Traffic Accident Investigation

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Research Report
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TRAFFIC ACCIDENT INVESTIGATION

Training Materials Prepared for

KENTUCKY TRANSPORTATION CENTER

Editors

Kenneth R. Agent

and

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Kentucky Transportation Center
University of Kentucky
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Uniform Traffic Accident Report Form</td>
<td>3</td>
</tr>
<tr>
<td>Sections on Accident Report</td>
<td>3</td>
</tr>
<tr>
<td>Cover Code Sheet</td>
<td>7</td>
</tr>
<tr>
<td>Basic Report Information</td>
<td>13</td>
</tr>
<tr>
<td>Supplemental Report</td>
<td>23</td>
</tr>
<tr>
<td>Basic Equipment</td>
<td>23</td>
</tr>
<tr>
<td>Accident Scene Measurement Procedure</td>
<td>24</td>
</tr>
<tr>
<td>Diagram and Templates</td>
<td>26</td>
</tr>
<tr>
<td>Roadway Measurements</td>
<td>26</td>
</tr>
<tr>
<td>Photographs</td>
<td>27</td>
</tr>
<tr>
<td>Types of Tire Marks</td>
<td>28</td>
</tr>
<tr>
<td>Road Scars</td>
<td>31</td>
</tr>
<tr>
<td>Debris</td>
<td>31</td>
</tr>
<tr>
<td>Point of Impact</td>
<td>32</td>
</tr>
<tr>
<td>Common Formulas</td>
<td>33</td>
</tr>
<tr>
<td>Summary</td>
<td>38</td>
</tr>
</tbody>
</table>
INTRODUCTION

The information given in this report deals with the reporting and at-scene investigation of traffic accidents. The procedure to complete the uniform police traffic accident report used in Kentucky is described. Also, the proper procedure necessary to document the accident scene is described. The objective of this report is to summarize the material included in the "Traffic Accident Investigation" workshop. The workshop also included case studies which were used to illustrate the procedures for proper reporting and documenting traffic accidents. Slides were used to show traffic accident scenes in order to illustrate the proper interpretation and documentation of accident scene information. While the workshop did not deal with accident reconstruction, basic formulas used in technical investigation were discussed to demonstrate the importance of proper at-scene investigation.

Over the past several years, up to 150,000 traffic accidents per year have occurred in Kentucky. Accident data have been analyzed and reported to show trends in some of the most frequently used statistics. The following accident statistics were taken from the University of Kentucky Transportation Center report KTC-92-16 "Analysis of Traffic Accident Data in Kentucky (1987-1991)."

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Accidents</td>
<td>151,422</td>
<td>148,158</td>
<td>134,207</td>
</tr>
<tr>
<td>Fatal Accidents</td>
<td>690</td>
<td>758</td>
<td>724</td>
</tr>
<tr>
<td>Fatalities</td>
<td>776</td>
<td>851</td>
<td>828</td>
</tr>
<tr>
<td>Injury Accidents</td>
<td>35,504</td>
<td>35,670</td>
<td>32,957</td>
</tr>
<tr>
<td>Injuries</td>
<td>53,383</td>
<td>54,057</td>
<td>49,926</td>
</tr>
<tr>
<td>Speed-Related Accidents</td>
<td>11,787</td>
<td>11,120</td>
<td>9,455</td>
</tr>
<tr>
<td>Alcohol-Related Accidents</td>
<td>7,669</td>
<td>8,052</td>
<td>7,185</td>
</tr>
<tr>
<td>Drug-Related Accidents</td>
<td>378</td>
<td>368</td>
<td>331</td>
</tr>
<tr>
<td>Pedestrian Accidents</td>
<td>1,542</td>
<td>1,486</td>
<td>1,452</td>
</tr>
<tr>
<td>Bicycle Accidents</td>
<td>807</td>
<td>730</td>
<td>706</td>
</tr>
<tr>
<td>Motorcycle Accidents</td>
<td>1,084</td>
<td>1,132</td>
<td>1,035</td>
</tr>
<tr>
<td>School Bus Accidents</td>
<td>819</td>
<td>822</td>
<td>838</td>
</tr>
<tr>
<td>Truck Accidents</td>
<td>11,566</td>
<td>11,103</td>
<td>9,365</td>
</tr>
</tbody>
</table>

Approximately 20 percent of all traffic accidents are investigated by the Kentucky State Police. Another 20 percent occur in Jefferson County with slightly under 10 percent of all accidents statewide occurring in Fayette County. This shows that approximately 50 percent of traffic accidents were investigated by other police agencies. The remaining agencies represent a wide range of capabilities and expertise relative to accident investigation. It is generally those agencies without
formalized training in accident investigation that the workshop was intended to benefit.

According to KRS 189.580, an operator must report an accident if:

1. the accident involves an injury or death, or
2. the accident involves total property damage of $500 or more.

According to KRS 189.635, an accident must be investigated by a police agency if:

1. the accident involves an injury or death, or
2. damage renders the vehicle inoperable.

KRS 189.635 also states that "a report of the accident must be filed with the Department of State Police within 10 days after investigation of the accident upon forms supplied by the department." The Kentucky State Police is responsible for maintaining a reporting system for all motor vehicle accidents which occur in the Commonwealth. A system is in place for coding information from the accident report forms into a computer file which is used by the State Police to produce an annual report of accident statistics titled "Kentucky Traffic Accident Facts".

Levels of Accident Investigation

Accident investigation may be categorized into the following four levels of activity.

1. Reporting
2. At-scene Investigation
3. Technical Follow-up
4. Accident Reconstruction

The Traffic Investigation Workshop and the material contained in this report deal in detail with reporting and at-scene investigation. There is a brief discussion of technical follow-up and reconstruction.

Objectives of Traffic Accident Investigation

An accident investigation attempts to answer the following questions.

1. WHAT happened (type of accident)?
2. WHERE accident occurred?
3. WHEN accident occurred?
4. WHY accident occurred (human, environmental, and vehicular factors)?
5. WHO was involved?

The on-scene investigator must perform the following duties.

1. care for the injured,
2. protect persons and property from further injury or damage,
3. gather information at the scene that will assist in determining the cause of the accident,
4. interview drivers, passengers, victims and other witnesses,
5. record facts by making notes, taking statements, scene measurements and photographs, and
6. conduct basic mechanical inspections of vehicles involved.

The Traffic Accident Investigation Workshop and the material contained in this report include discussions of the procedures required for collecting and recording information necessary to reconstruct a traffic accident.

**UNIFORM TRAFFIC ACCIDENT REPORT FORM**

**SECTION ON ACCIDENT REPORT**

The uniform traffic accident report used in Kentucky may be divided into the following sections:

A. accident identification,
B. units involved,
C. collision description,
D. other involvement,
E. people involvement, and
F. police action.

