



Federal Aviation Administration

Memorandum

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To: All Airports Regional Division Managers

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Subject: Engineering Brief No. 102, Asphalt Treated Permeable Base Course

The use of drainage layers will protect pavements from moisture related subgrade, subbase and base failures. Drainage layers facilitate quick removal of excess moisture from the pavement structure. Advisory Circular (AC) 150/5370-10H *Standard Specifications for Airport Construction* contains P-307 *Cement Treated Permeable Base Course*. This Engineering Brief provides a standard specification P-407 *Asphalt Treated Permeable Base Course (ATPB)* that may be used on airport pavement projects. Both asphalt and cement treated permeable base courses have been used with success on airport pavements under both flexible and rigid pavements.

Attachment



FAA Airports

ENGINEERING BRIEF #102

Asphalt Treated Permeable Base

1.0 Purpose.

Provide a standard specification for Asphalt Treated Permeable Base.

2.0 Background.

The use of drainage layers will protect pavements from moisture related subgrade, subbase and base failures. Drainage layers facilitate quick removal of excess moisture from the pavement structure.

3.0 Application.

May be used with flexible or rigid pavements. See the current version of AC 150/5320-6, *Airport Pavement Design and Evaluation* for guidance on design procedures using Asphalt Treated Permeable Base.

4.0 Related Advisory Circulars.

The current version of AC 150/5370-10 *Standard Specifications for Airport Construction* contains other standard specifications for pavement layers including P-307 *Cement Treated Permeable Base Course (CTPB)*.

5.0 Questions.

Please contact Harold Honey at 202-267-4689, harold.honey@faa.gov, or Jeffrey Crislip at 609-485-9553, jeffrey.d.crislip@faa.gov for any questions about this Engineering Brief.

6.0 Effective Date.

This Engineering Brief becomes effective as of the date the associated memorandum is signed by the Manager, FAA Airport Engineering Division, AAS-100.

Item P-407 Asphalt Treated Permeable Base Course (ATPB)

Item P-407 can be used as a stabilized base under flexible and rigid pavements.

Generally the drainage layer under flexible pavements is placed between the subgrade and subbase and drainage layers under rigid pavements are placed immediately beneath the PCC layer.

Size 78 gradation will have better stability under construction loads, and has found to take less compactive effort than Size 57. Some fines may need to be added to the Size 57 stone to make it more stable. A stiffer asphalt binder will also improve the stability of the ATPB layer.

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. [___]

The Engineer shall define when additional sampling points are needed in the above paragraph. Generally testing from supplier and at least one test as delivered to job to insure no material breakdown in transport.

407-2.3 Asphalt binder. Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) [___].

Use the binder typically used for primary highway construction in area.

407-2.4 Anti-stripping agent. Any anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the Department of Transportation of the State in which the project is located.

407-2.5 Bond Breaker. [Not Used] [Choke stone shall be an ASTM C33 Number 89 stone [Fabric shall meet the requirements of AASHTO M 288 Class I woven fabric with elongation less than 50% at the specified strengths. A certificate of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond breaker.]

Bond breaker needed if used as a stabilized base under PCC.

407-2.6 Separation Geotextile. [Not used.] [Separation geotextile shall be [[Class 2], [0.05 sec⁻¹] permittivity per ASTM D4491, Apparent opening size per ASTM D4751 with [0.60 mm] maximum average roll value.]

If the ATPB is constructed on a dense graded aggregate layer, e.g. P-209, a separation fabric is not needed. Use of a separation geotextile is recommended to maintain the integrity of the drainage layer when ATPB is the first layer above subgrade. Generally, a Class 2 geotextile with a permittivity of 0.05 and AOS of 0.6 mm will be sufficient.

See AASHTO M288 for additional notes regarding separation geotextiles.

