

WELCOME TO LECTURE ON FORENSIC PHYSICS (PART-2)



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HOW IS GLASS INVOLVED IN CRIME?

- Small fragments can be used as **trace evidence** (link objects/people)
- Crime scene reconstruction



EXAMINATION OF GLASS

Available forms:

- Glass pieces, fragments, sheets of glass containing broken pattern
- Glass fractures
 - Radial fractures
 - Concentric fractures
 - Rib marks
 - Cone fracture
 - Sequence of bullets
 - Backward fragmentation

- **Cone** – When a high velocity bullet strikes a glass plate a round crater (funnel) hole is formed. The hole is wider at the exit side than entry side looking like cone appearance.

107

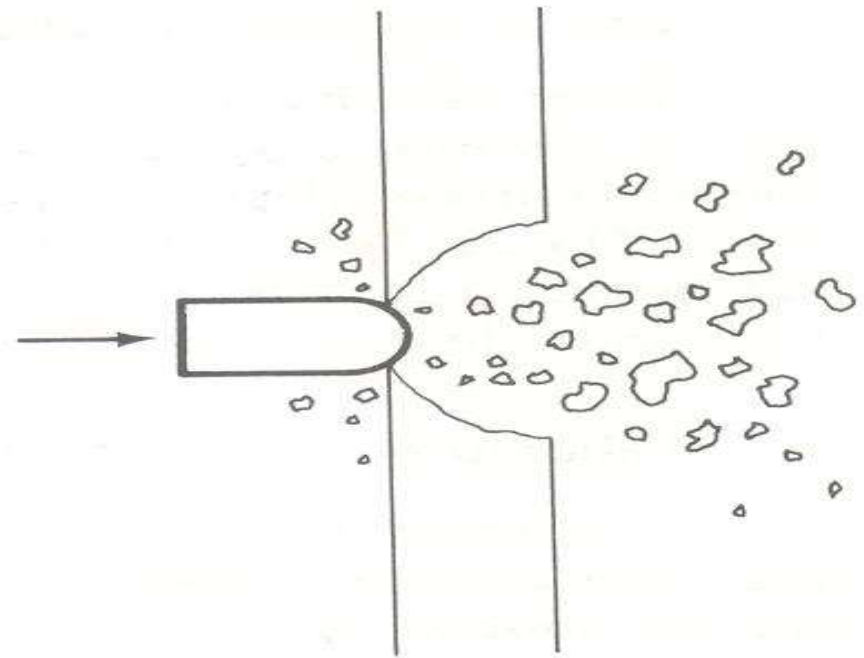


FIGURE 7-5 A missile striking a pane of glass forms a crater on the side opposite to the impact. Some glass chips also fly backward.

- **Radial** – When the force is applied on the glass plate it bends causing tension on outer side resulting radial fractures. These fractures radiate outward from the point of impact
- **Concentric** – When the glass plate tries to come to its normal state another force acting in the opposite direction causing the glass to brake into secondary fractures on inner side called concentric fractures.

- **Hackle marks** – They are caused by sudden strong force. They are small straight lines perpendicular to the ribmarks.
- In the absence of ribmarks these are useful in determining the surface of impact.
- A radial fracture if meets another radial fracture which was formed earlier, it will be stopped. So if two bullet holes are present in a glass pane their sequence can be determined.

