SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

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Early Acquisition and Preservation of Information in a Motor Vehicle Crash

RATIONALE

This document has been revised with editorial changes and to include additional technical information. The term “accident” has been replaced with the term “crash” in all instances including the title.

1. SCOPE

The purpose of this SAE Recommended Practice is to offer simplified and prioritized guidelines for collecting and preserving on-scene data related to motor vehicle crashes. It is intended that these guidelines improve the effectiveness of data collection, which will assist subsequent analysis and reconstruction of a particular crash.

This document is intended to guide early data collectors whose objectives include documenting information related to the crash. It may be used by law enforcement personnel, safety officials, insurance adjusters and other interested parties.

This document identifies categories of scene physical features that deteriorate relatively quickly and recommends documentation task priorities. Detailed methods of collecting data are not part of this document. However, some widely used methods are described in the references in Section 2.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein.

1. Baker, J. S. and Fricke, L. B., “Traffic Accident Investigation Manual,” 9th Edition, Northwestern University Traffic Institute, 1986

2. Tumbas, N. S., Gilberg, A. N. and Fricke, L. B., “Minimum Guidelines for Efficiently Acquiring or Preserving Basic Information in a Motor Vehicle Accident,” SAE 880067

3. Rivers, R. W., “Traffic Accident Investigator’s Handbook,” Charles C. Thomas, Springfield, IL, 1980

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3. IDENTIFYING EVIDENCE

Types of evidence ordinarily found at the scene of a motor vehicle crash may be classified as follows:

3.1 Positions of Vehicles

Which includes cars, trucks, trailers, bicycles, motorcycles, etc.

3.2 Places where Dead or Injured Persons Lie

After the crash, particularly if they are outside of vehicles.

3.3 Gouges

Made by heavy metal parts which have displaced road or other surface material.

3.4 Scratches and Scrapes

Made by weak or rounded metal objects where pavement or other surface material has not been significantly displaced.

3.5 Tire Marks

On the pavement or elsewhere if they may be related to the crash.

3.6 Scars

On the roadside such as furrows or ruts.

3.7 Debris

Various kinds of materials not originally at the scene; such as underbody dirt or snow, loose vehicle glass and parts, vehicle liquids, personal belongings, blood, body tissues, etc.

3.8 Objects

Originally on or near the road, which were broken or contacted as a result of the crash.

3.9 Electronic Vehicle Information

Some vehicles have an event data recorder (EDR) which stores vehicle operation information after a crash. Care should be taken to preserve or download this information.

4. PHOTOGRAPHING EVIDENCE

Photography (film or electronic/digital) and/or video should be used in the documentation of vehicle crashes. Photography is one of the least expensive items involved in the investigation of a crash, so, a simple guideline is, "When in doubt, photograph."

4.1 Photographic Priorities

When policy decisions or cost considerations limit the number of photographs, the photographic resources should be metered according to the following priorities:

a. The Crash Scene, before traffic units and people are moved

b. Evidence on and off the Road (the crash site)

c. Exterior of the Least Damaged Vehicles

d. Exterior of the Most Damaged Vehicles

e. Interior of the Most Damaged Vehicles

f. Interior of the Least Damaged Vehicles

g. Objects Associated with the Crash (e.g., child restraint seat)

These priorities are based upon the following considerations. The crash scene changes the moment the vehicles and victims are moved from their final rest positions. Because this information has a life span of minutes and is often critical to any reconstruction; the relationships of the vehicles to each other, to the roadway evidence and to fixed reference objects should be photographed first.

It is often helpful to include a reference object (such as a yard stick or other item of known dimension) in the photographs.

It is important to realize that the top priority is to record the relationship of vehicles to each other and fixed references (curbs, edges, poles, etc.) and not to detail specific damages. Often, photographs taken for this purpose will be usable for documentation of the damage; but, unlike damage photographs, the scene photographs cannot be made at a later time.

The tire markings, liquid spills, and debris remaining on and off the road are usually the next items of evidence to be lost and are therefore listed as the second priority. Sometimes, the arrival of other vehicles disturbs or obliterates evidence. On other occasions, this information may last for days or weeks or, with some marking enhancements, months. Photographing these items along with the identification markings, discussed later, will enhance their visibility in the photographs and provide additional references for any follow-on investigation.

