This sheet replaces the first sheet of EI 93-36 dated 12/7/93 and titled
"RASED REFLECTORIZED SNOWPLOWABLE PAVEMENT MARKERS."
The correct number (code) is 93-37.

TO:

MODIFIED BY
EI 06-008
EFFECTIVE 9/7/06

& EB 03-021 EFFECTIVE 9/11/03

ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: RAISED REFLECTORIZED SNOWPLOWABLE PAVEMENT MARKERS

Subject Code: 7.27-1-685

Distribution: 30 Main Office 32 Regions 34 Specials

Code: 93-37

Date: 12/07/93

Supersedes:

EI 83-13

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BACKGROUND

Raised Reflectorized Snowplowable Pavement Markers (RSPM's) have been used in New York State for nearly 20 years to primarily improve nighttime wet-weather delineation. Accident reductions of 19 percent have resulted at locations where RSPM's are installed to reduce nighttime wet-weather accidents. As a result of a large number of markers being installed recently, various problems arose that warranted investigation. This EI reflects the findings of that investigation and makes recommendations for future marker installations.

Testing and evaluation which began in 1990, found the reflective lenses were prematurely damaged on one-way roadways as a result of the wing plows infringing between the marker's ramps. This problem did not exist on two-lane two-way highways as only the front plow contacted the marker at a small angle.

A three rail RSPM was developed that protected the lens during wing plowing operations. This marker has been used in New York State since 1991 with no significant snowplow damage to the lens or casting and is on the current "Approved Products List" for application on one-way roadways.

The installation of the markers raised several new operational and maintenance concerns including additional wear on snowplow equipment (blades and inserts), added maintenance to tighten loose bolts, slower plowing speeds, snow remaining on the highway after the plow passes over the marker and isolated reports of snowplow driver fatigue and nausea. These concerns should be considered when evaluating the use of RSPM's.

POLICY

RSPM's reduce accident frequency in a cost effective manner by improving nighttime wet weather delineation. In deciding whether to use RSPM's, accident data should be reviewed to determine if the type of accidents are correctable by improved lane delineation. Correctable accidents include: run-off-the-road, head-on, encroachment, side-swipe, etc.

Once a decision has been made to installed raised markers, the project should be designed using the following criteria. Based on our experience these guidelines should ensure optimum performance and effectiveness.

- o On multilane, divided highways, RSPM's shall be limited to skiplines.
- o On multilane, undivided highways, RSPM's can be used to delineate skiplines only if centerline markers are used.
- o On two lane, undivided highways, RSPM's shall be limited to centerlines.

RSPM's are not recommended for use in lighted areas due to the glare during wet conditions. Areas where the lighting has been turned off may be suitable for RSPM's if the benefits out-weigh the snowplowing concerns discussed later.

RSPM's shall only be used for short sections of highways (maximum 1/2 mile) where there is a correlation between poor delineation and accident experience. Where visibility is good and there is no accident experience, RSPM's shall not be used.

DESIGN CRITERIA

Markers delineating skiplines should be one-way and spaced 80 feet on center. They should be aligned longitudinally with the skipline and placed between them.

RSPM's delineating centerlines shall be two-way markers. When wrong-way delineation is warranted, two-way markers (red facing the wrong direction) may be used. Centerline markers are normally placed between the centerline pavement markings but may be placed outside the line if they will be straddling a longitudinal pavement joint. If placed outside the line two markers should be used, one on each side of the centerline. This placement needs to be determined when developing contract quantities. The normal longitudinal spacing is as follows:

DEGREE OF CURVE	SPACING (ft)	EXAMPLE
< 4	80	Tangents and Long Radius Curves
4 - 15	40	Sharp Curves
> 15	20	Gores and Islands

The color of the RSPM lens should be the same as the pavement marking it is supplementing with the exception of wrong-way markers. Red lenses shall face the **wrong** direction of travel and should be limited to one-way ramps and other locations having wrong-way movement problems.

The pavement condition is a prime concern when determining whether to use RSPM's. The casting of the marker normally has a life equal to the pavement in which it is installed. Therefore, pavements in poor condition or scheduled for resurfacing within the next 3 years should not receive markers. RSPM's must be removed from the pavement prior to resurfacing.

The marker lens normally has a life of three to four years. A lens replacement program should be considered when making the decision to install RSPM's. This replacement should be done through a capital contract.

INSTALLATION

Two concerns should be monitored to assure proper installation of the RSPM. One of the most important steps, and the first in the installation procedure, is sawing the slot in the pavement to accommodate the marker. RSPM's should be placed four to six inches from any pavement joint or crack (longitudinal or transverse). When placed on the outside of the centerline, markers should be offset two inches from the line. Raised markers are normally fabricated with tabs or leveling lugs on the outside of the casting. Special attention is needed here to guarantee the saw cut is deep enough to allow all four of the marker's tabs to sit flat on the pavement surface. Inspectors should check the depth of the saw cut periodically during the day to insure proper seating of the marker. Failure to cut deep enough, to properly clean the saw cut or to properly seat the marker will result in a marker installed higher than designed and will create problems during snowplowing. The result will be damaged markers and/or snowplow equipment damage. The second area of concern is the minimum temperature required for proper curing of the adhesive used to bond the marker to the pavement. The manufacturer of the RSPM is responsible for specifying installation temperature. The marker and the pavement must be surface dry at the time of installation and installed markers must be protected from traffic until the adhesive cures. All components (casting, lens, saw cut and adhesive) of the installation must function properly for the RSPM perform as designed.

OTHER ISSUES

There are a number of concerns associated with plowing RSPM's that should be considered when making decisions on RSPM use. The following problems may occur and should be considered during the selection and decision process.

- Accelerated damage to the carbide plow inserts.
- Frequent (after each 10 hr. shift) retightening of nuts and bolts of the truck plow components.
- There is a strong possibility that the plow components (masts, cables, stand-off arms, etc.) will need replacing prematurely due to the continual bouncing of the plow blades.
- Greater snowplow driver fatigue.
- Some cases of nausea have been reported by snowplow drivers.
- Slower (<22 mph) than normal speeds during the plowing operation are required.
- A small rift of snow being left on the pavement on the sides and far end of the marker.

Ultimately, the decision whether to use RSPM's rests with the Regional Director. Any deviation from this EI may only be made after discussion between the appropriate Regional groups (Traffic Engineering and Safety, Maintenance and Equipment Management) and agreement with the Central Office Traffic Engineering and Safety Division .

Questions on this EI can be directed to the Safety Program Development Section at (518) 457-3537.