

## A

### **Abatement**

Removal of scrap tires from stockpiles or other sites which have accumulation of whole or size reduced scrap tires.

### **Ambient Ground Rubber or Ambient Grind**

Scrap rubber processed at or above ordinary room temperature. Produces a rough texture with increased surface area due to a tearing process.

### **Asphalt Binder**

A viscous, tar-like petroleum product used as a cement that binds stone and sand together in asphalt pavements

### **Asphalt Rubber**

Asphalt cement modified with crumb rubber modifier (CRM)

### **ASTM International**

(formerly American Society of Testing Materials)

A voluntary standards organization that develops and publishes international voluntary consensus standards for materials, products, systems and services. (See more in Appendix)

## B

### **Bagel Cut**

Cutting a tire in half along its circumference.

### **Baling**

A method of volume reduction whereby tires are compressed into a bundle and banded together.

### **Barrel Stack**

A means of storage in which tires are stacked flat on top of each other in a vertical position.

### **Bead**

That part of the tire's construction that is shaped to fit the rim. Made of high tensile steel wires that are wrapped in woven fabric and held by the tire body plies.

### **Bead to Bead Retreading**

The process of buffing a casing to remove the original sidewall, shoulder, and tread, and applying new materials over these surfaces. Sometimes referred to as "Remanufacturing".

### **Bias Belted Tire**

A tire with a bias ply carcass and stiff reinforcing belts extending from shoulder-to-shoulder usually at about a 25-degree angle. There are very few bias belted tires produced at this time. However, there are some Off-the-Road tires (OTRs) that have cord or steel stabilizing belts attached to the bias ply cords under the tread.

### **Bias Ply Tire**

A tire with cords running at an acute angle to the circumferential center line of the tire (usually about 36-degree angle).

## **BR**

(Butadiene Rubber) is a synthetic rubber used in various parts of the tire. In the sidewall it helps to improve fatigue due to continuous flexing and in the tread area to improve wear abrasion.

## **Buffing Rubber (Buffings)**

Particulate rubber produced as a byproduct of the buffing operation in the carcass preparation stage of tire retreading, characterized by a wide range of particle sizes that are predominately elongated or acicular in shape (ASTM 1566-15).

## **Butyl Rubber**

A general-purpose synthetic elastomer (rubber) produced by copolymerizing isobutylene with small amounts of isoprene. Butyl rubber has a high resistance to chemicals and low permeability to gases. Its permeability to air is 70 percent better than that of natural rubber and for this reason is superior for tire tubes and tubeless tire inner liners.

## **C**

### **Carbon Black**

An amorphous form of carbon produced commercially by thermal or oxidative decomposition of hydrocarbons. It is used principally in rubber goods, pigments, and printers' ink. It is not an inert filler but enhances and reinforces various properties of rubber. It is a primary ingredient in the compounding of tires.

### **Casing**

The whole tire generally in a worn state suitable for retreading.

### **Char**

Residue remaining after pyrolysis of a tire. ASTM D3053 defines char as an unprocessed material which is a low value and may contain steel and textile waste in addition to all the additives from rubber production. It is a fine particulate composed of carbon black, ash and other inorganic materials such as zinc oxide, carbonates and silicates.

### **Chopped Tire**

A tire cut into randomly sized pieces which have no uniformity.

### **Civil Engineering Application**

A form of reusing scrap tires, either whole or shredded, in place of naturally occurring materials in construction. Uses include: as an aggregate replacement in leachate collection systems, as lightweight fill material, stormwater drainage, bridge abutment backfill, slope stabilization and vibration dampening.

*See Appendix for additional civil engineering information and properties of Tire Derived Aggregate (TDA).*

## **Classifier**

Any apparatus for separating mixtures of material into their constituents according to size and density.

## **Collection**

The act of picking up and moving take-off tires from the location of their generation to sorting stations or tire recycling facilities.

## **Collection Fee**

Fee charged to collect and/or haul and/or transport take-off tires or shredded tire material.

## **Commodity**

A commercial material such as ground rubber.

## **Cracker Mill**

A machine that tears apart scrap tire rubber by passing the material between rotating corrugated hardened steel rolls, reducing the rubber to various sizes.

