

Background Information

When an investigator enters a crime scene, it is extremely important that they do not destroy any evidence that might lead to the apprehension of the criminal. A close examination of a crime scene will often reveal impression evidence that has been left behind. This fact is based on the logic of the *exchange principle* by Edmund Locard, which states that "Every contact leaves a trace". It is simply impossible to enter a location without changing it in some way; either by bringing something to it or by taking something from it. Footprints, shoe prints, tire tracks, or other impressions imbedded in soft material, if properly identified, preserved, and evaluated, may serve as valuable class evidence. This type of evidence may not convict a criminal, but may lead to their apprehension.

Often it is the job of the crime scene technician to photograph, cast, and record each and every piece of collected material found during the evaluation of the crime scene. More often than not, pieces of collected evidence are found that do not relate to the particular investigation. However, even this evidence must be processed. The total laboratory analysis is very time consuming. But, when a single piece of evidence is discovered that fits the crime scene scenario, it could be the key to cracking and solving the investigation.

Extreme care must be exercised by the investigating officers and the crime scene technicians not to contaminate the crime scene when exploring it. Careful reasoning and observation must also be employed by the investigators when selecting evidence to be preserved. Proper evidence collection may establish or disprove identity allowing future matched identification during the investigatory process. If there is reason to believe that an impression can be linked to known suspects, casts will be made and pictures will be taken, to provide a positive match with evidence recovered from a suspect. This evidence will then be used in a court of law.

There are many possible types of impressions that can be found during criminal investigations. In this kit, we will concentrate on writing impressions, plastic prints (indented into soft and pliable material), rope and binding impressions, key impressions, foot or shoe prints, and tire tracks. There are many other types of impressions, including teeth impressions (bite marks), fabric impressions, and tool marks. Let's see how impressions might lead to the capture of a fugitive.

SCENARIO:

Officers Dodge and Summer were called at 12:45 A.M. on the night of October 12th to the trailer of Miss Alexandria Bendor, located on West Fifth Street of our city. Miss Bendor, a single, 22 year old female, had been attacked in her own home by a perpetrator, earlier that evening. The call was made to the police by Miss Alexandria's boyfriend, Mr. Sam Swingle.

Upon arriving at the crime scene, Officers Dodge and Summer met with Alex and Sam. After interviewing both Alex and Sam separately, and assuring that Alex was not physically harmed, the officers began piecing together what had happened on that evening.

Alex and Sam had gone to a football game at the local high school. This was a standard occurrence, since they had been dating ever since they had graduated from MHS four years earlier. Shortly before the game had ended, a few words were spoken and an argument commenced regarding Sam's wanting to date someone else. Harsh words had been spoken and Alex walked off very upset. Since her trailer was only six blocks from the football field, Alex walked home. She thought that the walk would calm her emotions. After arriving home, since it was late, she locked her door and got ready for bed. She believed that she fell asleep by 11:45 P.M. Sometime after midnight, she was surprised and attacked by an intruder who had non-forcibly entered her home. She was quickly tied to her bed and gagged.

Sam felt badly about the argument, and had decided to come over and apologize to Alex. At 12:10 A.M., Sam knocked on Alex's door. This must have startled the intruder, who disappeared out of the rear door of the trailer. Sam heard a door slam and a car speed away. He also found the front door of the trailer unlocked. He knew that Alex would have never left her door unlocked. Sam entered the trailer and found Alex. He was there just in the nick of time, she told Dodge. Sam had frightened the perpetrator off and had saved her.

After the interview, Dodge and Summer, continued their investigation. They asked Alex if anything unusual had happened that evening. She said that she could not think of anything, but that she had misplaced her purse during the game. Some kind gentleman had found it behind the bleachers and returned it to her. She thought that it had simply slid and fallen off of the bleachers. Upon investigating the contents of the purse, Summer noticed that her house key had a small bit of a clay-like material adhered to it. Aha! Summer thought. Someone had taken the purse and made an impression of Alex's house key. That is how they got in the trailer so quietly.

The officers continued their investigation around the trailer. They found fresh shoe prints in the small flowerbed near the bedroom window. Someone had been watching Alex until they were certain that she was asleep. The shoe prints were as clean as one could hope.