A detailed description of the procedure to complete the uniform traffic accident report is given in the Traffic Accident Report Forms Manual. This manual is produced by the Kentucky State Police and is included as one of the handout materials for the workshop. Following is a discussion of the six major sections of the accident report.

A. Accident Identification

The accident identification section includes general information about the accident. This information includes the following:

1. local code (code number for local agency),
2. agency identification number (local agency NCIC number),
3. master file number (for State Police Records Section),
4. name of investigating agency,
5. number of people killed (dying within 30 days of accident),
6. number of people injured,
7. note if investigation is complete or incomplete,
8. hit and run (when driver leaves scene to avoid responsibility),
9. day of week,
10. time of accident (in military time),
11. month and day and year,
12. trafficway number or name (highest class trafficway),
13. miles to nearest town,
14. name of town used as reference,
15. county where accident occurred,
16. note if accident occurred at an intersection or between streets,
17. check "Yes" if accident was on a one way street,
18. check "Yes" if accident was on a ramp,
19. distance to nearest milepost, and
20. speed limit.

B. Units Involved

This section provides detailed information about the vehicles and drivers involved. This information includes:

1. removed to (location where vehicle was taken after accident),
2. number of occupants in vehicle,
3. operator's license number,
4. state of operator's license,
5. restriction on license,
6. compliance with restriction,
7. operator's name,
8. operator's date of birth,
9. street number and name of operator's residence,
10. code (used in Kentucky State Police Records Section),
11. city and state of operator's residence,
12. owner name,
13. owner address,
14. motor carrier (name and address of business if commercial vehicle),
15. vehicle year,
16. vehicle make and model,
17. vehicle type (body style),
18. state of vehicle registration,
19. registration number,
20. year registration expires,
21. name of vehicle insurance company,
22. check "Yes" if vehicle caught fire,
23. check "Yes" if vehicle overturned,
24. estimated travel speed (range),
25. vehicle size, and
26. vehicle identification number (VIN).

If a heavy truck is involved in the accident, the following information must be determined.

1. check "Yes" if carrying hazardous cargo,
2. cargo code (four digit number indicating type of hazardous cargo or Unit Number if cargo code is not available),
3. type of cargo (enter type based on cargo code or visual observation; also note if empty),
4. number of trailers,
5. truck length and width,
6. indicate if truck is a single unit or a combination and
7. number of axles.

C. Collision Description

A brief description of the collision should be completed. The description includes the following information.

1. location of damage (first point of impact on vehicle other than truck),
2. extent of damage (circle one of five codes available),
3. damage to truck (first point of impact to truck - a separate diagram for trucks),
4. diagram space (for minor, non-injury accidents, the following numbers may by inserted in the diagram space (1 for rear end; 2 for overtaking sideswipe; 3 for left turn; 4 for intersection, no turn; 5 for right turn; 6 for head-on; and 7 for opposite direction sideswipe) and
5. accident description (a narrative description of the accident).

D. Other Involvement

This section describes the involvement of other individuals not directly involved in the accident. The following information is given in this section.

1. property damage (other than vehicles),
2. address of owner of damaged property,
3. time Emergency Medical Services (EMS) were notified,
4. time EMS arrived at scene,
5. time EMS arrived at hospital,
6. first-aid given by,
7. injured or deceased removed by (EMS or others),
8. removed to (hospital, clinic, or other),
9. check "No" if chemical test given (indicate operator number),
10. type chemical test (breath, blood or urine and whether the person was tested for alcohol or drugs, or both),
11. person who administrated chemical test,
12. location where chemical test sent (where analysis was performed), and
13. results of chemical test (provide supplement if not known at time report was submitted).

E. People Involvement

The names and addresses of the following must be included:

1. drivers,
2. passengers,
3. pedestrians, and
4. witnesses.

The date and time of death must be given, if applicable.

Additional information related to people involved should be provided and is discussed in detail under another section titled "Drivers/Witnesses/Passengers".

F. Police Action

The last section to be completed includes the following information related to police action.

1. note if enforcement action was taken (indicate vehicle number),
2. citation or case number,
3. applicable KRS number,
4. offense,
5. check "Yes" if photographs taken (indicate police unit taking photos),
6. name of investigator,
7. investigator ID number,
8. police beat or post number,
9. time notified,
10. time arrived,
COVER CODE SHEET

The blocks on the outside of the accident report form are completed using the codes given in the following sections. If the accident cannot be described using the codes given, additional information should be included in either the diagram or narrative portion of the report.

Pre-Accident Vehicle Action

This information is completed for each vehicle. The codes describe the action of the vehicle before the driver took any sudden emergency action to avoid the collision.

1. going straight ahead,
2. making right turn,
3. making left turn,
4. making U-Turn,
5. starting from parked position,
6. starting in traffic,
7. slowing or stopping,
8. stopped in traffic,
9. entering parked position,
10. parked,
11. avoiding object in roadway,
12. changing lanes,
13. overtaking,
14. merging,
15. backing, and
16. other or unknown.

For example, if a vehicle was proceeding around a left-hand curve when the driver lost control, the correct code would be "going straight ahead" as opposed to "making left turn" which would be appropriate when a driver is attempting to turn left from one road onto another road.

Location of First Event

This code describes the location of the first harmful event regardless of the degree of seriousness.
1. on roadway,  
2. off roadway, and  
3. public access lot.

Type of Accident

This code describes the type of collision, if applicable, or noncollision. The first event is coded as well as the second event, if applicable, for each vehicle.

Collision with:

1. other motor vehicle,  
2. pedestrian,  
3. bicyclist,  
4. animal (other than deer),  
5. railroad train, and  
10. other object-not fixed (give explanation),

Collision with Fixed Object:

11. light support or utility pole,  
12. guardrail,  
13. crash cushion,  
14. sign post,  
15. tree,  
16. building or wall,  
17. curbing,  
18. fence,  
19. bridge structure,  
20. culvert or headwall,  
21. median or median barrier,  
22. snow embankment,  
23. earth embankment, rock cut, or ditch,  
24. fire hydrant,  
25. guardrail end treatment, and  
30. other fixed object (give explanation).

Non-Collision:

31. overturned,  
32. fire or explosion,  
33. submersion,  
34. ran off roadway (only), and  
40. other.
Contributing Factors

A traffic accident is caused by one or, more commonly, several factors in three general areas. These general areas are:

1. human,
2. vehicular, and
3. environmental.

Codes indicating the contributing factors in these three general areas are listed. Up to three codes may be entered for any vehicle with the most serious factor entered first. Codes indicating apparent factors in these three areas must be noted for all vehicles involved in the accident.

Apparent Human Contributing Factors

1. unsafe speed,
2. failed to yield right-of-way,
3. following too close,
4. improper passing,
5. disregard traffic controls,
6. turning improperly,
7. alcohol involvement,
8. drug involvement,
9. sick,
10. fell asleep,
11. lost consciousness,
12. driver inattention (give explanation),
13. distraction (give explanation),
14. physical disability (give explanation)
15. other (give explanation), and
16. none detected.

