



Designation: D 6700 – 01

Standard Practice for Use of Scrap Tire-Derived Fuel¹

This standard is issued under the fixed designation D 6700; 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 covers and 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 recovery practice 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.

1.2 Combustion units engineered to use solid fuels, such as coal or wood or both, are fairly numerous throughout the U.S. Many of these units are now using TDF even though they were not specifically designed to burn TDF. It is clear that TDF has combustion characteristics similar to other carbon-based solid fuels. Similarities led to pragmatic testing in existing combustion units. Successful testing led to subsequent acceptance of TDF as a supplemental fuel when blended with conventional fuels in existing combustion devices. Changes required to modify appropriate existing combustion units to accommodate TDF range from none to relatively minor. The issues of proper applications and specifications are critical to successful utilization of this alternative energy resource.

1.3 This practice 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.

1.4 *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 limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

D 2013 Practice for Preparing Coal Samples for Analysis

D 2361 Test Method for Chlorine in Coal
D 2795 Test Method for Analysis of Coal and Coke Ash
D 3172 Practice for Proximate Analysis of Coal and Coke
D 3173 Test Method for Moisture in the Analysis of Coal and Coke
D 3174 Test Method for Ash in the Analysis Sample of Coal and Coke from Coal
D 3175 Test Method for Volatile Matter in the Analysis Sample of Coal and Coke
D 3176 Practice for Ultimate Analysis of Coal and Coke
D 3177 Test Method for Total Sulfur in the Analysis Sample of Coal and Coke
D 3178 Test Method for Carbon and Hydrogen in the Analysis Sample of Coal and Coke
D 3179 Test Method for Nitrogen in the Analysis Sample of Coal and Coke
D 3682 Test Method for Major and Minor Elements in Combustion Residues from Coal Utilization Processes
D 4239 Test Methods for Sulfur in the Analysis Sample of Coal and Coke Using High-Temperature Tube Furnace Combustion Methods
D 4326 Test Method for Major and Minor Elements in Coal and Coke Ash by X-Ray Fluorescence
D 4749 Test Method for Performing Sieve Analysis of Coal and Designating Coal Size
D 5468 Test Method for Gross Calorific and Ash Value of Waste Materials
D 5865 Test Method for Gross Calorific Value of Coal and Coke
E 873 Test Method for Bulk Density of Densified Particulate Biomass Fuels

2.2 Other Standards:

SW-846-5050 Bomb Calorimeter Preparation
SW-846-9056 Ion Chromatography

3. Terminology

3.1 Definitions:

¹ This practice is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.03.03 on Industrial Recovery and Reuse.

Current edition approved Aug. 10, 2001. Published November 2001.

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.



3.1.1 *all season radial*, *n*—a highway tire designed to meet the weather conditions in all seasons of the year, that meets the Rubber Manufacturers Association³ definition of a mud and snow tire.

3.1.2 *altered tire*, *n*—a scrap tire which has been modified so that it is no longer capable of retaining air, holding water, or being used on a vehicle.

3.1.3 *analysis*, *n*—the activity to determine the proximate and ultimate analysis, fuel value and size specification of TDF.

3.1.4 *bead*, *n*—the anchoring part of the tire, which is shaped to fit the rim. The bead is constructed of high tensile steel wires wrapped by the plies.

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

3.1.6 *bear claw*, *n*—the rough-edged bead wire sticking out from a shredded tire.

3.1.7 *belt*, *n*—an assembly of rubber coated fabric or wire used to reinforce a tire's tread area. In radial tires, also constrains the outside diameter against inflation pressure and centrifugal force.

3.1.8 *belt wire*, *n*—a brass-plated high tensile steel wire cord used in the steel belts.

3.1.9 *bias ply tires*, *n*—a tire built with two or more casing plies, which cross each other in the crown at an angle of 30 to 45° to the tread centerline.

3.1.10 *body*, *n*—tire structure not including the tread portion of the tire. (See also *casing* and *carcass*.)

3.1.11 *carcass*, *n*—See *casing*.

3.1.12 *casing*, *n*—the basic tire structure excluding the tread. (See also *carcass*.)

3.1.13 *chip size*, *n*—the range of rubber particle sizes resulting from the processing of whole tires.

3.1.14 *chipped tire*, *n*—a classified scrap tire particle that has a basic geometrical shape, which generally is 2 in. (5.08 cm) or smaller and has most of the bead wire removed. Also referred to as a *tire chip*.

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

3.1.16 *classifier*, *n*—equipment designed to separate oversized tire shreds from the desired size.