## **Crumb Rubber**

Material derived by reducing scrap tires or other rubber into uniform granules with the inherent reinforcing materials such as steel and fiber removed along with any other type of inert contaminates such as dust, glass, or rock. Typical crumb rubber sizes can range from 3/8 inch to 40 mesh.

## **Crumb Rubber Modifier (CRM)**

A general term for scrap tire rubber that is reduced in size and used as a modifier in asphalt paving materials.

## **Cryogenics**

A technology for processing materials at very low temperatures. For processing rubber, liquid nitrogen, or commercial refrigeration methods are commonly used to embrittle rubber. The embrittled rubber is then processed in a hammermill or granulator to a desired product size.

## **Cryogenically Ground Rubber**

Rubber that results from the process of freezing scrap tire rubber or other rubber and crushing the rubber to the particle size desired.

## **D**

### **Depolymerization**

A process that reduces a polymer to individual elements. For rubber, this reduction permits the blending of these individual elements with other polymers.

### **Devulcanization**

A process in which crumb rubber is subjected to treatment by heat, pressure, or the addition of softening agents to regenerate the rubber compound to its original plastic state. Chemical, thermophysical, or biological means are used to break apart the sulfur bonds found in rubber.

## Dry Process

The addition of chemically engineered ground tire rubber (GTR) during the hot mix asphalt production process. Rubber-binder interactions, after mixing and mechanical changes in the mix, promote greater pavement resistance to both rutting and cracking. Dry process mix modification is commonly used as an alternative to polymer modification of asphalt binders and wet process modification with ground tire rubber (GTR).

## E

### End Use

The ultimate application for which a product has been designed or for which it is ultimately used. Examples of end use for scrap tires and tire derived materials are: tire derived fuel, tire derived aggregate, rubber mulch, playground material, products made from crumb rubber (flooring, mats, molded products, turf infill, rubber modified asphalt, etc.).

### End User

An entity that purchases and uses tire derived material as a finished product.

### Energy Recovery

The extraction of the fuel or heat value from whole processed tires through incineration.

### Engineered Crumb Rubber (ECR)

The modification of very fine crumbs of ground tire rubber (GTR) with chemical treatments that enhance rubber-binder interactions and improve the performance of asphalt mixes. ECR is typically added to hot mix asphalt during production using the dry process method.

### EPDM

Ethylene Propylene Diene Monomer: a synthetic rubber used in a range of applications including various seals used in the automotive and construction industries. Recycled post-industrial EPDM rubber granules mixed with polyurethane is used as a top layer, typically over a recycled tire rubber base, in pour-in-place surfacing.

### Extruder

A machine for forcing material through a confined opening or die to produce a desired shape in any length.

### Extrusion

A process of mechanically forcing material (such as blended crumb rubber) through a confined opening to produce film, strip, tubing, or other shapes.

## F

### Fines

Naturally occurring small rubber particles created during the shredding process. Fines pass through a standard size screen on which coarser fragments are retained. For example, a 20-mesh screen may produce a small

percentage of material that is smaller than the 20-mesh size. Material specifications for ground tire rubber will often indicate a percent of fines acceptable for the material use.

### Flow Control

A legal or economic means that directs the movement of materials to a specific destination.

### Fluff (Fiber)

The textile or reinforcing materials liberated from scrap tires or other rubber reinforced products during processing for crumb rubber.

## G

### Gasification

Any chemical or heat process used to convert rubber to gas.

### Generator

Any person or business entity who produces or accumulates worn or scrap tires through personal use or in the ordinary course of business.

### Granulated Rubber

particulate rubber composed of mainly non-spherical particles that span a broad range of maximum "particle dimension" from below 425  $\mu\text{m}$  (40 mesh) to 12 mm (0.47 in.); the key feature of this type of particulate rubber is the fraction of the material in the greater than 1-mm (0.08-in.) up to 12-mm (0.47-in.) maximum "particle dimension" range. ASTM 1566-15

### Granulator

A high-speed machine used predominately for processing wire free tire chips at ambient temperature. The machine consists of flat rotating knives that come in very close contact with stationary knives. This interaction creates a cutting and tearing process best suited for liberating the fiber from the tire rubber and reducing the size. An internal interchangeable screen consisting of round holes is used to control the size of the rubber produced. Granulators are best suited for processing wire free rubber from 1-inch (25mm) and below to 1/2-inch (12mm) and 1/4-inch (6mm) sizes.

