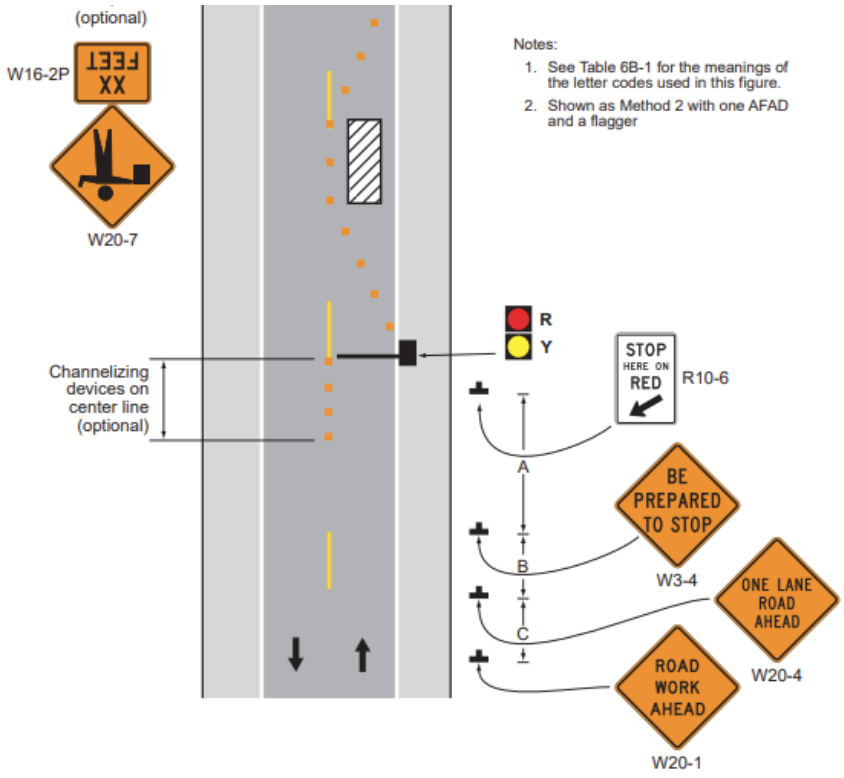
Temporary Traffic Control Technologies for One-Lane, Two-Way Operations



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Developed by the American Traffic Safety Services Association

ATSSA
Safer Roads Save Lives

U.S. Department of Transportation
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Introduction

This document is part of a series of products developed under the 2023 Federal Highway Administration (FHWA)-sponsored American Traffic Safety Services Association (ATSSA) Work Zone Safety Grant. It outlines the application of technologies that can improve safety and efficiency on two-lane, two-way roadways under temporary traffic control (TTC). The document highlights the use of Automated Flagger Assistance Devices (AFADs), Portable Traffic Signals (PTSs), and Residential Driveway Temporary Signals (RDTSs).

To support the development of this publication, ATSSA held a product demonstration on March 4, 2025, at the Annual Convention and Traffic Expo in Orlando, Florida (Figure 1). At this event, five vendors provided technical presentations and a demonstration of two versions of the trailer-mounted PTS, two versions of the AFAD (STOP/SLOW and Red/Yellow lens), and one RDTS. Approximately 40 public and private sector individuals attended the demonstration and reviewed the devices. The following sections provide characteristics and uses of each device as well as common features and configurations. In addition, the report relates the application of the devices to common field situations encountered.

Figure 1. ATSSA Product Demonstration Area (Image: ATSSA)

Characteristics of Devices for One-Lane, Two-Way Operations

Each device provides unique features and is used based on characteristics such as project duration and location (including geometry, speed, and traffic volume) as noted below.

Automated Flagger Assistance Devices

AFADs may be trailer-, pedestal-, or cart-mounted devices that allow for flagger control from a nearby location using a handheld remote. Flaggers must be present to control these devices. The Manual on Uniform Traffic Control Devices (MUTCD) outlines two versions of the AFAD—the STOP/SLOW AFAD and the Red/Yellow Lens AFAD.