Alex also thought that after she had been tied up the perpetrator had left the room and made a phone call to someone. However, she could not overhear the conversation. Looking near the phone, Dodge saw a small note pad. There had been something written on a top sheet and its impression was still present on the piece of paper that had been directly under the original imprint. Near the phone, there were also some fresh scraps of cookie dough. There were fingerprints in it! Dodge smugly said, "Our criminal must not only be stupid, but also must have a sweet tooth."

Upon their initial arrival, Dodge called a paramedic to examine Alex. After the examination, the paramedic told Alex that she was very lucky. The rope burns on her ankles should heal in a few days. He gave her some lotion to soften the injuries. Dodge told her to wait and not to touch the rope marks, until pictures of them could be taken. He had found that the rope used to bind her was not from her home. It must have been brought into her home by the perpetrator.

Outside the trailer, it was very easy to locate where the getaway car had been parked. It was behind the trailer and parked on some soft clay. Tire tracks were more than abundant.

After collecting all of the evidence, taking numerous pictures, and making casts where appropriate, Officer Dodge told Alex that he felt this should be an easy crime to solve. The perpetrator had left a lot of evidence and if he did not flee from the community, they should be able to apprehend him quickly.

Three days later, with all of the impression evidence: writing impression, plastic prints, rope and binding impressions, key impressions, shoe prints, and tire prints, Officers Dodge and Summer apprehended Mr. Tory Kline. Mr. Kline had once dated Alex while they were students at MHS. According to Alex, the dating had been short lived because of Mr. Kline's attitude and self-centeredness. Alex had ended their relationship after the first date. Since that time, Mr. Kline had been angry with Alex. When he had overheard the couple's argument that evening at the ball game, he thought he would take the opportunity to get even with Alex for dumping him.

Officer Dodge was initially correct in his analysis of the perpetrator. Tory was found guilty of aggravated assault, breaking and entering, fleeing a crime scene, and numerous other violations.

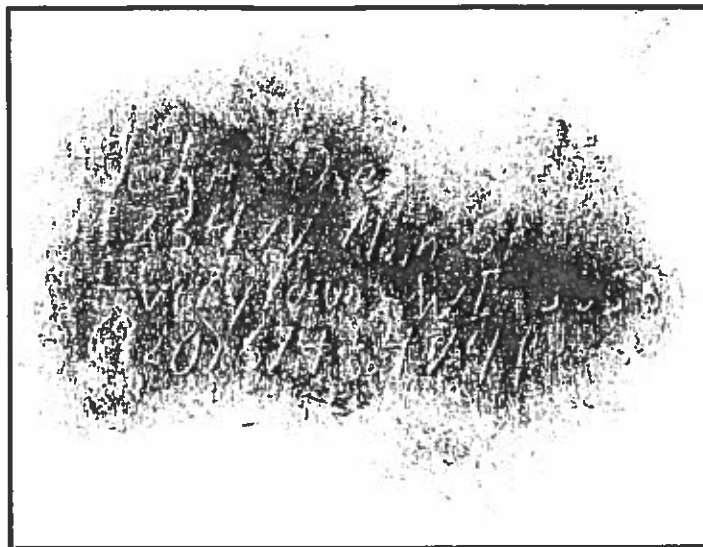
Case closed.

Let us now investigate the six types of impression evidence that our crime scene scenario has revealed so that we may support our case against Mr. Kline. We will observe, classify, make casts, and analyze writing impressions, plastic finger prints, rope and binding impressions, a key impression, foot prints, and tire tracks.

Happy sleuthing, Sherlock!

Experiment 1: Writing Impressions

(12 groups of 2)



Background: We will begin with the simplest of impression evidence; a written impression. When copying a message on a notepad, (using a #2 Pencil works best), an impression of the original message is often left behind on an underlying sheet of paper on the notepad. This is more evident when the pressure of writing is hard and the strokes are bold. The hidden message can be recovered with the aid of carbon powder.