Apparent Vehicular Factors

1. brakes defective,
2. headlights defective,
3. other lighting defects,
4. steering failure,
5. tire failed or inadequate,
6. tow hitch defective,
7. over or improper load,
8. oversized load on vehicle,
9. other (give explanation), and
10. none detected.

Apparent Environmental Factors

1. animal's action,
2. glare,
3. view obstructed or limited (give explanation),
4. debris in roadway,
5. improper or non-working traffic controls (give explanation),
6. shoulders defective,
7. holes or deep ruts or bumps,
8. road under construction,
9. improperly parked vehicle,
10. fixed object,
11. slippery surface (give explanation),
12. water pooling (give explanation),
13. other (give explanation), and
14. none detected

Total Units Involved

This refers to the total number of motor vehicle units involved. Only motor vehicles are to be included. A vehicle towing another vehicle is considered as only one unit. The total does not include pedestrians, bicycles or trains.

Total Through Lanes

The number of through lanes in both directions of the major trafficway is given. A four lane highway divided by a median would be listed as having four lanes, not two lanes. Separate left turn and right turn lanes are not included.

Lane Use/Locality

This code refers to the description of the land use of the neighborhood at the scene of the accident.

1. rural,
2. business,
3. industrial,
4. residential,
5. school,
6. park,
7. private property (give explanation), and  
8. limited access.

**Roadway Surface**

The roadway surface is described by two categories as follows:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. dry,</td>
<td>1. asphalt,</td>
</tr>
<tr>
<td>2. wet,</td>
<td>2. concrete,</td>
</tr>
<tr>
<td>3. snow or ice,</td>
<td>3. gravel, and</td>
</tr>
<tr>
<td>4. slush, and</td>
<td>4. other (give explanation).</td>
</tr>
<tr>
<td>5. muddy.</td>
<td></td>
</tr>
</tbody>
</table>

**Weather**

Indicate the weather at the time of the accident.

<table>
<thead>
<tr>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. clear,</td>
</tr>
<tr>
<td>2. raining,</td>
</tr>
<tr>
<td>3. snowing,</td>
</tr>
<tr>
<td>4. fog or smog or smoke,</td>
</tr>
<tr>
<td>5. sleet or hail, and</td>
</tr>
<tr>
<td>6. cloudy.</td>
</tr>
</tbody>
</table>

**Roadway Character**

Indicate the roadway character at the accident location. This code describes the roadway character at the point where the first harmful event occurred.

<table>
<thead>
<tr>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. straight and level,</td>
</tr>
<tr>
<td>2. straight and grade,</td>
</tr>
<tr>
<td>3. straight and hillcrest,</td>
</tr>
<tr>
<td>4. curve and level,</td>
</tr>
<tr>
<td>5. curve and grade, and</td>
</tr>
<tr>
<td>6. curve and hillcrest.</td>
</tr>
</tbody>
</table>

**Traffic Control**

List the traffic control, if any, at the accident location.

<table>
<thead>
<tr>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. stop sign,</td>
</tr>
<tr>
<td>2. stop and go signal,</td>
</tr>
<tr>
<td>3. officer or flagman,</td>
</tr>
<tr>
<td>4. railroad signs or signals,</td>
</tr>
<tr>
<td>5. railroad gates,</td>
</tr>
<tr>
<td>6. yield signs,</td>
</tr>
<tr>
<td>7. flashing light,</td>
</tr>
<tr>
<td>8. no passing zone,</td>
</tr>
<tr>
<td>9. curve sign,</td>
</tr>
<tr>
<td>10. center line,</td>
</tr>
<tr>
<td>11. median,</td>
</tr>
<tr>
<td>12. advisory speed sign,</td>
</tr>
<tr>
<td>13. other, and</td>
</tr>
<tr>
<td>14. none.</td>
</tr>
</tbody>
</table>
More than one code may be used to describe the traffic control. When an advisory speed sign is noted, the speed displayed should be noted in the report.

Light Conditions

This code describes the light condition that existed at the time of the accident.

1. daylight, 4. darkness (highway lights on),
2. dawn, 5. darkness (highway lights off), and
3. dusk, 6. darkness (highway not lighted).

Pedestrian Action

This code describes the pedestrian action, if any, that applies to the accident. Up to three codes may be reported with the most descriptive code listed first.

1. at intersection, 10. not in roadway
2. crossing with signal, 11. laying in roadway,
3. crossing against signal, 12. darting into road,
4. not at intersection, 13. pedestrian drinking,
5. getting on or off vehicle, 14. pedestrian drug related,
6. emerging from parked vehicle, 15. pedestrian jogging,
7. walking in roadway, 16. physical impairment,
8. playing in roadway, 17. dark clothing not visible, and
9. working in roadway, 18. in crosswalk.

Direction of Travel at Scene

The direction of travel for unit(s) involved in the accident is given. The direction (north, south, etc.) refers to the pre-accident travel direction. For state-maintained roadways, odd numbered routes are in a general north/south direction while even numbered routes are in a general east/west direction.

Was Driver Suspected of Drinking?

Either a yes or no code is checked depending on whether a driver was suspected of drinking. Noting yes does not necessarily mean that alcohol was a contributing factor to the accident.

Method of Determination

The method used to determine whether the driver was drinking is given.
1. evidential test (breath, blood or urine test),
2. preliminary breath test (PBT),
3. field sobriety test,
4. observation, and
5. other (give explanation).

Drivers/Witnesses/Passengers

The following information is listed for all occupants and others involved in the accident and any witnesses to the accident.

1. vehicle occupied (number of vehicle listed on report),
4. seating position (each position in the vehicle is given a number),
5. safety equipment used (type of equipment used is coded),
6. ejection from vehicle (not ejected, partially ejected or ejected),
7. age,
8. sex,
9. location of injury (most severe with part of the body identified),
10. classification of injury, and
11. extrication (yes or no).

BASIC REPORT INFORMATION

The preceding portion of the report discussed the sections of the accident report and the cover code sheet. When the accident report is completed, some basic types of information must be identified. The following list includes the basic types of information which must be reported to adequately describe an accident.

A. location,
B. when accident occurred,
C. driver information,
D. vehicle information,
E. characteristics of road,
F. vehicle actions,
G. occupant information,
H. type of accident,
I. contributing factors,
J. accident description (narrative), and
K. accident diagram.

Several types of information must be included on the accident report to adequately document this basic report information. Following are lists describing the types of information necessary to document each of these areas.
A. Location

Adequate information must be given to accurately locate the accident. Accurate location information is necessary to identify high accident locations. The following information is needed.

1. county,
2. route and/or road name,
3. milepoint (always use on state-maintained highway),
4. intersecting or adjacent streets (if applicable), and
5. town or distance to nearest town (to 1/10 mile).

