READ THIS FIRST

The Engineer shall verify that the latest version of the Federal Aviation Administration Advisory Circular AC 150/5370-10, “Standards for Specifying Construction Of Airports” and that the latest version of the “Errata Sheet for Advisory Circular (AC) 150/5370-10, Standard Specifications for Construction of Airports” are incorporated into this specification.

This Project Spec Document may need additional modifications to suit your project. It is recommended that you proofread each section, paying attention to any “Notes” boxes such as this one--you should remove these “Notes” sections as you go. Also, do a search for all bracket characters “ [ ] “ as they are used to show you areas containing options or project specific details (you can use Microsoft Word’s Find feature {Ctrl-F} to jump to an open bracket “ [ “ character quickly). Again, these bracket characters should be removed.

It is important that every paragraph be numbered to allow for easy referencing. If you use the document’s built in styles and formatting your outline should be fine (turn on the formatting toolbar by going to View > Toolbars > Formatting). Most paragraphs will use the style “Numbered Material” and can be promoted (Shift) or demoted (Shift-Tab).

You should not have to manually enter extra spaces, carriage returns or outline characters such as A, B, C, or 1.01, 1.02; the formatting will do this for you. The entire document is 11 pt. Arial. If you paste items in, you may need to reapply the “Numbered Material” format.

PART 1 GENERAL

* 1. SUMMARY OF WORK
     1. Excavation, placement of embankments (fill), grading, subgrade preparation, compaction, haul and borrow excavation shall be conducted in accordance with the applicable provisions of FAA Item P-152 Excavation, Subgrade, and Embankment, attached hereto.
  2. GOVERNING CODES, STANDARDS, AND REFERENCES
     1. TBD
  3. SUBMITTALS
     1. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.
     2. Submittals shall include the following:

PART 2 NOT USED

PART 3 NOT USED

PART 4 NOT USED

End of Section

Revision History:

05/01/2014 Conversion to 2004 CSI Numbering System

10/15/2014 Added Sole Source and Salient Characteristics Note to Part 2 and revisions

02/21/2020 Renamed and Revised per FAA AC 150/5370-10H including errata through 11/12/2019

**Item P-152 Excavation, Subgrade, and Embankment**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Some projects may require use of local materials or methods not included in this item and subsurface investigations by the geotechnical engineer may require additions or edits of this item to address specific project requirements. When adding local materials or methods include item description, construction method, method of measurement, and basis of payment. Typical items may include, but are not limited to, additional classifications of materials, such as shot or quarried rock; blasting techniques and requirements; specialized types of excavation; or use of local materials or methods identified during project design such as dewatering.**

**Coordinate modifications in accordance with Order 5300.1.**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**DESCRIPTION**

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

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

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

**[   b. [**      **]**

**[   Rock excavation**. Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers. All boulders containing a volume of more than 1/2 cubic yard (0.4 m3) will be classified as “rock excavation.”    **]**

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

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

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

**[**   **Other.**    **]    ]**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**All material excavated shall be considered “unclassified” unless the Engineer specifies other classifications in the project specifications.**

**Add or delete the classifications not applicable for the project.**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

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

**CONSTRUCTION METHODS**

A. If only one product is acceptable (single or sole source product), obtain an approved Competition Waiver and submit to the CPO Construction, Contract Administrator. The language shall read as: “Manufacturer Name, Product # XXXXX, No Equal.” Refer to CPO-6 Competition Waiver Policy for more information.

B. If a Competition Waiver is not approved or more than one product is acceptable, this section must list a minimum of 2 products plus the language “Or Approved Equal,” along with salient characteristics. Refer to CPO Construction’s Salient Characteristics Guidelines for more information.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Delete bracketed DTM paragraphs if DTM not used.**

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

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

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

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

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**During the design phase, perform subsurface investigations to identify existing subsurface conditions to minimize the potential for unforeseen conditions arising during excavation such as the need for dewatering or removal of unsuitable materials.**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

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

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

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**The Engineer shall specify the appropriate class of excavation. If rock or muck excavation is not included under paragraph 152-1.2, unclassified excavation should be specified.**

**The plans shall show details for draining pockets created in rock cuts.**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

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

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

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

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

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**For on-site borrow areas, the Engineer must determine the acceptability of the borrow material before identifying the area on the plans.**

**For off-site borrow areas obtained by the Contractor, the RPR must determine the acceptability of the borrow material before its use on the project.**

**Address hazardous wildlife attractants when opening borrow sites on or near an airport. Add references and sources addressing standing water, permitting, approvals, and zoning. Reference AC 150/5200-33, Hazardous Wildlife Attractants on or near Airports.**

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**152-2.4 Drainage excavation.** Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the RPR. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