### Ground Rubber

Particulate rubber composed of mainly non-spherical particles that span a range of maximum "particle dimension" from well below 425  $\mu\text{m}$  (40 mesh) to 2 mm (0.08 in.) as a maximum "particle dimension." ASTM 1566-15

### Ground Tire Rubber (GTR)

A granular reduction of vulcanized tire rubber that typically has the wire removed. Ground tire rubber has become the preferred term used for rubberized asphalt applications.

# H

## **Hammermill**

A high-speed machine used predominately for processing wire free tire rubber that has been frozen. The machine consists of rotating hammers that impact material at high velocity against a grate. The hammer size, speed and velocity as well as the openings between the grates control the size of the rubber produced. A hammermill is best suited for reducing tire rubber from 1 inch (25MM) and below sizes down to 100 mesh.

## **Hauler**

Those persons, firms, corporations, or governmental agencies responsible (under oral or written contract, or otherwise and licensed if required) for the collection of take-off tires, whole scrap tires, or rubber materials within the geographic boundaries of the contract community(s), and the transportation of such materials to sorting stations, recycling centers or end markets.

# L

## **Lacing Tires**

A method of arranging tires to maximize the use of space. This method can be used to store tires indoors or outdoors, or to transport tires. See Appendix for Lacing diagram.

# M

## **Managed Tire Site**

A tire pile or storage facility where the owner/operator stores or processes scrap tires in compliance with the appropriate regulations.

## **Mesh**

A term commonly used to describe or measure the size of crumb rubber. Crumb rubber is sized by the screen through which it passes in the production process. The finer the screen, the more openings it will have per linear inch, i.e. 30 mesh means there are 30 holes or openings per linear inch. The greater number of openings, the smaller the material must be to pass through the screen. (See mesh screen examples in Appendix)

## **Micro Mill**

A machine that further reduces crumb rubber to a very fine particle, at ambient temperatures, using rotating abrasive discs or other abrasives.

## **Micronized Rubber Powder (MRP)**

A fine, dry, powdered elastomeric crumb rubber in which a significant proportion of particles are less than 100  $\mu\text{m}$  (micrometers) and free of foreign particulates. MRP particle size distributions typically range from 180  $\mu\text{m}$  to 10  $\mu\text{m}$ .

## **Monofill**

A single use landfill or landfill cell used for homogeneous material storage.

# N

## **NR (Natural Rubber)**

Rubber or rubber latex from a plant that can be vulcanized and finished into products.

## **Nominal**

A term commonly used to refer to the average size product (chip) that comprise 50 percent or more of the throughput in a scrap tire processing operation. It should be noted that any scrap tire processing operation also would generate products (chips) above and below the nominal range of the machine. ASTM D6700-17.

## **NPT**

Non-pneumatic tire- airless tires or flat free tires that are not supported by air pressure. They are used on vehicles such as lawn mowers, golf carts, lift trucks, military vehicles and other similar applications.

# O

## **OTR (Off-the-Road tire )**

A term used within the tire industry to define a broad range of tires that are not designed for use on the road. The term generally encompasses tires that fall outside the motorcycle, passenger car, light truck, and heavy-duty truck tire categories. To more specifically define the type of tires included within the OTR term, specific classifications and examples are offered in the Appendix under OTR.

# P

## **Particulate Rubber**

Rubber, vulcanized or un-vulcanized, that has been transformed into a collection of particles, with or without a coating of a partitioning agent to prevent agglomeration during production, transportation, or storage. ASTM 1566-15

## **Passenger and Light Truck Tire Equivalent (PLTTE)**

An industry conversion measurement used to identify the weight for an average size passenger and light truck take-off tire. Formerly identified in the Industry as Passenger Tire Equivalents (PTE) and assigned a value of 20 pounds. Recent field evaluations of passenger and light truck tire weights indicate the value for the PLTTE in year 2020 is 25 pounds. See the Appendix for field study information.

## **Polymer Modified Binder**

A binder material produced by blending and reacting small amounts of un-vulcanized synthetic rubber (referred to as "polymers") with liquid asphalt at high temperatures for extended periods. The resulting modified binder is incorporated as a cement in asphalt paving or surfacing applications. Polymer modification increases pavement rutting and cracking resistance.

