Terminology Used for Forensic Footwear and Tire Impression Evidence

1. Scope

1.1 This Guide provides terminology that is commonly used in the forensic examination of footwear.

1.2 This Guide provides terminology that is commonly used in the forensic examination of tires.

1.3 This Guide provides other terminology that is commonly used in the recovery and examination of footwear and tire evidence.

NOTE: There may be terms not in this Guide that appear in other sources.

2. Terminology commonly used in the forensic examination of footwear

Blocker: an oversized outsole made of one or more components that is later cut to size

CAD-CAM: abbreviation for Computer Assisted Design – Computer Assisted Manufacture

Calendaring: a process where raw rubber is passed between rollers under heat and pressure to produce sheets of designed outsole material that is later cut to size

Chemical etching: a texture selectively applied to a mold surface through the use of an acid bath. A chemical etch pattern is unique to a specific mold.

Clicker: a machine that forces a steel die through outsole and/or midsole materials in a cookie-cutter fashion

Compression molding: a method for making outsoles where the outsole material is placed into an open mold, which is then closed and subjected to heat and pressure to allow the material to fill the mold cavity

Die cut: outsoles or other shoe components produced by forcing a sharpened steel die through preformed outsole material with the assistance of a clicker machine

Direct attach: a manufacturing process where the upper of the shoe is lowered into a mold cavity and the midsole or outsole is molded directly onto the upper

EDM: abbreviation for electrical discharge machine; a machine used to produce

molds by electrically burning away the undesired metal portions

EVA: abbreviation for ethylene vinyl acetate; a soling compound often produced in an expanded form

Flash: small amounts of rubber that have escaped between mold components during compression and injection molding and may be seen on shoes and tires

Footwear: any apparel worn on the foot, such as shoes, boots, etc.

Foxing: a strip of rubber wrapped around the lower part of the shoe to cover the seam between the upper and the outsole

Injection molding: a manufacturing method where the sole or entire shoe is made by forcing midsole or outsole material into a closed mold; outsoles can be molded individually as unit soles or directly onto the shoe upper as direct attach soles

Insole: a cushioned liner that occupies the inner surface of a shoe, where the foot rests, and may or may not be removable.

Last: a piece of wood, metal, or synthetic material that has been shaped and sized to simulate a foot; the last serves as a form over which the shoe is built

Logo: a name, design, or pattern that is the trademark of the manufacturer that may appear on the shoe or on the outsole

Midsole: a component placed between the upper and the outsole on some shoes

Natural Crepe rubber: a crude natural rubber with a light color and a knobby surface used for shoe soles

Open pour molding: a method of making outsoles utilizing polyurethane (PU); the mold is filled by pouring the PU into the mold cavity and then closing the mold; single unit soles and direct attach soles can be made utilizing this process

Outsole: the portion of the shoe that contacts the ground and is exposed to wear

Polyurethane (PU): a polyester or polyether-based polymer used in both the outsoles and midsoles of shoes

Polyvinyl chloride (PVC): a thermoplastic polymer used in shoe outsoles

Shoe upper: the top portion of the shoe excluding the outsole or midsole

Siping: the process of creating a pattern of parallel cuts commonly found on deck or boat shoes

Sprue: the piece of material which remains attached to the outsole at the point where the molding material is injected into the mold in the injection molding process

Sprue mark: a mark left on the surface of the shoe after the sprue has been removed

Stippling: a hand struck pattern of small raised designs sometimes placed on otherwise smooth parts of the mold. A stipple pattern is unique to a specific mold.

Texture: a rough surface or shallow design added to otherwise smooth surfaces of a mold through the process of chemical etching or hand stippling.

