on the truck or placed in the mat,
308 which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or
309 overheated asphalt mixture. Such rejection may be based on only visual inspection or temperature
310 measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected
311 material in the presence of the DEN Project Manager, and if it can be demonstrated in the laboratory, in the
312 presence of the DEN Project Manager, that such material was erroneously rejected, payment will be made for
313 the material at the contract unit price.

314
315 Areas of segregation in the surface course, as determined by the DEN Project Manager, shall be removed and
316 replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the
317 construction lift thickness as specified in paragraph 401-3.3, Table 2 for the approved mix design. The area
318 to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet (3 m) long.

319
320 **403-4.12 COMPACTION OF ASPHALT MIXTURE.** After placing, the asphalt mixture shall be
321 thoroughly and uniformly compacted by self-propelled rollers. The surface shall be compacted as soon as
322 possible when the asphalt has attained sufficient stability so that the rolling does not cause undue
323 displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at

324 the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid
325 displacement of the hot mixture and be effective in compaction. Any surface defects and/or displacement
326 occurring as a result of the roller, or from any other cause, shall be corrected at the Contractor's expense.
327 Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface
328 is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent
329 adhesion of the asphalt to the roller, the wheels shall be equipped with a scraper and kept moistened with
330 water as necessary.

331
332 In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power
333 tampers.

334
335 Any asphalt that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective
336 shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the
337 surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

338
339 **403-4.13 JOINTS.** The formation of all joints shall be made in such a manner as to ensure a continuous
340 bond between the courses and obtain the required density. All joints shall have the same texture as other
341 sections of the course and meet the requirements for smoothness and grade.

342
343 The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a
344 transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead
345 or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to
346 expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated
347 with an asphalt tack coat before placing any fresh asphalt against the joint.

348
349 Longitudinal joints which are have been left exposed for more than four (4) hours; the surface temperature
350 has cooled to less than 175°F (80°C); or are irregular, damaged, uncompacted or otherwise defective shall be
351 cut back with a cutting wheel or pavement saw a maximum of 3 inches (75 mm) to expose a clean, sound,
352 uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from
353 cutting joints shall be removed from the project. An asphalt tack coat or other product approved by the DEN
354 Project Manager shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the
355 joint. The cost of this work shall be considered incidental to the cost of the asphalt.

356
357 **403-4.14 SAW-CUT GROOVING.** Saw-cut grooves shall be provided as specified in Item P-621.

358
359 **403-4.15 DIAMOND GRINDING.** Diamond grinding shall be completed prior to pavement grooving.
360 Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond
361 abrasive.

362
363 Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of
364 cutting a path at least 3 feet (0.9 m) wide. The saw blades shall be 1/8-inch (3-mm) wide with a minimum of
365 55 to 60 blades per 12 inches (300 mm) of cutting head width; grooves between 0.090 and 0.130 inches (2
366 and 3.5 mm) wide; and peaks and ridges approximately 1/32 inch (1 mm) higher than the bottom of the
367 grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness
368 of the aggregate. Equipment or grinding procedures that causes ravels, aggregate fractures, spalls or
369 disturbance to the pavement will not be permitted.

370
371 Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The
372 slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean

373 condition. The Contractor shall apply a surface treatment per P-608 to all areas that have been subject to
374 grinding.

375
376 **403-4.16 NIGHTTIME PAVING REQUIREMENTS.** The Contractor shall provide adequate lighting
377 during any nighttime construction. A lighting plan shall be submitted by the Contractor and approved by the
378 DEN Project Manager prior to the start of any nighttime work. All work shall be in accordance with the
379 approved CSPP and lighting plan.

380 **CONTRACTOR QUALITY CONTROL (CQC)**

381 **403-5.1 GENERAL.** The Contractor shall develop a CQCP in accordance with Item C-100. No partial
382 payment will be made for materials that are subject to specific QC requirements without an approved CQCP.

383
384 **403-5.2 CONTRACTOR QUALITY CONTROL (QC) FACILITIES.** The Contractor shall provide or
385 contract for testing facilities in accordance with Item C-100. The DEN Project Manager shall be permitted
386 unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The DEN Project
387 Manager will advise the Contractor in writing of any noted deficiencies concerning the QC facility,
388 equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be
389 adversely affecting the test results, the incorporation of the materials into the work shall be suspended
390 immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

391
392 **403-5.3 QUALITY CONTROL (QC) TESTING.** The Contractor shall perform all QC tests necessary to
393 control the production and construction processes applicable to these specifications and as set forth in the
394 approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of
395 asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface
396 smoothness. A QC Testing Plan shall be developed as part of the CQCP.

397 **a. Asphalt content.** A minimum of two tests shall be performed per day in accordance with ASTM
398 D6307 or ASTM D2172 for determination of asphalt content. When using ASTM D6307, the correction
399 factor shall be determined as part of the first test performed at the beginning of plant production; and as part
400 of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the
401 test results.

402 **b. Gradation.** Aggregate gradations shall be determined a minimum of twice per lot from mechanical
403 analysis of extracted aggregate in accordance with ASTM D5444 and ASTM C136, and ASTM C117.

404 **c. Moisture content of aggregate.** The moisture content of aggregate used for production shall be
405 determined a minimum of once per lot in accordance with ASTM C566.

406 **d. Moisture content of asphalt.** The moisture content of the asphalt shall be determined once per lot in
407 accordance with AASHTO T329 or ASTM D1461.

408 **e. Temperatures.** Temperatures shall be checked, at least four times per lot, at necessary locations to
409 determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and
410 the asphalt at the job site.

411 **f. In-place density monitoring.** The Contractor shall conduct any necessary testing to ensure that the
412 specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in
413 accordance with ASTM D2950.

414 **g. Smoothness for Contractor Quality Control.**

415 The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify
416 that the construction processes are producing pavement with variances less than 1/4 inch in 12 feet, identifying
417 areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met,
418 appropriate changes and corrections to the construction process shall be made by the Contractor before
419 construction continues

420 The Contractor may use a 12-foot (3.7 m) “straightedge, a rolling inclinometer meeting the requirements
421 of ASTM E2133 or rolling external reference device that can simulate a 12-foot (3.7m) straightedge approved
422 by the DEN Project Manager. Straight-edge testing shall start with one-half the length of the straightedge at
423 the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for
424 each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be
425 determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to
426 rest upon the two highest spots covered by its length, and measuring the maximum gap between the
427 straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or
428 external reference device is used, the data may be evaluated using the FAA profile program, ProFAA or
429 FHWA ProVal, using the 12-foot straightedge simulation function.

430 Smoothness readings shall not be made across grade changes or cross slope transitions. The transition
431 between new and existing pavement shall be evaluated separately for conformance with the plans.

432 **(1) Transverse measurements.** Transverse measurements shall be taken for each day’s production
433 placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet (15 m)
434 or more often as determined by the DEN Project Manager. The joint between lanes shall be tested separately
435 to facilitate smoothness between lanes.

436 **(2) Longitudinal measurements.** Longitudinal measurements shall be taken for each day’s
437 production placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes
438 when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths
439 of paving lanes are 20 ft (6 m) or greater. When placement abuts previously placed material the first
440 measurement shall start with one half the length of the straight edge on the previously placed material.

441 Deviations on the final surface course in either the transverse or longitudinal direction that will trap
442 water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph 403-4.15 or by
443 removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide
444 smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed
445 shall be subject to the final pavement thickness tolerances specified in paragraph 401-6.1d(3) Areas that have
446 been ground shall be sealed with a surface treatment in accordance with Item P-608. To avoid the surface
447 treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

448 Control charts shall be kept to show area of each day’s placement and the percentage of corrective
449 grinding required. Corrections to production and placement shall be initiated when corrective grinding is
450 required. If the Contractor’s machines and/or methods produce significant areas that need corrective actions
451 in excess of 10 percent of a day’s production, production shall be stopped until corrective measures are
452 implemented by the Contractor.

453 **h. Grade.** Grade shall be evaluated daily to allow adjustments to paving operations when grade
454 measurements do not meet specifications. As a minimum, grade shall be evaluated prior to the placement of
455 the first lift and then prior to and after placement of the surface lift.

456 Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane)
457 and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not
458 vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm)

459 vertically and 0.1 feet (30 mm) laterally. The documentation will be provided by the Contractor to the DEN
 460 Project Manager within 24 hours by the end of the following working day .

461 Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the
 462 surface must be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm)
 463 less than the thickness specified on the plans. Grinding shall be in accordance with paragraph 403-4.15.

464 The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of
 465 deficient areas to the depth of the final course plus 1/2 inch and replacing with new material. Skin patching is
 466 not allowed.

467 **403-5.4 SAMPLING.** When directed by the DEN Project Manager, the Contractor shall sample and test any
 468 material that appears inconsistent with similar material being sampled, unless such material is voluntarily
 469 removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with
 470 standard procedures specified.

471
 472 **403-5.5 CONTROL CHARTS.** The Contractor shall maintain linear control charts both for individual
 473 measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation,
 474 asphalt content, and VMA. The VMA for each day shall be calculated and monitored by the QC laboratory.
 475 Control charts shall be posted in a location satisfactory to the DEN Project Manager and kept current. As a
 476 minimum, the control charts shall identify the project number, the contract item number, the test number,
 477 each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's
 478 test results. The Contractor shall use the control charts as part of a process control system for identifying
 479 potential problems and assignable causes before they occur. If the Contractor's projected data during
 480 production indicates a problem and the Contractor is not taking satisfactory corrective action, the DEN
 481 Project Manager may suspend production or acceptance of the material.

482 **a. Individual measurements.** Control charts for individual measurements shall be established to
 483 maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control
 484 charts shall use the JMF target values as indicators of central tendency for the following test parameters with
 485 associated Action and Suspension Limits:

486 **CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS**

Sieve	Action Limit	Suspension Limit
3/4 inch (19.0 mm)	±6%	±9%
1/2 inch (12.5 mm)	±6%	±9%
3/8 inch (9.5 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (300 µm)	±3%	±4.5%
No. 200 (75 µm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
Minimum VMA	-0.5%	-1.0%

487

488 **b. Range.** Control charts for range shall be established to control process variability for the test
 489 parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference
 490 between the two test results for each control parameter. The Suspension Limits specified below are based on
 491 a sample size of $n = 2$. Should the Contractor elect to perform more than two tests per lot, the Suspension
 492 Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for $n = 3$ and by 1.27 for $n = 4$.

493 **CONTROL CHART LIMITS BASED ON RANGE**
 494 **(N = 2)**

Sieve	Suspension Limit
1/2 inch (12.5 mm)	11%
3/8 inch (9.5 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (300 μ m)	6%
No. 200 (75 μ m)	3.5%
Asphalt Content	0.8%

495

496 **c. Corrective action.** The CQCP shall indicate that appropriate action shall be taken when the process is
 497 believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control
 498 and detail what action will be taken to bring the process into control. As a minimum, a process shall be
 499 deemed out of control and production stopped and corrective action taken, if:

- 500 (1) One point falls outside the Suspension Limit line for individual measurements or range; or
 501 (2) Two points in a row fall outside the Action Limit line for individual measurements.

502

503 **403-5.6 QUALITY CONTROL (QC) REPORTS.** The Contractor shall maintain records and shall submit
 504 reports of QC activities daily, in accordance with the CQCP described in Item C-100.

505

MATERIAL ACCEPTANCE

506

507 **403-6.1. QUALITY ASSURANCE ACCEPTANCE SAMPLING AND TESTING.** Unless otherwise
 508 specified, all acceptance sampling and testing necessary to determine conformance with the requirements
 509 specified in this section will be performed by the DEN Project Manager at no cost to the Contractor except
 510 that coring as required in this section shall be completed and paid for by the Contractor.

511 **a. Quality Assurance (QA) testing laboratory.** The QA testing laboratory performing these
 512 acceptance tests will be accredited in accordance with ASTM D3666. The QA laboratory accreditation will be
 513 current and listed on the accrediting authority's website. All test methods required for acceptance sampling
 514 and testing will be listed on the lab accreditation.

515 **b. Lot Size.** A standard lot will be equal to one day's production divided into approximately equal
 516 sublots of between 400 to 600 tons. When only one or two sublots are produced in a day's production, the
 517 sublots will be combined with the production lot from the previous or next day.

518 Where more than one plant is simultaneously producing asphalt for the job, the lot sizes will apply
519 separately for each plant.

520 **c. Asphalt air voids.** Plant-produced asphalt will be tested for air voids on a subplot basis.

521 **(1) Sampling.** Material from each subplot shall be sampled in accordance with ASTM D3665.
522 Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with
523 ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for not less
524 than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature
525 as specified in the JMF.

526 **(2) Testing.** Air voids will be determined for each subplot in accordance with ASTM D3203 for a set
527 of compacted specimens prepared in accordance with ASTM D6925.

528 **d. In-place asphalt mat and joint density.** Each subplot will be tested for in-place mat and joint density
529 as a percentage of the theoretical maximum density (TMD).

530 **(1) Sampling.** The Contractor will cut minimum 5 inches (125 mm) diameter samples in accordance
531 with ASTM D5361. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the
532 cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and
533 core holes shall be filled within one day after sampling in a manner acceptable to the DEN Project Manager.

534 **(2) Bond.** Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the
535 surface is not bonded, additional cores shall be taken as directed by the DEN Project Manager to determine
536 the extent of unbonded areas. Unbonded areas shall be removed by milling and replaced at no additional cost
537 as directed by the DEN Project Manager.

538 **(3) Thickness.** Thickness of each lift of surface course will be evaluated by the DEN Project
539 Manager for compliance to the requirements shown on the plans after any necessary corrections for grade.
540 Measurements of thickness will be made using the cores extracted for each subplot for density measurement.
541 The maximum allowable deficiency at any point will not be more than 1/4 inch (6 mm) less than the
542 thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated
543 thickness. Where the thickness tolerances are not met, the lot or subplot shall be corrected by the Contractor
544 at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his
545 expense, may take additional cores as approved by the DEN Project Manager to circumscribe the deficient
546 area.

547 **(4) Mat density.** One core shall be taken from each subplot. Core locations will be determined by the
548 DEN Project Manager in accordance with ASTM D3665. Cores for mat density shall not be taken closer than
549 one foot (30 cm) from a transverse or longitudinal joint. The bulk specific gravity of each cored sample will
550 be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be
551 determined by dividing the bulk specific gravity of each subplot sample by the TMD for that subplot.

552 **(5) Joint density.** One core centered over the longitudinal joint shall be taken for each subplot which
553 contains a longitudinal joint. Core locations will be determined by the DEN Project Manager in accordance
554 with ASTM D3665. The bulk specific gravity of each core sample will be determined in accordance with
555 ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk
556 specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the
557 joint density at joints formed between lots will be the lower of the average TMD values from the adjacent
558 lots.

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562 **403-6.2 Acceptance criteria.**

563 **a. General.** Acceptance will be based on the implementation of the Contractor Quality Control Program
564 (CQCP) and the following characteristics of the asphalt and completed pavements: air voids, mat density,
565 joint density, grade.

566 **b. Air voids.** Acceptance of each lot of plant produced material for air voids will be based upon the
567 average air void from the sublots. If the average air voids of the lot are equal to or greater than 2% and equal
568 to or less than 5%, then the lot will be acceptable. If the average is below 2% or greater than 5%, the lot shall
569 be removed and replaced at the Contractor's expense.

570 **c. Mat density.** Acceptance of each lot of plant produced material for mat density will be based on the
571 average of all of the densities taken from the sublots. If the average mat density of the lot so established
572 equals or exceeds 94%, the lot will be acceptable. If the average mat density of the lot is below 94%, the lot
573 shall be removed and replaced at the Contractor's expense.

574 **d. Joint density.** Acceptance of each lot of plant produced asphalt for joint density will be based on the
575 average of all of the joint densities taken from the sublots. If the average joint density of the lot so established
576 equals or exceeds 92%, the lot will be acceptable. If the average joint density of the lot is less than 92%, the
577 Contractor shall stop production and evaluate the method of compacting joints. Production may resume once
578 the reason for poor compaction has been determined and appropriate measures have been taken to ensure
579 proper compaction.

580 **e. Grade.** The final finished surface of the pavement of the completed project shall be surveyed to verify
581 that the grade elevations and cross-sections shown on the plans do not deviate more than 1/2 inch (12 mm)
582 vertically or 0.1 feet (30 mm) laterally.

583 Cross-sections of the pavement shall be taken at a minimum 50-foot (15-m) longitudinal spacing and at all
584 longitudinal grade breaks. Minimum cross-section grade points shall include grade at centerline and edge of
585 runway and taxiway pavement.

586 The survey and documentation shall be stamped and signed by a licensed surveyor. Payment for
587 sublots that do not meet grade for over 25% of the subplot shall not be more than 95%.

588 **403-6.3 RESAMPLING PAVEMENT FOR MAT DENSITY.**

589 **a. General.** Resampling of a lot of pavement will only be allowed for mat density and then, only if the
590 Contractor requests same in writing, within 48 hours after receiving the written test results from the DEN
591 Project Manager. A retest will consist of all the sampling and testing procedures contained in paragraphs 403-
592 6.1. Only one resampling per lot will be permitted.

593 **(1)** A redefined mat density will be calculated for the resampled lot. The number of tests used to
594 calculate the redefined mat density will include the initial tests made for that lot plus the retests.

595 **(2)** The cost for resampling and retesting shall be borne by the Contractor.

596 **b. Payment for resampled lots.** The redefined mat density for a resampled lot will be used to evaluate
597 the acceptance of that lot in accordance with paragraph 403-6.2.

598 **c. Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers
599 will be discarded and density determined using the remaining test values.

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METHOD OF MEASUREMENT

403-7.1 MEASUREMENT. Plant mix asphalt mix pavement shall be measured by the number of tons (kg) of asphalt pavement used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

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BASIS OF PAYMENT

403-8.1 PAYMENT. Payment for a lot of asphalt mixture meeting all acceptance criteria as specified in paragraph 403-6.2 shall be made at the contract unit price per ton (kg) for asphalt. The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

612 Payment will be made under:

613 Item P-403a Bituminous Surface Course - per ton
 614 Item P-403b Bituminous Base Course – per ton

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616

QUALITY CONTROL TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Asphalt Content P-403-5.3a	¹ ASTM D6307 or ASTM D2172	Action Limit $\pm 0.45\%$ Suspension Limit $\pm 0.70\%$	Daily	2 test per day
Gradation P-403-5.3b	ASTM D5444 and ASTM C136, and ASTM C117.	Paragraph 403-5.5a Control Chart Limits for Individual Measurement Table	Daily	minimum of twice per lot from mechanical analysis of extracted aggregate
Moisture content of aggregate P-403-5.3c	ASTM C566	—	—	1 per lot
Moisture content of asphalt P-403-5.3d	AASHTO T329 or ASTM D1461	—	—	1 per lot
Temperatures P-402-5.3e	—	—	—	4 times per lot
In-place density monitoring P-403-5.3f	ASTM D2950	—	—	As needed for QC monitoring
Smoothness (1) Transverse measurements	12-foot straightedge	1/4 inch (final surface)	for each day's production placed	Transverse measurements will be taken

P-403-5.3g				perpendicular to the pavement centerline each 50 feet or more often as determined by the DEN Project Manager
Smoothness (2) Longitudinal measurements P-403-5.3g	12-foot straightedge	1/4 inch (final surface)	for each day's production placed	Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 ft or greater.
Grade P-403-5.3h	Survey	1/2 inch vertically and 0.1 feet laterally	The documentation will be provided by the Contractor to the DEN Project Manager within 24 hours by the end of the following working day	Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans

617 1 When using ASTM D6307, the correction factor shall be determined as part of the first test performed at the beginning of plant
 618 production; and as part of every tenth test performed thereafter.

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629 **QUALITY ASSURANCE SAMPLING AND TESTING**

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Air Voids P-403-6.2b	ASTM D3203 ASTM D6925	greater than 2% and equal to or less than 5%, then the lot will be acceptable.	Next following workday	1 per sub lot
Mat Density P-403-6.2c	ASTM D2726	Mat density will be based on the average of all of the densities taken from the sublots. If the average mat density of the lot so established equals or exceeds 94%, the lot will be acceptable.	Next following workday	1 per sub lot
Joint Density P-403-6.2d	ASTM D2726	If the average joint density of the lot so established equals or exceeds 92%, the lot will be acceptable	Next following workday	1 per subplot
Grade P-403-6.2e	Survey	do not deviate more than 1/2 inch vertically or 0.1 feet laterally.	Next following workday	grade elevations and cross-sections shown on the plans

630 * A standard lot will be equal to one day's production divided into approximately equal sublots of between 400 to 600 tons. When only
 631 one or two sublots are produced in a day's production, the sublots will be combined with the production lot from the previous or next
 632 day.
 633

634 **REFERENCES**

635
 636 The publications listed below form a part of this specification to the extent referenced. The publications are
 637 referred to within the text by the basic designation only.

638 ASTM International (ASTM)

639 ASTM C29 Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

640 ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or
 641 Magnesium Sulfate

642 ASTM C117 Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral
 643 Aggregates by Washing

644 ASTM C127 Standard Test Method for Density, Relative Density (Specific Gravity), and
 645 Absorption of Coarse Aggregate

646	ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
647		
648	ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
649	ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
650	ASTM C183	Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
651	ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by
652		Drying
653	ASTM D75	Standard Practice for Sampling Aggregates
654	ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
655	ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in
656		Pavement Construction
657	ASTM D979	Standard Practice for Sampling Bituminous Paving Mixtures
658	ASTM D1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
659	ASTM D1074	Standard Test Method for Compressive Strength of Bituminous Mixtures
660	ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Bituminous Paving
661		Mixtures
662	ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of
663		Bituminous Paving Mixtures
664	ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Bituminous
665		Paving Mixtures
666	ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
667	ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-
668		Aggregate Mixtures
669	ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive
670		Compacted Bituminous Mixtures
671	ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear
672		Methods
673	ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open
674		Bituminous Paving Mixtures
675	ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement
676		Construction

677	ASTM D3665	Standard Practice for Random Sampling of Construction Materials
678 679	ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
680 681	ASTM D4125	Standard Test Methods for Asphalt Content of Bituminous mixtures by the Nuclear Method
682	ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
683	ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
684 685	ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
686	ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
687	ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
688 689	ASTM D5581	Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)
690 691	ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
692	ASTM D6307	Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method
693	ASTM D6373	Standard Specification for Performance Graded Asphalt Binder
694 695	ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
696 697 698	ASTM D6925	Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyratory Compactor
699 700	ASTM D6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
701	ASTM D6927	Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
702 703	ASTM D6995	Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix (Gmm)
704	ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
705	ASTM E178	Standard Practice for Dealing with Outlying Observations
706 707	ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM P-403 ASPHALT MIX PAVEMENT
AC 150/5370-10H

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708	American Association of State Highway and Transportation Officials (AASHTO)	
709	AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
710		
711	AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
712		
713	AASHTO T 340	Standard Method of Test for Determining the Rutting Susceptibility of Hot Mix Asphalt (APA) Using the Asphalt Pavement Analyzer (APA)
714		
715	Asphalt Institute (AI)	
716	MS-2	Mix Design Manual, 7th Edition
717	MS-26	Asphalt Binder Handbook
718		AI State Binder Specification Database
719	FAA Orders	
720	5300.1	Modifications to Agency Airport Design, Construction, and Equipment Standards
721	Federal Highway Administration (FHWA)	
722	Long Term Pavement Performance Binder program	
723	Software	
724	FAARFIELD	

725 **END OF ITEM P-403**

726

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM P-407 ASPHALT TREATED
PERMEABLE BASE COURSE (ATPB)
EB No. 102

DENVER INTERNATIONAL AIRPORT
RUNWAY 17L-35R PAVEMENT REHABILITATION
AND ELECTRICAL UPGRADES PACKAGE 2
CONST. CONTRACT NO. 202473360

ITEM P-407 ASPHALT TREATED PERMEABLE BASE COURSE (ATPB)

DESCRIPTION

407-1.1 This item shall consist of an asphalt treated permeable base composed of mineral aggregate, and asphalt cement mixed in a central mixing plant and placed on a prepare subgrade or subbase course in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross sections shown in the plans.

MATERIALS

407-2.1 Aggregate. The aggregate shall consist of clean, sound, hard, durable, angular particles of crushed gravel or crushed stone and shall meet the gradation requirements of ASTM D448 Size 78, ASTM C33 Size 67, or ASTM C33 Size 57. Fine aggregate shall consist of natural sand or manufactured sand meeting the requirements of ASTM C33. The aggregate shall meet the material requirements in the table below.

Aggregate Material Requirements

Material Test	Requirement	Standard
Coarse Aggregate		
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Fractured Faces	90% by weight of particles with at least 2 fractured faces	ASTM D5821
Flat Particles, Elongated Particles, or Flat and Elongated Particles ¹	10% maximum, by weight, for fraction retained on the 3/8 inch (9.5mm) sieve and 10% maximum, by weight, for the fraction passing the 3/8-inch (9.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate		
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88

¹ A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

407-2.2 Sampling and testing.

a. Aggregate base materials. The Contractor shall take samples of the aggregate base stockpile in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraph 407-2.1. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

30 **407-2.3 Asphalt binder.** Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) 64-22.

31
 32 **407-2.4 Anti-stripping agent.** Any anti-stripping agent or additive (anti-strip) shall be heat stable and
 33 shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material
 34 of the Department of Transportation of the State in which the project is located.

35
 36 **407-2.5 Bond Breaker.** Not Used.

37
 38 **407-2.6 Separation Geotextile.** Separation geotextile shall be Class 2 , 0.05 sec-1 permittivity per ASTM
 39 D4491, Apparent opening size per ASTM D4751 with 0.60 mm maximum average roll value.

40 COMPOSITION OF MIXTURE

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 43
 44 **407-3.1 Mix design.** The Mix Design shall be composed of a mixture of open graded aggregate, a minimum
 45 of 0.5% antistripping agent and asphalt binder. An acceptable mix will have between 2 – 3.5% asphalt, sufficient to
 46 cover 95% of mixture with a shiny black appearance with minimal draindown at 200°F, and will bind the
 47 compacted mix. When the aggregates are blended and mixed with the asphalt cement at 250°F (121°C) and
 48 compacted at 150°F (65°C) with 35 blows of a standard Marshall hammer, the JMF shall have a permeability
 49 of not less than 500 ft/day (150 m/day) nor more than 1,500 ft/day (455 m/day) when tested with constant
 50 head permeability test ASTM D 2434/AASHTO T 215.

51
 52 **407-3.2 Submittals.** At least 30 days prior to the placement of the ATPB, the Contractor shall submit certified
 53 test reports to the DEN Project Manager for those materials proposed for use during construction, as well as
 54 the mix design information for the material. The submittal package shall include the following:

- 55
 56 a. Sources of materials, including aggregate, asphalt binder, additives, and bond-breaking
 57 materials (if used).
 58
 59 b. Physical properties of the aggregates, asphalt binder, antistripping agent and bond-breaking
 60 materials.
 61
 62 c. Percent of asphalt
 63
 64 d. Amount of antistripping agent
 65
 66 e. Permeability of JMF

67
 68 No drainable ATPB material shall be placed until the submittal is accepted in writing by the DEN
 69 Project Manager .

70
 71 During production, the Contractor shall submit batch tickets for each delivered load.

72 CONSTRUCTION METHODS

73
 74
 75
 76 **407-4.1 Control strip.** The contractor shall produce, place and compact a control strip of at least 250 ft (75-
 77 m). The Contractor shall demonstrate, in the presence of the DEN Project Manager , that the materials,
 78 equipment, and construction processes meet the requirements of the specification. Control strips that do not
 79 meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations

80 shall not continue until the control strip has been accepted by the DEN Project Manager . Upon acceptance of
81 the control strip by the DEN Project Manager , the Contractor shall use the same equipment, materials, and
82 construction methods for the remainder of construction, unless adjustments made by the Contractor are
83 approved in advance by the DEN Project Manager .
84

85 When additional effort beyond that provided by the paver is required to seat the aggregate, additional
86 compaction shall not be initiated until mixture has cooled to below 175°F (or lower as determined during
87 construction of the test strip). One to two passes of a self-propelled, steel-wheel static roller with weight
88 between 5 and 12 tons (4.5 to 10.9 metric tons) is usually sufficient. The roller shall be in good condition and
89 shall be capable of reversing without backlash and of compacting the ATPB without undue displacement or
90 excessive crushing of the aggregate. The actual rolling pattern and sequence shall be established during
91 placement of the control strip and approved by the DEN Project Manager . In areas inaccessible to the paver
92 and roller, hand operated vibrator-plate compactors may be used to seat the aggregate.
93

94 The control strip ATPB layer shall be considered acceptable when aggregate is completely coated with asphalt
95 cement with minimal evidence of crushing; the surface is firm, unyielding and stable under construction traffic;
96 and the layer meets the field permeability per paragraph 407-3.1.
97

98 **407-4.2 Weather limitations.** The ATPB material shall not be mixed or placed while the air temperature is
99 below 40°F (4°C). The ATPB shall not be placed on frozen underlying courses or mixed when aggregate is
100 frozen. The ATPB may not be placed when rainfall is occurring or where rain is imminent.
101

102 **407-4.3 Equipment.** All equipment necessary to mix, transport, place, compact, and finish the ATPB material
103 shall be furnished by the Contractor and approved by the DEN Project Manager . The equipment will be
104 inspected by the DEN Project Manager prior to the start of construction operations.
105

106 **407-4.4 Preparation of the underlying course.** The underlying course shall be checked and accepted by the
107 DEN Project Manager before placing operations begin. Prior to placing the material, the final grade should be
108 firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted.
109

110 **407-4.5 Mixing.** The batch plant site, layout, equipment, and provisions for transporting material shall assure
111 a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents
112 segregation and intermixing of deleterious materials. Free access to the plant must be provided to the DEN
113 Project Manager at all times for inspection of the plant's equipment and operation and for sampling the ATPB
114 mixture and its components.
115

116 **407-4.6 Hauling.** The ATPB mixture shall be transported from the plant to the job site in trucks or other
117 hauling equipment having beds that are smooth and clean. Truck bed covers shall be provided to protect the
118 ATPB during transport from rain.
119

120 **407-4.7 Placing.** The ATPB material shall be placed using an asphalt paver. The ATPB shall be installed in a
121 single 7 inch (178 mm lift).
122

123 **407-4.8 Compaction.** The ATPB material shall be compacted using the approved compaction equipment and
124 roller pattern/sequence, as determined in the approved control strip. Sufficient rollers shall be furnished to
125 handle the output of the plant. If the rolling pattern/sequence results in undue displacement of the surface, or
126 causes crushing of the aggregate, work shall be stopped until the cause(s) can be determined and corrections
127 are made. The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary
128 to form a transverse joint.
129

130 **407-4.9 Joints.** The formation of all joints shall be made in such a manner as to ensure a continuous bond
131 between old and new sections of the course. All joints shall present the same texture and smoothness as other
132 sections of the course. Transverse joints shall be formed by placement of a bulkhead or by tapering the mixture.
133 Tapered joints shall be cut back full depth and width creating a vertical joint before placing additional mixture
134 against the joint. Joints which are irregular, damaged shall be cut back to expose a clean, sound surface for full
135 depth of course.
136

137 **407-4.10 Quality Control.** The Contractor shall perform tests for smoothness, grade, gradation and asphalt
138 content daily. Asphalt content and gradation must be within job tolerances or appropriate steps taken to
139 maintain production control within tolerances. Any area not meeting smoothness and grade shall be corrected
140 by the Contractor at the Contractor's expense. The Contractor shall provide gradation, asphalt content,
141 smoothness and grade data to the DEN Project Manager on a daily basis.
142

- 143 a. **Asphalt Content.** Determine asphalt content a minimum of two times per day in accordance with
144 ASTM D6307 or ASTM D2172.
145
- 146 b. **Gradation.** Determine aggregate gradation a minimum of two times per day from mechanical
147 analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136 and ASTM C117.
148
- 149 c. **Smoothness.** The finished surface shall not vary more than $\pm 3/8$ -inch (9 mm) when tested with
150 a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline, and, moved
151 continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of
152 each line on a 25-foot (7-m) grid. The Contractor shall correct any high spots more than $3/8$ inch
153 (9 mm) in 12-foot (3.7-m) with a grinding machine or remove and replace the material at the
154 Contractor's expense. Any areas that have been ground shall have curing compound reapplied.
155
- 156 d. **Grade.** The grade shall be measured on a 25-foot (7-m) longitudinal by 5-foot (1-m) transverse
157 grid and shall be within ± 0.05 feet (15 mm) of the specified grade. When the surface is more
158 than $1/2$ inch (12 mm) above the grade shown in the plans, the surface shall be corrected at the
159 Contractor's expense to an elevation that falls within a tolerance of $1/4$ inch (6 mm).
160

161 **407-4.11 Field Permeability.** One test shall be performed by the Contractor in the presence of the DEN
162 Project Manager for 300 square yards (250 square meters). Test locations will be determined on a random basis
163 in accordance with ASTM D3665. The permeability of the base will be determined in accordance with ASTM
164 C1701. If it can be demonstrated that a 1-gallon container of water will flow through the layer within
165 approximately 1 minute the DEN Project Manager can waive additional permeability testing.
166

167 **407-4.12 Bond breaker.** Prior to placing the overlaying concrete pavement a bond breaker shall be placed on
168 the surface to prevent bonding per 407-2.5.
169

170 **407-4.13 Maintenance.** The completed drainable base shall be maintained by the Contractor in a condition to
171 meet all specification requirements until the pavement has been placed. Placement of the next higher pavement
172 layer shall be made as soon as practicable but no more than thirty (30) calendar days after placement of the
173 drainage layer. The ATPB shall not be opened to traffic until the mixture has cooled to ambient temperature.
174 Traffic on ATPB should be kept to a minimum to avoid rutting or displacement of the ATPB. Limit traffic on
175 ATPB to equipment needed to construct next higher pavement layer.
176
177

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM P-407 ASPHALT TREATED
PERMEABLE BASE COURSE (ATPB)
EB No. 102

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MATERIAL ACCEPTANCE

178
179
180 **407-5.1 Sampling and testing.** All acceptance sampling and testing necessary to determine conformance with
181 the requirements specified in this section will be performed by the DEN Project Manager for each 300 square
182 yards (250 square meters) or one day's production, whichever is less. Sampling locations will be determined by
183 the DEN Project Manager on a random basis per ASTM D3665. The Contractor shall bear the cost of
184 providing curing facilities for the strength specimens.

- 185
186 a. **Thickness.** One core shall be drilled by the Contractor for thickness determination for each 300
187 square yards (250 square meters). Thickness will be determined by measuring the depth of core
188 hole. Thickness may be determined by survey on a 25-foot longitudinal by 5-foot transverse grid
189 if approved by the DEN Project Manager.

METHOD OF MEASUREMENT

192
193
194 **407-6.1 Asphalt Treated Permeable Base (ATPB).** The quantity of ATPB to be paid for shall be the number
195 of square yards (m²) of material placed, and accepted in the completed base course.

196
197 **407-6.2 Geotextile Fabric.** Geotextile fabric used in conjunction with pavement construction shall be
198 measured by the number of square yards in-place based on the areas on the plans or approved by the DEN
199 Project Manager and measured in the field. No allowance will be made for materials in laps, seams, or for waste
200 trimmed.

BASIS OF PAYMENT

201
202
203
204 **407-7.1 Asphalt Treated Permeable Base (ATPB).** Payment will be made at the contract unit price per
205 square yard (m²) for ATPB as measured by DEN Project Manager. This price shall be full compensation for
206 furnishing all materials, for all preparation, mixing, placing, compacting curing and placement of overlaying
207 bond breaker; and for all labor, equipment, tools, and incidentals necessary to complete the item.
208 Payment will be made under:

209
210 **407-7.2 Geotextile Fabric.** Payment shall be made at the contract unit price per square yard for geotextile
211 fabric. The price shall be full compensation for furnishing and placing all material and for all labor, equipment,
212 tools, and incidentals necessary to complete the work prescribed in this item.

213
214 Payment will be made under:

- 215
216 Item P-407a Asphalt Treated Permeable Base 7" - per square yard.
217 Item P-407b Geotextile Fabric – per square yard

TECHNICAL SPECIFICATIONS
 DIVISION 2-AIRFIELD STANDARDS
 ITEM P-407 ASPHALT TREATED
 PERMEABLE BASE COURSE (ATPB)
 EB No. 102

DENVER INTERNATIONAL AIRPORT
 RUNWAY 17L-35R PAVEMENT REHABILITATION
 AND ELECTRICAL UPGRADES PACKAGE 2
 CONST. CONTRACT NO. 202473360

220 **CONTRACTOR QUALITY CONTROL TESTING**

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Aggregate Base Material P-407-2.2	ASTM D75 ASTM D448 Size 78, ASTM C33 Size 67, or ASTM C33 Size 57.	P-4072.1 Aggregate Material Requirement Table	At time of placement	Twice daily
Asphalt Content P-407-4.10.a	ASTM D2172 or ASTM D6307	2.0-3.5 Percent	At time of placement	Twice daily
Gradation P-407- 4.10.b	ASTM D5444, ASTM C136, and ASTM C117		At time of placement	Twice daily
Smoothness	12 foot Straight Edge	±3/8 inch	After ATPB has been compacted	parallel with and at right angles to the centerline
Grade P-407-4.10.d	Survey, 25' by 5' grid	± 0.05 feet of specified grade.	After ATPB has been compacted	As placed

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QUALITY ASSURANCE SAMPLING AND TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Sampling and testing P-407-5.1	ASTM D3665		At time of placement	Every 300 square yards or one days production
Thickness	Coring or Survey at 25' by 5' grid		At time of placement	Every 300 square yards

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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 C33 Standard Specification for Concrete Aggregates

ASTM D75 Standard Practice for Sampling Aggregates

TECHNICAL SPECIFICATIONS
 DIVISION 2-AIRFIELD STANDARDS
 ITEM P-407 ASPHALT TREATED
 PERMEABLE BASE COURSE (ATPB)
 EB No. 102

DENVER INTERNATIONAL AIRPORT
 RUNWAY 17L-35R PAVEMENT REHABILITATION
 AND ELECTRICAL UPGRADES PACKAGE 2
 CONST. CONTRACT NO. 202473360

237	ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
238		
239		
240	ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
241		
242		
243	ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
244		
245	ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
246		
247		
248	ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
249		
250	ASTM D3665	Standard Practice for Random Sampling of Construction Materials
251		
252		ASTM C1701 Standard Test Method for Infiltration Rate
253		of In Place Pervious Concrete American
254		
255		
256		
257	Association of State Highway and Transportation Officials (AASHTO)	
258		
259	M288	Standard Specification for Geosynthetic Specification for Highway Applications
260		
261		
262	T215	Standard Method of Test for Permeability of Granular Soils (Constant Head),
263		
264		
265		

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM P-407 ASPHALT TREATED
PERMEABLE BASE COURSE (ATPB)
EB No. 102

DENVER INTERNATIONAL AIRPORT
RUNWAY 17L-35R PAVEMENT REHABILITATION
AND ELECTRICAL UPGRADES PACKAGE 2
CONST. CONTRACT NO. 202473360

266

****END ITEM P-407****

ITEM P-501 CEMENT CONCRETE PAVEMENT

DESCRIPTION

501-1.1 This work shall consist of pavement composed of cement concrete with reinforcement and without reinforcement constructed on a prepared underlying surface in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross-sections shown on the plans. The terms cement concrete, hydraulic cement concrete, and concrete are interchangeable in this specification.

