Traffic Engineering and Highway Safety Bulletin 22-01
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Emergency Vehicle Accommodations

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Overview

An emergency vehicle is any vehicle that is designated and authorized for use by emergency services to respond to an incident (e.g., police vehicles, fire trucks, and ambulances). These vehicles are usually operated by designated agencies, often part of the government, but can also be run by charities or volunteer groups, non-governmental organizations and some commercial companies. On military bases, they are typically operated by the installation. The sizes of emergency vehicles differ by use. When responding to an emergency, time is very critical; therefore, it is important that all sizes of local emergency vehicles are accommodated on roadways, and that drivers do their part to allow emergency vehicles to proceed.

Emergency vehicles must be accommodated by both drivers and by the roadway. Drivers are required by most state codes to pull over and allow emergency vehicles, with their lights and siren activated, to pass without delay. Roadways should also accommodate emergency vehicles to the extent practical. This includes roadways open to travel, as well as roadways intended for emergency vehicle access to buildings. The roadway design and traffic control for emergency vehicles will be the focus of this bulletin.

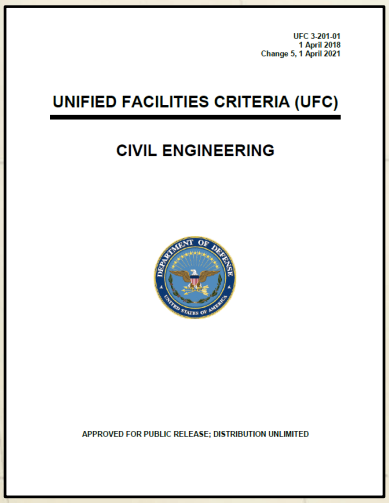
Emergency vehicles should always be considered when designing roadway geometrics. Roadways designed for trucks and buses will accommodate most emergency vehicles, but in areas not designed for trucks and buses, emergency vehicle accommodations should be evaluated. Areas not often designed for trucks and buses include housing areas, entrance access to and around buildings and low volume streets and alleyways. There are also several other aspects of design that are influenced by emergency vehicles, including traffic signal features and fire hydrant access.

Incident management, or managing roadway traffic while an incident is occurring, goes hand in hand with emergency response. There are practices that should be followed to maintain motorist safety when an incident impacts a roadway normally open to traffic.

Roadway Design

Higher classification roadways utilize a larger design vehicle (such as a WB-62 or WB-67 semi-trailer) since they are used frequently by these vehicles. Mobility is provided for all types of vehicles by linking highest classification roadways to local roads and local destination access. Arterial roads provide the highest level of mobility. Collectors connect arterials with local roads and streets so therefore provide a balance of mobility with land access. Trucks generally must access many local land uses, especially as neighborhood size increases. By providing for truck access in design, emergency vehicles are also accommodated by default since they are rarely larger in size than trucks. These arterials, collectors, and local roads serve as primary emergency routes.

Local roadways must be designed for larger vehicles. While larger vehicles such as tractor trailers do not travel often in housing areas, they should still be accommodated. In these areas, off-tracking into the adjacent travel lane is acceptable for trucks to navigate since their volumes are low. Also, school buses may be appropriate as the design vehicle in housing areas. Designing for these types of vehicles would also accommodate emergency vehicles, especially with the lights and siren activated to warn drivers if off-tracking is necessary.


UFC 3-201-01
1 April 2018
Change 5, 1 April 2021

UNIFIED FACILITIES CRITERIA (UFC)

CIVIL ENGINEERING

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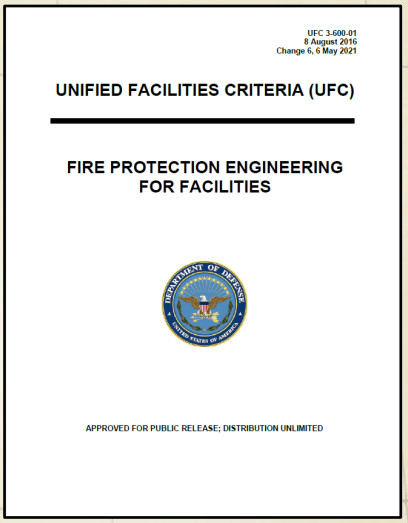
Per UFC 3-201-01, *Civil Engineering*, roads on military installations are to be designed in accordance with AASHTO's *A Policy on Geometric Design of Highways and Streets* (the "Green Book"). A two-lane roadway designed to AASHTO standards would typically provide sufficient space for an emergency vehicle. However, a single lane roadway may be adequate if the roadway leads to buildings that are not high traffic generators. For building access, per UFC 3-201-01: *Single-lane roads may be provided for fire lanes and approach drives to buildings within built-up areas. Access roads to unmanned facilities may also be single-lane roads. Where shoulders are not sufficiently stable to permit all-weather use and the distance between intersections is greater than ½-mile (805 m), turnouts must be provided at 1/4-mile (402 m) intervals along single lane roads for use by occasional passing or meeting vehicles.*

Roadways should use traffic control devices per the *Manual on Uniform Traffic Control Devices* (*MUTCD*). Traffic control devices can include roadway pavement markings, signing, signals and temporary traffic control.

