



Standard Guide for Construction and Maintenance of Skinned Areas on Baseball and Softball Fields¹

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1. Scope

1.1 This guide covers techniques that are appropriate for the construction and maintenance of skinned areas on baseball and softball fields. This guide provides guidance for the selection of materials, such as soil, sand, gravel, crushed stone, crushed brick, calcined clay, calcined diatomaceous earth, vitrified clay, etc., for use in constructing or reconditioning skinned areas and for the selection of management practices that will maintain a safe and playable skinned surface. Although this guide is specific to baseball/softball, it has application to other sports where ball bounce, ball roll, or player footing, or a combination thereof, are of importance.

1.2 Decisions in selecting construction and maintenance techniques are influenced by existing soil types, climatic factors, level of play, intensity of use, equipment available, budget, and training and ability of management personnel.

1.3 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

1.5 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. The ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this*

document means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents

2.1 ASTM Standards:²

- C33 Specification for Concrete Aggregates
- C242 Terminology of Ceramic Whitewares and Related Products
- D422 Test Method for Particle-Size Analysis of Soils
- D653 Terminology Relating to Soil, Rock, and Contained Fluids
- D5883 Guide for Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes
- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
- F405 Specification for Corrugated Polyethylene (PE) Pipe and Fittings
- F1632 Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes
- F2270 Guide for Construction and Maintenance of Warning Track Areas on Athletic Fields

3. Terminology

3.1 *Definitions*—Except as noted, soil related definitions are in accordance with Terminology D653.

3.1.1 *calcined clay*—granular, lightweight material produced by calcining clay minerals, such as montmorillonite and attapulgite, at temperatures of about 700°C or higher. Those used as soil amendments should be hard, resistant to physical breakdown, and screened to appropriate sizes. Calcined clay is a manufactured product that lacks the particle size and plasticity properties that would allow it to be included in the definition of clay. (1)³

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The boldface numbers in parentheses refer to the list of references at the end of this standard.

3.1.2 *calcined diatomite*—stable, lightweight granules produced by calcining diatomite (diatomaceous earth), a hydrated silica mineral derived from the remains of diatoms. (1)

3.1.3 *clay*—clay can be defined in terms of a particular size fraction of a soil, a soil textural class, a soil particle size class, a soil textural group, soil mineralogy, or, in engineering terms, as materials that exhibit plastic soil properties when at appropriate water contents.

3.1.3.1 *Discussion*—Ideally, the term “clay” should be appropriately defined when used to describe soils for skinned infield mixes. For example, a 60 % sand/40 % clay mixture could imply either 60 % sand/40 % clayey soil (or other soils with textures containing enough clay (<0.002 mm) to exhibit plasticity) or 60 % sand (2 to 0.05 mm)/40 % clay (<0.002 mm).

3.1.3.1 *clay*—(1) as a particular size fraction of a soil, a soil separate consisting of particles <0.002 mm (fine earth fraction) in equivalent diameter. (2) as a textural class, soil material that contains 40 % or more clay, <45 % sand and <40 % silt. (3) as a soil particle size class, soil material that contains 35 % or more clay, (clayey soils). (4) as a soil textural group, soil material that falls within the textural classes of “sandy clay,” “silty clay” and “clay” (clayey soils). (5) in terms of mineralogy, soil particulates that are commonly occurring but not restricted to the <0.002 mm fraction (clay minerals). Commonly occurring in soil mineralogy classes as smectitic, kaolinitic, illitic (micaceous), gibbsitic, ferritic, or mixed. Soil mineralogy classes are defined predominantly by the type of soil mineral dominating (40 % or more) the fine earth fraction. (6) in engineering terms, soils containing enough soil material in the less than 0.4 mm fractions such that when moist they exhibit consistence characteristics of “moderately plastic” or “very plastic” forming a roll 4 cm or longer and 4 mm or thinner that supports its own weight. (2-7)

3.1.4 *vitrified clay*—clay that has been manufactured through vitrification, which is the progressive reduction and elimination of porosity of a ceramic composition, with the formation of a glass phase, as a result of a heat treatment. C242

3.1.5 *expanded shale, clay, or slate (ESCS)*—a rotary kiln produced vesicular amorphous silicate particulate material. It is a highly porous, low density material with an apparent specific gravity of approximately 0.8 to 2.4, and a dry/loose unit weight of approximately 35 to 70 lb/ft³ (561 to 1121 kg/m³). D5883

3.1.6 *sand*—sand can be defined in terms of a particular size fraction of soil, a soil textural class, a soil particle size class, and a soil textural group.

