



Introduction to Traffic Signals

An Online Continuing Education Course for Engineers

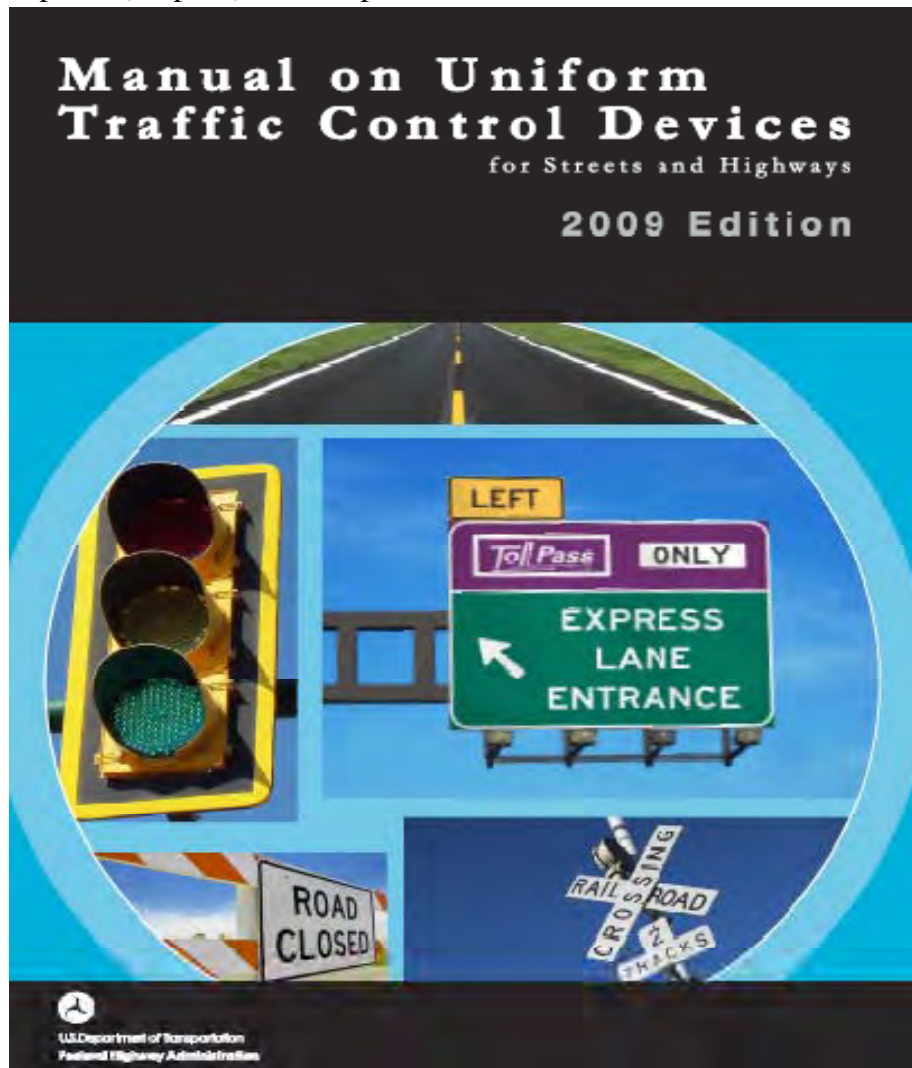
Course Number: T-3002

Credit: 3 Hours / 3 PDH / 3 CPD

INTRODUCTION TO TRAFFIC SIGNALS

This Traffic Signal Design course provides an introduction to intersection control, with an emphasis on the use of traffic signals. Also included in this course is a discussion of MUTCD requirements and safety concerns relative to intersection control and traffic signal operation.

The primary national reference document with respect to traffic signals is the Manual on Uniform Traffic Control Devices (commonly referred to as the "MUTCD"), which is published by the Federal Highway Administration. The first MUTCD was published in 1935 with updated manuals being produced on an intermittent basis at roughly ten year intervals. The most recent MUTCD has 9 "parts" (chapters) and was published in 2009.