The Mile Post Reference Guide may be used to determine the appropriate milepoint on state-maintained highways. (Mile post reference information representing the county of responsibility for each agency is provided as a handout for the workshop participants.)

B. When Accident Occurred

The following basic information is needed to document when an accident occurred.

1. date,
2. day of week,
3. time of day (military time), and
4. light conditions.

When an accident occurs during nighttime conditions, additional information would be beneficial. Relevant types of information useful in accidents occurring during nighttime conditions include the following:

1. location of roadway lighting,
2. location of ambient lighting,
3. type of pavement markings,
4. vehicle lamp examination,
5. color of clothes of pedestrian,
6. number and location of reflectors on bicycle,
7. number and location of lights on trucks, and
8. whether the involved vehicles' headlights were on high beam or low beam.

Information useful in the investigation of nighttime accidents is included in the Code of Federal Regulations and the Kentucky Revised Statutes (KRS). The requirements concerning the number and location of lights on various types of vehicles are given in the Code of Federal Regulations (Part 393). Requirements for
the placement of warning devices for a vehicle stopped on the traveled portion of a highway are listed. Warning devices must be put in place within 10 minutes of stopping. Typically, reflective triangles are used as warning devices.

In KRS 189.450 it is noted that a police officer may have a vehicle moved that is stopped on the shoulder of a state-maintained highway for 24 hours or more. It is also noted that no vehicle having a gross weight over 44,000 pounds may be stopped on the shoulder of a fully controlled access highway except in the case of emergency and the maximum length of time allowed in an emergency is 24 hours and then the vehicle may be towed at the cost of the owner.

The Revised Statutes specify that lights must be illuminated during the period from one-half hour after sunset to one-half hour before sunrise and at other times when atmospheric conditions render visibility as low or lower than during that period (KRS 189.030). It is also specified in KRS 189.040 that the uppermost distribution of light will reveal persons and vehicles at a distance of at least 350 feet; with the lowermost distribution of light illuminating a distance of at least 100 feet.

C. Driver Information

The following information is needed for each driver.

1. name,
2. address,
3. license information (number, state, restrictions),
4. date of birth,
5. alcohol involvement (was alcohol suspected and method of determination),
6. safety belt usage,
7. injury location and severity, and
8. source of injury.

D. Vehicle Information

The following information is needed for each vehicle.

1. vehicle year,
2. make (BUIC, TOYT),
3. model (CEN, CAM),
4. type (2D, 4D, PK, TS),
5. registration information,
6. vehicle identification number (VIN),
7. insurance information,
8. size (compact, full size),
9. fire involvement,
10. whether vehicle overturned,
11. estimated travel speed,
12. vehicle damage,
13. truck description (if applicable), and
14. appropriate mechanical inspections.

Standard practice is for Unit 1 to be the vehicle considered to be at fault in the accident.

Truck Information

When a truck is involved, additional information is required. The following information must be obtained and recorded.

1. length (total),
2. width,
3. single unit or combination,
4. number of axles,
5. number of trailers, and
6. cargo information.

The length and number of axles include both the tractor and trailer for a combination truck.

Vehicle Damage Information

The following basic vehicle damage information is required on the report.

1. location of damage from first contact, and
2. extent of damage
   a. other property
   b. no damage
   c. minor damage
   d. moderate damage
   e. severe damage

In many instances, more detailed vehicle information is needed. Following is a list of the types of information which may be obtained as part of the investigation.

1. note location of contact damage and induced damage,
2. note direction of force (angle of impact to vehicle),
3. condition of tires (tread depth, pressure, flat tires),
4. lamp examination (inspection of filaments, position of headlight switch),
5. damage to steering mechanisms,
6. evidence of contact with pavement (part of vehicle causing gouge mark),
7. safety belt inspection,
8. evidence of alcoholic beverage containers,
9. cargo type and means for securing, if applicable,
10. crush measurements (location and depth), and
11. vehicle interior examination.

Contact damage is damage to any part of the motor vehicle by direct contact with some object which is not part of the vehicle. This is in contrast to induced damage which is damage to any part of a motor vehicle caused by some other part of the same vehicle or by the shock of collision.

Several references include formulas which relate crush depth to impact speed. Frontal, side and rear crush can be related to impact speed. Measurements of the impact crush depth may be used in estimating the impact speed.

An issue which may be important in an accident is whether a light, such as the headlights or brake lights, were on at impact. Evidence of whether a lamp is on at impact may be obtained from an examination of the filament. The following characteristics indicate the lamp was on at impact.

1. filament stretched (glass broken or unbroken),
2. blackened filament (glass broken), and
3. fused glass on filament (glass broken).

E. Characteristics of Road

It is important to describe the significant features of the roadway. The following basic features should be described.

1. speed limit (give regulatory speed but note if advisory speed is posted and describe in narrative or diagram),
2. roadway cross-section (number of through lanes, roadway width, shoulder width, median width, etc.),
3. roadway surface condition (wet, dry),
4. type of surface (asphalt, gravel, etc.),
5. roadway character (curvature, grade, etc.) and
6. traffic control (stop sign, curve sign, etc.).

Traffic control may be classified as including signs, markings and traffic signals. The following information illustrates the type of information which should be obtained for these types of traffic control.

1. Signs
   a. location of stop signs,
b. warning signs such as curve warning sign,
c. advisory speed signs,
d. construction warning and regulatory signs, and
d. date of installation, if available on back of sign.

2. Markings
a. presence of lane delineation markings such as edge lines (especially for nighttime accidents),
b. location of stop bar, and
c. temporary markings in construction zones should be noted.

3. Traffic Signals
a. separate left-turn phasing, and
b. length of yellow and all-red intervals.

All traffic control devices must conform to the Manual on Uniform Traffic Control Devices, as specified in KRS 189.337.

The Kentucky Revised Statutes contains relevant traffic regulations in Chapter 189. For example, in KRS 189.338, the requirements for drivers facing a traffic signal indication is given. A yellow indication warns a driver that the green interval is ending and a red interval will be shown. When the red interval is shown, a vehicle shall not enter the intersection. However, a vehicle may still enter the intersection during a yellow indication. An all-red interval is commonly used to clear the intersection of vehicles that entered the intersection during the yellow interval.

The location at which a vehicle is to stop for a stop sign is presented in KRS 189.330. A driver is required to stop at a stop bar, if present, or before entering a crosswalk. If neither a stop bar nor crosswalk is present, the driver must stop at the point nearest the intersecting roadway where the driver has a view of approaching traffic. The location of the stop sign does not indicate the point where a driver should stop.

F. Vehicle Action

The vehicle action leading to the collision is described by the pre-accident vehicle action (going straight, turning left) and the direction of travel.

G. Occupant Information

The following information is needed for the driver and passengers.

1. extrication (yes or no),
2. classification of injury,
3. location of injury (head, chest, legs),
4. sex,
5. age,
6. ejection from vehicle,
7. safety equipment used,
8. position in vehicle, and
9. vehicle occupied.