3.1.6.1 *sand*—(1) as a particular size fraction of soil, a soil separate consisting of particles >0.05 mm and <2.0 mm in equivalent diameter. (2) as a textural class, soil material that contains 85 % or more sand, and not more than 10 % clay. (3) as a soil particle size class, soil material that contains 70 % or more sand, and not more than 15 % clay (sandy soils). (4) as a soil textural group, soil material that falls within the textural classes of “sand” and “loamy sand” (sandy soils). (3,4)

3.1.6.1 *Discussion*—Although no mineralogy term is associated with the definition of sand, common usage often utilizes the terms “quartz” or “silica” as synonyms for sand. While

quartz is the most common silicate mineral in soils and in the sand fractions in particular, quartz being a mineral highly resistant to weathering, the synonymy with the term sand is incorrect. A proper mineralogy class for quartz is “siliceous,” defined as 90 % or more of the 0.2 to 2.0 mm fraction composed of silica minerals (quartz, chalcedony, or opal) and other extremely durable minerals that are resistant to weathering. (4)

3.1.7 *gravel*—commonly used to denote spherical, cube-like, or equiaxial aggregate materials with an equivalent diameter >2.0 mm and <7.6 mm. More correctly used, this classification refers to “rock fragments” classified as pebbles in the Glossary of Soil Science Terms (1997). (3,6)

3.1.8 *skinned area*—area on sports fields that, by design, is devoid of turfgrasses or other vegetation; may be entire field or a portion of the field (for example, skinned infield in baseball or softball; skinned base paths in otherwise turfed infield). Pitching mounds and catcher’s and batter’s boxes are also considered skinned areas. Warning tracks (Guide F2270) can be considered skinned areas as well.

3.1.9 *soil*—sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.

3.1.10 *soil profile*—vertical section of a soil, showing the nature and sequence of the various layers, as developed by deposition or weathering or both or as developed by construction procedures.

3.1.11 *soil texture* (gradation) (grain-size distribution) —the proportions by mass of a soil or fragmented rock distributed in specified particle size ranges.

3.1.11.1 *soil textural class*—texture designation based on relative proportions of the various soil separates: sand (2.0 to 0.05 mm in diameter), silt (0.05 to 0.002 mm), and clay (<0.002 mm). (2-7)

NOTE 1—Particle size ranges for sand, silt, and clay as listed above vary somewhat from ranges given in Test Method D422 and Terminology D653.

4. Significance and Use

4.1 The skinned areas of baseball and softball fields should provide a uniform playing surface of high quality. Ball bounce should be true and predictable. Footing and sliding properties should favor optimum performance of players. Undulations, rough surface, hard or soft surfaces, weeds, stones, and wet spots detract from good play. Playing surface quality is largely affected by construction and maintenance procedures, and this standard guide addresses those procedures. While warning tracks are a type of skinned area found on baseball and softball fields, this standard does not apply to warning tracks. A separate standard, Guide F2270, presents information pertaining to warning tracks.

4.1.1 During construction, consideration should be given to factors such as the physical and chemical properties of materials used in the area, freedom from stones and other debris, and surface and internal drainage.

4.1.2 Maintenance practices that influence the playability of the surface include edging, dragging, rolling, watering, vegetation control, brushing or hosing to prevent buildup of a lip of mineral matter in turfgrass at the skinned/turfed edges, and removal of stones and debris that may adversely affect play and safety.

4.2 Those responsible for the design, construction, or maintenance, or a combination thereof, of skinned areas on baseball and softball fields will benefit from this guide.

4.3 This guide provides flexibility in choices of procedures and can be used to cover a variety of use and budget levels.

5. Construction

5.1 Skinned Infield and Basepath Areas:

5.1.1 *Skinned Infield Mix*—Materials used to provide the skinned surface should be relatively inert mineral matter, which will resist chemical and physical degradation. This soil or mixture is sometimes referred to as “dirt,” for example, infield dirt. It is used in constructing skinned infields and basepath areas.

5.1.2 *Particle Size Distribution*—Particle size analyses (Test Method **D422** or **F1632**) are based on oven-dried mass of a weighed sample; shaker is the preferred method of dispersion if the skinned infield mix contains internally porous amendments. Such analyses are satisfactory when the skinned infield mix consists of sand and soil materials; however, analysis based on mass can give misleading results if the skinned infield mix contains internally porous amendments.