Introduction to Traffic Signals by Jeffrey W. Buckholz, PhD, PE, PTOE

PART 1: GENERAL

Part 1 of the MUTCD discusses the purpose of traffic control devices, outlines the responsibility for traffic control devices, and describes how the manual is updated. Definitions and standard abbreviations are also provided for words and phrases used in the manual.

The MUTCD states that the purpose of traffic control devices, including traffic signals, is to: "...promote highway safety and efficiency by providing for the orderly movement of all road users on streets, highways, bikeways, and private roads open to public travel throughout the Nation." The key to ensuring "orderly and predictable movement" is the use of uniform traffic control devices, that is, standard devices that treat similar situations in the same way. For this reason, the use of unique or custom made devices is generally considered undesirable. It is important to understand that uniformity can also be lost if a standard device is used in a nonstandard location, such as would be the case if a traffic signal were inappropriately installed on a freeway mainline.

The clause "private roads open to public travel" is a new clause in the 2009 MUTCD and indicates that the requirements of the MUTCD must now be met in private facilities such as roads serving shopping centers, airports, sports arenas and other similar business or recreational facilities. However, it does not include parking lot aisles or roads within gated residential communities.

Design, placement, operation, and maintenance of traffic control devices are the responsibilities of the agency having official jurisdiction over the area in question. In most cases this is the state, county, or city with federal agencies having little direct involvement. The major exception is on military bases where federal agencies do play a direct role. Responsibilities with respect to traffic control devices are typically spelled out in legislation and intergovernmental agreements; and it is common for areas of responsibility to be allocated amongst more than one agency. For example, state law might require that the state design and construct all traffic signals located on state highways with the local city or county being responsible for operation and maintenance of these signals. The MUTCD allows states to develop their own manual on traffic control devices. However, the MUTCD requires that the state manual be "in substantial conformance" with the federal MUTCD.

The MUTCD makes it clear that, although the manual provides standards for the application and design of traffic control devices, it is not a substitute for sound engineering judgment. Qualified engineers are still needed to properly locate and design traffic control devices. This is especially true in the case of traffic signals where placement, design and timing involve relatively complex issues.

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The MUTCD uses the verbs "Shall", "Should", and "May" to denote the requirement for varying degrees of conformity with its directives. "Shall" is the most restrictive term, indicating a mandatory condition that must be met. Such mandatory conditions are referred to as "Standards". An example standard is: "A yellow signal indication shall be displayed following every circular green or green arrow signal indication." "May" is the least restrictive term, indicating a permissive condition that leaves the choice to the designer. Such permissive conditions are referred to as "Options". An example option is: "Pushbutton locator tones may be used with accessible pedestrian signals". It is left up to the discretion of the designer as to whether or not to use locator tones. "Should" is an advisory condition which recommends that a certain action be taken, but does not require it. Such advisory conditions are considered "Guidance". An example of such guidance is: "Traffic control signals within 1/2 mile of one another along a major route or in a network of intersecting major routes should be coordinated". The indication is that this is a highly desirable thing to do; however, for one of many valid reasons, the designer may decide that it is best not to coordinate a given pair of signals that are within 1/2 mile.

The MUTCD permits any person or organization to submit to the Federal Highway Administration (FHWA) a request for a change. This change might involve modification of an existing device, the use of a new device, or changes to the way in which a device is applied. Although many changes have been granted by the FHWA, in most past cases the requested change has been considered unnecessary and has been rejected to preserve uniformity.

If any agency desires to experiment with a new traffic control device, such as field deploying a new device for the purpose of testing it, they must file a request with the FHWA. The FHWA may or may not permit the requested experimentation.

The FHWA also provides written interpretations as to the exact meaning of requirements contained within the MUTCD.