If there is time available, the vehicles should be photographed to document damages before they are moved. This is preferable because they will be subjected to the potential of further damage in towing operations. If this is not practical, they can be photographed at a later time.

The exterior of the least damaged vehicles should be documented first because they are the most likely to be repaired or driven and damaged in further crashes. Conversely, more severely damaged vehicles tend to be either repaired or scrapped less quickly.

The interior of the most damaged vehicle is given priority because its occupants are more likely to have sustained injury. Because the interiors of vehicles offer the most protection to the accident evidence, photography of the occupant contact marks and restraint devices can often be delayed until the final task. Often useful information can be gained months or years after an accident, particularly when the area of interest is damaged and has no resale value.

4.2 Limited Photography

In some cases, a limited number of photographs may be allocated to an investigation. If such a restriction is in effect, this priority list is a good guide. If only a few photographs can be made, overall views of the accident scene, paying attention to the damages as much as practical, are preferred.

4.2.1 The Crash Scene

Photographs of the crash scene should be taken at a distance sufficient to include the entire scene within the frame of the photograph. Once this minimum requirement has been fulfilled, further photos of specific objects should be taken at a distance that best shows what you want to show.

Initial photographs should be taken well back from the accident vehicles and other objects of interest so that the entire crash scene is located within the frame of the photograph.

Whenever possible, a nearby fixed reference object or other involved vehicle should be captured in the frame. A fixed reference could be a manhole cover, telephone pole, centerline marking, sidewalk or road surface seam or imperfection, bridge, guardrail, or sign. An object of known dimensions or a measurement tool such as a yard stick may also be helpful to include in the photo.

The best photographs will include the intersection of the reference object and the ground plane. This is because most maps of highway crash scenes are two-dimensional representations of the road surface (or ground plane). Photos which do not show this intersection are sometimes difficult to interpret in terms of location on the roadway. The relationship of vehicles to the reference object and the markings on the roadway is the principle reason for making a map. Photographs taken from an elevated position (e.g., car hood, extension pole, nearby overpass, fire truck ladder, or lift bucket) often provide the best perspective for viewing this intersection. Wide angle lenses are at an advantage in high angle perspectives; however the photographic distortion they produce should be considered as a tradeoff.

One photograph showing a pair of involved vehicles is often more valuable than two photographs showing each vehicle individually. This benefit can be greatly enhanced when a fixed reference point is also visible in the camera's field of view.

Photographs which show the relationship of vehicles to tire marks, loose debris, gouges in the pavement, liquid spills, and damage to roadside objects are also valuable in documenting the scene. As with multi-vehicle photographs, there is more value if the items pictured (vehicles, etc.) can be linked to fixed objects at the scene. At times, this linkage can be created by marking the pavement surface with the techniques discussed later.

Photographs of victims after they have been moved from their accident rest positions are generally a lower priority. Medical records usually provide detailed injury information if it is needed. On the other hand, photographs of bloodstains or victim impact evidence at the crash site, referenced to fixed objects or to a full view of a vehicle, can be invaluable.

4.2.2 The Crash Site

The crash site is distinguished from the crash scene by the passage of time and the rearrangement or removal of vehicles or other evidence. Photographic documentation of the site can often be delayed for favorable weather, lighting, or traffic conditions, especially when critical items of evidence have been highlighted.

Tire marks, ruts, or long gouges should be photographed along their axes (in the direction they were made) and perpendicular to their axes, if resources permit. If the marks, for example, are too long to show much detail in a single, comprehensive photograph, then overlapping views should be taken of shorter ground segments which chain the items of evidence together along the path of propagation. Each element of physical evidence at the accident site should be photographed at least twice, preferably from different directions. Whenever possible, two or more angles should contain a fixed reference object within the frame.

4.2.3 The Vehicles

In detailing vehicle damage, at least four photographs per vehicle should be considered a minimum. The preferred views would show the full front, rear and sides at a right angle to the original surface with a minimal border between the viewing frame of the camera and the subject image.

It is especially important to document both damaged and undamaged areas. If film is limited, two planes (end and side) may be captured in one corner-view.

If possible, the original four views may be augmented by corner views. Resources permitting, close-ups may then be taken of the damaged region, particularly of "witness" marks which associate interactions between specific objects. An impression, for example, may exist in a radiator of one vehicle from the corner of the bumper of an impacting vehicle.

