



U.S. Department
of Transportation

**Federal Aviation
Administration**

Advisory Circular

Subject: AIRSIDE APPLICATIONS FOR
ARTIFICIAL TURF

Date: 09/30/2011
Initiated by: AAS-100

AC No: 150/5370-15B
Change:

- 1. PURPOSE.** This Advisory Circular (AC) provides guidance for the planning, design, installation, and maintenance of aviation grade artificial turf in areas adjacent to the operational areas of an airport.
- 2. BACKGROUND.** Specially designed artificial turf systems are available for use in areas adjacent to certain airfield pavements as an alternate to natural turf or other surface treatments used to stabilize shoulders and safety areas. An additional use is to install these systems on paved areas not intended for aircraft movement. These systems can mitigate localized erosion problems caused by jet blast, storm water runoff and surface damage caused by vehicles. The Federal Aviation Administration (FAA) conducted a study to investigate the ability of these systems to resist jet blast, weather effects, and contaminants (fuel, deicing chemicals, hydraulic fluids); to support vehicle loads; and to be skid and fire resistant. At the time of the study, there were only two suppliers/installers of artificial turf for airside applications.

The study included an informal survey of airports that have test installations of these systems. The results of the survey indicate the main reason for the use of artificial turf instead of natural turf is to mitigate soil erosion, which creates potentially damaging debris. Secondary considerations for use of artificial turf were found to be abatement of turf management/low maintenance, wildlife control, and visual enhancement. Research in investigating airside applications for artificial turf is incomplete. Sufficient data are not available to report on the specific long-term operational performance and cost effectiveness of these systems, but indications are that artificial turf systems can be cost effective in comparison to the other solutions evaluated by the airports that have used the systems to address specific problem areas.
- 3. APPLICATION.** The FAA recommends the guidelines and standards in this AC for artificial turf. In general, use of this AC is not mandatory. However, use of the AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charges (PFC) Program. See Grant Assurance No. 34, "Policies, Standards, and Specifications," and PFC Assurance No. 9, "Standards and Specifications."

Artificial turf can be considered a substitute for natural turf although it is not cost effective for all applications. Artificial turf systems that meet the requirements of this AC can be used at locations adjacent to taxiway and apron pavement where the use of natural turf has resulted in repeated soil erosion, where natural turf has unusually high costs associated with its maintenance, or where natural turf is impractical (e.g. paved islands).

Artificial turf systems can be considered for installation on existing asphalt or concrete pavements, or portions thereof, to reduce maintenance requirements, minimize FOD and to enhance visual delineation of permanently closed pavement areas.

4. CANCELLATION. This AC cancels AC 150/5370-15A, Airside Applications for Artificial Turf, dated September 30, 2009.

5. PLANNING. Sufficient data are not available on the performance of artificial turf systems in the case of high-speed veer-offs to consider its use along runways, runway ends, and high-speed taxiways. The FAA will consider such use on a case-by-case basis. Such use requires coordination with and approval by the FAA Office of Airport Safety and Standards through the responsible FAA Airports Regional/District Office.

6. ARTIFICIAL TURF SYSTEM DESIGN REQUIREMENTS. Airside artificial turf systems must meet the following minimum design standards. The design standards must be successfully tested prior to the installation of an airside artificial turf system.

a. Material Requirements. The following testing procedures and material requirements are available for any airfield artificial turf system.

