FIREARM & TOOLMARK SECTION
STANDARD OPERATING PROCEDURES

Footwear & Tire Tread Impression Examination Protocol

INTRODUCTION & PURPOSE

The Charlotte Mecklenburg Crime Laboratory Firearm/Toolmark Section will only examine/compare the types of evidence listed below. Any request that requires development or significant enhancement of suspected prints will need to be redirected to the NC State Crime Laboratory or another capable laboratory.

TYPES OF EVIDENCE EXAMINED

The following types of footwear evidence are examined by this laboratory:

A. Casts
B. 1:1 photographic reproductions
C. Visible dust impressions
D. Visible impressions made into and/or with foreign matter (blood, mud, grease, oil, etc.)
E. Lifts

INTRODUCTION

The methods, techniques, and practices employed in shoe and tire impression identification are similar in some respects to those of latent fingerprint and/or impressed toolmark identification.

Characteristics may be divided into two general categories: (1) intentionally or accidentally imparted characteristics imparted during manufacture which are shared by a number of shoes (class characteristics), and (2) individual/ accidental characteristics which separate one shoe from others in the same class. No minimum number of characteristic agreements is required to effect an identification.

Formation of the individual characteristics created by use is generally the result of cuts, nicks or abrasions to the sole material. The shape and size of the accidental damage are dependent upon surfaces and objects encountered during wear. In addition, just using footwear results in overall wear, which is not consistent throughout the entire surface of the material. Wear patterns develop on footwear, which are unique to each person. The degree to which general wear conditions contribute to a conclusion must be determined with each impression.

Most impressions are submitted because they are readily visible, either as substantially two-dimensional impressions on hard surfaces, or as three-dimensional impressions in softer surfaces.

Footwear / tire tread impression comparison is a procedure requiring observation of characteristics according to size, shape, and spatial relationships. The evaluation of any impression is the determination of whether or not class characteristics and individual characteristics are present.

Comparison requires a known standard that is most often restricted to the suspect shoes or tires. Previously made/recorded known standards, either inked or photographically recorded, will not normally be sufficient. Test marks made in the lab can attempt to duplicate the conditions of contact transference including force of impact, weight distribution and nature of surface contacted.

Continued use of the footwear after the suspect impression has been made may affect the results of a comparison, but no assumption should be made solely on the time interval between transfer and recovery of suspect items. The variables in amount of wear, the overall design, and the nature of individual characteristics make any precise prediction of standard usability impossible. As a general guide, however, prolonged wear will diminish the likelihood of conclusive examination results.

PURPOSE

The purpose of conducting a footwear or tire tread impression examination is to associate a shoe or tire with questioned impressions at the scene of a crime. Objectives of footwear and tire tread impression examinations conducted in the laboratory may include the following:

A. Comparison of the questioned (scene) impressions with the tread pattern of the footwear or tires for agreement in class characteristics (i.e., tread pattern, size and general wear).

B. Comparison of the questioned (scene) impression with the tread pattern of the footwear or tires for positive identification through accidental characteristics (i.e., cuts or gouges found in the tread).

C. Comparison of the questioned (scene) impressions with submitted footwear or tires for elimination.

EVIDENCE IMPRESSIONS

All impressions that are suitable for comparison or elimination purposes will be compared with suspect or elimination shoes, if available.

- Questioned impressions will be evaluated to determine suitability for comparison purposes.

- Laboratory produced test impressions are then compared with the question footwear impressions utilizing measurement and/or overlays, specifically searching for a correspondence in size, tread surface design, mold characteristics, wear characteristics, and individual characteristics.

In cases where obvious dissimilarity in size, pattern, or design conclusively eliminate a shoe, no further documentation is required.

Visible Impressions

Visible footwear impressions must be examined to determine if they are suitable for comparison or elimination purposes. The impressions should either be examined directly or photographically (1:1 reproductions).

- Footwear impressions must contain sufficient discernible class characteristics to effect a comparison.
- Footwear standards must be submitted to the Laboratory to effect a complete comparison.

Submitted Photographs of Impressions

Photographs that are submitted as the questioned footwear impression evidence are visually examined to determine if they are suitable for comparison or elimination purposes.