Whether a seat belt was used can become an issue in an accident. When determining whether seat belts were used, the following items should be inspected.

1. mounting points,
2. retractor mechanism,
3. restraint system hardware, and
4. webbing.

Evidence of forces on the seat belt when worn in an accident can be identified. For example, there may be stretching of the webbing.

When determining the classification of injury, the following descriptions should be used.

Incapacitating  Severe lacerations, broken limbs, skull fracture, internal injuries, unconsciousness when leaving scene, or inability to leave scene without assistance.

Non-Incapacitating  Minor lacerations, bruises, and abrasions.

Possible Injury  Claim of injury and/or pain not evident to the eye such as momentary unconsciousness, limping, nausea or hysteria.

When pedestrians are involved, the following information can be useful.

1. direction pedestrian traveling at impact,
2. general description of injuries to pedestrian,
3. point of impact on vehicle,
4. rate of travel of pedestrian,
5. location of debris,
6. distance pedestrian traveled from impact to final rest, and
7. color of pedestrian's clothing.

This type of information would also apply to bicycle accidents.

H. Type of Accident

The type of accident codes shown on the coding sheet indicates the first event in the accident and the second event for any vehicle. The accident diagram and description will further describe the type of accident.

I. Contributing Factors

The codes shown on the police report describe the contributing factors. Past summaries of accident data have identified the most frequently occurring contributing factors. Following is a listing of the most common human contributing factors.

<table>
<thead>
<tr>
<th>PERCENT OF ACCIDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Driver inattention</td>
</tr>
<tr>
<td>2. Failed to yield right-of-way</td>
</tr>
<tr>
<td>3. Unsafe speed</td>
</tr>
<tr>
<td>4. Alcohol</td>
</tr>
<tr>
<td>5. Follow too closely</td>
</tr>
<tr>
<td>6. Disregard traffic control</td>
</tr>
<tr>
<td>7. Improper turn</td>
</tr>
</tbody>
</table>

Driver inattention is the most common factor reported. If possible, an explanation should be given in the narrative describing this factor.

Following is a listing of the most common vehicular contributing factors.

<table>
<thead>
<tr>
<th>PERCENT OF ACCIDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Defective brakes</td>
</tr>
<tr>
<td>2. Tire problem</td>
</tr>
<tr>
<td>3. Steering defective</td>
</tr>
<tr>
<td>4. Lighting defective</td>
</tr>
</tbody>
</table>
As can be seen, vehicular factors are listed infrequently when compared with human factors. When possible, contributing vehicular factors should be described in the narrative.

Following is a listing of the most common environmental contributing factors.

<table>
<thead>
<tr>
<th>PERCENT OF ACCIDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Slippery surface</td>
</tr>
<tr>
<td>2. View obstruction</td>
</tr>
<tr>
<td>3. Water pooling</td>
</tr>
<tr>
<td>4. Debris in roadway</td>
</tr>
<tr>
<td>5. Improperly parked vehicle</td>
</tr>
<tr>
<td>6. Road construction</td>
</tr>
<tr>
<td>7. Defective shoulder</td>
</tr>
<tr>
<td>8. Hole/bump</td>
</tr>
</tbody>
</table>

There is important information which should be obtained when some of these environmental factors are listed as contributing to the accident. When slippery surface or water pooling is listed, the following investigation should be conducted.

1. measure tire tread depth,
2. note location and length, width, and depth of water pooling,
3. give reason for water pooling (improper drainage, wheel ruts), and
4. measure depth of any wheel ruts (using straightedge and tape or ruler).

The Code of Federal Regulations specifies a minimum tread depth of 4/32 inch on the front tires of a truck with a minimum of 2/32 inch on other tires. Tires on passenger cars are to have a tread wear indicator to provide a visual indication that the tire has worn to a tread depth of 1/16 inch.

If a view obstruction is listed as a contributing factor, the following information is useful.

1. cause of view obstruction,
2. location of view obstruction, and
3. available sight distance.

The driver eye height must be considered when estimating the available sight distance. The driver eye height varies by type of vehicle. Typical driver eye
heights are 3.5 to 3.75 feet for a passenger car, 5 feet for a pickup truck and 7 to 8 feet for a tractor-trailer.

When a shoulder dropoff is listed as a contributing factor, the dropoff height and slope should be documented. When measuring the dropoff, a straightedge should be placed across the pavement extending off the edge of the pavement. The dropoff would then be measured from the straightedge down to the point the pavement meets the shoulder. The horizontal distance from the point the dropoff starts to the point the pavement meets the shoulder should also be measured to determine the slope of any dropoff.

Other valuable shoulder dropoff related information would include an inspection of the inside of tires for scrub marks and documentation of any evidence of the path of the tires off the edge of the pavement.

The dimensions of any pothole should be documented when a pothole is listed as a contributing factor. The measurements should include the length, width and depth of the pothole as well as the slope of the edge.

J. Accident Description

The accident description involves a narrative description of the accident. This narrative should include the following:

1. description of actions of vehicles leading up to impact,
2. locations of point of impact on roadway,
3. description of orientation of vehicles at impact and point of contact,
4. indication of travel path of vehicles after impact,
5. explanation of coding containing an asterisk,
6. notation of relevant points from statements from occupants or witnesses, and
7. listing of important distances.

K. Accident Diagram

The accident diagram should include the following:

1. travel lanes,
2. important roadway features,
3. travel path of vehicles prior to impact (including tire marks related to the accident),
4. point of impact,
5. final rest positions of vehicles,
6. north arrow,
In addition to this basic information the following other information is requested on the police report.

1. property damage (other than vehicles),
2. emergency medical services (EMS) information,
   a. time notified, and arrived at hospital,
   b. first aid given by,
   c. who removed injured and where they were taken,
3. chemical test information,
   a. who was given test,
   b. what type of test given,
   c. test for drug or alcohol,
   d. who took sample and where it was taken,
   e. results,
4. police action,
   a. citation number,
   b. KRS number,
   c. offense,
5. photographs taken,
6. investigator, and
7. time notified and arrived.

SUPPLEMENTAL REPORT

A supplemental report may be necessary in some instances. A standard supplementary form is used. Following is a listing of reasons for which a supplemental report may be used.

1. more than 5 drivers, passengers and witnesses,
2. fatal accident,
3. chemical test results,
4. accident diagram scene,
5. investigator's narrative, and
6. statements from vehicle occupants or witnesses.

BASIC EQUIPMENT

There is some basic equipment which should be available for use in the investigation and documentation of a traffic accident. The list of basic equipment should include:
1. measuring devices, 
2. camera, and 
3. material for marking.

The measuring devices commonly used range from a measuring wheel for long distances to a ruler/tape for small measurements.