MATERIALS

501-2.1 AGGREGATES.

- a. **Reactivity.** Fine and Coarse aggregates to be used in PCC on this project shall be tested and evaluated by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Tests must be representative of aggregate sources which will be providing material for production. ASTM C1260 and ASTM C1567 tests may be run concurrently.

(1) Test coarse aggregate and fine aggregate separately, in accordance with ASTM C1260; however, extend the length of the test to 28 days (30 days from casting). Complete the tests within six months of the date of the concrete submittal. If expansion of either the coarse or fine aggregate exceeds 0.10% at 28 days, limit the alkali loading of the concrete to be less than or equal to 3.0 lb per cubic yard (1.8 kg per cubic meter), calculated in accordance with FAA EB 106.

(2) The combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

(3) If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) Concrete Research Division (CRD) C662 in lieu of ASTM C1567. If lithium nitrate admixture is used, it shall be nominal 30% \pm 0.5% weight lithium nitrate in water. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

- b. **Fine aggregate.** Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and the parameters identified in the fine aggregate material requirements below. Fine aggregate material requirements and deleterious limits are shown in the table below.

TECHNICAL SPECIFICATIONS
 DIVISION 2-AIRFIELD STANDARDS
 ITEM P-501 CEMENT CONCRETE PAVEMENT
 AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
 RUNWAY 17L-35R PAVEMENT REHABILITATION
 AND ELECTRICAL UPGRADES PACKAGE 2
 CONST. CONTRACT NO. 202473360

Fine Aggregate Material Requirements		
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Sand Equivalent	45 minimum	ASTM D2419
Fineness Modulus (FM)	$2.50 \leq FM \leq 3.40$	ASTM C136
Limits for Deleterious Substances in Fine Aggregate for Concrete		
Clay lumps and friable particles	1.0% maximum	ASTM C142
Coal and lignite	0.5% using a medium with a density of Sp. Gr. of 2.0	ASTM C123
Total Deleterious Material	1.0% maximum	

49 **c. Coarse aggregate.** The maximum size coarse aggregate shall be 1-1/2-inch.

50 Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of crushed
 51 stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete
 52 pavement, or a combination. The aggregates shall have no known history of detrimental
 53 pavement staining. Steel blast furnace slag shall not be permitted. Coarse aggregate material
 54 requirements and deleterious limits are shown in the table below; washing may be required to
 55 meet aggregate requirements.
 56

57

Coarse Aggregate Material Requirements

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 for any size group coarser than 3/8 (9.5 mm) sieve ¹	ASTM D4791
Bulk density of slag ²	Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)	ASTM C29
D-cracking (Freeze-Thaw) ³	Durability factor \geq 95	ASTM C666

58 ¹ A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one
 59 having a ratio of length to width greater than five (5).

60 ² Only required if slag is specified.

61 ³ Coarse aggregate may only be accepted from sources that have a 20-year service history for the same
 62 gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of
 63 service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking
 64 shall not be used unless the material currently being produced has a durability factor greater than or equal
 65 to 95 per ASTM C666. The Contractor shall submit a current certification and test results to verify the
 66 aggregate acceptability. Test results will only be accepted from a State Department of Transportation
 67 (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated
 68 or which are over one (1) year old or which are for different gradations will not be accepted.
 69

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

72

73 The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

74

75

Limits for Deleterious Substances in Coarse Aggregate

Deleterious material	ASTM	Percentage by Mass
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (75 μm)	ASTM C117	1.0 ¹
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert ² (less than 2.40 Sp Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.40)	0.1 ³

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¹ The limit for material finer than 75-μm is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale. Test results supporting acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Concrete mix. Acceptable techniques to characterizing these fines include methylene blue adsorption or X-ray diffraction analysis.

² Chert and aggregates with less than 2.4 specific gravity.

³ The limit for chert may be increased to 1.0 percent by mass in areas not subject to severe freeze and thaw.

d. Combined aggregate gradation. This specification is targeted for a combined aggregate gradation developed following the guidance presented in United States Air Force Engineering Technical Letter (ETL) 97-5: Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements. Base the aggregate grading upon a combination of all the aggregates (coarse and fine) to be used for the mixture proportioning. Three aggregate sizes may be required to achieve an optimized combined gradation that will produce a workable concrete mixture for its intended use. Use aggregate gradations that produce concrete mixtures with well-graded or optimized aggregate combinations. The Contractor shall submit complete mixture information necessary to calculate the volumetric components of the mixture. The combined aggregate grading shall meet the following requirements:

(1) The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in paragraph 501-2.1d(4) below, the point thus determined shall fall within the parallelogram described therein.

(2) The CF shall be determined from the following equation:

$$CF = \frac{(\text{cumulative percent retained on the } 3/8 \text{ in. (9.5 mm) sieve})(100)}{(\text{cumulative percent retained on the No. 8 (2.36 mm) sieve})}$$

(3) The WF is defined as the percent passing the No. 8 (2.36 mm) sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds (42 kg) of cementitious material per cubic meter yard greater than 564 pounds per cubic yard (335 kg per cubic meter).

111 (4) A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from
 112 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right
 113 side). On this diagram a parallelogram shall be plotted with corners at the following
 114 coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If
 115 the point determined by the intersection of the computed CF and WF does not fall within
 116 the above parallelogram, the grading of each size of aggregate used and the proportions
 117 selected shall be changed as necessary. The point determined by the plotting of the CF and
 118 WF may be adjusted during production ± 3 WF and ± 5 CF. Adjustments to gradation may
 119 not take the point outside of the parallelogram.
 120

121 e. **Contractors combined aggregate gradation.** The Contractor shall submit their combined
 122 aggregate gradation using the following format:
 123
 124

Contractor's Combined Aggregate Gradation

Sieve Size	Contractor's Concrete mix Gradation (Percent passing by weight)
2 inch (50 mm)	*
1-1/2 inch (37.5 mm)	*
1 inch (25.0 mm)	*
3/4 inch (19.0 mm)	*
1/2 inch (12.5 mm)	*
3/8 inch (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (600 μ m)	*
No. 50 (300 μ m)	*
No. 100 (150 μ m)	*

125
 126 **501-2.2 CEMENT.** Cement shall conform to the requirements of ASTM C150 Type I/II or ASTM C595
 127 Type IL(HS)(MH) with less than 0.6% equivalent alkali.
 128

129 **501-2.3 CEMENTITIOUS MATERIALS.**
 130

131 a. **Fly ash.** Fly ash shall meet the requirements of ASTM C618, with the exception of loss of
 132 ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO)
 133 content of less than 15% and a total alkali content less than 3% per ASTM C311. The
 134 Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for
 135 each source of fly ash proposed in the concrete mix, and shall furnish each additional report as
 136 they become available during the project. The reports can be used for acceptance or the material
 137 may be tested independently by the DEN Project Manager.
 138

139 **b. Slag cement (ground granulated blast furnace (GGBF)).** Slag cement shall conform to
140 ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and
141 55% of the total cementitious material by mass.
142

143 **c. Raw or calcined natural pozzolan.** Natural pozzolan shall be raw or calcined and conform to
144 ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in
145 controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6%. Class N
146 pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total available alkali content
147 less than 3%.
148

149 **501-2.4 JOINT SEAL.** The joint seal for the joints in the concrete pavement shall meet the requirements of
150 Item P-604 and Item P-605 and shall be of the type specified in the plans.
151

152 **501-2.5 ISOLATION JOINT FILLER.** Premolded joint filler for isolation joints shall conform to the
153 requirements of ASTM D1751 or ASTM D1752 and shall be where shown on the plans. The filler for each
154 joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise
155 specified by the DEN Project Manager. When the use of more than one piece is required for a joint, the
156 abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening
157 means satisfactory to the DEN Project Manager.
158

159 **501-2.6 STEEL REINFORCEMENT.** Reinforcing shall consist of Deformed and Plain Carbon-Steel Bars
160 conforming to the requirements of ASTM A615, and/or Bar Mats conforming to the requirements of ASTM
161 A184, and/or Welded Wire Fabric conforming to the requirements of ASTM A1064.
162

163 **501-2.7 DOWEL AND TIE BARS.** Dowel bars shall be plain steel bars conforming to ASTM A615 and
164 shall be free from burring or other deformation restricting slippage in the concrete.
165

166 **a. Dowel Bars.** Before delivery to the construction site each dowel bar shall be epoxy coated per
167 ASTM A1078, Type 1, with a coating thickness after curing greater than 10 mils. Patched ends
168 are not required for Type 1 coated dowels. The dowels shall be coated with a bond-breaker
169 recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention
170 rings shall be fully circular metal or plastic devices capable of supporting the dowel until the
171 grout hardens.
172

173 **b. Tie Bars.** Tie bars shall be deformed steel bars and conform to the requirements of ASTM
174 A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for
175 construction requiring bent bars.
176

177 **501-2.8 WATER.** Water used in mixing or curing shall be potable. If water is taken from other sources
178 considered non-potable, it shall meet the requirements of ASTM C1602.
179

180 **501-2.9 MATERIAL FOR CURING CONCRETE.** Curing materials shall conform to one of the
181 following specifications:
182

183 **a.** Liquid membrane-forming compounds for curing concrete shall conform to the requirements of
184 ASTM C309, Type 2, Class A, or Class B.
185

- 225 c. Material for use for injecting cracks shall be Type IV, Grade 1.
226
227 d. Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy
228 resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.
229

230 **501-2.12 BOND BREAKER.** Fabric shall meet the requirements of AASHTO M 288 Class I fabric with
231 elongation not less than 50% at the specified strengths, with a weight not less than 14.5 oz/sy. A certificate
232 of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond
233 breaker.

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236

CONCRETE MIX

237 **501-3.1. GENERAL.** No concrete shall be placed until an acceptable concrete mix has been submitted to
238 the DEN Project Manager for review and the DEN Project Manager has taken appropriate action. The
239 DEN Project Manager's review shall not relieve the Contractor of the responsibility to select and proportion
240 the materials to comply with this section.
241

242 **501-3.2 CONCRETE MIX LABORATORY.** The laboratory used to develop the concrete mix shall be
243 accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the
244 accrediting authority's website. All test methods required for developing the concrete mix must be included
245 in the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be
246 submitted to the DEN Project Manager prior to start of construction.
247

248 **501-3.3 CONCRETE MIX PROPORTIONS.** Develop the mix using the procedures contained in
249 Portland Cement Association (PCA) publication, "Design and Control of Concrete Mixtures." Concrete shall
250 be proportioned to achieve a 28-day flexural strength that meets or exceeds the acceptance criteria contained
251 in paragraph 501-6.6 for a flexural strength of 650 psi per ASTM C78.
252

253 The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum
254 cementitious material (cement plus fly ash, or slag cement) shall be 517 pounds per cubic yard (310 kg per
255 cubic meter). The ratio of water to cementitious material, including free surface moisture on the aggregates
256 but not including moisture absorbed by the aggregates shall be between 0.38 – 0.45 by weight.
257

258 Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance
259 with ASTM C78. At the start of the project, the Contractor shall determine an allowable slump as determined
260 by ASTM C143 not to exceed 2 inches (50 mm) for slip-form placement. For fixed-form placement, the
261 slump shall not exceed 3 inches (75 mm). For hand placement, the slump shall not exceed 4 inches (100
262 mm).
263

264 The results of the concrete mix shall include a statement giving the maximum nominal coarse aggregate size
265 and the weights and volumes of each ingredient proportioned on a one cubic yard (meter) basis. Aggregate
266 quantities shall be based on the mass in a saturated surface dry condition.
267

268 If a change in source(s) is made, or admixtures added or deleted from the mix, a new concrete mix must be
269 submitted to the DEN Project Manager for approval.

270
271 The DEN Project Manager may request samples at any time for testing, prior to and during production, to
272 verify the quality of the materials and to ensure conformance with the applicable specifications.
273

274 **501-3.4 CONCRETE MIX SUBMITTAL.** The concrete mix shall be submitted to the DEN Project
275 Manager at least 30 days prior to the start of operations. The submitted concrete mix shall not be more than
276 180 days old and must use the materials to be used for production for the project. Production shall not begin
277 until the concrete mix is approved in writing by the DEN Project Manager.
278

279 Each of the submitted concrete mixes (i.e, slip form, side form machine finish and side form hand finish)
280 shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the
281 following items and quantities as a minimum:
282

- 283 • Certified material test reports for aggregate in accordance with paragraph 501-2.1. Certified
284 reports must include all tests required; reporting each test, test method, test result, and
285 requirement specified (criteria).
- 286 • Combined aggregate gradations and analysis; and including plots of the fine aggregate fineness
287 modulus.
- 288 • Reactivity Test Results.
- 289 • Coarse aggregate quality test results, including deleterious materials.
- 290 • Fine aggregate quality test results, including deleterious materials.
- 291 • Mill certificates for cement and supplemental cementitious materials.
- 292 • Certified test results for all admixtures, including Lithium Nitrate if applicable.
- 293 • Specified flexural strength, slump, and air content.
- 294 • Recommended proportions/volumes for proposed mixture and trial water-cementitious
295 materials ratio, including actual slump and air content.
- 296 • Flexural and compressive strength summaries and plots, including all individual beam and
297 cylinder breaks.
- 298 • Correlation ratios for acceptance testing and Contractor QC testing, when applicable.
- 299 • Historical record of test results documenting production standard deviation, when applicable.
- 300 • ***Alkali loading contributed by the cement per cubic yard, calculated in accordance with***
301 ***FAA EB 106.***
302
303

304 **501-3.5 CEMENTITIOUS MATERIALS.**
305

- 306 a. **Fly ash.** When fly ash is used as a partial replacement for cement, the replacement rate shall be
307 determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total
308 cementitious material. If fly ash is used in conjunction with slag cement the maximum
309 replacement rate shall not exceed 10% by weight of total cementitious material.
310
- 311 b. **Slag cement (ground granulated blast furnace (GGBF)).** Slag cement may be used. The slag
312 cement, or slag cement plus fly ash if both are used, may constitute between 25 to 55% of the
313 total cementitious material by weight.
314

- 315 c. **Raw or calcined natural pozzolan.** Natural pozzolan may be used in the concrete mix. When
316 pozzolan is used as a partial replacement for cement, the replacement rate shall be determined
317 from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious
318 material. If pozzolan is used in conjunction with slag cement the maximum replacement rate
319 shall not exceed 10% by weight of total cementitious material.
320

321 501-3.6 ADMIXTURES.

- 322
- 323 a. **Air-entraining admixtures.** Air-entraining admixture are to be added in such a manner that will
324 ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed
325 air-entrained concrete shall be based upon trial mixes with the materials to be used in the work
326 adjusted to produce concrete of the required plasticity and workability. The percentage of air in
327 the mix shall be 5.5 percent. Air content shall be determined by testing in accordance with
328 ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly
329 porous coarse aggregate.
- 331 b. **Water-reducing admixtures.** Water-reducing admixtures shall be added to the mix in the
332 manner recommended by the manufacturer and in the amount necessary to comply with the
333 specification requirements. Tests shall be conducted with the materials to be used in the work, in
334 accordance with ASTM C494.
- 335 c. **Other admixtures.** Set controlling, and other approved admixtures shall be added to the mix in
336 the manner recommended by the manufacturer and in the amount necessary to comply with the
337 specification requirements. Tests shall be conducted with the materials to be used in the work, in
338 accordance with ASTM C494.
- 339 d. **Lithium nitrate.** Lithium nitrate shall be added to the mix in the manner recommended by the
340 manufacturer and in the amount necessary to comply with the specification requirements in
341 accordance with paragraph 501-2.10d.
342
343

344 CONSTRUCTION METHODS

345

346 **501-4.1 CONTROL STRIP.** The control strip(s) shall be to the next planned joint after the initial 250 feet
347 (75 m) of each type of pavement construction (slip-form pilot lane, slip-form fill-in lane, or fixed form). The
348 Contractor shall demonstrate, in the presence of the DEN Project Manager, that the materials, concrete mix,
349 equipment, construction processes, and quality control processes meet the requirements of the specifications.
350 The concrete mixture shall be extruded from the paver meeting the edge slump tolerance and with little or no
351 finishing. Pilot, fill-in, and fixed-form control strips will be accepted separately. Minor adjustments to the
352 mix design may be required to place an acceptable control strip. The production mix will be the adjusted mix
353 design used to place the acceptable control strip. Upon acceptance of the control strip by the DEN Project
354 Manager, the Contractor must use the same equipment, materials, and construction methods for the
355 remainder of concrete paving. Any adjustments to processes or materials must be approved in advance by
356 the DEN Project Manager. Acceptable control strips will meet edge slump tolerance and surface acceptable
357 with little or no finishing, air content within action limits, strength equal or greater than requirements of
358 P501-3.3. The control strip will be considered one lot for payment (no sublots required for control strip).
359 Payment will only be made for an acceptable control strip in accordance with paragraph 501-8.1 using a lot
360 pay factor equal to 100.

361

362 **501-4.2 EQUIPMENT.** The Contractor is responsible for the proper operation and maintenance of all
363 equipment necessary for handling materials and performing all parts of the work to meet this specification.
364

365 a. **Plant and equipment.** The plant and mixing equipment shall conform to the requirements of
366 ASTM C94 and/or ASTM C685. Each truck mixer shall have attached in a prominent place a
367 manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed
368 concrete and the speed of rotation of the mixing drum or blades. The truck mixers shall be
369 examined daily for changes in condition due to accumulation of hard concrete or mortar or wear
370 of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4
371 inch (19 mm) or more. The Contractor shall have a copy of the manufacturer's design on hand
372 showing dimensions and arrangement of blades in reference to original height and depth.
373

374 Equipment for transferring and spreading concrete from the transporting equipment to the
375 paving lane in front of the finishing equipment shall be provided. The equipment shall be
376 specially manufactured, self-propelled transfer equipment which will accept the concrete outside
377 the paving lane and will spread it evenly across the paving lane in front of the paver and strike
378 off the surface evenly to a depth which permits the paver to operate efficiently.
379

380 b. **Finishing equipment.**

381
382 (1) **Slip-form.** The standard method of constructing concrete pavements shall be with an
383 approved slip-form paving equipment designed and operated to spread, consolidate,
384 screed, and finish the freshly placed concrete in one complete pass of the machine so that
385 the end result is a dense and homogeneous pavement which is achieved with a minimum
386 of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine
387 designed specifically for paving and finishing high quality concrete pavements.
388

389 (2) **Fixed-form.** On projects requiring less than 5,000 cubic yards of concrete pavement or
390 irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement
391 may be placed with equipment specifically designed for placement and finishing using
392 stationary side forms. Methods and equipment shall be reviewed and accepted by the
393 DEN Project Manager. Hand screeding and float finishing may only be used on small
394 irregular areas as allowed by the DEN Project Manager.
395

396 c. **Vibrators.** Vibrator shall be the internal type. The rate of vibration of each vibrating unit shall
397 be sufficient to consolidate the pavement without segregation or voids. The number, spacing,
398 and frequency shall be as necessary to provide a dense and homogeneous pavement and meet
399 the recommendations of American Concrete Institute (ACI) 309R, Guide for Consolidation of
400 Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators
401 shall be automatically controlled so that they shall be stopped as forward motion ceases. The
402 Contractor shall provide an electronic or mechanical means to monitor vibrator status. The
403 checks on vibrator status shall occur a minimum of two times per day or when requested by the
404 DEN Project Manager.
405

406 Hand held vibrators may only be used in irregular areas and shall meet the recommendations of
407 ACI 309R, Guide for Consolidation of Concrete.
408

409 d. **Concrete saws.** The Contractor shall provide sawing equipment adequate in number of units
410 and power to complete the sawing to the required dimensions. The Contractor shall provide at
411 least one standby saw in good working order and a supply of saw blades at the site of the work at
412 all times during sawing operations.
413

414 e. **Fixed forms.** Straight side fixed forms shall be made of steel and shall be furnished in sections
415 not less than 10 feet (3 m) in length. Forms shall be provided with adequate devices for secure
416 settings so that when in place they will withstand, without visible spring or settlement, the impact
417 and vibration of the consolidating and finishing equipment. Forms with battered top surfaces
418 and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as
419 approved by the DEN Project Manager. The top face of the form shall not vary from a true
420 plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more
421 than 1/4 inch (6 mm). The forms shall contain provisions for locking the ends of abutting
422 sections together tightly for secure setting. Wood forms may be used under special conditions,
423 when approved by the DEN Project Manager. The forms shall extend the full depth of the
424 pavement section.
425

426 **501-4.3 FORM SETTING.** Forms shall be set to line and grade as shown on the plans, sufficiently in
427 advance of the concrete placement, to ensure continuous paving operation. Forms shall be set to withstand,
428 without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.
429 Forms shall be cleaned and oiled prior to the concrete placement.
430

431 **501-4.4 BASE SURFACE PREPARATION PRIOR TO PLACEMENT.** Any damage to the prepared
432 base, subbase, and subgrade shall be corrected full depth by the Contractor prior to concrete placement. The
433 underlying surface shall be entirely free of frost when concrete is placed. The prepared grade shall be
434 moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of
435 moisture from concrete. Bond breaker shall be applied in accordance with 501-2.12.
436

437 **501-4.5 HANDLING, MEASURING, AND BATCHING MATERIAL.** Aggregate stockpiles shall be
438 constructed and managed in such a manner that prevents segregation and intermixing of deleterious materials.
439 Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch
440 plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All
441 aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned
442 for draining at least 12 hours before being batched. Store and maintain all aggregates at a uniform moisture
443 content prior to use. A continuous supply of materials shall be provided to the work to ensure continuous
444 placement.
445

446 **501-4.6 MIXING CONCRETE.** The concrete may be mixed at the work site, in a central mix plant or in
447 truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the
448 time all materials are placed into the drum until the drum is emptied into the truck. All concrete shall be
449 mixed and delivered to the site in accordance with the requirements of ASTM C94 or ASTM C685.
450

451 Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-
452 agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is
453 discharged from the truck should not exceed 30 minutes when the concrete is hauled in non-agitating trucks,
454 nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. In no case shall the
455 temperature of the concrete when placed exceed 90°F (32°C). Retempering concrete by adding water or by
456 other means will not be permitted. With transit mixers additional water may be added to the batch materials
457 and additional mixing performed to increase the slump to meet the specified requirements provided the

458 addition of water is performed within 45 minutes after the initial mixing operations and provided the
459 water/cementitious ratio specified is not exceeded.

460

461 **501-4.7 WEATHER LIMITATIONS ON MIXING AND PLACING.** No concrete shall be mixed,
462 placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting
463 system is operated.

464

465 a. **Cold weather.** Unless authorized in writing by the DEN Project Manager, mixing and
466 concreting operations shall be discontinued when a descending air temperature in the shade and
467 away from artificial heat reaches 40°F (4°C) and shall not be resumed until an ascending air
468 temperature in the shade and away from artificial heat reaches 35°F (2°C).

469

470 The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The
471 temperature of the mixed concrete shall not be less than 50°F (10°C) at the time of placement.
472 Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the
473 concrete.

474

475 When concreting is authorized during cold weather, water and/or the aggregates may be heated
476 to not more than 150°F (66°C). The apparatus used shall heat the mass uniformly and shall be
477 arranged to preclude the possible occurrence of overheated areas which might be detrimental to
478 the materials.

479

480 Curing during cold weather shall be in accordance with paragraph 501-4.13d.

481

482 Information regarding cold weather concreting practices may be found in ACI 306R,
483 Cold Weather Concreting.

484

485 b. **Hot weather.** During periods of hot weather when the maximum daily air temperature exceeds
486 85°F (30°C), the following precautions shall be taken.

487

488 The forms and/or the underlying surface shall be sprinkled with water immediately before
489 placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in
490 no case shall the temperature of the concrete when placed exceed 90°F (32°C). The aggregates
491 and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not
492 more than the specified maximum.

493

494 The concrete placement shall be protected from exceeding an evaporation rate of 0.2 psf (0.98
495 kg/m² per hour) per hour. When conditions are such that problems with plastic cracking can be
496 expected, and particularly if any plastic cracking begins to occur, the Contractor shall
497 immediately take such additional measures as necessary to protect the concrete surface. If the
498 Contractor's measures are not effective in preventing plastic cracking, paving operations shall be
499 immediately stopped.

500

501 Curing during hot weather shall be in accordance with paragraph 501-4.13e.

502

503 Information regarding hot weather concreting practices may be found in ACI 305R, Hot
Weather Concreting.

504

505 c. **Temperature management program.** Prior to the start of paving operation for each day of
paving, the Contractor shall provide the DEN Project Manager with a Temperature Management

506 Program for the concrete to be placed to assure that uncontrolled cracking is avoided. (Federal
507 Highway Administration HIPERPAV 3 is one example of a temperature management program.)
508 As a minimum, the program shall address the following items:

- 509 (1) Anticipated tensile strains in the fresh concrete as related to heating and cooling of the
510 concrete material.
511 (2) Anticipated weather conditions such as ambient temperatures, wind velocity, and relative
512 humidity; and anticipated evaporation rate using Figure 19-9, PCA, Design and Control of
513 Concrete Mixtures.
514 (3) Anticipated timing of initial sawing of joint.
515 (4) Anticipated number and type of saws to be used.
516

517 Federal Highway Administration HIPERPAV 3 is one example of a temperature
518 management program. The software is available at <http://www.hiperpav.com/>
519

520 **d. Rain.** The Contractor shall have available materials for the protection of the concrete during
521 inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least
522 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic concrete slab and any
523 edges. The sheeting may be mounted on either the paver or a separate movable bridge from
524 which it can be unrolled without dragging over the plastic concrete surface. When rain appears
525 imminent, all paving operations shall stop and all available personnel shall begin covering the
526 surface of the unhardened concrete with the protective covering.
527

528 **501-4.8 CONCRETE PLACEMENT.** At any point in concrete conveyance, the free vertical drop of the
529 concrete from one point to another or to the underlying surface shall not exceed 3 feet (1 m). The finished
530 concrete product must be dense and homogeneous, without segregation and conforming to the standards in
531 this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the
532 paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation,
533 including under and around all load-transfer devices, joint assembly units, and other features embedded in the
534 pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining previously
535 constructed pavement when the concrete strength reaches a flexural strength of 550 psi (3.8 MPa), based on
536 the average of four field cured specimens per 2,000 cubic yards (1,530 cubic meters) of concrete placed. The
537 Contractor must determine that the above minimum strengths are adequate to protection the pavement from
538 overloads due to the construction equipment proposed for the project.
539

540 The Contractor shall have available materials for the protection of the concrete during cold, hot and/or
541 inclement weather in accordance with paragraph 501-4.7.
542

543 **a. Slip-form construction.** The concrete shall be distributed uniformly into final position by a self-
544 propelled slip-form paver without delay. The alignment and elevation of the paver shall be
545 regulated from outside reference lines established for this purpose. The paver shall vibrate the
546 concrete for the full width and depth of the strip of pavement being placed and the vibration
547 shall be adequate to provide a consistency of concrete that will stand normal to the surface with
548 sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent
549 spreading of the forms. The plastic concrete shall be effectively consolidated by internal
550 vibration with transverse vibrating units for the full width of the pavement and/or a series of
551 equally placed longitudinal vibrating units. The space from the outer edge of the pavement to
552 longitudinal unit shall not exceed 9 inches (23 cm) for slipform and at the end of the dowels for
553 the fill-in lanes. The spacing of internal units shall be uniform and shall not exceed 18 inches (0.5
554 m).

555 The term internal vibration means vibrating units located within the specified thickness of
556 pavement section.

557
558 The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement
559 without, segregation, voids, or vibrator trails and the amplitude of vibration shall be sufficient to
560 be perceptible on the surface of the concrete along the entire length of the vibrating unit and for
561 a distance of at least one foot (30 cm). The frequency of vibration or amplitude should be
562 adjusted proportionately with the rate of travel to result in a uniform density and air content. The
563 paving machine shall be equipped with a tachometer or other suitable device for measuring and
564 indicating the actual frequency of vibrations.

565
566 The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with
567 as nearly a continuous forward movement as possible and all operations of mixing, delivering,
568 and spreading concrete shall be coordinated to provide uniform progress with stopping and
569 starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward
570 movement of the paver, the vibratory and tamping elements shall also be stopped immediately.
571 No tractive force shall be applied to the machine, except that which is controlled from the
572 machine.

573
574 When concrete is being placed adjacent to an existing pavement, that part of the equipment
575 which is supported on the existing pavement shall be equipped with protective pads on crawler
576 tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance
577 from the edge of the pavement to avoid breaking the pavement edge.

578
579 Not more than 15% of the total free edge of each 500-foot (150 m) segment of pavement, or
580 fraction thereof, shall have an edge slump exceeding 1/4 inch (6 mm), and none of the free edge
581 of the pavement shall have an edge slump exceeding 3/8 inch (9 mm). (The total free edge of
582 500 feet (150 m) of pavement will be considered the cumulative total linear measurement of
583 pavement edge originally constructed as nonadjacent to any existing pavement; that is, 500 feet
584 (150 m) of paving lane originally constructed as a separate lane will have 1,000 feet (300 m) of
585 free edge, 500 feet (150 m) of fill-in lane will have no free edge, etc.). The area affected by the
586 downward movement of the concrete along the pavement edge shall be limited to not more than
587 18 inches (0.5 m) from the edge.

588
589 When excessive edge slump cannot be corrected before the concrete has hardened, the area with
590 excessive edge slump will be removed the full width of the slip form lane and replaced at the
591 expense of the Contractor as directed by the DEN Project Manager.

592
593 **b. Fixed-form construction.** Forms shall be drilled in advance of being placed to line and grade to
594 accommodate tie bars / dowel bars where these are specified.

595
596 Immediately in advance of placing concrete and after all subbase operations are completed, side
597 forms shall be trued and maintained to the required line and grade for a distance sufficient to
598 prevent delay in placing.

599
600 Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all
601 cases until the edge of the pavement no longer requires the protection of the forms. Curing
602 compound shall be applied to the concrete immediately after the forms have been removed.

603

604 Side forms shall be thoroughly cleaned and coated with a release agent each time they are used
605 and before concrete is placed against them.

606 Concrete shall be spread, screed, shaped and consolidated by one or more self-propelled
607 machines. These machines shall uniformly distribute and consolidate concrete without
608 segregation so that the completed pavement will conform to the required cross-section with a
609 minimum of handwork.

610
611 The number and capacity of machines furnished shall be adequate to perform the work required
612 at a rate equal to that of concrete delivery. The equipment must be specifically designed for
613 placement and finishing using stationary side forms. Methods and equipment shall be reviewed
614 and accepted by the DEN Project Manager.

615
616 Concrete for the full paving width shall be effectively consolidated by internal vibrators. The
617 rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without
618 segregation, voids, or leaving vibrator trails.

619
620 Power to vibrators shall be connected so that vibration ceases when forward or backward
621 motion of the machine is stopped.

622
623 **c. Consolidation.** Concrete shall be consolidated with the specified type of lane-spanning, gang-
624 mounted, mechanical, immersion type vibrating equipment mounted in front of the paver,
625 supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be
626 inserted into the concrete to a depth that will provide the best full-depth consolidation but not
627 closer to the underlying material than 2 inches (50 mm). Vibrators shall not be used to transport
628 or spread the concrete. For each paving train, at least one additional vibrator spud, or sufficient
629 parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all
630 times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets,
631 or any other evidence) or over-consolidation (vibrator trails, segregation, or any other evidence)
632 shall require the immediate stopping of the paving operation and adjustment of the equipment or
633 procedures as approved by the DEN Project Manager.

634
635 If a lack of consolidation of the hardened concrete is suspected by the DEN Project Manager,
636 referee testing may be required. Referee testing of hardened concrete will be performed by the
637 DEN Project Manager by cutting cores from the finished pavement after a minimum of 24
638 hours curing. The DEN Project Manager shall visually examine the cores for evidence of lack of
639 consolidation. Density determinations will be made by the DEN Project Manager based on the
640 water content of the core as taken. ASTM C642 shall be used for the determination of core
641 density in the saturated-surface dry condition. When required, referee cores will be taken at the
642 minimum rate of one for each 500 cubic yards (382 m²) of pavement, or fraction. The
643 Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

644
645 The average density of the cores shall be at least 97% of the original concrete mix density, with
646 no cores having a density of less than 96% of the original concrete mix density. Failure to meet
647 the referee tests will be considered evidence that the minimum requirements for vibration are
648 inadequate for the job conditions. Additional vibrating units or other means of increasing the
649 effect of vibration shall be employed so that the density of the hardened concrete conforms to
650 the above requirements.

651
652 **501-4.9 STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT.** Following
653 the placing of the concrete, it shall be struck off to conform to the cross-section shown on the plans and to

654 an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall
655 be at the elevation shown on the plans. When reinforced concrete pavement is placed in two layers, the
656 bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat
657 may be laid full length on the concrete in its final position without further manipulation. The reinforcement
658 shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed,
659 struck off, and screed. If any portion of the bottom layer of concrete has been placed more than 30 minutes
660 without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with
661 freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the
662 reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by
663 mechanical or vibratory means after spreading.

664
665 Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may
666 adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be
667 considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-
668 brushed test specimen are not less than the applicable ASTM specification requirements.

669
670 **501-4.10 JOINTS.** Joints shall be constructed as shown on the plans and in accordance with these
671 requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and
672 finished or edged as shown on the plans. Joints shall not vary more than 1/2-inch (12 mm) from their
673 designated position and shall be true to line with not more than 1/4-inch (6 mm) variation in 10 feet (3 m).
674 The surface across the joints shall be tested with a 12-foot (3 m) straightedge as the joints are finished and
675 any irregularities in excess of 1/4 inch (6 mm) shall be corrected before the concrete has hardened. All joints
676 shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.

677
678 **a. Construction.** Longitudinal construction joints shall be slip-formed or formed against side
679 forms as shown in the plans.

680
681 Transverse construction joints shall be installed at the end of each day's placing operations and at
682 any other points within a paving lane when concrete placement is interrupted for more than 30
683 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The
684 installation of the joint shall be located at a planned contraction or expansion joint. If placing of
685 the concrete is stopped, the Contractor shall remove the excess concrete back to the previous
686 planned joint.

687
688 **b. Contraction.** Contraction joints shall be installed at the locations and spacing as shown on the
689 plans. Contraction joints shall be installed to the dimensions required by forming a groove or
690 cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the
691 concrete surface after the concrete has hardened. When the groove is formed in plastic concrete
692 the sides of the grooves shall be finished even and smooth with an edging tool. If an insert
693 material is used, the installation and edge finish shall be according to the manufacturer's
694 instructions. The groove shall be finished or cut clean so that spalling will be avoided at
695 intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch (3 mm)
696 wide and to the depth shown on the plans.

697
698 **c. Isolation (expansion).** Isolation joints shall be installed as shown on the plans. The premolded
699 filler of the thickness as shown on the plans, shall extend for the full depth and width of the slab
700 at the joint. The filler shall be fastened uniformly along the hardened joint face with no buckling

701 or debris between the filler and the concrete interface, including a temporary filler for the sealant
702 reservoir at the top of the slab. The edges of the joint shall be finished and tooled while the
703 concrete is still plastic.
704

705 **d. Dowels and Tie Bars for Joints**

706
707 **(1) Tie bars.** Tie bars shall consist of deformed bars installed in joints as shown on the plans.
708 Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be
709 spaced at intervals shown on the plans. They shall be held in position parallel to the
710 pavement surface and in the middle of the slab depth and within the tolerances in
711 paragraph 501-4.10(f). When tie bars extend into an unpaved lane, they may be bent
712 against the form at longitudinal construction joints, unless threaded bolt or other
713 assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in
714 sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.
715

716 **(2) Dowel bars.** Dowel bars shall be placed across joints in the proper horizontal and vertical
717 alignment as shown on the plans. The dowels shall be coated with a bond-breaker or other
718 lubricant recommended by the manufacturer and approved by the DEN Project Manager.
719 Dowels bars at longitudinal construction joints shall be bonded in drilled holes.
720

721 **(3) Placing dowels and tie bars.** Horizontal spacing of dowels shall be within a tolerance of
722 $\pm 3/4$ inch (19 mm). The vertical location on the face of the slab shall be within a tolerance
723 of $\pm 1/2$ inch (12 mm). The method used to install dowels shall ensure that the horizontal
724 and vertical alignment will not be greater than $1/4$ inch per foot (6 mm per 0.3 m), except
725 for those across the crown or other grade change joints. Dowels across crowns and other
726 joints at grade changes shall be measured to a level surface. Horizontal alignment shall be
727 checked perpendicular to the joint edge. The portion of each dowel intended to move
728 within the concrete or expansion cap shall be wiped clean and coated with a thin, even
729 film of lubricating oil or light grease before the concrete is placed. Dowels shall be
730 installed as specified in the following subparagraphs.
731

732 Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar or tie
733 bar length to the planned joint line. If the last regularly spaced longitudinal dowel
734 and/or tie bar is closer than that dimension, it shall be moved away from the joint
735 to a location 0.6 times the dowel bar and/or tie bar length, but not closer than 6
736 inches (150 mm) to its nearest neighbor.
737

738 **(a) Contraction joints.** Dowels and tie bars in longitudinal and transverse contraction
739 joints within the paving lane shall be held securely in place by means of rigid metal
740 frames or basket assemblies of an approved type. The basket assemblies shall be
741 held securely in the proper location by means of suitable pins or anchors. Do not
742 cut or crimp the dowel basket tie wires.
743

744 At the Contractor's option, dowels and tie bars in contraction joints may be installed
745 by insertion into the plastic concrete using approved equipment and procedures per
746 the paver manufacturer's design. Approval of installation methods will be based on
747 the results of the control strip showing that the dowels and tie bars are installed
748 within specified tolerances as verified by cores or non-destructive rebar location
749 devices approved by the DEN Project Manager.
750

751 (b) **Construction joints.** Install dowels and tie bars by the cast-in- place or the drill-
752 and-dowel method. Installation by removing and replacing in preformed holes will
753 not be permitted. Dowels and tie bars shall be prepared and placed across joints
754 where indicated, correctly aligned, and securely held in the proper horizontal and
755 vertical position during placing and finishing operations, by means of devices
756 fastened to the forms.

