National Committee on
Uniform Traffic Control Devices

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National Committee on Uniform Traffic Control Devices (NCUTCD) Recommended Changes to Proposed Text for 11th Edition of the MUTCD Docket Number: FHWA-2020-0001

Federal Register Item Number: 448 to 452
NPA MUTCD Section Numbers: Chapter 5A
Legend: Base text shown in proposal is the NPA "clean" proposed text.

- NCUTCD recommendation for text to be added in final rule.
- ~~NCUTCD recommendation for text to be deleted in final rule~~.
- NCUTCD recommendation for text to be moved/relocated in final rule.
- NPA text that was not previously approved by NCUTCD but is now approved.
- Explanatory note: [Note that explains purpose of recommended change.]

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The following pages present NCUTCD recommendations for changes to the MUTCD NPA proposed text for Chapter 5A. Below is a summary of the NCUTCD position for each section of this chapter. A more detailed summary is provided at the beginning of each section.

NPA #448, Part 5: Changes recommended based on Council action in virtual meetings in spring 2021.
NPA #449, Section 5A.01: Changes recommended based on Council action in virtual meetings in spring 2021.
NPA #450, Section 5A.02: Changes recommended based on Council action in virtual meetings in spring 2021.
NPA #451, Section 5A.03: Changes recommended based on Council action in virtual meetings in spring 2021.
NPA #452, Section 5A.04: Changes recommended based on Council action in virtual meetings in spring 2021.

PART 5 – AUTOMATED VEHICLES

Part 5 Comments: This is a new Part added to the MUTCD in the NPA. NCUTCD recommends all of Part 5 be revised from Standard, Guidance, or Option to Support so agencies can obtain information they can use to prepare their network for Automated Vehicles (AVs) and continue to be in compliance with the Manual without the burden of having to conform to new provisions in Part 5 different from those in other parts of the MUTCD.

CHAPTER 5A. GENERAL

Section 5A.01 Comments: NCUTCD recommends revising 5A.01 as follows:

- Revise the first Support paragraph to identify driving automation system (AV) subcategories ADAS and ADS, all three of which are defined in Section 5A.03

- Delete maintenance-level content in the third Support paragraph since some maintenance levels for traffic control devices are standardized elsewhere within the MUTCD in Sections 1D.12, 2A.18, 4A.10, among others
- Other edits as needed for clarity

Section 5A.01 Purpose and Scope

Support:

The purpose of this Chapter is to provide agencies with general considerations as they work to support the safe integration of Advanced Driver Assistance Systems (ADAS) and Automated Driving Systems (ADS), collectively known as Automated Vehicles (AVs), into their surface transportation network. ~~for vehicle automation as they assess their infrastructure needs, prepare their roadways for automated vehicle (AV) technologies, and to support the safe deployment of automated vehicle technology.~~ [revise to identify driving AV, ADAS and ADS]

This Chapter provides an overview of foundational AV technology terminology, key principles, considerations for traffic control device selection, and other topics for agencies to consider. The MUTCD does not address standardizing several areas that might be important to AV technologies such as digital infrastructure, geometric road design, ~~setting maintenance levels for all traffic control devices,~~ and setting minimum condition levels for paving materials. [delete maintenance level content]

It is important for early implementers of automated vehicles to understand the ramifications of traffic control devices in a mixed fleet environment and to consider the needs of both human ~~and machine led~~ road users and AVs. Partial automation or ADAS technologies are already commercially available in the vehicle fleet and are operating under current infrastructure conditions. The overall effectiveness of ~~the automation is impacted by the~~ these technologies benefit from system uniformity and consistent application of the highway infrastructure, including traffic control devices. [edited for clarity]

Section 5A.02 Comments: NCUTCD agrees with 5A.02 as presented in the NPA, but recommends minor editorial revisions.

Section 5A.02 Overview of Connected and Automated Vehicles

Support:

Connected vehicle technology enables cars, buses, trucks, trains, roads and roadside infrastructure, as well as other devices such as cellular telephones, to communicate with one another. This technology enables every vehicle on the road to be aware of where other nearby vehicles are. Drivers ~~would~~ could receive notifications and alerts of dangerous situations, such as a vehicle about to run a red traffic signal as it nears an intersection or an oncoming car, out of sight beyond a curve, swerving into the opposing lane to avoid an object on the road.