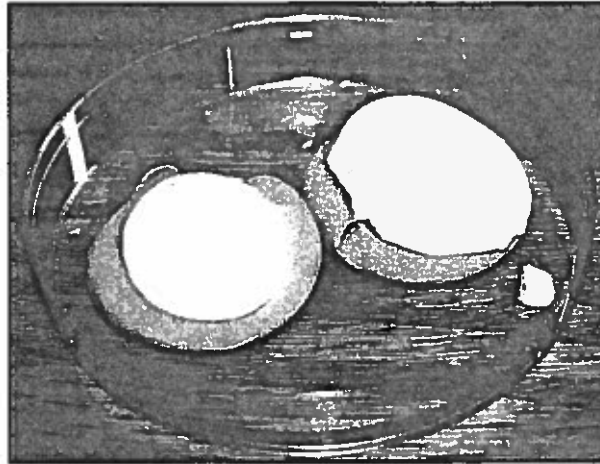
Materials needed per group:

8 ½" x 11" Sheets of Paper (3)	#2 Pencil (Provided by Students)
Carbon Powder (Charcoal)	Note Pads (Provided by Students)
Paintbrush	Scissors

Procedure:

- Step 1.** Take a sheet of paper and fold it in half. Place the sheet on a note pad or small stack of paper. With a non-pointed, moderately sharpened #2 Pencil, write your name, address, and telephone number on the top of the folded sheet. Use big, bold strokes. Apply pressure as you write, but be careful not to force and tear the paper.
- Step 2.** Open the folded paper and hold it to the sunlight. Do you see an impression?
- Step 3.** With the sheet folded open, so that the impression is easily obtainable, shake a small amount of powdered carbon onto the impression. Using a small brush, gently rub the carbon across the impression found on the paper. Use even strokes back and forth across the paper, until all of the impression is covered. Is the impression visible, yet? If not, pour off the excess powdered carbon and paint the impression a little harder with the brush, moving the brush gently back and forth and up and down across the impression.
- Step 4.** What do you see? The technique may take a little practice to get the right amount of carbon and find the correct painting motion to use. Spend some time perfecting your technique.
- Step 5.** You and your partner should each obtain another piece of paper, fold it, and write short three-lined messages to one other as described in Step 1. Cut off and save the printed message. Exchange the impressions you have made on the folded sheet of paper with your partner. Using the method described above, decipher the message you have been given.

Experiment 2: Plastic Prints (12 Groups of 2)



Background: *Plastic Prints* are prints made when the ridge impressions of the fingers, etc. are left on a soft material such as putty, wax, soap, grease, or dust. In our scenario, the cookie dough was the medium in which the fingerprints were left. Plastic prints are much more visible than a *latent print*. A latent print is an invisible print left behind due to perspiration on the ridges of one's skin coming in contact with a surface and making an impression on an object, or a clearly *visible print*, that was made when the fingers came in contact with a colored material such as blood, paint, grease, or ink. Usually the first thing done to a *plastic print*, is to photograph it, since it is clearly visible. Next, the print may be cast. More information on how to classify fingerprints may be obtained from your instructor.

Materials per Group of 2:

¼ Stick of modeling clay (2)	Tongue Depressor
4 tsp. Plaster of Paris	Plastic Cup
2 Tsp. Water	Toothbrush
Petri Dish	Plastic teaspoon

Procedure:

Step 1. Each partner should soften a ball of modeling clay about 1" in diameter. Place the softened ball of clay into a Petri dish, on a hard counter top. Gently, press your right thumb into the clay, until a small bowl is formed. Do not rotate the thumb left or right. Gently press straight down into the clay. You need not press too far. Lift the thumb straight up and away from the clay. Note the impression left in the clay. The ridges should be clean and clear. You should be able to describe and classify the type of print that was left. Are there any other distinct identifying characteristics in the impression (cuts, warts, etc.)? If so, make note of these clues.

Now is a good time to note the difference between a positive and a negative impression. Turn your thumb upward and compare it to the clay impression. The two should appear like mirror images. The thumb (original) is the positive impression and the clay is the negative impression. If your thumbprint has a radial or ulnar loop, note which way the loop opening extends at the bottom of the print. Is it toward the little finger (ULNAR) or toward the thumb (RADIAL)? When describing fingerprints, you must always report the correct detailed description.

Step 2. Now you will make a hard copy, or cast of the print, to make the positive impression. Mix 4 teaspoons of Plaster of Paris into a plastic cup with 2 teaspoons water (a 2 to 1 ratio) and mix well with a tongue depressor. You may need to add a small amount of extra plaster, to keep the consistency from being "too runny." Stir until smooth and thickened. The consistency should be neither watery nor hard, about like that of soft flowing honey.