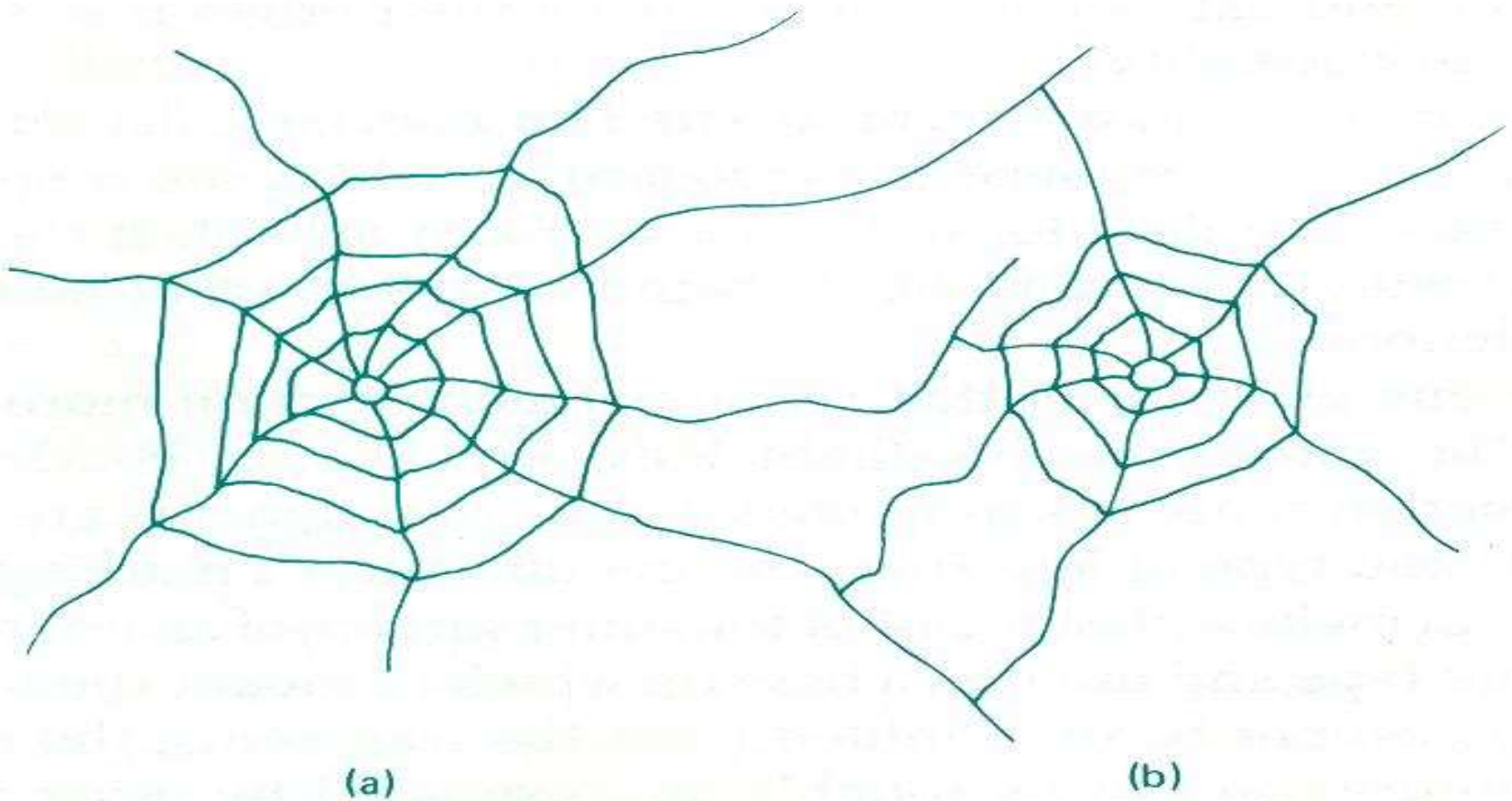


FIGURE 7-6 Penetration sequence. Bullet hole (b) was made after bullet hole (a).

COUNTING BULLET HOLES

- Determination of the sequence of bullet holes can be made by noting the radial fractures.
- Radial fractures caused by the passage of a bullet stop at pre-existing fracture.