### **Post-Consumer Scrap**

Scrap materials, normally source separated, that no longer have value for which they were originally intended but can have potential reuse value as a raw material in new product applications.

### **Post Industrial Scrap**

Scrap materials, normally source separated, that are a by-product of the manufacturing process. When properly processed can be reused in the manufacturing process or used for new product applications.

### **Powdered Rubber**

Particulate rubber composed mainly of non-spherical particles that have a maximum particle dimension equal or below 40 mesh (425 microns). ASTM 1566-15

### **Primary Shredding**

Method of processing whole scrap tires into rough shreds to reduce the volume for further processing.

### **Pulverized Rubber**

material that has been crushed, pounded or ground to smaller particles.

### **Pyrolysis**

The thermal decomposition of whole scrap tires or scrap tire derived rubber in an oxygen free reactor to chemically break the tire into its original components of oil, gas, char and steel.

## **R**

### **Radial Tire**

A tire construction in which the body ply cords are placed nearly straight across the tire from bead to bead; the belt plies run circumferentially around the tire, under the tread, and constrict the radial ply cords.

### **Reclaim or Reclaimed Rubber**

Vulcanized rubber treated by a combination of heat, chemical agents, and intense kneading to give a material essentially its pre-vulcanized plasticity, which is useful as a rubber compounding material. ASTM 1566-15

### **Recovered Carbon Black (rCB)**

A semi-reinforcing filler obtained from the thermal degradation of rubber compounds, most frequently scrap tires. It contains 10-20 percent by weight inorganic compounding ingredients but is wire and fabric-free. rCB can be used in various applications including reinforcing filler in tires, pigments, ink, plastic and coatings.

### **Recycled Rubber**

Any rubber material derived from processing scrap tires or other rubber products either through ambient shredding or cryogenic grinding. At no point in the process does the rubber undergo any chemical change. In short, recycled rubber is rubber.

### **Recycling**

The process of collecting, recovering and processing materials from the waste stream, and turning them into new products, reducing the amount of virgin raw materials needed to meet consumer demands

### **Recycled Vulcanizate Rubber**

Vulcanized rubber that has been processed to give particulates or other forms of different shapes, sizes, and size distributions. The words "vulcanizate" and "vulcanized rubber" are interchangeable. ASTM 5644-01.

### **Repaired Tire**

Any tire with punctures, cuts, or other types of injuries that have been reconditioned to restore strength and flexibility for additional vehicle service.

### **Resource Recovery**

A general term used to describe the extraction of usable materials or energy from discarded products for reuse, repurposing or recycling. The U.S. Environmental Protection Agency (EPA) has set up a hierarchy for resource recovery: reduce first, then reuse, recycle, incinerate with energy recovery and landfill. The end goal is sustainability.

### **Retreadability**

Ability of the tire casing to be retreaded and provide acceptable tire performance.

### **Retreaded Tire**

A casing to which a new tread has been affixed to extend the usable life of the tire.

### **Rubber**

Material that is capable of recovering from large deformations quickly and forcibly, and can be, or already is, modified to a state in which it is essentially insoluble (but can swell) in boiling solvent, such as benzene, methyl ethyl ketone, or ethanol-toluene azeotrope. ASTM 1566-15

### **Rubber Modified Asphalt**

A general term used to identify the incorporation of ground tire rubber into asphalt paving materials.

### **Rubber powder (fine)**

Fine rubber powders are products with designations smaller (finer) than 1.0 mm (18 mesh). These materials typically range in particle sizes from less than 600  $\mu\text{m}$  (30 mesh) to less than 75  $\mu\text{m}$  (200 mesh) regardless of polymer type present in the recycled vulcanizate or the method of processing ASTM D5603-19

### **Reuse**

The recovery or reapplication of a tire in a manner that retains its original form or identity (e.g. used tire or retread).

### **Rough Shred**

A piece of a shredded tire that is larger than 2 inches by 2 inches by 2 inches, but smaller than 30 inches by 2 inches by 4 inches. Shredded material that is not classified with a screen.

# S

## SBR

Styrene-butadiene Rubber

### Scrap Tire

A tire which can no longer be used for its original purpose due to wear or damage, but which can be recovered whole or in part through reuse, recycling, conversion or transformation.