Step 3. Carefully pour this plaster mixture into the clay impressions. You should have plenty of plaster for both prints. Spread the plaster over the impressions with a tongue depressor, if necessary. Gently tap the side of the Petri

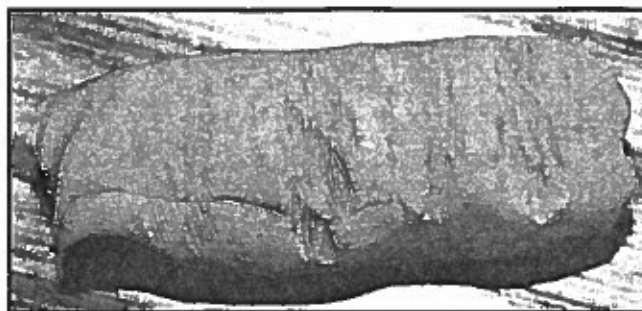
dish to remove any bubbles. The plaster material should not overflow the edges of the clay mold or the Petri dish. Let this plaster cast harden for about half an hour. You may leave the cast until your next class if necessary.

Step 4. When the plaster cast has dried and hardened, carefully take it out of the Petri dish. Peel away the clay and gently brush the cast. Note the positive fingerprint.

Step 5. You and your lab partner now have a positive thumb-print to take home and keep for your identification.

Experiment 3: Rope and Binding Impressions

(6 Groups of 4)



Background: Rope burns are very important impressions to be characterized. A person may be bound with a rope or twine that was brought by the perpetrator. Excess rope may be found in the possession of a suspect, when apprehended. Often a rope burn will not make a good impression, since most victims will have resisted and tried to escape. Sometimes an investigator may obtain a good impression when a rope burn is wide or the victim was able to loosen the rope and forced an impression into the skin while doing so. Such impressions may link a perpetrator with a crime. In this experiment, we will identify different types of rope and twine impressions.

Materials per Group of 4:

1/2 Stick of Modeling Clay	Set of Five Different Rope Samples
Magnifying Glass (2)	

Procedure:

Step 1. Soften and roll a piece of modeling clay into a cylinder 6 inches long by 1 inch in diameter.

Step 2. Place this rolled cylinder on a laboratory table perpendicular to you.

Step 3. Take the first of the five samples of rope in your left hand. Working from one end, place the rope on the cylinder of rolled clay. Using the fingers of your right hand, carefully press the rope onto the clay, keeping it taut. The rope should barely penetrate the clay roll, by not more than $\frac{1}{2}$ of the rope's thickness. Gently lift up on the rope. An impression should be visible. If not, either the clay is too soft or the pressure applied to the rope was too great.

Step 4. Check to see if a good impression was made by using a magnifying glass to carefully observe the impression for detail. If clear details are not evident, re-roll the clay and try the above procedure again.

Step 5. Repeat the procedure in Step 3 for the other four pieces of rope, making each impression about one inch away from the previously made impression.

Step 6. Using the magnifying glass, carefully observe all of the five rope impressions. Clearly draw each of the impressions. Are there any identifying characteristics?

Step 7. Have one of your lab partners secretly select one of the five strips of rope to make a sixth impression. Observe this new impression. Which of the original five impressions does it match?

Step 8. Now make a secret impression with one of the ropes for your partner to identify.

Experiment 4: Impressions of a Key (6 Groups of 4)

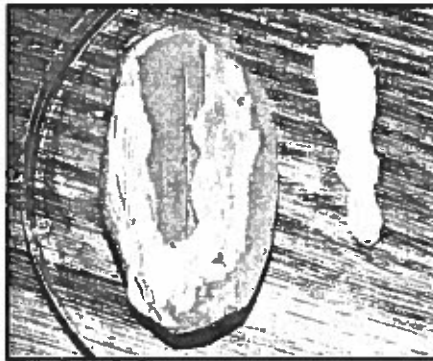
Background: In our crime scene scenario, an impression of a key was made from the original key which was taken, then returned to the stolen purse. The officer found a bit of clay-like material on this key. Although we will not make a true duplicate of the key here, we will illustrate the method of making the negative and positive impressions.

Materials per Group of 4:

Key	1 tsp of Water
¼ Stick of Modeling Clay	Tongue Depressor
2 tsp. Plaster of Paris	Petri Dish
Plastic Cup	

Procedure:

- Step 1.** Soften and roll a ball of clay with a diameter of about 1 inch. Place the clay into a Petri dish. Flatten the clay out using a tongue depressor, so that it is flat, but extends above the edge of the lid by about the thickness of a key.
- Step 2.** Carefully set a key onto the smoothed out sample of clay. Gently press the key into the clay. Be extremely careful that the key stays parallel with the clay so that one edge or side of the key does not penetrate deeper than any other. See figure below.

