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# Standard Practice for
# Use of Scrap Tires in Civil Engineering Applications[1]

This standard is issued under the fixed designation D6270; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice provides guidance for testing the physical properties, design considerations, construction practices, and leachate generation potential of processed or whole scrap tires in lieu of conventional civil engineering materials, such as stone, gravel, soil, sand, lightweight aggregate, or other fill materials.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

C127 Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates

D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$))

D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$ (2,700 kN-m/m$^3$))

D1566 Terminology Relating to Rubber

D2434 Test Method for Permeability of Granular Soils (Constant Head) (Withdrawn 2015)[3]

D2974 Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D3080 Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions

D4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

D5681 Terminology for Waste and Waste Management

~~D2974~~D7760 Test ~~Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils~~Method for Measurement of Hydraulic Conductivity of Tire Derived Aggregates Using a Rigid Wall Permeameter

F538 Terminology Relating to the Characteristics and Performance of Tires

2.2 *American Association of State Highway and Transportation Officials ~~Standard:~~Standards:*

T 274 Standard Method of Test for Resilient Modulus of Subgrade Soils[4]

M 288 Standard Specification for Geotextiles[5]

2.3 *U.S. Environmental Protection Agency Standard:*

Method 1311 Toxicity Characteristics Leaching Procedure[6]

## 3. Terminology

3.1 *Definitions*—For definitions of common terms used in this practice, refer to Terminologies D5681 (waste management), F538 (tires), and D1566 (rubber), respectively.

[1] This practice is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.03 on Treatment, Recovery and Reuse.

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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 last approved version of this historical standard is referenced on www.astm.org.

[4] *Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Part II: Methods of Sampling and Testing*, American Association of State Highway and Transportation Officials, Washington, DC.

[5] *Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Part I: Specifications*, American Association of State Highway and Transportation Officials, Washington, DC.

[6] *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, 3rd ed., Report No. EPA 530/SW-846, U.S. Environmental Protection Agency, Washington, DC.

3.2 ~~*Definitions:*~~*Definitions of Terms Specific to This Standard:*

~~3.1.1 *baling, n*—a method of volume reduction whereby tires are compressed into bales.~~

~~3.1.2 *bead, n*—the anchoring part of the tire which is shaped to fit the rim and is constructed of bead wire wrapped by the plies.~~

3.2.1 *bead wire, n*—a ~~high tensile~~ high-tensile steel wire surrounded by rubber, which forms the bead of a tire that provides a firm contact to the rim.

~~3.1.4 *belt wire, n*—a brass plated high tensile steel wire cord used in steel belts.~~

~~3.1.5 *buffing rubber, n*—vulcanized rubber usually obtained from a worn or used tire in the process of removing the old tread in preparation for retreading.~~

~~3.1.6 *carcass, n*—see *casing*.~~

3.2.2 *casing, n*—the ~~basic~~ tire structure ~~excluding~~ not including the tread ~~(Syn.~~portion ~~carcass~~of~~).~~ the tire.

~~3.1.8 *chipped tire, n*—see *tire chip*.~~

~~3.1.9 *chopped tire, n*—a scrap tire that is cut into relatively large pieces of unspecified dimensions.~~

~~3.1.10 *granulated rubber, n*—particulate rubber composed of mainly non-spherical particles that span a broad range of maximum particle dimension, from below 425 µm (40 mesh) to 12 mm (also refer to *particulate rubber*).[7]~~

~~3.1.11 *ground rubber, n*—particulate rubber composed of mainly non-spherical particles that span a range of maximum particle dimensions, from below 425 µm (40 mesh) to 2 mm (also refer to *particulate rubber*).[7]~~

3.2.3 *mineral soil, n*—soil containing less than 5 % organic matter as determined by a loss on ignition test ~~(.D2974).~~ **(D2974)**

~~3.1.13 *nominal size, n*—the average size product that comprises 50 % or more of the throughput in a scrap tire processing operation; scrap tire processing operations generate products above and below the nominal size.~~

~~3.1.14 *particulate rubber, n*—raw, uncured, compounded or vulcanized rubber that has been transformed by means of a mechanical size reduction process into a collection of particles, with or without a coating of a partitioning agent to prevent agglomeration during production, transportation, or storage (also see definition of *buffing rubber, granulated rubber, ground rubber*, and *powdered rubber*).[7]~~

~~3.1.15 *passenger car tire, n*—a tire with less than a 457-mm rim diameter for use on cars only.~~

~~3.1.16 *powdered rubber, n*—particulate rubber composed of mainly non-spherical particles that have a maximum particle dimension equal to or below 425 µm (40 mesh) (also refer to *particulate rubber*).[7]~~

3.2.4 *preliminary remediation ~~guideline,~~goal, n*—risk-based concentrations that the USEPA considers to be protective for lifetime exposure to humans.

3.2.5 *rough shred, n*—a piece of a shredded tire that is larger than 50 ~~mm~~ by 50 ~~mm~~ by 50 mm, but smaller than 762 ~~mm~~ by 50 ~~mm~~ by ~~100 mm.~~100 mm.

3.2.6 *rubber buffings, n*—vulcanized rubber usually obtained from a worn or used tire in the process of removing the old tread in preparation for retreading.

3.2.7 *rubber fines, n*—small particles of ground rubber that result as a by-product of producing shredded rubber.

3.2.8 *scrap tire, n*—a ~~tire which can no longer be used for its original purpose due to wear or damage.~~pneumatic rubber tire discarded because it no longer has value as a new tire, but can be either reused and processed for similar applications as new or processed for other applications not associated with its originally intended use.