### Screen

A large sieve of suitably mounted wire cloth, grate bars, or perforated sheet iron used to separate materials by size. (See examples in Appendix)

### Shear Shredder

A type of shredder which has two counter-rotating shafts fitted with cutting discs or knives with hooks and spacers that intermesh and overlap.

### Sieving

A process for classifying two or more different size rubber particles. Gradations are usually expressed in terms of total percent passing or retained. (See sieve diagram in Appendix)

# T

### Take-Off Tire

A tire which has been removed from a vehicle and retained for reuse or recycling by qualified tire processors.

### Tipping Fee

A fee charged by the operator of a tire processing, recycling, energy recovery, or disposal facility to accept scrap tires – either whole or shredded – delivered to these locations.

### Tire Chip

A term used to define the approximate size of a shredded tire once it is shredded and screened or classified to create a fairly consistent size. Typically, this term is used in conjunction with a size specification required by the end user. Examples are: 6"x6"/150 mm x 150 mm, 4" x 4"/100mm x 100mm, 2" x 2"/50 mm x 50mm, or 1"x 1"/25 mm x 25 mm. Tire Chips are generally smaller than twelve inches in length and most of the exposed metal is removed. Actual dimensions should be specified by the design engineer or design professional based on the specific performance criteria needed for the project.

### Tire Components or Parts:

- **Beads:** Tire beads hold the tire to the rim, or the outer edge of the wheel. They are made of copper, brass, or bronze-plated high tensile steel wires wound into a rubber band. Tire beads prevent the tire from sliding out of place when the wheel rolls.

- **Bead Filler:** Bead filler is a rubber compound inside the tire's beads. It provides stability to the lower sidewall and bead area. The density and stiffness of a tire's bead filler help to determine a tire's performance characteristics.
- **Body Ply cord:** The cord body gives the tire strength and transmits cornering forces from the tread to the wheel. Rubber coated fabric, called body plies, make up the cord body. Body plies can be made of polyester, rayon, or nylon. Polyester is most commonly used.
- **Inner Liner:** The inner liner is a rubber compound bonded to the inside of the cord body that retains air under pressure. It has no cord reinforcement, and it functions like an inner tube. However, modern tires no longer have inner tubes inside them. A tire's beads, bead filler and inner liner work together to hold air within the tire walls.
- **Belt Plies:** Belt plies are two or more strong layers of cord just under the tread area of the tire. The primary function of belt plies is to provide strength and stability to the tire tread. They play a role in improving tire mileage, impact resistance, and traction. Steel is the most common cord material used in belt plies.
- **Sidewall:** The area of a tire from the bead to the tread—the side of the tire—is called the sidewall. It forms a protective covering for the cord. Information about the tire is printed on the sidewall. This information includes the tire size, load index, and speed rating. Sidewall rubber compounds are designed to resist damage from ozone, cuts, and snags.
- **Tread:** The tread is the portion of the tire that comes in contact with the road surface. The tread's compound and its design have to balance wear, traction, handling, fuel economy, resistance, and other characteristics of the tire. Tread designs vary greatly.

### Tire Composition

The weight percent of the respective tire components can be broken down for average passenger and truck/ bus original equipment tires. Since each manufacturer may have different design characteristics, the following tire compositions are offered for the average tire:

#### Tire Composition:

	Passenger/ Light Truck	Truck/Bus
Natural Rubber:	19%	34%
Synthetic Rubber:	24%	11%
Compounding additives:	40%	34%
Non-Rubber:		
Steel:	13%	21%
Textile:	4%	0%

*Note: Compounding additives include: antioxidants, antiozonants, curing systems (sulfur/zinc oxide), carbon black, silica, processing oils.*

### **Tire Derived Aggregate (TDA)**

Consists of scrap tires cut into pieces that have a basic geometrical shape and are “generally between 0.5 inches (12 mm) and 12 inches (305 mm) in size and are intended for use in civil engineering applications” (ASTM D6270-08). There are two types of TDA: Type A with a maximum size of 3 inches (75 mm) and Type B with a maximum size of 12 inches (305 mm). See Civil Engineering section in the Appendix.

### **Tire Derived Fuel (TDF)**

A fuel derived from scrap tires of various kinds. This may include whole tires or tires processed into uniform flowable pieces which satisfy the specifications of the fuel end-user. TDF has a high BTU value and can lower greenhouse gas emissions when compared to coal and other fuel oil. TDF may be used in cement kilns, pulp and paper mills, and electric utility boilers.