It is important to link close-up photos to general area photos to provide a perspective on location. It is desirable to photograph all the damaged parts of a vehicle from different directions and different distances to show the depth of crush. Overhead photographs as well as photographs of the undercarriage also provide a great deal of additional information.

Photographs of the interior of vehicles should be framed so as to show as much occupant contact damage as possible. Occupant contact can occur to the headliner, sun visors, and trim around window and door openings, as well as to the instrument panel, windshield, steering wheel, seatback, and doors. Be alert for this and for contact to other surfaces such as the hood or deck lid in extreme collisions when documenting occupant impacts.

For interior surfaces a flash and a wide-angle lens are a great advantage. The restraint system photographs should emphasize marks left by occupant loading on "D" rings, deformed mounting brackets, broken plastic covers on belt buckles, or occupant contact marks on airbags.

5. MARKING THE SCENE EVIDENCE

After the crash results have been observed, they may then be marked to:

a. Facilitate comparison with the photographs, and

b. To preserve the key items for later measurement

5.1 Using Only One Point

One point will adequately locate relatively small things such as:

a. Grooves, gouges, or groups of gouges less than 1 m (3 ft) across (mark the middle of the group or item).

b. Collision scrubs or other tire marks less than 1 m (3 ft) (mark the middle of the item).

c. Small scrapes or dents in guardrails, posts, and trees.

d. Spatter areas and puddles less than 1 m (3 ft) across.

e. Small debris areas.

f. Vehicle parts that are detached.

5.2 Using Two or More Points

Two or more points are needed to locate such things as:

5.2.1 Curved Tire Marks

Two end-points if the mark's length is apparent. One or more intermediate points when the mark is more than 2 m (6 ft) long.

5.2.2 Straight Marks with Angles, Crooks, Gaps, or Other Irregularities in Them

Locate each end and any irregularity.

5.2.3 Large Debris Areas

Three to six points may be located on the perimeter of the debris, along with a central mark at the point of maximum concentration.

5.3 Uniform Scene Marking Symbols

It is a good policy to take a few photographs of the overall scene prior to any marking or other modification on the part of the investigator. Subsequent photographs which contain the symbols are much easier for the viewer to understand when the key points of evidence have been highlighted. Refer to Figure 1 for illustration of the following uniform marking symbols.

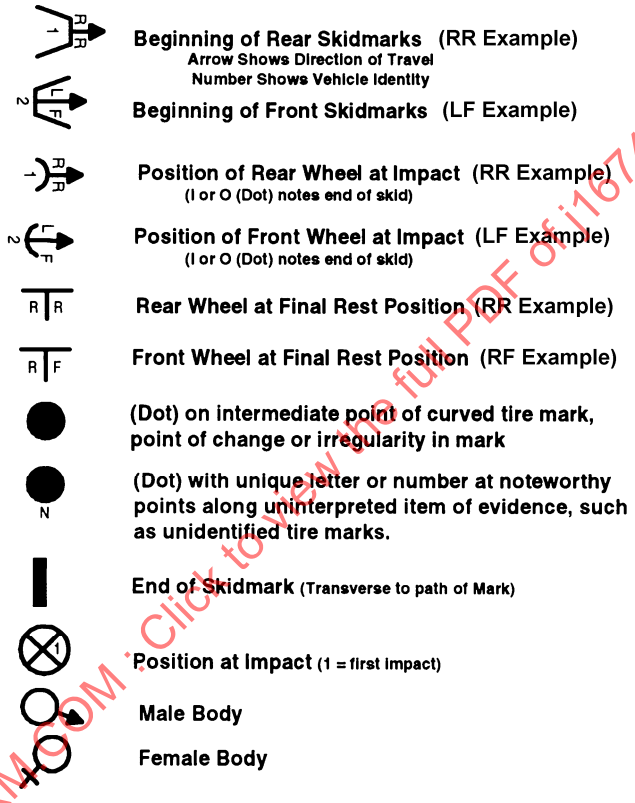


FIGURE 1 - UNIFORM SCENE MARKING SYMBOLS

5.3.1 Final Rest Positions

Note that symbols are on the outboard side of the tire and the stem of the "T" is aligned with the hub (or axle) of the wheel. The stem may even continue a bit onto the sidewall of the tire (provided the investigator has the authority to do so); this marks the part of the tread in contact with the ground to assist looking for braking flat spots, for example.

