TRAFFIC ACCIDENT STUDY GUIDE 2010

SECTION FOUR

This study guide is designed to provide the law enforcement Explorer with basic principles. The guide is not all inclusive, and does not delineate specific techniques that must be used. The focus of this guide is to provide principals that are flexible and adaptable to various law enforcement situations.

Following the basic principals in this guide should allow the law enforcement Explorer to successfully handle various law enforcement training activities safely and professionally.

The study guide was developed through the cooperation of International Association of Chiefs of Police and the Federal Law Enforcement Training Center.

SECTION FOUR

TRAFFIC TEMPLATE

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SYLLABUS

COURSE TITLE: Traffic Template

LENGTH OF PRESENTATION

LECTURE	LAB	PE	TOTAL	PROGRAM
2:00			2:00	

DESCRIPTION:

This course of instruction will enable the student to become familiar with the various features, uses, and functions of the Northwestern Accident Investigator's Traffic Template.

TERMINAL PERFORMANCE OBJECTIVE (TPO):

The student will be able to identify and use the different traffic template cutouts used for diagramming purposes; the various scales used to determine speed, drag factor, or skidding distance; and be able to use the template as a clinometer in determining the grade or superelevation of the road surface. Additionally, the student will be able to identify and use the different scales on the radius calculator.

ENABLING PERFORMANCE OBJECTIVES (EPO):

EPO #1: Identify the various traffic template scales and cutouts used for diagramming purposes.

EPO #2: Identify the traffic template speed nomograph and demonstrate familiarity with its use to determine speed, drag factor, and skidding distance when given two of the three required known quantities. Identify the mathematical calculations performed by the nomograph.

EPO #3: Identify the use of the radius nomograph to determine the radius of a circle or arc, and demonstrate the ability to determine and calculate radiuses using both the nomograph and/or mathematical calculations.

EPO #4: Demonstrate the use of the traffic template as a clinometer to determine the grade or superelevation of a road surface.

STUDENT SPECIAL REQUIREMENTS:

1. Participate in classroom discussions.

2. Take notes as desired.

3. Review instructions on "How to Use the Traffic Template" provided in the template envelope.

Instructor Guide

METHODOLOGIES:

1. Lecture.
2. Discussion.
3. Demonstration.

TRAINING AIDS/EQUIPMENT:

1. Instructor:
    a. Classroom and lesson plan.
    b. Writing board or lecture pad with markers.
    c. Traffic Accident Template
    d. Clipboard.
    e. Vugraph and transparencies.
    f. Radius nomograph.
    g. Mathematical calculator.
    h. Computer and overhead projection.
2. Student:
    a. Note taking materials.
    b. Traffic template.

INSTRUCTOR SPECIAL REQUIREMENTS:

None.

Outline of Instruction

I. INTRODUCTION

A. Rapport and Opening Statement.

1. There is probably no one tool more valuable to the traffic accident investigator than the traffic template.

2. With this one piece of equipment the trained investigator will be able to draw scale diagrams, compute speeds of vehicles, determine drag factors of road surfaces, change miles per hour into feet per second, determine the angle of roadway intersections, and, with a slightly modified clipboard, be able to determine road grades and superelevations.

B. Lesson Plan Overview.

1. Terminal Performance Objective.

The student will be able to identify and use the different traffic template cutouts used for diagramming purposes; the various scales used to determine speed, drag factor, or skidding distance; and be able to use the template as a clinometer in determining the grade or superelevation of the road surface. Additionally, the student will be able to identify and use the different scales on the radius calculator.

2. Enabling Performance Objectives.

a. EPO #1: Identify the various traffic template scales and cutouts used for diagramming purposes.

b. EPO #2: Identify the traffic template speed nomograph and demonstrate familiarity with its use to determine speed, drag factor, and skidding distance when given two of the three required known quantities.

c. EPO #3: Identify the use of the radius nomograph to determine the radius of a circle or arc, and demonstrate the ability to determine and calculate radiuses using both the nomograph and/or mathematical calculations.

d. EPO #4: Demonstrate the use of the traffic template as a clinometer to determine the grade or superelevation of a road surface.

II. PRESENTATION

A. EPO #1: Identify the various traffic template scales and cutouts used for diagramming purposes.

1. **Template scales:** The two straight edges of the template are used for drawing straight lines and each straight edge has a different engineering scale for diagram measuring.

   a. **Long edge -** commonly referred to as the as the "<u>large</u>" scale.

      (1) It is represented as 1 in. = 10 ft.

      (2) This scale can also be represented as **1:120** (one inch equals 120 inches).

   b. **Short edge -** commonly referred to as the "<u>small</u>" scale.

