LED STOP SIGNS

WHAT ARE LED STOP SIGNS?

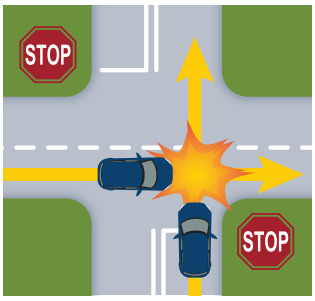
Light-emitting diode (LED)-enhanced STOP signs are the familiar octagonal red signs with white lettering that also include red LEDs on the outer edge of the sign. The LEDs are configured to operate continually.

KEY FUNCTIONS

Drivers approaching an intersection receive heightened visual input via the flashing LEDs, which:

- Increases conspicuity and awareness of the STOP sign under normal and low-visibility conditions
- Attempts to increase driver compliance and caution at stop-controlled intersections

FIGURE 1: ENHANCED LED STOP SIGN



WHAT IS THE PURPOSE OF LED STOP SIGNS?

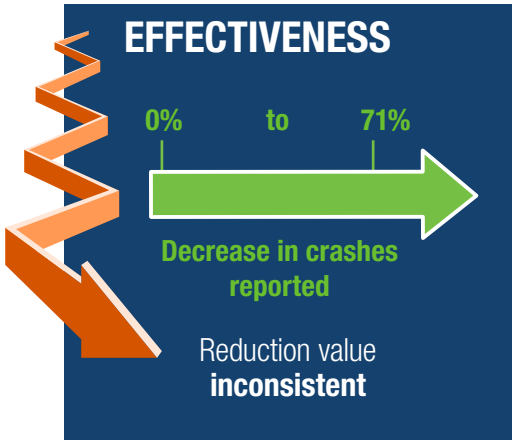
The purpose of LED STOP signs is to capture the driver's attention through supplemental visual input. It is intended to increase stopping compliance and prevent right-angle crashes by alerting drivers of upcoming roadway changes so they do not unintentionally run the STOP sign. Right-angle crashes are the most common type of crash that result in a fatality or serious injury at through-stop controlled intersections. Although some crashes involve drivers running a STOP sign, nearly two-thirds of angle crashes are attributed to drivers not selecting a large enough gap between their car and the approaching vehicle on the major road to safely complete a crossing or turning maneuver. This type of right-angle crash is not addressed by the installation of an LED STOP sign.

HOW EFFECTIVE ARE LED STOP SIGNS?

Research[1] documents three primary performance measures for LED STOP signs:

(1) deceleration rates of approaching vehicles, (2) the fraction of vehicles making a complete stop, and (3) change in the frequency of crashes at the intersection. The research included the following results[1]:

1. Adding LED STOP signs did not substantially change driver reaction to slow their vehicles as they approached the intersections – reported reductions were in the range of 1 to 3 miles per hour with slightly higher reductions at night.
2. The LED STOP signs did not change the fraction of vehicles making complete stops at the intersections (when minor approach drivers did not encounter opposing vehicles on the major approaches).
3. The estimated crash reduction was determined to be approximately 42 percent. However, this estimate is not statistically significant because of the small number of right-angle crashes at intersections with the LED installations. The statistical analysis indicates that the reduction may range between 0 and 71 percent; a more precise number cannot credibly be supported by the data.



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WHAT ARE THE MOST SUITABLE APPLICATIONS FOR LED STOP SIGNS?

Installing LED STOP signs reactively in response to one severe crash at one intersection is not likely to be an effective approach because of a low density of severe right-angle crashes at through-stop intersections, only a minority of crashes involve running the STOP sign, and a lack of consistent crash reduction estimate. Instead, a potentially more effective approach would be to install LED STOP signs selectively at the few intersections along a system that have actually experienced multiple crashes from drivers running stop signs. Alternatively, broader effective deployment across a system should include intersections identified to be high-risk based on a data-driven evaluation and where sight lines to the STOP sign are restricted by road geometry or topography. LED STOP signs are generally for application at rural intersections.

Guidance from the NDDOT Highway Safety Improvement program includes the following:

To make drivers on minor road more aware of the upcoming stop condition (intersection recognition), a base improvement package includes the following:

- Stop bar
- "STOP AHEAD" pavement markings
- retro-reflective strip on sign supports
- larger stop sign (36"x 36" or larger) with higher retro reflective sheeting
- stop-ahead sign (W3-1)
- intersection rumble strips
- double arrow sign (for T-intersections only)

Lighting warrants should also be evaluated for the intersection where upgraded signs and markings are being considered.

If the intersection is determined to have a severe crash history and/or identified as a "high risk" in the SRSP, additional 2nd tier treatments may also be considered in addition to the base treatments:

- Intersection warning sign(s) - such as W2-I, W2-2
- Additional enhancement to the stop condition using one of the following:
  - Flashing LED stop signs
  - Flashing red beacon on stop sign

> *"Note that most right angle crashes at rural TWSC intersections are associated with gap recognition as opposed to intersection recognition. These enhanced conspicuity countermeasures will **not** help motorists select better gaps." NDDOT Highway Safety Improvement Guidebook*

COST

- Per Intersection: $3,000 to $6,000
- Includes one LED-enhanced STOP sign on two approaches, sizes between 30" and 48"
- Cost primarily covers the LED and commonly solar charging equipment

REFERENCES

1. Davis, Gary and J. Hourdos. 2014. *Estimating the Crash Reduction and Vehicle Dynamics Effects of Flashing LED STOP Signs.* Report No. 2014-02. http://www.its.umn.edu/Publications/ ResearchReports/reportdetail.html?id=2330. Accessed June 2017.

2. Arnold, E. and K. Lantz. 2007. *Evaluation of Best Practices in Traffic Operations and Safety: Phase I: Flashing LED STOP Signs and Optical Speed Bars.* Report VTRC 07-R34. http://www. virginiadot.org/vtrcfmainlonline_reports/pdf/07-r34.pdf. Accessed June 2017.