The Red/Yellow Lens AFAD also includes a gate arm that raises and lowers but instead utilizes a Red/Yellow lens that indicates when motorists must stop and when to proceed (Figure 2). This device also includes a wireless remote control and has the capability for a flagger to operate the remote in wired form for redundancy in the event of a communication issue. Two trailers can be towed to a site in tandem (where allowed by law), allowing for an AFAD at each end of the work zone. Many Red/Yellow Lens AFADs feature a "breakaway" gate arm that allows the arm to bend upon impact, reducing damage to the AFAD and the impacting vehicle. Some devices also include a tilting camera and have an audible alarm that can alert workers of an errant vehicle.

Figure 2. RED/YELLOW Lens AFAD (Image: ATSSA)

The STOP/SLOW AFAD includes a regulatory STOP indication and a typical SLOW sign template (Figure 3). The device rotates each sign inside a display to change from the STOP sign and allows traffic to proceed using the SLOW sign, with a gate arm that raises and lowers on the operator's command. The device is controlled by a flagger using a handheld remote and includes a manual horn to alert workers of an errant vehicle. Some devices include battery power with a solar charging system. A handheld remote uses a back-lit light emitting diode (LED) display with interchangeable battery pack.

Figure 3. STOP/SLOW AFAD (Image: ATSSA)

Part 6 of the MUTCD outlines guidance for use of the AFAD as noted in the following list.

- AFADs shall only be used in situations where there is only one lane of approaching traffic in the direction to be controlled.
- If used, an AFAD shall be operated only by a flagger who has been trained on the operation of the AFAD.
- The flagger(s) operating the AFAD(s) shall not leave the AFAD(s) unattended at any time while the AFAD(s) is being used.

Portable Traffic Signals

Trailer-, cart-, or pedestal-mounted PTS devices are programmed to operate similarly to permanent traffic signals. They control traffic automatically, based on pre-timed plans, without the need for human intervention. Cart/pedestal-mounted PTS provide a smaller footprint compared with trailer-mounted PTS and are typically used for TTC that may be in place for up to several days.

Trailer-mounted PTSs are typically used for long duration projects (often greater than 7 days) but can also be used for intermediate-term situations (more than 1 daylight period and up to 3 days). The trailer mounted devices may be used in applications other than work zones, including special events where traffic levels increase significantly due to the event. In these situations, the devices may temporarily convert two-way stop controlled intersections into signalized intersections to improve safety and optimize traffic flow (where during typical conditions a traffic signal would not be warranted). These devices fold up to a smaller footprint for towing and can also be towed in tandem configuration (where permitted by law).

Some of the features available on PTS Systems include (but are not limited to):

- Solar cells to support power needs in addition to on-board battery power.
- Wireless connectivity to the device using a website link or smart phone application.
- Manual remote control for pilot car drivers to operate the PTS from their vehicle.
- Emergency vehicle preemption capabilities.
- Live video monitoring via cameras installed on the device.

Figure 4. Trailer-Mounted Portable Signals (Image: ATSSA)

One type of PTS allows up to ten preset timing plans per day, and another type allows 14 phases of traffic in one network. The devices communicate with each other to control movements within the one-lane, two-way TTC zone on a two-lane roadway. As shown in Figure 4, one device includes a wait time display to alert motorists of the conditions and estimated delay in the temporary traffic control zone.

Part 4 of the MUTCD outlines guidance for using temporary traffic signals as noted in the following list.

- Advance signing shall be used when employing a temporary traffic control signal.
- A temporary traffic control signal shall meet the physical display and operational requirements of a conventional traffic control signal and shall be removed when no longer needed.
- A temporary traffic control signal shall also be placed in the flashing mode during periods when it is not desirable to operate the signal, or the signal heads shall be covered, turned, or taken down to indicate that the signal is not in operation.