AV technology automates some or all aspects of the driving tasks to assist or replace the human vehicle operator. Automat~~ed~~ing ~~vehicle~~ features may include adaptive cruise control, adaptive headlights, automatic emergency braking, lane tracking assist, or other technology-based ~~features~~ systems used to control some or all aspects of the vehicle. AVs are vehicles in which at least one element of vehicle control (e.g. steering, speed control, braking) occurs without direct driver input. AVs work by gathering information from a suite of sensors such as:

A. Cameras;
B. Radar;
C. Light detection and ranging (LiDAR);
D. Ultrasonic; and
E. Infrared.

AVs may combine sensor data with other inputs including detailed map data and information from other connected vehicles or infrastructure. AVs may be able to detect and classify objects in their surroundings and may predict how they are likely to behave.

Section 5A.03 Comments: NCUTCD generally agrees with 5A.03 as presented in the NPA, but recommends revisions as follows:

- Add wording to line item B noting ADAS is generally associated with Level 1 or 2 automated vehicles.
- Revise line item E to change the definition from DAS to "Driving automation system (AV)". SAE J3016 (JUN 2018) includes a footnote under 3.2 Automated Driving Systems (ADS) that requests that DAS not be used as an acronym for driving automation systems. In USDOT's Automated Vehicle 3.0, Appendix A, the term Automated Vehicle (AV) is defined as: "Any vehicle equipped with driving automation technologies (as defined in SAE J3016). The MUTCD should either use the term "driving automation system" when referring to the full scope of automating technologies, or the acronym "AV."
- Replace DAS with "driving automation system (AV)" in line item G.

Section 5A.03 Definitions and Terms

Support:

The following definitions and terms, found in the Society of Automotive Engineers standard SAE J3016 and other sources, are used extensively in automated vehicle technology. Their definitions are summarized for reference and for use with the provisions of this Manual:

A. Automated Driving Systems (ADS) - The hardware and software that are collectively capable of performing the entire dynamic driving task (DDT) on a sustained basis, regardless of whether it is limited to a specific operational design domain (ODD); this term is used specifically to describe a level 3, 4, or 5 driving automation system (DAS).

B. Advanced Driver Assistance Systems (ADAS) – are electronic systems that aid a vehicle driver with one or more driving tasks while driving. They are intended to increase safe operation of a vehicle and includes applications such as automatic braking, lane keep assistance, adaptive cruise control, and others. ADAS is often used to describe a level 1 or Level 2 Automated Vehicle (AV). [Text added to improve understanding.]

C. Automation Levels:

1. Level 0 - The full-time performance by the human driver of all aspects of the DDT, even when enhanced by warning or intervention systems.
2. Level 1 - The driving mode specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the DDT.
3. Level 2 - The driving mode specific execution by one or more driver assistance systems of both steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the DDT.
4. Level 3 - The driving mode specific performance by an ADS of all aspects of the DDT with the expectation that the human driver will respond appropriately to a request to intervene.
5. Level 4 - The driving mode specific performance by an ADS of all aspects of the DDT, even if a human driver does not respond appropriately to a request to intervene.
6. Level 5 - The full-time performance by an ADS of all aspects of the DDT under all roadway and environmental conditions that can be managed by a human driver.

D. Cooperative Automation – technology that enables communication with other vehicles and the infrastructure to coordinate automated vehicle operation.

E. ~~DAS~~ Driving automation system (AV) - The hardware and software that are collectively capable of performing part or all of the DDT on a sustained basis; this term is used generically to describe any system capable of level 1 - 5 driving automation. This full spectrum of automating technologies is differentiated within this document by the term Automated Vehicle (AV). [revise definition]

F. DDT - All of the real-time operational and tactical functions required to operate a vehicle in on-road traffic, excluding the strategic functions such as trip scheduling and selection of destinations and waypoints.