- In most cases, the photographs of the footwear impressions must be 1:1 reproductions or the photographic negatives must have the capability of being photographically printed 1:1. (There are instances when photographs are not 1:1 reproductions, however, they contain a sufficient amount of tread surface design, and therefore they may be utilized for elimination purposes.)
- The photographs must also contain sufficient discernible class characteristics to effect a comparison.
- Footwear standards must be submitted to the Laboratory to effect a footwear comparison.

The absence of a scaling device, which makes a 1:1 reproduction impossible, usually renders a photograph unsuitable for complete and accurate comparison.

Cast Impressions

Unknown cast impressions are examined and processed in the following manner:

1. Casts are carefully cleaned in an attempt to remove excess soil and other debris.

2. Casts are visually examined to determine the suitability for comparison and identification purposes. This examination can include:

    a. Determination of tread surface design
    b. Determination of possible brand or manufacturer
    c. Determination of approximate size (length and width)
    d. Determination of mold defects
    e. Determination of wear characteristics
    f. Determination of individual characteristics

Casts that contain a sufficient amount of class and individual characteristics and are deemed suitable will be examined and compared with known footwear submitted by the requesting agency.

TEST IMPRESSIONS OF KNOWN SHOES

PHOTOGRAPHING SHOES

Prior to making test impressions of the shoes, (the soles of the shoes at a minimum) should be photographed or photocopied. Additionally the examiner should photograph the tops, sides and backs of the shoes to document the condition of the shoes prior to examination. If the shoes have an internal tag with identifying features, it should also be photographed if possible. Photographs of the soles will serve as a suitable record if test prints are not needed (prints exhibit different class characteristics).

TEST IMPRESSIONS

All known exemplars used for comparison in the examination must be a legible reproduction (photographs/ reproductions (ink/gel lifters, etc., or photocopy) suitable for comparison of the known exemplar and must be retained as part of the examination documentation.

Worksheets will be completed for all exhibits submitted for impression examination and comparison.

Two-Dimensional Impressions

The two-dimensional questioned impression is a reverse positive image of the shoe. Comparing the crime scene impression directly to the shoe can be difficult. Not only will accidental characteristics be reversed, but also a visual examination of a shoe outsole cannot alone show how a feature or characteristic will appear in an impression. The test impression provides a medium that may be compared against the questioned impression and also used in chart form for court purposes. Every effort should be made to obtain a test impression that closely resembles the questioned impression.

When making a test impression by wearing the footwear it is suggested to wear gloves and use plastic bags to cover your foot.

PRINTER'S INK AND PAPER

A shoe which has had printer's ink applied to the bottom with a roller will make a good contrasting impression on white paper. After applying a thin coating of printer's ink to the outsole the impression is made by stepping on a supported piece of paper. Supporting the paper with a piece of gum rubber mat works well. Several prints should be attempted while varying the amount of ink on the outsole. This method is most successful when the shoe is being worn because it is easier to apply even and steady pressure to the shoe.

CARBON PAPER OR BLACK CHARTBOARD AND TALCUM POWDER IMPRESSIONS

Carbon paper or black chartboard can also be used in conjunction with talcum powder. To make impressions this way, dust the shoes with talcum powder or white fingerprint powder and then make the impression on black carbon paper or chartboard. This method works well when dealing with "negative" impressions.

PHOTOCOPIED TRANSPARENCIES OF TEST IMPRESSIONS

Test impressions are made using the printer's ink and paper technique above. The best of the tests is chosen and a transparency is made on the photocopier. Note that it is very important to compare the photocopied transparency back to the original test to

verify that the size and characteristics were copied completely and correctly. It may be necessary to lighten or darken the image on the photocopier or to change the contrast level in order to get the best photocopied image. The photocopied image may then be laid directly over the questioned print for comparison purposes.

THREE DIMENSIONAL TEST IMPRESSIONS

It is on rare occasion necessary to make a three-dimensional test impression of a shoe in order to effectively compare that shoe with a three-dimensional questioned impression. Three-dimensional questioned impressions contain characteristics of both the raised and depressed surfaces of the outsole. If the impression is sufficiently deep, it can also contain impressions of the side of the outsole, the side of the midsole, and sometimes even the upper of the shoe.
Three-dimensional impressions that are received in the laboratory for comparison can be photographs of questioned three-dimensional impressions and/or casts of those impressions. Since casts are a positive likeness of the shoe that made the impressions, they are best compared directly with the known shoe. For three-dimensional impressions represented by photographs, three-dimensional test impression methods can be used. If necessary, the test impression can be photographed using a light source at a similar height and position as the lighting in the photograph of the questioned impression. A transparency can also be made from the photographs of the test impressions, if needed.