If more than one vehicle is involved, the final rest symbols of the different vehicles may be distinguished by adding a unique number or letter at the base of the stem. Marking but two tires (preferably on the same side of the vehicle) adequately locates the vehicle and establishes its heading angle while keeping the number of symbols on the terrain to a minimum.

The investigator is strongly encouraged to mark the rest positions of the vehicles as soon as possible. If this is done and there is a pressing need to clear the roadway for traffic, the involved vehicles can be moved with little or no loss of information.

In locating the rest position of a body, an alternative to the customary outlining of the entire body is to use a circle at the belt-buckle position with either a cross or an arrow (consistent with the gender) pointing toward the feet. This is especially suited to situations where the exact orientation of all the extremities are unknown when the on-scene person arrives.

5.3.2 End of Mark

If a tire mark ends short of impact or rest, the point where it ended may be identified by a straight line symbol (perpendicular to the mark) about equal in length to the width of the tire. Alternatively, the investigator might create a dot there about the size of a golf ball.

5.3.3 Impact Position

This symbol is merely a circle with an "X" in it. It is intended for shorthand use when time is not available to map the (often numerous) data items generated in a collision. It is probably best to think of the symbol as representing a small but not clearly bounded area rather than a point.

There is probably no need to use this symbol when one finds obvious deflections in the tire marks. It has more utility in pedestrian accidents, for example, when one may know where a pedestrian came out from between two parked cars but there is no obvious perturbation in the tire marks from the impact.

5.3.4 At-Impact Locations

Symbols are distinguished by the tail of an arrow joining an arc-segment. It is the intersection of the tail and the arc that represents a given tire's location. The end points of the arc are toward the rear for rear tires and the front for front tires. In practice, the location of a tire at impact is frequently back a small distance from any deflection in the mark, thus allowing for some crushing to occur before the vehicle's course is affected.

5.3.5 Intermediate Points

When locating a long curved tire mark, and the beginning and end points have already been marked, then creating an intermediate dot about the size of a golf ball will help define the curvature of the tire mark.

5.3.6 Beginning of Tire Marks

The tail of the arrow for this symbol joins with a bracket and that intersection represents the beginning location of a unique tire mark. The flanges of the bracket are either pointed towards the rear for rear tire marks, (if known) or forward for front tire marks respectively.

5.3.7 Size of Symbols

If the total width of a symbol is restricted to no more than 1.5 times the width of a tire's tread or less, it will be less obtrusive, and a governmental unit is less likely to effect a policy against the use of such marks. When only one vehicle produces any pre-impact marks, and it is obvious which vehicle it was, the on-scene person may elect not to mark the number of the traffic unit next to the symbol. Such considerations are particularly important when using a more lasting marking medium.

5.4 Marking Materials

The type of marking medium will vary with the expected time between marking and any measurement, the weather, and if the item to be marked is on or off the road surface. If the delay between marking and measurement is to be less than a day, common lumber crayons often work on dry or wet (no standing water) surfaces for on-road evidence. Stakes may be used off-road in any type of weather.

When the marked symbols are required to last longer than a day and the evidence is on a dry road, the investigator should use crayon, spray chalk, or spray paint. The spray chalk tends to last for several weeks rather than the longer period associated with the paint.

When the road is wet, paint sticks or crayons may be used. A more permanent marker on a wet road is a survey nail ("PK nail"). It may also be used to create a tangible reference point near the evidence when natural objects are felt to be too distant. Again, wooden stakes, mini-flags, weighted bags, and lots of paint may be used off-road when the conditions are wet.

5.5 Uninterpreted Items or Irregularities in Evidence

The position of items of uncertain interpretation, which may be significant, should be marked with one or more dots (as discussed earlier) and then labeled with a unique letter or number not used elsewhere.

6. MEASURING EVIDENCE

When the investigator has finished collecting the evidence, his final product generally has two parts:

a. A freehand field sketch showing the general layout of the roadway and the crash evidence. A typical scene with pavement markings and the resulting field sketch are shown in Figure 2, also shown are the corresponding measurement tabulation methods as described in the following paragraphs.

b. A tabular list or other record of measurements made to locate the evidence, consistent with the field sketch. The investigator must also identify the reference point or points used for the measurements.