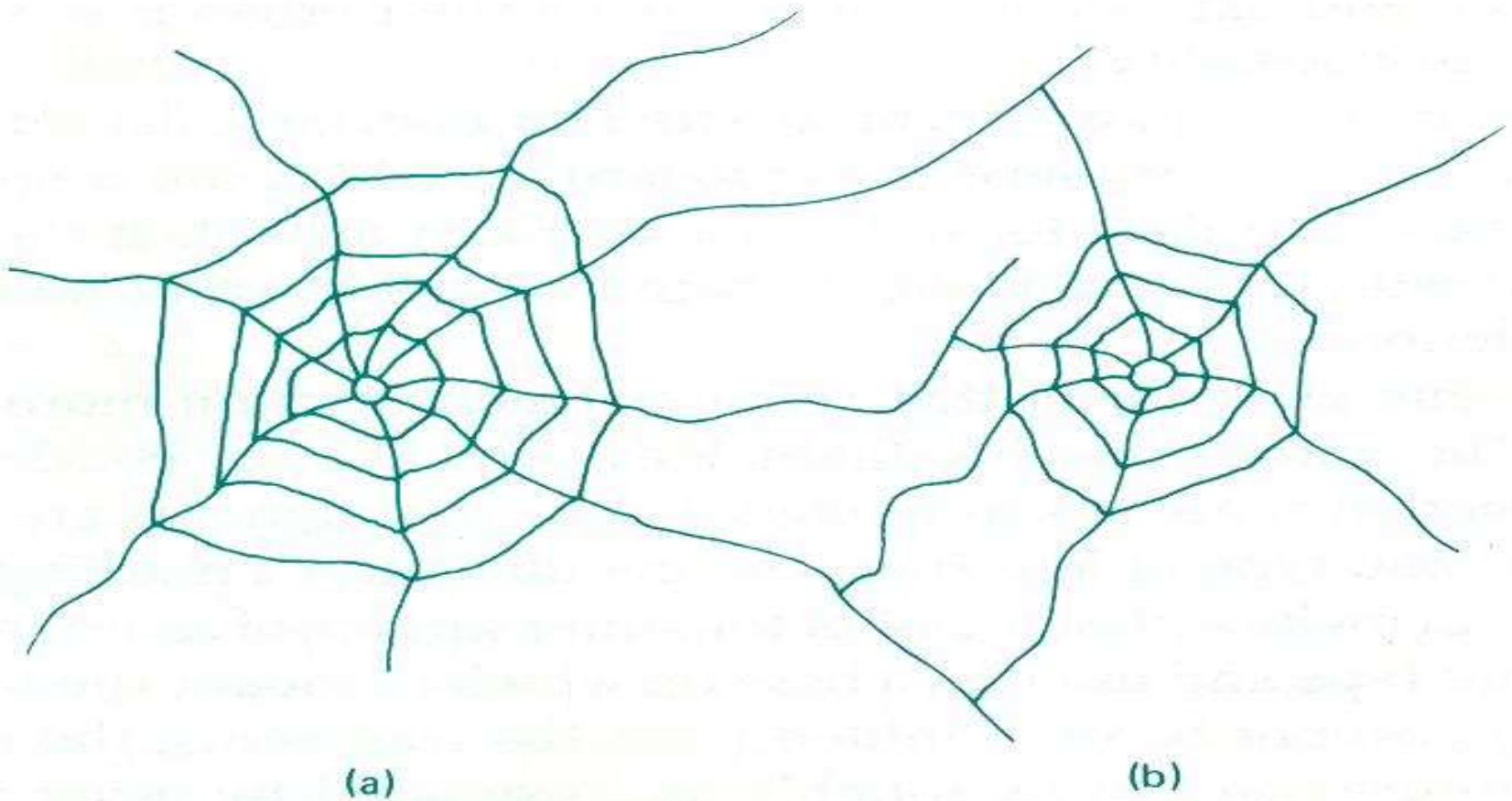


FIGURE 7-6 Penetration sequence. Bullet hole (b) was made after bullet hole (a).

Collection & preservation:

- Photograph the scene
- Photograph the glass pane on both sides by keeping a scale near the hole
- Larger fragments should be numbered and photographed
- Collect fragments present on both sides separately

Lab testing-

1. Physical matching of glass pieces
2. Physical properties (density, refractive index, thickness etc.,)
3. Microscopic (texture, appearance Colour)
4. Fluorescence
5. Emission spectrography (for trace elements)
6. Density gradient analysis

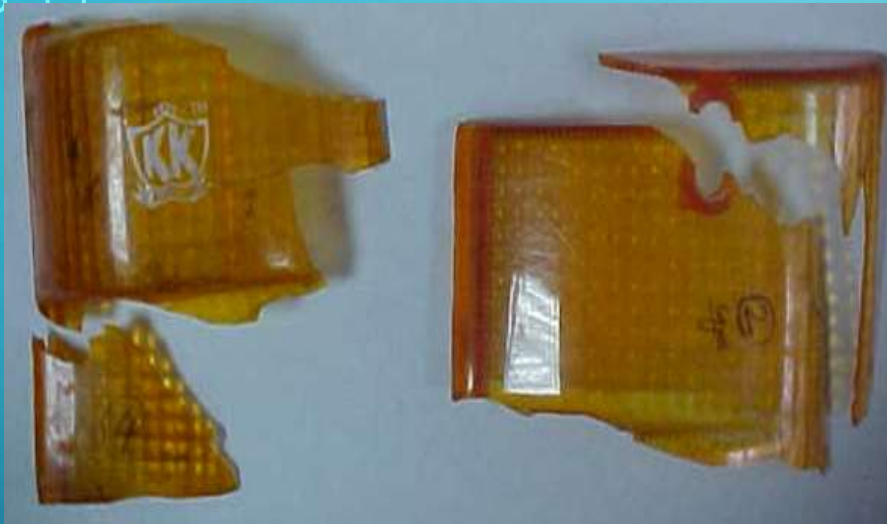
EXAMINATION OF GLASS

■ METHODS OF EXAMINATION:

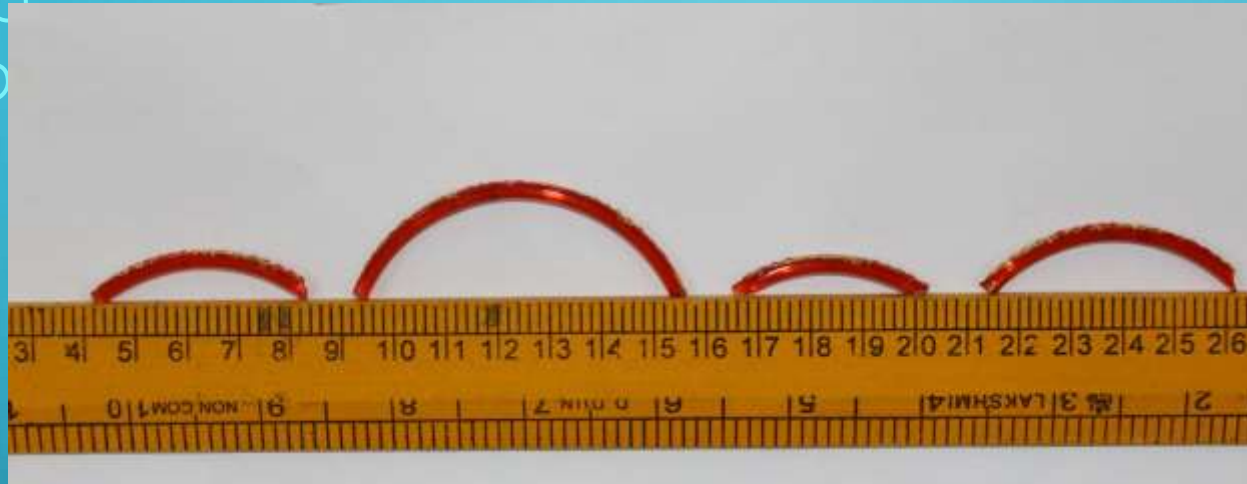
- Physical matching
- Microscopic examination
- Colour
- Ultra violet fluorescence
- Density
- Refractive Index
- Elemental composition (By instrumental methods)