TEST IMPRESSIONS OF KNOWN TIRES

The following section will include information needed to record test impressions as well as a specific test print method. There are many methods for recording test impressions of tires. The examiner should not limit himself to this specific method. The method used will depend on a number of factors, the most important being the materials available. Whatever method is used, be sure to include the information necessary to use the test impression for comparison purposes.

FACTORS TO CONSIDER

- Examine the tire for wear bars (tread wear indicators) which normally are 1/16th of an inch above the base of the groove and run laterally across the tread.
- Mark on the sidewall of the tire the location of each of the wear bars. The wear bars are not always evenly spaced around the tire.
- Wear bars help divide the tire into SEGMENTS which may be identified by number. Wear bar location can prove to be useful when comparing the test impression to the crime scene impression in order to locate the proper area on the tire circumference.

SERIAL, DESIGN, DRAWING & MOULD NUMBERS

The following information may be found on the inside tire sidewall near the bead area: the Serial Number, Design Number, Drawing Number and Mould Number.
The Serial Number provides the company name and plant of manufacture, the Design and Drawing Numbers provide information on the mould drawing used to design the tire and the mould number refers to the actual mould that produced the tire.
This information is important if you wish to write to the company and obtain further information regarding the tire in question.

SUGGESTED PROCEDURE FOR RECORDING A TIRE TEST IMPRESSION

- Allow the vehicle to reach room temperature and dry if necessary in order to prevent dripping onto the test impression.
- Clean the area of the floor, where the paper is to be placed.
- Clean the tire with a rag to get rid of any loose dirt prior to making your test impression. (IMPORTANT: Do not remove material such as small stones firmly imbedded in the grooves or sipes.)
- Apply printer's ink on the tire and be careful not to fill-in the minute **scratches, cuts, sipes**, etc. appearing on the tread design.
- It is recommended that pieces of paper approximately 40" long be used in order to record more than one complete circumference. This will avoid the problem of having the area you may need for comparison only partially recorded at one end of the paper.

Caution: It is preferable to push the car rather than starting the motor and placing it in gear. The vibrations of the car may cause dirt to fall onto the clean paper.

Once you have rolled the car partway over the paper, stop;

(a) cover the impression with a paper hand towel to protect it,

(b) clean the area of the tire that was resting on the ground when the printer's ink was first applied,

(c) cover this new exposed area with ink and then continue rolling the tire over the paper until you have completed your test impression.

Note: It is better to make a test impression with the tire mounted on the vehicle. This will more accurately recreate the same type of pressures as were present when the crime scene impression was made.

CHARACTERISTICS FOR COMPARISON

CLASS CHARACTERISTICS

TEST IMPRESSION COMPARISONS

Once a proper test impression has been prepared, the analyst can then carry out the comparison with the crime scene impression.
Photographs of the crime scene impression should be prepared full size (1:1) for comparison with the test impression which is itself actual size. When comparisons are conducted on a 1:1 basis any discrepancies between the two impressions are far more apparent than they would be at a reduced scale.

There are two separate phases involved in an identification:

1. Class Characteristics: In footwear these would be size, shape, pattern design, manufacturing characteristics and wear.
2. Accidental/Individual Characteristics: These are cuts, tears, wear marks and randomly placed nails and flaws acquired during or after manufacturing, but not reproduced on subsequent soles or heels manufactured.

All forms of physical comparison identification begin with agreement of class characteristics. Accidental characteristics are used to establish individuality.
Five areas, namely physical shape and size, design, manufacturing characteristics, wear and random identifying characteristics, should be considered during each comparison.

PHYSICAL SHAPE AND SIZE

The physical shape and size of an impression refer to just that. They do not refer to the manufacturer's size. If the actual physical size and shape of an impression or a partial impression is in close agreement with the respective portions of the known shoe, then it can be said that the physical size and shape of features in that impression corresponds with the known shoe. This means that the respective areas of a particular known shoe could have made the impression, considering the variables of the impression-making process. If the physical size and shape of an impression is not in close agreement with a known shoe, it is either because the known shoe did not make the impression or because of some other factor, such as distortion. Positive identification of a shoe with a questioned impression cannot be made based on physical size and shape characteristics alone. Non-identification, however, can be affected through absolute confirmable differences between the questioned impression and test impressions of the known shoe.