3.1.17 *combustion*, *n*—the chemical reaction of a material through rapid oxidation with the evolution of heat and light.

3.1.18 *combustion unit*, *n*—any number of devices to produce or release energy for the beneficial purpose of production by burning a fuel to include, but not limited to, units such as industrial power boilers, electrical utility generating boilers, and cement kilns.

3.1.19 *commercial tire*, *n*—truck and industrial tires.

3.1.20 *compound*, *n*—a mixture of blended chemicals tailored to meet the needs of the specific components of the tire.

3.1.21 *converted tire*, *n*—a scrap tire that has been processed into a usable commodity other than a tire.

3.1.22 *cords*, *n*—the strands of wire or fabric that form the plies and belts in a tire.

3.1.23 *dewired*, *n*—the absence of exposed wire on the perimeter of the tire chips. Belt wire typically remains in the chip, but it is embedded in the chip.

3.1.24 *discarded tires*, *n*—a worn or damaged tire that has been removed from a vehicle.

3.1.25 *end user*, *n*—the facility which utilizes the heat content or other forms of energy from the combustion of scrap tires (for energy recovery). The last entity who uses the tire, in whatever form, to make a product or provide a service with economic value (for other uses).

3.1.26 *energy recovery*, *n*—a process by which all or part of the tire is utilized as fuel (TDF) to recover its entire value.

3.1.27 *energy value*, *n*—the assignment of a value to the tire-derived fuel as measured in British thermal units per pound or calories per gram.

3.1.28 *fabric*, *n*—textiles cords used in tire manufacturing.

3.1.29 *fishhooks*, *n*—strands of belt or bead wire exposed from a processed scrap tire or an individual piece of belt or bead wire. (See also *bear claw*.)

3.1.30 *fluff*, *n*—the fibrous, nonrubber, nonmetal portion of a tire that remains after the scrap tire is processed (that is, cotton, rayon, polyester, fiberglass, or nylon).

3.1.31 *fuel value*, *n*—the heat content, as measured in British thermal units (Btu)/lb or cal/g.

3.1.32 *hair*, *n*—wire protruding from the perimeter of a tire chip or shred. (See also *fishhooks*.)

3.1.33 *heavy-duty tires*, *n*—tires weighing more than 40 lb (18.1 kg), used on trucks, buses, and off the road vehicles in heavy-duty applications.

3.1.34 *horsetail*, *n*—a rough piece of shredded tire with a width of 2 to 4 in. (5.1 to 10.2 cm) and a length greater than 6 in. (15.2 cm).

3.1.35 *innerliner*, *n*—the layer or layers of rubber laminated to the inside of a tire and which meets the Rubber Manufacturers Association³ definition of a mud and snow tire.

3.1.36 *light duty tires*, *n*—tires weighing less than 40 lb (18.2 kg), used on passenger cars and light trucks.

3.1.37 *light truck tires*, *n*—tires with a rim diameter of 16 to 19.5 in. (40.6 to 49.5 cm), manufactured specifically for light truck use.

3.1.38 *logger tires*, *n*—a special tire designed for the logging industry.

3.1.39 *minus*, *n*—the sieve designating the upper limit or maximum size shall be the sieve of the series with the largest opening upon which is cumulatively retained a total of less than or equal to 1 % of the sample.

3.1.40 *mucker tire*, *n*—a flotation type of tire specifically designed for use in soft grounds.

3.1.41 *natural rubber*, *n*—the material processed from the spa (latex) of *Hevaca Brasiliensis* (rubber tree).

3.1.42 *new tire*, *n*—a tire that has never been mounted on a rim.

3.1.43 *nominal*, *n*—commonly used to refer to the average size product (chip) that comprises 50 % 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.

³ Available from the Rubber Manufacturers Association (RMA) 1400 K Street, NW, Suite 900, Washington, DC 20005.

3.1.44 *off the road tire (OTR)*, *n*—tire designed primarily for use on unpaved roads or where no roads exist, built for ruggedness and traction rather than for speed.

3.1.45 *passenger car tires*, *n*—a tire with less than an 18 in. (45.7 cm) rim diameter for use on cars only.

3.1.46 *pneumatic tires*, *n*—a tire that depends on the compressed air it holds to carry the load. It differs from a solid tire in which the tire itself carries the load.

3.1.47 *processed tire*, *n*—a scrap tire that has been altered, converted, or size reduced.

3.1.48 *passenger tire equivalent (PTE)*, *n*—a measurement of mixed passenger and truck tires, where five passenger tires are equal to one truck tire.

