NCHRP 17-113 COUNTERMEASURES

Replace Incandescent Traffic Signal Bulbs with Light Emitting Diodes

INTERSECTIONS

Light Emitting Diodes (LEDs) improve driver awareness and visibility of signals and signs at intersections.

Implementation Strategy

How and Where to Apply

- Replace incandescent bulbs with LEDs at signalized intersections on urban roads to improve visibility, reduce maintenance needs, and cut energy consumption.
- LED signal heads are typically installed during routine maintenance, signal upgrades, or as part of broader energy efficiency or safety initiatives.
- LEDs provide brighter illumination, better visibility during adverse weather, and a faster onset time – improving signal conspicuity and driver response times.

Use in a Safe System Approach

Upgrading to LEDs aligns with the SSA approach by enhancing visibility and signal clarity, helping drivers detect and respond to signals more reliably. This contributes to reducing angle and rear-end crashes at intersections, especially during low-light conditions or inclement weather.

Key Stakeholders

State DOTs, Municipal Traffic Engineers, Utility and Energy Departments

Proactive Implementation

Agencies should proactively retrofit existing incandescent signal bulbs with LEDs during signal maintenance, upgrades, or energy-efficiency programs. Prioritize intersections with high crash rates, poor visibility, or high energy and maintenance costs. LED conversions typically yield rapid cost savings and crash reductions, and bulk or corridor-based implementations can increase efficiency.

Countermeasure Overview

Objective: Improve driver awareness of intersections and signal control

Strategy: Improve visibility of signals and signs at intersections

Targeted Solution

CONTRIBUTING FACTORS	▪ Reduced visibility
TARGET CRASH TYPE	▪ Angle ▪ Rear-end ▪ Turning
ROAD FACILITY TYPE	▪ Not specified
AREA TYPE	▪ Urban

Safety Linkage

NCHRP 500 Series	SAFE SYSTEM APPROACH
Intersection	Safe Roads
AASHTO'S TOWARD ZERO DEATHS	SAFE SYSTEM ROADWAY DESIGN
Safer Infrastructure	TIER 1 TIER 2 TIER 3 TIER 4 Tier 4

Selected Related Countermeasures

- CM1 LED-enhanced STOP signs or warning beacons
- CM2 Backplates with retroreflective borders
- CM3 Automated Traffic Signal Performance Monitoring

Cost: $ (low)

Service Life: 5 years

Benefit-Cost Ratio:

Incandescent and LED signal head. Source: fhwa.dot.gov

Safety Benefits

17% Reduce rear end crashes at urban signalized intersections[1]

7% Reduce nighttime crashes of all severities[2]

[1] CMF ID: 4901
[2] CMF ID: 4902

Resources

- LED Traffic Signal Lifespan and Replacement Assessment
- LED Traffic Signal Management System