6.1 Coordinates

A coordinate reference system requires that two measurements, one along or parallel to each axis of the coordinate system, be made to locate any one point. These two measurements are the coordinates of the single point of evidence.

6.1.1 Reference Line and Point

The coordinate system is generally the most useful and the easiest to use. With this method one landmark is a reference line (RL) (usually straight) and the other is a reference point (RP) located on the reference line to establish the coordinate system origin. The RP is typically identified by some permanent landmark (pole, tree, manhole, etc.) which is on an imaginary line perpendicular to the RL at the RP. One should exercise care or resort to a form of triangulation when any point to be located is a large distance from the RL; especially if the RL is curved.

6.1.2 Curved Reference Line

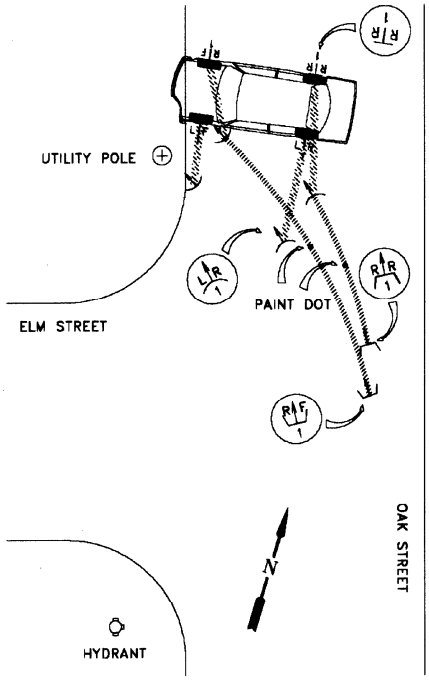
The reference line does not always have to be straight. It can be a curved roadway edge. In that case, first measure from the RP along the RL to a position nearest the point to be located, and secondly measure from that position directly to the point to be located. While it is usually of no practical difference, it is generally safer if the investigator measures the distance from the RP along the curve of the RL instead of using a chord distance. This will keep him out of the roadway for at least half of the measurements. If this method is used, RL curvature geometry information is needed to produce a scale diagram (e.g., radius by chord and middle ordinate).

6.1.3 Recording the Coordinates

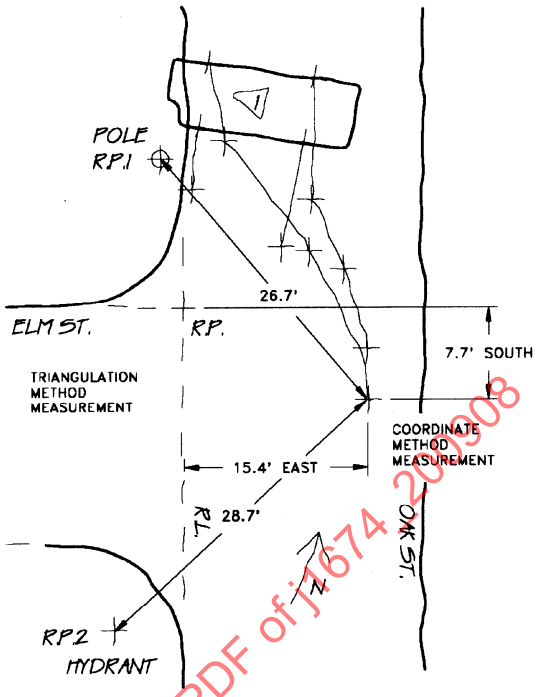
If there are only a few points to be measured, these may be put on the field sketch. With a larger number of points, there is less chance of confusion if they are put in a table, refer to Figure 2. In either case, always describe the RL and the RP on the sketch, table, or both. Make the description as brief and concise as possible.

6.2 Triangulation

The coordinate method is not the only way to locate points. Another method, triangulation, is sometimes used. Just like the coordinate method, two measurements are required to locate one point. One measurement is required from each of two separate landmarks, refer to Figure 2. Be sure to measure and record the distance between the two reference points as well as recording their locations.