Property	Testing Standard	Material Requirement
Total Weight	ASTM D5848-07 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings	Min. Total Weight 105 oz Per SY Max. Total Weight 115 oz Per SY Manufacturing Tolerance +/- 5% Per SY
Pile Weight	ASTM D5848-07 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings	Grass Zone Fiber – Slit Film Min. Pile Weight 38 oz Per SY Max. Pile Weight 44 oz Per SY Manufacturing Tolerance +/- 1 oz Per SY Micro Bed Fiber - Polyethylene Min. Pile Weight 38 oz Per SY Max. Pile Weight 44 oz Per SY Manufacturing Tolerance +/- 1 oz Per SY
Primary Backing Weight	ASTM D5848-07 Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings	Min. Primary Backing Weight 7 oz Per SY Max. Primary Backing Weight 8 oz Per SY Manufacturing Tolerance +/-1 oz Per SY
Secondary Backing Weight	ASTM D5848-07 Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings	Min. Secondary Backing Weight 18 oz Per SY Max. Secondary Backing Weight 22 oz Per SY Manufacturing Tolerance +/-2 oz Per SY
Pile Height	ASTM D5823-05a Standard Test Method for Tuft Height of Pile Floor Coverings	Pile Height 1.5 Inches Manufacturing Tolerance +/- 1/8 Inch
Grab Tear Strength	ASTM D5034-05 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test) modified for seam strength:	Min. Grab Tear Strength-Length (MD) 210 LBS Min. Grab Tear Strength-Width (CMD) 190 LBS

Property	Testing Standard	Material Requirement
Stitches per 3-Inch	ASTM D5793-05 Standard Test Method for Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings	Stitches Per 3 Inches 10 Stitches Manufacturing Tolerance +/-1 Stitch
Machine Gauge	ASTM D5793-05 Standard Test Method for Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings	Machine Gauge 5/32" to 3/8 Inch Manufacturing Tolerance 1/8 Inch
Fiber Denier	ASTM D1907-07 Standard Test Methods for Linear Density of Textile Fibers by the Skein Method	Min. Average Linear Density 7,500 Denier
Fiber Thickness	ASTM D3218-07 Standard Specification for Polyolefin Monofilaments	Min. Ribbon Thickness 0.007 Inches Min. Microns 150 Microns
Fiber Width	ASTM D3218-07 Standard Specification for Polyolefin Monofilaments	Min. Ribbon Width 0.030 Inches
Fiber Melting Point	ASTM D789-07 Standard Test Methods for Determination of Solution Viscosities of Polyamide (PA)	Min. Melting Point - Polyethylene 120°C/248°F
Fiber Specific Gravity	ASTM D792-08 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement:	Min. Specific Gravity 0.90
Fiber Breaking Strength	ASTM D2256-02 Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method	Min. Average Breaking Strength 18 lbs/force Min. Average Breaking Strength 80 N
Fiber Elongation	ASTM D2256-02 Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method	Min. Average Elongation 100 % Max. Average Elongation 110 %

b. Jet Blast. The artificial turf system must be designed and installed so it will not become displaced or damaged from expected aircraft jet blast. For artificial turf located in safety areas, under normal operating conditions there must be less than 5-percent migration or evacuation of infill material for the artificial turf system. Anchors or adhesive strength, seams, and ballast integrity must be confirmed through wind tunnel test procedures at various jet blast angles and with varied engine types and speeds. An anchor pull test for each type of anchor used must be performed by the installer after installation is complete. Similarly for artificial turf systems installed on pavement a post-installation adhesive shear strength test will be required for every separate area. Results must equal or exceed test results from wind tunnel tests. If any anchor pull test fails, all similar type anchors must be tested and deficient anchors replaced and retested. In the event of a failed adhesive shear strength test, additional tests of the area will be performed demonstrating that the installed artificial turf edges provide the adherence characteristics required by wind tunnel testing.

Critical factors to be demonstrated	<ul style="list-style-type: none"> • Integrity of anchoring system • Integrity of turf sections adhered to pavement • Integrity of joints • Stability of ballast at various jet blast angles
Laboratory tests	<ul style="list-style-type: none"> • Wind tunnel testing
Field testing/post-installation	<ul style="list-style-type: none"> • Quality assurance • Anchor pull test // adhesive Shear strength. Use ASTM D 4541 Pull-Off Strength of Coatings Using Portable Adhesion Testers
References	<ul style="list-style-type: none"> • Respective aircraft manufacturers' manuals, usually titled Airplane Characteristics for Planning Purposes

The procedure described in Chapter 4 and Appendix C of research report DOT/FAA/AR-06/23, Airside Applications for Artificial Turf, is an acceptable procedure to evaluate jet blast resistance. The report is available on the FAA website at www.tc.faa.gov/its/worldpac/techrpt/ar06-23.pdf.