      (1) It is represented as 1 in. = 20 ft.

      (2) This scale can also be represented as **1:240** (one inch equals 240 inches).

2. **Diagramming cut-outs:** You will notice that the template contains various cut-outs for both the large and small scales. Many of these are the same, with the exception of their size. Usually, but not in every case, whenever you have a cut-out for the large scale, there is a corresponding cut-out on the small scale. Some of the cut-outs of particular importance are;

   a. **Vehicle cut-outs**:

      (1) Large or full size vehicle.

      (2) Mid-sized vehicle.

      (3) Compact vehicle.

      (4) Tractor.

      (5) Trailer.

      (6) Motorcycle (only one size on template).

   b. **Other cut-outs**:

      (1) North Arrow **-** used to indicate NORTH on scale diagram.

(2) Sign Symbol **-** used to indicate traffic control signs (stop, yield, speed, etc.).

(3) Circles of various diameters **-** used to draw such items as light poles, fire hydrants, manhole covers, etc. Notice that on each of the circle cut-outs, the **radius** of the circle is provided in both the large and small scales.

3. **Protractor:** One end of the template is graduated into **degrees** up to a right angle (90 degrees). This feature of the template is particularly useful for measuring or drawing the angle at which two roads intersect.

4. **Curve radius cutouts:** Within the area of the protractor there are several commonly used radius cut-outs. These are used to draw curves rather than having to use a drawing compass. The radiuses are marked for both large and small scales.

5. **Corners of the template:** Three of the four corners of the template have different radiuses in both the large and small scales.

B. EPO #2: Identify the traffic template speed nomograph and demonstrate familiarity with its use to determine speed, drag factor, and skidding distance when given two of the three required known quantities.

1. **Nomograph definition:** A nomograph is a graph consisting of three scales whereby a straight line drawn through all three scales intersects the related value of each scale. In other words, <u>you can always find an unknown value on one scale if two of the values of the other scales are known.</u>

2. **Skidding or sliding distance scale:** On the **left** side of the template you will find a scale from 3 feet to 1300 feet, read from bottom to top. These numbers correspond to the average skidding distance of either an accident or test skid vehicle.

3. **Speed scale:** The **middle** scale of the nomograph enables you to convert miles per hour (**right side** of the scale) to feet per second, or velocity (**left** side of scale). For the most part, the majority of work in this class will be accomplished by using the miles per hour, right side of this scale.

4. **Drag factor and acceleration/deceleration scale:** The scale to the extreme right of the template, like the middle scale, also has two corresponding values. The **left** of the scale represents the acceleration or deceleration of a vehicle in feet per second squared

(or g factor), and the **right** side of the scale represents drag factor (f). The majority of work in this class will deal with the **right side** of this scale - **drag factor**.

5. **Practice problems:** As stated earlier, a nomograph will enable you to find an unknown third value if two of the three values are given. In order to use the nomograph, you must begin by drawing a **<u>fine</u>** straight line on a plain piece of paper. You can use a straight edge, such as a ruler, or the edge of a piece of paper. **When intersecting the three scales, it is important to look straight down onto the template in order to obtain correct values.**

6. **Speed problems:**

   a. **Exercise #1:**

      (1) Locate **.70** (drag factor) on the **right side of the right hand scale**.

      (2) Locate **58 feet** (distance) on the **left-hand** scale.

      (3) Determine minimum **speed** on the **right side** of the **middle scale** in mph (**35**) (do not read the left side, which gives you feet per second).

   b. **Exercise #2:**

      (1) Locate **.78** on the drag factor scale.

      (2) Locate **107** feet on the distance scale.

      (3) Determine minimum speed **(50 mph)** on the speed scale.

   c. **Exercise #3:**

      (1) Locate **.85** on the drag factor scale.

      (2) Locate **150** feet on the distance scale.

      (3) Determine minimum speed **(63 mph)**.

7. **Drag factor problems:**

   a. **Exercise #1:**

(1) Given a vehicle traveling **30 mph** and sliding **45 feet** after locking the brakes, determine the drag factor of the road surface. Locate 45 feet on the **left-hand** (distance) scale.

(2) Locate **30 mph** on the **right-side of the middle scale.**

(3) Determine drag factor **(.66)** on the **right side** of the **right-hand** scale.

b. **Exercise #2:**

(1) Locate **60 feet** on the distance scale.

(2) Locate **45 mph** on the speed scale.

(3) Determine drag factor **(1.12)** on the drag factor scale.

c. **Exercise #3:**

(1) Locate **100 feet** on the distance scale.
(2) Locate **35 mph** on the speed scale.

(3) Determine drag factor **(.40)** on the drag factor scale.