757
758 (c) **Joints in hardened concrete.** Install dowels in hardened concrete by bonding the
759 dowels into holes drilled into the concrete. The concrete shall have cured for seven
760 (7) days or reached a minimum flexural strength of 450 psi (3.1 MPa) before drilling
761 begins. Holes 1/8 inch (3 mm) greater in diameter than the dowels shall be drilled
762 into the hardened concrete using rotary-core drills. Rotary-percussion drills may be
763 used, provided that excessive spalling does not occur. Spalling beyond the limits of
764 the grout retention ring will require modification of the equipment and operation.
765 Depth of dowel hole shall be within a tolerance of $\pm 1/2$ inch (12 mm) of the
766 dimension shown on the drawings. On completion of the drilling operation, the
767 dowel hole shall be blown out with oil-free, compressed air. Dowels shall be
768 bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the
769 back of the hole before installing the dowel and extruded to the collar during
770 insertion of the dowel so as to completely fill the void around the dowel.
771 Application by buttering the dowel will not be permitted. The dowels shall be held
772 in alignment at the collar of the hole by means of a suitable metal or plastic grout
773 retention ring fitted around the dowel.

774
775 e. **Sawing of joints.** Sawing shall commence, without regard to day or night, as soon as the
776 concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and
777 before uncontrolled shrinkage cracking of the pavement occurs and shall continue without
778 interruption until all joints have been sawn. All slurry and debris produced in the sawing of joints
779 shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in
780 the initial saw-cut and maintained for the remaining cure period.

781
782 Joints shall be cut in locations as shown on the plans. The initial joint cut shall be a minimum
783 1/8 inch (3 mm) wide and to the depth shown on the plans. Prior to placement of joint sealant
784 or seals, the top of the joint shall be widened by sawing as shown on the plans.

785
786 **501-4.11 FINISHING.** Finishing operations shall be a continuing part of placing operations starting
787 immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or
788 extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if
789 used, straightedge finishing, edging of joints, and then texturing. Finishing shall be by the machine method.
790 The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a
791 breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished
792 pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable
793 hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and
794 proper adjustments made or the equipment replaced. Equipment, mixture, and/or procedures which produce
795 more than 1/4 inch (6 mm) of mortar-rich surface shall be immediately modified as necessary to eliminate
796 this condition or operations shall cease. Compensation shall be made for surging behind the screeds or
797 extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing
798 machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the
799 screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in
800 an approved condition. At no time shall water be added to the surface of the slab with the finishing

801 equipment or tools, or in any other way. Fog (mist) sprays or other surface applied finishing aids specified to
802 prevent plastic shrinkage cracking, approved by the DEN Project Manager, may be used in accordance with
803 the manufacturers requirements.
804

805 **a. Machine finishing with slipform pavers.** The slipform paver shall be operated so that only a
806 very minimum of additional finishing work is required to produce pavement surfaces and edges
807 meeting the specified tolerances. Any equipment or procedure that fails to meet these specified
808 requirements shall immediately be replaced or modified as necessary. A self-propelled non-
809 rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities
810 and score marks. Only one pass of the pipe float shall be allowed. Equipment, mixture, and/or
811 procedures which produce more than 1/4 inch (6 mm) of mortar-rich surface shall be
812 immediately modified as necessary to eliminate this condition or operations shall cease. Remove
813 excessive slurry from the surface with a cutting straightedge and wipe off the edge. Any slurry
814 which does run down the vertical edges shall be immediately removed by hand, using stiff
815 brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the
816 edges of the pavement to compensate for excessive edge slump, either while the concrete is
817 plastic or after it hardens.
818

819 **b. Machine finishing with fixed forms.** The machine shall be designed to straddle the forms and
820 shall be operated to screed and consolidate the concrete. Machines that cause displacement of
821 the forms shall be replaced. The machine shall make only one pass over each area of pavement.
822 If the equipment and procedures do not produce a surface of uniform texture, true to grade, in
823 one pass, the operation shall be immediately stopped and the equipment, mixture, and
824 procedures adjusted as necessary.
825

826 **c. Other types of finishing equipment.** Clary screeds, other rotating tube floats, or bridge deck
827 finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped
828 slabs, and near buildings or trench drains, subject to the DEN Project Manager's approval.
829

830 Bridge deck finishers shall have a minimum operating weight of 7500 pounds (3400 kg) and shall
831 have a transversely operating carriage containing a knock-down auger and a minimum of two
832 immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand
833 finishing is permitted as specified, and only where specifically approved.
834

835 **d. Hand finishing.** Hand finishing methods will not be permitted, except under the following
836 conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be
837 used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or of
838 irregular dimensions where operation of the mechanical equipment is impractical.
839

840 **e. Straightedge testing and surface correction.** After the pavement has been struck off and
841 while the concrete is still plastic, it shall be tested for trueness with a 12-foot (3.7-m) finishing
842 straightedge swung from handles capable of spanning at least one-half the width of the slab. The
843 straightedge shall be held in contact with the surface in successive positions parallel to the
844 centerline and the whole area gone over from one side of the slab to the other, as necessary.
845 Advancing shall be in successive stages of not more than one-half the length of the straightedge.
846 Any excess water and laitance in excess of 1/8 inch (3 mm) thick shall be removed from the
847 surface of the pavement and wasted. Any depressions shall be immediately filled with freshly
848 mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and
849 refinished. Special attention shall be given to assure that the surface across joints meets the
850 smoothness requirements. Straightedge testing and surface corrections shall continue until the

851 entire surface is found to be free from observable departures from the straightedge and until the
852 slab conforms to the required grade and cross-section. The use of long-handled wood floats shall
853 be confined to a minimum; they may be used only in emergencies and in areas not accessible to
854 finishing equipment.
855

856 **501-4.12 SURFACE TEXTURE.** The surface of the pavement shall be finished as designated below for all
857 newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly
858 roughen the pavement surface during the operation. The texture shall be uniform in appearance and
859 approximately 1/16 inch (2 mm) in depth. Any imperfections resulting from the texturing operation shall be
860 corrected to the satisfaction of the DEN Project Manager.
861

862 a. **Brush or broom finish.** Shall be applied when the water sheen has practically disappeared. The
863 equipment shall operate transversely across the pavement surface.
864

865 b. **Burlap drag finish.** Not used.
866

867 c. **Artificial turf finish.** Not used.
868

869 **501-4.13 CURING.** Immediately after finishing operations are completed and bleed water is gone from the
870 surface, all exposed surfaces of the newly placed concrete shall be cured for a 7-day cure period in accordance
871 with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor
872 may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be
873 cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more
874 than 1/2 hour during the curing period.
875

876 When a two-saw-cut method is used to construct the contraction joint, the curing compound shall be applied
877 to the saw-cut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until
878 after the curing period has been completed. When the one cut method is used to construct the contraction
879 joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be
880 kept moist for the duration of the curing period.
881

882 a. **Impervious membrane method.** Curing with liquid membrane compounds should not occur
883 until bleed and surface moisture has evaporated. All exposed surfaces of the pavement shall be
884 sprayed uniformly with white pigmented curing compound immediately after the finishing of the
885 surface and before the set of the concrete has taken place. The curing compound shall not be
886 applied during rainfall. Curing compound shall be applied by mechanical sprayers under pressure
887 at the rate of one gallon (4 liters) to not more than 150 square feet (14 sq m). The spraying
888 equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use,
889 the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed
890 throughout the vehicle. During application, the compound shall be stirred continuously by
891 mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the
892 removal of forms will be permitted. When hand spraying is approved by the DEN Project
893 Manager, a double application rate shall be used to ensure coverage. Should the film become
894 damaged from any cause, including sawing operations, within the required curing period, the
895 damaged portions shall be repaired immediately with additional compound or other approved
896 means. Upon removal of side forms, the sides of the exposed slabs shall be protected
897 immediately to provide a curing treatment equal to that provided for the surface.
898

- 899 **b. White burlap-polyethylene sheets.** The surface of the pavement shall be entirely covered with
900 the sheeting. The sheeting used shall be such length (or width) that it will extend at least twice
901 the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that
902 the entire surface and both edges of the slab are completely covered. The sheeting shall be placed
903 and weighted to remain in contact with the surface covered, and the covering shall be maintained
904 fully saturated and in position for seven (7) days after the concrete has been placed.
905
- 906 **c. Water method.** The entire area shall be covered with burlap or other water absorbing material.
907 The material shall be of sufficient thickness to retain water for adequate curing without excessive
908 runoff. The material shall be kept wet at all times and maintained for seven (7) days. When the
909 forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the
910 Contractor to prevent ponding of the curing water on the subbase.
911
- 912 **d. Concrete protection for cold weather.** Maintain the concrete at a temperature of at least 50°F
913 (10°C) for a period of 72 hours after placing and at a temperature above freezing for the
914 remainder of the 7-day curing period. The Contractor shall be responsible for the quality and
915 strength of the concrete placed during cold weather; and any concrete damaged shall be removed
916 and replaced at the Contractor's expense.
917
- 918 **e. Concrete protection for hot weather.** Concrete should be continuous moisture cured for the
919 entire curing period and shall commence as soon as the surfaces are finished and continue for at
920 least 24 hours. However, if moisture curing is not practical beyond 24 hours, the concrete
921 surface shall be protected from drying with application of a liquid membrane-forming curing
922 compound while the surfaces are still damp. Other curing methods may be approved by the
923 DEN Project Manager.
924

925 **501-4.14 REMOVING FORMS.** Unless otherwise specified, forms shall not be removed from freshly
926 placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing.
927 After the forms have been removed, the sides of the slab shall be cured in accordance with paragraph 501-
928 4.13.
929

930 If honeycombed areas are evident when the forms are removed, materials, placement, and consolidation
931 methods must be reviewed and appropriate adjustments made to assure adequate consolidation at the edges
932 of future concrete placements. Honeycombed areas that extend into the slab less than approximately 1 inch
933 (25 mm), shall be repaired with an approved grout, as directed by the DEN Project Manager. Honeycombed
934 areas that extend into the slab greater than a depth of 1 inch (25 mm) shall be considered as defective work
935 and shall be removed and replaced in accordance with paragraph 501-4.19.
936

937 **501-4.15 SAW-CUT GROOVING.** If shown on the plans, grooved surfaces shall be provided in accordance
938 with the requirements of Item P-621.
939

940 **501-4.16 SEALING JOINTS.** The joints in the pavement shall be sealed in accordance with Item P-604 or
941 P-605.
942

943 **501-4.17 PROTECTION OF PAVEMENT.** The Contractor shall protect the pavement and its
944 appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until
945 accepted by the DEN Project Manager. This shall include watchmen to direct traffic and the erection and

946 maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from
947 intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be
948 repaired or the pavement replaced at the Contractor's expense.

949
950 Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic
951 shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete
952 is at least seven (7) days old, or for a longer period if directed by the DEN Project Manager.

953
954 In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment
955 will be permitted on the new pavement after the pavement has been cured for seven (7) days, the joints are
956 protected, the concrete has attained a minimum field cured flexural strength of 450 psi (3100 kPa), and the
957 slab edge is protected.

958
959 All new and existing pavement carrying construction traffic or equipment shall be kept clean and spillage of
960 concrete and other materials shall be cleaned up immediately.

961
962 Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to
963 the full depth, width, and length of the slab.

964
965 **501-4.18 OPENING TO CONSTRUCTION TRAFFIC.** The pavement shall not be opened to traffic
966 until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 450
967 pounds per square inch (3100 kPa) when tested in accordance with ASTM C78. If such tests are not
968 conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to
969 opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the
970 joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to
971 protect the joints from foreign matter intrusion.

972
973 **501-4.19 REPAIR, REMOVAL, OR REPLACEMENT OF SLABS.** New pavement slabs that are
974 broken or contain cracks or are otherwise defective or unacceptable as defined by acceptance criteria in
975 paragraph 501-6.6 shall be removed and replaced or repaired, as directed by the DEN Project Manager, at the
976 Contractor's expense. Spalls along joints shall be repaired as specified. Removal of partial slabs is not
977 permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of
978 removal shall be normal to the paving lane and to each original transverse joint. The DEN Project Manager
979 will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the
980 crack to determine depth of cracking. Such cores shall be have a diameter of 2 inches (50 mm) to 4 inches
981 (100 mm), shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated
982 concrete mixture bonded to the walls of the hole with a bonding agent, using approved procedures. Drilling
983 of cores and refilling holes shall be at no expense to the Owner. Repair of cracks as described in this section
984 shall not be allowed if in the opinion of the DEN Project Manager the overall condition of the pavement
985 indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of
986 cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse
987 aggregate in the upper 1/8 inch (3 mm) of the pavement surface.

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- a. **Shrinkage cracks.** Shrinkage cracks which do not exceed one-third of the pavement depth shall be cleaned and either high molecular weight methacrylate (HMWM) applied; or epoxy resin (Type IV, Grade 1) pressure injected using procedures recommended by the manufacturer and approved by the DEN Project Manager. Sandblasting of the surface may be required following the application of HMWM to restore skid resistance. Care shall be taken to ensure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the DEN Project Manager. Shrinkage cracks which exceed one-third the pavement depth shall be treated as full depth cracks in accordance with paragraphs 501-4.19b and 501-19c.
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- b. **Slabs with cracks through interior areas.** Interior area is defined as that area more than 6 inches (150 mm) from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than one-third the pavement depth, that extend into the interior area.
- 1003
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- c. **Cracks close to and parallel to joints.** All full-depth cracks within 6 inches (150 mm) either side of the joint and essentially parallel to the original joints, shall be treated as follows.
- 1006
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- (1) **Full depth cracks and original joint not cracked.** The full-depth crack shall be treated as the new joint and the original joint filled with an epoxy resin.
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- i. **Full-depth crack.** The joint sealant reservoir for the crack shall be formed by sawing to a depth of 3/4 inches (19 mm), $\pm 1/16$ inch (2 mm), and to a width of 5/8 inch (16 mm), $\pm 1/8$ inch (3 mm). The crack shall be sawed with equipment specially designed to follow random cracks. Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent raveling or spalling. The joint shall be sealed with sealant in accordance with P-605 or as directed by the DEN Project Manager.
- 1017
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- ii. **Original joint.** If the original joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.
- 1022
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- If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures.
- 1025
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- Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.
- 1030
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- (2) **Full depth cracks and original joint cracked.** If there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced.
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1038
- d. **Removal and replacement of full slabs.** Make a full depth cut perpendicular to the slab surface along all edges of the slab with a concrete saw cutting any dowels or tie-bars. Remove damaged slab protecting adjacent pavement from damage. Damage to adjacent slabs may result in removal of additional slabs as directed by the DEN Project Manager at the Contractor's expense.

- 1039
- 1040 The underlying material shall be repaired, re-compacted and shaped to grade.
- 1041
- 1042 Dowels of the size and spacing specified for other joints in similar pavement on the project shall
- 1043 be installed along all four (4) edges of the new slab in accordance with paragraph 501-4.10d.
- 1044
- 1045 Placement of concrete shall be as specified for original construction. The joints around the new
- 1046 slab shall be prepared and sealed as specified for original construction.
- 1047
- 1048 **e. Spalls along joints.**
- 1049
- 1050 (1) Spalls less than one inch wide and less than the depth of the joint sealant reservoir, shall be
- 1051 filled with joint sealant material.
- 1052
- 1053 (2) Spalls larger than one inch and/or deeper than the joint reservoir, but less than 1/2 the slab
- 1054 depth, and less than 25% of the length of the adjacent joint shall be repaired as follows:
- 1055
- 1056 i. Make a vertical saw cut at least one inch (25 mm) outside the spalled area and to a
- 1057 depth of at least 2 inches (50 mm). Saw cuts shall be straight lines forming
- 1058 rectangular areas surrounding the spalled area.
- 1059
- 1060 ii. Remove unsound concrete and at least 1/2 inch (12 mm) of visually sound concrete
- 1061 between the saw cut and the joint or crack with a light chipping hammer.
- 1062
- 1063 iii. Clean cavity with high-pressure water jets supplemented with compressed air as
- 1064 needed to remove all loose material.
- 1065
- 1066 iv. Apply a prime coat of epoxy resin, Type III, Grade I, to the dry, cleaned surface of
- 1067 all sides and bottom of the cavity, except any joint face.
- 1068
- 1069 v. Fill the cavity with low slump concrete or mortar or with epoxy resin concrete or
- 1070 mortar.
- 1071
- 1072 vi. An insert or other bond-breaking medium shall be used to prevent bond at all joint
- 1073 faces.
- 1074
- 1075 vii. A reservoir for the joint sealant shall be sawed to the dimensions required for other
- 1076 joints, or as required to be routed for cracks. The reservoir shall be thoroughly
- 1077 cleaned and sealed with the sealer specified for the joints.
- 1078
- 1079 (3) Spalls deeper than 1/2 of the slab depth or spalls longer than 25% of the adjacent joint
- 1080 require replacement of the entire slab.
- 1081
- 1082
- 1083 **f. Diamond grinding of Concrete surfaces.** Diamond grinding shall be completed prior to
- 1084 pavement grooving. Diamond grinding of the hardened concrete should not be performed until
- 1085 the concrete is at least 14 days old and has achieved full minimum strength. Equipment that
- 1086 causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The
- 1087 depth of diamond grinding shall not exceed 1/2 inch (13 mm) and all areas in which diamond
- 1088 grinding has been performed will be subject to the final pavement thickness tolerances specified.

1089 Diamond grinding shall be performed with a machine specifically designed for diamond grinding
1090 capable of cutting a path at least 3 feet (0.9 m) wide. The saw blades shall be 1/8-inch (3-mm)
1091 wide with sufficient number of flush cut blades that create grooves between 0.090 and 0.130
1092 inches (2 and 3.5 mm) wide; and peaks and ridges approximately 1/32 inch (1 mm) higher than
1093 the bottom of the grinding cut. The Contractor shall determine the number and type of blades
1094 based on the hardness of the aggregate. Contractor shall demonstrate to the DEN Project
1095 Manager that the grinding equipment will produce satisfactory results prior to making
1096 corrections to surfaces.

1097
1098 Grinding will be tapered in all directions to provide smooth transitions to areas not requiring
1099 grinding. The slurry resulting from the grinding operation shall be continuously removed and the
1100 pavement left in a clean condition. All grinding shall be at the expense of the Contractor.

CONTRACTOR QUALITY CONTROL (CQC)

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1104
1105 **501-5.1 QUALITY CONTROL PROGRAM.** The Contractor shall develop a Quality Control Program in
1106 accordance with Item C-100. No partial payment will be made for materials that are subject to specific
1107 quality control requirements without an approved quality control program.

1108
1109 **501-5.2 CONTRACTOR QUALITY CONTROL (CQC).** The Contractor shall provide or contract for
1110 testing facilities in accordance with Item C-100. The DEN Project Manager shall be permitted unrestricted
1111 access to inspect the Contractor's QC facilities and witness QC activities. The DEN Project Manager will
1112 advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or
1113 testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test
1114 results, the incorporation of the materials into the work shall be suspended immediately and will not be
1115 permitted to resume until the deficiencies are satisfactorily corrected.

1116
1117 **501-5.3 CONTRACTOR QC TESTING.** The Contractor shall perform all QC tests necessary to control
1118 the production and construction processes applicable to this specification and as set forth in the CQCP. The
1119 testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate
1120 moisture content, slump, and air content. A QC Testing Plan shall be developed and approved by the DEN
1121 Project Manager as part of the CQCP.

1122
1123 The DEN Project Manager may at any time, notwithstanding previous plant acceptance, reject and require
1124 the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to
1125 contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the
1126 event of such rejection, the Contractor may take a representative sample of the rejected material in the
1127 presence of the DEN Project Manager, and if it can be demonstrated in the laboratory, in the presence of the
1128 DEN Project Manager, that such material was erroneously rejected, payment will be made for the material at
1129 the contract unit price.

1130

- 1131 **a. Fine aggregate.**
1132
1133 (1) **Gradation.** A sieve analysis shall be made at least twice daily in accordance with ASTM
1134 C136 from randomly sampled material taken from the discharge gate of storage bins or
1135 from the conveyor belt.
1136
1137 (2) **Moisture content.** If an electric moisture meter is used, at least two direct measurements
1138 of moisture content shall be made per week to check the calibration. If direct
1139 measurements are made in lieu of using an electric meter, two tests shall be made per day.
1140 Tests shall be made in accordance with ASTM C70 or ASTM C566.
1141
1142 (3) **Deleterious substances.** Fine aggregate as delivered to the mixer shall be tested for
1143 deleterious substances in fine aggregate for concrete as specified in paragraph 501-2.1b,
1144 prior to production of the control strip, and a minimum of every 30-days during
1145 production or more frequently as necessary to control deleterious substances.
1146
1147 **b. Coarse Aggregate.**
1148
1149 (1) **Gradation.** A sieve analysis shall be made at least twice daily for each size of aggregate.
1150 Tests shall be made in accordance with ASTM C136 from randomly sampled material
1151 taken from the discharge gate of storage bins or from the conveyor belt.
1152
1153 (2) **Moisture content.** If an electric moisture meter is used, at least two direct measurements
1154 of moisture content shall be made per week to check the calibration. If direct
1155 measurements are made in lieu of using an electric meter, two tests shall be made per day.
1156 Tests shall be made in accordance with ASTM C566.
1157
1158 (3) **Deleterious substances.** Coarse aggregate as delivered to the mixer shall be tested for
1159 deleterious substances in coarse aggregate for concrete as specified in paragraph 501-2.1c,
1160 prior to production of the control strip, and a minimum of every 30-days during
1161 production or more frequently as necessary to control deleterious substances.
1162
1163 **c. Slump.** One test shall be made for each subplot. Slump tests shall be performed in accordance
1164 with ASTM C143 from material randomly sampled from material discharged from trucks at the
1165 paving site. Material samples shall be taken in accordance with ASTM C172.
1166
1167 **d. Air content.** One test shall be made for each subplot. Air content tests shall be performed in
1168 accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or
1169 other porous coarse aggregate, from material randomly sampled from trucks at the paving site.
1170 Material samples shall be taken in accordance with ASTM C172.
1171
1172 **e. Unit weight and Yield.** One test shall be made for each subplot. Unit weight and yield tests
1173 shall be in accordance with ASTM C138. The samples shall be taken in accordance with ASTM
1174 C172 and at the same time as the air content tests.
1175
1176 **f. Temperatures.** Temperatures shall be checked at least four times per lot at the job site in
1177 accordance with ASTM C1064.
1178
1179 **g. Smoothness for Contractor Quality Control.**

1180 The Contractor shall perform smoothness testing in transverse and longitudinal directions daily
1181 to verify that the construction processes are producing pavement with variances less than 1/4 inch
1182 in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If
1183 the smoothness criteria is not met, appropriate changes and corrections to the construction
1184 process shall be made by the Contractor before construction continues.
1185

1186 The Contractor may use a 12-foot (3.7 m) “straightedge, a rolling inclinometer meeting the
1187 requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot
1188 (3.7m) straightedge approved by the DEN Project Manager. Straight-edge testing shall start with
1189 one-half the length of the straightedge at the edge of pavement section being tested and then
1190 moved ahead one-half the length of the straightedge for each successive measurement. Testing
1191 shall be continuous across all joints. The surface irregularity shall be determined by placing the
1192 freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the
1193 two highest spots covered by its length, and measuring the maximum gap between the
1194 straightedge and the pavement surface in the area between the two high points. If the rolling
1195 inclinometer or external reference device is used, the data may be evaluated using the FAA
1196 profile program ProFAA or FHWA ProVal, using the 12-foot straightedge simulation function.
1197

1198 Smoothness readings shall not be made across grade changes or cross slope transitions. The
1199 transition between new and existing pavement shall be evaluated separately for conformance
1200 with the plans.
1201

1202 **(1) Transverse measurements.** Transverse measurements shall be taken for each day’s
1203 production placed. Transverse measurements shall be taken perpendicular to the
1204 pavement centerline each 50 feet (15 m) or more often as determined by the DEN Project
1205 Manager. The joint between lanes shall be tested separately to facilitate smoothness
1206 between lanes.
1207

1208 **(2) Longitudinal measurements.** Longitudinal measurements shall be taken for each day’s
1209 production placed. Longitudinal tests shall be parallel to the centerline of paving; at the
1210 center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the
1211 third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater.
1212

1213 Deviations on the final surface course in either the transverse or longitudinal direction that
1214 will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per
1215 paragraph 501-4.19f or by removing and replacing the surface course to full depth.
1216 Grinding shall be tapered in all directions to provide smooth transitions to areas not
1217 requiring grinding. All areas in which diamond grinding has been performed shall be
1218 subject to the final pavement thickness tolerances specified in paragraph 501-6.6.
1219

1220 Control charts shall be kept to show area of each day’s placement and the percentage of
1221 corrective grinding required. Corrections to production and placement shall be initiated
1222 when corrective grinding is required. If the Contractor’s machines and/or methods
1223 produce significant areas that need corrective actions in excess of 10 percent of a day’s
1224 production, production shall be stopped until corrective measures are implemented by the
1225 Contractor.
1226

1227 **h. Grade.** Grade will be evaluated prior to and after placement of the concrete surface.
1228 Measurements will be taken at appropriate gradelines (as a minimum at center and edges of
1229 paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of

1230 the pavement will not vary from the gradeline elevations and cross-sections shown on the plans
1231 by more than 1/2 inch (12 mm) vertically and 0.1 feet (30 mm) laterally. The documentation will
1232 be provided by the Contractor to the DEN Project Manager within 48 hours.
1233

1234 Areas with humps or depression that that exceed grade or smoothness and that retain water on
1235 the surface must be ground off provided the course thickness after grinding is not more than 1/2
1236 inch (12 mm) less than the thickness specified on the plans. If these areas cannot be corrected
1237 with grinding then the slabs that are retaining water must be removed and replaced in accordance
1238 with paragraph 501-4.19d. Grinding shall be in accordance with paragraph 501-4.19f. All
1239 corrections will be at the Contractors expense.
1240

1241 **501-5.4 CONTROL CHARTS.** The Contractor shall maintain linear control charts for fine and coarse
1242 aggregate gradation, slump, and air content. The Contractor shall also maintain a control chart plotting the
1243 coarseness factor/workability factor from the combined gradations in accordance with paragraph 501-2.1d.
1244

1245 Control charts shall be posted in a location satisfactory to the DEN Project Manager and shall be kept up to
1246 date at all times. As a minimum, the control charts shall identify the project number, the contract item
1247 number, the test number, each test parameter, the Action and suspension Limits, or Specification limits,
1248 applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts
1249 as part of a process control system for identifying potential problems and assignable causes before they occur.
1250 If the Contractor's projected data during production indicates a potential problem and the Contractor is not
1251 taking satisfactory corrective action, the DEN Project Manager may halt production or acceptance of the
1252 material.
1253

1254 **a. Fine and coarse aggregate gradation.** The Contractor shall record the running average of the
1255 last five gradation tests for each control sieve on linear control charts. Superimposed on the
1256 control charts shall be the action and suspension limits. Gradation tests shall be performed by
1257 the Contractor per ASTM C136. The Contractor shall take at least two samples per lot to check
1258 the final gradation. Sampling shall be per ASTM D75 from the flowing aggregate stream or
1259 conveyor belt.
1260

1261 **b. Slump and air content.** The Contractor shall maintain linear control charts both for individual
1262 measurements and range (that is, difference between highest and lowest measurements) for
1263 slump and air content in accordance with the following Action and Suspension Limits.
1264

1265 **c. Combined gradation.** The Contractor shall maintain a control chart plotting the coarseness
1266 factor and workability factor on a chart in accordance with paragraph 501-2.1d.

1267

Control Chart Limits¹

Control Parameter	Individual Measurements	
	Action Limit	Suspension Limit
Gradation ²	*3	*3
Coarseness Factor (CF)	±3.5	±5
Workability Factor (WF)	±2	±3
Slump	+0.5 to -1 inch (+13 to -25 mm)	+1 to -1.5 inch (+25 to -38 mm)
Air Content	±1.5%	±2.0%

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¹ Control charts shall developed and maintained for each control parameter indicated.

1269

² Control charts shall be developed and maintained for each sieve size.

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³ Action and suspension limits shall be determined by the Contractor.

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501-5.5 CORRECTIVE ACTION AT SUSPENSION LIMIT. The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of control. The CQCP shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

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- a. Fine and coarse aggregate gradation. When two consecutive averages of five tests are outside of the suspension limits, immediate steps, including a halt to production, shall be taken to correct the grading.

1281

1282

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1284

- b. Coarseness and Workability factor. When the CF or WF reaches the applicable suspension limits, the Contractor, immediate steps, including a halt to production, shall be taken to correct the CF and WF.

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1288

- c. Fine and coarse aggregate moisture content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

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1292

- d. Slump. The Contractor shall halt production and make appropriate adjustments whenever:

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1294

- (1) one point falls outside the Suspension Limit line for individual measurements

1295

1296

OR

1297

1298

- (2) two points in a row fall outside the Action Limit line for individual measurements.

1299

1300

- e. Air content. The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:

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1302

1303

- (1) one point falls outside the Suspension Limit line for individual measurements

1304
1305 OR
1306
1307 (2) two points in a row fall outside the Action Limit line for individual measurements.
1308
1309

MATERIAL ACCEPTANCE

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1311
1312 **501-6.1 QUALITY ASSURANCE (QA) ACCEPTANCE SAMPLING AND TESTING.** All acceptance
1313 sampling and testing necessary to determine conformance with the requirements specified in this section,
1314 with the exception of coring for thickness determination, will be performed by the DEN Project Manager.
1315 The Contractor shall provide adequate facilities for the initial curing of beams. The Contractor shall bear the
1316 cost of providing initial curing facilities and coring and filling operations, per paragraph 501-6.5b(1).
1317

1318 The samples will be transported while in the molds. The curing, except for the initial cure period, will be
1319 accomplished using the immersion in saturated lime water method. During the 24 hours after molding, the
1320 temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F (16° to
1321 27°C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly
1322 constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in
1323 favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the
1324 temperature and moisture loss requirements are met.
1325

1326 **501-6.2 QUALITY ASSURANCE (QA) TESTING LABORATORY.** Quality assurance testing
1327 organizations performing these acceptance tests will be accredited in accordance with ASTM C1077. The
1328 quality assurance laboratory accreditation must be current and listed on the accrediting authority's website.
1329 All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy
1330 of the laboratory's current accreditation and accredited test methods will be submitted to the DEN Project
1331 Manager prior to start of construction.
1332

1333 **501-6.3 LOT SIZE.** Concrete will be accepted for strength and thickness on a lot basis. A lot will consist of
1334 a day's production not to exceed 4,000 square yards. Each lot will be divided into approximately equal
1335 sublots with individual sublots between 800 to 1,200 square yards. Where three sublots are produced, they
1336 will constitute a lot. Where one or two sublots are produced, they will be incorporated into the previous or
1337 next lot. Where more than one plant is simultaneously producing concrete for the job, the lot sizes will apply
1338 separately for each plant.
1339

1340 **501-6.4 PARTIAL LOTS.** When operational conditions cause a lot to be terminated before the specified
1341 number of tests have been made for the lot or for overages or minor placements to be considered as partial
1342 lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.
1343 Where three sublots have been produced, they will constitute a lot. Where one or two sublots have been
1344 produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will
1345 be used in the acceptance criteria calculation, that is, n=5 or n=6.
1346
1347
1348

1349 **501-6.5 ACCEPTANCE SAMPLING AND TESTING.**

1350

1351 **a. Strength.**

1352

1353 (1) **Sampling.** One sample will be taken for each subplot from the concrete delivered to the
1354 job site. Sampling locations will be determined by the DEN Project Manager in
1355 accordance with random sampling procedures contained in ASTM D3665. The concrete
1356 will be sampled in accordance with ASTM C172.

1357

1358 (2) **Test Specimens.** The DEN Project Manager will be responsible for the casting, initial
1359 curing, transportation, and curing of specimens in accordance with ASTM C31. Two (2)
1360 specimens will be made from each sample and slump, air content, unit weight, and
1361 temperature tests will be conducted for each set of strength specimens. Within 24 to 48
1362 hours, the samples will be transported from the field to the laboratory while in the molds.
1363 Samples will be cured in saturated lime water.

1364

The strength of each specimen will be determined in accordance with ASTM C78. The
1365 strength for each subplot will be computed by averaging the results of the two test
1366 specimens representing that subplot.

1367

1368 (3) **Acceptance.** Acceptance of pavement for strength will be determined by the DEN
1369 Project Manager in accordance with paragraph 501-6.6b(1). All individual strength tests
1370 within a lot will be checked for outliers in accordance with ASTM E178, at a significance
1371 level of 5%. Outliers will be discarded and the remaining test values will be used to
1372 determine acceptance in accordance with paragraph 501-6.5b.

1373

1374

1375

b. Pavement thickness.

1376

1377 (1) **Sampling.** One core will be taken by the Contractor for each subplot in the presence of the
1378 DEN Project Manager. Sampling locations will be determined by the DEN Project
1379 Manager in accordance with random sampling procedures contained in ASTM D3665.
1380 Areas, such as thickened edges, with planned variable thickness, will be excluded from
1381 sample locations.

1382

Cores shall be a minimum 4 inch (100 mm) in diameter neatly cut with a core drill. The
1383 Contractor will furnish all tools, labor, and materials for cutting samples and filling the
1384 cored hole. Core holes will be filled by the Contractor with a non-shrink grout approved
1385 by the DEN Project Manager within one day after sampling.

1386

1387 (2) **Testing.** The thickness of the cores will be determined by the DEN Project Manager by
1388 the average caliper measurement in accordance with ASTM C174. Each core shall be
1389 photographed and the photograph included with the test report.

1390

1391 (3) **Acceptance.** Acceptance of pavement for thickness will be determined by the DEN
1392 Project Manager in accordance with paragraph 501-6.6.

1393

1394

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1396

1397 **501-6.6 ACCEPTANCE CRITERIA.**

1398

1399 **a. General.** Acceptance will be based on the following characteristics of the completed pavement
 1400 discussed in paragraph 501-6.5b:

1401

1402 (1) Strength

1403 (2) Thickness

1404 (3) Grade

1405 (4) Profilograph smoothness Not used.

1406 (5) Adjustments for repairs

1407

1408 Acceptance for strength, thickness, and grade, will be based on the criteria contained in
 1409 accordance with paragraph 501-6.6b(1), 501-6.6b(2), and 501-6.6b(3), respectively.

1410

1411 Production quality must achieve 90 PWL or higher to receive full payment.

1412

1413 Strength and thickness will be evaluated for acceptance on a lot basis using the method of
 1414 estimating PWL. Production quality must achieve 90 PWL or higher to receive full payment. The
 1415 PWL will be determined in accordance with procedures specified in Item C-110.

1416

1417 The lower specification tolerance limit (L) for strength and thickness will be:

1418

1419

Lower Specification Tolerance Limit (L)

Strength	0.93 × strength specified in paragraph 501-3.3
Thickness	Lot Plan Thickness in inches, - 0.50 in

1420

1421 **b. Acceptance criteria.**

1422 (1) **Strength.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance
 1423 and payment for the lot will be determined in accordance with paragraph 501-8.1.

1424 (2) **Thickness.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance
 1425 and payment for the lot will be determined in accordance with paragraph 501-8.1.

1426

1427 (3) **Grade.** The final finished surface of the pavement of the completed project will not vary
 1428 from the gradeline elevations and cross-sections shown on the plans by more than 1/2
 1429 inch (12 mm) vertically or 0.1 feet (30 mm) laterally. The documentation, stamped and
 1430 signed by a licensed surveyor shall be in accordance with paragraph 501-5.3h. Payment for
 1431 sublots that do not meet grade for over 25% of the subplot shall reduced by 5% and not be
 1432 more than 95%.

1433

1434 (4) **Profilograph roughness for QA Acceptance.** Not used.

1435

1436 (5) **Adjustments for repair.** Sublots with spall repairs, crack repairs, or partial panel
 1437 replacement, will be limited to no more than 95% payment.

1438

1439 (6) **Adjustment for grinding.** For sublots with grinding over 25% of a subplot, payment will
 1440 be reduced 5%.

1441

1442

METHOD OF MEASUREMENT

1443
1444
1445 **501-7.1** Concrete pavement shall be measured by the number of square yards (square meters) of plain or
1446 reinforced pavement as specified in-place, completed and accepted.

1447
1448 **501-7.2** Bond Breaker Fabric shall be measured by the number of square yards (square meters) in-place,
1449 completed and accepted.

1450
1451 **501-7.3** Spall Repair shall be measured by the number of square yard of spalls repairs completed and
1452 accepted.

1453
1454 **501-7.4** Base Can Reinforcing Mat shall be measured per each of the number of light cans requiring
1455 additional mat reinforcing that are completed and accepted.

BASIS OF PAYMENT

1456
1457
1458
1459
1460 **501-8.1 PAYMENT.** Payment for concrete pavement meeting all acceptance criteria as specified in
1461 paragraph 501-6.6. Acceptance Criteria shall be based on results of strength, smoothness, and thickness tests.
1462 Payment for acceptable lots of concrete pavement shall be adjusted in accordance with paragraph 501-8.1a
1463 for strength and thickness; 501-8.1b for repairs; 501-8.1c for grinding; and 501-8.1d for smoothness, subject
1464 to the limitation that:

1465
1466 The total project payment for concrete pavement shall not exceed 100 percent of the product of the contract
1467 unit price and the total number of square yards (square meters) of concrete pavement used in the accepted
1468 work (See Note 1 under the Price Adjustment Schedule table below).

1469
1470 Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to
1471 complete the work as specified herein and on the drawings.

1472
1473 **a. Basis of adjusted payment.** The pay factor for each individual lot shall be calculated in
1474 accordance with the Price Adjustment Schedule table below. A pay factor shall be calculated for
1475 both strength and thickness. The lot pay factor shall be the higher of the two values when
1476 calculations for both strength and thickness are 100% or higher. The lot pay factor shall be the
1477 product of the two values when only one of the calculations for either strength or thickness is
1478 100% or higher. The lot pay factor shall be the lower of the two values when calculations for
1479 both strength and thickness are less than 100%.

1480

1481

Price Adjustment Schedule¹

Percentage of Materials Within Specification Limits (PWL)	Lot Pay Factor (Percent of Contract Unit Price)
96 – 100	106
90 – 95	PWL + 10
75 – 90	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject ²

1482

¹ Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment in excess of 100% shall be subject to the total project payment limitation specified in paragraph 501-8.1.

1483

1484

² The lot shall be removed and replaced unless, after receipt of FAA concurrence, the Owner and Contractor agree in writing that the lot will remain; the lot paid at 50% of the contract unit price; and the total project payment limitation reduced by the amount withheld for that lot.

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For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 501-8.1. Payment in excess of 100% for accepted lots of concrete pavement shall be used to offset payment for accepted lots of concrete pavement that achieve a lot pay factor less than 100%; except for rejected lots which remain in place and/or sublots with adjustments for repairs.