The following table shows the recommended profiles for evaluating the artificial turf system.

RECOMMENDED PROFILES FOR EVALUATING AIRCRAFT JET BLAST RESISTANCE

Average at 40 feet		Average at 75 feet	
12 repetitions for 1 month		12 repetitions for 1 month	
Time (sec)	Power (%)	Time (sec)	Power (%)
0	85	0	85
240	85	180	85
250	90	190	90
375	90	280	90
380	85	290	85
565	85	470	85
580	100	485	100
595	100	495	100
600	85	510	85
Note: Power is expressed in terms of percentage of take-off thrust			

c. Load-Bearing Capacity. The artificial turf system must be constructed on a prepared surface capable of supporting the occasional passage of the heaviest aircraft using the adjacent pavement and the occasional passage of the heaviest anticipated traffic (e.g. maintenance, snow removal, and ARFF vehicles) without structural damage to the aircraft or vehicles and without rupturing, tearing, or shearing the material, seams, or connections to anchor systems. It must be designed to perform satisfactorily under all local weather, temperature, and soil conditions. Surface deformations in excess of 3 inches or that allow shoving or wrinkles in the material will require immediate inspection and repair.

Critical factors to be demonstrated	<ul style="list-style-type: none"> • Turf must not shear or pull from the anchoring system under design wheel loading. • System must maintain its integrity when subjected to all traffic loads.
-------------------------------------	--

d. Drainage Characteristics. The artificial turf system must be designed and installed so water does not accumulate on the surface or cause other drainage problems. Heavy precipitation must not wash/flush any infill material from the turf surface. Pre-installation testing must include measuring surface runoff drainage coefficients and permeability in accordance with the requirements of ASTM F 1551. As artificial turf systems installed in the safety area may provide storm water run-off characteristics similar to paved surfaces, a hydraulic analysis that includes erosion protection requirements for slopes and channels and the adequacy of downstream storm water conveyances may be necessary.

Critical factors to be demonstrated	<ul style="list-style-type: none"> • Heavy precipitation must not wash/flush any infill material from the turf surface.
Laboratory tests	<ul style="list-style-type: none"> • Testing must conform to ASTM F 1551

Longitudinal and transverse grade requirements for airside surfaces can be found in AC 150/5300-13, Airport Design.

e. Skid Resistance. The artificial turf must not have properties inferior to natural grass under wet/dry and above/below freezing conditions. Pre-installation testing must conform to ASTM C 1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method. In-field /post-installation testing must conform to ASTM C 1028. Information on obtaining ASTM test methods is available at <http://www.astm.org>.

Critical factors to be demonstrated	<ul style="list-style-type: none"> The turf must not have properties inferior to natural grass under wet/dry and above/below freezing conditions.
Laboratory tests	<ul style="list-style-type: none"> Conform to ASTM C 1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
Field testing/post-installation	<ul style="list-style-type: none"> Quality assurance procedure followed. Tests in accordance with ASTM C 1028.

Chapter 4 of research report DOT/FAA/AR-06/23, Airside Applications for Artificial Turf, contains limited results from test method ASTM C 1028 for materials that have been installed at airports.

f. Durability. Installed material must maintain its integrity when maintained in accordance with the manufacturer's recommendations. Pre-installation testing must include ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles, and ASTM D 1435, Standard Practice for Outdoor Weathering of Plastics. Information on obtaining ASTM test methods is available at <http://www.astm.org>.