8. **Skidding distance problems:**

a. **Exercise #1:**

(1) How far will a vehicle slide before coming to a stop when traveling **45 mph** on a road surface with a drag factor of **.70**? Locate **.70** on the drag factor scale.

(2) Locate **45 mph** on the **speed scale.**

(3) Determine skidding distance on the distance scale **(96 feet)**.

b. **Exercise #2:**

(1) Locate **.85** on the drag factor scale.

(2) Locate **65 mph** on the speed scale.

(3) Determine skidding distance **(165 feet)** on the distance scale.

c. **Exercise #3:**

(1) Locate **.40** on the drag factor scale.

(2) Locate **65 mph** on the speed scale.

(3) Determine skidding distance **(355 feet)** on the distance scale.

> **NOTE:** At this point you could call to the attention of the class how drag factor will affect stopping distances. As the speeds in Exercise 2 and 3 were the same, there is a great deal of difference in the drag factor.

9. **Using mathematical calculations to determine speed, drag factor and distance problems.**

> **NOTE:** It is **not** a requirement of this course that the students be able to calculate speed, distance, or drag factor derived from mathematical formulas, this information is provided for **familiarity purposes** only.

a. **Speed problems** (using formulas):

$S = 5.5\sqrt{df}$ **or** $S = \sqrt{30}df$

(1) Using the same figures used in previous nomograph speed calculations, demonstrate to the class the computation of speed estimates using the formula and a mathematical calculator.

(a) **Exercise #1:**

d = 58 feet
f = .70
S = 35.04 mph

(b) **Exercise #2:**

d = 107 feet
f = .78
S = 50.24 mph

(c) **Exercise #3:**
d = 150 feet

f = .85
S = 62.10 mph

b. **Drag factor** (using formula):

$$f = \frac{S^2}{30d}$$

(1) Using the same figures used in previous nomograph drag factor calculations, demonstrate to the class the computation of drag factor estimates using the formula and a mathematical calculator.

(a) **Exercise #1:**

S = 30 mph
d = 45 feet
f = .66

(b) **Exercise #2:**

S = 40 mph
d = 60 feet
f = .88

(c) **Exercise #3:**

S = 35 mph
d = 100 feet
f = .40

c. **Distance calculations** (using formula):

$$d = \frac{S^2}{30f}$$

(1) Using the same figures used in previous nomograph distance calculations, demonstrate to the class the computation of distance using the formula and a mathematical calculator.

(a) **Exercise #1:**

S = 45 MPH
f = .70

d = 96.42

(b) **Exercise #2:**

S = 65 MPH
f = .85
d = 165.68 feet

(c) **Exercise #3:**

S = 65 MPH
f = .40
d = 352.08 feet

C. EPO #3: Identify the use of the radius nomograph to determine the radius of a circle or arc, and demonstrate the ability to determine and calculate radiuses using both the nomograph and/or mathematical calculations.

1. **Radius nomograph/calculator (handout).**

a. **Radius nomograph:** A nomograph consists of three scales so arranged that a straight line drawn through two known values will intersect the third scale at the unknown (sought) value. In accident investigation, you will be required to calculate the radius of a circle on at least two different occasions.

(1) When computing the **radius of a skid mark** to determine speed in a centrifugal skid.

(2) When computing radiuses, such as **curbs** at road intersections, etc.

b. **Radius:** The distance from the center of a circle to a point on its perimeter.

c. **Chord:** A straight line connecting the ends of an **arc**, or two points on a curve.

d. **Middle ordinate:** The **perpendicular** distance between an arc and its chord at the **middle of the chord**.

e. **Radius nomograph scales:**

(1) The **left-hand** scale consists of full chord measurements on the left-side and half-chord measurements on the right-side. We will be primarily working with the **full chord** measurement on the **left-**

side of this scale.

(2) The **middle scale** consists of a **middle ordinate** measurement in feet on the left-side and in inches on the right-side. In most cases, you will be using the **left-side** of the scale (**feet**).

(3) The **right-hand** scale consists of **radius** measurements depicted in **feet**. By knowing the **chord** and the **middle ordinate** measurements, the **radius** can be determined by using this nomograph.

2. **Practice problems:**

a. **Exercise #1:**

(1) Given a chord measurement of **100 feet**, and a middle ordinate measurement of **6 feet**, determine the radius of the circle;

(a) Locate **100 feet** on the **left-hand** scale.

(b) Locate **6 feet** on the **middle** scale.

(c) With a straight edge (template), determine the **radius** of the circle **(211 feet)**.

b. **Exercise #2**:

(1) Given a chord measurement of **50 feet**, and a middle ordinate measurement of **1 foot**, determine the radius of the circle;

(a) Locate **50 feet** on the **left-hand** scale.