PART 2: SIGNS

Part 2 of the MUTCD discusses signing standards and is divided into 14 sections:

- A. General Standards
- B. Regulatory Signs, Barricades and Gates
- C. Warning Signs and Object Markers
- D. Guide Signs on Conventional Roads
- E. Guide Signs on Freeways and Expressways
- F. Toll Road Signs

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- G. Preferential and Managed Lane Signs
- H. General Information Signs
- I. General Service Signs
- J. Specific Service Signs
- K. Tourist Oriented Directional Signs
- L. Changeable Message Signs
- M. Recreational and Cultural Interest Area Signs
- N. Emergency Management Signing

Unique colors and shapes are used to differentiate the various types of road signing. Signs (such as “SIGNAL AHEAD” or “NO TURN ON RED”) are often an integral part of a traffic signal installation and guidance is provided in this part of the MUTCD on the proper application of these signs.

PART 3: MARKINGS

Part 3 of the MUTCD discusses pavement and curb marking standards. Included in this section are pavement marking standards for crosswalks, stop lines, and pavement arrows at signalized intersections. Sections are also provided that deal with the use of object markers, delineators, colored pavements, channelizing devices, and islands.

PART 4: TRAFFIC SIGNALS

Part 4 of the MUTCD discusses the operation of traffic signals and the nine traffic signal warrants that are used to evaluate the need for a traffic signal installation. Sections are also provided dealing with pedestrian signals, emergency vehicle signals, signals at freeway entrance ramps, signals at moveable bridges, signals at toll plazas, signals on one-lane roads, and lane use control signals. In addition, information is provided on the use of flashing beacons and in-roadway lights.

PART 5: LOW-VOLUME ROADS

Part 5 of the MUTCD discusses traffic control devices for Low-Volume Roads. A low volume road is defined as either a paved or unpaved facility lying outside of the built-up areas of cities, towns and communities and having a traffic volume of less than 400 vehicles per day. Freeways, expressways, interchanges ramps, and freeway service roads are excluded. Also excluded are roads on a designated State Highway System and streets within a residential neighborhood.

PART 6: TEMPORARY TRAFFIC CONTROL

Part 6 of the MUTCD discusses measures for safely controlling traffic during construction, maintenance or utility work. Sections are included on pedestrian and worker safety, flagging, work zone signing, work zone barricades, work zone pavement markings, control of the work zone for nighttime work, detours, and lane closures. A section on emergency situations (such as a natural disaster) has information on how to control traffic through areas affected by such events. Information on the proper way to handle a shoulder closure, shoulder closure on a highway, and so on..

PART 7:

Part 7 of the MUTCD discusses measures for safely controlling traffic during construction, maintenance or utility work. Sections are included on pedestrian and worker safety, flagging, work zone signing, work zone barricades, work zone pavement markings, control of the work zone for nighttime work, detours, and lane closures. A section on emergency situations (such as a natural disaster) has information on how to control traffic through areas affected by such events. Information on the proper way to handle a shoulder closure, shoulder closure on a highway, and so on..

PART 8:

Part 8 of the MUTCD discusses measures for safely controlling traffic during construction, maintenance or utility work. Sections are included on pedestrian and worker safety, flagging, work zone signing, work zone barricades, work zone pavement markings, control of the work zone for nighttime work, detours, and lane closures. A section on emergency situations (such as a natural disaster) has information on how to control traffic through areas affected by such events. Information on the proper way to handle a shoulder closure, shoulder closure on a highway, and so on..

PART 9: BICYCLE FACILITIES

Part 9 of the MUTCD discusses measures for safely controlling traffic during construction, maintenance or utility work. Sections are included on pedestrian and worker safety, flagging, work zone signing, work zone barricades, work zone pavement markings, control of the work zone for nighttime work, detours, and lane closures. A section on emergency situations (such as a natural disaster) has information on how to control traffic through areas affected by such events. Information on the proper way to handle a shoulder closure, shoulder closure on a highway, and so on..