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Payment shall be made under:

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1505

Item P-501a Portland Cement Concrete Pavement (Non-Reinforced. 17'') per square yard

1506

Item P-501b Portland Cement Concrete Pavement (Reinforced. 17'') per square yard

1507

Item P-501c Portland Cement Concrete Pavement (Reinforced. 21'') per square yard

1508

Item P-501d Bondbreaker Fabric per square yard

1509

Item P-501e Pavement Spall Repair per square yard

1510

Item P-501f Base Can Reinforcing Mat per each

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1513

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1515

QUALITY CONTROL TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Fine Aggregate Gradation P-501-5.3a (1)	ASTM C136	Paragraph 501-5.4c Control Charts Limits	Next following work day	2 samples per lot
Fine Aggregate Moisture Content P-501-5.3a (2)	ASTM C70 ASTM C566		Next following work day	2 direct measurements per week for calibration 2 test per day for direct measurement
Fine Aggregate Deleterious Substances P-501-5.3a(3)	ASTM C142 ASTM C123	Paragraph 501-2.1b	prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances	prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances
Coarse Aggregate Gradation P-501-5.3b (1)	ASTM C136	Paragraph 501-5.4c And Control Charts Limits	Next following work day	P-5001-5.3b (1) twice daily for each size of aggregate P-501-5.4a. 2 samples per lot
Coarse Aggregate Moisture Content P-501-5.3b (2)	ASTM C566		Next following work day	2 direct measurements per week for calibration 2 test per day for direct measurement
Coarse Aggregate Deleterious Substances P-501-5.3 (3)	ASTM C142 ASTM C117 ASTM C123	Paragraph 501-2.1c	prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances	prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control

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				deleterious substances
Slump P-501-5.3c	ASTM C143 ASTM C172	Action Limit +.5 to -1 inch Suspension limit +1 to -1.5 inch	At time of truck delivery at paving site	1 test for each sublot
Air Content P-501-5.3d	ASTM C231 ASTM C173	Action Limit $\pm 1.5\%$ Suspension Limit $\pm 2.0\%$	At time of truck delivery at paving site	1 test per each sublot
Unit Weight and Yield P-501-5.3e	ASTM C138 ASTM C172		At time of truck delivery at paving site	At the same time as the air content test
Temperatures P-501-5.3f	ASTM C1064			4 times per lot at the job site
Smoothness (1) Transverse P-501-5.3g	12-foot straightedge	1/4 inch	for each day's production placed	Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the DEN Project Manager
Smoothness (2) Longitudinal P-501-5.3g	12-foot straightedge	1/4 inch	for each day's production placed	Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 ft or greater
Grade P-501-5.3h	Survey	1/2 inch vertically and 0.1 feet laterally	Prior to acceptance	gradeline elevations and cross-sections shown on the plans

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 1518
 1519

1520

QUALITY ASSURANCE SAMPLING AND TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Strength P-501-6.5a	ASTM D3665 ASTM C172 ASTM C31 ASTM C78 ASTM E178	650 psi (Min) Apply PWL	28 days at time of testing	Average of 2 samples per subplot.
Thickness P-501-6.5b	ASTM D3665 ASTM C174	Depth depicted on plans Apply PWL	At time of coring	1 core per subplot
Grade P-501-6.6b (3)	Survey	1/2 inch vertically or 0.1 feet laterally	Prior to acceptance	gradeline elevations and cross-sections shown on the plans
Profilograph Roughness P-501-6.6 b(4)	ASTM E1274 or a Class I inertial profiler meeting ASTM E950.	average profile index less than 15 inches per mile per 1/10 mile	48 hours after profilograph is performed	When project is completed

1521

REFERENCES

1522

1523

1524 The publications listed below form a part of this specification to the extent referenced. The publications are
 1525 referred to within the text by the basic designation only.

1526

1527 ASTM INTERNATIONAL (ASTM)

1528

1529 ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete
 1530 Reinforcement

1531

1532 ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for
 1533 Concrete Reinforcement

1534

1535 ASTM A704 Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete
 1536 Reinforcement

1537

1538 ASTM A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for
 1539 Concrete Reinforcement

1540

1541	ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
1542		
1543	ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
1544		
1545		
1546	ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
1547		
1548		
1549	ASTM A996	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
1550		
1551		
1552	ASTM A1035	Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
1553		
1554		
1555	ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
1556		
1557		
1558	ASTM A1078	Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
1559		
1560		
1561	ASTM C29	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
1562		
1563		
1564	ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
1565		
1566		
1567	ASTM C33	Standard Specification for Concrete Aggregates
1568		
1569	ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
1570		
1571		
1572	ASTM C70	Standard Test Method for Surface Moisture in Fine Aggregate
1573		
1574	ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
1575		
1576		
1577	ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
1578		
1579		
1580	ASTM C94	Standard Specification for Ready-Mixed Concrete
1581		
1582	ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
1583		
1584	ASTM C117	Standard Test Method for Materials Finer than 75- μm (No. 200) Sieve in Mineral Aggregates by Washing
1585		
1586		
1587	ASTM C123	Standard Test Method for Lightweight Particles in Aggregate
1588		
1589	ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
1590		

1591	ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
1592		
1593		
1594	ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
1595		
1596		
1597	ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
1598		
1599		
1600	ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
1601		
1602	ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
1603		
1604	ASTM C150	Standard Specification for Portland Cement
1605		
1606	ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
1607	ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
1608		
1609	ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
1610		
1611		
1612	ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
1613		
1614		
1615	ASTM C227	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
1616		
1617		
1618	ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
1619		
1620		
1621	ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
1622		
1623	ASTM C295	Standard Guide for Petrographic Examination of Aggregates for Concrete
1624		
1625	ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
1626		
1627		
1628	ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
1629		
1630		
1631	ASTM C494	Standard Specification for Chemical Admixtures for Concrete
1632		
1633	ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregates by Drying
1634		
1635		
1636	ASTM C595	Standard Specification for Blended Hydraulic Cements
1637		
1638	ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
1639		
1640		

1641	ASTM C642	Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
1642		
1643		
1644	ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
1645		
1646		
1647	ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
1648		
1649		
1650	ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
1651		
1652		
1653	ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
1654		
1655	ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
1656		
1657		
1658	ASTM C1064	Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
1659		
1660		
1661	ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
1662		
1663		
1664	ASTM C1157	Standard Performance Specification for Hydraulic Cement
1665		
1666	ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
1667		
1668		
1669	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
1670		
1671		
1672		
1673	ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
1674		
1675		
1676		
1677	ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
1678		
1679		
1680	ASTM D75	Standard Practice for Sampling Aggregates
1681		
1682	ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
1683		
1684		
1685		
1686	ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
1687		
1688		
1689		

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1690	ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
1691		
1692		
1693	ASTM D3665	Standard Practice for Random Sampling of Construction Materials
1694		
1695	ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
1696		
1697		
1698	ASTM E178	Standard Practice for Dealing with Outlying Observations
1699		
1700	ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph
1701		
1702		
1703	ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface
1704		
1705		
1706	AMERICAN CONCRETE INSTITUTE (ACI)	
1707		
1708	ACI 305R	Guide to Hot Weather Concreting
1709		
1710	ACI 306R	Guide to Cold Weather Concreting
1711		
1712	ACI 309R	Guide for Consolidation of Concrete
1713		
1714	ADVISORY CIRCULARS (AC)	
1715		
1716	AC 150/5320-6	Airport Pavement Design and Evaluation
1717		
1718	FEDERAL HIGHWAY ADMINISTRATION (FHWA)	
1719		
1720	HIPERPAV 3, version 3.2	
1721		
1722	PORTLAND CONCRETE ASSOCIATION (PCA)	
1723		
1724	PCA	Design and Control of Concrete Mixtures, 16 th Edition
1725		
1726	U.S. ARMY CORPS OF ENGINEERS (USACE) CONCRETE RESEARCH DIVISION (CRD)	
1727		
1728	CRD C662	Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)
1729		
1730		
1731		
1732	UNITED STATES AIR FORCE ENGINEERING TECHNICAL LETTER (ETL)	
1733		
1734	ETL 97-5	Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements
1735		
1736		
1737		
1738	**END ITEM P-501**	
1739		

ITEM P-603 EMULSIFIED ASPHALT TACK COAT

DESCRIPTION

603-1.1 This item shall consist of preparing and treating an asphalt or concrete surface with asphalt material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

MATERIALS

603-2.1 ASPHALT MATERIALS. The asphalt material shall be an emulsified asphalt as specified in ASTM D3628 as an asphalt application for tack coat appropriate to local conditions. The emulsified asphalt shall not be diluted. The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the asphalt material to the DEN Project Manager before the asphalt material is applied for review and acceptance. The furnishing of COA for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

CONSTRUCTION METHODS

603-3.1 WEATHER LIMITATIONS. The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50°F (10°C) or above; the temperature has not been below 35°F (2°C) for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the DEN Project Manager.

603-3.2 EQUIPMENT. The Contractor shall provide equipment for heating and applying the emulsified asphalt material. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour (13 km per hour) or seven (700) feet per minute (213 m per minute).

The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a minimum 12-foot (3.7-m) spreader spray bar with individual nozzle control with computer-controlled application rates. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper.

The distributor truck shall be equipped to effectively heat and mix the material to the required temperature prior to application as required. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Do not overheat or over mix the material.

The distributor shall be equipped with a hand sprayer.

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50 Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must
 51 furnish a current calibration certification for the asphalt distributor truck from any State or other agency as
 52 approved by the DEN Project Manager.

53
 54 A power broom and/or power blower suitable for cleaning the surfaces to which the asphalt tack coat is to be
 55 applied shall be provided.

56
 57 **603-3.3 Application of emulsified asphalt material.** The emulsified asphalt shall not be diluted. Immediately
 58 before applying the emulsified asphalt tack coat, the full width of surface to be treated shall be swept with a
 59 power broom and/or power blower to remove all loose dirt and other objectionable material.

60
 61 The emulsified asphalt material shall be uniformly applied with an asphalt distributor at the rates appropriate
 62 for the conditions and surface specified in the table below. The type of asphalt material and application rate
 63 shall be approved by the DEN Project Manager prior to application.

Emulsified Asphalt

Surface Type	Residual Rate, gal/SY (L/square meter)	Emulsion Application Bar Rate, gal/SY (L/square meter)
New asphalt	0.02-0.05 (0.09-0.23)	0.03-0.07 (0.13-0.32)
Existing asphalt	0.04-0.07 (0.18-0.32)	0.06-0.11 (0.27-0.50)
Milled Surface	0.04-0.08 (0.18-0.36)	.06-0.12 (0.27-0.54)
Concrete	0.03-0.05 (0.13-0.23)	0.05-0.08 (0.23-0.36)

66
 67 After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period
 68 of time necessary to permit drying and setting of the tack coat. This period shall be determined by the DEN
 69 Project Manager. The Contractor shall protect the tack coat and maintain the surface until the next course has
 70 been placed. When the tack coat has been disturbed by the Contractor, tack coat shall be reapplied at the
 71 Contractor's expense.

72
 73 **603-3.4 FREIGHT AND WAYBILLS.** The Contractor shall submit waybills and delivery tickets, during
 74 progress of the work. Before the final statement is allowed, file with the DEN Project Manager certified
 75 waybills and certified delivery tickets for all emulsified asphalt materials used in the construction of the
 76 pavement covered by the contract. Do not remove emulsified asphalt material from storage until the initial
 77 outage and temperature measurements have been taken. The delivery or storage units will not be released
 78 until the final outage has been taken.

METHOD OF MEASUREMENT

81
 82 **603-4.1** There shall be no direct measurement or payment for tack coat. The work under this item shall be
 83 considered subsidiary to other items of work.

BASIS OF PAYMENT

84
 85
 86
 87
 88 **603.5-1** Bituminous tack coat shall be considered incidental to the project. No payment shall be made for
 89 bituminous tack coat.

90

91

92 **REFERENCES**

93

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

96

97 ASTM International (ASTM)

98

99 ASTM D1250 Standard Guide for Use of the Petroleum Measurement Tables

100 ASTM D2995 Standard Practice for Estimating Application Rate and Residual Application
101 Rate of Bituminous Distributors

102

103 ASTM D3628 Standard Practice for Selection and Use of Emulsified Asphalts

104

105

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109

****END ITEM P-603****

ITEM P-604A PREFORMED EXPANSION JOINT COMPRESSION SEALS

DESCRIPTION

604A-1.1 This item shall consist of a moisture tight sealing system for structural sealing of expansion joints in concrete pavement. The seal shall consist of an impermeable closed-cell, closed link, ethylene vinyl acetate, low-density polyethylene copolymer, nitrogen blown resilient, nonextrudable foam material with a Ultraviolet (UV) stabilizer added.

MATERIALS

604A-2.1 GENERAL. The material shall be meet the following physical requirements in Table 1. The material must be jet fuel resistant, glycol compatible, and include a UV stabilizer.

Table 1. Physical Requirements

Test	Test Method	Requirements
Compression Set	ASTM D3575 Suffix B	10% - 2 Hr Recovery 9% - 24 Hr Recovery
Elongation at break	ASTM D3575 Suffix T	185% - 280%
Tensile Strength	ASTM D3575 Suffix T	92 - 140 psi
Tear Resistance	ASTM D624	10-20 lbs/in
Density	ASTM D3575 Suffix W	2.7 -3.4 lbs/ft ³
Water Absorption	ASTM D3575 Suffix L	0.02 lbs/ft ²
Weather/Deterioration	AASHTO T42	No Deterioration

604A-2.2 ADHESIVE. Adhesive used for the preformed foam compression seal shall be as recommended by the manufacturer.

604A-2.3 DELIVERY AND STORAGE. Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided at the job site to protect materials from weather and to maintain them at temperatures as recommended by the manufacturer.

604A-2.4 SUBMITTALS. Certified copies of test results shall be provided in accordance with Section 013300 Submittal Procedures and 013325 Shop and Working Drawings, Product Data and Samples.

a. Construction Equipment List. List of proposed equipment to be used in the performance of construction work, including descriptive data, shall be provided in accordance with Section 013300 and Section 013325.

b. Manufacturer's Instructions. Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer's recommendations, printed copies of the recommendations shall be furnished in accordance with Section 013300 and Section 013325. Installation

27 of the material will not be allowed until the recommendations are received. Failure to furnish these
28 recommendations can be a cause for rejection of the material.

29 **c. Test Reports/Samples.** The Contractor shall submit certified copies of the test reports
30 and samples of the materials for approval in accordance with Section 013300 and Section 013325. Printed
31 directions from the manufacturer on recommended installation criteria shall be furnished with the test
32 reports, plus the manufacturer's certification that the selected seal is recommend for the installation on
33 this project. No material will be used until it has been approved by the DEN Project Manager.

34 **EQUIPMENT**

35 **604A-3.1** Machines, tools, and equipment used in the performance of the work required by this
36 section shall be approved before the work is started and shall be maintained in satisfactory condition at
37 all times.

38 **a. Joint Cleaning Equipment:**

39 **(1) Concrete Saw.** A self-propelled power saw with water cooled diamond or
40 abrasive saw blades shall be provided for cutting joints to the depths and widths specified and for
41 removing filler (existing old joint seal) or other material embedded in the joints or adhered to the joint
42 faces.

43 **(2) Sandblasting Equipment.** Sandblasting equipment shall include an air
44 compressor, hose, and a longwearing venturi type nozzle of proper size, shape, and opening. The
45 maximum nozzle opening should not exceed 1/4 inch. The air compressor shall be portable and shall be
46 capable of furnishing not less than 150 cubic feet per minute and maintaining a line pressure of not less
47 than 90 psi at the nozzle while in use. The compressor shall be equipped with traps that will maintain the
48 compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle
49 aligned with the joint about one inch above the pavement surface and will direct the blast to clean the
50 joint walls. The height, angle of inclination, and the size of the nozzle shall be adjusted as necessary to
51 ensure satisfactory results.

52 **(3) Waterblasting Equipment.** Waterblasting equipment shall include a trailer
53 mounted water tank, pumps, high pressure hose, and a wand with safety release cutoff controls, nozzle,
54 and auxiliary water resupply equipment. The water tank and auxiliary water resupply equipment shall be
55 sufficient capacity to permit continuous operations. The pumps, hoses, wand, and nozzle shall be of
56 sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width
57 of at least 1/2 inch on either side of the joint. The pump shall be capable of supplying a pressure of at
58 least 3,000 psi. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per
59 square inch at which the equipment is operating.

60 **CONSTRUCTION METHODS**

61 **604A-4.1 GENERAL.** Installation of foam joint sealant shall comply with Manufacturer's
62 instructions and recommendations for foam joint sealant installation complete with a compatible epoxy
63 adhesive for adhesion to all surfaces.

64 Prior to installing foam joint sealant, make certain that surfaces to which adhesive will adhere are clean
65 and free of dust, dirt and other residues that would inhibit a proper bond.

66 The Contractor shall make arrangements for the Manufacturer's representative to meet with the
67 Contractor and the DEN Project Manager prior to the start of sealing operations to ensure the

68 installation procedures are in accordance with the Manufacturer's direction. A representative of the joint
69 sealant manufacturer shall visit the job-site a sufficient number of times during the sealing operations and
70 after the sealing is completed to certify that the joint sealant was installed in accordance with the
71 manufacturer's recommended methods and procedures

72 **604A-4.2 PREPARATION OF JOINTS.** Immediately before installation of the preformed joint
73 seal, the joints shall be thoroughly cleaned full depth to remove all laitance, filler, old existing sealant,
74 foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space
75 to be sealed. Any irregularity in the joint face, which would prevent uniform contact between the joint
76 seal and the joint face shall be corrected prior to the installation of the joint seal. All joint faces shall be
77 vertical.

78 **a. Sawing.** Joints shall be sawed to clean and to open them to the full specified width and
79 depth. Immediately following the sawing operation, the joint faces and opening shall be thoroughly
80 cleaned using a water jet to remove all saw cuttings or debris remaining on the faces or in the joint
81 opening. Compression seal shall be installed within 3 calendar days of the time the individual joint cavity
82 is sawed. Depth of sawing the cavity shall be the full depth of the adjacent concrete pavement. The saw
83 cut for the joint seal cavity shall at all locations be centered over the joint line. The nominal width of the
84 sawed joint seal cavity shall be as follows; the actual width shall be within a tolerance of plus or minus
85 1/16 inch or as noted in the details.

86 **b. Sandblast Cleaning.** The concrete joint faces and pavement surfaces extending at least
87 1/2 inch from the joint edges shall be sandblasted clean. A multiple pass technique shall be used until the
88 surfaces are free of dust, direct curing compound, or any residue that might prevent ready insertion or
89 uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning
90 and immediately prior to sealing, the joints shall be blown out with compressed air and left completely
91 free of debris and water.

92 **c. Waterblast Cleaning.** The concrete joint faces and pavement surfaces extending at
93 least 1/2 inch from the joint edges shall be waterblasted clean. A multiple pass technique shall be used
94 until the surfaces are free of dust, direct, curing compound, or any residue that might prevent ready
95 insertion or uniform contact of the seal and bonding of the adhesive to the concrete. After final cleaning
96 and immediately prior to sealing, the joints shall be blown out with compressed air and left completely
97 free of debris and water. When waterblast cleaning is used, slurry residue must be removed to provide a
98 relatively dust free concrete surface.

99 **d. Rate of Progress.** The stages of joint preparation which includes sandblasting or
100 waterblasting of the joint faces and air pressure cleaning of the joints shall be limited to only the linear
101 footage of joint that can be sealed during the same workday.

102 **604A-4.3 TIME OF INSTALLATION.** Joints shall be sealed within 3 calendar days of sawing
103 the joint seal cavity and immediately following concrete cure and the final cleaning of the joint walls.
104 Open joints ready for sealing that cannot be sealed under the conditions specified herein shall be
105 provided with an approved temporary seal to prevent infiltration of foreign material. When rain
106 interrupts the sealing operations, the joints shall be washed, air pressure cleaned and allowed to dry prior
107 to installing the lubricant/adhesive and preformed seal.

108 **604A-4.4 CLEAN UP.** Prior to Substantial Completion, all unused materials shall be removed
109 from the site, any adhesive on the pavement surface shall be removed, and the pavement shall be left in
110 clean condition.

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111 **604A-4.5 WARRANTY.** The Manufacturer shall provide a warranty on the materials furnished
112 for a minimum of 5 years from the date of acceptance by the DEN Project Manager. The Contractor
113 shall provide a warranty on the installation for a minimum of 5 years from the date of acceptance by the
114 DEN Project Manager.

115

QUALITY CONTROL

116 **604A-5.1 PROCEDURES.** Quality control provisions shall be provided during the joint cleaning
117 process to prevent or correct improper equipment and cleaning techniques that damages the concrete in
118 any manner. Cleaned joints shall be approved by the DEN Project Manager prior to installation of the
119 adhesive and preformed joint seal.

120 **604A-5.2 PRODUCT.** The joint sealing system (preformed seal) shall be inspected for proper
121 rate of cure and bonding to the concrete, cuts, twists, nicks, and other deficiencies. Seals exhibiting any
122 defects, at any time prior to final acceptance of the project, shall be removed from the joint, wasted, and
123 replaced in a satisfactory manner.

124

METHOD OF MEASUREMENT

125 **604A-6.1** There shall be no direct measurement or payment for Preformed Expansion Joint
126 Compression Seals associated with new pavement construction. The work under this item shall be
127 considered incidental to the project.

128 **604A-6.2** The Preformed Expansion Joint Compression Seal replacement associated with joints
129 adjacent to existing pavement on both sides will be measured by the linear foot.

130

BASIS OF PAYMENT

131 **604A-7.1** Preformed Expansion Joint Compression Seals associated with new pavement
132 construction shall be considered incidental to the project. No payment shall be made for Preformed
133 Expansion Joint Compression Seals associated with new pavement

134 **604A-7.2** Preformed Expansion Joint Compression Seal replacement associated with joints
135 adjacent to existing pavement on both sides shall be paid for by the linear foot.

136 Payment will be made under:

137 P-604Aa Precompressed Expansion Sealant – per linear foot

138

TESTING REQUIREMENTS

139 AASHTO T42 Standard Specification for Preformed Expansion Joint Filler for
140 Concrete Construction

141 ASTM D 6211 Test Strength of Conventional Vulcanized Rubber and Thermoplastic
142 Elastomers

143 ASTM D 3575 SUFFIX B Flexible Cellular Materials Made from Olefin Polymers

144 ASTM D 3575 SUFFIX L Flexible Cellular Materials Made from Olefin Polymers

145 ASTM D 3575 SUFFIX T Flexible Cellular Materials Made from Olefin Polymers

146 ASTM D 3575 SUFFIX W Flexible Cellular Materials Made from Olefin Polymers

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END OF ITEM P-604A

149

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ITEM P-605 JOINT SEALANTS FOR PAVEMENTS

DESCRIPTION

605-1.1 This item shall consist of providing and installing a resilient and adhesive joint sealing material capable of effectively sealing joints in pavement; joints between different types of pavements; and cracks in existing pavement.

MATERIALS

605-2.1 JOINT SEALANTS. Joint sealant materials shall meet the requirements of ASTM D 5893 for concrete joints or ASTM D6690-Type II for joints between concrete and asphalt.

Each lot or batch of sealant shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the sealant meets the requirements of this specification.

605-2.2 BACKER ROD. The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be $25\% \pm 5\%$ larger in diameter than the nominal width of the joint.

605-2.3 BOND BREAKING TAPES. Provide a bond breaking tape or separating material that is a flexible, non-shrinkable, non-absorbing, non-staining, and non-reacting adhesive-backed tape. The material shall have a melting point at least 5°F (3°C) greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately $1/8$ inch (3 mm) wider than the nominal width of the joint and shall not bond to the joint sealant.

CONSTRUCTION METHODS

605-3.1 TIME OF APPLICATION. Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be 50°F (10°C) and rising at the time of application of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

605-3.2 EQUIPMENT. Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, 14 days prior to use on the project.

a. Concrete saw. Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified.

b. Sandblasting equipment. The Contractor must demonstrate sandblasting equipment including the air compressor, hose, guide and nozzle size, under job conditions, before approval in accordance with paragraph 605-3.3. The Contractor shall demonstrate, in the presence of the DEN Project Manager, that the method cleans the joint and does not damage the joint.

- 49
- 50 c. **Hand tools.** Hand tools may be used, when approved, for removing defective sealant from a
- 51 crack and repairing or cleaning the crack faces. Hand tools should be carefully evaluated for
- 52 potential spalling effects prior to approval for use.
- 53
- 54 d. **Hot-poured sealing equipment.** The unit applicators used for heating and installing ASTM
- 55 D6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-
- 56 type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-
- 57 type extruding device with a nozzle shaped for inserting in the joint to be filled; positive
- 58 temperature devices for controlling the temperature of the transfer oil and sealant; and a recording
- 59 type thermometer for indicating the temperature of the sealant. The applicator unit shall be
- 60 designed so that the sealant will circulate through the delivery hose and return to the inner kettle
- 61 when not in use. e. **Cold-applied, single-component sealing equipment.** The equipment for
- 62 installing ASTM D5893 single component joint sealants shall consist of an extrusion pump, air
- 63 compressor, following plate, hoses, and nozzle for transferring the sealant from the storage
- 64 container into the joint opening. The dimension of the nozzle shall be such that the tip of the
- 65 nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain
- 66 the initially approved equipment in good working condition, serviced in accordance with the
- 67 supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held
- 68 air-powered equipment (i.e., caulking guns) may be used for small applications.
- 69
- 70

71 **605-3.3 PREPARATION OF JOINTS.** Pavement joints for application of material in this specification must

72 be dry, clean of all scale, dirt, dust, curing compound, and other foreign matter. The Contractor shall

73 demonstrate, in the presence of the DEN Project Manager, that the method cleans the joint and does not

74 damage the joint.

75

- 76 a. **Sawing.** All joints shall be sawed in accordance with specifications and plan details. Immediately
- 77 after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area
- 78 by flushing with a jet of water, and by use of other tools as necessary.
- 79
- 80 b. **Sealing.** Immediately before sealing, the joints shall be thoroughly cleaned of all remaining
- 81 laitance, curing compound, filler, protrusions of hardened concrete, old sealant and other foreign
- 82 material from the sides and upper edges of the joint space to be sealed. Cleaning shall be
- 83 accomplished by sandblasting concrete saw as specified in paragraph 605-3.2. The newly exposed
- 84 concrete joint faces and the pavement surface extending a minimum of 1/2 inch (12 mm) from
- 85 the joint edge shall be sandblasted clean. Sandblasting shall be accomplished in a minimum of two
- 86 passes. One pass per joint face with the nozzle held at an angle directly toward the joint face and
- 87 not more than 3 inches (75 mm) from it. After final cleaning and immediately prior to sealing,
- 88 blow out the joints with compressed air and leave them completely free of debris and water. The
- 89 joint faces shall be surface dry when the seal is applied.
- 90
- 91 b. **Backer Rod.** When the joint opening is of a greater depth than indicated for the sealant depth,
- 92 plug or seal off the lower portion of the joint opening using a backer rod in accordance with
- 93 paragraph 605-2.2 to prevent the entrance of the sealant below the specified depth. Take care to
- 94 ensure that the backer rod is placed at the specified depth and is not stretched or twisted during
- 95 installation.
- 96
- 97 c. **Bond-breaking tape.** Where inserts or filler materials contain bitumen, or the depth of the joint
- 98 opening does not allow for the use of a backup material, insert a bond-separating tape breaker in

99 accordance with paragraph 605-2.3 to prevent incompatibility with the filler materials and three-
100 sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will
101 not float up into the new sealant.
102

103 **605-3.4 INSTALLATION OF SEALANTS.** Joints shall be inspected for proper width, depth, alignment,
104 and preparation, and shall be approved by the DEN Project Manager before sealing is allowed. Sealants shall
105 be installed in accordance with the following requirements:
106

107 Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning
108 with compressed air. Fill the joints from the bottom up to 1/4 inch \pm 1/16 inch below the top of pavement
109 surface; or bottom of groove for grooved pavement. Remove and discard excess or spilled sealant from the
110 pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and
111 entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic
112 shall not be permitted over newly sealed pavement until authorized by the DEN Project Manager. When a
113 primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the
114 manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a
115 tack-free condition within the time specified.
116

117 **605-3.5 INSPECTION.** The Contractor shall inspect the joint sealant for proper rate of cure and set, bonding
118 to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants
119 exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed
120 from the joint, wasted, and replaced as specified at no additional cost to the airport.
121

122 **605-3.6 CLEAN-UP.** Upon completion of the project, remove all unused materials from the site and leave
123 the pavement in a clean condition.
124

125 **605-3.7 FIELD TEST.** Before sealing the joints, the Contractor shall demonstrate that the equipment and
126 procedures for preparing, mixing, and placing the sealant will produce a satisfactory joint seal. The
127 demonstration shall include the preparation of at least two small batches and the application of the resulting
128 material in five joints of at least 25 feet in length each. A representative of the joint sealant manufacturer shall
129 be present at the demonstration to ensure that the installation procedures are in accordance with the
130 manufacturer's recommended installation instructions.
131

132 **a. Testing For Cold Applied Silicone Sealants.** When checking for adhesions of silicone, a
133 pull test may be performed on the job site 21 days after the sealant has been placed.
134

135 **(1)** Make a knife cut horizontally across and through the silicone from one side of the
136 joint to the other.
137

138 **(2)** Make a vertical cut approximately 2-3 inches long on each side of the joint starting at
139 the horizontal cut, keeping the cuts the same length on each side.
140

141 **(3)** Hold the piece of silicone firmly and slowly pull at a 90° angle stretching the silicone
142 not more than 10" per minute as if trying to pull the adhered silicone out of the joint.
143

144 **(4)** If adhesion is proper, the silicone will not pull out of the joint, but will eventually tear
145 cohesively across the joint at the base of the knife cut.
146

147 **b.** If the silicone releases from the joint, adhesion has been affected. Several possible causes are:
148

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- 149 (1) Moisture in the joint during sealant application
 150
 151 (2) Dirty of dusty joint sidewalls
 152
 153 (3) Improper application (overfilling, etc.)
 154
 155 (4) Spalling of the joint walls. (pieces of the concrete will be adhered to the silicone)
 156

157 c. **Repair Of Sealant In Areas Of Adhesion Test.** The silicone sealant may be replaced by
 158 simply applying additional new silicone (normally using a tube of like silicone) in the same manner as
 159 it was originally placed, providing good adhesion was achieved. Proper preparation of the area should
 160 be performed prior to reapplying the silicone assuring the original silicone and the newly applied
 161 silicone are in good contact with each other.
 162

163 **605-3.8 WARRANTY.** The manufacturer shall provide a warranty on the materials furnished for a minimum
 164 of 5 years from the date of acceptance by the Project Manager. The Contractor shall provide a warranty on the
 165 installation for a minimum of 2 years from the date of acceptance by the Project Manager.
 166

167 **METHOD OF MEASUREMENT**

168
 169 **605-4.1** There shall be no direct measurement of Joint Sealing associated with new pavement construction.
 170 The work under this item shall be considered incidental to the project.
 171

172 **605-4.2** Joint sealing material associated with joints adjacent to existing pavement on both sides shall be
 173 measured by the linear foot of sealant in place, completed, and accepted.
 174

175 **BASIS OF PAYMENT**

176
 177 **605-5.1** Joint Sealing associated with new pavement construction shall be considered incidental to the project.
 178 No payment shall be made for Joint Sealing.
 179

180 **605-5.2** Payment for joint sealing material associated with joints adjacent to existing pavement on both sides
 181 shall be made at the contract unit price per linear foot . The price shall be full compensation for furnishing all
 182 materials, for all preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and
 183 incidentals necessary to complete the item.
 184

185
 186 Payment will be made under:
 187 P-605a Joint Sealing Filler – per linear foot
 188

189 **REFERENCES**

190
 191 The publications listed below form a part of this specification to the extent referenced. The publications are
 192 referred to within the text by the basic designation only.

193 ASTM International (ASTM)

194
 195 ASTM D789 Standard Test Method for Determination of Relative Viscosity of Polyamide
 196 (PA)
 197

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198	ASTM D5249	Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
199		
200		
201	ASTM D5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
202		
203		
204	ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt
205		
206	Advisory Circulars (AC)	
207		
208	AC 150/5340-30	Design and Installation Details for Airport Visual Aids
209		
210		

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****END ITEM P-605****

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FOR SEALING WIRE AND LIGHTS IN PAVEMENT
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1

2

Item P-606 Adhesive Compounds, Two-Component for Sealing Wire and Lights in Pavement

3

4

5

DESCRIPTION

6 **606-1.1** This specification covers two types of material; a liquid suitable for sealing electrical wire in saw cuts
7 in pavement and for sealing light fixtures or bases in pavement, and a paste suitable for embedding light
8 fixtures in the pavement. Both types of material are two-component filled formulas with the characteristics
9 specified in paragraph 606-2.4. Materials supplied for use with asphalt and/or concrete pavements must be
10 formulated so they are compatible with the asphalt and/or concrete.

11

12

MATERIALS

13 **606-2.1 CURING.** When pre-warmed to 77°F (25°C), mixed, and placed in accordance with manufacturer's
14 directions, the materials shall cure at temperatures of 45°F (7°C) or above without the application of external
15 heat.

16 **606-2.2 STORAGE.** The adhesive components shall not be stored at temperatures over 86°F (30°C), unless
17 otherwise specified by the manufacturer.

18 **606-2.3 CAUTION.** Installation and use shall be in accordance with the manufacturer's recommended
19 procedures. Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with
20 water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well-ventilated
21 areas. Keep in cool place. Keep away from children.

22 **606-2.4 CHARACTERISTICS.** When mixed and cured in accordance with the manufacturer's directions,
23 the materials shall have the following properties shown in Table 1.

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24

Table 1. Property Requirements

Physical or Electrical Property	Minimum	Maximum	ASTM Method
Tensile			
Portland cement concrete	1,000 psi (70 kg/sq cm)		D 638
Asphalt concrete	500 psi (35 kg/sq cm)		
Elongation			
Portland cement concrete		See note ¹	D 638
Asphalt concrete	50%		D 638
Coef. of cub. exp. cu. cm/cu. cm/°C	0.00090	0.00120	D 1168
Coef. of lin. exp. cm/cm/°C	0.000030	0.000040	D 1168
Dielectric strength, short time test	350 volts/mil.		D 149
Arc resistance	125 sec		
Pull-off			
Adhesion to steel	1,000 psi (70 kg/sq cm)		
Adhesion to Portland cement concrete	200 psi (14 kg/sq cm)		
Adhesion to asphalt concrete	No test available.		
Adhesion to aluminum	250 psi		

25 ¹ 20% or more (without filler) for formulations to be supplied for areas subject to freezing.

26

SAMPLING, INSPECTION, AND TEST PROCEDURES

27 **606-3.1 TENSILE PROPERTIES.** Tests for tensile strength and elongation shall be conducted in
 28 accordance with ASTM D638.

29 **606-3.2 EXPANSION.** Tests for coefficients of linear and cubical expansion shall be conducted in
 30 accordance with, Method B, except that mercury shall be used instead of glycerine. The test specimen shall be
 31 mixed in the proportions specified by the manufacturer, and cured in a glass tub approximately 2 inch (50
 32 mm) long by 3/8 inch (9 mm) in diameter. The interior of the tube shall be precoated with a silicone mold
 33 release agent. The hardened sample shall be removed from the tube and aged at room temperature for one (1)
 34 week before conducting the test. The test temperature range shall be from 35°F (2°C) to 140°F (60°C).

35 **606-3.3 TEST FOR DIELECTRIC STRENGTH.** Test for dielectric strength shall be conducted in
 36 accordance with ASTM D149 for sealing compounds to be furnished for sealing electrical wires in pavement.

37 **606-3.4 TEST FOR ARC RESISTANCE.** Test for arc resistance shall be conducted for sealing
 38 compounds to be furnished for sealing electrical wires in pavement.

39 **606-3.5 TEST FOR ADHESION TO STEEL.** The ends of two smooth, clean, steel specimens of
 40 convenient size (1 inch by 1 inch by 6 inch) (25 mm by 25 mm by 150 mm) would be satisfactory when

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41 bonded together with adhesive mixture and allowed to cure at room temperature for a period of time to meet
 42 formulation requirements and then tested to failure on a Riehle (or similar) tensile tester. The thickness of
 43 adhesive to be tested shall be 1/4 inch (6 mm).

44 **606-3.6 ADHESION TO PORTLAND CEMENT CONCRETE**

45 **a. Concrete test block preparation.** The aggregate grading shall be as shown in Table 2.

46 The coarse aggregate shall consist of crushed rock having a minimum of 75% of the particles with at least
 47 one fractured face and having a water absorption of not more than 1.5%. The fine aggregate shall consist of
 48 crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a
 49 water-cement ratio of 5.5 gallons (21 liters) of water per bag of cement, a cement factor of 6, ± 0.5 , bags of
 50 cement per cubic yard (0.76 cubic meter) of concrete, and a slump of 2-1/2 inch (60 mm), $\pm 1/2$ inch (60 mm
 51 ± 12 mm). The ratio of fine aggregate to total aggregate shall be approximately 40% by solid volume. The air
 52 content shall be 5.0%, $\pm 0.5\%$, and it shall be obtained by the addition to the batch of an air-entraining
 53 admixture such as Vinsol® resin. The mold shall be of metal and shall be provided with a metal base plate.

54 Means shall be provided for securing the base plate to the mold. The assembled mold and base plate shall
 55 be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be
 56 such that several one inch (25 mm) by 2-inch (75 mm) by 3-inch (25 mm by 50 mm by 75 mm) test blocks
 57 can be cut from the specimen with a concrete saw having a diamond blade. The concrete shall be prepared
 58 and cured in accordance with ASTM C192.

59

Table 2. Aggregate for Bond Test Blocks

Type	Sieve Size	Percent Passing
Coarse Aggregate	3/4 inch (19.0 mm)	97 to 100
	1/2 inch (12.5 mm)	63 to 69
	3/8 inch (9.5 mm)	30 to 36
	No. 4 (4.75 mm)	0 to 3
Fine Aggregate	No. 4 (4.75 mm)	100
	No. 8 (2.36 mm)	82 to 88
	No. 16 (1.18 mm)	60 to 70
	No. 30 (600 μ m)	40 to 50
	No. 50 (300 μ m)	16 to 26
	No. 100 (150 μ m)	5 to 9

60 **b. Bond test.** Prior to use, oven-dry the test blocks to constant weight at a temperature of 220°F to
 61 230°F (104°C to 110°C), cool to room temperature, 73.4°F ± 3 °F (23°C ± 1.6 °C), in a desiccator, and clean
 62 the surface of the blocks of film or powder by vigorous brushing with a stiff-bristled fiber brush. Two test
 63 blocks shall be bonded together on the one inch by 3 inch (25 mm by 75 mm) sawed face with the adhesive
 64 mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and
 65 then tested to failure in a Riehle (or similar) tensile tester. The thickness of the adhesive to be tested shall be
 66 1/4 inch (6 mm).

67 **606-3.7 COMPATIBILITY WITH ASPHALT MIX.** Test for compatibility with asphalt in accordance
 68 with ASTM D5329.