5.1.2.1 Native Soil Skinned Areas:

(1) Depending on the soil texture, some existing or native soils containing greater than 70 % sand (2.0 to 0.05 mm) may be satisfactory in skinned areas; however, some soils will need to be modified to improve drainage and ease of soil grooming. Additions of coarse amendments (sand, calcined mineral (clay or diatomite), expanded shale, clay or slate, vitrified clay or combinations in appropriate amounts (dependent on textural class of soil being modified)) should increase permeability, and improve the overall aesthetics of the surface after grooming. Added sand or calcined materials should have a minimum of 85 % of the particles passing a 4.0 mm (No. 5) sieve and retained on a 106 µm (No. 140) sieve. Quartz sands are recommended; if sand contains more than 5 % calcium carbonate equivalent, the sand has the potential for particle cementation due to dissolution and precipitation. If additions will increase the grade to an unacceptable elevation, remove appropriate amounts of soil prior to the addition of coarse amendments. The final mixture should have approximately 90 to 100 % of the particles passing a 4.0 mm (No. 5) sieve and 15 to 30 % passing a 106 µm (No. 140) sieve. In final raking and grading, remove all debris and stone greater than 1 cm in diameter from the surface 1.5 cm. The settled depth of the modified soil should be about 10 cm.

(2) Modification of an existing soil should be done during construction of the facility. In some recreational baseball/softball situations, consideration of skinned areas occurs only after a turfgrass stand is worn down to the soil surface. Layout and modification of skinned areas can take place at that time

and will require taking the field out of play unless the work is done after the playing season.

5.1.2.2 Artificial (Man-made) Skinned Areas:

(1) Artificial (man-made) profiles are sometimes constructed to create the skinned area. In situations where profiles contain more than 85 % sand and exhibit high internal permeability under heavy compaction, the skinned infield mix can be placed on a drainage blanket of gravel, which provides subsurface drainage. In situations where profiles contain less than 85 % sand and exhibit limited internal permeability under heavy compaction, a drainage blanket of gravel is not required, as subsurface drainage will be minimal. Skinned infield mixes of this nature may be placed directly on top of the subsoil. Additional information regarding the construction of skinned infield areas with subsurface drainage systems is found in the appendix.

(2) *Skinned Infield Mix*—A skinned infield mix can be used to bring the surface to final grade. Add approximately 10 to 15 cm (4 to 6 in.) of skinned infield mix and finish to final grade. Skinned infield mix materials should meet the following particle size specifications. Quartz sands are recommended; if sand contains more than 5 % calcium carbonate equivalent, the sand has the potential for particle cementation due to dissolution and precipitation.

Standard	Sieve Designation (E-11)	Alternate	Skinned Infield Mix % passing
2.00 mm	No. 10		85-100
1.00 mm	No. 18		62-90
500 µm	No. 35		48-84
250 µm	No. 60		38-71
150 µm	No. 100		27-60
53 µm	No. 270		19-40

(a) Management of the surface will be affected by the amount of material <53 µm (<0.05 mm, silt and clay). As this fraction decreases, the area will be more permeable but will retain less water. Management requirements based on this fraction will be affected by the relative proportion of silt to clay and the type of clay. The presence of clay is desirable from the standpoint of providing both a firm and stable surface for good footing. Clays that are oxides and hydroxides of iron and aluminum are less cohesive, sticky, and plastic than silicate (layer silicate) clays. Smectitic clays (for example, montmorillonite) are silicate clays that have the highest cohesive, plastic, and shrink/swell properties. Illitic clays (fine-grained mica clay) are characterized by a much lower expression of these properties than found in smectites. Cohesion, swelling, shrinkage, plasticity, and stickiness properties of kaolinitic clays are lower than smectitic and illitic clays. The order of decreasing cohesiveness and plasticity are as follows: Smectitic, Illitic, Kaolinitic, Quartz. Because of differences in the physical properties of different clay types and variations in total clay that can occur in the suggested particle size specification for a skinned infield mix, adjustments to these specifications may be appropriate in some cases.

(b) In general, skinned infield mixes with less than 19 % in the <53 µm (<0.05 mm) fraction are better suited in rainy climates due to greater internal drainage. In dry periods, they may require additional irrigation to minimize dust and to provide a firm surface. Skinned infield mixes with greater than 19 % in the <53 µm (<0.05 mm), will drain more slowly but

will retain more water. Frequency of irrigation will be less. These mixes will be more cohesive and will be more difficult to loosen when they compact.

(c) If the performance of a skinned infield mix is not totally satisfactory after installation, its physical composition can be altered by incorporating sand or amendments to loosen it or by adding clayey soil to create a firmer mix. Such alterations may be related to player preference or to ease of maintenance.

(d) For baseball/softball areas, it is desirable to have a firm, moist mix with a loose 6 to 7 mm cap over the entire area. This cap, comprised of loosened skinned infield mix or a mixture of sand or amendment and the skinned infield mix, should allow for uniform ball bounce and roll to occur, as well as provide a good surface for sliding. It also gives players material to repair divots or other imperfections that may occur during the game. An advantage to using stable, lightweight amendments in this surface layer is their relatively high water retention properties. Their internal porosity can absorb moisture from light rain and help to keep the surface at a consistency favorable for play.