Residential Driveway Temporary Signals

RDTS (previously known in the industry as Driveway Assistance Devices) are trailer-mounted devices that provide signal control of driveway traffic within longer sections of one-lane, two-way traffic operations on two-lane roadways. RTDSs communicate with PTSs at each end of the work zone and provide guidance to driveway traffic via flashing yellow arrows about the direction of flow on the mainline. This device ensures that driveway traffic turns in the proper direction within the TTC zone.

The FHWA Interim Approval for use of the RDTS includes flashing and solid yellow arrow indications along with the circular red stop lens indication on the signal head (Figure 5). The required regulatory signs include NO TURN ON RED and TURN ONLY IN DIRECTION OF ARROW. The device in the image includes a mast that rotates 360 degrees to assist with orientation in placement. Multiple devices can be connected within one signal network, and RDTSs are connected to portable traffic signals controlling mainline traffic. RDTSs control traffic at driveways by indicating either a STOP condition, or the direction to turn when entering the mainline on a one-lane, two-way temporary traffic control condition.

The FHWA Interim Approval notes that *"FHWA will grant permission for the optional use of Residential Driveway Temporary Signal to any jurisdiction that submits a written request to the Office of Transportation Operations. A State may request Interim Approval for all jurisdictions in that State."*

In addition, FHWA outlines several conditions for the optional use of RDTSs once approved.

- The use of the RDTS is limited to residential driveways within the one-lane, one-direction portion of a temporary traffic control zone resulting from closing one lane on a two-lane, two-way roadway.
- The device shall consist of a three-section signal face in an inverted "T" configuration with a NO TURN ON RED regulatory sign and TURN ONLY IN DIRECTION OF ARROW regulatory plaque (Figure 6).
- The driveway approach may be provided with only one signal face.

- The Residential Driveway Temporary Signal shall be coordinated with the Temporary Traffic Control Signal controlling the main roadway traffic.
- The all-red interval of the Temporary Traffic Control Signal shall be adjusted appropriately to account for the addition of driveway vehicles to the platoon.
- The RDTS shall flash red when the associated temporary traffic control signal is operating in flashing mode and shall be covered or turned to face away from traffic when not in use.

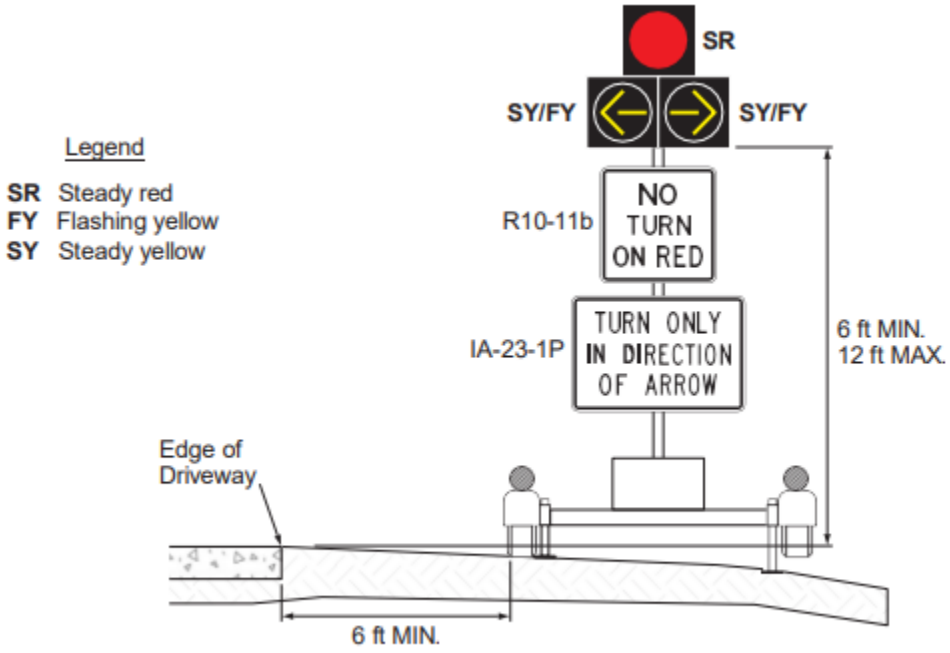

Figure 5. RDTS Device Configuration (Image: FHWA)

Example Case Studies on Application of Devices

The following case studies provide examples of how agencies have used the AFAD, PTS, and RDTS in temporary traffic control situations.