69 **606-3.8 ADHESIVE COMPOUNDS - CONTRACTOR'S RESPONSIBILITY.** The Contractor shall
 70 furnish the vendor's certified test reports for each batch of material delivered to the project. The report shall

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71 certify that the material meets specification requirements and is suitable for use with concrete or asphalt
 72 pavements, as required. The report shall be provided to and accepted by the Resident Project Representative
 73 (RPR) before use of the material. In addition, the Contractor shall obtain a statement from the supplier or
 74 manufacturer that guarantees the material for one year. The supplier or manufacturer shall furnish evidence
 75 that the material has performed satisfactorily on other projects.

76 **606-3.9 APPLICATION.** Adhesive shall be applied on a dry, clean surface, free of grease, dust, and other
 77 loose particles. The method of mixing and application shall be in strict accordance with the manufacturer's
 78 recommendations. When used with Item P-605, such as light can installation, Item P-605 shall not be applied
 79 until the Item P-606 has fully cured.

80 **METHOD OF MEASUREMENT**

81 **606-4.1** No measurement will be made for direct payment of adhesive, the cost of furnishing and installing
 82 shall be considered as incidental to the item of which the adhesive is a component part.

83 **BASIS OF PAYMENT**

84 **606-5.1** No direct payment will be made for adhesive, the cost of furnishing and installing shall be considered
 85 as incidental to the item of which the adhesive is a component part.

86 **REFERENCES**

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

89 ASTM International (ASTM)

90 ASTM C192 Standard Practice for Making and Curing Concrete Test Specimens in the
 91 Laboratory

92 ASTM D149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric
 93 Strength of Solid Electrical Insulating Materials at Commercial Power
 94 Frequencies

95 ASTM D638 Standard Test Method for Tensile Properties of Plastics

96 ASTM D5329 Standard Test Methods for Sealants and Fillers, Hot-applied, for Joints and
 97 Cracks in Asphaltic and Portland Cement Concrete Pavements

98

99 **END OF ITEM P-606**

100

ITEM P-608 EMULSIFIED ASPHALT SEAL COAT

DESCRIPTION

608-1.1 This item shall consist of the application of a emulsified asphalt surface treatment composed of an emulsion of natural and refined asphalt materials, water and a polymer additive, for taxiways and runways with the application of a suitable aggregate to maintain adequate surface friction; and airfield secondary and tertiary pavements including low-speed taxiways, shoulders, overruns, roads, parking areas, and other general applications with or without aggregate applied as designated on the plans. The terms seal coat, asphalt sealer, and asphalt material are interchangeable throughout this specification. The term emulsified asphalt means an emulsion of natural and refined asphalt materials.

MATERIALS

608-2.1 AGGREGATE. The aggregate material shall be a dry, clean, dust and dirt free, sound, durable, angular shaped manufactured specialty sand, such as that used as an abrasive, with a Mohs hardness of 6 to 8. The Contractor shall submit the specialty sand manufacturer's technical data and a manufacturer's Certificate of Analysis (COA) indicating that the specialty sand meets the requirements of the specification to the DEN Project Manager prior to start of construction. The sand must be approved for use by the DEN Project Manager and shall meet the following gradation limits when tested in accordance with ASTM C136 and ASTM C117:

Aggregate Material Gradation Requirements¹

Sieve Designation (square openings)	Individual Percentage Retained by Weight
No. 10 (2.00 mm)	0
No. 14 (1.41 mm)	0-4
No. 16 (1.18 mm)	0-8
No. 20 (850 µm)	0-35
No. 30 (600 µm)	20-50
No. 40 (425 µm)	10-45
No. 50 (300 µm)	0-20
No. 70 (212 µm)	0-5
No. 100 (150 µm)	0-2
No. 200 (75 µm)	0-2

¹Locally available sand or abrasive material that is slightly outside of the gradation requirements may be approved by the DEN Project Manager with concurrence by the seal coat manufacturer for the use of locally available sand or abrasive material. The DEN Project Manager and manufacturer's field representative should verify acceptance during application of Control strips indicated under paragraph 608-3.2.

The Contractor shall provide a certification showing particle size analysis and properties of the material delivered for use on the project. The Contractor's certification may be subject to verification by testing the material delivered for use on the project.

608-2.2 ASPHALT EMULSION. The asphalt emulsion shall meet the properties in the following table:

Concentrated Asphalt Emulsion Properties

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Properties	Specification	Limits
Viscosity, Saybolt Furol at 77°F (25°C)	ASTM D7496	20 – 100 seconds
Residue by Distillation or Evaporation	ASTM D6997 or ASTM D6934	57% minimum
Sieve Test	ASTM D6933	0.1% maximum
24-hour Stability	ASTM D6930	1% maximum
5-day Settlement Test	ASTM D6930	5.0% maximum
Particle Charge ¹	ASTM D7402	Positive 6.5 maximum pH

39 ¹ pH may be used in lieu of the particle charge test which is sometimes inconclusive in slow setting, asphalt emulsions.

40

41 The asphalt material base residue shall contain not less than 20% gilsonite, or uintaite and shall not contain any
42 tall oil pitch or coal tar material and shall contain no less than one percent (1%) polymer.

43

44

Tests on Residue from Distillation or Evaporation

Properties	Specification	Limits
Viscosity at 275°F (135°C)	ASTM D4402	1750 cts maximum
Solubility in 1, 1, 1 trichloroethylene	ASTM D2042	97.5% minimum
Penetration	ASTM D5	50 dmm maximum
Asphaltenes	ASTM D2007	15% minimum
Saturates	ASTM D2007	15% maximum
Polar Compounds	ASTM D2007	25% minimum
Aromatics	ASTM D2007	15% minimum

45

46 The asphalt emulsion, when diluted in the volumetric proportion of two parts concentrated asphalt material to
47 one part hot water shall have the following properties:

48

49

51

Two-to-One Dilution Emulsion Properties

Properties	Specification	Limits
In Ready-to-Apply Form, two parts concentrate to one part water, by volume		
Viscosity, Saybolt Furol at 77°F (25°C)	ASTM D7496	5 – 50 seconds
Residue by Distillation or Evaporation	ASTM D6997 or ASTM D6934	38% minimum
Pumping Stability ¹		Pass

52

53

54

¹ Pumping stability is tested by pumping one pint (475 ml) of seal coat diluted one (1) part concentrate to one (1) part water, at 77°F (25°C), through a 1/4-inch (6 mm) gear pump operating 1750 rpm for 10 minutes with no significant separation or coagulation.

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55 The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the emulsified
 56 asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the
 57 Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion
 58 properties.

59
 60 The COA shall be provided to and approved by the DEN Project Manager before the emulsified asphalt is
 61 applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as
 62 a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material
 63 delivered for use on the project.

64
 65 The asphalt material storage and handling temperature shall be between 50°F - 160°F (10°C - 70°C) and the
 66 material shall be protected from freezing, or whenever outside temperature drops below 40°F (4°C) for
 67 prolonged time periods.

68
 69 Contractor shall provide a list of airport pavement projects, exposed to similar climate conditions, where this
 70 product has been successfully applied within at least 5 years of the project.

71
 72 **608-2.3 WATER.** Water used in mixing or curing shall be from potable water sources. Other sources shall be
 73 tested in accordance with ASTM C1602 prior to use. Water used in making and diluting the emulsion shall be
 74 potable, with a maximum hardness of 90ppm calcium and 15ppm magnesium; deleterious iron, sulfates, and
 75 phosphates maximum 7ppm, and less than 1ppm of organic byproducts. Water shall be a minimum of 140°F
 76 (60°C) prior to adding to emulsion.

77
 78 **608-2.4 POLYMER.** The polymer shall meet the properties in the following table:

Polymer Properties

Properties	Limits
Solids Content	47% to 65%, Percent by Weight
Weight	8.0 to 9.0 pounds/gallon (1.07 to 1.17 kg/L)
pH	3.0 to 8.0
Particle Charge	Nonionic/Cationic
Mechanical Stability	Excellent
Film Forming Temperature, °C	+5°C, minimum
Tg, °C	22°C, maximum

81
 82 The manufacturer shall provide a copy of the Certificate of Analysis (COA) for the polymer used in the seal
 83 coat; and the Contractor shall include the COA with the emulsified asphalt COA when submitting to the DEN
 84 Project Manager.

85
 86 **608-2.5 SEAL COAT WITH AGGREGATE.** The Contractor shall submit friction test data from no less
 87 than one of the airport projects identified under 608-2.2. The test data must be from the same project and
 88 include technical details on application rates, aggregate rates, and point of contact at the airport to confirm use
 89 and success of sealer with aggregate.

90

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91 Friction test data in accordance with AC 150/5320-12, at 40 or 60 mph (65 or 95 km/h) wet, must include as
 92 a minimum; the friction value prior to sealant application; two values, between 24 and 96 hours after application,
 93 with a minimum of 24 hours between tests; and one value between 180 days and 360 days after the application.
 94 The results of the tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar
 95 friction value of the pavement surface prior to application, and the long-term test shall indicate no apparent
 96 adverse effect with time relative to friction values and existing pavement surface.

97
 98 Seal coat material submittal without required friction performance will not be approved. Friction tests
 99 performed on this project cannot be used as a substitute of this requirement.

100

101

102 COMPOSITION AND APPLICATION RATE

103

104 **608-3.1 APPLICATION RATE.** The approximate amounts of materials per square yard (square meter) for
 105 the asphalt surface treatment shall be as provided in the table for the treatment area(s) at the specified dilution
 106 rate(s) as noted on the plans. The actual application rates will vary within the range specified to suit field
 107 conditions and will be recommended by the manufacturer's representative and approved by the DEN Project
 108 Manager from the test area/sections evaluation.

109

110

Application Rate

Dilution Rate	Quantity of Emulsion gal/yd ² (l/m ²)	Quantity of Aggregate lb/yd ² (kg/m ²)
2:1	0.08-0.17 (0.36-0.77)	NA

111

112

113 **608-3.2 CONTROL AREAS AND CONTROL STRIPS.** Prior to full application, the control strip must
 114 be accepted by the DEN Project Manager. The surface preparation, personnel, equipment, and method of
 115 operation used on the test area(s) and control strip(s) shall be the same as used on the remainder of the work.

116

117 A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying control
 118 areas and/or control strips to determine the appropriate application rate of both emulsion and aggregate to be
 119 approved by the DEN Project Manager.

120

121 A test area(s) and control strip(s) shall be applied for each differing asphalt pavement surface identified in the
 122 project. The test area(s) and control strip(s) shall be used to determine the material application rate(s) of both
 123 emulsion and sand prior to full production.

124

125 **a. For taxiway, taxilane and apron surfaces.** Prior to full application, the Contractor shall place test
 126 areas at varying application rates as recommended by the Contractor's manufacturer's representative
 127 to determine appropriate application rate(s). The test areas will be located on representative section(s)
 128 of the pavement to receive the asphalt surface treatment designated by the DEN Project Manager.

129

130 **b. For runway and high-speed exit taxiway surfaces.** Prior to full application, the Contractor shall
 131 place a series of control strips a minimum of 300 feet (90 m) long by 12 feet (3.6 m) wide, or width of
 132 anticipated application, whichever is greater, at varying application rates as recommended by the

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133 manufacturer's representative and acceptable to the DEN Project Manager to determine appropriate
134 application rate(s). The control strips should be separated by a minimum of 200 feet between control
135 strips. The area to be tested will be located on a representative section of the pavement to receive the
136 asphalt surface treatment designated by the DEN Project Manager. The control strips should be placed
137 under similar field conditions as anticipated for the actual application. The skid resistance of the
138 existing pavement shall be determined for each control strip with a continuous friction measuring
139 equipment (CFME). The skid resistance of existing pavement can be immediately adjacent to the
140 control strip or at the same location as the control strip if testing prior to application. The Contractor
141 may begin testing the skid resistance of runway and high-speed exit taxiway control strips after
142 application of the asphalt surface treatment has fully cured, generally 8 to 36 hours after application of
143 the control strips depending on site and environmental conditions. Aircraft shall not be permitted on
144 the runway or high speed exit taxiway control strips until such time as the Contractor validates that its
145 surface friction meets the maintenance planning friction levels in AC 150/5320-12, Table 3-2 when
146 tested at speeds of 40 and 60 mph (65 and 95 km/h) wet with approved CFME.

147
148 If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement
149 operations, and equipment shall be made. Additional control strips shall be placed and additional skid resistance
150 tests performed and evaluated. Full production shall not begin without the DEN Project Manager's approval
151 of an appropriate application rate(s). Acceptable control strips shall be paid for in accordance with paragraph
152 608-8.1.

153

154

155 CONSTRUCTION METHODS

156

157 **608-4.1 WORKER SAFETY.** The Contractor shall obtain a Safety Data Sheet (SDS) for both the asphalt
158 emulsion product and sand and require workmen to follow the manufacturer's recommended safety
159 precautions.

160

161 **608-4.2 WEATHER LIMITATIONS.** The asphalt emulsion shall be applied only when the existing
162 pavement surface is dry and when the weather is not foggy, rainy, or when the wind velocity will prevent the
163 uniform application of the material. No material shall be applied in strong winds that interfere with the uniform
164 application of the material(s), or when dust or sand is blowing or when rain is anticipated within eight (8) hours
165 of application completion. The atmospheric temperature and the pavement surface temperature shall both be
166 at, or above 60°F (16°C) and rising. Seal coat shall not be applied when pavement temperatures are expected
167 to exceed 130°F within the subsequent 72 hours if traffic will be opened on pavement within those 72 hours.
168 During application, account for wind drift. Cover existing buildings, structures, runway edge lights, taxiway
169 edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect
170 against overspray before applying the emulsion. Should emulsion get on any light or marker fixture, promptly
171 clean the fixture. If cleaning is not satisfactory to the DEN Project Manager, the Contractor shall replace any
172 light, sign or marker with equivalent equipment at no cost to the Owner.

173

174

175 **608-4.3 EQUIPMENT AND TOOLS.** The Contractor shall furnish all equipment, tools, and machinery
176 necessary for the performance of the work.

177

178 **a. Pressure distributor.** The emulsion shall be applied with a manufacturer-approved computer rate-
179 controlled asphalt distributor. The equipment shall be in good working order and contain no
180 contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to
181 maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will

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182 maintain predetermined flow rates and constant pressure during the application process with
183 application speeds under eight (8) miles per hour (13 km per hour) or seven hundred (700) feet per
184 minute (213 m per minute). The equipment will be tested under pressure for leaks and to ensure
185 proper set-up before use. The Contractor will provide verification of truck set-up (via a test-shot area),
186 including but not limited to, nozzle tip size appropriate for application per nozzle manufacturer, spray-
187 bar height and pressure and pump speed appropriate for the viscosity and temperature of sealer
188 material, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure
189 the truck is in good working order before use.

190
191 The distributor truck shall be equipped with a 12-foot (3.7-m), minimum, spray bar with individual
192 nozzle control. The distributor truck shall be capable of specific application rates in the range of 0.05
193 to 0.25 gallons per square yard (0.15 to 0.80 liters per square meter). These rates shall be computer-
194 controlled rather than mechanical. The distributor truck shall have an easily accessible thermometer
195 that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge
196 that can be used to cross-check the computer accuracy.

197
198 The distributor truck shall effectively heat and mix the material to the required temperature prior to
199 application in accordance with the manufacturer's recommendations.

200
201 The distributor shall be equipped with a hand sprayer to spray the emulsion in areas not accessible to
202 the distributor truck.

203
204 **b. Aggregate spreader.** The asphalt distributor truck will be equipped with an aggregate spreader
205 mounted to the distributor truck that can apply sand to the emulsion in a single pass operation without
206 driving through wet emulsion. The aggregate spreader shall be equipped with a variable control system
207 capable of uniformly distributing the sand at the specified rate at varying application widths and speeds.
208 The aggregate spreader must be adjusted to produce an even and accurate application of specified
209 aggregate. Prior to any seal coat application, the aggregate spreader will be calibrated onsite to ensure
210 acceptable uniformity of spread. The DEN Project Manager will observe the calibration and verify
211 the results. The aggregate spreader will be re-calibrated each time the aggregate rate is changed either
212 during the application of test strips or production. The Contractor may consult the seal coat
213 manufacturer representative for procedure and guidance. The sander shall have a minimum hopper
214 capacity of 3,000 pounds (1361 kg) of sand. Push-type hand sanders will be allowed for use around
215 lights, signs and other obstructions, if necessary.

216
217 **c. Power broom/blower.** A power broom and/or blower shall be provided for removing loose material
218 from the surface to be treated.

219
220 **d. Equipment calibration.** Asphalt distributors must be calibrated within the same construction season
221 in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for
222 the asphalt distributor truck from any State or other agency as approved by the DEN Project Manager.

223
224 **608-4.4 PREPARATION OF ASPHALT PAVEMENT SURFACES.** Clean pavement surface
225 immediately prior to placing the seal coat so that it is free of dust, dirt, grease, vegetation, oil or any type of
226 objectionable surface film. Remove oil or grease from the asphalt pavement by scrubbing with a detergent,

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227 washing thoroughly with clean water, and then treat these areas with a spot primer. Any additional surface
228 preparation, such as crack repair, shall be in accordance with Item P-101, paragraph 101-3.6.
229

230

231 **608-4.5 EMULSION MIXING.** The application emulsion shall be obtained by blending asphalt material
232 concentrate, water and polymer, if specified. Always add heated water to the asphalt material concentrate, never
233 add asphalt material concentrate to heated water. Mix one part heated water to two parts asphalt material
234 concentrate, by volume.
235

236

236 Add 1% polymer, by volume, to the emulsion mix. If the polymer is added to the emulsion mix at the plant,
237 submit weight scale tickets to the DEN Project Manager. As an option, the polymer may be added to the
238 emulsion mix at the job site provided the polymer is added slowly while the asphalt distributor truck circulating
239 pump is running. The mix must be agitated for a minimum of 15 minutes or until the polymer is mixed to the
240 satisfaction of the DEN Project Manager.
241

242

242 **608-4.6 APPLICATION OF ASPHALT EMULSION.** The asphalt emulsion shall be applied using a
243 pressure distributor upon the properly prepared, clean and dry surface at the application rate recommended by
244 the manufacturer's representative and approved by the DEN Project Manager from the test area/sections
245 evaluation for each designated treatment area. The asphalt emulsion should be applied at a temperature
246 between 130°F (54°C) and 160°F (70°C) or in accordance with the manufacturer's recommendation.
247

248

249 If low spots and depressions greater than 1/2 inch (12 mm) in depth in the pavement surface cause ponding
250 or puddling of the applied materials, the pavement surface shall be lightly broomed with a broom or brush type
251 squeegee until the pavement surface is free of any pools of excess material.
252

253

253 During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered
254 or marred.
255

256

256 **608-4.7 APPLICATION OF AGGREGATE MATERIAL.** Immediately following the application of the
257 asphalt emulsion, friction sand at the rate recommended by the manufacturer's representative and approved by
258 the DEN Project Manager from the test area/sections evaluation for each designated application area, shall be
259 spread uniformly over the asphalt emulsion in a single-pass operation simultaneous with the sealer application.
260 The aggregate shall be spread to the same width of application as the asphalt material and shall not be applied
261 in such thickness as to cause blanketing.
262

263

263 Sprinkling of additional aggregate material, and spraying additional asphalt material over areas that show up
264 having insufficient cover or bitumen, shall be done by hand whenever necessary. In areas where hand work is
265 necessitated, the sand shall be applied before the sealant begins to break.
266

267

267 Minimize aggregate from being broadcast and accumulating on the untreated pavement adjacent to an
268 application pass. Prior to the next application pass, the Contractor shall clean areas of excess or loose aggregate
269 and remove from project site.
270

271

272

QUALITY CONTROL (QC)

273

274 **608-5.1 MANUFACTURER'S REPRESENTATION.** The manufacturer's representative knowledgeable
275 of the material, procedures, and equipment described in the specification is responsible to assist the Contractor
276 and DEN Project Manager in determining the appropriate application rates of the emulsion and aggregate, as

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277 well as recommendations for proper preparation and start-up of seal coat application. Documentation of the
278 manufacturer representative's experience and knowledge for applying the seal coat product shall be furnished
279 to the DEN Project Manager a minimum of 10 work days prior to placement of the control strips. The cost of
280 the manufacturer's representative shall be included in the Contractor's bid price.

281
282 **608-5.2 CONTRACTOR QUALIFICATIONS.** The Contractor shall provide documentation to the DEN
283 Project Manager that the seal coat Contractor is qualified to apply the seal coat, including personnel, and
284 equipment, and has made at least three (3) applications similar to this project in the past two (2) years.

285
286
287 **MATERIAL ACCEPTANCE**

288
289 **608-6.1 APPLICATION RATE.** The rate of application of the asphalt emulsion shall be verified at least
290 twice per day.

291
292 **608-6.2 FRICTION TESTS.** Friction tests in accordance with AC 150/5320-12, Measurement,
293 Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces, shall be performed on all runway
294 and high-speed taxiways that received a seal coat. Each test includes performing friction tests at 40 mph and
295 60 mph (65 or 95 km/h) both wet, 15 feet (4.5 m) to each side of runway centerline with approved continuous
296 friction measuring equipment (CFME). The Contractor shall coordinate testing with the DEN Project Manager
297 and provide the DEN Project Manager a written report of friction test results. The DEN Project Manager shall
298 be present for testing.

299
300
301 **METHOD OF MEASUREMENT**

302
303 **608-7.1 ASPHALT SURFACE TREATMENT.** The quantity of asphalt surface treatment shall be measured
304 by the square yards of material applied in accordance with the plans and specifications and accepted by the
305 DEN Project Manager.

306
307 The Contractor must furnish the DEN Project Manager with the certified weigh bills when materials are
308 received for the asphalt material used under this contract. The Contractor must not remove material from the
309 tank car or storage tank until initial amounts and temperature measurements have been verified.

310
311
312 **BASIS OF PAYMENT**

313
314 **608-8.1** Payment shall be made at the contract unit price per square yard for the asphalt surface treatment
315 applied and accepted by the DEN Project Manager. This price shall be full compensation for all surface
316 preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools,
317 and incidentals necessary to complete the item, and any costs associated with furnishing a qualified
318 manufacturer's representative to assist with control strips.

319
320
321 Payment will be made under:

322
323 Item P-608a Emulsified Asphalt Seal Coat without Aggregate – per square yard

324

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325

326

REFERENCES

327

328

329

330

331

332

333

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)

334

335

ASTM C117 Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing

336

ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

337

338

ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

339

ASTM D5 Standard Test Method for Penetration of Asphalt Materials

340

ASTM D244 Standard Test Methods and Practices for Emulsified Asphalts

341

342

343

ASTM D2007 Standard Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method

344

345

ASTM D2042 Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene

346

347

ASTM D2995 Standard Practice for Estimating Application Rate of Bituminous Distributors

348

349

ASTM D4402 Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer

350

351

ASTM D5340 Standard Test Method for Airport Pavement Condition Index Surveys

Advisory Circulars (AC)

352

353

354

355

AC 150/5320-12 Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces

356

357

AC 150/5320-17 Airfield Pavement Surface Evaluation and Rating (PASER) Manuals

358

359

AC 150/5380-6 Guidelines and Procedures for Maintenance of Airport Pavements

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363

****END ITEM P-608****

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 DEN Project Manager 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. The laboratory performing the tests shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. Test method ASTM C1260 must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the DEN Project Manager prior to start of construction. Test results shall be submitted to the DEN Project Manager. 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 expansion of either the coarse or fine aggregate exceeds 0.08% at 14 days, limit the alkali of the concrete to be less than or equal to 3.0 lb per cubic yard (1,8 kg per cubic meter), calculated in accordance with FAA EB 106.

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.

45

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
3/4 inch (19 mm)	67
1/2 inch (12.5 mm)	7

46

47 **610-2.2.1 COARSE AGGREGATE SUSCEPTIBILITY TO DURABILITY (D) CRACKING.**

48

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

57

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

60

61 **610-2.3 FINE AGGREGATE.** The fine aggregate for concrete shall meet all fine aggregate requirements of
 62 ASTM C33.

63

64 **610-2.4 CEMENT.** Cement shall conform to the requirements of ASTM C150 Type I/II, or V, ASTM C595
 65 Type IP(HS), or IL(HS), or ASTM C1157 GU, HS, or MH.

66

67 **610-2.5 CEMENTITIOUS MATERIALS.**

68

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

77

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

81

82 **610-2.6 WATER.** Water used in mixing or curing shall be from potable water sources. Other sources shall be
 83 tested in accordance with ASTM C1602 prior to use.

84

85 **610-2.7 ADMIXTURES.** The Contractor shall submit certificates indicating that the material to be furnished
86 meets all of the requirements indicated below. In addition, the DEN Project Manager may require the
87 Contractor to submit complete test data from an approved laboratory showing that the material to be furnished
88 meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the
89 DEN Project Manager from the supply of the material being furnished or proposed for use on the work to
90 determine whether the admixture is uniform in quality with that approved.

- 91
- 92 a. **Air-entraining admixtures.** Air-entraining admixtures shall meet the requirements of ASTM
93 C260 and shall consistently entrain the air content in the specified ranges under field conditions.
94 The air-entrainment agent and any water reducer admixture shall be compatible.
- 95
- 96 b. **Water-reducing admixtures.** Water-reducing admixture shall meet the requirements of ASTM
97 C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and
98 ASTM C1017 flowable admixtures shall not be used.
- 99
- 100 c. **Other chemical admixtures.** The use of set retarding, and set-accelerating admixtures shall be
101 approved by the DEN Project Manager. Retarding shall meet the requirements of ASTM C494,
102 Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium
103 chloride and admixtures containing calcium chloride shall not be used.

104

105 **610-2.8 PREMOLDED JOINT MATERIAL.** Premolded joint material for expansion joints shall meet the
106 requirements of ASTM D1751.

107

108 **610-2.9 JOINT FILLER.** The filler for joints shall meet the requirements of Item P-605, unless otherwise
109 specified.

110

111 **610-2.10 STEEL REINFORCEMENT.** Reinforcing shall consist of bar mats conforming to the
112 requirements of ASTM A184.

113

114

115 **610-2.11 MATERIALS FOR CURING CONCRETE.** Curing materials shall conform to ASTM C309.

116

117

CONSTRUCTION METHODS

118

119 **610-3.1 GENERAL.** The Contractor shall furnish all labor, materials, and services necessary for, and incidental
120 to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used
121 by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall
122 be subject to the inspection and approval of the DEN Project Manager.

123

124 **610-3.2 CONCRETE MIXTURE.** The concrete shall develop a required compressive strength in 28 days as
125 determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39.

- 126 a. 4,5000 psi for utility structure installation or adjustment.
- 127 b. 4,000 psi for concrete encased lighting ducts and light cans.
- 128 c. 1,200 psi at 7 days for the repair of cement treated base course.

129

130 The concrete shall contain 615 - 660 pounds of cementitious material (cement plus fly ash) per cubic yard for
131 4,500 psi in 28 days, not less than 470 pounds of cementitious material for 4,000 psi in 28 days, and as needed
132 for 1,200 psi in 7 days. The concrete shall contain 6% of entrained air, $\pm 1.5\%$, as determined by ASTM C231
133 and shall have a slump of not more than 4 inches as determined by ASTM C143.

134

135 The concrete mixtures utilized shall provide resistance to Class 3 sulfate exposure. The concrete shall have a
 136 maximum water/cementitious material ratio of 0.40 and one of the following:

- 137
- 138 **a.** A blend of portland cement meeting ASTM C150 Type II, or V with a minimum of a 20 percent
 139 substitution of Class F fly ash, High-Reactivity Pozzolan, or slag cement by weight, where the
 140 blend has less than 0.10 percent expansion at 18 months when tested according to ASTM C1012.
 141
- 142 **b.** ASTM C595 Type IP(HS), or IL(HS), having less than 0.10 percent expansion at 18 months when
 143 tested according to ASTM C1012. Class F fly ash, slag cement, or High-Reactivity Pozzolan may
 144 be substituted for Type IL cement.
 145
- 146 **c.** ASTM C595 Type IL with a minimum of a 20 percent substitution of Class F fly ash or slag cement
 147 by weight, where the blend has less than 0.10 percent expansion at 18 months when tested
 148 according to ASTM C1012.
 149
- 150 **d.** ASTM C150 Type I, II, or V plus a minimum of 20 percent Class F fly ash when the R factor of
 151 the fly ash is less than 0.75. R factor is determined using the following from the chemical
 152 composition of the fly ash:
 153

$$R = \frac{CaO - 5}{Fe_2O_3}$$

154

155

156 The maximum Water/Cementitious Material Ratio may be exceeded when an expansive cement additive is
 157 used.
 158

159 When fly ash or high-reactivity pozzolan is used to enhance sulfate resistance, it shall be used in a proportion
 160 greater than or equal to the proportion tested in accordance with ASTM C1012, shall be the same source, and
 161 shall have a calcium oxide content no more than 2.0 percent greater than the fly ash or high-reactivity pozzolan
 162 tested according to ASTM C1012. ASTM C1012 test results are acceptable for up to two years from the
 163 completion date of the test.
 164

165 **610-3.3 MIXING.** Concrete may be mixed at the construction site, at a central point, or wholly or in part in
 166 truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94 or
 167 ASTM C685.
 168

169 The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while
 170 the air temperature is below 40°F (4°C) without the DEN Project Manager approval. If approval is granted for
 171 mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at
 172 a temperature not less than 50°F (10°C) nor more than 100°F (38°C). The Contractor shall be held responsible
 173 for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall
 174 replace such work at his expense.
 175

176 Retempering of concrete by adding water or any other material is not permitted.
 177

178 The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.
 179

180 **610-3.4 FORMS.** Concrete shall not be placed until all the forms and reinforcements have been inspected and
 181 approved by the DEN Project Manager. Forms shall be of suitable material and shall be of the type, size, shape,
 182 quality, and strength to build the structure as shown on the plans. The forms shall be true to line and grade and
 183 shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces

184 of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible
185 for their adequacy.

186
187 The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface
188 when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-
189 staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be
190 constructed so they can be removed without injuring the concrete or concrete surface.

191
192 **610-3.5 PLACING REINFORCEMENT.** All reinforcement shall be accurately placed, as shown on the
193 plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at
194 intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending
195 details shall be supplied by the Contractor when required.

196
197 **610-3.6 EMBEDDED ITEMS.** Before placing concrete, all embedded items shall be firmly and securely
198 fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any
199 foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The
200 embedding of wood shall not be allowed.

201
202 **610-3.7 CONCRETE CONSISTENCY.** The Contractor shall monitor the consistency of the concrete
203 delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each
204 truck at the project site in accordance with ASTM C143.

205
206 **610-3.8 PLACING CONCRETE.** All concrete shall be placed during daylight hours, unless otherwise
207 approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms
208 and falsework, and the placing of the steel reinforcing have been approved by the DEN Project Manager.
209 Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has
210 been added to the mix. The method and manner of placing shall avoid segregation and displacement of the
211 reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The
212 concrete shall not be dropped from a height of more than 5 feet (1.5 m). Concrete shall be deposited as nearly
213 as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to
214 procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water,
215 or on a properly consolidated soil foundation.

216
217 **610-3.9 VIBRATION.** Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee
218 309R, Guide for Consolidation of Concrete.

219
220 **610-3.10 JOINTS.** Joints shall be constructed as indicated on the plans.

221
222 **610-3.11 FINISHING.** All exposed concrete surfaces shall be true, smooth, and free from open or rough
223 areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper
224 elevation with the finished top surface struck-off with a straightedge and floated.

225
226 **610-3.12 CURING AND PROTECTION.** All concrete shall be properly cured in accordance with the
227 recommendations in American Concrete Institute (ACI) 308R, Guide to External Curing of Concrete. The
228 concrete shall be protected from damage until project acceptance.

229
230 **610-3.13 COLD WEATHER PLACING.** When concrete is placed at temperatures below 40°F (4°C), follow
231 the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

232

233 **610-3.14 HOT WEATHER PLACING.** When concrete is placed in hot weather greater than 85°F (30 °C),
234 follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.
235

236 QUALITY ASSURANCE (QA)

237
238 **610-4.1 QUALITY ASSURANCE SAMPLING AND TESTING.** Concrete for each day's placement will
239 be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The DEN Project Manager
240 will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; test
241 air content in accordance with ASTM C231; make and cure compressive strength specimens in accordance with
242 ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of
243 ASTM C1077.

244
245 The Contractor shall provide adequate facilities for the initial curing of cylinders.
246

247 The first load of concrete, per mix, delivered each day will be sampled and tested.
248

249 Concrete placed for structures will be sampled and tested for each additional 50 cubic yards per day with a
250 minimum one test per structure. When a single load of concrete is used for more than one structure, that load
251 will be sampled and tested once.
252

253 Concrete placed for light cans will be sampled and tested for each additional 50 cubic yards per day.
254

255 Lean concrete will be sampled and tested for each additional 50 cubic yards per day.
256

257 Concrete strengths for acceptance shall be the average of at least two 6 by 12 inch or at least three 4 by 8 inch
258 cylinders tested at 28 days.
259

260 **610-4.2 DEFECTIVE WORK.** Any defective work that cannot be satisfactorily repaired as determined by the
261 DEN Project Manager, shall be removed and replaced at the Contractor's expense. Defective work includes,
262 but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the
263 concrete.
264

265 METHOD OF MEASUREMENT

266
267
268 **610-5.1** In general, and unless, listed in the proposal as a separate payment item, structural concrete will not be
269 measured for payment, but shall be incidental to those proposed items constructed of concrete.
270

271 **610-5.2** Cement Treated Base (CTB) repair shall be measured per square yard including existing cement treated
272 base milling and structural concrete installation.
273

274 BASIS OF PAYMENT

275
276
277 **610-6.1** Structural concrete shall be considered incidental to the project. No payment shall be made for
278 structural concrete, unless listed in the proposal as a separate payment item.
279

280 **610-6.2** Payment for Cement Treated Base Repair shall be made at the contract price by the number of square
281 yards (square meters). This price shall be full compensation for furnishing all materials including reinforcement

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282 and embedded items and for all preparation, delivery, installation, and curing of these materials, and for all
 283 labor, equipment, tools, and incidentals necessary to complete the item.

284
 285 Payment will be made under:

286
 287 Item P-610a Cement Treated Base Repair – per square yard
 288

289
 290

CONTRACTOR QUALITY CONTROL TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Slump P-610-3.2	ASTM C143	Max. 4-inches	At Time of Test	Each batch ticket
Temperature P-610-3.3	ASTM C1064	50-100 degrees F	At Time of Test	Each batch ticket

291
 292
 293

QUALITY ASSURANCE SAMPLING AND TESTING

Test	Test Procedures	Min. Testing Tolerance	Information Due By	Frequency of Tests Required
Air Content P-610-3.2	ASTM C231	6% of entrained air $\pm 1.5\%$	At Time of Test	Each day of placement
Compressive Strength P-610-3.2	ASTM C31 ASTM C39	4,5000 psi @ 28 days for utility structure installation or adjustment. 4,000 psi @ 28 days for concrete encased lighting ducts and light cans 1,200 psi at 7 days for the repair of cement treated base course.	28 Days for utility structure installation or adjustments, and concrete encased lighting ducts and light cans 7 days for repair of cement treated base course	Structures will be tested 50 Cubic Yards per day with a minimum 1 test per structure Light cans will be tested 50 Cubic Yards per day Lean concrete will be tested 50 Cubic Yards per day
Slump P-610-3.2	ASTM C143	Max. 4-inches	At Time of Test	Each day of placement

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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

349	ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
350		
351	ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
352		
353	ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the
354		Pressure Method
355		
356	ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
357		
358	ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for
359		Curing Concrete
360		
361	ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural
362		Pozzolans for Use in Portland-Cement Concrete
363		
364	ASTM C494	Standard Specification for Chemical Admixtures for Concrete
365		
366	ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural
367		Pozzolan for Use in Concrete
368		
369	ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and
370		Thawing
371		
372	ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and
373		Continuous Mixing
374		
375	ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
376	ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing
377		Flowing Concrete
378		
379	ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates
380		for Use in Construction and Criteria for Testing Agency Evaluation
381		
382	ASTM C1157	Standard Performance Specification for Hydraulic Cement
383		
384	ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-
385		Bar Method)
386		
387	ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in
388		Portland Cement and Portland-Cement Clinker Using X-Ray Powder
389		Diffraction Analysis
390		
391	ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic
392		Cement Concrete
393		
394	ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete
395		Paving and Structural Construction (Nonextruding and Resilient Asphalt
396		Types)
397		

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM P-610 CONCRETE FOR MISCELLANEOUS STRUCTURES
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398 ASTM D1752 Standard Specification for Preformed Sponge Rubber Cork and Recycled
399 PVC Expansion Joint Fillers for Concrete Paving and Structural
400 Construction
401

402 American Concrete Institute (ACI)

403 ACI 305R Hot Weather Concreting

404 ACI 306R Cold Weather Concreting

405 ACI 308R Guide to External Curing of Concrete

406 ACI 309R Guide for Consolidation of Concrete

407
408
409
410
411
412 ****END OF ITEM P-610****

413
414

TECHNICAL SPECIFICATIONS
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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 DEN Project Manager. 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 DEN Project Manager prior to the initial application of markings. The reports can be used for material acceptance or the DEN Project Manager may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the DEN Project Manager 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 DEN Project Manager.

620-2.2 MARKING MATERIALS.

47

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 or II	White	37925	115 ft ² /gal (2.8 m ² /l)	Type I, Gradation A	7 lb/gal (0.85 kg/l)
Waterborne Type I or II	Red	31136	115 ft ² /gal (2.8 m ² /l)	Type I, Gradation A	5 lb/gal (0.85 kg/l)
Waterborne Type I or II	Yellow	33538	115 ft ² /gal (2.8 m ² /l)	Type I, Gradation A	7 lb/gal (0.85 kg/l)
Waterborne Type I or II	Black	37038	115 ft ² /gal (2.8 m ² /l)	Not Used	Not Used
Temporary Marking Waterborne Type I or II	All	See Above	230 ft ² /gal (5.6 m ² /l)	Not Used	Not Used
Methacrylate	White	37925	45 ft ² /gal (1.1 m ² /l)	Type I, Gradation A	15 lb/gal (1.8 kg/l)
Methacrylate	Red	31136	45 ft ² /gal (1.1 m ² /l)	Type I, Gradation A	13 lb/gal (1.8 kg/l)
Methacrylate	Yellow	33538	45 ft ² /gal (1.1 m ² /l)	Type I, Gradation A	15 lb/gal (1.8 kg/l)
Methacrylate	Black	37038	45 ft ² /gal (1.1 m ² /l)	Not Used	Not Used

48 ¹See paragraph 620-2.2a

49 ²See paragraph 620-2.2b

50 **a. Paint.** Paint shall be waterborne or methacrylate in accordance with the requirements of this paragraph.
 51 Paint colors shall comply with Federal Standard No. 595.

53 **Waterborne.** Paint shall meet the requirements of Federal Specification TT-P-1952F, Type I or Type II. The
 54 non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as
 55 determined by infrared spectral analysis.