**152-2.5 Preparation of cut areas or areas where existing pavement has been removed.** In those areas on which a subbase or base course is to be placed, the top **[**   12 inches (300 mm)    **]** of subgrade shall be compacted to not less than **[**   100 %   **]** of maximum density for non-cohesive soils, and **[**   95%   **]** of maximum density for cohesive soils as determined by ASTM **[**      **]**. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**For subgrade under flexible and rigid pavements, the Engineer shall specify the required compaction depth and density as determined from the geotechnical report and the FAARFIELD Airport Pavement Design compaction recommendations. The current version of FAARFIELD is available at: www.faa.gov/airports/engineering/design\_software/**

**Specify ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds (27200 kg) or less and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27200 kg).**

**For soils with expansive characteristics, the maximum density should be determined in accordance with ASTM D698 regardless of aircraft weight.**

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

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

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**The Engineer shall include benching details on the plans based on the type of material, degree of consolidation of the material, and the degree of homogeneity of the material. The minimum width of the bench shall be sufficient to accommodate construction equipment.**

**The Engineer should consider the consolidation of embankments over 4 feet (1.2 m) and consider installation of monitoring equipment such as settlement plates and inclinometers for deep fills.**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

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

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

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

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

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

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

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

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

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

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

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

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

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**It is recommended that density tests be made for each 3,000 square yards (2500 square meters) of material placed per lift. Testing frequency should be determined by the Geotechnical Engineer. The Engineer may specify other frequencies as appropriate to the job size. If necessary to apply special controls to the moisture content of the soil during or after compaction to ensure strength because of the presence of expansive soils or other unusually sensitive soils), the Engineer must specify the appropriate moisture content. The moisture limitations shall be specified using acceptable moisture ranges as determined by ASTM D698 or ASTM D1557. Refer to FAA RD-76-66, Design and Construction of Airport Pavements on Expansive Soils, for additional guidance.**

**If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow the methods in the ASTM D698 or D1557; or AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles.**

**If nuclear density machines are to be used for density determination, the machines shall be calibrated in accordance with ASTM D6938.**

**Include testing frequencies per square yard for density and moisture acceptance tests.**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

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

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**For subgrade under flexible and rigid pavements, the Engineer shall specify the required compaction depth and density as determined from the geotechnical report and the FAARFIELD Airport Pavement Design compaction recommendations. The current version of FAARFIELD is available at:** [**www.faa.gov/airports/engineering/design\_software/**](http://www.faa.gov/airports/engineering/design_software/)

**Specify ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds (27200 kg) or less and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27200 kg).**

**For soils with expansive characteristics, the maximum density should be determined in accordance with ASTM D698 regardless of aircraft weight.**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

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

The in-place field density shall be determined in accordance with [   ASTM D1556   ] [   ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938.   ]. The [   RPR shall perform all density tests   ] [   Contractor’s laboratory shall perform all density tests in the RPR’s presence and provide the test results upon completion to the RPR for acceptance   ]. If the specified density is not attained, the area represented by the test or as designated by the RPR shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

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

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

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

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

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

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

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**The Engineer shall select the proof-rolling method and number of coverages.**

**Drawings should be checked to ensure that any supplementary information required by this paragraph has been shown and that there is no conflict between the drawings and the specifications.**

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

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

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**The Engineer shall specify the required compaction depths and densities as determined from FAARFIELD Airport Pavement Design Report. The current version of FAARFIELD is available at:** <https://www.faa.gov/airports/engineering/design_software/>

**The Engineer shall specify ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds (27200 kg) or less, and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27200 kg).**

**If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow the methods in the ASTM D698 or D1557; or AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles.**

**Include testing frequencies per square yard (square meter) for density and moisture acceptance tests.**

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

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

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

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

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

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

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

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

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

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

1. **Smoothness.** The finished surface shall not vary more than +/- ½ inch (12 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.
2. **Grade.** The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/-0.05 feet (15 mm) of the specified grade.

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

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

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**Refer to AC 150/5370-2, Operational Safety on Airports During Construction when developing the Construction Safety and Phasing Plan (CSPP).**

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

**METHOD OF MEASUREMENT**

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

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**The Engineer may edit method of volume calculations. The method of calculating volumes must meet or exceed the accuracy of the average end area method. The method of field verification should be described and must meet or exceed what is currently specified for the average end area method.**

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**152-3.1** **[**The quantity of **[**unclassified**]** **[**rock**]** **[**muck**]** **[**drainage**]** excavation to be paid for shall be the number of cubic yards (cubic meters) measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.**]**

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

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

**BASIS OF PAYMENT**

**152-4.1** **[**Unclassified excavation**] [**Rock Excavation**] [**Muck Excavation**]** **[**Drainage Excavation**]** **[**Stockpiled Material**]** payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

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

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

Payment will be made under:

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

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

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

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**The Engineer shall include only those classifications shown in the bid schedule.**

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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**