AFAD Use in Michigan

The Michigan Department of Transportation (MDOT) has used AFADs on several projects to control traffic on two-lane highways during construction. MDOT initially piloted the technology on a 27-mile fine-textured milling and resurfacing project using hot-mix asphalt on several sections of M-65 in the northeastern portion of the lower peninsula. For this project, MDOT used two sets of AFADs during a one-lane two-way traffic closure for the milling and paving work. MDOT also used the AFADs on a 7-mile overband crack fill, chip seal and fog seal project on M-72. The challenge for this project was to allow adequate

access to the work space for the contractor to ensure quality while also managing traffic and ensuring motorist and worker safety on the approach to and within the TTC zone. The length of the work space at any given time on these projects using the AFAD was approximately 2 miles.

One event in the fall of 2021 precipitated the need for technologies to improve safety: a commercial motor vehicle struck and killed a flagger working on a project. Because the AFAD separates the flagger (referred to as a traffic regulator in Michigan) from the approaching motorists, using the AFAD enables flaggers to stand in a nearby driveway or off the shoulder, as applicable. For added safety, the AFAD can also be equipped with a horn that can be used to alert workers and other motorists of an errant vehicle.

After 2 days of use and observations of traffic and AFAD operators, MDOT realized the qualitative safety benefits of using the device. In addition to the AFAD, the contractor used a pilot car to guide traffic through the work zone on each project and deployed portable temporary rumble strips at the approaches to further enhance safety.

MDOT's special provision requires a maximum of 750 feet between the flagger and AFAD. In addition, a key consideration is traffic demand; in lower volume situations, the delay between activation and the lowering of the gate arm is less impactful. When considering AFADs for higher volume conditions, the delay time between button push and gate arm lowering may be dictated by local specifications to ensure safe stopping after the last vehicle passes the device. In these two cases, the use of the AFAD and flagger(s) was lower in cost than deploying portable signals.

Trailer-Mounted PTS Use for Special Events in South Dakota

The South Dakota Department of Transportation (SDDOT) identified an annual need to manage ten-day special event traffic in Sturgis, South Dakota. Outside of this event, several two-way stop controlled intersections do not meet the warrant criteria for conversion to signalized intersections. However, during the special event, there is a need for additional traffic management strategies to alleviate safety and mobility concerns due to the significantly higher event traffic compared to normal daily operations.

In planning for TTC for the special event, SDDOT installed PTSs at 12 locations, including several Interstate 90 access ramps and several existing unsignalized several intersections along mainline routes.[1] The portable trailer-mounted signals provided protected left turns and optimal traffic flow based on estimated mainline and side-street demand (Figure 6). Cameras also allowed the intersections to be monitored remotely, allowing operators to

[1] https://dot.sd.gov/inside-sddot/media/press-releases/temporary-traffic-devices-and-speed-reductions-to-be-placed-during-sturgis-motorcycle-rally/

refine signal timing as needed for even greater efficiency. SDDOT observed improvements in surrogate safety measures, noting that the PTS also contributed to greater compliance with reduced posted speed limits in the area during the special event.

Figure 6. Temporary Signalized Intersection in Sturgis, S.D. Using PTS (image: Street Smart Rentals)

Pedestal-Mounted PTS Use in North Carolina

The North Carolina Department of Transportation (NCDOT) allows contractors to use pedestal-mounted PTSs on two-lane highway construction projects. NCDOT does not specify or require use of PTSs (or AFADs) but rather allows contractors the flexibility to determine the type of traffic control needed for two-lane two-way operations when a lane is closed. Instead of providing a pay item for a flagger or flaggers, NCDOT utilizes a flagger station pay item, which allows contractors to select the appropriate device for their project. As one phase is shown in Figure 7, the PTSs provide red, yellow, and green phases for approaching traffic based on pre-programmed signal timing patterns. Local personnel place the signals in red mode that remains until a pilot car operator triggers the green phase or a detection system identifies approaching vehicles.