DESIGN

Design is an exceptionally specific category. To say that the design of a questioned impression corresponds with a known impression means the specific design characteristics of both are in agreement. It pertains not only to a full impression but also to any partial impression compared to the respective portion of the known shoe. Sometimes a shoe will have several different design elements, which, together constitute the full design of the shoe, but all of them may not be represented in a partial questioned impression. Nevertheless, the comparison can still address whether or not the design elements in the partial impression correspond and are in agreement with the respective portions of the known shoe.
Although they are in fact two separate areas of comparison, the physical size, the shape of the perimeter of the outsole and the design elements are so interrelated that those features in a questioned impression are usually hard to separate during the

comparison. This is because: (1) the design element size may remain the same but change in quantity within the confines of outsoles of smaller or larger sizes and (2) other designs may be enlarged or shrunk proportionally on larger or smaller outsoles. Except in rare cases, a positive identification cannot be effected based on both physical size and shape and design alone. In order for design to be a basis for identification, it would have to be a custom-cut outsole or some similar type of unusual shoe. The significance of the agreement, in specific terms, of physical size and shape and design between a questioned impression and a known shoe, is highly significant.

MANUFACTURING CHARACTERISTICS

The examination of manufacturing characteristics can address two areas: the first is whether or not the cut or molded outsole agrees in all characteristics that could vary in a particular manufacturing process, and the second is the amount of any variation that exists in that process and how likely it would be for another shoe to be made exactly like the known shoe.
On examination of a known shoe, the examiner should try to determine the general method of manufacturing. This should include first, the determination of whether the shoe's outsole was cut or was molded to reach its final condition. Both the left and right shoes should be used when determining what procedure went into the assembly of a shoe, and what if any characteristics may be variable ones.
Examinations that determine that a shoe possesses characteristics of physical shape and size, specific design, and variable manufacturing characteristics that correspond to a questioned impression, even when lacking wear and identifying characteristics, are still highly significant. Although it is statistically impossible to predict how many shoes will possess the same combined characteristics, it is evident that the number of shoes is significantly smaller than just those sharing the size and general design categories alone.
In addition, some manufacturing characteristics, including air bubbles that are random and the incomplete formation of outsole material in calendered outsoles, could be of sufficient randomness to allow for a positive identification.

WEAR CHARACTERISTICS

Wear of the shoe may be defined as the erosion of the outsole due to frictional and abrasive forces that occur between the outsole and the ground. Two factors in wear are of importance: the position and the degree of the wear on the shoe.
In the continuing examination process, the addition of corresponding wear to the other observed characteristics of physical size and shape, design, and possibly manufacturing variables, further reduces the chances that another shoe or shoes would share the same features. As a shoe wears, all of the characteristics present on the outsole are slowly but constantly undergoing change. The design, due to the wearing of the shoe, can change in its appearance and with considerable wear can even begin to disappear. Some finely detailed characteristics, such as stippling, that were visible when the shoes were new, will also change and eventually disappear, while others, such as air bubbles or the joint of a foxing strip, will change or become more evident both in the impression and on the shoe.

INDIVIDUAL/ACCIDENTAL CHARACTERISTICS

Individual or accidental characteristics result when something is randomly added to or taken away from a shoe outsole that either causes or contributes to making that shoe outsole unique.
Random - infers that the size, shape, and/or position of the characteristic depends, to some degree, on chance.
The value each characteristic should receive towards a positive identification will depend on the following:

- clarity of the characteristic
- its reproducibility in the test impressions
- the random occurrence on the shoe
- its degree of uniqueness

There must be some degree of association between the random characteristics on the shoe and the characteristics in the questioned impression before that characteristic can be used in the comparison.

A positive identification occurs when the questioned impression and the known shoe share confirmed random characteristics that, by virtue of their features and placement on the shoe outsole, in the opinion of a qualified footwear impression expert, could not be repeated on another outsole sharing the same class characteristics. The positive identification means that no other shoe in the world could have made that particular impression.

Information to be Included on Test Impressions, Lifts and Photographs

Evidence items will be marked in the manner described in the Laboratory's Policy Manual (PM4). Test impressions will be considered as reference materials and stored in the case file after completion of the case. Each lift, photograph or test impression which is used as the (standard) source of an impression upon which an evaluation or comparison is based will include the following minimum information.