PHYSICAL MATCHING

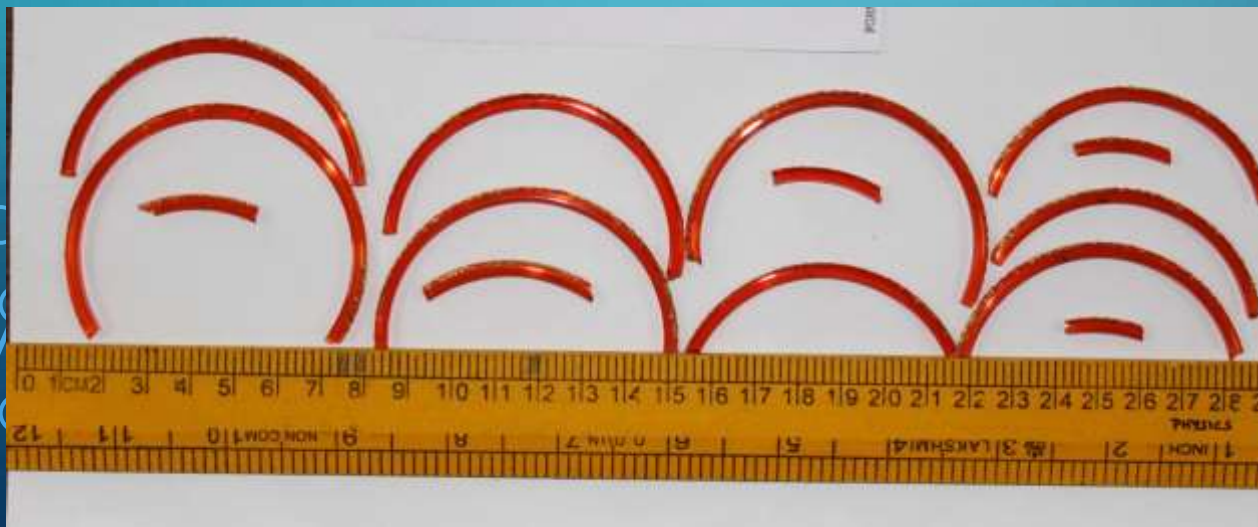
Broken indicator dome pieces



ACCUSED (MALE) AND DECEASED (FEMALE) BOTH ARE HUSBAND AND WIFE, HE HAS SUSPICION ON HIS WIFE AND DECIDED TO ELIMINATE HER. IN WHICH HE STRANGLED HER NECK WITH HER SAREE.



Broken bangle pieces
Collected from scene
of crime



Broken bangle
pieces collected
from Autopsy

EXAMINATION OF PAINT

■ Available forms:

Chips, flakes, smears etc.,

■ METHODS OF EXAMINATION:

- Macroscopic examination
- Microscopic examination
- Ultra violet fluorescence
- Density Gradient analysis
- Instrumental analysis

WHAT IS PAINT?

- Paints are related surface coatings are of three main general types:

1. Drying oil paint

2. Solvent paint

3. Plastic paint

- paints are used in automobiles are of two varieties:

1. Lacquer paints

2. Enamel paints

COMPOSITION OF PAINT :

- **Pigment** – gives paint color
- **Binder** – hardens & holds it to the surface
- **Fillers** – will increase bulkiness of paint
- **Solvents** – useful for spreading pigments & will be evaporated after applying on a surface
- **Extenders** – used to modify gloss, texture, opacity, etc.

What crimes are paint involved in?

- paint evidence is usually encountered in the form of chips or flakes of smears in burglary ,hit and run and other offences against property .
- Evidence may be available on victim, accused, on vehicles & in scene of crime
- paint chips may be present on clothing, shoes ,tool used in crime.
- In case of hit and run it may be usually present at the spot where collision takes place.
- >In case of wet paint –
 - (a) paints smears may stick to criminal clothing,
 - or
 - (b) fibers / hair of criminal may stick to paint surface

Lab Analysis:

1. Physical matching & alignment of marks of paint chips
2. Stereo microscope examination for colour, texture, number of layers, layers thickness, sequence of colours etc.,
3. Raman spectroscopy
4. Emission spectrograph or Infrared spectrograph
5. Pyrolysis gas chromatography
6. Refractive Index using refractometer
7. XRD
8. Solvent Tests
9. Density gradient

CROSS SECTION OF A PAINT CHIP



EXAMINATION OF SOIL

■ Definition

Soil is a complex mixture. It contains mineral particles, plant materials, living organisms, decayed and other organic matter (humus), man-made particles etc.,

- Available forms:

Soil, mud, dust and debris



Soil is mostly present in out door crimes

- * Common evidence in accidental cases, rape, murder, etc.,
- * Soil may be present on shoes, clothes & limbs of victim & accused. Also present on mudguards & tyres of vehicles
- * In house breaking criminal may leave some dust / debris in foot prints / shoe prints
- * Proves the presence of criminal at scene of crime
- * Soil may also stick to the implement used
- * Dust is composed of minute articles which are characteristic of a particular place

SIGNIFICANCE OF SOIL:

- Soil gives circumstantial evidence in case like rape, committed in open field assault where the offender is thrown on the ground, theft and burglary committed by entering the home on cutting the door at the bottom and soiling the wearing clothing of the offender and theft of agricultural crops if soil sticks to them.