**ACCIDENT SCENE MEASUREMENT PROCEDURE**

Important at-scene information to measure and locate on the accident diagram include:

1. positions of vehicles (pre-impact, impact, and final rest),
2. locations of involved persons (outside of vehicles),
3. gouges (chips, chops and grooves),
4. scratches and scrapes,
5. tire marks,
6. scars on roadside,
7. debris,
8. view obstructions, and
9. objects on or near the road related to accident.

Other information which could be measured and located on the diagram includes:

1. parked or disabled vehicles,
2. location of witnesses,
3. ice patches, standing water, and
4. traffic control devices.

When performing measurements, a measuring device must be used. The preferred measurement procedure involves locating a reference point and a reference line, and then locating important measurements north/south and east/west of the reference point and reference line.

The measurement procedure commonly used to document the important information is called the coordinate method. Two measurements are required to locate a spot from a reference point. One measurement is the shortest distance from a spot to the reference line. The second measurement is the distance from that place on the reference line to the reference point (which is on the reference line). The two measurements are usually at right angles to each other. In addition to the distance, the direction must be specified. The reference line does not have to be straight (such as a curved roadway edge). The direction of the measurement does not have to be an exact compass direction. The direction may be a nominal direction for the general direction of the roadway.
An alternative measurement method is called the triangulation method. In this procedure, the location of a spot is determined by noting the distance to two reference points. The distance between the two reference points forms the third side of the triangle.

As previously noted, reference lines are necessary when using the coordinate measurement procedure. Following is a list of possible reference lines.

1. roadway edge,
2. imaginary extension of roadway edge,
3. guardrails,
4. bridge rails, and
5. railroad rails.

Reference points must also be selected in the coordinate measurement procedure. Following is a list of possible reference points.

1. pole,
2. tree,
3. traffic sign or signal,
4. end of guardrail,
5. culvert headwall,
6. corner of building,
7. station numbers on paving, and
8. other permanent landmarks.

The final rest position of a vehicle should not be located only from the estimated point of impact. In many instances, the point of impact is not a specific point. Also, evidence of the point of impact can be lost. The final rest position and the point of impact should be located relative to the reference points.

The measurements obtained using the coordinate procedure should be listed in a table. The table would include a description of the spot identified and the distance from the reference point and reference line.

A field sketch should describe and define the spots to be located and reference points and should give a general picture of the after-accident situation. The number of spots necessary to identify an object would depend on the type of object. One spot would be sufficient for a human body, vehicle parts, small debris areas, and splatter areas and puddles less than 3 feet across. Two spots would be necessary for vehicles, straight tire marks (each end), and straight grooves. Three or more spots would be necessary for curved tire marks, a straight tire mark with angles or gaps, and a large debris area.
DIAGRAM AND TEMPLATES

A diagram of the accident scene may be drawn on the report or supplementary page. The diagram does not have to be drawn to scale. When the diagram is to scale, the scale must be noted. The final rest positions of vehicles, pedestrians, bicycles, etc. should be shown. The important roadway features should be shown. Tire marks (both pre-impact and post-impact) should be shown as well as gouge marks.

Templates are available to assist in preparing the accident diagram. Two of the most common templates used are: 1) the Accident Investigator's Template from the Traffic Institute at Northwestern University 2) the Blue Blitz Traffic Template from the Institute of Police Technology and Management at the University of North Florida.

The template provides the following information.

1. engineering scales for distances,
2. protractor for angles,
3. procedure to draw curves, circles or arcs,
4. outlines for cars, trucks, bodies, and cycles,
5. map symbols,
6. procedure to perform slope measurements, and
7. procedure to perform basic calculations.

ROADWAY MEASUREMENTS

Some basic roadway measurements may be needed in the investigation of traffic accidents. The need for any given measurement depends on the circumstances of the accident.

Roadway curvature is important in accidents such a head-on accident where a vehicle crosses the centerline in a curve. To determine the radius of a curve or skid mark, measure the length of the middle ordinate of a chord of a known length. The radius may then be calculated with the following formula.

\[
\text{Radius (feet)} = \frac{3 \ C^2}{2 \ M} + \frac{M}{24}
\]  

(1)

where:

\( C = \text{chord length (feet)} \) and
\( M = \text{middle ordinate (inches)} \)
Several types of vertical measurements may be useful in the investigation. The types include grade, superelevation, and fall.

The measuring devices which may be used to perform vertical measurements include:

1. carpenter’s level and ruler/tape,
2. string, line level, and tape,
3. traffic template,
4. clinometer, and
5. surveying level and rod.

The following formulas are used in calculations involving vertical measurements where:

\[ H = \text{Horizontal distance (feet)} \]
\[ V = \text{Vertical drop over horizontal distance (inches)} \]

\[ \text{Percent Grade} = \frac{100 \ V}{12 \ H} \quad (2) \]

\[ \text{Crown} = \frac{V}{12 \ H} \quad \text{feet} \quad \text{feet} \quad (3) \]

\[ \text{Superelevation} = \frac{V}{12 \ H} \quad \text{feet} \quad \text{feet} \quad (4) \]

\[ \text{Slope} = \frac{12 \ H}{V} : 1 \quad \text{expressed as ratio such as 4:1} \quad (5) \]

PHOTOGRAPHS

Photographs are very important for documenting traffic accidents. A camera is a basic piece of equipment needed by an accident investigator.

When taking photographs, the following information should be documented.

1. final positions of vehicles and bodies,
2. evidence of accident on road (tire marks, gouges),
3. signs of accident on roadside (rutting),
When taking photographs of vehicle damage, at least four photographs are typically taken. These photographs should include one photograph of each side of the vehicle.

More detailed documentation of vehicle damage is necessary in some accidents. Such information would include the following.

a. imprints of one vehicle on another,
b. friction or abrasion marks,
c. damage to lamps,
d. damage to load,
e. sources of injury to pedestrians or occupants and
f. damage to tires and wheels.

Care should be exercised when taking the photographs to ensure that the proper information is given. Potential problems relating to photographs involve improper camera height, camera position or perspective, the angle of the photograph, the type of lens, and insufficient light. For example, if a photograph is taken to show the view of a driver, the photograph must be taken at the proper driver height.

**TYPES OF TIRE MARKS**

Various types of tire marks may be observed at an accident scene. The types of tire marks include:

1. skidmark,
2. yawmark,
3. acceleration scuff,
4. flat tire mark, and
5. tire imprint.

The characteristics of these tire marks must be understood in order to interpret what types of marks are present.

**Skidmark**

In many instances, a tire mark will be referred to as a skidmark when it is actually a yawmark. Following is a summary of conditions and/or characteristics which allow marks to be identified as skidmarks.
1. tire sliding,
2. vehicle braking,
3. multiple or single tire marks,
4. striations parallel to mark, and
5. outer edges often stronger.