(b) Locate **1 foot** on the **middle** scale.

(c) With a straight edge (template), determine the **radius** of the circle **(313 feet)**.

3. **Using mathematical calculations to determine radiuses.**

NOTE: It is **not** a requirement of this course that the students be able to calculate radiuses derived from mathematical formulas, this information is provided for **familiarity purposes** only.

$$R = \frac{C^2}{8M} + \frac{M}{2}$$

b. **Practice problems:**

(1) Using the same figures provided for radius calculations with the nomograph, demonstrate to the class the mathematical calculations to determine radiuses by using the radius formula and mathematical calculator.

(a) **Exercise #1:**
C = 100 feet
M = 6 feet
R = 211 feet

(b) **Exercise #2:**
C = 50 feet
M = 1 foot
R = 313 feet

C. EPO #4: Demonstrate the use of the traffic template as a clinometer to determine the grade or superelevation of a road surface.

1. **Definition:** A clinometer is a device used to measure grade or superelevation of the road surface. We will now show you how to determine either of these by using your template and a clipboard modified for such purpose (**refer students to page 15, "How to Use the Traffic Template" booklet**).

NOTE: The students should know why Superelevation and grade is important. **Grade**, as read from the template, is the rise or fall vertically in feet per foot of horizontal distance, this is read as the **grade figure** not the **percent** of the grade. To express the grade in percent, multiply the grade reading by one hundred (e.g., +.10 is a 10% percent upgrade).

2. **Measuring grade:** The grade is the rise or fall of a road (in the direction of travel). The grade determines if the vehicle was going **up-hill** or **down-hill**. The **grade figure** must be added to, or subtracted from, the coefficient of friction of the surface to get the effective drag factor.

a. Place a pencil through the **pivot hole** in the template.

b. Place the pencil into the hole on the clipboard, assuring the template will swing freely.

c. Place the edge of the clipboard, **pivot hole and pencil at the top**, on the pavement parallel to, or on, the centerline of the road.

d. Allow the template to swing to a neutral position. Grasp the template and clipboard firmly to hold the template in its neutral position.

e. Read the grade of the road surface (**plus or minus**) on the bottom of the template at the point where the line on the clipboard crosses the grade or superelevation scale.

3. **Measuring superelevation: Superelevation** is the grade across the roadway at right angles to the center line from the inside to the outside edge on a curve, or expressed as the **rise or fall** of the road **perpendicular** to the direction of travel (**banking of the road**). Superelevation affects the speed at which a vehicle may safely round a curve. The procedures for measuring the superelevation are identical to those for measuring grade, except the edge of the clipboard is placed at a **right angle** to the centerline of the road.

4. **Measuring grade or superelevation on uneven road surfaces:** When the road surface is too uneven to accommodate the use of the clipboard on the road surface, hold the clipboard using the line-of-sight method. **DEMONSTRATE METHOD TO CLASS.**

III. SUMMARY

A. Review performance objectives.

EPO #1: Identify the various traffic template scales and cutouts used for diagramming purposes.

EPO #2: Identify the traffic template speed nomograph and demonstrate familiarity with its use to determine speed, drag factor, and skidding distance when given two of the three required known quantities. Identify the mathematical calculations performed by the nomograph.

EPO #3: Identify the use of the radius nomograph to determine the radius of a circle or arc, and demonstrate the ability to determine and calculate radiuses using both the nomograph and/or mathematical calculations.

EPO #4: Demonstrate the use of the traffic template as a clinometer to determine the grade or superelevation of a road surface.

B. Review the teaching points.

As we have seen the template is a truly versatile piece of equipment. In the hands of a trained investigator it can be used to render scale diagrams in either of two scales. It contains cut outs to assist in drawing, as well as a multitude of scaled curves and circles with the scaled radii inscribed. It has a protractor for angular measurements as well as a nomograph for computation of speed, distance, drag factor, velocity in feet per second or feet per second squared. When used with an adapted clipboard it will yield measurements of grade and superelevation in percent to an accuracy of .015.

C. Practical Exercise.

None.

REFERENCES

Baker, J. Stannard, (1975). Traffic Accident Investigation Manual, published by the Traffic Institute, Northwestern University, Second Edition 1987.

Rivers, R. W., (1986). Traffic Accident Investigation - A Training and Reference Manual, Institute of Police Technology and Management, University of North Florida, Charles C. Thomas Publisher.

U.S. Department of Transportation, (1971). Manual on Uniform Traffic Control Devices, Federal Highway Safety Administration, Washington, DC: U.S. Government Printing Office.