Toe bumper guard: a thick strip of rubber that is placed around the front perimeter of the shoe surrounding the toe area

Unit sole: an individual heel or sole which must be glued and/or stitched to the upper

Vulcanization: process in which a rubber compound is heated under pressure causing a chemical change which transforms the rubber from a soft, tacky substance to tough, hard rubber

Wellman outsole cutting machine: a machine used to cut outsoles from unvulcanized calendared outsole material

3. Terminology commonly used in the forensic examination of tires

Aspect ratio: the proportion of the tire's height to its width

Asymmetric tread design: a tread pattern where one half is not a mirror image of the other half

Bead: a hoop of steel wires that hold the tire on the rim

Bias tire: a tire that has plies which cross over one another at an angle

Bias-belted tire: a bias tire that has reinforced belts which lie beneath the tread

Carcass: the portion of the tire which includes the liner, plies, belts, and beads which forms the foundation for the tread and sidewall

Center rib: a rib that runs circumferentially and evenly centered within the tread design

Cord : fabrics placed under tension and covered with rubber used to form the plies of the tire

Design element: same as *tread block*

Directional tread design: a tread pattern that is optimized to work best when rotating in one direction only

DOT number: Department of Transportation serial number assigned to every tire sold in the United States which gives information regarding the manufacturer, size, and date of manufacture of the tire

Dual Tire: a pair of tires mounted side-by-side on one wheel assembly

Footprint: the contact area of a tire tread against a flat surface when under load, also known as a contact patch

Grooves: the space or channels that separate the tread ribs and elements; circumferential grooves run around the circumference of the tire. Transverse or lateral grooves, also known as slots, run across the tire.

Liner: a thin layer of butyl rubber compound that holds the air inside the tire

Low profile: a term describing a tire that has a low aspect ratio, thus a short sidewall

Mold: the cavity containing the tread and sidewall designs that are transferred to the green tire under heat and pressure in a process known as vulcanization

Mold parting line: the dividing line between two halves of a clam shell mold, or between the segments of a segmented mold

Noise treatment: the mixed arrangement of tread block lengths used by the tire industry to reduce noise generated by tires

Notches: small void areas that extend off of grooves or slots but don't fully cross the design block

Offset: the positive or negative distance from the wheel's centerline to the wheel's mounting surface

Overall diameter: the diameter of an inflated tire without any load

Pitch length: circumferential length allotted for a tread block

Pitch sequence: the arrangement of tread blocks of varied pitch lengths to reduce tire noise

Ply: rubber-coated parallel cord fabric placed over the liner forming the tire carcass

Pneumatic tire: a tire filled with air under pressure

Radial ply tire: a tire whose plies run from bead to bead at right angles to the centerline of the tread

Retreaded tire: a used tire to which a new tread has been added

Rib: row of continuous rubber or disconnected tread blocks that run circumferentially around a tire to form the tread pattern, further distinguished as center, intermediate, or shoulder ribs

Rim diameter: the diameter of the rim that supports the tire bead and is expressed in inches, such as 13", 16", 16.5" etc.

Rolling circumference: the linear distance traveled by a tire in one revolution

Section height: the distance from the rim to the tread surface of an unloaded tire

Section width: the distance between the sidewalls of an inflated tire, exclusive of any lettering or designs

Segmented mold: a mold consisting of several segments that open and close around the tire. The sidewall plates are mounted separately.

Shell mold: also known as a two-piece mold, it consists of a top and bottom, each containing a sidewall ring and half of the full-circle tread design

Shoulder: the portion of the tire where the sidewall and tread meet

Sidewall: the portion of the tire between the shoulder and the bead that contains the tire information

Sipe: a slit approximately 1 mm wide molded in tire tread blocks to improve traction

Siping: the process of creating a pattern of additional sipes on after market tires

Slot: a lateral groove

Tandem: tires set immediately one behind the other

Track width: the distance between the center points of the tires from one side of the vehicle to the other (i.e., from the center point of the right front tire to the center point of the left front tire); on a dual axle vehicle, this is the distance from the center points between the dual tires from one side of the vehicle to the other

Tread: the designed part of the tire that comes into contact with the road

Tread block: (also known as design element) individual shapes that are arranged circumferentially around a tire tread to compose the tread design

Tread depth: a vertical measurement between the top of the tread to the bottom of the tire's deepest groove, measured in 32nds of an inch

Tread depth gauge: a device used to measure the depth of the tread

Tread wear indicator: bands of raised rubber, sometimes called "wear bars", that are 2/32" above the bottom of the main grooves