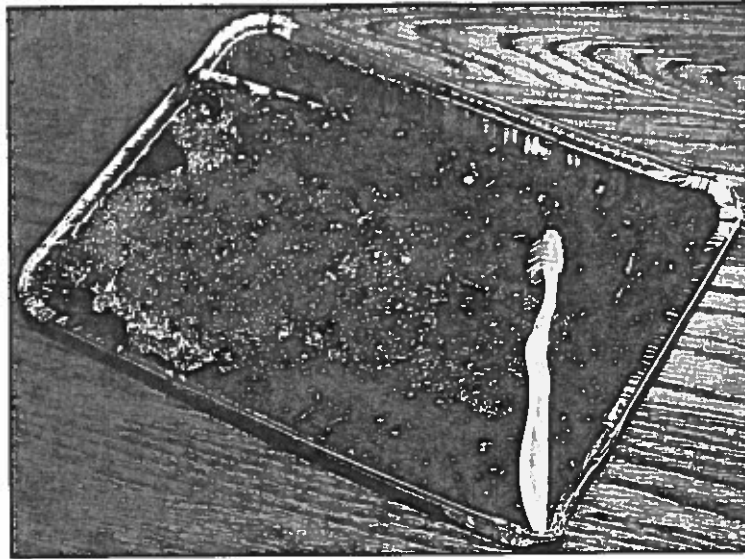


- Step 3.** Gently lift out the key. An impression of the teeth should be visually apparent in the clay. If it is not, the clay may have been too soft or the key was too forcibly and/or unevenly placed into the clay. If the impression is not clear, try again with a fresh piece of clay.
- Step 4.** Mix two teaspoons of Plaster of Paris with one teaspoon of water in the plastic cup. As before, note the proper consistency. Pour this mixture into the impression, covering it about ½ inch thick. Tap the edge of the Petri dish to remove any air bubbles. Level the plaster using a tongue depressor. Let the cast harden for about one half of an hour.
- Step 5.** When hardened, remove the cast from the clay and carefully clean the impression. Compare the teeth marks with the teeth of the key. They should match. Although this is not a real key, the process illustrates the concept.

Realistically, a liquid metal would be used for making the duplicate key. This would require a different hardening material to be used in place of the modeling clay. The method requires making a hard, temperature resistant mold which would be used to pour metal into to create a duplicate key. Once cooled, the duplicate impression would be filed and polished to get rid of metal burrs or imperfections.

Experiment 5: Shoe Impressions

(6 groups of 4)



Background: Two types of comparisons are made from shoe casts. The first comparison, *class evidence*, seeks to determine the general design, size, and manufacture of a shoe that made the original print, especially if a shoe is not available for direct comparison. Such an examination may reveal whether the shoe has been re-soled or re-healed, as well as the size, design, and manufacturer of the material used in the repair work. The second comparison, *individual evidence*, is more detailed. This comparison investigates for unique information about cuts, tears, manufacturing defects, and signs of irregular wear patterns that can be more specific to the identification of the exact shoe in question. In this experiment, we are going to make casts of shoe prints.

There is a type of Mylar™ film material that uses static electricity to collect shoe prints from flat surfaces. A number of supply houses have this material and the instructions on how to use it. You may want to extend your investigation to try this Electrostatic Mark Lifting method and apply Coulomb's Law for ESL as well (<http://theiai.org/member/jfi/JFI-2012-2-154.pdf>).

Materials per Group of 4:

9 ½" x 12" Foil Baking Pan	Cup of Water
Soil	Mixing Container
Sifting Screen	Toothbrush
2 Cups of Plaster of Paris	Tongue Depressor
Spray Bottle	

Procedure:

Step 1. Place clean sifted soil in the foil baking pan, to a height of about 1 inch below the top edge.

Step 2. Lightly moisten the soil using a spray bottle of water and tap the pan of soil lightly on desk to flatten the soil out within the pan. Do not compact the soil.

Step 3. Clean the sole of a gym shoe. Remove any rocks and other embedded debris.

Step 4. With the shoe on your foot, carefully step into the middle of the box, walking into and out of the box by placing your foot heel to toe, as you would when you walk naturally. Be sure that pressure is applied to imbed the impression of the shoe's sole into the soil.