(e) Color of the skinned infield mix may be of concern aesthetically (for example, contrast of adjoining turf color with skinned infield mix color); however, functional qualities should also be considered. White markings of foul lines, boundaries, etc. are more distinct on darker surfaces. Reflectivity of light is less on darker surfaces. In general, the soil/clay component in these mixes will impart a brownish, reddish, or yellowish color. Avoid white or very lightly colored top mixes that can cause excessive glare.

(3) *Placement and Grading of Skinned Infield Mix*—Dump materials at the edge of area and use tracked equipment to spread them onto the area. Roll skinned infield mix to obtain a firm, but not severely compacted, surface. Establish surface grade of 1 to 1.5 %, or as specified by rules of a sport. Slope may be established by crowning the field or by having the grade uniform across the field. Slope should continue at least 3 m beyond side lines. On baseball or softball infields, slope should be away from the pitchers mound to the outfield grass and extend at least 3 m beyond the foul lines and home plate. Water running off the field to a low point should be directed away from the sidelines to a natural or constructed drainage swale or be removed by vertical drain trenches (slit trenches) backfilled with gravel or other coarse material, prefabricated channel drains, or, if well off the playing field including sideline and foul areas, catch basins.

(4) Crushed brick, screenings (fines, most of which will pass a No. 8 (2.36 mm) sieve) created when rocks, boulders, etc. are artificially crushed, cinders, and slag are alternative materials used on some areas to create a skinned surface. When such materials are used, particle sizes should be appropriate for providing a firm, stable playing surface. Because sharpness of particle edges may occur as a result of the manufacturing process, limit the inclusion of particles greater than 2 mm to minimize abrasions.

5.2 *Pitcher's Mound, Batter's Box, and Catcher's Box:*

5.2.1 *Particle Size Distribution*—A fine-textured soil, containing more than 35 % clay (<0.002 mm), is used to establish a stable, wear-resistant surface that will be exposed to the foot traffic of pitchers, catchers, and batters. Such materials are sometimes mixed with an infield mix to provide firmer base paths.

5.2.2 *Pitcher's Mound*—Excavate to 20 to 30 cm (8 to 12 in.). Construct mound by alternately adding 5 to 7.5 cm (2 to 3 in.) of mound mix (“mound clay”) and tamping. Moisten “clay” as required to allow ease of compaction. Continue additions and tamping until required dimensions of mound are obtained. Materials used for mound construction include clay products in the forms of moist, loose packing clay, moist bricks of clay, and dry, granular material that must be moistened prior to packing (tamping). A very firm footing area is essential for the front half (landing area) of a pitching mound. Less firm, but stable, materials may be used on the sides and back of the mound. When construction is completed, lightly topdress the mound with skinned infield mix, sand, calcined amendments, or a combination of these materials.

5.2.3 *Batter's Boxes and Catcher's Box*—Excavate to 20 to 30 cm (8 to 12 in.). Add “clay” as described in 5.2.2 until 2.5 to 5 cm (1 to 2 in.) below desired final grade. Fill to surface with skinned infield mix or a mixture of “clay” and top mix, moisten as needed, tamp.

NOTE 2—Packing clays, clay blocks or bricks, and unfired bricks used to construct mounds and batter's and catcher's boxes can vary in type of clay (for example, illite, kaolinite) and amount of clay (<0.002 mm); however, when at proper water content, all of these materials exhibit the plasticity and strength properties required on these areas.

5.3 *Base Paths*—They are generally comprised of the skinned infield mix used on the rest of the infield. If a firmer or looser path is desired, an appropriate soil, sand, or amendment can be mixed into these areas.

5.4 *Water*—In that adequate soil water content is needed to obtain desired firmness and dust control on all skinned areas, it is recommended that new installations provide a means of watering the surface, for example, irrigation system or hydrants of sufficient capacity to allow for efficient watering of the surface. On a baseball infield, consider locating a quick coupler valve about 3 m directly behind the pitcher's mound. This location is the least impacted area on the field and this is the safest and most logical place to put the valve. The valve box should be slightly below grade. Other good locations for quick coupler valves used to maintain the infield are at the back of the infield arc outside the foul lines.

6. Maintenance

NOTE 3—It has often been observed that the skills of the grounds manager are a greater contributing factor to high quality skinned areas than the materials used to construct these areas. Successful grounds managers must select management practices that are appropriate for the field at hand, or modify field conditions to match a given maintenance program.

6.1 *Water:*

6.1.1 *Soil Water Content*—Skinned areas need moisture to maintain proper consistency. If allowed to dry, these areas become dusty, powdery, or rock hard. Footing is poorer when sandy top mixes become dry or less stable. When necessary, water the area to maintain desired soil water content in the