Critical factors to be demonstrated	<ul style="list-style-type: none"> Limited visual degradation may occur over the life expectancy of the turf product. The system must maintain its integrity when subjected to exposure to UV Light throughout the expected life of the system. If rolls or extended lengths of material are joined, it must be demonstrated that the strength of joints is equal to or greater than the material being joined and that strength is maintained throughout the expected life of the system.
Laboratory tests	<ul style="list-style-type: none"> ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles, and ASTM D 1435, Standard Practice for Outdoor Weathering of Plastics.
Field testing/post-installation	<ul style="list-style-type: none"> Quality assurance procedure followed.

g. Artificial Turf Infill. All artificial turf systems must incorporate a non-flammable infill system that will be sand. The gradation of the infill material must not exceed the maximum size aggregate in the gradation limits provided for winter operations sand contained in AC 150/5200-30, Airport Winter Safety and Operations.

h. Glue-down Installations. Artificial turf systems may be installed on existing asphalt or concrete pavements where the existing pavement is not available to aircraft traffic. Paragraphs 6a through 6f and paragraphs 7a through 7f of this AC are applicable to these situations and must be complied with.

(1) Beginning three feet from the edge of pavement, the pavement surface will be milled by diamond grinding on a constant slope to a depth that will be level with the infill sand / ballast required for the artificial turf system installed. The surface of the remaining glue-down area will be milled by diamond grinding to a depth sufficient to expose aggregate (e.g., 1/8" may remove contaminants and expose aggregate). The final slope of the artificial turf will match the existing pavement slope. Load-bearing capacity is limited by the pavement structure. Drainage considerations must be addressed during the design process. Debris removal must include at least five sweeping operations to prepare the surface for adhesive.

(2) When used as a border for large painted areas, the width of the installation will be at least 20 feet.

(3) Adhesive materials will conform to manufacturer's specifications.

(4) Procedures for application of adhesives will comply with industry accepted best-practices for personnel safety and environmental protection.

(5) Adhesive coverage will be equal to 100 percent of the area to be covered with artificial turf.

(6) Post-installation tests will include satisfactory anchor pull testing. See ASTM D 4541 Pull-Off Strength of Coatings Using Portable Adhesion Testers (referenced in paragraph 6a, Jet Blast.)

7. MATERIAL CHARACTERISTICS. Artificial turf products must meet the following requirements:

a. Flammability. Artificial turf products must have documented flammability testing to ensure the material does not emit toxic fumes when enflamed. Manufacturer's tests must demonstrate the turf is easily extinguishable with conventional firefighting materials.

Pre-installation testing must conform to ASTM D 4804, Standard Test Method for Determining the Flammability Characteristics of Non-Rigid Solid Plastics. A cone calorimeter for smoke analysis test must be performed prior to installation. The manufacturer must provide documentation of burn tests and cone calorimeter test to the airport for acceptance.

Critical factors to be demonstrated	<ul style="list-style-type: none"> • Easily extinguishable with conventional fire fighting materials. • Does not emit toxic fumes when enflamed.
Laboratory tests	<ul style="list-style-type: none"> • Conform to, ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials or NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials • ASTM D 4804, Standard Test Method for Determining the Flammability Characteristics of Non-Rigid Solid Plastics. • A cone calorimeter for smoke analysis.

b. Chemical Resistance. Artificial turf products must endure extensive chemical resistance tests prior to being approved for airport use. The tests must conform to ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles. The product must be resistant to deterioration due to prolonged exposure to the following elements by comparative testing of original and aged specimens.

- (1) Aircraft and Runway/Taxiway Deicing Chemicals.
- (2) Aircraft Fuels.
- (3) Hydraulic Fluids.
- (4) Lubricating Oils.
- (5) Salt.
- (6) Occasional Exposure to Herbicides.

Critical factors to be demonstrated	<ul style="list-style-type: none"> • The product must be resistant to deterioration due to prolonged exposure and comparative testing of original and aged specimens.
-------------------------------------	--

c. Resistance to Ultraviolet Rays. Limited visual degradation may occur over the life expectancy of the turf product. Turf chemical compounds must be pre-tested in accordance with ASTM G 90, Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight, ASTM D5870 Standard Practice for Calculating Property Retention Index of Plastics, and ASTM G154 Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.

