



Tech Brief

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Drive-by Inspection of Barrier Systems

CATEGORY: Maintenance

ISSUE: W-Beam barrier, cable guardrail, and their various terminals must be installed and maintained properly to function as intended in a crash. Routine drive-by inspections for the purpose of discovering deterioration and/or damage should be conducted as a part of roadway inspections. Maintenance personnel must be able to identify at a glance the types of deficiencies that need to be repaired to restore a feature to its original performance characteristics.

OBJECTIVE: To recommend general guidelines that will enable agency personnel to identify the types of deficiencies to barriers and terminals that may degrade crash performance and that can be seen on a drive-by type inspection.

METHODOLOGY: Show the types of deficiencies to barriers and terminals that can be readily observed without an in-depth inspection. NCHRP Report 656, Criteria for Restoration of Longitudinal Barriers, is the primary reference; it should be noted that information included in the report is based on NCHRP 350 testing of the old 27" high barrier system. A secondary guidance is available, report # FHWA-SA-08-002, November 2008; W-Beam Guardrail Repair: A Guide for Highway and Street Maintenance Personnel.

GENERAL: Traffic barriers and terminals are designed to reduce the severity of a crash and be crashworthy when stuck on or near their approach end. Initial inspections should ensure that these features were installed to meet State specifications and manufacturer's requirements. However, environmental factors and traffic impacts may lessen the crash performance of these safety features. This Technical Brief identifies the most common deficiencies (generally rated **high**-priority per NCHRP 656) that can be identified and expeditiously repaired without an in-depth inspection.

The area under and around barriers and terminals should be kept clean and free of debris. Objects should not be placed on top of barriers that could become a projectile if hit. It is critical that the appropriate personnel be notified as soon as practical after damage or deficiencies are identified. Temporary delineation (e.g. cones, barrels, or barricades) should be used to warn the public of the damage. In some instances, a temporary barrier and/or a temporary crash cushion or a truck mounted attenuator (TMA) may be warranted, depending on site conditions and the time required to complete repairs.

Cable Guardrail:

All cable guardrail should be inspected and re-tensioned twice annually as required by North Dakota Maintenance Manual Chapter 4. Additional inspection should occur after an impact.

Inspect cable guardrail periodically for :

- *Do the cables appear to be in tension?*

Noticeable sag in cables. Cables can lose tension because of construction stretch, anchor creep, fitting slippage, and/or previous impacts elsewhere in the same run of cable. (Photo I - Low Tension Cable).

- *Is barrier at the correct height after impact?*

Cable height should be checked and repaired to meet NDDOT Standard Drawing D-764-32 for low tension cable or manufacturer's specifications for high tension cable.

- *Are any posts missing, severely misaligned or damaged?*

Low tension cable with damaged posts or missing hooks usually cause the cables to drop (Photo J), making repair more critical. High-tension cable guardrail remains effective with missing posts as long as cable heights are essentially maintained (Photo K).

Damaged posts can also present a spearing concern should a secondary impact occur (Photo K); crews should remove damaged or bent-over posts to eliminate the spearing potential.

- *Are the cables attached to the anchors, and the anchors flush with the ground surface?*

Most anchors for cable guardrail are designed that when impacted end-on the tension in the barrier run is released making it ineffective. Therefore, repair of the anchorage and resetting the cable should be a high priority. Maintenance personnel should also periodically inspect anchors for any damage or movement as seen in Photo L.



I



J



K



L

EXPECTED RESULTS:

Maintenance personnel and other DOT employees will be able to identify, without an in-depth inspection the type of barrier and terminal deficiencies that should be reported and repaired.

If a spearing condition is present and cannot be immediately repaired, the spear end should be lowered to the ground and retained by rebar pin(s) or a TMA may be appropriate. Photo A shows inadequate delineation and a potential of a spearing concern.

North Dakota Maintenance Manual Chapter 4 requires: Inspect barriers at least annually.

TYPES OF DEFICIENCIES:

W-Beam Rail:

- *Is barrier at the correct height?*

The purpose of guardrail is to contain the vehicle and not allow vaulting or underride. Therefore, any reduction in the system height to less than 26 ½" should be considered a high-priority repair (Photo B). However, the MGS system, originally installed at 31", should be evaluated if less than 28". Excessively high rail (>2 or 3") should also be evaluated.

- *Is the barrier generally in good shape, with no significant corrosion, damage from impact, or other misalignment?*

Guardrail failure also results if a vehicle penetrates through it. Therefore, any deterioration or damage that significantly decreases the tensile strength of the w-beam rail should be considered a high-priority repair, such as,

- Vertical tears in the w-beam (Photo C) that extend to the top or bottom of the rail greatly reduce the capacity of the rail and create areas of high stress concentrations.
- Non-manufactured holes (e.g., those caused by crash damage, lug nut damage, or corrosion) in the rail element that intersect the top or bottom edges of the rail.
- Non-manufactured holes or rail that has been cut with a torch. Rail element needs to be replaced (Photo D).
- Rail deflected more than 9 inches over a 25-foot length, (Photo E).
- Damaged or missing bolts at a splice.

Barrier Post:

- *Are any posts missing or severely misaligned or ineffective due to tears, rot, broken, or detached?*

These types of deficiencies can result in greater vehicle instability in a crash, possibly leading to rollover, barrier rupture, or barrier override. Prompt repairs should be made (note: the MGS can function with one missing post if no curb is present).



A



B



C



D



E

Terminal: (Have manufacturer's Installation Manual with you when conducting inspection and/or repairs).

Historically, the most commonly used w-beam guardrail terminals were designed to transmit tensile forces in the rail to a cable and ground anchor system and be crashworthy for end-on impacts. This anchor keeps the rail in tension for side impacts downstream from the end of the barrier installation.

Inspect terminals periodically for:

- *Is the rail element fully seated into the impact head?*

This is critical because the rail elements feed into the impact head on any head-on crash, absorbing the vehicle's energy. Photo F shows a poorly seated rail element. (Refer to installation manual for proper connection of head to post.)

The axial strength of the rail must be maintained (i.e., no kinks or bends). (Photo G).

- *Is the end post broken, the anchor cable missing, steel bearing plate missing or buried?*

In Photo H the anchorage is lost and any motorist striking the rail downstream from the terminal end would likely penetrate the system rather than be redirected.

- *Is the bearing plate properly oriented and restrained from turning?*

The bearing plate (8 x 8-inch square with an off-center hole) must be installed with the longer dimension upright (5" dimension up and the 3" dimension down). If the cable slackens over time, the plate may rotate downward due to gravity. If this happens, the ability of post #1 to fracture and separate in a head-on impact may be compromised and would essentially create a blunt end. Note: although this is only rated as a medium-priority under the NCHRP 656 report, this can very easily be repaired in the field, thus avoiding a potentially serious crash outcome. It's significance is illustrated by it being listed on the manufacturers' inspection checklists.

- *Is 4 inch stub height for soil tubes or hinge posts criteria satisfied?*

The grading must permit a vehicle to pass over any non-breakaway portion of the installation that remains without the vehicle snagging. The criteria is not to exceed 4 inches. Although NCHRP 656 rates this deficiency as medium-priority, if the height is excessive it could be potentially catastrophic.



F



G



H