- Laboratory Case Number.
- The original initials of the examiner.
- Date produced for tests
- Date of examination for other standards
- Item number and sub item designation, if given, of the article from which the impression was created
- Shoes – Left/Right Tires – Left/right/front/rear/spare and orientation as placed on vehicle

EXAMINATION RESULTS AND REPORTING

Following are a listing of results and suggested wording for reporting the given result. By ASCLD-LAB requirement, where no definitive conclusion can be reached, the report will clearly communicate the reason(s); e.g. insufficient agreement of individual characteristics, damage, etc. The results are listed in **bold**. The bullet(s) beneath each result are the suggested wording for the report.

IMPRESSION EVALUATION RESULTS

No Pattern or Detail Visible or Developed: Footwear/tire detail not visible.

- No patterned impressions were detected on Item _____.

Insufficient-Not suitable for comparison: Footwear/tire, etc. impression does not contain sufficient detail for any meaningful comparison or individualization.

- No impressions of value for comparison are present on Item _____ (.;) therefore, no comparison(s) was/were made with Item(s) _____.

Suitable for comparison: Impression may have sufficient quality and quantity of detail for comparison.

- ____ footwear/tire, etc. impression(s) (which may be) of value for comparison (is/are) present on Item(s) ____.

IMPRESSION COMPARISON RESULTS

Identification: (Definite conclusion of identity) Questioned footwear/tire, etc. impression (was/were) made by the known footwear/tire, etc. The questioned footwear/tire impression and the known footwear/tire have sufficient corresponding point(s)/characteristics in agreement and that the footwear/tire impression and known footwear/tire originated from the same source. No unexplainable differences exist between the questioned and known impressions. *All identifications must be verified by another examiner* qualified in the areas of shoe and tire tread impressions. The verifying examiner will document on the worksheets of the identified items with his/her initials and the date of the verification.

- The _____ footwear/tire, etc. impression(s) on Item(s) ___ (was/were) produced with the submitted footwear/tire(s), etc.

Probably Made (very high degree of association): this opinion means that the evidence is very persuasive that the shoe/tire made the impression, yet some critical feature or quality is lacking and/or missing so that an individualization is not in order.

- The Item _____ (partial/fragmentary) footwear/tire impression corresponds in (physical size, design and (general) wear), and shares (?) individual random characteristics or defects with the Item _____ footwear/tire. This impression was probably made by this footwear/tire. Due to the lack of additional identifying characteristics, a more conclusive determination could not be made.

Could Have Made: (significant association of multiple class characteristics): this opinion means that the design and physical size correspond, and there may also be some correspondence of the general condition of wear.

- The Item ____ (partial/fragmentary) footwear/tire impression, corresponds in (approximate/size, physical size and shape, design and wear, (and shares (?) individual random characteristic(s) or defect(s)) with the Item _____ footwear/tire. Due to the limited detail in the impression, a more conclusive determination could not be made.

Inconclusive: (Limited association of some characteristics): this opinion means some similarities are noted; however, there are significant limiting factors in the questioned impression that do not permit a specific association between the questioned impression and the known shoe or tire. Questioned impression(s) cannot be conclusively individualized or excluded with the

known footwear/tires, usually due to the lack of a proper scale, incomplete recording and/or poor quality of the questioned impression or the fragmentary nature of the questioned impression.

- The Item ____ (partial/fragmentary) footwear/tire impression shares similar (design characteristics/design/approximate/size/physical size and shape (general/specific wear) with the Item ____ footwear/tire. Due to the limited detail in the impression, (lack of proper/scale), a more conclusive determination could not be made.

Probably did not make (Very high degree of non-association): this opinion means that the evidence is very persuasive that the shoe or tire did not make the impression, but the impression lacks sufficient quality or clarity for an exclusion.

- The Item _____ questioned impression probably was not made by the Item _____ shoe or tire. The Item _____ impression appears to exhibit some dissimilarities; however, certain details or features are not sufficiently clear to permit an exclusion.
- Although the Item _____ questioned impression shares general design features with the Item _____ shoe or tire, some possible dissimilarities were noted which would indicate that this impression probably was not made by the Item _____ shoe or tire.

