CHAPTER 11: LIGHTING (VEHICLE CONSPICUITY)

During Phase I focus group activities, equipment operators in all three consortium states expressed concern about snowplows being visible when weather conditions are poor.   Fiber optic lighting systems have the potential to improve visibility of the vehicles. Innovative Warning Systems provided a fiber optic lighting system to supplement existing strobe lights and revolving beacons on the Iowa and Minnesota prototype vehicles.

OBJECTIVE

Conduct proof of concept regarding use of high-intensity lighting systems to improve snowplow visibility.

MEASUREMENT

High-intensity lights are successfully installed on the prototype vehicles and perform as expected; that is, they provide vehicle visibility superior to conventional rotating beacons.

DISCUSSION

Innovative Warning Systems, located in Minneapolis, Minnesota, supplied the Innovative Warning Systems Spectra High-Intensity Discharge (HID) fiber optic lightning system, HIDSYS-01, for the Iowa and Minnesota prototype vehicles. See Figure 11-1 for a rear view of Iowa's prototype vehicle showing the fiber optic lights.

Figure 11-1 Fiber optic light system (circled), Iowa prototype vehicle

The Spectra Distributed Light system projects light instead of reflecting it, directing all of the light energy where it is required. The Spectra system also uses color contrasting, which creates a powerful attention-getting flash effect by changing colors instead of flashing the lights on and off. Spectra can produce numerous color or combination of color patterns.

The heart of the Spectra Distributed Light System is the light engine, which utilizes a high intensity discharge (HID) short-arc lamp. The light engine's 60-watt lamp is resistant to shock and vibration failure because it has no filament. This lamp has 10 times the life and uses less than one-third the energy of four halogen lamps. It may replace the typical revolving warning light. The Spectra system also has a rapid-start and instant-restart technology to ensure a warning signal is always available when needed.

Light from the light engine is transmitted through "light pipes"—flexible, plastic optical fibers that conduct the light produced by the light engine to its ultimate destination. Light pipes can diverge and distribute light in any direction and at any intensity, allowing a single high-intensity lamp to replace multiple halogen lamps, thus dramatically lowering current draw.

The light pipes are connected to light converters, which take light from the light pipes and project it outwardly in any desired direction and intensity. Light converters have a variety of designs and can be mounted in spaces that do not accommodate larger conventional lights.

Iowa DOT mechanics encountered challenges with Innovative Warning Systems' High Intensity Discharge (HID) Fiber Optic Lighting System. It was installed by Iowa DOT personnel. The light engine in the prototype vehicle's cab was the first component to cause challenges. It seemed very sensitive to mounting orientation, mounting location, and the routing of the fiber-optic cables.

According to Iowa DOT mechanics, most of the challenges with the HID lighting system stemmed from the system's fiber-optic cables. The most troublesome challenge involved the intrusion of moisture into the cables' lining, causing the light to reflect along the cable improperly, or not at all. The moisture entered between the cable's inner lining and the fiber optic strands. Through experimentation, Iowa DOT mechanics discovered an improvement in light transmission when they cut the fiber-optic cables to make them shorter. There is a limit to the extent that the fiber optic cables may be shortened, namely a length long enough to permit continued operation, free movement, and deployment of the prototype truck's components when the lighting system is still in use.

The HID light on top of the prototype vehicle is mounted to the U-bracket on which the conventional rotating yellow beacons are mounted.

To solve the two rear HID light challenges involving (1) moisture intrusion and (2) precise aim and positioning required with the HID lights, Iowa DOT mechanics mounted the rear HID light upside down (to eliminate the water intrusion) and onto a ball and socket joint to provide proper positioning. This ball and socket joint enabled Iowa DOT mechanics to easily tilt and aim the rear HID light up, down, left, and right. The ball and socket joint was originally conceived by the Minnesota DOT on their prototype vehicle. See Figures 11-2 and 11-3 for pictures of these ball-and-socket jointed lights.

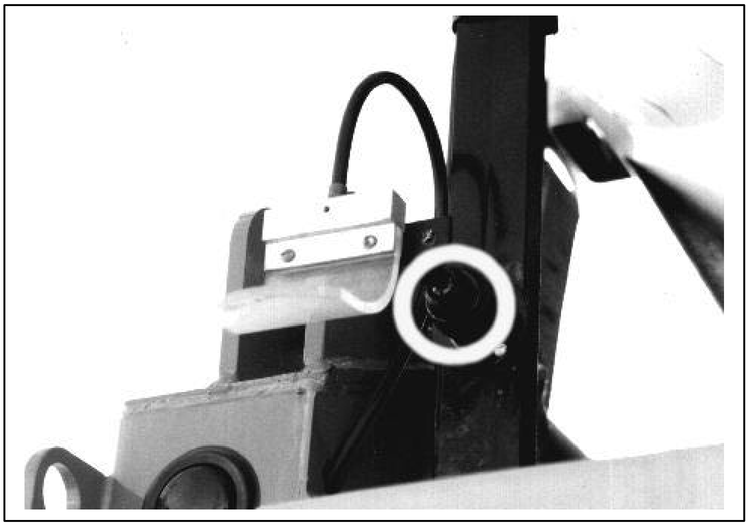

Figure 11-2 Left ball-and-socket joint (circled), HID lighting system, Iowa vehicle

Figure 11-3 Right ball-and-socket joint (circled), HID lighting system, Iowa vehicle

Minnesota DOT mechanics extended a fiber optic cable along the top of the wing plow. They removed the black casing, exposing the clear tubing. This provided illumination along the blade, making it more visible to motorists during dark or adverse weather conditions. The result is a glowing tube on top of the wing plow. Conventional lights could not be used for this purpose because the extreme vibrations broke their filaments. Iowa used the same installation procedure along the top of the wing plow.

OBSERVATION

Installation of the HID lighting was successful on Iowa's and Minnesota's prototype vehicles after modifications to prevent moisture infiltration. Michigan did not install this system. Proof of conduct was not formally conducted on the lights' performance. CTRE received only anecdotal evidence about performance; observations were primarily based on weather and light conditions. Some users thought the lights provided superior visibility of the vehicle to conventional rotating beacons in fog and snow, but others did not.