NCDOT also noted that pedestal-mounted devices use a smaller footprint than their trailer-mounted counterparts and can also be used on narrow shoulders on bridges where a flagger would otherwise stop and release traffic in advance of the bridge (due to lack of an escape route on the bridge). Drivers can also see the PTS better and may be less inclined to perform unsafe maneuvers such as driving around a queue of traffic on a bridge.

In North Carolina and other States, PTSs have alleviated labor shortage issues and are cost-competitive devices for payment to the contractor. Pedestal-mounted PTSs are almost exclusively used for short-term operations in North Carolina, with NCDOT limiting their use to 72 hours because the visibility of the larger, trailer-mounted PTS is better for long-term projects. For example, on one project, NCDOT installed trailer-mounted PTSs to create a temporary intersection to allow an occupancy permit to be issued for a new building prior to construction of an adjacent permanent signalized intersection.

Figure 7. Pedestal-Mounted Portable Traffic Signals (Image: Branz Technologies)

The size and portability of the pedestal-mounted PTSs make them suitable for a variety of short-term uses. For example, a contractor noted that four pedestal-mounted PTSs can fit on one trailer, and one person can set up each device. The ability to fit multiple devices on one trailer means that deployment time for pedestal-mounted PTSs is shorter compared to trailer-mounted devices because tandem trailering (connecting multiple PTS trailers to one truck) is against North Carolina State law.

RDTS Use in Michigan

Prior to FHWA's Interim Approval for the RDTS, MDOT deployed the devices (formerly known as the driveway assistance device) at five locations:

- M-44 Test Signal Project Request (2015)
- M-68 in Tower, Michigan (2016)
- US-23 in Cheboygan, Michigan (2016)
- M-66 in Stanton, Michigan (2017)
- M-31 in Manistee, Michigan (2018)

MDOT evaluated each deployment of the RDTS. For the most recent project example, MDOT used the RDTS on a 700-foot segment of US-31 in the town of Bear Lake. The project included slope stabilization and shoulder reconstruction. This location included access through the project site for six homes; therefore, alternatives such as a complete closure was not feasible and a one-way detour would require approval to use county roadways. The evaluation focused on proper turns (motorists followed the signal indication), improper turns (motorists proceeded against the signal indication), and improper but safe turns (motorists turning on solid red to join the end of the queue in the correct direction).

Results of the evaluation showed that 70 percent of the affected vehicles made proper turns (76 vehicle observations), with an overall safe movement rate of 97 percent. For improper turns, 32 percent of the violations included construction vehicles turning on the solid red indication. For the deployments prior to the FHWA Interim Approval, several devices used flashing red arrow indications in addition to the solid red lens.

Specifications and Guidance

The following examples outline considerations and requirements for use of each device by representative specifications or guidance and includes links to each source.

Caltrans AFAD Specifications (2023)

- The gate arm must cover at least half the lane but not extend into the opposing lane.
- Must have a failsafe device that prevents flashing circular yellow conflicts.
- Must have a 24x30 inch R10-6 STOP HERE ON RED (R10-6) sign mounted on trailer.
- For inoperative units, replace units, revert to traditional flagging, or terminate operations.
- Single flagger may be used if unobstructed views to both devices (second flagger must be onsite to assist if needed).
- Do not use CA9A flagger symbol sign with AFADs.
- Pilot car driver must not operate device.

Michigan DOT AFAD Special Provision (July 2022)

- Furnish the required STOP HERE ON RED (R10-6) sign as part of the device or installed on the right-hand side of the approach at the point at which drivers are expected to stop.
- Furnish up to 1 hour of training on installation, removal, and operation.
- Delineate with three channelizing devices.
- One person may operate two AFADs if the distance between the individual and the device is a maximum of 750 feet with clear line of sight to both AFADs.