### **Tire Derived Material (TDM)**

Any rubber, steel, or fabric material derived from processing tires or rubber products. These materials are found in a variety of sizes, shapes, or forms.

### **Tire Hauler**

Transports tires to a site for processing, reuse, retreading or disposal.

### **Tire Processor**

A permitted individual or business that processes tires by shredding, chipping, grinding, cutting, cryogenically crushing, chemical alteration or other means, thereby producing a material that is readily suitable for marketing into product manufacturing, energy recovery, or other beneficial reuse markets. Tire processor does not mean a person who re-treads tire casings or who collects and stores tires.

### **Tire Recycling**

The series of activities by which take-off tires are collected, sorted, processed, and converted into raw materials and used in the production of new products (e.g. rubberized asphalt).

### **Tire Retreader**

replaces the tread on a worn tire (casing) so that that it can continue to be used as a tire.

### **Tire and Road Wear Particles (TRWP)**

Tiny debris produced when tires are used on the road. Generated by friction between tires and the road surface. TRWP are a mixture of tire tread material and road pavement material.

### **Tire Shredder**

A mechanical device used to reduce tire materials into smaller pieces. The pieces are usually irregularly shaped.

### **Tire Shred**

A term used to define randomly ripped, torn, or cut tire pieces which have no uniformity. A tire that is processed with no particular size requirement other than to render it no longer a whole tire.

### **Tread Peels**

Strips of tire tread rubber or “peelings” which are removed during tire processing.

### **Trommel**

A revolving cylindrical screen used for separating mixtures of materials into their constituents according to size and density. Also referred to as a trommel screen.

### **Transporter**

A person or entity responsible for the transport of take-off tires, scrap tires or tire material.

## **U**

### **Used Passenger and Light Truck Tire**

A take-off tire that retains more than 2/32-inch tread depth in its most worn groove and can be safely returned to its original purpose after inspection or proper repair.

### **Used Commercial, Truck and Bus Tires**

Please see the Appendix for additional information.

## **V**

### **Vulcanized Rubber**

Crosslinked elastic material compounded from an elastomer, susceptible to large deformations by a small force and capable of rapid, forceful recovery to approximately its original dimensions and shape upon removal of the deforming force. ASTM 1566-15

### **Vulcanization**

Reversible process during which a rubber compound, through a change in its chemical structure (for example, crosslinking), becomes less plastic and more resistant to swelling by organic liquids, while elastic properties are conferred, improved, or extended over a greater range of temperature. ASTM 1566-15

## **W**

### **Waste Tire**

A tire that is permanently disposed rather than recycled, reused, or burned for its energy value.

### **Wet Process**

Blending and reacting crumb rubber with liquid asphalt at high temperatures for extended periods before incorporating the modified binder as a cement in an asphalt paving or surfacing application. Wet process crumb rubber modified (CRM) binders are commonly used as an alternative to polymer modification of asphalt binders. Both processes increase pavement rutting and cracking resistance.

## APPENDIX

ASTM International, formerly the American Society for Testing and Materials (ASTM) publishes thousands of standards per year used worldwide to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence. Working in an open and transparent process, ASTM producer, user and consumer members participate in developing industry standards that include: test methods, classification, specification, guides, practices and terminology that support industries and governments worldwide.

ASTM standards that apply to tire derived materials are listed below. The definitions found within these standards are used to define some of the terms listed in the Glossary. The Glossary provides a reference to the specific standard definition when it is used.

### **ASTM D1566-15 Standard Terminology Relating to Rubber**

#### **ASTM 1566-15: Devulcanization**

Destruction of the chemical crosslinks in a vulcanized rubber.

#### **ASTM D3053 Terminology Relating to Carbon Black**

Material consisting essentially of elemental carbon in the form of near-spherical colloidal particles and coalesced particle aggregates of colloidal size, obtained by partial combustion or thermal decomposition of hydrocarbons.

#### **ASTM D5603-19 Standard Classification for Rubber Compounding Materials**

Recycled Vulcanizate Particulate, classifies the compounding material – recycled vulcanizate particulate rubber – according to maximum particle size, size distribution and parent materials including passenger car tires, light truck, truck, bus, agriculture, off-the-road (OTR) tires; tire peels, buffings generated from the tire tread and shoulder, buffings generated from tire tread, shoulder and sidewall and non-tire rubber.