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

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

59 **(a) IWhite:**

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

62 **(b) Yellow and Colors:**

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

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

- 65 • Methacrylate resin shall be 18% minimum.

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

69
 70 **(3) Daylight directional reflectance:**

71
 72 **(a) White:** The daylight directional reflectance of the white paint shall not be less than 80%
 73 (relative to magnesium oxide), when tested in accordance with ASTM E2302.

74
 75 **(b) Yellow:** The daylight directional reflectance of the yellow paint shall not be less than 55%
 76 (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values
 77 shall be consistent with the federal Hegman yellow color standard chart for traffic yellow
 78 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

79
 80 **(4) Accelerated weathering.**

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

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

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

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

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

94 **(7) Abrasion resistance.** Subject the panels prepared in paragraph 620-2.2c(4) to the abrasion test in
 95 accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from
 96 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
 97 test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less
 98 than 150 liters (525 lbs (239 kg)) of sand for the removal of the paint films.

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

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

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

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

107 **b. Reflective media.** Glass beads for white and yellow paint shall meet the requirements for Federal
108 Specification TT-B-1325D Type I, Gradation A .

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

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

112 Glass beads shall not be used in black paint.

113 **CONSTRUCTION METHODS**

114

115 **620-3.1 WEATHER LIMITATIONS.** Painting shall only be performed when the surface is dry, and the
116 ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in
117 accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface
118 temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the
119 wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be
120 applied when weather conditions are forecasts to not be within the manufacturers' recommendations for
121 application and dry time.

122

123 **620-3.2 EQUIPMENT.** Equipment shall include the apparatus necessary to properly clean the existing
124 surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment
125 as may be necessary to satisfactorily complete the job.

126 The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass
127 bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness
128 and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform
129 cross-sections and clear-cut edges without running or spattering and without over spray. The marking
130 equipment for both paint and beads shall be calibrated daily.

131

132 **620-3.3 PREPARATION OF SURFACES.** Immediately before application of the paint, the surface shall be
133 dry and free from dirt, grease, oil, laitance, or other contaminants that would reduce the bond between the paint
134 and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in
135 advance by the DEN Project Manager. After the cleaning operations, sweeping, blowing, or rinsing with
136 pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from
137 the cleaning process.

138 **a. Preparation of new pavement surfaces.** The area to be painted shall be cleaned by broom, blower,
139 water blasting, or by other methods approved by the DEN Project Manager to remove all contaminants,
140 including PCC curing compounds, minimizing damage to the pavement surface.

141 **b. Preparation of pavement to remove existing markings.** Existing pavement markings shall be
142 removed by water blasting or by other methods approved by the DEN Project Manager minimizing damage
143 to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate
144 ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block
145 out' the removal area to eliminate 'ghost' markings.

146 **c. Preparation of pavement markings prior to remarking.** Prior to remarking existing
147 markings, loose existing markings must be removed minimizing damage to the pavement surface, with a

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148 method approved by the DEN Project Manager. After removal, the surface shall be cleaned of all residue
 149 or debris.

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

155

156 **620-3.4 LAYOUT OF MARKINGS.** The proposed markings shall be laid out in advance of the paint
 157 application. The locations of markings to receive glass beads shall be shown on the plans.

158

159 **620-3.5 APPLICATION.** A period of 30 days shall elapse between placement of surface course or seal coat
 160 and application of the permanent paint markings. If new pavement areas need to open to traffic prior to the
 161 completion of the 30-day cure time, temporary markings can be placed. Permanent paint marking shall then be
 162 placed once the 30-day cure time has ended. Paint shall be applied at the locations and to the dimensions and
 163 spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been
 164 approved by the DEN Project Manager.

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

167

168

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)

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

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

177

178 **620-3.6 APPLICATION--PREFORMED THERMOPLASTIC AIRPORT PAVEMENT**
 179 **MARKINGS.**

180 Preformed thermoplastic pavement markings not used

181

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182 **620-3.7 CONTROL STRIP.** Prior to the full application of airfield markings, the Contractor shall prepare a
 183 control strip in the presence of the DEN Project Manager. The Contractor shall demonstrate the surface
 184 preparation method and all striping equipment to be used on the project. The marking equipment must achieve
 185 the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded
 186 and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings
 187 must be evaluated during darkness to ensure a uniform appearance.

188

189 **620-3.8 RETRO-REFLECTANCE.** Reflectance shall be measured with a portable retro-reflectometer
 190 meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3
 191 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings
 192 which are within 30% of each other. Testing shall occur a minimum of 2 times per day during marking
 193 operations and results shall be submitted to the DEN PM.

194

MINIMUM RETRO-REFLECTANCE VALUES

Material	Retro-reflectance mcd/m ² /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 than 1	100	75	10

195 1 Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

196

197 **620-3.9 PROTECTION AND CLEANUP.** After application of the markings, all markings shall be
 198 protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from
 199 disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all
 200 debris, waste, loose reflective media, and by-products generated by the surface preparation and application
 201 operations to the satisfaction of the DEN Project Manager. The Contractor shall dispose of these wastes in
 202 strict compliance with all applicable state, local, and federal environmental statutes and regulations.

203

204

METHOD OF MEASUREMENT

205

206
 207 **620-4.1a** The quantity of markings for permanent markings shall be measured by the number of square feet of
 208 painting.

209 **620-4.1b** The quantity of reflective media shall be paid for by the number of pounds (km) of reflective media.

210 **620-4.1c** The quantity of reflective pavement marking testing shall be paid for by the lump sum.

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211 **620-4.1d** The quantity of markings for temporary markings shall be measured by the number of square feet of
 212 painting.

213 **BASIS OF PAYMENT**

214
 215 **620-5.1** This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and
 216 incidentals necessary to complete the item complete in place and accepted by the DEN Project Manager in
 217 accordance with these specifications.

218 **620-5.2b** Payment for markings for permanent markings shall be made at the contract price for by the number
 219 of square feet (square meters) of painting.

220 **620-5.3c** Payment for reflective media shall be made at the contract unit price for the number of pounds (km)
 221 of reflective media.

222 **620-5.4d** Payment for the reflective pavement marking testing shall be made per lump sum of the testing
 223 reflective media.

224 **620-5.2e** Payment for markings for temporary markings shall be made at the contract price for the number of
 225 square feet (square meters) of painting.

226

227 Payment will be made under:

228	Item P-620a	Pavement Markings, Waterborne - per square foot
229	Item P-620b	Pavement Markings, Methacrylate (MMA) - per square foot
230	Item P-620c	Reflective Media – per pound
231	Item P-620d	Reflective Pavement Marking Testing – per lump sum
232	Item P-620e	Temporary Markings, Waterborne - per square foot

233 **REFERENCES**

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

236 ASTM International (ASTM)

237	ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
238	ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by
239		Falling Abrasive
240	ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
241	ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine
242		Values of Fatty Amines by Alternative Indicator Method
243	ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
244	ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using
245		Portable Hand-Operated Instruments
246	ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using
247		the British Pendulum Tester

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248	ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement
249		Marking Materials with CEN-Prescribed Geometry Using a Portable
250		Retroreflectometer
251	ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient
252		Under Diffuse Illumination of Pavement Marking Materials Using a
253		Portable Reflectometer
254	ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp
255		Apparatus for Exposure of Nonmetallic Materials
256	Code of Federal Regulations (CFR)	
257	40 CFR Part 60, Appendix A-7, Method 24	
258		Determination of volatile matter content, water content, density, volume
259		solids, and weight solids of surface coatings
260	29 CFR Part 1910.1200	Hazard Communication
261	Federal Specifications (FED SPEC)	
262	FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
263	FED SPEC TT-P-1952F	Paint, Traffic and Airfield Marking, Waterborne
264	FED STD 595	Colors used in Government Procurement
265	Commercial Item Description	
266	A-A-2886B	Paint, Traffic, Solvent Based
267	Advisory Circulars (AC)	
268	AC 150/5340-1	Standards for Airport Markings
269	AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport
270		Pavement Surfaces

271 **END OF ITEM P-620**

TECHNICAL SPECIFICATIONS
 DIVISION 2-AIRFIELD STANDARDS
 ITEM T-901 SEEDING
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\Item T-901 Seeding

DESCRIPTION

901-1.1 This item shall consist of soil preparation, seeding and fertilizing the areas shown on the plans or as directed by the DEN Project Manager 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 DEN Project Manager 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.

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27
 28 Seeds shall be applied as follows:
 29
 30

Mix Design 2 - Upland Seed Mix

Scientific Name	Common Name	Variety	lbs PLS /acre*	% of mix**
GRASSES				
Pascopyrum smithii	Western Wheatgrass	Native -VNS†	3.75	25.00
Agropyron cristatum	Crested Wheatgrass	Native -VNS†	3.75	25.00
Buchloe dactyloides	Buffalograss	Native -VNS†	3.00	20.00
Elymus trachycaulus	Slender Wheatgrass	Native -VNS†	2.25	15.00
Bouteloua gracilis	Blue Grama	Native -VNS†	1.50	10.00
Sporobolus airoides	Alkali Sacaton	Native -VNS†	0.75	5.00
Grass species subtotal			15.00	100
TOTAL PLS RATE			15.00	100

33 * PLS means Pure Live Seed; rates shown are for drill seeding, if broadcast, rates should be doubled.

34 ** Percent by seed number

35 *** Wetland mixes to be used only where wetland hydrology exists. Check with DEN Environmental
 36 Services.

37 † VNS = Variety Not Stated

38
 39 Seeding shall be performed during the period between July 1 and October 15 inclusive, unless otherwise
 40 approved by the DEN Project Manager.

41
 42 **901-2.2 LIME.** Not required.

43
 44 **901-2.3** required.

45
 46 **901-2.4 SOIL FOR REPAIRS.** The soil for fill and topsoiling of areas to be repaired shall be at least of equal
 47 quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from
 48 large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting,
 49 and establishing turf, and shall be approved by the DEN Project Manager before being placed.

CONSTRUCTION METHODS

50
 51
 52
 53
 54 **901-3.1 ADVANCE PREPARATION AND CLEANUP.** After grading of areas has been completed, areas
 55 to be seeded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks,
 56 stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent
 57 maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion
 58 of grading and before seeding, the Contractor shall repair such damage include filling gullies, smoothing
 59 irregularities, and repairing other incidental damage.

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

70

71 **901-3.2 DRY APPLICATION METHOD.**

72

73 a. **Liming.** Not required.

74

75 b. **Fertilizing.** Not Used

76

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

83

84 d. **Rolling.** After the seed has been properly covered, the seedbed shall be immediately compacted
85 by means of an approved lawn roller, weighing 40 to 65 pounds per foot (60 to 97 kg per meter)
86 of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per
87 foot (223 to 298 kg per meter) of width for sandy or light soils.

88

89 **901-3.3 WET APPLICATION METHOD.**

90

91 a. **Not Used.**

92

93 **901-3.4 MAINTENANCE OF SEEDED AREAS.** The Contractor shall protect seeded areas against traffic
94 or other use by warning signs or barricades, as approved by the DEN Project Manager. Surfaces gullied or
95 otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor
96 shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final
97 inspection and acceptance of the work.

98

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

103

104

105

105 **METHOD OF MEASUREMENT**

106

107 **901-4.1** The quantity of seeding to be paid for shall be the number of units acre measured on the ground surface,
108 completed and accepted.

109

110

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM T-901 SEEDING
AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
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CONST. CONTRACT NO. 202473360

111 **BASIS OF PAYMENT**
112
113 **901-5.1** Payment shall be made at the contract unit price per acre or fraction thereof, which price and payment
114 shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and
115 incidentals necessary to complete the work prescribed in this item.

116
117 Payment will be made under:
118

119 Item T-901a Seeding (Seed Mix Design 2) - per acre

120
121
122 **REFERENCES**
123

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

126
127 ASTM International (ASTM)

128
129 ASTM C602 Standard Specification for Agricultural Liming Materials

130 Federal Specifications (FED SPEC)

131
132 FED SPEC JJJ-S-181, Federal Specification, Seeds, Agricultural

133
134 Advisory Circulars (AC)

135
136 AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

137
138 FAA/United States Department of Agriculture

139
140 Wildlife Hazard Management at Airports, A Manual for Airport Personnel

141
142
143 ****END OF ITEM T-901****
144

ITEM T-905 TOPSOIL

DESCRIPTION

905-1.1 This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the DEN Project Manager.

MATERIALS

905-2.1 TOPSOIL. Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 inches (50 mm) or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sod and herbaceous growth such as grass and weeds are not to be removed, but shall be thoroughly broken up and intermixed with the soil during handling operations. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means, shall be removed. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 7.6 pH to 8.0 pH, when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall be not less than 1% nor more than 10% as determined by the wet-combustion method (chromic acid reduction). Soil textures (USDA) suitable for re-vegetation include Sandy Loam, Loam, Silt Loam, Clay Loam, Sandy Clay Loam, Silty Clay Loam, and Loamy Sand

When topsoil is imported to the site, it shall meet the following criteria:

<u>Parameter</u>	<u>Acceptable</u>	<u>Unacceptable</u>
<u>Texture</u>	<u>Sandy Loam, Loam, Silt Loam, Clay Loam, Sandy Clay Loam, Silty Clay Loam, Loamy Sand</u>	<u>Silty Clay, Clay, Sandy Clay, Sand, Silt</u>
<u>Soil Reaction</u>	<u>pH 5.0 to 8.0</u>	<u>< 5.0 or > 8.0</u>
<u>Salinity (mmhos/cm)</u>	<u>< or = 4.0</u>	<u>> 4.0</u>
<u>Organic Matter (%)</u>	<u>> or = 1.0</u>	<u>< 1.0</u>
<u>Coarse Fragment Content (%)*</u>	<u>< or = 20</u>	<u>> 20</u>

*Percent by weight of particles > 2 mm diameter (ie. gravels; cobbles and boulders excluded by provisions of 901-3.2)

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

905-2.2 INSPECTION AND TESTS. Within 10 days following acceptance of the bid, the DEN Project Manager shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil

33 samples from several locations within the area under consideration and to the proposed stripping depths, for
34 testing purposes as specified in paragraph 905-2.1.

35 **CONSTRUCTION METHODS**

36

37 **905-3.1 GENERAL.** Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the
38 location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the
39 plans.

40 Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of
41 topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and
42 approved by the DEN Project Manager before the various operations are started.

43

44 **905-3.2 PREPARING THE GROUND SURFACE.** Immediately prior to dumping and spreading the
45 topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means
46 approved by the DEN Project Manager, to a minimum depth of 18 inches minus the specified depth of the
47 topsoil. If, for example, the topsoil depth is three inches (as would be typical) the ripping need only go to 15
48 inches. In FAA determined safety areas on the shoulders of taxiways, runways or ramps where only 6 inches
49 of ripping is allowed, the total depth of loosened material including topsoil will be 6 inches.

50 The surface of the area to be topsoiled shall be cleared of all stones larger than 2 inches (50 mm) in any
51 diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary
52 moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too
53 compact to respond to these operations shall receive special scarification.

54 Grades on the area to be topsoiled, which have been established by others as shown on the plans, shall be
55 maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-
56 graded and the surface left at the prescribed grades in an even and compacted condition to prevent the
57 formation of low places or pockets where water will stand.

58

59 **905-3.3 OBTAINING TOPSOIL.** Prior to the stripping of topsoil from designated areas, any vegetation,
60 briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent
61 operations, shall be removed using methods approved by the DEN Project Manager. Heavy sod or other
62 cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

63 When suitable topsoil is available on the site, the Contractor shall remove this material from the designated
64 areas and to the depth as directed by the DEN Project Manager. The topsoil shall be spread on areas already
65 tilled and smooth-graded, or stockpiled in areas approved by the DEN Project Manager. Any topsoil
66 stockpiled by the Contractor shall be rehandled and placed without additional compensation. Any topsoil that
67 has been stockpiled on the site by others, and is required for topsoil purposes, shall be removed and placed
68 by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the
69 Contractor shall be graded if required and put into a condition acceptable for seeding.

70 When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject
71 to the approval of the DEN Project Manager. The Contractor shall notify the DEN Project Manager
72 sufficiently in advance of operations in order that necessary measurements and tests can be made. The
73 Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be
74 hauled to the site of the work and placed for spreading, or spread as required. Any topsoil hauled to the site
75 of the work and stockpiled shall be rehandled and placed without additional compensation.

76 **a. Topsoil Amendments.** If topsoil is unavailable or of such poor quality that available materials need
 77 supplementary organic matter, then soil amendments shall be used. The soil amendment shall consist of
 78 composted biosolids or composted manure, or other organic soil amendment product approved by the Project
 79 Manager.

80 Organic amendment comprised of composted biosolids shall comply with all requirements of U.S.
 81 EPA's biosolids regulations.

82 Organic amendment comprised of composted manure shall be produced as follows:

83 (1) Compost organic amendment (cow or sheep manure) for 90 to 120 days. Certification must
 84 be provided to prove the product has gone through this process.

85 (2) Eradicate harmful pathogens including coliform bacteria.

86 (3) Create a carbon to nitrogen ratio of 15:1 to 25:1.

87 (4) Contain no solid particle greater than ½ inch diameter.

88 (5) Have a non-offensive smell similar to fresh turned soil.

89 (6) Contain no significant level of dirt, soil, or chemical preservatives and contain a maximum of
 90 30 percent composted plant residue.

91 (7) Have a Ph after composting between 6 and 8 with an organic matter content of at least 20
 92 percent.

93 (8) Contain soluble salts not greater than 5mmhos/cm.

94 (9) Produced by aerobic decomposition.

95 (10) Processed at a consistent temperature of 140 degrees F or greater.

96

97 A Certificate of Compliance shall be provided to the Project Manager to verify the organic matter content,
 98 Ph, and carbon matter to nitrogen ratio, and salt levels (by electrical conductivity mmhos/cm).

99 If organic amendment is not available, a natural trace mineral, carbon, and humic acid based granular soil
 100 conditioner may be used (such as Menefee Humate, or approved equal).

101 The proposed soil amendment shall be submitted to the Project Manager for his work approval as a part of
 102 the Common Excavation Plan. The soil amendment plan shall be based on soil samples obtained from the
 103 topsoil removed and stockpiled and shall be formulated to develop a suitable seed bed at least as suitable as
 104 those areas where topsoil is placed.

105 **b. Topsoil Plan.** The Contractor shall prepare a Topsoil Plan which shall include but not be limited to the
 106 following items:

107 (1) Location and quantity of topsoil stockpiles available for the project.

108 (2) Location and quantity of topsoil available from borrow areas.

109 (3) Location and quantity of topsoil required for all areas to be topsoiled within project limits.

110 (4) Identification of and plan for removal of all undesirable materials such as weeds, trash,
 111 debris, etc., before actual stripping commences.

112 (5) Haul routes, schedules, utility conflicts, and other Topsoil Plan features by the Project
 113 Manager.

114

115 **905-3.4 STOCKPILING.** Stockpiled side slopes shall not exceed 3:1. All stockpiles and adjacent areas that
 116 have been disturbed by the Contractor shall be graded, topsoiled if necessary, ripped and seeded in
 117 accordance with Sections T-901 and T-908. Whenever it is practical, topsoil shall be hauled directly from the
 118 salvage site to the placement site to avoid double handling.

119 A sufficient amount of topsoil for the entire project including shrinkage and waste shall be set aside before
 120 any quality topsoil material is used for purposes other than topsoiling.

121

122 **905-3.5 PLACING TOPSOIL.** The topsoil shall be evenly spread on the prepared areas that have been left
 123 roughened to prevent topsoil layer slippage. Topsoil shall be placed to an average depth of three (3) inches,
 124 where the subsoil is suitable according to the following.

125 Subsoil Suitability criteria are as follows:

<u>Parameter</u>	<u>Acceptable</u>	<u>Unacceptable</u>
<u>Soil Reaction</u>	<u>pH 5.0 to 8.7</u>	<u>< 5.0 or >8.7</u>
<u>Salinity (mmhos/cm)</u>	<u>≤ or = 7.0</u>	<u>> 7.0</u>

126

127 Where the subsoil does not meet the above suitability criteria, then the topsoil depth shall be 15 inches, or the
 128 Contractor shall apply soil amendments in order to bring brine soils within acceptance.

129 Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition
 130 detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum
 131 of soil preparation or tilling.

132 After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective
 133 means, and all stones or rocks (2 inches (50 mm) or more in diameter), roots, litter, or any foreign matter
 134 shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be
 135 satisfactorily compacted by rolling with a cultipacker or by other means approved by the DEN Project
 136 Manager. The compacted topsoil surface shall conform to the required lines, grades, and cross-sections. Any
 137 topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly
 138 removed.

139

140 **905-3.6 VERIFICATION OF TOPSOIL THICKNESS.** The contractor shall be required to provide
 141 depth measurements for every 5,000 square yards of topsoil placed to minimum of 3 inch depth of topsoil.
 142 To test the depth of topsoil, the redressed areas will be divided into 10 acre plots. Within each plot, at least
 143 ten randomly selected locations will be sampled for topsoil depth before seedbed preparation. More than
 144 90% of the samples must have a depth equal to or greater than the specified design depth. If this criterion is
 145 not met, the contractor will redress the plot. Topsoil shall be added as necessary to provide and maintain the
 146 minimum 3 inches of topsoil through the contract and maintenance period.

147

148 **905-3.7 TOLERANCES.** The surface of the finished topsoil surface shall be of such smoothness that it will
 149 not vary more than plus 0.10' to minus 0.10' from true grade as shown on the Contract Drawings. Any
 150 deviation in excess of this amount shall be corrected by loosening, adding and removing materials, and
 151 reshaping

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM T-905 TOPSOIL
AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
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AND ELECTRICAL UPGRADES PACKAGE 2
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152

METHOD OF MEASUREMENT

153

154 **905-4.1** No separate measurement for payment shall be made for topsoil. Topsoil shall be considered
155 necessary and incidental to the work of this contract.

156

BASIS OF PAYMENT

157

158 **905-5.1** No payment will be made separately or directly for topsoil. Topsoil shall be considered necessary and
159 incidental to the work of this contract.

160

161 Payment will be made under:

162 No pay items.

163

164

REFERENCES

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

167 ASTM International (ASTM)

168 ASTM C117 Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by
169 Washing

170 Advisory Circulars (AC)

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

172 FAA/United States Department of Agriculture

173 Wildlife Hazard Management at Airports, A Manual for Airport Personnel

174

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM T-905 TOPSOIL
AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
RUNWAY 17L-35R PAVEMENT REHABILITATION
AND ELECTRICAL UPGRADES PACKAGE 2
CONST. CONTRACT NO. 202473360

175

176

END OF ITEM T-905

ITEM T-908 MULCHING

DESCRIPTION

908-1.1 This item shall consist of furnishing, hauling, placing, and securing mulch on surfaces indicated on the plans or designated by the DEN Project Manager.

MATERIALS

908-2.1 MULCH MATERIAL. Acceptable mulch shall be the materials listed below or any approved locally available material that is similar to those specified. Mulch shall be free from noxious weeds, mold, and other deleterious materials. Mulch materials, which contain matured seed of species that would volunteer and be detrimental to the proposed overseeding, or to surrounding farm land, will not be acceptable. Straw or other mulch material which is fresh and/or excessively brittle, or which is in such an advanced stage of decomposition as to smother or retard the planted grass, will not be acceptable.

a. Wood-fiber Mulch. Wood fiber mulch must be virgin long-fiber material. Wood fiber shall be absent of materials toxic to plant growth. Wood chips are not acceptable.

b. Matting.

(1) Covering. Covering shall consist of blankets with close weave mesh and nettings with open weave mesh made of various materials as specified herein.

(2) Blankets and nettings shall be biodegradable, non-toxic to vegetation or germination of seed, and shall not be toxic or injurious to humans.

(a) Excelsior. Excelsior soil retention covering shall be biodegradable as follows:

The blanket shall consist of a machine produced mat of curled wood excelsior of 80 percent, 6 inch or longer fiber length with a consistent thickness of fibers evenly distributed over the entire area of the blanket. The top side of the blanket shall be covered with a biodegradable netting, manufactured from a jute or other biodegradable material and stitched on 2 inch centers the entire width of the blanket.

Dimensions: 48" by 180' or 96" by 90'

Roll Weight: 0.9 to 1.1 pounds per sq. yd.

(b) Soil Retention Blanket (Coconut). Soil Retention Blanket (Coconut) shall be a machine produced mat consisting of 100 percent coconut fiber. The blanket shall be of consistent thickness with the coconut fiber evenly distributed over the entire area of the mat. The blanket shall be sewn together with biodegradable thread.

Material requirements:

Coconut Fiber Content: 100%, 0.50 to 0.60 lb. per sq. yd

52	Netting:	Both sides, biodegradable 9.3 lbs. per 1000 sq. ft.
53	Thread:	Biodegradable
54	Roll Width:	6.5 to 7.5 feet
55	Roll Length:	83.5 to 110 feet
56	Area Covered by One Roll:	60 to 80 sq. yds.

- 57
- 58 **(c) Soil Retention Blanket (Straw).** Soil Retention Blanket (Straw) shall be a
 59 machine produced mat consisting of 100 percent agricultural straw. The blanket
 60 shall be of consistent thickness with the straw evenly distributed over the entire
 61 area of the mat. The blanket shall be covered on the top side with biodegradable
 62 netting having an approximate 5/8 inch x 5/8 inch to 1/2 inch x 1/2 inch mesh
 63 and on the bottom with biodegradable netting with an approximate 1/4 inch x 1/4
 64 inch to 1/2 inch x 1/2 inch mesh. The blanket shall be sewn together with
 65 biodegradable thread.

66

67 Material requirements:

68	Straw Content:	100%, 0.50 lb. per sq. yd.
69	Netting:	Bottom side biodegradable, 9. lbs. per 1000 sq. ft.;
70	Netting:	Top side biodegradable, 9.3 lbs. per 1000 sq. ft.
71	Thread:	Biodegradable
72	Roll Width:	6.5 to 7.5 feet
73	Roll Length:	83.5 to 110 feet
74	Area Covered by One Roll:	60 to 80 sq. yds

75

76 A sample of the soil retention blanket (straw) shall be submitted at least 2 weeks
 77 in advance of its use on the project for approval by the Project Manager.

- 78
- 79 **(d) Soil Retention Blanket (Straw and Coconut).** Soil Retention Blanket
 80 (Straw/Coconut) shall be a machine produced mat consisting of 70 percent
 81 agricultural straw and 30 percent coconut fiber. The blanket shall be of
 82 consistent thickness with the straw and coconut fiber evenly distributed over
 83 the entire area of the mat. The blanket shall be covered on the top side with
 84 polypropylene netting having an approximate 5/8 inch x 5/8 inch mesh and on
 85 the bottom with polypropylene netting with an approximate 1/4 inch x 1/4 inch to
 86 1/2 inch x 1/2 inch mesh. The blanket shall be sewn together with cotton,
 87 biodegradable or photodegradable thread.

88

89 Material requirements:

90	Straw Content:	70% 0.35 lb. per sq. yd.
91	Coconut Fiber Content:	30% 0.15 lb. per sq. yd.
92	Netting:	Bottom side biodegradable, 9.3 lbs. per 1000 sq. ft.;
93	Netting:	Top side biodegradable, 9.3 lbs. per 1000 sq. ft.
94	Thread:	Cotton, biodegradable
95	Roll Width:	6.5 to 7.5 feet
96	Roll Length:	83.5 to 110 feet
97	Area Covered by One Roll:	60 to 80 sq. yds

98

99

100 A sample of the soil retention blanket (straw and coconut) shall be submitted at
 101 least 2 weeks in advance of its use on the project for approval by the Project
 102 Manager.
 103

104 (3) Pins and Staples. Pins and staples shall be made of wire 0.162 inch or larger in
 105 diameter. “U” shaped staples shall have legs 8 inches long and a 1 inch crown. “T”
 106 shaped pins shall not be used
 107

108 c. **Tackifier.** Material for mulch tackifier shall consist of a free-flowing, organic, 100% all
 109 natural starch polymer, applied in a slurry with water and wood fiber
 110
 111

112
 113 **908-2.2 INSPECTION.** The DEN Project Manager shall be notified of sources and quantities of mulch
 114 materials available and the Contractor shall furnish him with representative samples of the materials to be
 115 used 30 days before delivery to the project. These samples may be used as standards with the approval of
 116 the DEN Project Manager and any materials brought on the site that do not meet these standards shall
 117 be rejected.
 118

119 **908-2.3 STORAGE.** The Contractor shall store mulch with protection from weather or other conditions
 120 that would damage or impact the effectiveness of the product.
 121

CONSTRUCTION METHODS

122
 123
 124 **908-3.1 MULCHING.** Before spreading mulch, all large clods, stumps, stones, brush, roots, and other
 125 foreign material shall be removed from the area to be mulched. Mulch shall be applied immediately after
 126 seeding.
 127

128 **908-3.2 HYDRAULIC MULCHING.** Wood-fiber mulch and tackifier shall be added to water to form
 129 homogeneous slurry. The operator shall apply the slurry mixture uniformly over the designated seeded
 130 area via spraying.
 131

132 Hydraulic mulching shall not be done in the presence of free surface water.
 133

134 Mixing procedure for the hydraulic mulch and tackifier mixture shall be as follows:
 135

- 136 a. Fill tank with water approximately ¼ full.
 137
 138 b. Continue filling while agitating with engine at full rpm.
 139
 140 c. Pour tackifier, at a moderate rate, directly into area of greatest turbulence.
 141
 142 d. With the recommended amount of tackifier in solution, add wood-fiber mulch. Do not add
 143 fertilizer.
 144

145 Apply the mulch and tackifier mixture at the following rate:
 146

<u>Wood-Fiber Mulch</u>	<u>Tackifier</u>	<u>Water</u>
2000 lbs./Acre	90 lbs./Acre	3000 gal./Acre

149

150 After the hydraulic mulch is applied, foot traffic on the mulch surface should be minimized. Mulch once
151 mixed with water and tackifier shall be used within 4 hours. Unused mulch mixture shall be promptly
152 removed from the site.

153

154 **908-3.3 MATTING.** All erosion control matting installed will be keyed into the ground surface along all
155 exposed (non-overlapping) edges. Keying will consist placing the edge across a six-inch deep trench and
156 backfilling over the mat to the original ground surface level.

157

158 **a. Excelsior.** The area to be covered shall be prepared, fertilized, and seeded, before the
159 blanket is placed. When the blanket is unrolled, the netting shall be on top and the fibers
160 shall be in contact with the soil. In ditches, blankets shall be unrolled in the direction of the
161 flow of water. The end of the upstream blanket shall overlap the buried end of the
162 downstream blanket a maximum of 8 inches and a minimum of 4 inches, forming a junction
163 slot. This junction slot shall be stapled across at 8 inch intervals. Adjoining blankets (side by
164 side) shall be offset 8 inches from center of ditch and overlapped a minimum of 4 inches. Six
165 staples shall be used across the start of each roll, at 4 foot intervals, alternating the center
166 row so that the staples form an “X” pattern. A common row of staples shall be used on
167 adjoining blankets.

168

169 **b. Soil Retention Blanket (Coconut), (Straw), and (Straw and Coconut).** The area to be
170 covered with Soil Retention Blanket (Coconut), (Straw), and (Straw and Coconut) shall be
171 properly prepared, fertilized, and seeded before the blanket is placed. When the blanket is
172 unrolled, the heavyweight polypropylene netting shall be on top and the lightweight
173 polypropylene netting shall be in contact with the soil. In ditches and on slopes, blankets
174 shall be unrolled in the direction of the flow of water. Installation shall be in accordance with
175 manufacturer’s recommendations. A representative of the manufacturer shall be present to
176 give instruction during the installation of the soil retention blanket.

177

178 The blanket shall be placed smoothly but loosely on the soil surface without stretching. The
179 upslope end shall be buried in a trench 6 inches wide by 6 inches deep beyond the crest of
180 the slope to avoid undercutting. For slope applications, there shall be a 6 inch overlap
181 wherever one roll of blanket ends and another begins with the uphill blanket placed on top
182 on the blanket on the downhill side. There shall be a 4 inch overlap wherever two widths of
183 blanket are applied side by side. Insert staples in a pattern according to the manufacturer’s
184 recommendation at approximately two staples per square yard.

185

186 At terminal ends, and every 35 feet, Soil Retention Blanket (Coconut), (Straw), and
187 (Straw/Coconut) placed in ditches shall be buried in a trench approximately 6 inches deep
188 by 6 inches wide. Before backfilling, staples shall be placed across the width of the trench
189 spaced at 6 inches on center in a zigzag pattern. The trench shall then be backfilled to grade
190 and compacted by foot tamping.

191

192 **908-3.4 CARE AND REPAIR.**

193

194 **a.** The Contractor shall care for the mulched areas until final acceptance of the project. Care
195 shall consist of providing protection against traffic or other use by placing warning signs, as
196 approved by the DEN Project Manager, and erecting any barricades that may be shown on
197 the plans before or immediately after mulching has been completed on the designated areas.

198

TECHNICAL SPECIFICATIONS
DIVISION 2 – AIRFIELD STANDARDS
ITEM T-908 MULCHING
AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
RUNWAY 17L-35R PAVEMENT REHABILITATION
AND ELECTRICAL UPGRADES **PACKAGE 2**
CONST. CONTRACT NO. **202473360**

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240

****END OF ITEM T-908****

ITEM L-100 LIGHTING AND ELECTRICAL WORK

DESCRIPTION

100-1.1 GENERAL. The airfield electrical work to be done under this contract shall include the furnishing of all supervision, labor, materials, tools, equipment, and incidentals necessary to provide new airfield lighting system and other electrical work as shown on the drawings.

The electrical work shall comply with latest adopted editions, codes, and standards applicable to this Contract as follows:

10	ICEA	Insulated Cable Engineers Association
11	ANSI C2	National Electrical Safety Code
12	ASTM	American Society of Testing and Materials
13	FAA	Advisory Circulars
14	FAA	Engineering Briefs
15	FAA	Orders
16	NECA	Standard for Installation
17	NEMA	Standard for Materials and Products
18	NFPA	National Electrical Code, 70
19	NFPA	Standard for Electrical Safety in the Workplace, 70E
20	NFPA	Life Safety Code, 101
21	OSHA	Occupational Safety and Health Administration, as Amended
22	UL	Underwriters Laboratories

All work shall be performed in strict accordance with these contract specifications, drawings, and any instructions that may be furnished by the DEN Project Manager during execution of the work to aid in interpretation of said drawings and specifications. Installation details and material and equipment specifications shall be in conformance with all applicable FAA Advisory Circulars, Orders and Engineering Briefs. The Contractor shall furnish written proof of FAA approval on all equipment covered by FAA specifications as part of the submittal package. The Contractor shall keep these specifications on file at their airport construction office.

100-1.2 RELATED DOCUMENTS. The general provisions of the contract apply to the work specified in Items L-100, L-108, L-110, L-125, and L-140.

100-1.3 SUMMARY OF WORK. The work to be performed includes furnishing all labor, supplies, materials, equipment, transportation, and services required to augment, move, install, and complete electrical work as specified herein and as shown on the contract drawings.

The work includes, but is not limited to, the following:

a. Maintain in operation, all existing field electrical facilities and circuits while this improvement work is in progress, including protection of airport personnel, aircraft, and vehicles; furnish and maintain

38 temporary circuits, and place augmented airport lighting into operation. Field lighting shall be operable each
39 night, each day when fog conditions exist, when the airport calls an emergency, or whenever the lighting system
40 is deemed critical for use by Airport Operations or the FAA for safe operations of the airfield.

41 **b.** Provide underground cable (L-824) in accordance with specifications, at the locations shown
42 on the plans. Test all circuit loops before and after installation of new cables to verify that no damage was
43 caused by the Contractor.

44 **c.** Return to Owner or remove from the site, as directed by the DEN Project Manager, existing
45 equipment that is to be removed or replaced.

46 **d.** Ground all equipment, enclosures, and conduits installed under this contract as shown on the
47 plans, specifications or in accordance with the NEC whichever is more stringent.

48 **e.** Adjust finished grade as necessary to accommodate existing and new airfield equipment.

49 **f.** Other items required to complete foregoing. The omission of expressed reference to any parts
50 necessary for or reasonably incidental to the complete installation shall not be construed as releasing the
51 Contractor from furnishing and installing such parts.

52 **g.** In P-501 panel removal, asphalt removal or grading areas, the counterpoise conductor shall be
53 tested prior to any work. The resistive value shall be documented and provided to the DEN Project Manager.
54 At the completion of panel placement, the counterpoise shall be measured to be less than or equal to the value
55 measured prior to demolition and witnessed by the DEN Project Manager. Counterpoise conductors shall be
56 found to be continuous based on the resistive value (size and length) between locations such as light can to
57 light can, manhole to light can, manhole to manhole, light can to ground rod, etc. Measurements shall be
58 completed and demonstrated to the DEN Project Manager or designated representative before work is to
59 proceed. Non-continuous counterpoise conductors shall be subject to removal of completed work and
60 counterpoise repaired at no additional cost to the owner.

61 **h.** The Contractor shall inspect the conduit system prior to paving to assure the conduit is not
62 damaged. The Contractor shall use an approved mandrel to proof the conduit system that runs through any
63 panel replacement area; once panel replacement is completed the conduit shall have a mandrel pulled through
64 the duct prior to re-installation of cable.

65 All items of general work required, such as excavation, cutting, patching, etc. shall be included in this Contract.

66 **100-1.4 WORK REQUIREMENTS.** The general work requirements are as follows:

67 • All work shall be scheduled to minimize the impact and duration of runway or taxiway shutdowns.
68 The Contractor shall keep the DEN Project Manager informed of scheduled work which will affect
69 existing equipment and operations. Minimum 10 working days advance notice shall be given to the
70 DEN Project Manager and approval received for any disconnections or shutdowns.

71 • Existing lighting systems shall be operational at the end of each working day prior to nightfall except
72 as permitted by the DEN Project Manager. Poor weather visibility or an emergency situation may
73 require postponement of a scheduled shutdown on any given day.

74 • The plans are diagrammatic. Locations of equipment to be installed are shown in the plans, but the
75 actual installation will depend on field conditions and the nature of the equipment furnished. When

76 conditions which will adversely affect the installation become apparent, the DEN Project Manager
77 shall be notified in writing.

78 • Locations and quantities of materials shown on the plans and in these specifications are approximate
79 and shall be used for estimating purposes only. Actual locations and quantities of materials shall be
80 reviewed by the Contractor through field investigation. No additional payment will be made for
81 discrepancies between estimated quantities and locations of materials as shown in these documents
82 and the actual field conditions.

83 The Contractor shall at all times keep the construction areas free from accumulations of waste material and
84 rubbish, and prior to completion of work shall remove any rubbish from the project, as well as all tools, reels,
85 equipment, and materials not a part of the project. Upon completion of the construction, the Contractor shall
86 leave the work and premises in a clean, neat, and safe condition satisfactory to the DEN Project Manager. The
87 Contractor shall be responsible for the proper performance in all respects, in whole and in part, of the electrical
88 equipment and for the mechanical installation of electrical equipment until acceptance of the entire work by
89 the DEN Project Manager.