Nebraska DOT AFAD Policy Directive (July 2024)

- Beginning with contracts let in August 2024, projects with a tentative start date in 2025 or later will require the use of AFADs in conjunction with flagging.
- AFAD use will be enforced as mandatory for flagging operations lasting 4 hours or longer.
- Projects let earlier include a $100 per day incentive for use of the AFAD.

Michigan DOT PTS Specifications (2016)

- Check PTS for required operation at 12-hour intervals when in use on a project.
- Delineate the trailer (must be mounted on the shoulder) using three plastic drums or 42-inch channelizing devices.
- PTS may remain in place in flashing yellow mode when work operations are suspended and traffic lanes are opened for less than 72 hours (remove if longer).
- Allow at least one signal head on the horizontal mast to be placed over the traffic lane.
- Delineate with one 2x36 inch red and white retroreflective tape strip on each side of trailer.
- Must have an integrated mechanism capable of recording system malfunctions.

Texas DOT RDTS Specifications (2024)

- Place two regulatory signs, conforming to standards and details shown on the plans, on each RDTS in an area clearly visible to the motorist.
- Repair any failure within 24 hours.
- Designate a system coordinator who will be responsible for overseeing the placement of the devices and for testing and calibration of equipment.

Washington DOT RDTS Specifications (May 2025)

- A fault mode shall be triggered and set the RDTS signals to flashing red mode during a malfunction (and automatically send a message to the Traffic Control Supervisor).
- Repairs shall be made or unit replaced within 24 hours.
- PTS and RDTS shall be equipped with an interface with a remote monitoring system and capture statistics on operation and location.

MUTCD Guidance (December 2023)

- AFADs shall only be used in situations where there is only one lane of approaching traffic in the direction to be controlled.
- When used at night, the AFAD location shall be illuminated.

- Because AFADs are not traffic control signals, they shall not be used as a substitute for or a replacement for a continuously operating temporary traffic control signal.
- If used, an AFAD shall be operated only by a flagger who has been trained on the operation of the AFAD.
- The flagger(s) operating the AFAD(s) shall not leave the AFAD(s) unattended at any time while the AFAD(s) is being used.
- Application includes one AFAD at each end of the TTC zone or an AFAD at one end and a flagger at the opposite end (two flaggers shall be used in each method).
- A single flagger may simultaneously operate two AFADs if they have an unobstructed view of each AFAD and of approaching traffic in both directions.
- STOP/SLOW and Red/Yellow lens AFADs are acceptable for use.

Summary and Conclusions

Temporary traffic control operations on two-lane roadways take a variety of forms based on project duration and other characteristics. Table 1outlines technologies used in flagging operations, their differences, benefits, and some considerations for each.

Table 1. Types of Flagging Operations and Technologies: Differences, Benefits, and Considerations

Flagging Strategy	Benefits, Uses, Challenges, and Considerations
Automated Flagger Assistance Device (AFAD)	• Designed for short- and intermediate-term activities • Allows the flagger(s) to stand in a safer position off the shoulder • May include red/yellow lens indicator or STOP/SLOW indicator • Typically trailer-mounted devices or pedestal or tripod units with gate arms and manual control • Must be controlled remotely by an appropriately trained individual with unobstructed views of the AFAD and approaching traffic (in both directions for a single operator) • May include one or two flaggers – AFAD shall not be left unattended • Requires signing similar to traditional flagging operations and may be supplemented with additional traffic control devices
Portable Traffic Signal (PTS)	• Designed for short- to long-term work zones with one-lane, two-way tapers that remain in place while no workers are present • No need to position a flagger on the shoulder near the path of oncoming traffic • Requires signing similar to traditional flagging operations (with exception of flagger symbol sign), although flaggers should not be used to control these devices • Use should be based on State/local municipality requirements for traffic signals, and authorization may be required in the jurisdiction
Residential Driveway Temporary Signal (RDTS)	• Controls driveway traffic entering a one-lane, two-way TTC zone • Provides an indication of the direction of turn by communicating with PTS at each end of the work zone • Received FHWA Interim Approval in January 2025

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