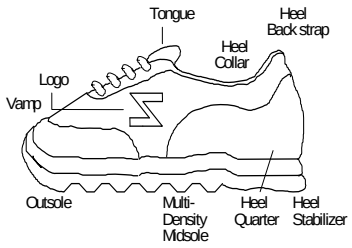
Exclusion: (Definite elimination) Questioned footwear/tire, etc. impression was not made by the known footwear/tire. Exclusion is the conclusion reached when an examiner determines that a questioned impression and a known footwear/tire are not in agreement and that the items originated from different sources.

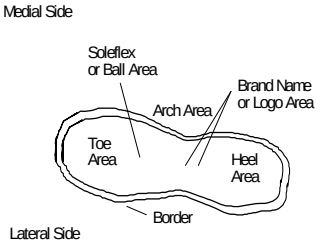
- The Item _____ footwear/tire impression(s) was not made by the Item _____ footwear/tire(s).
- The Item _____ footwear/tire impression(s) is of a different (design/size/wear) than the Item _____ footwear/tire(s). Therefore, the Item _____ impression(s) (was/were) was not made by the Item _____ footwear/tire(s).

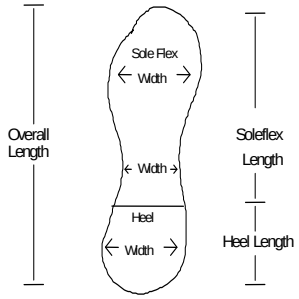
GLOSSARY AND REFERENCE INFORMATION

Footwear Terminology

There is a vast amount of shoe terminology used in the footwear industry. Listed in this section are only a few terms that will allow examiners to discuss shoes and footwear cases in the same manner.







Direct attach: a process wherein the lasted upper of a shoe is lowered into the mold cavity, where the midsole or outsole is molded directly onto that upper.

Dual density: a term used for a midsole-outsole combination in which the outsole and midsole are composed of materials having different densities.

Foxing strip: a shoe component, usually a strip of unvulcanized material, wrapped around the lower part of the shoe, covering and adding strength to the joint between the outsole and the shoe upper.

Heel: a separate component attached to the rear portion of the outsole or, in a continuous outsole, a raised area in the rear portion of the outsole. In a flat shoe, the heel area.

Heel area: in a flat shoe, the rear portion of the outsole; the area occupied by a separate heel component in a heeled shoe.

Heel backstrap: a piece of material centered at the rearmost portion of some shoes and extending from the heel collar down to the upper portion of the midsole or outsole.

Heel collar: the highest portion of the shoe upper in the rear of the shoe that surrounds the ankle when the shoe is worn.

Lasted: a shoe upper that is on a last and is ready for the bottom to be cemented or molded onto it.

Logo: a name, design, or pattern that often appears on the sides or outsole of athletic shoes and that is a trademark of the manufacturer.

Midsole: the component, found on some shoes, which is placed between the outsole and the shoe upper.

Multidensity midsole: a midsole composed of materials of two or more densities.

Outsole: the extreme bottom layer of the shoe that makes contact with the ground.

Shoe upper: the components of the shoe excluding the outsole and midsole.

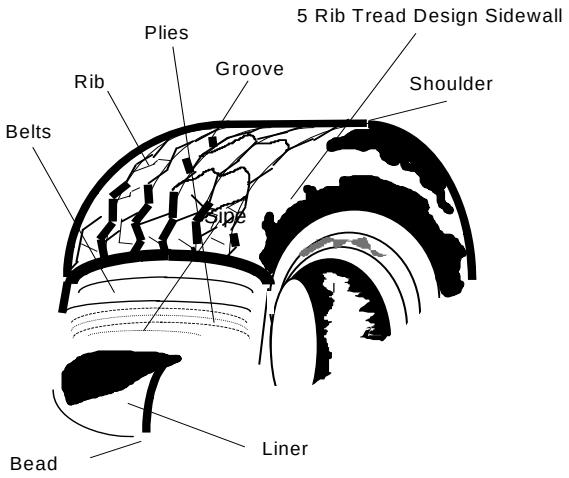
Toe bumper guard: a thick strip of rubber placed across the top of the toe area or vamp of a shoe to increase the durability and strength of the shoe in that area.

Tongue: a strip of material that covers the instep of the foot and lies beneath the shoe laces.

Unit soles: a molded heel-sole unit of a predetermined size.

Tire Terminology

The examiner should be aware of the following tire definitions so that he can better explain and discuss his examination process and findings.



Basic Tire Components

Liner: A thin rubber liner on the inside of the tire, bonded directly to the body plies, which acts like an inner tube to contain the air pressure.