Skidmarks of different lengths do not necessarily mean that the brakes are defective. This is especially true when the vehicle slides straight in its skid. All skid distances should be measured with the longest distance used in speed calculations. Multiple skid marks of different lengths usually mean that those tires not leaving marks are near peak friction, unless information is available to indicate otherwise.

In a single unit vehicle, when the front brakes lock first, the vehicle will slide straight. However, when the rear brakes lock first, the vehicle will tend to rotate. In a combination vehicle, a jackknife will occur when the tractor rear wheels lock. Trailer swing occurs in a combination vehicle when the trailer wheels lock first.

Skidding on wet pavement tends to leave "steam" marks which are lighter in color than the surrounding pavement.

A split coefficient of friction occurs when the two sides of a vehicle are traveling on surfaces having different coefficients of friction. If hard braking occurs in this situation, the vehicle will tend to rotate around the side of the vehicle with the higher coefficient of friction.

If a tire is underinflated or overloaded, it is pushed down and most of its weight is carried by the edges. This leaves a darker mark on the outside of the skidmark. A rotating underinflated tire leaves two parallel marks at the outer edges of the tire tread. An overinflated tire will result in a skid mark narrower in width than a normally inflated tire with more of the weight carried by the center of the tire. A normally inflated tire will have uniform pressure across the tire-road contact area.

Another type of skidmark is a collision scrub mark. These tire marks occur when damage to a vehicle causes a wheel to lock. They are usually not more than 10 feet long. They start abruptly when damage to the vehicle locks a wheel. This type of tire mark is a scrub mark since the wheel does not rotate but it is not a braking skidmark. The beginning of a scrub mark assists in determining the point of impact.

Skip skidmarks occur most commonly with bouncing semitrailers (typically with an empty trailer) and may also be related to road bumps and collisions.
Yawmark

Following is a summary of the characteristics of yawmarks.

1. tire rolling and side slipping,
2. vehicle steering,
3. mostly from one side of vehicle,
4. outside stronger if from both sides,
5. width varies from one inch to one foot, and
6. striations oblique or crosswise.

When determining the type of tire mark, consider that only a rolling tire can corner and make a vehicle turn. A locked tire cannot corner and turn.

Acceleration Scuff

The beginning of an acceleration mark is dark and is very dark at the edges (similar to an underinflated or overloaded tire mark). Tire tread rib marks are often visible in an acceleration mark.

Flat Tire Mark

A flat tire mark has some general characteristics which may be used to identify such tire marks. These characteristics include:

1. tire rolling,
2. usually one tiremark,
3. tire tread edge marks,
4. begins faint and ends strong, and
5. outer edges always stronger.

When a tire loses air pressure and becomes flat, the tire rotates under the tire rim. The tire sidewalls as well as the tread comes into contact with the pavement and this results in wavy marks on the pavement.

Tire Imprint

A tire imprint has the following general characteristics.

1. tire rolling,
2. from one or all tires,
3. width same as tire, and
4. tread design may show.
ROAD SCARS

Road scars must be documented as part of the accident investigation. They occur just after impact and may be used to assist in locating the impact area. The vehicle requires a short time to be pushed down to the pavement, and this fact must be considered when determining the impact point or area.

The following are the most common types of road scars:

1. gouges,
2. chips,
3. chops,
4. grooves, and
5. scratches and scrapes.

The shape of the scars can be used to determine the direction of travel of the vehicle. Gouge and chop marks are common types of road scars. Gouge marks go in shallow and come out deep. Chop marks go in deep and come out shallow. In many instances, the road scar will have a curved shape which indicates the rotation of the vehicle after impact.

In many instances, it is important to determine which vehicle caused the road scar and what part of the vehicle caused the scar. It may be possible to inspect the undercarriage of the vehicles and locate evidence of the part of the vehicle causing the road scar. There may be evidence of scraping on a part of the undercarriage or bituminous material may be located on a portion of the undercarriage.

It is important to determine if any of the road scars were made when a damaged vehicle was towed from the scene. This will not be a problem if the pavement scars are documented prior to the vehicles being towed from the scene. The scars should be located using the coordinate measurement procedure and documented with photographs. If the scene is inspected after the vehicles were towed, it may be necessary to determine how the vehicles were towed to ensure that certain scars were not the result of a towing operation.

DEBRIS

Debris is materials found on the roadway as a result of a traffic accident. Debris may be solids or liquids. The following are the most common types of debris to observe and document on the roadway or in the general accident area:

1. underbody debris (mud, rust),
2. vehicle liquid (coolant, oil, fuel),
3. vehicle parts, and
4. cargo (liquid, solid).

Debris is not often a reliable indicator of the point of impact, especially in high speed accidents or accidents involving vehicles having large mass differences. If the vehicle is moving when the debris is dislodged, the debris is also moving and will not drop straight to the ground. Debris is useful in determining the approximate point of impact. In some instances, the debris may not locate the exact point of impact but may be useful in locating the lateral location of a vehicle on the road. For example, if a vehicle hits a pedestrian and breaks a headlight, the location of the glass debris from the headlight will not locate the exact point of impact but will indicate the direction of travel of the vehicle at impact.

The investigator must determine if the debris was deposited at the location found or had been moved. Large debris may be moved to allow vehicles to travel through the accident scene.

**POINT OF IMPACT**

Several types of information may be used to estimate the point or area of impact. In many instances, information is not available to determine the exact point of contact but the area of contact may be determined. Following is a list of the types of evidence used to determine the point of impact.

1. change in direction of tire marks,
2. gouge marks,
3. debris, and
4. vehicle damage.

When a vehicle’s front tire is stopped and driven backward and rotated by a vehicle having more momentum, the tire will deposit a cone shaped mark with the narrow end of the cone pointing toward the point of impact.

When a pre-impact skidmark occurs, the point of impact may be established by following the straight skidmark to a point where there is a change in direction of the tire mark. At this point, the collision forces may result in the tire being forced down into the roadway surface causing a gouge mark. After this point, the tire mark is offset with a post-impact scrub or yaw mark occurring.
COMMON FORMULAS

There are numerous formulas used in the analysis of traffic accidents. This section summarizes some of the more common formulas.

The following basic formula is used to determine the speed to brake to a stop for a given distance and surface coefficient of friction.

\[ S = \sqrt{30 D F} \]  \hspace{2cm} (6)

where:
- \( S \) = speed in mph,
- \( D \) = distance to stop (in feet), and
- \( F \) = coefficient of friction (add or subtract grade).

This same formula may be written in the following manner to give the distance required for a vehicle to brake to a stop from a given speed and surface coefficient of friction.

\[ D = \frac{S^2}{30 F} \]  \hspace{2cm} (7)

In order to use these formulas, the coefficient of friction must be known. Typical values for the coefficient of friction (\( F \)) which may be used in these formulas follow:

- .70 - car skidding on dry asphalt,
- .65 - person sliding on pavement,
- .50 - single-unit truck skidding on dry asphalt,
- .45 - tractor-trailer skidding on dry asphalt,
- .40 - hard braking on dry asphalt with no brake lockup; motorcycle sliding on its side on dry asphalt,
- .35 - car sliding on wet asphalt,
- .35 - vehicle rotating to stop after impact,
- .20 - normal braking, and
- .10 - vehicle sliding on ice.