EXAMINATION OF SOIL

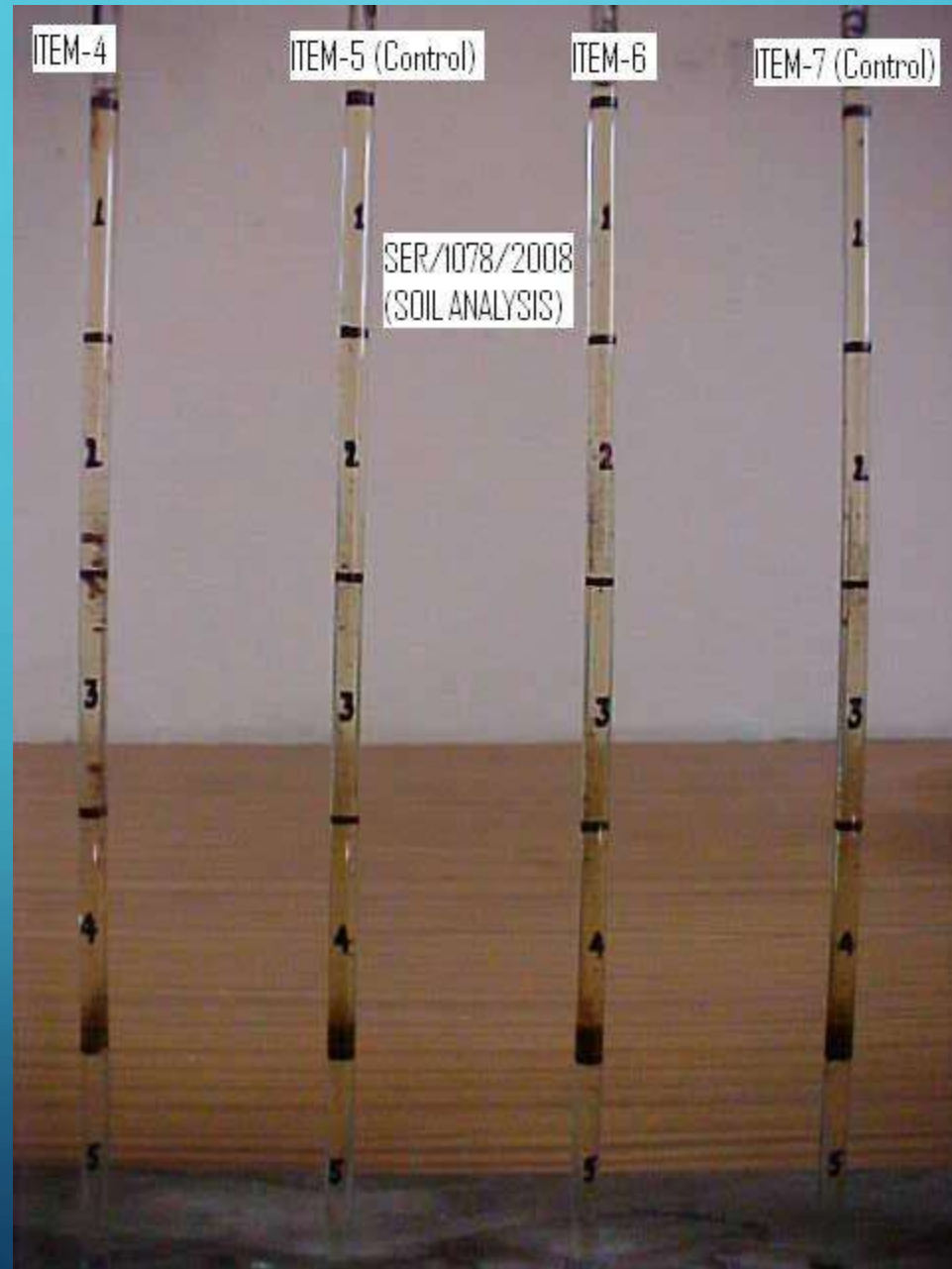
■ METHODS OF EXAMINATION:

1. Macroscopic examination
2. Microscopic examination
3. Ultra violet fluorescence
4. Particle size distribution
5. Dry colour
6. Ash colour
7. Loss on Ignition
8. Density Gradient analysis
9. Instrumental analysis

LAB TESTING

1. Physical – colour change when heated to 800°C
2. Microscopic – colour, texture, mineral particles, biological material (pollengrains), coal etc.,
3. Fluorescence
4. Particle size – sieving – sieves of different mesh (hole size)
5. Density gradient analysis
6. Elemental analysis (spectrographic)
7. XRD – for minerals

Density Gradient analysis



FORENSIC PHYSICS

➤ COUNTERFEIT CURRENCY

➤ GLASS

➤ PAINT

➤ SOIL

➤ SPURIOUS ARTICLES (GOLD, PLATINUM, AUTOMOBILE SPARES, ZANDUBALM, ETC.)

➤ TOOL MARKS

➤ TRACK MARKS-FOOTPRINTS, FOOTWEAR MARKS & TYRE MARKS

➤ RESTORATION OF ERASED NUMBERS OF VEHICLES.