APPEARANCE OF ACCIDENT SCENE WITH PAVEMENT MARKINGS



CORRESPONDING FIELD SKETCH WITH ALTERNATE METHODS FOR MEASURING THE BEGINNING OF THE RIGHT FRONT TIRE MARK

Accident: Oak/Elm Intersection Date: 5/10/94
RP.1: Center of pole near northwest corner
RP.2: Center of hydrant near southwest corner

ITEM	From RP.1	From RP.2
RF-1-D *	26.7	28.7
RR-1-D	24.7	32.2
RR-1-P	17.8	35.8
RF-1-P	14.7	36.6
LR-1-IMP	12.3	35.0
RR-1-IMP	13.0	39.9
LF-1-IMP	2.7	37.6
RF-1-IMP	5.3	41.8
RP2	39.9	---
LR-1-FRP	12.0	43.8
LF-1-FRP	4.0	42.5
RR-1-FRP	14.5	49.3
RF-1-FRP	9.0	48.5

* 1 = Traffic Unit Number One
D = Begin
P = Intermediate Point
IMP = At Impact
FRP = Final Rest Point

TABLE OF TRIANGULATION METHOD MEASUREMENTS

Accident: Oak/Elm Intersection Date: 5/10/94
RP.: Projection of curb lines - north/west corners
R.L.: West curb line of Oak St.

ITEM	From RP. (N-S)	From R.L. (E-W)
RF-1-D *	7.7 S	15.4 E
RR-1-D	3.5 S	15.5 E
RR-1-P	2.1 N	13.3 E
RF-1-P	4.7 N	10.6 E
LR-1-IMP	5.1 N	8.1 E
RR-1-IMP	9.1 N	10.9 E
LF-1-IMP	9.9 N	0.7 E
RF-1-IMP	14.0 N	3.2 E
Pole Center	12.5 N	2.0 W
LR-1-FRP	13.7 N	9.8 E
LF-1-FRP	15.0 N	0.9 E
RR-1-FRP	19.3 N	10.8 E
RF-1-FRP	20.6 N	1.9 E

* 1 = Traffic Unit Number One
D = Begin
P = Intermediate Point
IMP = At Impact
FRP = Final Rest Point

TABLE OF COORDINATE METHOD MEASURMENTS: GENERALLY PREFERRED

FIGURE 2 - TYPICAL SCENE WITH PAVEMENT MARKINGS CORRESPONDING FIELD SKETCH AND MEASUREMENT TABLES

6.3 Documenting Path Profiles

When any significant change in elevation occurs along the paths of travel of crash involved vehicles, the investigator should make an effort to document the path profile or, at least the total elevation change along the path. In cases where slippery surfaces or curved trajectories involving high-speed cornering or yawing motions are identified, it may also be important to record roadway super elevation or crown profiles. Techniques for accomplishing this range from simple to elegant. Often, a carpenter's level and ruler will provide sufficient information. For more precise information, the investigator may require surveyor's tools such as a transit/level and elevation rod, or equivalent modern equipment.

6.4 Vehicle Identification

It is recommended that vehicle identification numbers (VINs) be recorded (in their entirety) directly from the crash vehicles, to avoid possible error and because of the data coded within the VIN.

7. INTERVIEWING WITNESSES AND INVOLVED PARTIES

Focus on a limited number of elements which deal with human response and the dynamics of the collisions. Begin with the general, e.g., "Tell me what happened?," allowing the accident victim or witness to respond fully, then move toward more specific inquiries.

7.1 Direction of Travel

Of each vehicle/pedestrian observed.

7.2 Lane Used

Which lane each vehicle was in before any awareness of an impending collision. A numbering scheme for lanes and vehicles is often helpful.

7.3 Estimated Speed

Speed of the vehicle prior to any awareness of an impending collision. It may also be thought of as the general travel speed of the vehicle. Each speed or range-of-speed estimate should be accompanied by its basis (assumed versus monitoring speedometer) and by the approximate location of the vehicle for the reported speed.

7.4 Traffic Conditions

Non-contact vehicles.

7.5 Point of First Awareness

Where or if the danger was perceived before impact.

7.6 Decision/Evasive Actions

Steer (left or right), brake, or accelerate, or some combination or sequential mix. At what rate was the steering wheel turned (gradual, moderate, fast)? How much braking force was applied; (light, moderate, full) and did their tires skid?

7.7 Vehicle Response

If any driver or pedestrian attempted to alter his course or speed, the extent to which this was accomplished should be asked; also, include observations such as seeing the lights flash, hearing the horn sound, or tires squealing.

7.8 Location and Heading at Impact

Referencing the vehicle to fixed objects and the roadway is preferred.