ASTM G90 covers a procedure for performing accelerated outdoor exposure testing of nonmetallic materials. Fresnel-reflecting concentrators using the sun as source are utilized in the accelerated outdoor exposure test. ASTM D 5870 covers procedures for the calculation of a property retention index (PRI) of thermoplastics after exposure to thermal aging, natural or artificial accelerated weathering, or chemical exposures. ASTM G 154 covers the basic principles and operating procedures for using fluorescent UV light, and water apparatus intended to reproduce the weathering effects that occur when materials are exposed to sunlight and moisture as rain or dew in actual usage.

d. Wildlife. Artificial turf systems must be designed and installed to offer no source of food, water, or shelter for animals, including but not limited to reptiles, rodents, and birds.

e. Plant Growth. Artificial turf systems must be designed and installed to prevent unintended plant growth from penetrating up through the turf backing. Artificial turf systems must be designed to withstand periodic applications of chemicals intended to prevent or eradicate plant growth.

f. Turf Infill. Materials used as an artificial turf infill must not support combustion and must not exceed the maximum size aggregate in the gradation requirements for winter operation sand found in AC 150/5200-30, Airport Winter Safety and Operations. The infill material must be designed to withstand occasional exposure to herbicides.

8. DESIGN SUBMITTAL. The artificial turf system design and plans and specifications must be certified as meeting all the requirements of this AC and must be submitted to the airport sponsor for review and approval. A listing of and the results of all test methods referenced in this AC that have been performed on the artificial turf system proposed for installation must be included in the design submittal. Installations proposed along runways, runway ends, and high-speed taxiways require approval by the FAA Office of Airport Safety and Standards through the responsible FAA Airports Regional/District Office. The submittal must include all design assumptions and data utilized in its development as well as proposed construction procedures and techniques.

9. INSTALLATION.

a. Base preparation. Base preparation must be conducted in a manner required by the artificial turf manufacturer and meet the specific needs of the airport. FAA specifications for free-draining non-frost susceptible base material or state Department of Transportation specifications for high-quality free-draining non-frost susceptible base material may be used.

b. Post-installation checks. Checks must be conducted in accordance with the artificial turf manufacturer's post-installation checklist.

10. QUALITY ASSURANCE. Suppliers of artificial turf system systems must demonstrate that their firm administers a quality assurance program that includes defined quality assurance procedures and a quality assurance manual. The quality procedures must ensure that materials and installation procedures conform to those used in test site applications. Checks must be in place to assure the systems are installed according to quality procedures, and an internal audit must be conducted. The supplier must present to the airport owner Certificates of Origin that have been issued by the artificial turf manufacturer.

11. MAINTENANCE. Experience to date suggests that periodic brooming and additions to infill material will be required during the useful life of the artificial turf system. The artificial turf system supplier/installer must provide inspection and maintenance program documentation to the airport detailing any necessary procedures, equipment, and protocols for preventative maintenance and repair. The airport staff and/or turf supplier must administer the plan in accordance with a pre-established schedule. The plan must include inspection procedures to ensure the product is performing according to established quality standards.

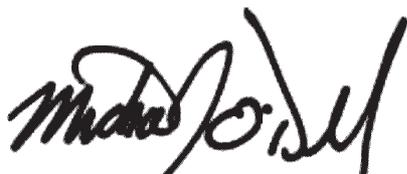
12. DOCUMENTATION. Airport documents must be annotated to show locations and dimensions of artificial turf installations. These annotations must be made after installation is complete and should be communicated to all appropriate airport personnel.

13. RELATED READING MATERIAL. Publications referenced in this AC are available from the following sources:

- a. ACs: www.faa.gov/airports/resources/advisory_circulars/
- b. DOT/FAA/AR-06/23, Airside Applications for Artificial Turf: www.tc.faa.gov/its/worldpac/techrpt/ar06-23.pdf
- c. American Society for Testing and Materials (ASTM) International: 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, or www.astm.org

14. COMMENTS OR SUGGESTIONS. Send comments or suggestions for improving this AC to:

Manager, Airport Engineering Division
Federal Aviation Administration
ATTN: AAS-100
800 Independence Avenue SW
Washington DC 20591



Michael J. O'Donnell
Director of Airport Safety and Standards