As part of the design of any roadway, ensure that tight horizontal curves and intersection turning radii are possible for the design vehicle, whether off-tracking into an adjacent lane is allowed or not. This verification can be performed by turning simulation software available in Computer-Aided Design (CAD) programs.

Site Design


UFC 3-600-01
8 August 2016
Change 6, 6 May 2021

UNIFIED FACILITIES CRITERIA (UFC)

FIRE PROTECTION ENGINEERING FOR FACILITIES

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Per UFC 3-201-01, fire lanes and emergency vehicle access must comply with UFC 3-600-01. Within this regulation, buildings have certain requirements related to emergency response. As stated in Section 9: *All Facilities greater than 5,000 ft^2, or more than two stories in height, must have at least one means of all-weather ground access to allow emergency vehicles unimpeded access to the Facility. All-weather ground access must be paved, start from the road, and terminate no farther than 33 feet from an exterior door accessible for fire department ingress (i.e. a stair door or some other exterior door that provides access to the Facility interior). The route between the access surface and exterior door must be able to be traversed without the use of a ladder. An engineered all-weather surface that is not paved may be provided if approved by the DFPE. (Designated Fire Protection Engineer).*

To summarize, these facilities require emergency vehicle access no farther than 33 feet from the building. This could be part of the parking lot or access serving the building. Frequently, a fire lane will be striped adjacent to a building with an area marked as no parking. This can

serve as the area for emergency vehicle staging. The photos below show two examples of a marked fire lane in front of a shopping plaza. Note that each follow different marking standards.

California Fire Code Edition 20210 is a good example of guidance for marking and signing fire lanes. This code requires that an 18 by 24-inch sign stating NO STOPPING FIRE LANE be marked at the entrance to the property facing incoming traffic. Additionally, the code requires that fire lanes be marked by one of three options:

- ☑ Option 1: Install a NO STOPPING FIRE LANE sign within three feet of the beginning and ending of the fire lane and every 100 feet in between. The sign size must be 12 by 18 inches.
- ☑ Option 2: Outline the fire lane area to the street network red traffic paint six inches (6”) in width to show the boundaries of the lane. Within the area of the fire lane, the words “NO PARKING FIRE LANE” or “FIRE LANE NO PARKING” shall appear in twelve-inch (12”) high white letters with a two-inch (2”) stroke at 50-feet intervals.
- ☑ Option 3: Outline the fire lane area with red traffic paint six inches (6") in width to show the boundaries of the lane. The words “NO PARKING FIRE LANE” or “FIRE LANE NO PARKING” shall appear in four-inch (4”) high white letters at 15-feet intervals on the red border markings along both sides of the fire lanes. Where a curb is present, additionally paint the vertical and horizontal faces of the curb.

On military bases, the building standoff distance to address antiterrorism measures can conflict with the required distance for fire access. In this situation, a fire access roadway can be closed off with bollards or other removable force protection device. Per UFC 3-600-01: *All force protection equipment, such as bollards or gates, must not require more than one person to remove or open. Access may require fire apparatus to drive over a curb. Any locking device controlling vehicle access must be under control of the fire department or 24-hour security personnel located at the specific Facility.* This requires that any bollard or fence be removable by one person; and that if the facility is locked but not manned by 24-hour security personnel, that the fire department have a key. This also allows for an area open to pedestrian traffic only to be used for emergency vehicle access via removal of the bollards.

The two (2) photos on the following page depict a building with a secure perimeter providing standoff distance outside the building. The aerial image (first photo) shows a pedestrian walkway leading to a building, which is also used as a fire lane. The street-level view of the same location (second photo) identifies the retractable barriers that are used where the walkway intersects the roadway. These retractable barriers enable emergency vehicles to access the building.

Emergency Vehicle Signals

An emergency-vehicle traffic control signal is a special traffic control signal that assigns the right-of-way to an authorized emergency vehicle. An emergency-vehicle traffic control signal may be installed at a location that does not meet one of the MUTCD traffic signal warrants that is required for signal installation at an intersection. A typical use of an emergency-vehicle traffic control signal is for fire department access as it permits direct access from the building housing the emergency vehicle to the street network.