Beads: As a tire rotates, the internal air pressure and centrifugal force tries to throw the tire off the rim. To prevent this, the plies of the tire are wrapped around bronze plated, high tensile steel wire, called beads. The beads anchor the tire to the rim, and are held in their proper place on the rim by air pressure within the tire.

Cord body: Layers of rubber coated cord, called plies, laid on top of one another and bonded together, make up the cord body of the tire. The cord body provides strength to the tire and acts as a container for the air pressure within the tire.

Plies: Plies are layers of reinforced cord fabric running from bead to bead on the tire.

Belts: Belts are layers of reinforced fabric or steel cords that are located directly under the tread.

Carcass: This is the main structure of the tire minus the tread and sidewall.

Sidewall: The covering on the side of the tire located between the tread and bead.

Tread: This is that portion of the tire that comes into contact with the surface it is riding over. The tread is composed of a special rubber compound and has a tread design molded into it. In the tire business, the impression left by a particular design is often referred to as the tire "footprint".

Ribs: The ribs are sections of rubber that run in rows around the tire circumference of the tread. It is the ribs which actually make contact with the road. The number of ribs running across the width of the tread including the outer ones determine the number of rib-tread design that the tire is. (If seven ribs are counted across the tread design, counting the outer ribs, then it is referred to as a seven rib tread design.

Grooves: The grooves are the furrows that separate the ribs and run around the circumference of the tire. Grooves serve several purposes, some of which are:

- to provide traction
- to provide steering control; and
- to channel water off the face of the tire

Sipes: Sipes are small grooves located on the tread ribs. Sipes are designed to provide improved traction and channel water off the surface of the ribs.

Tread Elements: Tread elements are rib sections, separated by grooves and sipes.

Blades: These are the edges of the tread elements designed to give the elements added traction.

Overall Width: The distance between the sidewall exteriors when the tire is inflated, including any raised lettering or protector bands.

Section Width: The distance between the sidewall exteriors when a tire is inflated excluding elevations due to raised lettering or protector bands, etc. This is the measurement located on information found on the tire sidewall.

Tread Design Width: The distance between the two shoulders across the face of the tread.

***Chunking*:** The breaking away of pieces of tread or sidewall.

Blemish: An irregularity in the tire surface or some imperfection in the tire.

Directional Tread: Tread design in which performance is dependent upon direction of rotation. (Rear farm tractor tires are an example.)

Gouging: Chisel-like action of rock or stubble on tires.

Mold: The heated cavity in which tires are vulcanized including the steam chamber, matrices, and adjusting devices.

Ozone Checking: Formation of fine cracks in surfaces of rubber due to ozone in air.

Recapping: In general terms, same as retreading. More specifically, refers to the process known as "top capping" in which rubber is applied only to the tread surface of the tire.

Retreading: The process of renewing the tread on a tire by buffing the old surface and applying a new tread. It differs from recapping in that new rubber is applied to both the tread surface and shoulder area of the tire.

Checking: Minute cracks appearing on the surface of the tire.

Cracking Tread or Groove: Larger cracks appearing on the tire, caused by too much strain.

Tire Construction

Tires can be broken down into several basic classifications, such as:

- passenger tires
- truck tires
- off-the-road tires
- agricultural tires
- industrial tires
- aircraft tires
- motorcycle, scooter, and bicycle tires

These classifications can, in turn, be broken down into three basic constructions:

(1) bias-ply construction
(2) belted bias construction
(3) radial construction

Bias-Ply Construction:

The bias-ply construction is characterized by having the cords in the body plies run from bead to bead at an angle of approximately 26 to 40 degrees to the centerline of the tire. The cords crisscross each other in opposite directions for each body ply layer. The advantage of the conventional bias construction is its lower cost, due to a more simplified construction. Yet, it is still a safe tire, with dependable traction, a smooth ride, and acceptable mileage performance. The crisscross effect of the body plies, however, creates a scissors-like effect, causing the tread to squirm while the tire is rolling. The bias-ply tire will show tread wear a lot sooner than the other two constructions - all other things being equal.

Belted Bias Construction:

The cord body of the belted bias tire is basically the same as the conventional bias-ply tire; however, two or more bias belts are then applied directly under the tread. The angle of the belts is kept less than the angle of the body plies. This construction makes for increased mileage (as much as 100%), improved road hugging ability, and, an increased resistance to punctures, cuts and bruises.