90 **100-1.5 SUBMITTALS.** Submittals of all equipment and materials shall meet the requirements of
91 Section 013300, Section 013325 and in accordance with this specification. Each submittal shall include no
92 more than one spec section, i.e., each spec section shall be submitted under a separate submittal form as per
93 Section 013300.

94 All materials and equipment used to construct this project shall be submitted to the DEN Project Manager for
95 approval prior to ordering the equipment. Indicate all optional equipment and delete non-pertinent data. The
96 Contractor is solely responsible for project delays accruing directly or indirectly from late submissions or
97 resubmissions of submittals. This book shall include all fixtures and appropriate incidentals for each fixture to
98 indicate to the DEN Project Manager that the Contractor comprehends the airfield lighting installation process.

99 The Contractor shall include wiring diagrams, cut sheets, brochures, etc. of all equipment used on the job,
100 including, but not limited to the items listed in these specifications and in the format described herein. The
101 submittal package will not be reviewed unless 100% complete.

102 The submittal shall consist of manufacturer's brochures and cut sheets describing the equipment and materials
103 the Contractor plans to incorporate in the work. These sheets shall be sequentially ordered by specification
104 number with the reference specification number shown on the bottom right of each sheet. Each cut sheet shall
105 show the complete specification or drawing number with which the item must comply (i.e., L-108.2.03 and/or
106 detail 3 on page EL-501). Clearly and boldly mark each copy to identify pertinent products or models applicable
107 to this project.

108 In the one bound book, the cut sheets shall be organized by the specification item number (L-100, L-108, etc.)
109 with a tabbed divider sheet separating each item section. The submitted cut sheet shall clearly show the
110 equipment manufacturer's name, catalog number, size, type, and/or rating as required by these specifications
111 or drawings by underlining or circling the information, highlighting is not acceptable. The conformance to
112 FAA criteria or other standards where called for shall be clearly indicated for each item. Each sheet shall be
113 dedicated to one piece of equipment, and all sheets shall be sequentially numbered (i.e., 1/50; indicating page
114 1 of 50 total pages). One manufacturer's cut sheet shall be submitted for each item. All sheets shall be 8-1/2"
115 x 11" or 17" x 11". When these sizes are unpractical, a folded 24" x 36" drawing may be substituted. All
116 drawings shall be to scale. All sheets shall be bound in a 3-ring binder. Each submittal shall show on the cover
117 the complete job name and number, date, Contractor's name, and the words: "Electrical Submittal." The
118 checklist shown in this specification shall be included as the first sheet of each submittal and shall show the

119 page number of each item included in the submittal. Additional items to be submitted which are not on the list
120 shall be added to the bottom of the table.

121 Samples of conduit, duct, fittings, cables, tapes, fixtures, etc., may be requested by the DEN Project Manager
122 or required in these specifications. After they have been reviewed, samples will be returned in tested condition
123 to the Contractor. In the event any items of material or equipment contained in the list fail to comply with
124 specification requirements, such items will be rejected. All rejected items shall be amended to meet the criteria
125 and then resubmitted for approval by the DEN Project Manager.

126 Substitutions of materials referenced herein is allowed when "or equal" is referenced. Any substitution shall be
127 included in the submittal package and contain additional information as required by Section 016000.

128 All methods and shop drawings of installations shall be submitted and approved prior to the start of installation
129 for each phase of work.

130 Contractor's liability to the City, in case of variations in the submittal document from the requirements of the
131 contract documents is not relieved by the City's review and acceptance of submittals containing variations
132 unless the City expressly approves the deviations in writing, in which the City describes the variation.

133 **100-1.6 DRAWINGS.** The plans, which constitute an integral part of this Contract, shall serve as the
134 working drawings. They indicate the extent and general layout of the lighting and signing system, arrangement
135 of circuits, cables through ducts, and connections to existing circuit cables, and other work. Field verification
136 of scale dimensions is required to determine actual locations, distances, and levels. The Contractor shall
137 research in the field the exact routing and identification of all circuits which extend through, serve, or are
138 affected by the area where work is to commence. No extra compensation will be allowed because of minor
139 differences between work shown on the drawings and field conditions. The Contractor shall check the plans
140 and specifications and, if any portion of the work is found to be omitted, unclear, or in error, the Contractor
141 shall immediately notify the DEN Project Manager. The directions of the DEN Project Manager shall be
142 followed and the work completed accordingly. The design drawings may be utilized in the preparation of the
143 shop or working drawings showing the permanent construction, as described in L-100.

144 The plans and specifications are complementary and what is called for in either one shall be as binding as if
145 called for in both.

146 Where a disagreement exists between the plans and specifications, the item or arrangements of better quality,
147 greater quantity, or higher cost shall be included in the bid.

148 Any discrepancies between the drawings, Advisory Circulars, and field conditions must be resolved with the
149 DEN Project Manager before proceeding. All agreements shall be verified in writing.

150 'Record' drawings covering equipment installed under previous contracts and which relate to this contract will
151 be available for the Contractor. The airport cannot, however, guarantee the accuracy of these drawings. Those
152 conditions which will affect the work under this contract should be verified prior to any
153 design/fabrication/installation commitment.

154 Detail dimensions shown on the plans are approximate and shall be field verified before construction. All
155 differences shall be submitted to the DEN Project Manager in writing before construction begins.

156 **100-1.7 RECORD DRAWINGS.** The Contractor shall mark up a set of blue line prints to show the
157 as-built conditions which differ from the contract plans. All changes shall be recorded by a skilled draftsman

158 with at least three years of CAD experience. The DEN Project Manager will furnish a newly printed set of
159 blue-line drawings to be used for this purpose. Record drawings will be checked periodically for accurateness
160 and partial payments will be withheld until the record drawings are completely updated. The mark-up set shall
161 be kept at the site, and any changes, discoveries, or deviations shall be recorded daily. The Contractor shall
162 furnish one newly printed as-built drawing set to the DEN Project Manager upon completion. This work shall
163 be completed and accepted by the DEN Project Manager before approval of final payment. The Contractor
164 shall include complete as-built drawings with Northing/Easting coordinates and elevations of duct banks
165 installed. The Contractor shall document all return splice locations and complete wiring diagrams including
166 the actual field configuration of circuits.

167 **100-1.8 MAINTENANCE AND OPERATING INSTRUCTIONS.** The Contractor shall
168 provide the Owner with complete instructions in the proper care and operation of the equipment installed
169 under this contract. This is considered as part of the final inspection, and final acceptance will not be given
170 until the Owner's representative is knowledgeable about the system.

171 The Contractor shall also collect and assemble into each of three hardcover books and three CDs the
172 installation details, instructions, parts list, source of local supply, schematics of actual equipment and operations,
173 and directions supplied by the manufacturer with all equipment. If cut sheets are included showing various
174 models and features of the equipment supplied, the specific model and features shall be clearly indicated to
175 show only the options of the equipment that are actually provided and installed. Final acceptance of the work
176 will be withheld until such data has been presented complete to the DEN Project Manager for transmission to
177 the Owner. The Contractor shall comply with Section 017825 Operation and Maintenance Data.

178 The Contractor shall install all equipment according to the manufacturers' instructions and as shown in the
179 drawings and specifications. The Contractor shall notify the DEN Project Manager in writing if any
180 discrepancies exist between the aforementioned documents. Work shall be suspended until resolved and
181 approval to proceed has been granted by the DEN Project Manager.

182 **100-1.9 SAFETY RULES.** The Electrical Safety Rules shall be observed and complied with in every
183 detail, and any violation thereof shall be cause for immediate termination of the Contractor's authority to
184 proceed with the work and recourse to their Surety for completion of the Project. The Electrical Safety Rules
185 are as follows:

186 The Contractor shall be responsible for conforming to the safety requirements of AC 150/5370-2, AC
187 150/5340-30, NFPA/NEC, as well as local building and electrical codes.

188 Electrical circuits, operating over 300 volts, phase-to-ground shall be de-energized before work is accomplished
189 thereon. Work on energized systems shall be accomplished by trained personnel, properly insulated, and done
190 with extreme caution.

191 Electrical circuits shall be considered de-energized only when one of the following conditions exists:

- 192 • Switches connecting subject circuit to the electrical supply are observed in the OPEN position, with
193 an air break, and safety-tagged (padlocked) in the OPEN position;
- 194 • Electrically operated switches are visibly OPEN, blocked or racked in the OPEN position, and safety-
195 tagged OPEN;

196 • Whenever the supply circuit breaker is not visible and clearly identified, the circuit shall be grounded.
197 The ground connection shall be safety-tagged before work thereon, when the ground connection is
198 not within sight of the work area.

199 • Oil switches observed OPEN in a sight window, and tagged OPEN; or oil fuse cutouts with fuse
200 carrier removed and tagged OPEN.

201 • For airfield lighting circuits fed by constant current regulators, the disconnect switches feeding all
202 affected regulators and power circuits leaving the vault shall be locked in the OPEN position. When
203 working in manhole housings, additional circuits not a part of the project, those circuits shall be locked
204 in the OPEN position as well. The circuits shall be put into maintenance lock out on the control
205 system with the assistance of the project management team prior to lock out of the regulator.

206 a. **Use of Red Safety Tags:** Safety tags shall be filled out daily and connected to any switch or
207 equipment opened for protection of personnel working upon circuits connected thereto.

208 Safety tags shall be removed only by the employee who placed the tag, or by another employee designated in
209 writing by the employee who placed the tag, to remove the tag. Removal of a safety tag placed by an employee
210 not available at the time of need to remove may be authorized by the Electrical Superintendent or his designated
211 representative, only after carefully checking that the circuit is ready to be energized.

212 Equipment with a safety tag attached shall not be operated, and connections with a safety tag attached shall not
213 be changed.

214 Insulated cables, operated at over 300 volts to ground shall be handled, when energized, only with rubber gloves
215 tested to 15,000 volts.

216 Insulated cables, which have been in operation, shall be cut only with grounded cable shears, or shall be
217 grounded by driving a grounded sharp tool through the shielding and the conductors before cutting.

218 All personnel working around energized electrical equipment operating at over 600 volts shall wear standard
219 insulated, non-conducting hard hats, and shall wear no garments with metallic zipper fasteners, and remove all
220 jewelry.

221 Ladders used in any electrical work shall be of wood or fiberglass construction.

222 The Contractor shall designate a supervisor for all contract personnel and operations; said supervisor shall be
223 present at the job site wherever contract operations are in progress.
224

225 EQUIPMENT AND MATERIALS

226 **100-2.1 GENERAL.** Airport lighting equipment and materials covered by Federal Aviation
227 Administration (FAA) specifications shall be certified by independent laboratory testing to be in compliance
228 with the specification, at the date of the Contractor's bid submission.

229 Equipment and materials covered by other referenced specifications shall be subject to acceptance through
230 manufacturer's certification of compliance with the applicable specification when requested by the DEN
231 Project Manager. Whenever Underwriters Laboratories has a published standard applicable to the equipment

232 furnished for this contract, the furnished equipment shall be listed by UL. The term 'Equipment' shall be as
233 defined in the NEC.

234 Materials and equipment shall be as specified herein. When materials are used that are not specifically
235 designated herein, they shall be in accordance with the best industry standards and practices for equipment of
236 this type. All components and parts shall be suitable for operation under the environmental conditions
237 specified herein. Metal parts shall be either inherently corrosion-resistant or shall be suitably protected to resist
238 corrosion or oxidation during extended service life.

239 **100-2.2 HARDWARE AND CORROSION PROTECTION.** In order to prevent deterioration
240 due to corrosion, all bolts, nuts, studs, washers, pins, terminals, springs, hangers and similar fastenings and
241 fittings shall be of an approved corrosion-resisting material and/or be treated in an approved manner to render
242 it adequately resistant to corrosion. All hardware such as cap screws, set screws, tap bolts, nuts, washers, etc.,
243 shall be of stainless steel type 304, if they are used outdoors unless specified otherwise on the plans. Brass,
244 bronze, or hot-dip galvanized ferrous hardware (per ASTM, Specification A1530) will be considered for indoor
245 use. All stainless steel and galvanized steel bolts, screws, nuts, etc., shall be coated with a layer of anti-seize
246 compound.

247 All ferrous metalwork shall be hot-dip galvanized. If any galvanizing is damaged, the metal work shall be
248 refinished by cleaning, treating with one coat of wash primer conforming to Federal (military) Specification
249 MIL-P-152388, and shall be given one shop coat of zinc-rich base paint (zinc dust paint) conforming to Federal
250 Specification TT-P-641F Type II, immediately when the wash primer is dry.

251 **100-2.3 PARTS RATING.** All parts shall be of adequate rating for the application and shall not be
252 operated above the parts manufacturer's recommended ratings.

253 **100-2.4 ENVIRONMENTAL CONDITIONS.** The equipment installed outdoors shall be
254 designated for continuous outdoor operation under the following environmental conditions unless specified
255 elsewhere:

256 a. Temperature: any ambient temperature from minus 20°F to plus 120°F.

257 b. Altitude: 6000 MSL.

258 c. Humidity: up to 100 percent.

259 d. Sand and Dust: exposure to windblown sand and dust particles.

260 e. Wind: operation at wind velocities up to 200 miles per hour.

261 f. Water: components provided for underground installation, direct buried or installed in
262 underground housing, shall be suitable for continuous operation, continuously or intermittently submerged in
263 water.

264 g. Chemical: shall be rated for exposure to all de-icing and anti-icing agents.

265 **100-2.5 SALVAGE.** Except as otherwise specified or indicated on the drawings, all electrical materials
266 and equipment to be salvaged, removed, or "stored" shall become the property of the airport, and shall be
267 moved by the Contractor to a site at the airport or within 5 miles of the airport designated by the DEN Project

268 Manager. All wastes such as removed asphalt, concrete, excess dirt, conductors, damaged base cans, etc., shall
269 become property of the Contractor and shall be disposed of off site by the Contractor.

270 **100-2.6 TESTING.** All materials and finishes are subject to testing. Material inspection and testing,
271 and strength tests on the concrete will be performed by the Contractor at no expense to the airport other than
272 material used. The Contractor shall assist the DEN Project Manager in obtaining samples during the course
273 of construction work. The testing of electrical equipment shall conform to the description of the individual
274 specification sections.

275 **100-2.7 INSPECTION.** Provide for electrical inspections by the DEN Project Manager. No work
276 shall be concealed or enclosed until after inspections. If work is concealed or enclosed without inspection and
277 approval, the Contractor shall be responsible for all expense and work required to open and restore the
278 concealed area in addition to all required modifications.

279 Mill inspection will be waived, and the materials accepted upon certified copies of mill reports identifying the
280 material specification requirements. Copies of order bills and test reports shall be furnished as requested.

281 **100-2.8 WARRANTY.** The Contractor shall provide a written 2-year warranty guaranteeing all work
282 installed under this contract. It shall cover all parts and labor against defective parts, corrosion or workmanship
283 necessary to repair or bring into proper operation any equipment including, but not limited to, isolation
284 transformers, lamps, inset and elevated lighting fixtures, poles, conduit system, and junction boxes. This
285 warranty work includes the Contractor to be on-site to remove, replace, and ship any defective equipment
286 discovered during the warranty period. At the end of the 2-year warranty period, the insulation resistance of
287 each circuit shall be measured to a minimum of 750 Mohms according to the testing requirements per Item L-
288 108. The warranty shall start upon the final acceptance of all work as accepted by the DEN Project Manager.
289 Final payment will be withheld until receipt of the warranty by the DEN Project Manager.

290 LED fixtures shall have a written 4 year warranty provided as required by FAA Engineering Brief 67 (latest
291 edition).
292

293 CONSTRUCTION METHODS

294 **100-3.1 GENERAL.** Installation shall be performed by experienced and skilled persons to obtain
295 only the best workmanship. All equipment shall be set square and true with construction. The work shall be
296 under constant supervision by the Contractor, or by an authorized and competent foreman with five years
297 airfield experience, until completion. The installation and adjustments shall be by competent Colorado State
298 recognized licensed journeyman electricians. The Contractor shall include no more than one certified
299 apprentice per journeyman electrician. Apprentices shall be under the direct supervision of a licensed electrician
300 at all times.

301 All work shall be inspected by the Contractor's electrical QC. The electrical QC shall be responsible to correct
302 or stop work when items of installation are found not to the contract documents. The number of inspectors
303 shall be adequate to cover all work areas during all phases of construction. The electrical QC inspector shall
304 be submitted under the electrical QC Manager Plan, per Section 014310.

305 **100-3.2 INSTALLATION METHOD.** The methods used for the installation of electrical system
306 and equipment shall conform to the National Electric Contractors Association (NECA) published "Standard
307 of Installation" except where specifically specified or shown otherwise, and to the requirements of the National
308 Electrical Code (NEC) and its revisions.

309 All electrical materials, construction methods, and installation shall be in accordance with applicable Federal
310 Aviation Administration's advisory circulars including amendments, the National Electrical Code, and the
311 American National Standards Institute Standard C2.

312 Workmanship shall be consistent with the best commercial practices for installation of this type. The
313 workmanship shall be first class and in accordance with the highest standards of the electrical industry.

314 The responsibility for the correct and satisfactory installation and operation of all materials and equipment
315 required herein shall rest with the Contractor. Before any equipment is ordered, a complete schedule of
316 materials and detailed shop drawings covering all items of equipment and brochures of the materials proposed
317 for installation shall be submitted for approval by the DEN Project Manager as described in Item L-100.

318 **100-3.3 SITE CONDITIONS.** At least five working days prior to commencing construction
319 operations in an area which may involve underground utility facilities, the Contractor shall notify the DEN
320 Project Manager and the owners of each underground utility facility shown on the plans. The FAA will assist
321 the Contractor in locating FAA cables.

322 The existence of any known buried wires, conduits, junction boxes, ducts, or other facilities is shown in a
323 general way only. It will be the duty of the Contractor, with the help of airport personnel, to visit the site and
324 make exact determination of the existence and location of any facilities prior to commencing any work. It is
325 understood that the Contractor will be responsible for making the exact determination of the location and
326 condition of such facilities. Any costs shall be paid for by the Contractor. The Contractor shall obtain from
327 the DEN Project Manager copies of contract drawings from previous construction projects, and examine these
328 drawings and verify at the site the location of all below grade utilities in the vicinity of the work performed
329 under this contract.

330 All items damaged by the Contractor's workers or equipment shall be replaced immediately at the Contractor's
331 expense.

332 **100-3.4 INTERRUPTIONS.** Interruptions of lighting circuits may be necessary during construction.
333 The Contractor shall provide a reliable shunt cable to provide temporary continuity of circuit service to runway
334 and taxiway lights and signs during construction where required. The Contractor shall not interrupt any circuit
335 or perform any work that might endanger any circuit until approval of the DEN Project Manager has been
336 received. Temporary cables shall be installed in conduit and identified as a hazard.

337 The Contractor shall be responsible for installing, maintaining, protecting, and removing all required temporary
338 jumper cables used to maintain power to electrical circuits.

339 For the permanent installation, all temporary connections and rerouting of circuits shall be replaced with new
340 materials installed in accordance with the specifications and as shown on the plans.

341 See Item L-100, paragraph SAFETY RULES. Payment for this work will be made under Item L-108,
342 Temporary Electrical Work/Jumpers when indicated. Otherwise the work shall be considered incidental.

343 If requested by the Project Manager, Contractor shall submit for approval an Operational Safety Plan (OSP)
344 including circuits to be locked off and signs to be covered during construction.

345 **100-3.5 CODES.** The Contractor shall comply with all ordinances, laws, regulations, and codes
346 applicable to the work involved and as referenced in these specifications. This does not relieve the Contractor

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM L-100 LIGHTING AND ELECTRICAL WORK

DENVER INTERNATIONAL AIRPORT
RUNWAY 17L-35R PAVEMENT REHABILITATION
AND ELECTRICAL UPGRADES PACKAGE 2
CONST. CONTRACT NO. 202473360

347 from furnishing and installing work shown or specified which may be beyond the requirements of such
348 ordinances, laws, regulations, and codes.

349 **100-3.6 SAFETY AREA.** The Contractor shall abide by the requirements of the contract
350 specifications when working within the runway or taxiway safety areas or as directed by the DEN Project
351 Manager.
352

353 **METHOD OF MEASUREMENT**

354 **100-4.1** No direct measurement or payment will be made for work under this specification. The work
355 under this specification shall be considered incidental to other items of work.
356

357 **BASIS OF PAYMENT**

358 **100-6.1** No direct measurement or payment will be made for work under this specification. The work
359 under this specification shall be considered incidental to other items of work.
360

361 **MATERIAL REQUIREMENTS**

362	AC 150/5370-2	Operational Safety on Airports During Construction
363	AC 150/5370-10	Standards for Specifying Construction of Airports
364	MIL-P-152388	Wash Primer Specification
365	TT-P-641F	Type II, Base Paint, Zinc-Rich

366 **END OF ITEM L-100**

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 DEN Project Manager. 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 DEN Project Manager.
- 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 DEN Project Manager) 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 DEN Project Manager 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 DEN Project Manager, to determine compliance with the plans and specifications. The Contractor's submittals shall be electronically submitted in pdf format. The DEN Project Manager 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.

50 **f.** All equipment and materials furnished and installed under this section shall be guaranteed against
51 defects in materials and workmanship for at least twelve (12) months from the date of final
52 acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced,
53 at the Owner's discretion, with no additional cost to the Owner. The Contractor shall maintain a
54 minimum insulation resistance in accordance with paragraph 108-3.10e with isolation transformers
55 connected in new circuits and new segments of existing circuits through the end of the contract
56 warranty period when tested in accordance with AC 150/5340-26, Maintenance Airport Visual Aid
57 Facilities, paragraph 5.1.3.1, Insulation Resistance Test.

58
59 **g.** Only Third-Party certified manufacturers, listed in AC 150/5345-53, Appendix 3 Addendum (as
60 required) and meeting the BUY AMERICAN preference requirements can provide equipment and
61 materials specified in the Contract Documents. Documentation certifying compliance with the
62 BUY AMERICAN preference rules for Airport Improvement Program (AIP) cited in 49 USC
63 §50101) shall be included with each equipment and material submittal.
64

65 **108-2.2 CABLE.** Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall
66 conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for
67 Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits
68 shall be single conductor, seven strand, #8 American wire gauge (AWG), L-824 Type C, 5,000 volts, non-
69 shielded, with cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting
70 series circuits shall be single conductor, seven strand, #6 AWG, L-824, Type C, 5,000 volts, non-shielded, with
71 cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series
72 circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall
73 comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not
74 apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.
75

76 Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Commercial Item
77 Description A-A-59544A and shall be type THWN-2, 75°C for installation in conduit and RHW-2, 75°C for
78 direct burial installations. Conductors for parallel (voltage) circuits shall be type and size and installed in
79 accordance with NFPA-70, National Electrical Code.
80

81 Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-
82 2, 600-volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free
83 air. The conduit/duct sizes are based on the use of THWN-2, 600-volt insulated conductors. The Contractor
84 shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the
85 conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.
86

87 Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment
88 provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the
89 Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal
90 blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental
91 to the respective pay items provided.
92

93 Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract
94 Document.
95

96 **108-2.3 BARE COPPER WIRE (COUNTERPOISE, BARE COPPER WIRE GROUND AND**
97 **GROUND RODS).** Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6
98 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for grounding bond wire

99 per ASTM B3 and ASTM B8, and shall be bare copper wire. For voltage powered circuits, the equipment
100 grounding conductor shall comply with NEC Article 250.
101

102 Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the
103 plans, but in no case be less than 10 feet (2.54 m) long and 3/4 inch (19 mm) in diameter.
104

105 **108-2.4 CABLE CONNECTIONS.** In-line connections or splices of underground primary cables shall be of
106 the type called for on the plans, and shall be one of the types listed below. No separate payment will be made
107 for cable connections.
108

109 a. **The cast splice.** A cast splice, employing a plastic mold and using epoxy resin equivalent to that
110 manufactured by 3M™ Company, "Scotchcast" Kit No. 82-B, or an approved equivalent, used for
111 potting the splice is acceptable.
112

113 b. **The field-attached plug-in splice.** Field attached plug-in splices shall be installed as shown on
114 the plans. The Contractor shall determine the outside diameter of the cable to be spliced and
115 furnish appropriately sized connector kits and/or adapters. Tape or heat shrink tubing with
116 integral sealant shall be in accordance with the manufacturer's requirements. Primary Connector
117 Kits manufactured by Amerace, "Super Kit", Integro "Complete Kit", or approved equal is
118 acceptable.
119

120 c. **The factory-molded plug-in splice.** Specification for L-823 Connectors, Factory-Molded to
121 Individual Conductors, is acceptable.
122

123 d. **The taped or heat-shrink splice.** Taped splices employing field-applied rubber, or synthetic
124 rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements
125 of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or
126 Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing
127 tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations.
128 The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the
129 insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat
130 shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory
131 kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be
132 manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved
133 equivalent.
134

135 In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping
136 tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and
137 terminations shall be made per the manufacturer's recommendations and listings.
138

139 All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic
140 process or approved equivalent, except that a light base ground clamp connector shall be used for attachment
141 to the light base. All exothermic connections shall be made per the manufacturer's recommendations and
142 listings.
143

144 **108-2.5 SPLICER QUALIFICATIONS.** Every airfield lighting cable splicer shall be qualified in making
145 airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit
146 to the DEN Project Manager proof of the qualifications of each proposed cable splicer for the airport cable
147 type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three
148 (3) years continuous experience in terminating/splicing medium voltage cable.

149
150 **108-2.6 CONCRETE.** Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for
151 Miscellaneous Structures.

152
153 **108-2.7 FLOWABLE BACKFILL.** Flowable material used to backfill trenches for power cable trenches shall
154 conform to the requirements of Item P-153, Controlled Low Strength Material.

155
156 **108-2.8 CABLE IDENTIFICATION TAGS.** Cable identification tags shall be made from a non-corrosive
157 material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed
158 on the plans.

159
160 **108-2.9 TAPE.** Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide)
161 and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as manufactured by the Minnesota
162 Mining and Manufacturing Company (3M™), or an approved equivalent.

163
164 **108-2.10 ELECTRICAL COATING.** Electrical coating shall be Scotchkote™ as manufactured by 3M™, or
165 an approved equivalent.

166
167 **108-2.11 EXISTING CIRCUITS.** Whenever the scope of work requires connection to an existing circuit, the
168 existing circuit's insulation resistance shall be tested, in the presence of the DEN Project Manager. The test
169 shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor
170 shall record the results on forms acceptable to the DEN Project Manager. When the work affecting the circuit
171 is complete, the circuit's insulation resistance shall be checked again, in the presence of the DEN Project
172 Manager. The Contractor shall record the results on forms acceptable to the DEN Project Manager. The second
173 reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to
174 the existing circuit to bring the second reading above the first reading. All repair costs including a complete
175 replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the
176 Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

177
178 **108-2.12 DETECTABLE WARNING TAPE.** Plastic, detectable, American Public Works Association
179 (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend tape shall be
180 polyethylene film with a metalized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is
181 incidental to the respective bid item. Detectable warning tape for communication cables shall be orange.
182 Detectable warning tape color code shall comply with the APWA Uniform Color Code.

183

184

185

CONSTRUCTION METHODS

186

187 **108-3.1 GENERAL.** The Contractor shall install the specified cable at the approximate locations indicated on
188 the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry
189 aircraft loads shall be installed in concrete encased duct banks. Cable shall be run without splices, from fixture
190 to fixture.

191

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

196

197 In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for
198 maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification

199 markers shall be installed on both sides of the L-823 connectors installed and on both sides of slack loops
200 where a future connector would be installed.

201
202 Provide not less than 3 feet (1 m) of cable slack on each side of all connections, isolation transformers, light
203 units, and at points where cable is connected to field equipment. Where provisions must be made for testing
204 or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot
205 (30 cm) vertically above the top of the access structure. This requirement also applies where primary cable
206 passes through empty light bases, junction boxes, and access structures to allow for future connections, or as
207 designated by the DEN Project Manager.

208
209 Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of
210 each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as
211 manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the
212 cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable
213 circuit identification shall match the circuits noted on the construction plans.

214
215 **108-3.2 INSTALLATION IN DUCT BANKS OR CONDUITS.** This item includes the installation of the
216 cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of
217 cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the
218 latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

219
220 The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

221
222 Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first,
223 with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the
224 shortest routes are selected and that any potential interference is avoided.

225
226 Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical
227 Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation
228 of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall
229 be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases,
230 manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all
231 accessible points of entry to the duct/conduit system shall be kept closed except when installing cables.
232 Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway
233 systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The
234 Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall
235 notify the DEN Project Manager of any blockage in the existing ducts.

236
237 The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the
238 insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal
239 tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing
240 before pulling into the conduit and it shall be left sealed until connections are made. Where more than one
241 cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a
242 cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of
243 cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's
244 recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed
245 shall be used where required.

246
247 The Contractor shall submit the recommended pulling tension values to the DEN Project Manager prior to
248 any cable installation. If required by the DEN Project Manager, pulling tension values for cable pulls shall be

249 monitored by a dynamometer in the presence of the DEN Project Manager. Cable pull tensions shall be
250 recorded by the Contractor and reviewed by the DEN Project Manager. Cables exceeding the maximum
251 allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.
252

253 The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply.
254 Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather,
255 particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be
256 installed when the temperature is at or below the manufacturer's minimum installation temperature. At the
257 Contractor's option, the Contractor may submit a plan, for review by the DEN Project Manager, for heated
258 storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures
259 are below the manufacturer's minimum cable installation temperature.
260

261 Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled,
262 lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.
263

264 **108-3.3 INSTALLATION OF DIRECT-BURIED CABLE IN TRENCHES.** Unless otherwise specified,
265 the Contractor shall not use a cable plow for installing the cable. Cable shall be unreeled uniformly in place
266 alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be
267 unreeled and pulled into the trench from one end. Slack cable sufficient to provide strain relief shall be placed
268 in the trench in a series of S curves. Sharp bends or kinks in the cable shall not be permitted.
269

270 Where cables must cross over each other, a minimum of 3 inches (75 mm) vertical displacement shall be
271 provided with the topmost cable depth at or below the minimum required depth below finished grade.
272

273 **a. Trenching.** Where turf is well established and the sod can be removed, it shall be carefully stripped
274 and properly stored. Trenches for cables may be excavated manually or with mechanical trenching
275 equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed.
276 Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches
277 shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable
278 trenches shall be excavated to a minimum depth of 18 inches (0.5 m) below finished grade per
279 NEC Table 300.5, except as follows:
280

- 281 • When off the airport or crossing under a roadway or driveway, the minimum depth shall be
282 36 inches (91 cm) unless otherwise specified.
283
- 284 • Minimum cable depth when crossing under a railroad track, shall be 42 inches (1 m) unless
285 otherwise specified.
286

287 The Contractor shall excavate all cable trenches to a width not less than 6 inches (150 mm). Unless
288 otherwise specified on the plans, all cables in the same location and running in the same general
289 direction shall be installed in the same trench.
290

291 When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below
292 the required cable depth and it shall be replaced with bedding material of earth or sand containing
293 no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. Flowable
294 backfill material may alternatively be used.
295

296 Duct bank or conduit markers temporarily removed for trench excavations shall be replaced as
297 required.
298

299 It is the Contractor's responsibility to locate existing utilities within the work area prior to
300 excavation. Where existing active cables cross proposed installations, the Contractor shall ensure
301 that these cables are adequately protected. Where crossings are unavoidable, no splices will be
302 allowed in the existing cables, except as specified on the plans. Installation of new cable where
303 such crossings must occur shall proceed as follows:

304
305 (1) Existing cables shall be located manually. Unearthed cables shall be inspected to assure
306 absolutely no damage has occurred.

307
308 (2) Trenching, etc., in cable areas shall then proceed, with approval of the DEN Project
309 Manager, with care taken to minimize possible damage or disruption of existing cable,
310 including careful backfilling in area of cable.

311
312 In the event that any previously identified cable is damaged during the course of construction, the
313 Contractor shall be responsible for the complete repair or replacement.

314
315 **b. Backfilling.** After the cable has been installed, the trench shall be backfilled. The first layer of
316 backfill in the trench shall encompass all cables; be 3 inches (75 mm) deep, loose measurement;
317 and shall be either earth or sand containing no mineral aggregate particles that would be retained
318 on a 1/4-inch (6.3 mm) sieve. This layer shall not be compacted. The second layer shall be 5 inches
319 (125 mm) deep, loose measurement, and shall contain no particles that would be retained on a one
320 inch (25.0 mm) sieve. The remaining third and subsequent layers of backfill shall not exceed 8
321 inches (20 cm) of loose measurement and be excavated or imported material and shall not contain
322 stone or aggregate larger than 4 inches (100 mm) maximum diameter.

323
324 The second and subsequent layers shall be thoroughly tamped and compacted to at least the density
325 of the adjacent material. If the cable is to be installed in locations or areas where other compaction
326 requirements are specified (under pavements, embankments, etc.) the backfill compaction shall be
327 per the requirements of specification P-152.

328
329 Trenches shall not contain pools of water during backfilling operations. The trench shall be
330 completely backfilled and tamped level with the adjacent surface, except that when turf is to be
331 established over the trench, the backfilling shall be stopped at an appropriate depth consistent with
332 the type of turfing operation to be accommodated. A proper allowance for settlement shall also
333 be provided. Any excess excavated material shall be removed and disposed of per the plans and
334 specifications.

335
336 Underground electrical warning (caution) tape shall be installed in the trench above all direct-
337 buried cable. Contractor shall submit a sample of the proposed warning tape for acceptance by the
338 DEN Project Manager. If not shown on the plans, the warning tape shall be located 6 inches (150
339 mm) above the direct-buried cable or the counterpoise wire if present. A 3-6 inch (75 - 150 mm)
340 wide polyethylene film detectable tape, with a metalized foil core, shall be installed above all direct
341 buried cable or counterpoise. The tape shall be of the color and have a continuous legend as
342 indicated on the plans. The tape shall be installed 8 inches (200 mm) minimum below finished
343 grade.

344
345 **c. Restoration.** Following restoration of all trenching near airport movement surfaces, the
346 Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is
347 found. Where soil and sod has been removed, it shall be replaced as soon as possible after the
348 backfilling is completed. All areas disturbed by work shall be restored to its original condition. The

349 restoration shall include the seeding and mulching as shown on the plans. The Contractor shall be
350 held responsible for maintaining all disturbed surfaces and replacements until final acceptance.
351 When trenching is through paved areas, restoration shall be equal to existing conditions. If the
352 cable is to be installed in locations or areas where other compaction requirements are specified
353 (under pavements, embankments, etc.) the backfill compaction shall be to a minimum of 100
354 percent of ASTM D1557 Restoration shall be considered incidental to the pay item of which it is
355 a component part.
356

357 **108-3.4 CABLE MARKERS FOR DIRECT-BURIED CABLE.** The location of direct buried circuits shall
358 be marked by a concrete slab marker, 2 feet (60 cm) square and 4-6 inch (10 - 15 cm) thick, extending
359 approximately one inch (25 mm) above the surface. Each cable run from a line of lights and signs to the
360 equipment vault shall be marked at approximately every 200 feet (61 m) along the cable run, with an additional
361 marker at each change of direction of cable run. All other direct-buried cable shall be marked in the same
362 manner. Cable markers shall be installed directly above the cable. The Contractor shall impress the word
363 "CABLE" and directional arrows on each cable marking slab. The letters shall be approximately 4 inches (100
364 mm) high and 3 inches (75 mm) wide, with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep.
365 Stencils shall be used for cable marker lettering; no hand lettering shall be permitted.
366

367 At the location of each underground cable connection/splice, except at lighting units, or isolation transformers,
368 a concrete marker slab shall be installed to mark the location of the connection/splice. The Contractor shall
369 impress the word "SPICE" on each slab. The Contractor also shall impress additional circuit identification
370 symbols on each slab as directed by the DEN Project Manager. All cable markers and splice markers shall be
371 painted international orange. Paint shall be specifically manufactured for uncured exterior concrete. After
372 placement, all cable or splice markers shall be given one coat of high-visibility aviation orange paint as approved
373 by the DEN Project Manager. Furnishing and installation of cable markers is incidental to the respective cable
374 pay item.
375

376 **108-3.5 SPLICING.** Connections of the type shown on the plans shall be made by experienced personnel
377 regularly engaged in this type of work and shall be made as follows:
378

379 a. **Cast splices.** These shall be made by using crimp connectors for jointing conductors. Molds shall
380 be assembled, and the compound shall be mixed and poured per the manufacturer's instructions
381 and to the satisfaction of the DEN Project Manager.
382

383 b. **Field-attached plug-in splices.** These shall be assembled per the manufacturer's instructions.
384 These splices shall be made by plugging directly into mating connectors. The joint where the
385 connectors come together shall be finished by one of the following methods: (1) wrapped with at
386 least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped,
387 extending at least 1-1/2 inches (38 mm) on each side of the joint (2) Covered with heat shrinkable
388 tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint or (3)
389 On connector kits equipped with water seal flap; roll-over water seal flap to sealing position on
390 mating connector.
391

392 c. **Factory-molded plug-in splices.** These shall be made by plugging directly into mating
393 connectors. The joint where the connectors come together shall be finished by one of the following
394 methods: (1) Wrapped with at least one layer of rubber or synthetic rubber tape and one layer of
395 plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint. (2)
396 Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm)
397 on each side of the joint. or (3) On connector kits so equipped with water seal flap; roll-over water
398 seal flap to sealing position on mating connector.

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- 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 contaminants 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 stranded #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables. The DEN Project Manager 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.

449 Counterpoise wire shall be installed in the same trench for the entire length of buried cable,
450 conduits and duct banks that are installed to contain airfield cables. The counterpoise is centered
451 over the cable/conduit/duct to be protected.
452

453 The counterpoise conductor shall be installed no less than 8 inches (200 mm) minimum or 12
454 inches (300 mm) maximum above the raceway or cable to be protected, except as permitted below:
455

456 (1) The minimum counterpoise conductor height above the raceway or cable to be protected
457 shall be permitted to be adjusted subject to coordination with the airfield lighting and
458 pavement designs.
459

460 (2) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be
461 calculated to ensure that the raceway or cable is within a 45-degree area of protection, (45
462 degrees on each side of vertical creating a 90 degree angle).
463

464 The counterpoise conductor shall be bonded to each metallic light base, mounting stake,
465 and metallic airfield lighting component.
466

467 All metallic airfield lighting components in the field circuit on the output side of the constant
468 current regulator (CCR) or other power source shall be bonded to the airfield lighting
469 counterpoise system.
470

471 All components rise and fall at the same potential; with no potential difference, no damaging
472 arcing and no damaging current flow.
473

474 See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA
475 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed
476 description of the Equipotential Method of lightning protection.
477

478 Reference FAA STD-019E, Lightning and Surge Protection, Grounding Bonding and
479 Shielding Requirements for Facilities and Electronic Equipment, Part 4.1.1.7.
480

481 **b. Common Installation requirements.** When a metallic light base is used, the grounding electrode
482 shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or
483 soft drawn, stranded copper conductor.
484

485 When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light
486 fixture or metallic base plate with a No. 6 AWG bare, annealed or soft drawn, stranded copper
487 conductor.
488

489 Grounding electrodes may be rods, ground dissipation plates, radials, or other electrodes listed in
490 the NFPA 70 (NEC) or NFPA 780.
491

492 Where raceway is installed by the directional bore, jack and bore, or other drilling method, the
493 counterpoise conductor shall be permitted to be installed concurrently with the directional bore,
494 jack and bore, or other drilling method raceway, external to the raceway or sleeve.
495

496 The counterpoise wire shall also be exothermically welded to ground rods installed as shown on
497 the plans but not more than 500 feet (150 m) apart around the entire circuit. The counterpoise
498 system shall be continuous and terminate at the transformer vault or at the power source. It shall

499 be securely attached to the vault or equipment external ground ring or other made electrode-
500 grounding system. The connections shall be made as shown on the plans and in the specifications.