Tread width: refers to the width of the tread from one edge to the other in an impression; not to be confused with section width

Turning diameter: the diameter of the smallest circle that is measured from the outer edge of the outermost front tire in a turn

Vents: drilled holes or gaps in the mold for the release of air during mold cure

Vulcanization: process in which a rubber compound is heated under pressure causing a chemical change which transforms the rubber from a soft, tacky substance to tough, hard rubber

Wheel base: the distance between the front and rear axles of a vehicle; an approximation of this dimension can be obtained by measuring the distance from the leading edge of the rear tire track to the leading edge of the front tire track on the same side of the vehicle

4. Terminology commonly used in the recovery and examination of footwear and tire evidence.

Accidental characteristic: same as *Individual characteristic*

Adhesive lifter: any adhesive-coated material or tape used to lift impressions

Blunt force pattern injury: (also known as contusion) an injury to the skin by an object resulting in a pattern which may replicate the design of the object

Brannock device: the registered name of a foot measuring device

Cast: the result of filling a three-dimensional impression with an appropriate material

Casting material: dental stone, sulfur, or other suitable materials specifically used for and generally accepted to accurately reproduce impressions

Chart board: a solid laminated board with a covering of white paper on at least one side (not foam core or gator board)

Class characteristics: A feature that is shared by two or more shoes or tires. The shoe outsole or tire tread design and the physical size features of a shoe outsole or tire tread are two common class characteristics which are acquired in the manufacturing process. General wear of the outsole or tire tread is also a class characteristic. Agreement of class characteristics alone does not provide a basis for identification however they reduce the possible number of shoes or tires that could have made an impression.

Clear film: a clear drafting film, with a minimum thickness of 4 mil, capable of accepting ink (also known as wet media film)

Coaxial light: illumination from the precise direction of the imaging lens, either through the lens or with a beam-splitter in front of the lens

Degree of Wear: The extent to which a shoe outsole or tire tread is eroded. Examples of degree of wear range from a shoe outsole or tire tread that is in a new and unworn condition to those that have considerable wear. The degree of wear continues to change as a shoe outsole or tire tread is worn.

Dental stone: a gypsum product generally having a pound per square inch (psi) rating of 8,000 or higher, commonly used to cast footwear and tire impressions

Design: the manufactured pattern of a shoe outsole or tire tread. Design is a class characteristic.

Die stone: a dental stone product with the highest psi ratings

Distortion: an unclear or inaccurate representation of the shoe or tire in the impression due to interference in the impression-making process or its subsequent retrieval

Dry Casting: a snow casting method utilizing the layering of dry dental stone powder and misted water

Dry origin impressions: impressions formed under dry conditions such as dry dust and dry residue impressions

Electrostatic detection device (EDD): an instrument used primarily to detect indented writing on documents, which can also be used to detect footwear and tire tread impressions on paper items (also known as an Electrostatic Detection Apparatus - ESDA)

Electrostatic lifting device: an instrument that utilizes electrostatic charges as a

means of transferring dry origin impressions from a surface to a film

Elimination impressions: impressions taken from shoes and tires of the first responders and other known individuals for the purpose of discerning these impressions from the questioned crime scene impressions

Enhancement: improving the ability to visualize an impression through physical, photographic, digital or chemical means

Examination quality photographs: high quality photographs taken with a scale specifically for use in the physical comparison of footwear and tire impressions with known footwear and tires

Fixative: substance that stabilizes blood prior to enhancement; any product that will stabilize the substrate prior to casting

Forensic light source: a fixed or tunable light source, with a series of excitation filters, which normally cover the spectral range from 280 – 1100 nm (UV-Visible/IR)

Gelatin lifter: gelatin applied to a pliable backing that can be used to lift impressions

General wear: The overall condition of a shoe outsole or tire tread related to its degree of use. General wear may be used to include or exclude shoe outsoles and tire treads based on similar or different degrees and positions of wear.

Holes: The result of erosion of a shoe outsole or tire tread that is so extreme that it results in removal of the outer layers of sole or tread materials, often resulting in irregular edges. These irregular edges are individual characteristics. Random holes due to punctures are also individual characteristics.