3.1.49 *radial tire*, *n*—a tire constructed so that the ply cords extend from bead to bead at a 90° angle to the centerline of the road.

3.1.50 *rim*, *n*—the metal support for the tire and tube assembly on the wheel.

3.1.51 *rip-shear shredders*, *n*—a tire shredder designed to reduce a scrap tire to pieces. The size and shape of the rubber particle is dependent on the processing action of the shredder (that is, by cutting blades, rotary shear, or rip shear).

3.1.52 *rough shred*, *n*—a piece of a shredded tire that is larger than 2 in. (5.1 cm) by 2 in. (5.1 cm) by 2 in. (5.1 cm), but smaller than 30 in. (76.2 cm) by 2 in. (5.1 cm) by 4 in. (10.2 cm).

3.1.53 *rubber*, *n*—an elastomer, generally implying natural rubber, but used loosely to mean any elastomer, vulcanized and unvulcanized. By definition, rubber is a 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 in a boiling solvent.

3.1.54 *scrap tire processing*, *n*—any method of size reducing whole scrap tires to facilitate recycling, energy recovery or disposal.

3.1.55 *screen*, *n*—an apparatus for separating sizes of granules.

3.1.56 *secondary material*, *n*—fragments or finished products or leftovers from a manufacturing process which converts a primary material into a commodity of economic value.

3.1.57 *sectioned tire*, *n*—a tire that has been cut into at least two parts.

3.1.58 *shred sizing*, *n*—generally refers to the process of particles passing through a rated screen opening rather than those which are retained on the screen. Examples include:

3.1.58.1 *1 by 1 in. (2.5 by 2.5 cm)*, *n*—a sized reduced scrap tire, with all dimensions 1 in. (2.5 cm) maximum.

3.1.58.2 *2 by 2 in. (5.1 by 5.1 cm)*, *n*—a size reduced scrap tire, with all dimensions 2 in. (5.1 cm) maximum.

3.1.58.3 *X in. minus*, *n*—sized reduced scrap tires, the maximum size of any piece has a dimension no larger than X plus 1 in. (X plus 2.5 cm), but 95 % of which is less than X in. (2.54 X cm) in any dimension (that is, 1 in. (2.5 cm) minus; 2 in. (5.1 cm) minus; 3 in. (7.6 cm) minus, and so forth).

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

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

3.1.61 *shredder*, *n*—a machine used to reduce whole tires to pieces.

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

3.1.63 *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.

3.1.64 *specifications*, *n*—written requirement for processes, materials or equipment.

3.1.65 *squirrel foot*, *n*—exposed, rough pieces of belt or bead wire. (See also *fishhooks*).

3.1.66 *steel belt*, *n*—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. The stiffness of the belts provides good handling, tread wear and penetration resistance.

3.1.67 *supplemental fuel*, *n*—a combustible material that displaces a portion of traditional fuel source. It refers to the product being used in conjunction with another conventional fuel but typically not as a sole fuel supply.

3.1.68 *TDF*, *n*—See *tire-derived fuel*.

3.1.69 *tire*, *n*—a continuous solid or pneumatic rubber covering encircling the wheel of a vehicle.

3.1.70 *tire chip*, *n*—See *chipped tire*.

3.1.71 *tire-derived fuel*, *n*—the end product of a process that converts whole scrap tires into a specific chipped form. This specified product then would be capable of being used as fuel.

3.1.72 *tire shreds*, *n*—See *shredded tire*.

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

3.1.74 *tread rubber*, *n*—compounded, natural, or synthetic rubber, which is placed on a buffed casing and vulcanized to it to provide a new wearing surface.

3.1.75 *trommel*, *n*—a mechanical device that sorts size-reduced scrap tires.

3.1.76 *truck tire*, *n*—tires with a rim diameter of 20 in. (50.8 cm) or larger.

3.1.77 *used tire*, *n*—a tire removed from a vehicle's rim, which cannot be described legally as new, but which is structurally intact and has a tread depth greater than the legal limit. This tire can be remounted onto another vehicle's rim without repair.

3.1.78 *waste tire*, *n*—a tire that is no longer capable of being used for its original purpose, but has been disposed of in such a manner that it can not be used for any other purpose.

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

3.1.80 *wires*, *n*—high tensile, brass plated steel wires, coated with a special adhesion-promoting compound, that are used as tire reinforcement. Belts or radial tires plies and beads are common uses.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *quality control*, *n*—the activity to collect samples of TDF, prepare the samples for testing, and to test the samples to determine compliance with size and fuel value specifications.