- Step 5.** Note the print. If the footprint is not clean, re-level the dirt and try the process again. You may need to adjust the wetness of the soil.
- Step 6.** Place two cups of Plaster of Paris in a container. Add 1 cup of water. Note the consistency, being careful not to add too much more water; you want a flowing soft honey-like consistency. Add the plaster to the center of the shoe print impression within the pan. Try to pour the plaster into the print as gently as possible to prevent damage to the impression. Add enough plaster to cover the entire print, extending at least 1 inch beyond the edge of the impression. Be sure that the plaster is at least 1/2 inch thick. Spread the plaster over the print with a tongue depressor, being careful not to use force which would destroy any print marks.
- Step 7.** Let the plaster harden for at least one half of an hour. When the impression is entirely dry, carefully take the cast out of the box. Brush the cast using a toothbrush. Rinse and clean the cast.
- Step 8.** Compare the plaster cast (positive impression) with the sole of the original shoe. Draw and note specific details of differences, imperfections, wear patterns, etc.

Experiment 6: Tire Impressions



Background: Tire impressions are much like shoe impressions. Each tire manufacturer has patented specific tire tread patterns. As with shoe impressions, class evidence, including tread type, is noted as well as individual evidence such as wear patterns and imperfections. We cannot supply an auto tire with this kit, but we are asking your instructor to supply at least one tire for you to use. You will ink a section of the tire tread and roll it onto paper to obtain an inked impression.

Materials:

Old Tire	Newspaper
Tire Tread Pictures (reproduced from manual)	Paper
Foam Brush	Ink (Tempera Paint)
Ruler	

Procedure:

- Step 1.** Begin by examining the pictures of five different types of tire treads, including samples one through five. Note the differences. Now look at the unknown tire tread image. Which type of sample tread does it match? You will note that while the unknown tire does show considerable wear, a tread type can still be readily identified.
- Step 2.** Now you will need the tire supplied by your instructor. Place newspaper on the floor to help contain the mess. Apply the "ink" directly to the brush from the bottle. Be careful **NOT TO INK YOURSELF OR YOUR CLOTHING**.
- Step 3.** Using the foam brush, apply the ink to a nine inch long section of the tread of the tire. Be sure to cover all parts of this section using the brush, including all of the tire tread edges.
- Step 4.** Place a piece of paper on a flat, smooth section of floor on top of the newspaper. Position the tire directly in front of the paper, so that the inked section just touches the front edge of the paper. Have your partner hold the paper down, so that it does not stick to the tire. Carefully, applying downward pressure, roll the tire across the paper.
- Step 5.** If the tire tended to skid and smear the ink, repeat the process with a fresh piece of paper, before the ink dries. Allow the ink on the paper and the ink on the tire to dry.
- Step 6.** Observe the inked impression and distinguish any individual characteristics that may be present including wear patterns, imperfections, etc., that might differentiate this tire from another tire of the same type.
- Step 7.** If a second tire is available, repeat the above procedure and compare the two tread types.

Tire Impression Pictures

Sample #1

 **TIMBERLINE**
PEAK PERFORMANCE

DAYTON®
TIMBERLINE® L/T

*All-Terrain Design
For Economy-Minded
Consumers*



Sample #2

 **TIMBERLINE®**
PEAK PERFORMANCE

DAYTON®
TIMBERLINE® A/T



Sample #3

TIMBERLINE
PEAK PERFORMANCE

DAYTON®
TIMBERLINE HT™
S-Speed Rated



Sample #4



DAYTON[®]
TIMBERLINE[™] A/S

*All-Season
Highway Design For
Commercial Or
Personal Applications*



Sample #5

DAYTON
Performance For Every Road™

Dayton Quadra SE...

A combination of high style and superior construction. The Dayton Quadra SE affords improved performance in rain, mud or snow.

WARRANTY SUMMARY

- 55,000 Mile Treadwear*
- 50% FREE Replacement Limited Warranty**

* Provided replacement if warranted mileage not attained; actual tread life may vary.

** 50% FREE replacement (excluding taxes and disposal fees) if your Dayton Quadra SE tire should fail due to defects in materials or workmanship for up to 5 years. Certain restrictions and limitations may apply.