Identicator®: an inkless method of recording black impressions on white chemically treated paper

Identification: the positive association of an impression as having been made by a single shoe or tire to the exclusion of all others

Identifying characteristic: same as *Individual characteristic*

Impression: the product of direct physical contact of an item resulting in the transfer and retention of characteristics of that item

Impression evidence: objects or materials that have retained the characteristics of other objects or materials which have been in direct physical contact with them

Individual Characteristics: Features that have occurred randomly on a footwear outsole or tire tread. Examples of individual characteristics include cuts, scratches, tears, holes, stone holds, and abrasions. The position, orientation, size and shape of

individual characteristics contribute to the uniqueness of a shoe outsole or tire tread. Individual characteristics may be used to identify a particular shoe or tire as the source of an impression.

Known shoe or tire: a shoe or tire of known origin that is compared to a questioned shoe or tire impression

Latent impression: an impression not visible to the naked eye

Mikrosil™: silicone casting material formulated to produce excellent rendering of fine detail

Mold characteristics: those design and size features unique to a particular mold

Negative impression: an impression that has resulted from the removal of a substance from a receiving surface by a shoe outsole or tire tread

Oblique angle: angle between zero and ninety degrees

Oblique lighting: (also known as side lighting) illumination from a light source that is at a low angle of incidence, or even parallel, to the surface of the item

Patent impression: a visible impression

Photo log: a written record of photographs taken at the crime scene

Physical size and shape: the size, shape, spacing and relative positions of the outsole design components and tire tread blocks (not the same as the manufacturer's shoe or tire size). Physical size and shape are class characteristics.

Polarized lighting: illumination consisting of light rays with a single propagation direction and a single vibration direction; polarized lighting is achieved through the use of polarizing filters

Polyvinylsiloxane: casting material formulated to produce excellent rendering of fine detail

Position and Orientation of Wear: The location and direction of an area of erosion on a shoe outsole or tire tread. Examples of location of wear include wear along the medial edge of the shoe outsole and wear along the outer edge of a tire tread. The position and orientation of wear can change as a shoe outsole or tire tread is worn.

Positive impression: deposition of a substance onto a substrate by a shoe outsole or tire tread

Printer's ink: a highly toned, glossy black ink that sets up in two to four hours

Questioned impression: an impression made by a shoe or tire whose origin is unknown

Release agent: any product that prevents soil from adhering to the cast

Residue impression: formed by the deposition of a substance from the shoe or tire onto another surface

Roller transport film: a seven mil Estar film base material designed to wet rollers and pick up loose particles on all types of roller transport photo-processing machines

Schallamach pattern / Feathering: Microscopic patterns of ridges that develop on rubber material as a result of repeated abrasive forces. These patterns are highly individual and continue to change as affected by continued abrasion. Schallamach patterns are individual characteristics.

Snow Print Wax™ or Snow Impression Wax: aerosol waxes used to coat the surface of snow impressions prior to casting

Specific Location of Wear: A defined area of erosion on a shoe outsole or tire tread. Examples of a specific location of wear are a worn tire sipe or a small area of worn stippling on a shoe outsole. Specific locations of wear may allow for a greater level of discrimination or association between shoe outsoles or tire treads.

Sulfur: a yellow non-metallic powder used for casting snow impressions

Tears: Fractures that have occurred in shoe outsoles or tire treads that reflect irregular edges. Tears are individual characteristics.

Test impression: an impression made from a known shoe or tire as an aid in comparing a questioned impression to the known shoe or tire

Three-dimensional impression: an impression with dimensions of length, width, and depth

Treadprint®: an inkless method for making tire test impressions

Two-dimensional impression: an impression with dimensions of length and width

Variations: those variables or subtle differences that normally exist between repetitive impressions of the same shoe or tire

Wear: erosion of the surfaces of a footwear outsole or tire tread during use

Wet origin impressions: impressions formed under wet conditions including

impressions consisting of residues of blood, grease, mud, and other wet substances