#### **ASTM D5644-18 Standard Test Method for Rubber Compounding Materials**

Determination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber describes the procedures for determining average particle size distribution of recycled vulcanizate particulate rubber using a mechanical sieve shaker (Ro-tap sieve test method) for 90 µm (170 mesh) or larger particles.

#### **ASTM D6270-17 Standard Practice for Use of Scrap Tires in Civil Engineering Applications**

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 material. 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

#### **ASTM D 6700-19 Standard Practice for Use of Scrap Tire Derived Fuel**

Provides guidance for the material recovery of scrap tires for their fuel value. The conversion of a whole scrap tire into a chipped formed for use as a fuel produces a product called tire-derived fuel (TDF). This guide explains TDF's use when blended and combusted under normal operating conditions with originally specified fuels. Whole-tire combustion for energy recovery is not discussed herein, since whole-tire usage does not require tire processing to a defined fuel specification. This recovery guide has moved from a pioneering concept in the early 1980s to a proven and continuous use in the United States with industrial and utility applications.

#### **ASTM D8268-19 Standard Practice for Rubber Compounding Materials—Evaluation of Recycled Vulcanizate Particulate Rubber**

Provides references for standard test methods for composition analysis of rubber and offers a guide for methods widely applied by the recycling industry.

### **Civil Engineering**

Properties of Tire Derived Aggregate:

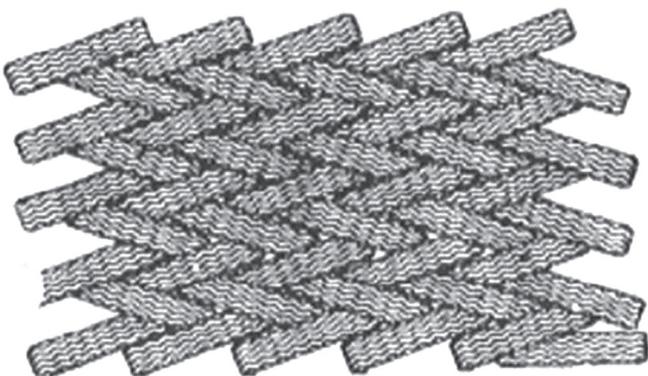
- **Lightweight TDA Definition:** Tire Derived Aggregate is approximately 1/3 weight of soils (600 pounds per loose volume cubic yard). 1 ton = 1.67 cubic yards (in place). In place density = 45-50 pounds per cubic foot.
- **High Permeability TDA Definition:** Drains ten times better than soil. TDA is free draining and has higher permeability than typical drainage rock. (> 1 to 30 cm/sec.)
- **Thermal Insulation:** Process of insulating material from transferring heat between the materials that are in thermal contact. TDA is eight times better than stone with an R-Value of 7.
- **Shear Strength:** The strength of a material or component against the type of yield or structural failure where the material of component fails in shear. The shear strength is the load that an object is able to withstand in a direct parallel to the face of the material as opposed to perpendicular to the surface.
- **Capillary Break:** TDA can be the material between the parallel layers stopping capillary action. The high porosity of TDA and its non-absorptive qualities prevent water from wicking toward the surface, eliminating frost heaving.

- **Interlocking:** The fibrous nature of TDA produces internal reinforcement, creating a “Snowshoe Effect” which prevents differential settlement and adds global support to an overlying structure.
- **Lateral Load:** Live loads that are applied parallel to the ground. They are horizontal forces acting on a structure. They are different to gravity loads which are vertical, downward forces. For example, water and earth pressures.
- **Void Space:** TDA has a large storage capacity due to its 50% Void Space (10% greater than stone).  
Void Ratio: The void ratio of a mixture is the ratio of the volume of voids to the volume of solids. It is a dimensionless quantity in material science and is closely related to porosity.
- **Vibration Mitigation:** TDA can reduce ground borne vibrations which describe mostly man-made vibrations of the ground, contrasted with natural vibrations of the Earth (studied by seismology). Examples of ground vibrations caused by explosions, construction work, railway and road transport, etc.
- **Water Filtration:** is the process of removing or reducing the concentration of particulate matter, including particles, parasites, bacteria, algae, viruses and fungi, as well as chemical and biological contaminants from contaminated drinking water.