All warranties are limited to original purchaser on originally installed vehicle. See each warranty at your authorized Dayton retailer for details and restrictions.

† For an explanation of UTQG (Uniform Tire Quality Grade) ratings, see label affixed to tire tread or ask retailer for a copy of our UTQG handout.

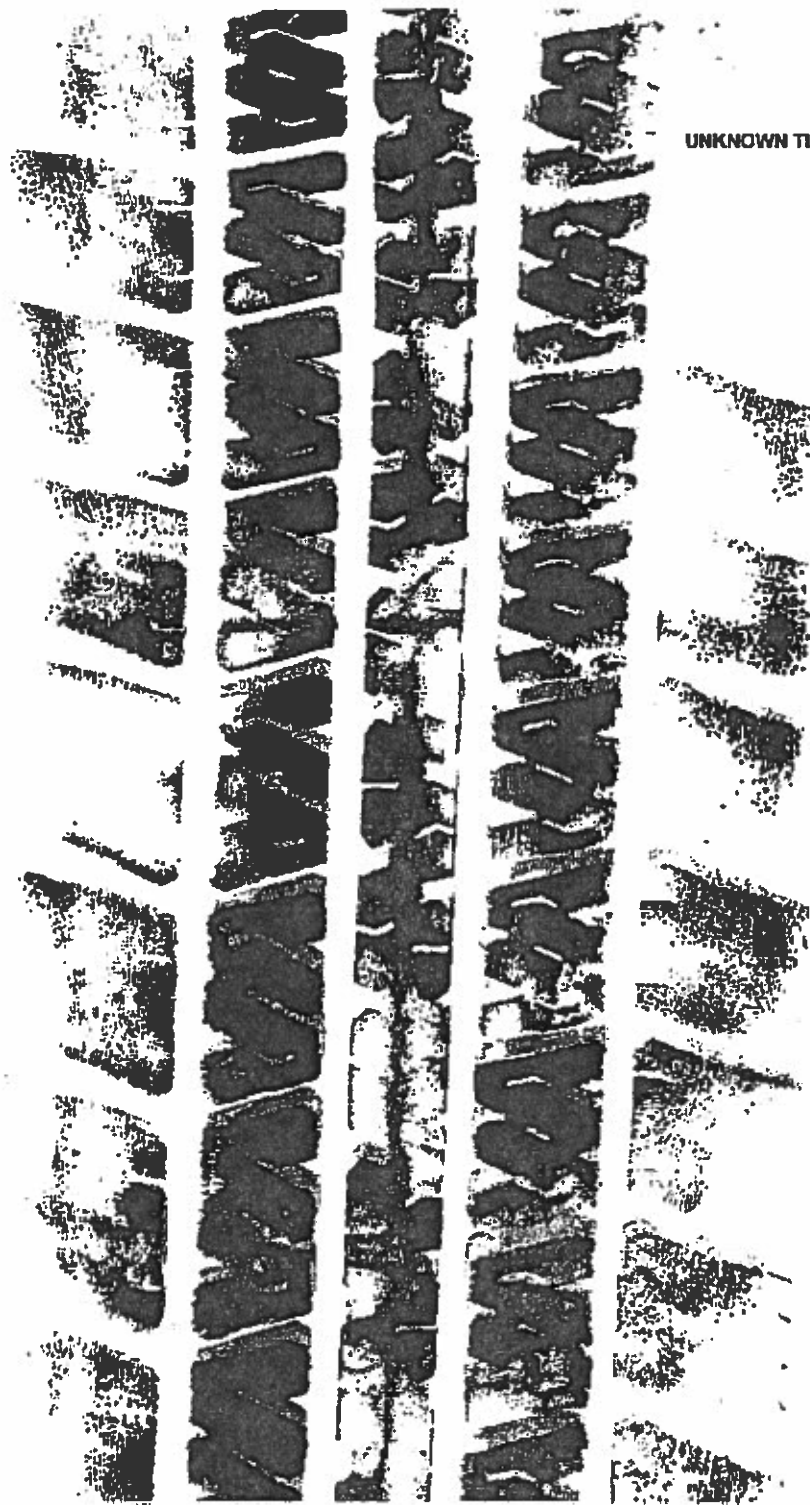
DAYTON
Quadra SE

Versatile, All-Season Radial

UTQG

Treadwear 55,000
Traction A
Resistance to Slipping B





UNKNOWN TIRE TREAD