These values are for skidmarks. The deceleration would decrease if the vehicle is not skidding in a straight path.

The Kentucky Traffic Accident Report Forms Manual contains a table which relates speeds to a skid distance. Following are the deceleration values used to obtain these speeds.
.75 - dry asphalt,  
.65 - wet concrete,  
.65 - deep gravel,  
.50 - wet asphalt,  
.50 - grass,  
.30 - deep snow,  
.30 - shallow gravel, and  
.10 - ice.

Test skids have been used to estimate the coefficient of friction. In many instances, calculating the coefficient of friction (F) by measuring the distance to skid to a stop (D) from a given speed (S) overestimates the value for F. It does not consider the distance traveled during brake system actuation and deceleration over this distance.

The stopping distance for a vehicle consists of the perception-reaction (PR) distance plus the braking distance. The distance required to brake to a stop is given in equation 7. The PR distance (in feet) is equal to the PR time multiplied by the speed (in feet per second). The speed in miles per hour (MPH) must be multiplied by a factor of 1.47. The PR time typically used in accident investigation is 1.5 seconds. The PR time used in highway design is 2.5 seconds. This value is higher than the typical value to account for older drivers and impaired drivers. A PR time as low as 1.0 second may be used if the driver is in an alerted condition. Values over 2.5 seconds have been used in locations where the driver has difficult-to-perceive information. This is termed a decision sight distance.

A fall is defined as a downward and onward movement in the air under the force of gravity after forward momentum carries an object beyond its supporting surface. The following information must be known to estimate the speed from a fall.

1. takeoff approach slope,  
2. vertical drop, and  
3. level distance from take off to first sign of touch down.

The speed to fall from a level takeoff is given by the following formula.

\[
S = \frac{2.74 \, D}{\sqrt{H}}
\]

where:
S = speed in mph,
D = horizontal distance traveled in feet, and
2H = vertical fall in feet.

The formula is modified as follows when the takeoff area has a grade.

\[ S = \frac{2.74 \, D}{\sqrt{H \pm GD}} \]  

where:

G = grade (positive when uphill)  \hspace{1cm} \text{(9)}

A flip is defined as a sudden upward and onward movement off the ground when an object's horizontal movement is obstructed below its center of mass by an obstacle on the surface supporting the object. A vault is an endwise flip where front wheels are stopped by an obstacle high enough and vertical so that the wheel does not roll over it. The speed to flip or vault is given by the following formula.

\[ S = \frac{3.87 \, D}{\sqrt{D \pm H}} \]  

where:

S = speed in mph,
D = horizontal distance in feet, and
H = vertical rise or fall in feet.  \hspace{1cm} \text{(10)}

It is sometimes useful to calculate the time necessary to accelerate from a stop or decelerate to a stop. This time is given by the following formula.

\[ T = 0.25 \sqrt{\frac{D}{F}} \]  

where:

T = time in seconds,
D = distance traveled in feet, and
F = acceleration or deceleration rate (feet per second squared).  \hspace{1cm} \text{(11)}

Typical values (in feet per second squared) to use for an acceleration rate are:
0.15 = normal acceleration for passenger car,
0.30 = rapid acceleration for passenger car,
0.10 = normal acceleration for medium truck, and
0.05 = normal acceleration for loaded large truck.

When the radius of a yawmark is measured using equation 1, the speed necessary to leave such a yawmark can be calculated using the following equation.

\[ S = 3.87 \sqrt{r (f \pm e)} \]  

where:

\[ S = \text{speed in miles per hour}, \]
\[ r = \text{radius in feet}, \]
\[ f = \text{deceleration factor}, \]
\[ e = \text{elevation in line with striations}. \]

In order to correctly use equation 12, an appropriate value must be used for the deceleration rate. The braking efficiency is reduced when tires are traveling in a turn compared to in a straight line. The reduction in braking efficiency is related to the speed and curve radius. For example, for a curve radius of 300 feet and a speed of 45 mph, a braking efficiency of 0.50 has been documented. This means that the values for deceleration in this equation must be lower than that used for a typical analysis of a skidmark.

In many instances, when determining the speed of a vehicle at a given location, deceleration from more than one source must be used. When this occurs, the initial speed from multiple speed losses must be determined. The following formula is used.

\[ S = \sqrt{A^2 + B^2 + C^2} \]  

where:

\[ S = \text{speed in mph (combined)}, \]
\[ A = \text{first speed loss}, \]
\[ B = \text{second speed loss}, \]
\[ C = \text{third speed loss}. \]

There is no limit for the number of speed loss components which may be combined using this type of analysis.
In some instances, the time required for a vehicle to increase or decrease velocity may be used in the analysis. The following formula may be used to determine this time.

\[ T = \frac{V_1 - V_2}{32.2 \cdot F} \]  

where:

- \( T \) = time to increase or decrease velocity,
- \( V_1 \) = highest velocity in fps,
- \( V_2 \) = lowest velocity in fps, and
- \( F \) = deceleration or acceleration rate.

A common method of determining impact speed is to use the principal of conservation of linear momentum. To use this procedure, the angles of approach and departure of both vehicles must be known as well as the weights of the vehicles, the distances traveled by both vehicles after impact and the deceleration of both vehicles after impact. The following formula can then be used.

\[ w_1v_1 + w_2v_2 = w_1v_3 + w_2v_4 \]

where:

- \( w_1 \) = weight of vehicle 1 (pounds),
- \( w_2 \) = weight of vehicle 2,
- \( v_1 \) = speed of vehicle 1 at impact (miles per hour),
- \( v_2 \) = speed of vehicle 2 at impact,
- \( v_3 \) = speed of vehicle 1 after impact, and
- \( v_4 \) = speed of vehicle 2 after impact.
SUMMARY

This report gives information which will assist an accident investigator in completing Kentucky's uniform traffic accident report and documenting the accident scene. The basic information needed to be included in the accident report is described with details concerning additional information which should be provided for various types of accidents. For example, a list of the types of information which would be beneficial in an accident occurring during nighttime conditions is given. Information concerning the vehicle (such as amount of crush or tread depth) and characteristics of the road (such as the location of signs) which may be needed in certain accidents is listed. Additional information to document contributing factors noted on the report (such as available sight distance when a view obstruction is listed) is discussed.

The proper method to obtain accident scene measurements is noted. The coordinate method is described. Typical roadway measurements needed in the investigation of traffic accidents are listed. Material describing types of tire marks and road scars is given. Information which may be obtained from debris is discussed. Methods of identifying the point of impact are discussed. Common formulas used in the analysis of the data obtained from the documentation of a traffic accident are given.