~~3.1.21 *shred sizing, n*—a term which generally refers to the process of particles passing through a rated screen opening rather than those which are retained on the screen.~~

~~3.1.22 *shredded tire, n*—a size reduced scrap tire where the reduction in size was accomplished by a mechanical processing device, commonly referred to as a shredder.~~

~~3.1.23 *shredded rubber, n*—pieces of scrap tires resulting from mechanical processing.~~

~~3.1.24 *sidewall, n*—the side of a tire between the tread shoulder and the rim bead.~~

~~3.1.25 *single pass shred, n*—a shredded tire that has been processed by one pass through a shear type shredder and the resulting pieces have not been classified by size.~~

3.2.9 *steel belt, n*—~~rubber coated~~ rubber-coated steel cords that run diagonally under the tread of steel radial tires and extend across the tire approximately the width of the tread.

3.2.10 *tire chips, n*—pieces of scrap tires that have a basic geometrical shape and are generally between 12 and 50 mm in size and have most of the wire ~~removed (Syn.~~ removed.~~chipped tire).~~

3.2.11 ~~*tire derived*~~ *tire-derived aggregate (TDA), n*—pieces of scrap tires that have a basic geometrical shape and are generally between 12 and 305 mm in size and are intended for use in civil engineering applications. ~~Also see definition of tire chips and tire shreds.~~

~~3.1.29 *tire shreds, n*—pieces of scrap tires that have a basic geometrical shape and are generally between 50 and 305 mm in size.~~

~~3.1.30 *tread, n*—that portion of the tire which contacts the road.~~

3.2.12 ~~*truck*~~*waste tire, n*—a tire ~~with a rim diameter of 500 mm or larger.~~that is no longer capable of being used for its original purpose, but has been disposed of in such a manner that it cannot be used for any other purpose.

3.2.13 *whole tire, n*—a ~~scrap~~ tire that has been removed from a ~~rim,~~rim but ~~which~~ has not been processed.

~~3.1.33 *x-mm minus, n*—pieces of classified, size-reduced scrap tires where a minimum of 95 % by weight passes through a standard sieve with an x-mm opening size (that is, 25-mm minus; 50-mm minus; 75-mm minus, etc.).~~

## 4. Significance and Use

4.1 This practice is intended for use of scrap tires including: tire derived aggregate (TDA) comprised of pieces of scrap tires, TDA/soil mixtures, tire sidewalls, and whole scrap tires in civil engineering applications. This includes use of TDA and TDA/soil mixtures as lightweight embankment fill, lightweight retaining wall backfill, drainage layers for roads, landfills, and other applications, thermal insulation to limit frost penetration beneath roads, insulating backfill to limit heat loss from buildings, vibration damping layers for rail lines, and replacement for soil or rock in other fill applications. Use of whole scrap tires and tire sidewalls includes construction of retaining walls, drainage culverts, road-base reinforcement, and erosion protection, as well as use as fill when whole tires have been compressed into bales. It is the responsibility of the design engineer to determine the appropriateness of using scrap tires in a particular application and to select applicable tests and specifications to facilitate construction and environmental protection. This practice is intended to encourage wider utilization of scrap tires in civil engineering applications.

4.2 Three TDA fills with thicknesses in excess of 7 m have experienced a serious heating reaction. However, more than 100 fills with a thickness less than 3 m have been constructed with no evidence of a deleterious heating reaction (**1**).[7] Guidelines have been developed to minimize internal heating of TDA fills (**2**) as discussed in 6.11. The guidelines are applicable to fills less than 3 m thick. Thus, this practice should be applied only to TDA fills less than 3 m thick.



## 5. Material Characterization

5.1 The specific gravity and water absorption capacity of TDA should be determined in accordance with Test Method C127. However, the specific gravity of TDA is less than half the value obtained for common earthen coarse aggregate, so it is permissible to use a minimum weight of test sample that is half of the specified value. The particle density or density of solids of TDA ($\rho_s$) may be determined from the apparent specific gravity using the following equation:

$$\rho_s = S_a(\rho_w) \quad (1)$$



where:

$S_a$ = apparent specific gravity, and
$\rho_w$ = density of water.

5.2 The gradation of TDA should be determined in accordance with Test Method C136. However, the specific gravity of TDA is less than half the values obtained for common earthen materials, so it is permissible to use a minimum weight of test sample that is half of the specified value.

5.3 The ~~laboratory compacted~~ laboratory-compacted dry density (or bulk density) of TDA and TDA/soil mixtures with less than 30 % retained on the 19.0-mm sieve can be determined in accordance with Test Method D698 or D1557. However, TDA and TDA/soil mixtures used for civil engineering applications almost always have more than 30 % retained on the 19.0-mm sieve, so these methods generally are not applicable. A larger compaction mold should be used to accommodate the larger size of the TDA. The sizes of typical compaction molds are summarized in Table 1. The larger mold requires that the number of layers, or the number of blows of the rammer per layer, or both, be increased to produce the desired compactive energy per unit volume.

**TABLE 1 Size of Compaction Molds Used to Determine Dry Density of TDA**

| Maximum Particle Size (mm) | Mold Diameter (mm) | Mold Volume ($m^3$) | Reference |
|---|---|---|---|
| 75 | 254 | 0.0125 | (**3**) |
| 75 | 305 | 0.0146 | (**4**) |
| 51 | 203 and 305 | N.R.[A] | (**5**) |

[A] N.R. = not reported.

~~[7] The defined term is the responsibility of Committee D11 on Rubber.~~

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