COMPOSITION OF MIXTURE

407-3.1 Mix design. The Mix Design shall be composed of a mixture of open graded aggregate, a minimum of 0.5% antistripping agent and asphalt binder. An acceptable mix will have between 2 – 3.5% asphalt, sufficient to cover 95% of mixture with a shiny black appearance with minimal draindown at 200°F, and will bind the compacted mix. When the aggregates are blended and mixed with the asphalt cement at [250°F (121°C)] and compacted at [150°F (65°C)] with 35 blows of a standard Marshall hammer, the JMF shall have a permeability of not less than 500 ft/day (150 m/day) nor more than 1,500 ft/day (455 m/day) when tested with constant head permeability test ASTM D 2434/AASHTO T 215.

407-3.2 Submittals. At least [30 days] prior to the placement of the ATPB, the Contractor shall submit certified test reports to the RPR for those materials proposed for use during construction, as well as the mix design information for the material. The submittal package shall include the following:

- a. Sources of materials, including aggregate, asphalt binder, additives, and bond-breaking materials (if used).
- b. Physical properties of the aggregates, asphalt binder, antistripping agent and bond-breaking materials.
- c. Percent of asphalt
- d. Amount of antistripping agent
- e. Permeability of JMF

No drainable ATPB material shall be placed until the submittal is accepted in writing by the RPR.

During production, the Contractor shall submit batch tickets for each delivered load.

CONSTRUCTION METHODS

407-4.1 Control strip. The contractor shall produce, place and compact a control strip of at least [250 ft (75-m)]. The Contractor shall demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the RPR. Upon acceptance of the control strip 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.

When additional effort beyond that provided by the paver is required to seat the aggregate, additional compaction shall not be initiated until mixture has cooled to below 175°F (or lower as determined during construction of the test strip). One to two passes of a self-propelled, steel-wheel static roller with weight between 5 and 12 tons (4.5 to 10.9 metric tons) is usually sufficient. The roller shall be in good condition and shall be capable of reversing without backlash and of compacting the ATPB without undue displacement or excessive crushing of the aggregate. The actual rolling pattern and sequence shall be established during placement of the control strip and approved by the RPR. In areas inaccessible to the paver and roller, hand operated vibrator-plate compactors may be used to seat the aggregate.

The control strip ATPB layer shall be considered acceptable when aggregate is completely coated with asphalt cement with minimal evidence of crushing; the surface is firm, unyielding and stable under construction traffic; and the layer meets the field permeability per paragraph 407-3.1.

407-4.2 Weather limitations. The ATPB material shall not be mixed or placed while the air temperature is below 40°F (4°C). The ATPB shall not be placed on frozen underlying courses or mixed when aggregate is frozen. The ATPB may not be placed when rainfall is occurring or where rain is imminent.

407-4.3 Equipment. All equipment necessary to mix, transport, place, compact, and finish the ATPB material shall be furnished by the Contractor and approved by the RPR. The equipment will be inspected by the RPR prior to the start of construction operations.

407-4.4 Preparation of the underlying course. The underlying course shall be checked and accepted by the RPR before placing operations begin. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted.

407-4.5 Mixing. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials. Free access to the plant must be provided to the RPR at all times for inspection of the plant's equipment and operation and for sampling the ATPB mixture and its components.

407-4.6 Hauling. The ATPB mixture shall be transported from the plant to the job site in trucks or other hauling equipment having beds that are smooth and clean. Truck bed covers shall be provided to protect the ATPB during transport from rain.

407-4.7 Placing. The ATPB material shall be placed using an asphalt paver. The ATPB shall be installed in a single [6 inch (150 mm)] lift.

407-4.8 Compaction. The ATPB material shall be compacted using the approved compaction equipment and roller pattern/sequence, as determined in the approved control strip. Sufficient rollers shall be furnished to handle the output of the plant. If the rolling pattern/sequence results in undue displacement of the surface, or causes crushing of the aggregate, work shall be stopped until the cause(s) can be determined and corrections are made. The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint.

407-4.9 Joints. The formation of all joints shall be made in such a manner as to ensure a continuous bond between old and new sections of the course. All joints shall present the same texture and smoothness as other sections of the course. Transverse joints shall be formed by placement of a bulkhead or by tapering the mixture. Tapered joints shall be cut back full depth and width creating a vertical joint before placing additional mixture against the joint. Joints which are irregular, damaged shall be cut back to expose a clean, sound surface for full depth of course.