Radial Ply Construction:

In the radial tire, the body cords run at right angles to the centerline of the tire from bead to bead. The radial tire also has belts applied under the tread which have a low cord angle - approximately 10 to 25 degrees, to the centerline of the tire. The radial ply construction, with its radial cord body ply and stabilizer belts, provides the best performance of all. These advantages include:

- increased traction
- greater mileage
- best resistance to bruises and impacts
- an average saving of 6% in fuel costs, due to reduced rolling resistance

Sidewall Markings

There is a considerable amount of information molded onto the sidewalls of tires. This information should be recorded when examining suspect tires, as it may prove useful later.

Size Marking

Many of the tires manufactured are now being marked on the tire sidewall with the P metric series signs. The following is how one such number is interpreted.

P 195/75 R 14

"P" - passenger car tire
"195" - section width in millimeters
"75" - 75 series
"R" - radial (B: bias belted; D: bias ply)
"14" - rim diameter (in inches)

Serial Numbers

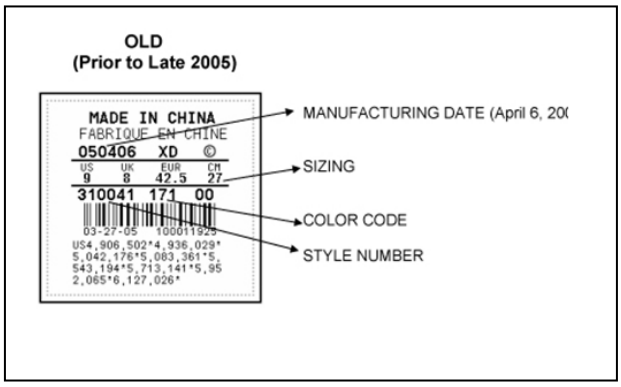
It is a requirement that all tires be marked with serial numbers, located on the tire sidewall (rear side), between the center of the sidewall and the bead. The following is how a tire serial number is read:

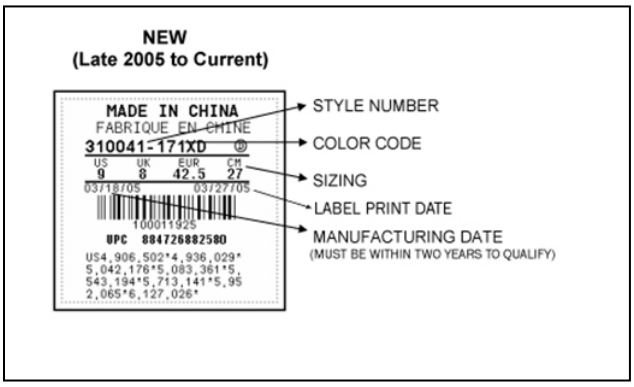
DOT DBHL E65410

DOT	Means the tire meets or exceeds the Department of Transport Safety Standards.
DB	Code used by the manufacturer and the plant.
HL	Tire size code.
E65	Group of symbols for optional use by the manufacturer.
410	The date the tire was manufactured. The first two numbers mean the forty-first week, and the last number means the year of manufacture was 1980.

Nike Tongue Label Information

From: http://www.nikebiz.com/customer_service/return_guidelines/images/tongue_labels.gif





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Issue Date	History
03/31/00	Original Issue
01/30/04	Revised to include new Firearms Examiner Gene Rivera, update process map, a couple of minor additions.
05/07/09	Fingerprint Ink to Printer's Ink
3/8/11	Extensively reformatted the entire document. Clarified the limited nature of this section's footwear and tire tread impression examination parameters. Extensively updated Results and Reporting to be more in line with current SWGTREAD terminology and to better comply with ISO requirements. Added Nike tongue label reference information, enhanced photographing of shoes prior to test making. Expanded bibliography.
6/17/11	Updated footers for ISO 17025

Approval

Director _____ Date:
Matthew C. Mathis

Issuance

Chief Criminalist _____ Date:
Todd J. Nordhoff

Criminalist _____ Date:
Gene C. Rivera

Criminalist _____ Date:

Jeffrey S. Taylor

Digitally signed by Jeffrey S. Taylor
DN: cn=Jeffrey S. Taylor, o=CMPD, ou=Crime Laboratory, email=jtaylor1@cmpd.org, c=US
Date: 2011.06.16 14:47:57 -04'00'