G. ODD - Operating conditions under which a given ~~DAS~~ driving automation system (AV) or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics. [revise definition]

Section 5A.04 Comments: NCUTCD generally agrees with 5A.04 as presented in the NPA, but recommends revisions as follows:

- Revise all references to DAS to AV or AVs.
- Revise first Guidance paragraph to Support (see general Part 5 comment) and delete reference to Section 1A.12 (not in NPA)
- Delete second Guidance paragraph since this is adequately address elsewhere in the chapter
- Extensively revise the final Support statement for simplicity and clarity

Section 5A.04 Traffic Control Device Design and Use Considerations

Support:

The interaction of traffic control devices with ~~DAS~~ AVs can create many challenges for agencies in determining traffic control device selection and application. The lack of tolerance of ~~DAS~~ AVs for nonuniformity in traffic control device design and application is a limiting factor of current ~~DAS~~ AV sophistication, i.e. Current AV technologies ~~DAS~~ ~~has~~ have limited ability to interpolate across gaps in traffic control device cues to the vehicle in the following situations:

A. The ~~DAS~~ AV technologies' ability to adapt to existing traffic control device design and typical quality,e.g. the refresh rates of electronic changeable message sign displays or the overall quality of a device that has been out on the roadway for many years;

B. The color perception of signs;

C. The electronically perceptible conspicuity and contrast of markings in different environments and lighting conditions;

D. The ~~DAS~~ AV camera technologies and device photometric characteristics in reading various types of traffic signals;

E. The ability to discern and comprehend temporary traffic control devices and their varying applications, e.g. active electronic display devices, flaggers, etc.;

F. The ability to decipher traffic control at rail grade crossings, especially with passive control. These and other challenges might limit the functionality of ~~DAS~~ AV making them less effective or functional.

The uniform design and consistent application of standardized traffic control devices supports the functionality of ~~DAS~~ AV technology in many situations. Similarly, good traffic control device maintenance practices and programs will help improve the potential for AVs ~~vehicle~~ ~~DAS~~ to operate properly in many roadway environments.

~~Guidance:~~ [Changed to support for consistency.]

~~Agencies should adopt~~ The increased deployment of AV technologies that utilize traffic control devices will result in maintenance policies and or practices ~~with~~ that give consideration to both the human vehicle operator and ~~DAS~~ AV technology needs (see Sections ~~1A.12,~~ 2A.18, 3A.05 and 4A.10 of this Manual). [Section 1A.12 does not exist in the NPA.]

~~Engineering judgment (see Section 1D.03 of this Manual) used to determine traffic control device selection and placement should consider uniformity in application and location needed to support both the human vehicle operator and DAS AV technology.~~

~~Support:~~

A systematic approach to traffic control device selection, application, and maintenance ~~taking into consideration certain fundamental principles,~~ will help agencies considering the inclusion of ~~DAS~~ AVs ~~vehicles~~ on their roadways. ~~Generally, improvements to~~ Improvements in traffic control device uniformity and ~~improved~~ maintenance policies and practices ~~that keep traffic control devices in good working order with high levels of conspicuity~~ that benefit the human vehicle operator also ~~will~~ benefit ~~DAS~~ AV ~~vehicles~~ technologies. ~~as well.~~ [Edited for clarity.]

~~Guidance:~~ [Changed to support for consistency.]

~~Agencies should apply t~~The following ~~fundamental~~ principles ~~and considerations~~ will assist agencies as they evaluate traffic control device~~s~~ installation and ~~other~~ maintenance practices to support AV technologies ~~during maintenance and infrastructure improvements~~:

A. Promote the~~The~~ uniform and consistent application of traffic control devices on each type of roadway. ~~applying a similar approach to traffic control at similar locations in similar situations.~~
B. Establish~~ed~~ maintenance policies that ~~incorporate effective practices to ensure the clear message intended to the road user on~~ identify, fix or replace traffic control devices that are damaged or reaching the end of their useful life. ~~or are damaged or otherwise no longer serviceable, be identified, fixed or replaced in a timely manner~~.
C. ~~Temporary~~ Develop temporary or emergency traffic control plans, to the extent practical, ~~is planned in advance using devices~~ that ~~comply with the provisions of this Manual and following policies designed to ensure~~ reinforce principles of uniformity. ~~throughout the site and across jurisdiction.~~
D. ~~Removal of~~ Remove extraneous traffic control. ~~devices that are no longer necessary or that provide limited benefit to vehicle operation or navigation.~~

[Edited for clarity to simplify guiding principles.]