407-4.10 Quality Control. The Contractor shall perform tests for smoothness, grade, gradation and asphalt content daily. Asphalt content and gradation must be within job tolerances or appropriate steps taken to maintain production control within tolerances. Any area not meeting smoothness and grade shall be corrected by the Contractor at the Contractor's expense. The Contractor shall provide gradation, asphalt content, smoothness and grade data to the RPR on a daily basis.

a. Asphalt Content. Determine asphalt content a minimum of two times per day in accordance with ASTM D6307 or ASTM D2172.

b. Gradation. Determine aggregate gradation a minimum of two times per day from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136 and ASTM C117.

c. Smoothness. The finished surface shall not vary more than $\pm 3/8$ -inch (9 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline, and, 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. The Contractor shall correct any high spots more than $3/8$ inch (9 mm) in 12-foot (3.7-m) with a grinding machine or remove and replace the material at the Contractor's expense. Any areas that have been ground shall have curing compound reapplied.

d. Grade. The grade shall be measured on a [50-foot (15-m)] grid and shall be within +/- 0.05 feet (15 mm) of the specified grade. When the surface is more than 1/2 inch (12 mm) above the grade shown in the plans, the surface shall be corrected at the Contractor's expense to an elevation that falls within a tolerance of 1/4 inch (6 mm).

407-4.11 Field Permeability. One test shall be performed by the [Contractor in the presence of the RPR] [RPR] for [1200 square yards (1000 square meters)]. Test locations will be determined on a random basis in accordance with ASTM D3665. The permeability of the base will be determined in accordance with ASTM C1701. If it can be demonstrated that a 1 gallon container of water will flow through the layer within approximately 1 minute the RPR can waive additional permeability testing.

407-4.12 Bond breaker. Prior to placing the overlaying concrete pavement a bond breaker shall be placed on the surface to prevent bonding per 407-2.5.

When placed directly beneath concrete pavement a bond breaker is required.

407-4.13 Maintenance. The completed drainable base shall be maintained by the Contractor in a condition to meet all specification requirements until the pavement has been placed. Placement of the next higher pavement layer shall be made as soon as practicable but no more than thirty (30) calendar days after placement of the drainage layer. The ATPB shall not be opened to traffic until the mixture has cooled to ambient temperature. Traffic on ATPB should be kept to a minimum to avoid rutting or displacement of the ATPB. Limit traffic on ATPB to equipment needed to construct next higher pavement layer.

MATERIAL ACCEPTANCE

407-5.1 Sampling and testing. All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the RPR for each [1200 square yards (1000 square meters)]. Sampling locations will be determined by the RPR on a random basis per ASTM D3665. The Contractor shall bear the cost of providing curing facilities for the strength specimens.

a. Thickness. [One core shall be drilled by the Contractor for thickness determination for each [1200 square yards (1000 square meters)]. Thickness will be determined by measuring the depth of core hole.]

[Thickness will be determined by survey on a [25-foot] by [25-foot] grid.]

The Engineer may change sampling frequency to compensate for project size and anticipated production.

The Engineer must select the method to determine the thickness and delete the other option. When the survey method is selected, the Engineer will specify the minimum survey grid.

METHOD OF MEASUREMENT

407-6.1 Measurement. The quantity of ATPB to be paid for shall be the number of square yards (m²) of material placed, and accepted in the completed base course.

BASIS OF PAYMENT

407-7.1 Payment. Payment will be made at the contract unit price per square yard (m²) for ATPB as measured by RPR. This price shall be full compensation for furnishing all materials, for all preparation, mixing, placing, compacting curing and placement of overlaying bond breaker; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-407	Asphalt treated permeable base course (ATPB) - per square yard (m ²).
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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
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D3665	Standard Practice for Random Sampling of Construction Materials

ASTM C1701 Standard Test Method for Infiltration Rate of In Place Pervious Concrete

American Association of State Highway and Transportation Officials (AASHTO)

M288 Standard Specification for Geosynthetic Specification for Highway Applications

T215 Standard Method of Test for Permeability of Granular Soils (Constant Head),

END ITEM P-407