INTRODUCTION

- The Electronic equipment's ,Automobiles & Fire arm are provided with serial numbers as a means of Identification or to establish ownership.
- Owners inscribe their names on valuable utensils & wares for identification.

- When such articles are stolen or involved in crime serial numbers & markings are destroyed by criminals by filing or grinding them.
- Obliterated marks can be restored 'These markings can be restored on material other than metal such as wood, plastics & fiber glass
- Forensic laboratory is increasingly called upon to restore such marks to enable the police to identify the stolen property with the owner.
- Different Metals & alloys require specific method for restoration by Forensic Experts.
- Restoration of obliterated marks is often possible in the laboratory, partly or wholly

TYPE OF MARKS

- Three types of Marks are commonly found on the Articles.
- Cast Marks
- Engraved Marks
- Punched Marks

Punched Marks-

- The marks on article are made by striking hard steel dies.
- Which result in the compression of the metal & disturbance on the surface underlying it.
- Restoration is possible if has been not deeply erased/grinded.



PRINCIPLE OF RESTORATION :-

- Serial numbers are usually stamped on a metal body or frame or on a plate, with hard steel dies
- This results in the crystalline microstructure of the metal to get compressed & strained
- When a suitable chemical reagent is applied, the strained & unstrained areas will dissolve the metal at different rate
- The unequal rate of dissolution, of strained & unstrained metal, permits bringing out the original numbers

RESTORATION OF OBLITERATED MARKS

- When serial number is stamped into piece of Metal.
- The Metal structure beneath the stamped letter & digits is dis ordered.
- Traces of dis ordered structure often remain after the serial number has been filed or grinded.
- The criminal removes the stamped marking by grinding & filing till it is not visible.
- The marks are strained & extends a short distance beneath the indented number or marks.
- When a suitable chemical reagent is applied.

- The strained & unstrained areas will dissolve the metal at different rates.
- This unequal dissolution rate helps in bringing out the original number or Marks.
- If Marks or number are erased deep & reach the inner thickness it is usually not possible to restore the number or marking.
- Occasionally a tool marks are in the form of scrape an examiner can see pattern of irregular ridges & valley through a microscope.
- It may be possible to match the pattern with those on a suspected tool used in the crime.

TECHNIQUE OF RESTORATION

- The technique of applying the reagent is the same for almost all metals , but chemical formulae differ from metal to metal.
- Before treatment with chemical reagent, the obliterated surface must be thoroughly cleaned of dirt and greasy matter or paint with suitable solvent & photographed.
- The reagent is then applied to this surface with a cotton ball, attached to a stick or glass rod

CONTD..

- The number is read under suitably adjusted illumination.
- As soon as number appears a photograph need to be taken because it may disappear after subsequent application of the reagent.
- Best photograph may be obtained after application of transparent oil to the metal surface





Existing Chassis No. – **DWH090240**

Deciphered No. - **FPE608388**



HERO HONDA SEIZED FROM THE ACCUSED

EXISTING CHASSIS NUMBER

00C20C05830

CY NO. 208X170/02 . CC.5-1 8
RTY

DECIPHERED CHASSIS NUMBER

00F20F01745

00C20C05830

TOOL MARKS





TOOL MARKS

- abrasion mark
 - cutting mark
 - indentation mark
 - tool mark
- 
- 
- 

INTRODUCTION

- Tool mark—any impression, abrasion, or cut made when contact occurs between a tool and an object
 - An example of physical evidence Even mass-produced tools have minor differences
 - The impressions can link the tool to a crime scene and potentially to the owner

TOOLS AND CRIME SCENES TOOLS:

- increase our ability to handle manual tasks, but can also be used in crimes
- How can a tool used in a crime lead investigators to the criminal?
- Why is ownership of a tool used in a crime circumstantial evidence?

TOOL MARK IMPRESSIONS

- **Indentation Marks**

Result when a tool is pressed against a softer surface

- Tools usually leave distinctive marks
- The hardness of a tool influences the resulting marks left in the softer object
- May indicate the size of the tool used in a



TOOL MARK IMPRESSIONS

- **Abrasion Marks**

An object's surface can be ground or worn away by a tool when they slide across each other

- The harder object causes abrasions (scratches) on the softer surface
- Indentation and abrasion marks sometimes occur at the same time

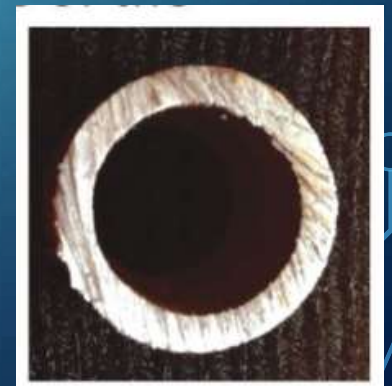


TOOL MARK IMPRESSIONS

- **Cutting Marks**

Edged instruments can penetrate a softer object and separate it into parts

- Cut marks are produced along the edge as a surface is cut
- The type of saw blade used to dismember a body can be determined by examining the cut surface of the bone



TOOL SURFACE CHARACTERISTICS

- Tools change over time as they are used repeatedly.
- Oxidation, or rusting of tools, as well as uneven sharpening, are additional characteristics that help distinguish a tool mark.