**Commercial, Truck and Bus Tires**

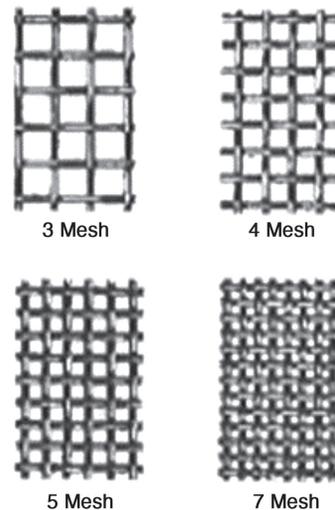
The U. S. Tire Manufacturers Association offers a document titled, “Care and Service of Commercial, Truck and Bus Tires” that provides in-depth information for this market segment. Construction diagrams, terminology references, size designations, compounds and applications for use are included.

**Lacing Diagram**



Source: Library of Rouse Rubber Industries

**Mesh Screen Examples**



Source: Library of Rouse Rubber Industries

**Off-the-Road (OTR) Classification examples**

- **Lawn & Sport vehicle Tires:** Examples include: Lawn & Garden, Golf Cart tires, ATV and four-wheeler tires
- **Industrial & Farm Tires:** Examples include: Large and Small Farm Tires, Mobile crane tires, Forklift tires and tires for military vehicles.
- **Airplane Tires:** Examples include: small aircraft tires, private and commercial jet tires and tires used by military aircraft.
- **Earth Mover & Mining Tires:** Examples include: loader, grader, earthmover tires and giant tires used in mining.

**Passenger and Light Truck Tire Equivalent (PLTTE) Field Study**

A study was conducted in March and April 2020 to determine the average weight for passenger and light truck take-off tires. The tire recycling industry believed that the tires produced today are heavier than the 20-pound PTE weight assigned by the industry several years ago. The PTE value is significant, because it is defined in scrap tire rules and regulations in many states. The PTE value may influence tire reimbursements for clean-up activities, end market creation, bonding requirements and other recycling incentives.

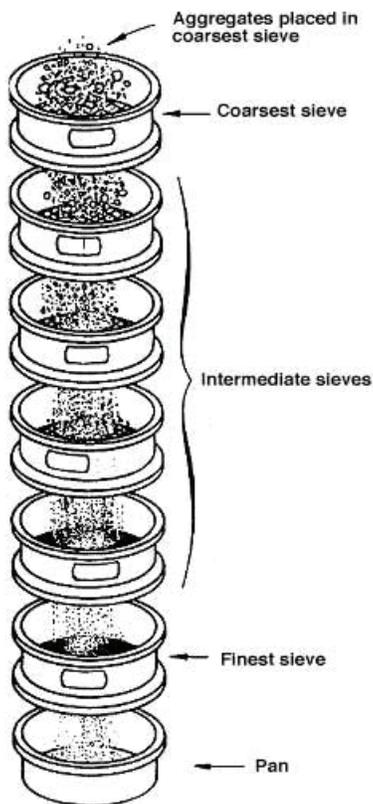
To determine the average weight for passenger and light truck take-off tires generated in 2020, studies were conducted in Florida, Illinois, Utah and California.

In Florida, Illinois and Utah, the weight of 100 tires was measured as they were unloaded from take-off tire collection vehicles in a tire recycling facility. The average weight for Florida was 23.6 pounds per tire, the average for Illinois was 25.6 pounds per tire and the average for Utah was 27.1 pounds per tire. The average for these three states, which represent distinct geographical differences, was 25.3 pounds per tire.

To further evaluate take-off tire weights, a much larger evaluation was performed in California. During a 10-day period, in April 2020, the passenger and light truck take-off tires collected, were counted as they passed into the processing shredder. At the end of each processing day, the raw material weight of those processed tires was recorded, along with the total number of tires processed. During the ensuing 10-day period, 35,000 tires were processed and the raw material weight for these tires recorded. The study found that the average raw material weight from these processed tires averaged 25.2 pounds per tire.

For this reason, the value of the Passenger and Light Truck Tire Equivalent (PLTTE) has been updated to represent the actual value of 25 pounds derived from the field study.

### Sieving Diagram



Source: W.S. Tyler Corp.