Though the intersection of the emergency access point with the roadway may not meet MUTCD-signal warrants, if gaps in traffic are not adequate to permit the timely entrance of emergency vehicles or if the stopping sight distance for vehicles approaching on the major street is insufficient for emergency vehicles, installation of an emergency-vehicle traffic control signal should be considered.

Emergency-vehicle traffic control signals can be located at midblock locations or at intersections. If at an intersection, operate the emergency-vehicle traffic control signal in the flashing mode during normal operations, or operate it full-actuated or semi-actuated stop-and-go mode to accommodate normal vehicular and pedestrian traffic on the streets. See additional discussion in the Emergency Vehicle Signal Preemption section of this bulletin. If operating in the flashing mode, the stop-controlled approaches must display a flashing red indication and free approaches must display a flashing yellow indication.

The manner of operation of an emergency-vehicle traffic control signal installed at a midblock location is as follows:

- ☑ The signal indication during normal operations is either green or flashing yellow. If the flashing yellow signal indication is used instead of the green signal indication, display it in the normal position of the green signal indication, and display the steady red and steady yellow signal indications in their normal positions.
- ☑ When an emergency-vehicle actuation occurs, display a steady yellow change interval followed by a steady red interval to traffic on the major street.
- ☑ A yellow change interval is not required following the green interval for the emergency-vehicle driveway.

A signal system can be actuated manually from the station where the emergency vehicles originate, or by an actuation device in the emergency vehicle. When actuated, the amount of time that the signal should remain in the red interval for the major street should be determined by test runs, but no more than 1.5 times the time needed for the emergency vehicles to clear the path of conflicting vehicles.

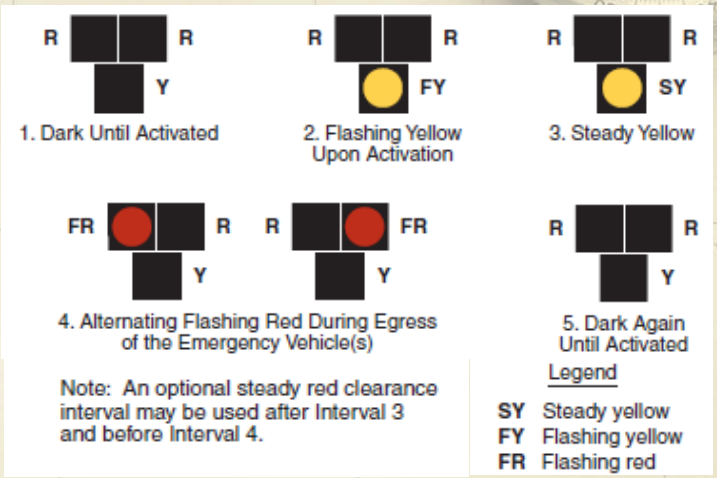
The following photo shows an example of an emergency-vehicle traffic control signal used at the exit from a fire department.

Emergency-vehicle hybrid beacons should only be used when all of the following criteria are satisfied:

- ☑ The conditions justifying an emergency-vehicle traffic control signal (see MUTCD Section 4G.01) are met; and
- ☑ An engineering study, considering the road width, approach speeds, and other pertinent factors, determines that emergency-vehicle hybrid beacons can be designed and located in compliance with the requirements contained in MUTCD Section 4G.04, and in MUTCD Section 4L.01, such that they effectively warn and control traffic at the location; and
- ☑ The location is not at or within 100 feet from an intersection or driveway where the side road or driveway is controlled by a STOP or YIELD sign.

If used, an emergency-vehicle hybrid beacon face shall consist of three signal sections, with a CIRCULAR YELLOW signal indication centered below two horizontally aligned CIRCULAR RED signal indications. Emergency-vehicle hybrid beacons are to be placed in a dark mode (no indications displayed) during normal operations. Upon actuation by authorized emergency personnel, the emergency-vehicle hybrid beacon faces shall each display a flashing yellow signal indication, followed by a steady yellow change interval, prior to displaying two CIRCULAR RED signal indications in an alternating flashing array for a duration of time adequate for egress of the emergency vehicles. The alternating flashing red signal indications are only to be displayed when it is required that drivers on the major street stop and then proceed subject to the rules applicable after making a stop at a STOP sign. Upon termination of the flashing red signal indications, the emergency-vehicle hybrid beacons would revert to a dark mode (no indications displayed) condition.

The following figure shows the required sequence for a hybrid beacon, from MUTCD Figure 4G-1.