PIECE OF RAIL WITH CRIME CUT



OTHER PIECE OF RAIL WITH CRIME CUT



CROSS SECTION OF CRIME CUT



CROSS SECTION SHOWING CUT WITH
IMPLEMENT AS WELL AS BROKEN AREA



TEST CUT DONE BY HACK-SAW AND
BROKEN AT THE BOTTOM EDGE



TEST CUT MADE WITH POWER HACKSAW

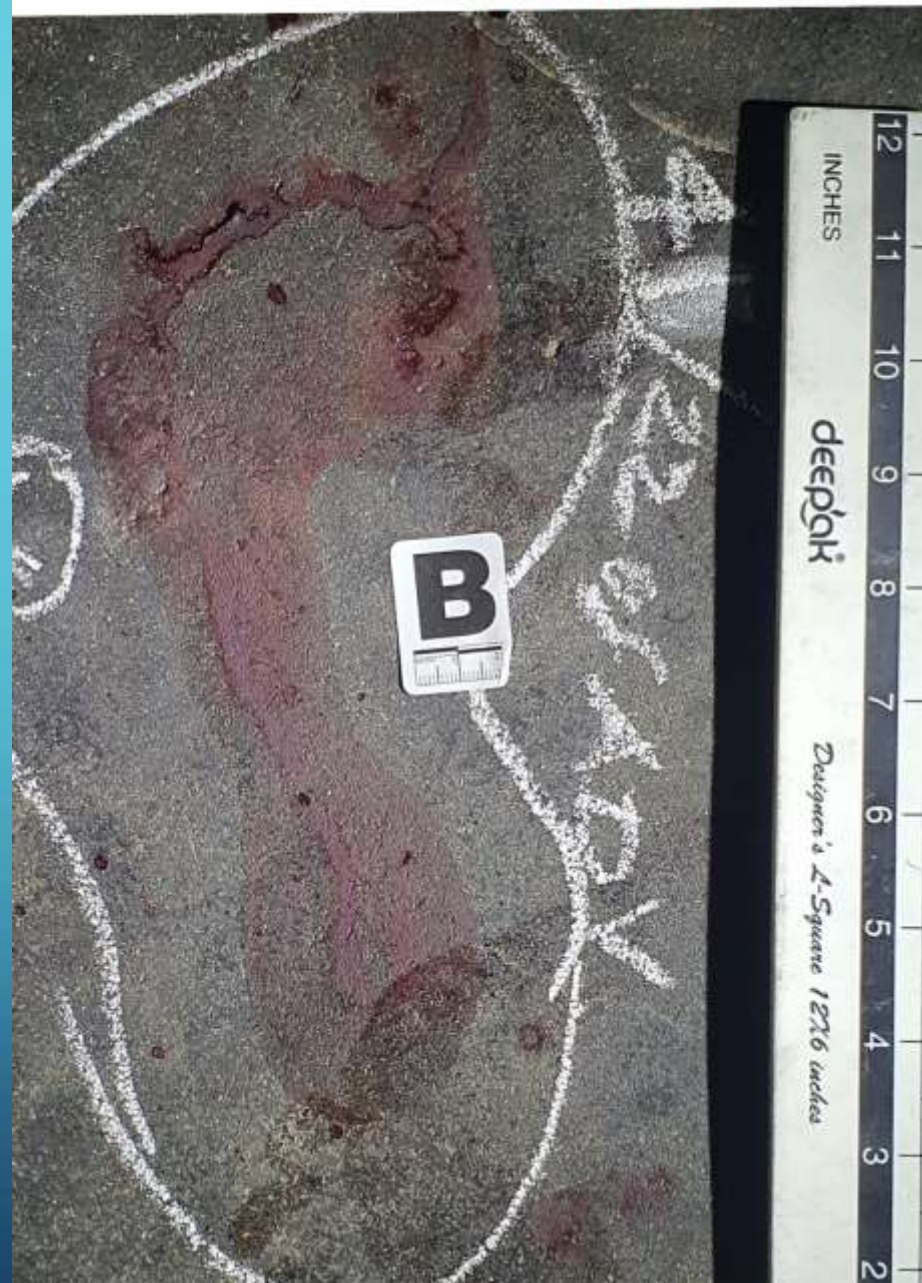


GAS WELDING CUT

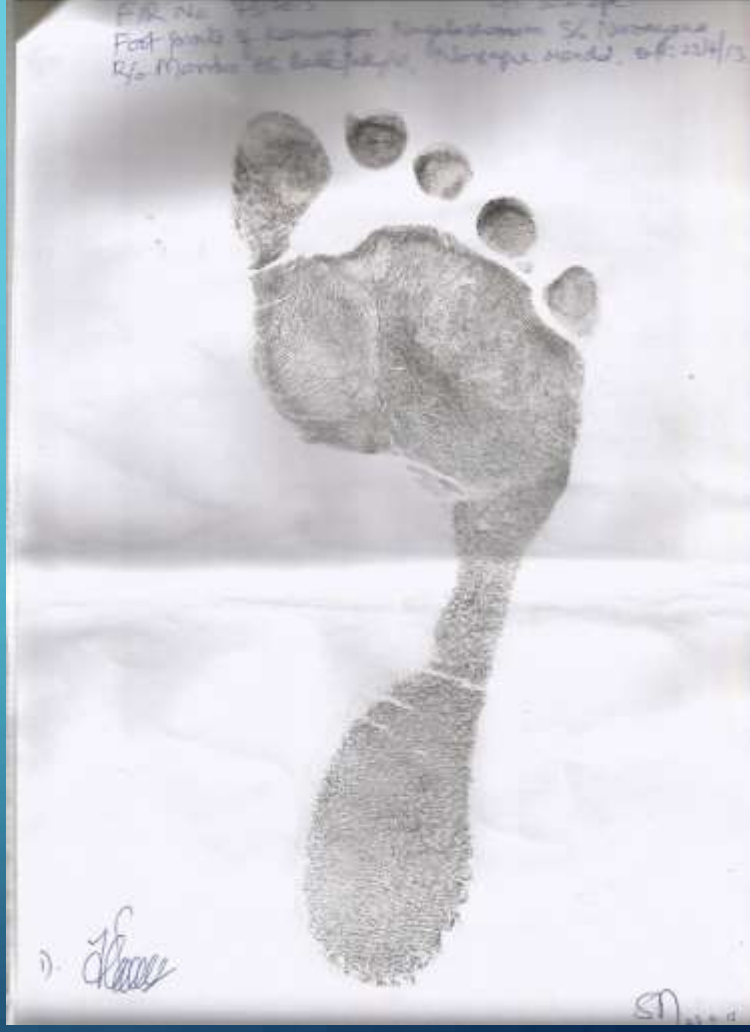


TOOLS RECOVERED FROM THE SCENE OF CRIME