501
502 Where an existing airfield lighting system is being extended or modified, the new counterpoise
503 conductors shall be interconnected to existing counterpoise conductors at each intersection of the
504 new and existing airfield lighting counterpoise systems.

505
506 **c. Parallel Voltage Systems.** Provide grounding and bonding in accordance with NFPA 70,
507 National Electrical Code.

508
509 **108-3.7 COUNTERPOISE INSTALLATION ABOVE MULTIPLE CONDUITS AND DUCT**
510 **BANKS.** Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables,
511 with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple
512 conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of
513 counterpoise wires above the conduits shall be adequate to provide a complete area of protection measured 45
514 degrees each side of vertical.

515
516 Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above
517 the duct bank. Reference details on the construction plans.

518
519 **108-3.8 COUNTERPOISE INSTALLATION AT EXISTING DUCT BANKS.** When airfield lighting
520 cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall
521 be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and
522 exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

523
524 **108-3.9 EXOTHERMIC BONDING.** Bonding of counterpoise wire shall be by the exothermic welding
525 process or equivalent method accepted by the DEN Project Manager. Only personnel experienced in and
526 regularly engaged in this type of work shall make these connections.

527
528 Contractor shall demonstrate to the satisfaction of the DEN Project Manager, the welding kits, materials and
529 procedures to be used for welded connections prior to any installations in the field. The installations shall
530 comply with the manufacturer's recommendations and the following:

531
532 **a.** All slag shall be removed from welds.

533
534 **b.** Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not
535 recommended unless the base has been specially modified. Consult the manufacturer's installation
536 directions for proper methods of bonding copper wire to the light base. See AC 150/5340-30 for
537 galvanized light base exception.

538
539 **c.** If called for in the plans, all buried copper and weld material at weld connections shall be
540 thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal
541 tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

542
543 **108-3.10 TESTING.** The Contractor shall furnish all necessary equipment and appliances for testing the
544 airport electrical systems and underground cable circuits before and after installation. The Contractor shall
545 perform all tests in the presence of the DEN Project Manager. The Contractor shall demonstrate the electrical
546 characteristics to the satisfaction of the DEN Project Manager. All costs for testing are incidental to the
547 respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must

548 maintain the test results throughout the entire project as well as during the warranty period that meet the
549 following:

550
551 **a.** Earth resistance testing methods shall be submitted to the DEN Project Manager for approval.
552 Earth resistance testing results shall be recorded on an approved form and testing shall be
553 performed in the presence of the DEN Project Manager. All such testing shall be at the sole
554 expense of the Contractor.

555
556 **b.** Should the counterpoise or ground grid conductors be damaged or suspected of being damaged
557 by construction activities the Contractor shall test the conductors for continuity with a low
558 resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested
559 for continuity. The DEN Project Manager shall approve of the test method selected. All such
560 testing shall be at the sole expense of the Contractor.

561
562 After installation, the Contractor shall test and demonstrate to the satisfaction of the DEN Project Manager
563 the following:

564
565 **a.** That all affected lighting power and control circuits (existing and new) are continuous and free
566 from short circuits.

567
568 **b.** That all affected circuits (existing and new) are free from unspecified grounds.

569
570 **c.** That the insulation resistance to ground of all new non-grounded high voltage series circuits or
571 cable segments is not less than 2,000 megohms. Verify continuity of all series airfield lighting
572 circuits prior to energization.

573
574 **d.** That the insulation resistance to ground of all new non-grounded conductors of new multiple
575 circuits or circuit segments is not less than 100 megohms.

576
577 **e.** That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

578
579 **f.** That all affected circuits (existing and new) are operable. Tests shall be conducted that include
580 operating each control not less than 10 times and the continuous operation of each lighting and
581 power circuit for not less than 1/2 hour.

582
583 **g.** That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing
584 connections to other ground electrodes. The fall-of-potential ground impedance test shall be used,
585 as described by American National Standards Institute/Institute of Electrical and Electronic
586 Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style
587 ground impedance test meters may be used to satisfy the impedance testing requirement. Test
588 equipment and its calibration sheets shall be submitted for review and approval by the DEN
589 Project Manager prior to performing the testing.

590
591 Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the DEN
592 Project Manager. Where connecting new cable to existing cable, insulation resistance tests shall be performed
593 on the new cable prior to connection to the existing circuit.

594
595 There are no approved “repair” procedures for items that have failed testing other than complete replacement.

TECHNICAL SPECIFICATIONS
 DIVISION 2-AIRFIELD STANDARDS
 ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS
 AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
 RUNWAY 17L-35R PAVEMENT REHABILITATION
 AND ELECTRICAL UPGRADES PACKAGE 2
 CONST. CONTRACT NO. 202473360

596
 597
 598
 599

METHOD OF MEASUREMENT

600 **108-4.2** Cable or counterpoise wire installed in duct bank, conduit, or trench shall be measured by the number
 601 of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and
 602 accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in
 603 trench, duct bank or conduit. The measurement for this item shall include additional quantities required for
 604 slack.

605
 606

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

607
 608
 609
 610

BASIS OF PAYMENT

611 **108-5.1** Payment will be made at the contract unit price for cable and counterpoise wire installed in duct bank,
 612 conduit, or trench, in place by the Contractor and accepted by the DEN Project Manager. This price shall be
 613 full compensation for furnishing all materials and for all preparation and installation of these materials, and for
 614 all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking
 615 tape, necessary to complete this item.

616
 617

Payment will be made under:

618
 619
 620
 621
 622

Item L-108a	#8 AWG L-824C, 5000V Conductor - per linear foot
Item L-108b	#6 AWG CU, Bare Copper Counterpoise, per linear foot

623
 624

REFERENCES

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

627
 628

Advisory Circulars (AC)

629
 630
 631
 632

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
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633
 634

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
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635
 636

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
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637
 638

AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
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639
 640

AC 150/5345-53	Airport Lighting Equipment Certification Program
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641
 642

Commercial Item Description

643
 644
 645

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
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A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
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TECHNICAL SPECIFICATIONS
 DIVISION 2-AIRFIELD STANDARDS
 ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS
 AC 150/5370-10H

DENVER INTERNATIONAL AIRPORT
 RUNWAY 17L-35R PAVEMENT REHABILITATION
 AND ELECTRICAL UPGRADES PACKAGE 2
 CONST. CONTRACT NO. 202473360

646		
647	ASTM International (ASTM)	
648		
649	ASTM B3	Standard Specification for Soft or Annealed Copper Wire
650		
651	ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
652		
653		
654	ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
655		
656		
657	ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
658		
659		
660	Mil Spec	
661		
662	MIL-PRF-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
663		
664		
665	MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive
666		
667	National Fire Protection Association (NFPA)	
668		
669	NFPA-70	National Electrical Code (NEC)
670		
671	NFPA-780	Standard for the Installation of Lightning Protection Systems
672		
673	American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)	
674		
675	ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
676		
677		
678	Federal Aviation Administration Standard	
679		
680	FAA STD-019E	Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment
681		
682		
683		
684		**END OF ITEM L-108**
685		

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 banks. 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 DEN Project Manager
- b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the DEN Project Manager. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the DEN Project Manager 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 DEN Project Manager 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 DEN Project Manager, to determine compliance with the plans and specifications. The Contractor's submittals shall be electronically submitted in pdf format, tabbed by specification section. The DEN Project Manager 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

50 acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced,
51 at the Owner's discretion, with no additional cost to the Owner.
52

53 **110-2.2 STEEL CONDUIT.** Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized
54 inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All
55 RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar
56 environments shall be painted with a 10-mil thick coat of asphaltum sealer or shall have a factory-bonded
57 polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mils of asphaltum
58 sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating.
59 Damaged PVC coating shall be repaired per the manufacturer's written instructions. In lieu of PVC coated
60 RGS, corrosion wrap tape shall be permitted to be used where RGS is in contact with direct earth.”
61

62 **110-2.3 PLASTIC CONDUIT.** Plastic conduit and fittings shall conform to the following requirements:
63

- 64 • UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10. ¹_{SEP}
- 65 • UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- 66 • UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- 67 • UL 651A covers W-C-1094-Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit
68 type III and Class 4.
69

70 Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be
71 one of the following, as shown on the plans:
72

- 73 a. Type I—Schedule 40 and Schedule 80 PVC suitable for underground use either direct-buried or
74 encased in concrete.
- 75 b. Type II—Schedule 40 PVC suitable for either above ground or underground use.
- 76 c. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-
77 buried or encased in concrete.
- 78 d. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with
79 directional boring under pavement.
80

81 The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.
82

83 **110-2.4 SPLIT CONDUIT.** Split conduit shall be pre-manufactured for the intended purpose and shall be
84 made of steel or plastic.
85

86 **110-2.5 CONDUIT SPACERS.** Conduit spacers shall be prefabricated interlocking units manufactured for
87 the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene
88 complete with interlocking cap and base pads. They shall be designed to accept No. 4 reinforcing bars installed
89 vertically.
90

91 **110-2.6 CONCRETE.** Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for
92 Miscellaneous Structures.
93
94
95

96
97
98

99 **110-2.7 PRECAST CONCRETE STRUCTURES.** Precast concrete structures shall be furnished by a plant
100 meeting National Precast Concrete Association Plant Certification Program or another DEN Project Manager
101 approved third party certification program. Precast concrete structures shall conform to ASTM C478.
102

103 **110-2.8 FLOWABLE BACKFILL.** Flowable material used to back fill conduit and duct bank trenches shall
104 conform to the requirements of Item P-153, Controlled Low Strength Material.
105

106 **110-2.9 DETECTABLE WARNING TAPE.** Plastic, detectable, American Public Works Association
107 (APWA) red (electrical power lines, cables, conduit and lighting cable), orange (telephone/fiber optic cabling)
108 with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6
109 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.
110

111 CONSTRUCTION METHODS

112
113 **110-3.1 GENERAL.** The Contractor shall install underground duct banks and conduits at the approximate
114 locations indicated on the plans. The DEN Project Manager shall indicate specific locations as the work
115 progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type
116 indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits
117 shall be not less than 2 inches (50 mm) inside diameter or comply with the National Electrical Code based on
118 cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward
119 access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at
120 least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one
121 way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or
122 conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate
123 shall be avoided. Under pavement, the top of the duct bank shall not be less than 18 inches (0.5 m) below the
124 subgrade; in other locations, the top of the duct bank or underground conduit shall be be not less than 18
125 inches (0.5 m) below finished grade.
126

127 The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct
128 bank. An iron-shod mandrel, not more than 1/4 inch (6 mm) smaller than the bore of the conduit shall be
129 pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than
130 the conduit hole.
131

132 The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors
133 immediately prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and
134 all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables.
135 Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway
136 systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All
137 accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts
138 proposed for use in this project as clear and open. The Contractor shall notify the DEN Project Manager of
139 any blockage in the existing ducts.
140

141 For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a
142 duct bank, shall be provided with a 200-pound (90 kg) test polypropylene pull rope. The ends shall be secured
143 and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare
144 conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs,
145 designed for this purpose.
146

147 All conduits shall be securely fastened in place during construction and shall be plugged to prevent
148 contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed.
149 Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet (1.5 m).
150

151 Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under
152 pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under
153 paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for
154 protection.
155

156 All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current
157 and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.
158

159 Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.
160

161 Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment
162 unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of
163 trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall
164 not be used to excavate the trench.
165

166 When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required
167 conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral
168 aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. Flowable backfill may alternatively be
169 used
170

171 Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks
172 and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by
173 the DEN Project Manager. If not shown on the plans, the warning tape shall be located 6 inches above the
174 duct/conduit or the counterpoise wire if present.
175

176 Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of
177 conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on
178 the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped
179 together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in
180 a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet (60 cm).
181

182 Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using
183 manufactured sweep bends.
184

185 Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank
186 grade is an unsuitable material, as determined by the DEN Project Manager, the unsuitable material shall be
187 removed per Item P-152 and replaced with suitable material. Additional duct bank supports shall be installed,
188 as approved by the DEN Project Manager.
189

190 All excavation shall be unclassified and shall be considered incidental to Item L-110. Dewatering necessary for
191 duct installation, and erosion per federal, state, and local requirements is incidental to Item L-110.

192 Unless otherwise specified, excavated materials that are deemed by the DEN Project Manager to be unsuitable
193 for use in backfill or embankments shall be removed and disposed of offsite.
194

195 Any excess excavation shall be filled with suitable material approved by the DEN Project Manager and
196 compacted per Item P-152.

197
198 It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where
199 existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately
200 protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified
201 on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

- 202
- 203 a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely
204 no damage has occurred
 - 205
 - 206 b. Trenching, etc., in cable areas shall then proceed with approval of the DEN Project Manager, with
207 care taken to minimize possible damage or disruption of existing cable, including careful backfilling
208 in area of cable.
 - 209

210 In the event that any previously identified cable is damaged during the course of construction, the Contractor
211 shall be responsible for the complete repair.

212

213 **110-3.2 DUCT BANKS.** Unless otherwise shown in the plans, duct banks shall be installed so that the top of
214 the concrete envelope is not less than 18 inches (0.5 m) below the bottom of the base or stabilized base course
215 layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (0.5
216 m) below finished grade where installed in unpaved areas.

217

218 Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet (1 m) beyond
219 the edges of the pavement or 3 feet (1 m) beyond any under drains that may be installed alongside the paved
220 area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any
221 obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all
222 duct banks shall be placed on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. The
223 Contractor shall space the conduits not less than 3 inches (75 mm) apart (measured from outside wall to outside
224 wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the
225 conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches
226 (75 mm) thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of
227 access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with
228 concrete.

229

230 Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven
231 vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth prior to placing
232 the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to
233 the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and
234 configurations to fit the conduits. Locking collars and spacers shall be submitted to the DEN Project Manager
235 for review prior to use.

236

237 When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing
238 mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional
239 supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans.
240 Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers,
241 or piles located at approximately 5-foot (1.5-m) intervals.

242

243 All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All
244 excavation shall be included in the contract with price for the duct.

245

246 Install a plastic, detectable, color as noted, 3 to 6 inches (75 to 150 mm) wide tape, 8 inches (200 mm) minimum
247 below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch (75-
248 mm) wide tape only for single conduit runs. Utilize the 6-inch (150-mm) wide tape for multiple conduits and
249 duct banks. For duct banks equal to or greater than 24 inches (600 mm) in width, utilize more than one tape
250 for sufficient coverage and identification of the duct bank as required.

251
252 When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and
253 exposed by hand tools. Prior to being placed in duct, the DEN Project Manager shall be notified so that he
254 may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as
255 shown on the drawings or as required by the DEN Project Manager.

256
257 **110-3.3 CONDUITS WITHOUT CONCRETE ENCASEMENT.** Trenches for single-conduit lines shall
258 be not less than 6 inches (150 mm) nor more than 12 inches (300 mm) wide. The trench for 2 or more conduits
259 installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete
260 encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit
261 along its entire length.

262 Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches (100 mm) thick (loose
263 measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material
264 shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4-
265 inch (6.3 mm) sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be
266 used.

267
268 Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's
269 secured area where trespassing is prohibited are at least 18 inches (0.5 m) below the finished grade. Conduits
270 outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches (60
271 cm) below the finished grade per National Electric Code (NEC), Table 300.5.

272
273 When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are
274 installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches (75 mm)
275 apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches (150 mm)
276 apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing
277 voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not
278 less than 3 inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and not
279 less than 6 inches (150 mm) apart in a vertical direction.

280
281 Trenches shall be opened the complete length between normal termination points before conduit is installed
282 so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

283
284 Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil
285 a minimum of 6 inches (150 mm) to anchor the assembly into the earth while backfilling. For this purpose, the
286 spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-
287 foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars
288 and spacers shall be submitted to the DEN Project Manager for review prior to use.

289
290 **110-3.4 MARKERS.** The location of each end and of each change of direction of conduits and duct banks
291 shall be marked by a concrete slab marker 2 feet (60 cm) square and 4 - 6 inches (100 - 150 mm) thick extending
292 approximately one inch (25 mm) above the surface. The markers shall also be located directly above the ends
293 of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable
294 or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200

295 feet (61 m) along the cable or duct run, with an additional marker at each change of direction of cable or duct
296 run.

297
298 The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. Impression of letters
299 shall be done in a manner, approved by the DEN Project Manager, for a neat, professional appearance. All
300 letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility
301 orange paint, as approved by the DEN Project Manager. The Contractor shall also impress on the slab the
302 number and size of conduits beneath the marker along with all other necessary information as determined by
303 the DEN Project Manager. The letters shall be 4 inches (100 mm) high and 3 inches (75 mm) wide with width
304 of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep or as large as the available space permits. Furnishing
305 and installation of duct markers is incidental to the respective duct pay item.

306
307 **110-3.5 BACKFILLING FOR CONDUITS.** For conduits, 8 inches (200 mm) of sand, soft earth, or other
308 fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over
309 them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 except
310 that material used for back fill shall be select material not larger than 4 inches (100 mm) in diameter.

311
312 Flowable backfill may alternatively be used.

313
314 Trenches shall not contain pools of water during back filling operations.

315
316 The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is
317 to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be
318 used, with proper allowance for settlement.

319
320 Any excess excavated material shall be removed and disposed of per instructions issued by the DEN Project
321 Manager.

322
323 **110-3.6 BACKFILLING FOR DUCT BANKS.** After the concrete has cured, the remaining trench shall be
324 backfilled and compacted per Item P-152 “Excavation and Embankment” except that the material used for
325 backfill shall be select material not larger than 4 inches (100 mm) in diameter. In addition to the requirements
326 of Item P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made
327 for each 250 linear feet (76 m) of duct bank or one work period’s construction, whichever is less.

328
329 Flowable backfill may alternatively be used.

330
331 Trenches shall not contain pools of water during backfilling operations.

332
333 The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is
334 to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be
335 used, with proper allowance for settlement.

336
337 Any excess excavated material shall be removed and disposed of per instructions issued by the DEN Project
338 Manager.

339
340 **110-3.7 RESTORATION.** Where sod has been removed, it shall be replaced as soon as possible after the
341 backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The
342 restoration shall include fertilizing, seeding, and mulching shown on the plans. The Contractor shall be held
343 responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall
344 be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport

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345 movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD),
 346 and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to
 347 the pay item of which it is a component part.
 348

349 **110-3.8 OWNERSHIP OF REMOVED CABLE.** All removed wire and cable shall become property of the
 350 contractor and shall be removed off site. Removal of wire and cable shall be considered incidental to installation
 351 of new wire and cable. No separate payment will be made for removal of wire and cable.
 352

353
 354 **METHOD OF MEASUREMENT**
 355

356 **110-4.1** Underground conduits and duct banks shall be measured by the linear feet (meter) of conduits and duct
 357 banks installed, including encasement, locator tape, trenching and backfill with designated material, and
 358 restoration, and for drain lines, the termination at the drainage structure, all measured in place, completed, and
 359 accepted. Separate measurement shall be made for the various types and sizes.
 360

361
 362 **BASIS OF PAYMENT**
 363

364 **110-5.1** Payment will be made at the contract unit price per linear foot for each type and size of conduit and
 365 duct bank completed and accepted, including trench and backfill with the designated material, and, for drain
 366 lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal
 367 of existing duct banks and conduits as shown on the plans, furnishing all materials and for all preparation,
 368 assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to
 369 complete this item per the provisions and intent of the plans and specifications.
 370

371 Payment will be made under:

372
 373 Item L-110a 1W-2" Sch. 40 PVC Conduit in New Concrete Pavement – per linear foot
 374
 375

376 **REFERENCES**
 377

378 The publications listed below form a part of this specification to the extent referenced. The publications are
 379 referred to within the text by the basic designation only.
 380

381 Advisory Circular (AC)

382
 383 AC 150/5340-30 Design and Installation Details for Airport Visual Aids
 384

385 AC 150/5345-53 Airport Lighting Equipment Certification Program
 386

387 ASTM International (ASTM)

388
 389 ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for
 390 Concrete Reinforcement
 391

392 National Fire Protection Association (NFPA)

393
 394 NFPA-70 National Electrical Code (NEC)

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395		
396	Underwriters Laboratories (UL)	
397		
398	UL Standard 6	Electrical Rigid Metal Conduit - Steel
399		
400	UL Standard 514B	Conduit, Tubing, and Cable Fittings
401		
402	UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
403		
404	UL Standard 1242	Electrical Intermediate Metal Conduit Steel
405		
406	UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
407		
408	UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
409		

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****END OF ITEM L-110****

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 DEN Project Manager.

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 perform 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 DEN Project Manager. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the DEN Project Manager 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 DEN Project Manager 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 DEN Project Manager, to determine compliance with the plans and specifications. The Contractor's submittals shall be submitted in electronic PDF format, tabbed by specification section. The DEN Project Manager reserves the right to reject any or all equipment, materials or procedures, which, in the DEN Project Manager's opinion, does not meet the system design and the standards and codes, specified herein.
- 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, with the

50 exception of obstruction lighting (AC 150/5345-43) must be warranted by the manufacturer for a
 51 minimum of 4 years after date of installation inclusive of all electronics. Obstruction lighting
 52 warranty is set by the individual manufacturer.
 53

54 EQUIPMENT AND MATERIALS

56 **125-2.2 CONDUIT/DUCT.** Conduit shall conform to Specification Item L-110 Airport Underground
 57 Electrical Duct Banks and Conduits.
 58

59 **125-2.3 CABLE AND COUNTERPOISE.** Cable and Counterpoise shall conform to Item L-108
 60 Underground Power Cable for Airports.
 61

62 **125-2.4 TAPE.** Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 23 and 88
 63 respectively, as manufactured by 3M Company or an approved equal.
 64

65 **125-2.5 CABLE CONNECTIONS.** Cable Connections shall conform to Item L-108 Installation of
 66 Underground Cable for Airports.
 67

68 **125-2.6 RETROREFLECTIVE MARKERS.** Not required.
 69

70 **125-2.7 RUNWAY AND TAXIWAY LIGHTS.** Runway and taxiway lights shall conform to the
 71 requirements of AC 150/5345-46. Lamps shall be of size and type indicated, or as required by fixture
 72 manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the
 73 specification for the light concerned or to the standard referenced.
 74

75 Lights

Type	Class	Mode	Style	Option	Base	Filter	Transformer	Notes
L-804(L)	N/A	1	N/A	N/A	Per Plans	Per Plans	Per Mfg	LED
L-850A(L)	2	1	3	N/A	Per Plans	Per Plans	Per Mfg	LED
L-850B(L)	2	1	3	N/A	Per Plans	Per Plans	Per Mfg	LED
L-850C(L)	2	1	3	N/A	Per Plans	Per Plans	Per Mfg	LED
L-852C(L)	2	1	3	N/A	Per Plans	Per Plans	Per Mfg	LED
L-852D(L)	2	1	3	N/A	Per Plans	Per Plans	Per Mfg	LED
L-852GS(L)	2	1	3	N/A	Per Plans	Per Plans	Per Mfg	LED
L-852K(L)	2	1	3	N/A	Per Plans	Per Plans	Per Mfg	LED
L-861T(L)	N/A	1	N/A	N/A	Per Plans	Per Plans	Per Mfg	LED
L-862(L)	N/A	1	N/A	N/A	Per Plans	Per Plans	Per Mfg	LED
L-862E(L)	N/A	1	N/A	N/A	Per Plans	Per Plans	Per Mfg	LED
L-862S(L)	N/A	1	N/A	N/A	Per Plans	Per Plans	Per Mfg	LED

76
 77 **125-2.8 RUNWAY AND TAXIWAY SIGNS.** Runway and Taxiway Guidance Signs should conform to the
 78 requirements of AC 150/5345-44. Signs shall be equipped with a weatherproof ON-OFF toggle switch. The
 79 switch shall be located on the end-panel of the sign on the side of the sign where power enters the sign. The
 80 switch shall be protected from driving rain and icing. The switch shall de-energize the sign so that maintenance
 81 work can be performed.

82 In addition, ID tags shall be installed on all new signs. ID tags shall consist of 2" high yellow text on a black
 83 background. Tags shall be constructed of UV resistant phenolic material and shall be attached to the side of
 84 the sign closest to the runway or taxiway pavement using stainless steel screws or pop rivets. Circuit name and
 85 sign identifier shall be engraved on tags as shown on plans.

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86
 87

Signs

Type	Size	Style	Class	Mode	Notes
L-858Y(L)	3	5	2	2	LED
L-858R(L)	3	5	2	2	LED
L-858L(L)	3	5	2	2	LED
L-858B(L)	4	5	2	2	LED

88

89 **125-2.9 RUNWAY END IDENTIFIER LIGHT (REIL).** Not required.

90

91 **125-2.10 PRECISION APPROACH PATH INDICATOR (PAPI).** Not required.

92

93 **125-2.11 CIRCUIT SELECTOR CABINET.** The circuit selector cabinet shall meet the requirements of AC
 94 150/5345-5, Type L-847, two or four circuit control, as indicated, Class A (indoor) or B (outdoor), per
 95 installation location, Rating 1, for 6.6 amperes.

96

97 **125-2.12 LIGHT BASE AND TRANSFORMER HOUSINGS.** Light Base and Transformer Housings
 98 should conform to the requirements of AC 150/5345-42. Light bases shall be Type L-867 or L-868, as indicated,
 99 Class 1A, Size as indicated shall be provided as indicated or as required to accommodate the fixture or device
 100 installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes
 101 of fixtures.

102

103 **125-2.13 ISOLATION TRANSFORMERS.** Isolation Transformers shall be Type L-830, size as required for
 104 each installation. Transformer shall conform to AC 150/5345-47.

105

106 **125-2.14 CEMENTITIOUS GROUT.** For use in the installation of ID markers. The cementitious grout
 107 shall be non-shrink, non-metallic and contain no chloride. When mixed to a fluid state, the typical compressive
 108 strength shall reach 5,800 psi in 28 days, and positive expansion. The grout shall meet the requirements of
 109 ASTM C1107 and ASTM C827.

110

111 **125-2.15 SILICONE GREASE.** Designed for application on rubber O-rings installed between flange rings
 112 and light fixtures. The grease shall consist of a composition of polydimethylsiloxane and fumed silica. The
 113 grease shall be moisture resistant, prevent corrosion/oxidation, and have a service temperature range of -40°F
 114 to +400°F.

115

116 **125-2.16 BASE CAN SEALANT.** For application between the top of a load bearing base can and spacer rings
 117 and/or spacer rings and bottom of flange ring with pavement dam. The 100% silicone sealant shall be non-
 118 shrink.

119

120 **125-2.17 BOLTING HARDWARE.** All bolts attaching equipment to a light base can shall extend 1/4"
 121 minimum to 1" maximum beyond the base can flange ring and be continuously threaded. Bolts attaching
 122 equipment to base cans shall conform to Engineering Brief 83A or latest approved edition, such as approved
 123 dual coated bolts, with ceramic-metallic base coat/fluoropolymer top coat. Existing airfield lighting bolting
 124 hardware consists of steel and stainless steel bolts.

125 Anti-Seize compound shall be applied to stainless steel bolts. Do not use anti-seize compound with coated
126 fixture mounting bolts.

127

128

129

INSTALLATION

130

131 **125-3.1 INSTALLATION.** The Contractor shall furnish, install, connect and test all equipment, accessories,
132 conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport
133 lighting system as specified here and shown in the plans.

134

135 The equipment installation and mounting shall comply with the requirements of the National Electrical Code
136 and state and local code agencies having jurisdiction.

137

138 The Contractor shall install the specified equipment in accordance with the applicable advisory circulars and
139 the details shown on the plans.

140

141 **125-3.2 TESTING.** All lights shall be fully tested by continuous operation for not less than 24 hours as a
142 completed system prior to acceptance. The test shall include operating the constant current regulator in each
143 step not less than 10 times at the beginning and end of the 24-hour test. The fixtures shall illuminate properly
144 during each portion of the test.

145

146 **125-3.3 SHIPPING AND STORAGE.** Equipment shall be shipped in suitable packing material to prevent
147 damage during shipping. Store and maintain equipment and materials in areas protected from weather and
148 physical damage. Any equipment and materials, in the opinion of the DEN Project Manager, damaged during
149 construction or storage shall be replaced by the Contractor at no additional cost to the owner. Painted or
150 galvanized surfaces that are damaged shall be repaired in accordance with the manufacturer's recommendations.

151

152 **125-3.4 ELEVATED AND IN-PAVEMENT LIGHTS.** Water, debris, and other foreign substances shall
153 be removed prior to installing fixture base and light.

154

155 A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper
156 elevation, alignment, level control, and azimuth control. Light fixtures shall be oriented with the light beams
157 parallel to the runway or taxiway centerline and facing in the required direction. The outermost edge of fixture
158 shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed.
159 The holding device shall remain in place until sealant has reached its initial set.

160

161 **125-3.5 LIGHT BASE REMOVAL AND CONDUIT REPAIR.** Where indicated on the drawings, light
162 bases shall be removed and a section of 2" sch. 40 PVC conduit shall be installed to provide a continuous
163 conduit run at the location of the removed light base. The cavity left by the light base demolition and conduit
164 repair shall be filled with concrete to the elevation of the top of the cement treated base course.

165

166 **125-3.6 TEMPORARY COVERING OF LIGHTS AND SIGNS.** Where indicated on the drawings or
167 directed by the DEN Project Manager, lights and sign legend panels shall be temporarily covered or obscured
168 from view.

169 Elevated taxiway edge lights shall be covered with PVC tubing, as shown on the drawings.

170 The lights output of in-pavement taxiway centerline and edge lights shall be obscured using foil backed tape.

171 Payment for obscuring in-pavement lights will be made on a per fixture basis, regardless of the number of
172 lenses on the fixture.

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173 Sign legend panels shall be covered with black painted 1/4" thick Masonite board. The board shall be attached
 174 to the sign using metal shipping banding. Signs shall be protected from damage from the shipping banding.
 175 Payment for covering sign legend panels will be made on a per sign basis, regardless of the size of the sign or
 176 the number of modules/panels covered.

177
 178

METHOD OF MEASUREMENT

181 **125-4.1** Runway and taxiway lights will be measured by the number of each type installed as completed units
 182 in place, ready for operation, and accepted by the DEN Project Manager. Guidance signs will be measured by
 183 the number of each type and size installed as completed units, in place, ready for operation, and accepted by
 184 the DEN Project Manager.

185
 186

BASIS OF PAYMENT

187
 188
 189 **125-5.1** Payment will be made at the Contract unit price for each complete runway or taxiway light or guidance
 190 sign installed by the Contractor and accepted by the DEN Project Manager. This payment will be full
 191 compensation for furnishing all materials and for all preparation, assembly, and installation of these materials,
 192 and for all labor, equipment, tools and incidentals necessary to complete this item.

193
 194

Payment will be made under:

195
 196

L-125a L-852C LED Taxiway Bidirectional Centerline Light (Single Circuit) – per
 197 each

198
 199

L-125b L-861T LED Taxiway Edge Light – per each

200
 201

L-125c New 22" Deep L-868B Base Can in New Concrete Pavement – per each

202
 203

L-125d Reinstall Existing Taxiway Centerline Light on New Base Can, Install New
 204 Transformer – per each

205
 206

L-125e Replace Spacer Rings and Epoxy, Install New Light or Cover Plate – per each

207
 208

L-125f Cover Taxiway Edge Light – per each

209
 210

L-125g Cover Guidance Sign – per each

211
 212

L-125h Remove Ground Rod Inspection Pit – per each

213
 214

L-125i Remove L-867 Base Can – per each

215
 216

REFERENCES

217
 218

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

220
 221

Advisory Circulars (AC)

222
 223

AC 150/5340-18 Standards for Airport Sign Systems

224
 225

AC 150/5340-26 Maintenance of Airport Visual Aid Facilities

226
 227

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

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222	AC 150/5345-5	Circuit Selector Switch
223		
224	AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting
225		Circuits
226		
227	AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
228		
229	AC 150/5345-28	Precision Approach Path Indicator (PAPI) Systems
230		
231	AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
232		
233	AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction
234		Boxes, and Accessories
235		
236	AC 150/5345-44	Specification for Runway and Taxiway Signs
237		
238	AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
239		
240	AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting
241		Systems
242		
243	AC 150/5345-51	Specification for Discharge-Type Flashing Light Equipment
244		
245	AC 150/5345-53	Airport Lighting Equipment Certification Program
246		
247	Engineering Brief (EB)	
248		
249	EB No. 67	Light Sources Other than Incandescent and Xenon for Airport and
250		Obstruction Lighting Fixtures
251		
252	EB No 83A	In-Pavement Light Fixture Bolts
253		
254		
255		
256		**END OF ITEM L-125**

41 The system shall be capable of automatically calculating the average intensity (in candela) in the main beam
 42 and 10 percent beam areas to estimate the vertical and horizontal beam alignment (in degrees) by identifying
 43 the brightest part of the light beam being measured.

44 The system shall log the data while testing commences, display the results and identify locations where the
 45 minimum average main beam intensities are below the levels listed in FAA AC 150/5345-46 and/or the main
 46 beam is misaligned either vertically or horizontally.

47 The system shall log the GPS coordinates for each light fixture while each test is being run.

48 A print out or electronic copy of the test readings will be made available periodically during the progress of
 49 the testing.

50 The measurements shall be compared to FAA standards as presented in FAA AC 150/5345-46. The
 51 calculated averages shall be not less than the minimum average intensities specified in the Advisory Circular in
 52 order for the fixture to be considered acceptable. In addition, all readings within the main beam shall be at
 53 least fifty percent (50%) of the specified average intensity in order for the fixture to be considered acceptable.

54 If any of the calculated average readings is below the specified minimum average intensity, or if any individual
 55 reading is below fifty percent (50%) of the specified minimum average intensity, additional sets of readings
 56 shall be taken as required to identify the problem(s) with the fixture in question.

57 **140-2.2 TEST REPORTS.** Initial reports will be submitted periodically during the progress of the
 58 work so that corrective measures may be taken as may be required. If the corrective measures are promptly
 59 made, the fixtures involved will be reevaluated during the scheduled period of field testing to assure that
 60 proper performance has been achieved.

61 The final test results shall be documented in a Final Report, with six (6) copies submitted to the Airport. The
 62 Final Report shall present an evaluation of each fixture tested. For those fixtures that do not meet the
 63 performance requirements, the Final Report shall include proposed corrective measures, such as cleaning or
 64 replacement of lenses, re-aiming of fixture including resetting of base can, grinding of pavement,
 65 repair/replacement of fixture, or any combination of issues. Allowance of the light output to 70% of the
 66 minimum average intensity as recommended by AC 150/5340-26, Maintenance of Airport Visual Aid
 67 Facilities, will not be accepted for new fixture installations. The final test results for existing light fixtures will
 68 indicate which fixtures do not meet the performance requirements in addition to the light output level being
 69 below 70% of the minimum average intensity listed in AC 150/5345-46.

70 The Final Report shall include the following:

71 **a.** Performance Bar Chart for each runway or taxiway system, such as Runway 34R centerline
 72 or Runway 16L touch down zone. This provides a visual indication of overall performance for the service
 73 and identifies the relative position of sub-standard fixtures.

74 **b.** Colour Iso-candela diagrams of fixture light output for representative fixtures that have
 75 failed due to low light output or misalignment.

76 **c.** Photometric test data tabulated with the following information:

77	Fixture Number	First and last fixture in a series as shown on the Plans
78	Light Direction	Direction/orientation of light beam

79	Max CD	Maximum candela output in a point along the main beam
80	Avg. CD	Average candela on fixture being tested
81	Lens Color	Color of lens on fixture being tested
82	d. Max Sensor Reading	Sensor number (on the sensor bar) that provides the maximum
83	reading.	

84 **140-2.3 SPARES.** The contractor shall have spare parts and fixtures on hand at the time of
 85 photometric testing. Spare parts and fixtures shall be used to correct deficiencies identified as a result of the
 86 photometric testing. Spare parts and fixtures which are not used to correct deficiencies shall remain the
 87 property of the contractor.

88 **140-2.4 CORRECTIVE ACTION.** The Contractor shall be responsible for correcting any **new**
 89 lights which are identified as deficient as a result of the photometric testing. If retesting of corrected
 90 conditions can be completed within the originally scheduled field test period, then retesting shall be
 91 performed to verify that any deficient condition has been successfully corrected. If retesting is required after
 92 the scheduled photometric testing period, additional costs to test corrected fixtures shall be borne by the
 93 Contractor.

94 **METHOD OF MEASUREMENT**

95 **140-3.1** Runway and taxiway light photometric testing shall be measured as lump sum for all runway
 96 and/or taxiway light fixtures verified as correct and ready for operation, with documentation submitted to
 97 and accepted by the DEN Project Manager.

98 **BASIS OF PAYMENT**

99 **140-4.1** Payment will be made at the contract unit price per lump sum for completed and approved
 100 testing of lights. This price shall be include all labor, equipment, and materials necessary to completely
 101 perform all of the work specified, including retesting of new fixtures found to be deficient in the initial testing
 102 and corrected by the Contractor. Any photometric retesting shall be paid by the Contractor and is incidental
 103 to the installation of the lighting systems.

104 Payment will be made under:

105 Item L-140a Photometric Testing – lump sum

106

107

108

TECHNICAL SPECIFICATIONS
DIVISION 2-AIRFIELD STANDARDS
ITEM L-140 FIELD PHOTOMETRIC TESTING

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109

END OF ITEM L-140

110

111

EXHIBIT J

Construction Drawings - Stamped

202473360 Flatiron Constructors, Inc.

Runway 17L-35R Pavement Rehabilitation

**Incorporated by Reference as found in File #20240070
at the Denver Office of the Clerk and Recorder**

EXHIBIT K

IFB & Vendor Response 6.6

202473360 Flatiron Constructors, Inc.

Runway 17L-35R Pavement Rehabilitation

**Incorporated by Reference as found in File #20240071
at the Denver Office of the Clerk and Recorder**