Stop lines and EMERGENCY SIGNAL—STOP WHEN FLASHING RED (R10-14 or R10-14a) signs are to be used with emergency-vehicle hybrid beacons. See the MUTCD for additional design considerations.

Emergency Vehicle Signal Preemption

Traffic signal preemption for emergency vehicles is a common design feature in traffic signal design, and should conform to MUTCD Section 4D.27. Signal preemption gives an exclusive phase to the direction from which an emergency vehicle is approaching and is activated by the emergency vehicle. The signal would give a green indication to that direction early enough for a queue of traffic at the signal to clear, and for the emergency vehicle to proceed without delay – creating a significantly safer condition for emergency vehicles. Without preemption, the likelihood of crashes greatly increases for emergency vehicles as conflicting vehicles may not hear the siren or see the emergency lights. Additionally, emergency responses have the potential to take more time to respond.

There are two primary types of signal preemption: optical and acoustic. Optical preemption uses infrared emitters located on the emergency vehicle to activate the preemption phase of the signal. The optical emitter is activated at all times when the siren and lights are activated on an emergency vehicle, so the vehicle driver approaching a signal does nothing to activate the

preemption phase. The signal is equipped with an optical receiving device for each approach, usually mounted adjacent to the signal heads. Acoustic preemption is activated by the siren of an emergency vehicle. For this type of system, the signal is equipped with an acoustic receiving device for each approach. Historically, acoustic systems have been less reliable than optical systems but have increased in reliability in recent years. Less common types of preemption include GPS and radio-based systems. The following photo shows an example of an optical preemption receiver installed at a signal.

Emergency Vehicles at ECFs

A modern entry control facility (ECF) is built with active vehicle barriers and a response zone with an appropriate amount of time to contain a threat vehicle. Containment is often achieved by delaying a threat vehicle. This is achieved by slowing vehicles through tight geometric curvature to increase the time it takes to travel between the ID check area and the active vehicle barrier. Other traffic calming measures such as speed humps are sometimes used to slow down the everyday driver. While the goal of providing delay at an ECF is desired for both safety and security, it can conflict with the goal of minimizing delay for emergency response.

Curvature is desired to delay threat vehicles, and the amount of needed delay time is usually only a few seconds. It is possible that adding only a few seconds of travel time may not be significant, and may still allow for adequate emergency response time. When speed humps are installed to reduce the speed of non-threat vehicles (everyday driver), they can be designed and placed so that emergency vehicles can traverse them without being hindered. Emergency services should be involved with ECF design to determine what amount of delay is considered acceptable. If emergency services are located on-base, delays would only affect secondary response from off-base responders to the primary cantonment area.

There are also other ECF components that have the potential to interfere with emergency vehicles. These include the ID check islands that limit lane width and canopies that limit height. Nonetheless, the majority of emergency vehicles are not larger than tractor trailer trucks allowed to be on roadways. Therefore, when properly designed, height and width are not a limitation for emergency vehicles at an ECF.

ECFs can often be prone to queued traffic in the morning peak period and significant delays can be possible. This underscores the importance of ensuring that ECFs are designed with sufficient capacity to accommodate the peak demand. However, if an emergency vehicle must enter the installation during periods of significant queuing, consider using the outbound lane for the emergency vehicle to enter, or clear an inbound lane at the ID checkpoint.

Fire Hydrants

Fire hydrants must be accessible by emergency personnel at all times. Though they are often located alongside a roadway, they are an outshoot from an adjacent waterline that is running under or adjacent to the street. When on-street parking is also located along the roadway, there can be a conflict with parked vehicles blocking fire hydrants. TEA Pamphlet 55-17, citing the National Uniform Vehicle Code, identifies that on-street parking must be prohibited within 15-feet of a fire hydrant on each side. Doing this provides a clear distance of 30-feet for emergency access to the fire hydrant.

In addition to fire hydrants being accessible, they must also be visible to responders. Fire hydrants can be delineated in two primary ways: (1) per MUTCD Section 3B.11.05, use of a blue raised pavement marker in the roadway to assist emergency personnel in locating the fire hydrant as they drive along the roadway; and (2) use of a metal or fiberglass antenna extending above the hydrant to provide a visual indication. The second option is

especially useful if the hydrant is useful if it is prone to being blocked by vehicles, plowed snow, vegetation or other items common to roadsides. The following photo illustrates this.