Blood stained foot print at scene of offence



Suspected foot print taken from accused

Super imposition



Collected from scene of offence

Sample foot print of suspected person



Collected from scene of offence

Sample foot print of suspected person

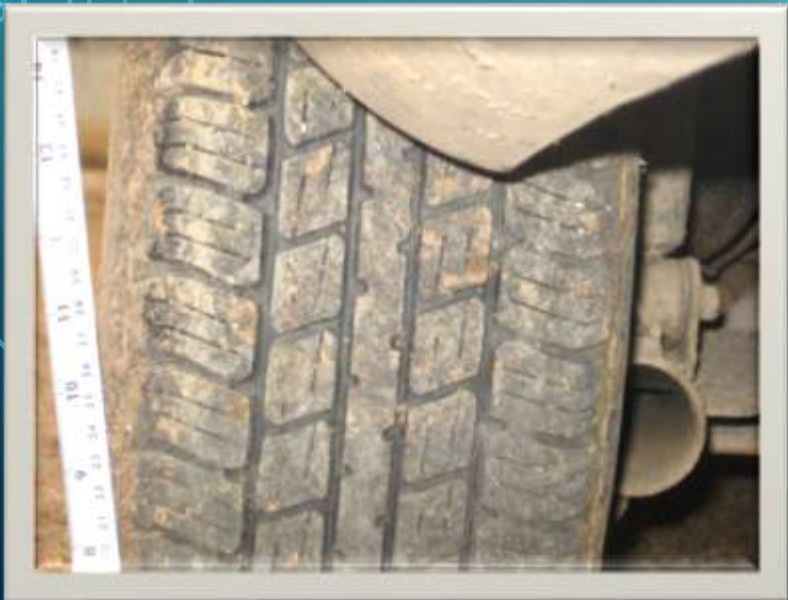


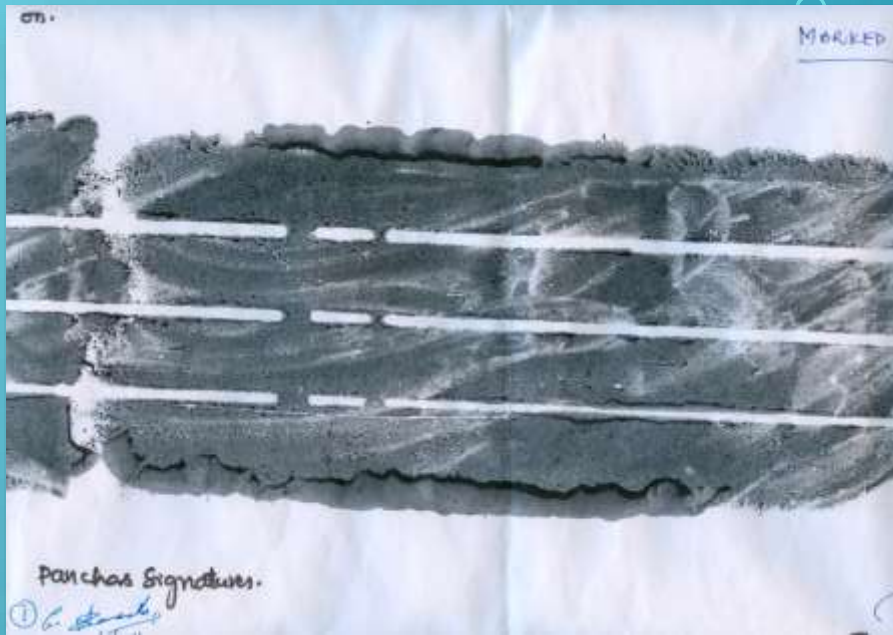
4
CLUES



5
CLUES









Thank You
Thank You
Thank You!!!!