Incident Management

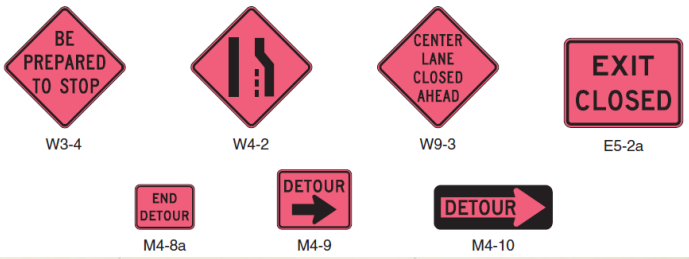
Incident management includes the management of traffic during the emergency response to an incident. This could include a crash on a roadway, or it could include the use of a roadway as a staging area to access a building. FEMA's National Incident Management System (NIMS) is *'a systematic, proactive approach to guide all levels of government and the private sector to work together to prevent, protect against, mitigate, respond to, and recover from the effects of incidents'*. Local, state, territorial, and tribal nation jurisdictions are required to adopt NIMS in order to receive federal Preparedness grants. The NIMS identifies a standardized incident management system, inclusive of the Incident Command System (ICS). The NIMS requires the use of the ICS during responses to any/all incidents (including traffic incident management scenes) whether or not there is Federal or State involvement. A traffic incident is an emergency road user occurrence, a natural disaster, or other unplanned event that affects or impedes the normal flow of traffic. A traffic incident management area is an area of a highway where temporary traffic controls (TTC) have been installed, as authorized by a public authority or the official having jurisdiction of the roadway, in response to a road user incident, natural disaster, hazardous material spill, or other unplanned incident. It is a type of TTC zone and extends from the first warning device (such as a sign, light, or cone) to the last TTC device or to a point where vehicles return to the original lane alignment and are clear of the incident.

MUTCD Chapter 6I - Control of Traffic Through Traffic Incident Management Area, is dedicated to this topic.

The primary functions of TTC at a traffic incident management area are to inform road users of the incident and to provide guidance information on the path to follow through the incident area. Alerting road users and establishing a well-defined path to guide road users through the incident area will serve to protect the incident responders and those involved in working at the incident scene and will aid in moving road users expeditiously past or around the traffic incident, will reduce the likelihood of secondary traffic crashes, and will preclude unnecessary use of the surrounding local road system. Examples include a stalled vehicle blocking a lane, a traffic crash blocking the traveled way, a hazardous material spill along a highway, and natural disasters such as floods and severe storm damage.

Warning and guide signs used for TTC traffic incident management situations may have a black legend and border on a fluorescent pink background (see below, from MUTCD Figure 6I-1).

Figure 6I-1. Examples of Traffic Incident Management Area Signs



While some traffic incidents might be anticipated and planned for, emergencies and disasters might pose more severe and unpredictable problems. The ability to quickly install proper temporary traffic controls might greatly reduce the effects of an incident, such as secondary crashes or excessive traffic delays. An essential part of fire, rescue, spill clean-up, highway agency, and enforcement activities is the proper control of road users through the traffic incident management area in order to protect responders, victims, and other personnel at the site.

Traffic incidents can be divided into three general classes of duration, each of which has unique traffic control characteristics and needs. These classes are:

A. Major—expected duration of more than 2 hours,

B. Intermediate—expected duration of 30 minutes to 2 hours, and

C. Minor—expected duration under 30 minutes.

Major Traffic Incidents

Major traffic incidents are typically traffic incidents involving hazardous materials, fatal traffic crashes involving numerous vehicles, and other natural or man-made disasters. These traffic incidents typically involve closing all or part of a roadway facility for a period exceeding 2 hours.

If the traffic incident is anticipated to last more than 24 hours, applicable procedures and devices set forth in Part 6 of the MUTCD on Temporary Traffic Control should be used, similar to a work zone.

Intermediate Traffic Incidents

Intermediate traffic incidents typically affect travel lanes for a time period of 30 minutes to 2 hours, and usually require traffic control on the scene to divert road users past the blockage. Full roadway closures might be needed for short periods during traffic incident clearance to allow traffic incident responders to accomplish their tasks.

The establishment, maintenance, and prompt removal of lane diversions can be effectively managed by interagency planning that includes representatives of highway and public safety agencies.

Minor Traffic Incidents

Minor traffic incidents are typically disabled vehicles and minor crashes that result in lane closures of less than 30 minutes. On-scene responders are typically law enforcement and towing companies, and occasionally highway agency service patrol vehicles.

Diversion of traffic into other lanes is often not needed or is needed only briefly. It is not generally possible or practical to set up a lane closure with traffic control devices for a minor traffic incident. Traffic control is the responsibility of on-scene responders.

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for pamphlets, bulletins and studies

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