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1620.01 General

Impact attenuator systems are protective systems that help aid an errant vehicle from impacting an object by either gradually decelerating the vehicle to a stop when hit head-on or by redirecting it away from the feature when struck on the side. These systems are used for rigid objects or other features that cannot be removed, relocated, or made breakaway.

Approved systems shall meet standardized testing defined in the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware (MASH) as updated in 2016*. In addition, these devices shall have an acceptance letter from FHWA that certifies that the device meets the appropriate crash test criteria and is eligible for federal-aid reimbursement.

1620.02 Design Criteria

The following design criteria apply to new, existing, or reset permanent and temporary impact attenuators.

Impact attenuators are placed so that they do not present a feature that requires mitigating in relation to opposing traffic. For median and reversible lane locations, the backup structure or attenuator-to-object connection is designed to help in aiding opposing traffic from being snagged.

Avoid placement of curbs between attenuators and traffic. Refer to the specific attenuator manufacturer's instructions if considering placement of curbing between an attenuator and the travelled way. It is desirable that existing curbing be removed and the surface smoothed with asphalt or cement concrete pavement before an impact attenuator is installed. However, mountable curbs 4 inches or less in height may be retained depending on the feasibility of removal and as long as the manufacturer's installation requirements are met.

In general, attenuators are aligned parallel to the roadway.

Consult with the Area Maintenance Superintendent who will be maintaining the system prior to selecting the attenuator systems to include in a construction contract.

1620.03 Selection Considerations

WSDOT classifies impact attenuators as **permanent** (for final installations that will remain in place) or **temporary** (for systems that will be in place during work zone traffic control operations and then removed). Some impact attenuator systems can be used in **both** a temporary capacity and then in a final/permanent installation.

For approved systems to choose from, see the WSDOT Impact Attenuator Design page at http://www.wsdot.wa.gov/publications/fulltext/design/ProductFolder/PENDING_Impact_Attenuator_Design.docx.

Consider that each application is unique when selecting impact attenuators for use in particular applications. This applies to both permanent and temporary installations.

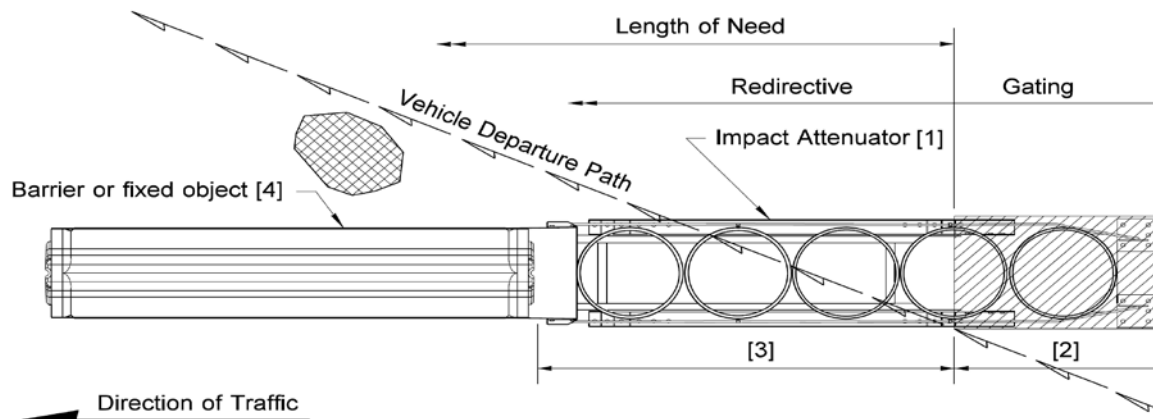
To select an appropriate impact attenuator system, the following factors must be assessed:

- Posted speed
- Operating speed
- Average daily traffic (ADT)
- Repair crew exposure
- Proximity to the roadway
- Anticipated number of yearly impacts
- Available space (length and width)
- Lifecycle Maintenance costs
- Initial cost
- Duration (permanent or temporary use)
- Portion of the impact attenuator that is redirective/gating (see [Exhibit 1620-1](#))
- Width of object to be shielded

Entries on the WSDOT Impact Attenuator Design page indicate whether the system is National Cooperative Highway Research Program (NCHRP) Report 350 or MASH-compliant. If it's determined that a MASH-compliant system is not available for the specific configuration required, document the selection of an NCHRP 350 system in the DDP.

When selecting the appropriate impact attenuator system, consider the portion that is designed to redirect vehicles during a side impact of the unit, such that fixed objects, either permanent or temporary (such as construction equipment), are not located behind the gating portion of these devices (see [Exhibit 1620-1](#)).

Exhibit 1620-1 Impact Attenuator Distance Beyond Length of Need

**Notes:**

- [1] Impact attenuator type and manufacturer varies with application. See the Attenuator Selection Template at:
http://www.wsdot.wa.gov/publications/fulltext/design/ProductFolder/Impact_attenuator_selection_template.xlsx
- [2] Distance beyond the length of need. This portion is gating.
- [3] This portion is redirective (nongating) and can be included as part of the barrier needed to satisfy length of need.
- [4] Concrete barrier shown for illustration purposes only. Type of fixed object varies.

Select the system and configuration appropriate for the posted speed. In the interest of a cost-effective design, selecting a system applicable for the posted speed is recommended (although using a system tested for a higher speed is acceptable). Note that attenuators used on highways with posted speeds of 70 mph have additional considerations discussed below. Where there is evidence that the average operating speed of the facility is higher than the posted speed, consider selecting an attenuator system rated at the facility's operating speed.

Manufacturer's product information may indicate that a different system is required for speeds of 70 mph or greater. These models are generally referred to as "high speed" or "70 mph" systems. Use of these systems on facilities with 70 mph posted speeds is not required, and selection of a system rated for at least 60 mph will typically be appropriate for most sites on these facilities. For permanent installations where unusual conditions warrant consideration of a high-speed device, these systems are available and may be used with justification. Contact the HQ Design Office for guidance when considering one of these systems.

For information regarding spatial requirements and initial cost information related to impact attenuator systems, see the Attenuator Selection Template at:

http://www.wsdot.wa.gov/publications/fulltext/design/ProductFolder/Impact_attenuator_selection_template.xlsx.

When considering maintenance costs, anticipate the average annual impact rate. If few impacts are anticipated, lower-cost devices might meet the need. (See [Chapter 301](#) for examples of how to determine lifecycle costs for proposed hardware). Attenuators with the lowest initial cost and initial site preparation will have high maintenance costs after each impact. Labor and equipment

are needed to clean up the debris and install a new attenuator, as the lowest cost attenuators are typically destroyed after a single impact. Attenuators with higher initial installation cost typically have lower maintenance costs.

In selecting a system, one consideration is the anticipated exposure to traffic that the workers making the repairs may encounter. In areas with high traffic exposure, a low-maintenance system that can be repaired quickly is most desirable. Some systems need nearly total replacement or replacement of critical components (such as cartridges or braking mechanisms) after a head-on impact, while others simply need to be reset.

When a transition to connect with a concrete barrier, fixed object, or beam guardrail is needed, the transition type and connection may need to be specified (see the impact attenuator descriptions accessible through the Attenuator Selection Template at:

http://www.wsdot.wa.gov/publications/fulltext/design/ProductFolder/Impact_attenuator_selection_template.xlsx).

In most cases, the transition type and connection required will be a custom design per the manufacturer (these transitions are included in the cost of the impact attenuator). In a few cases, the transition type and connection to use will be as described in [Chapter 1610](#) and the *Standard Plans* (these transition sections are not included in the cost of the impact attenuator and must be included as a separate bid item in the construction contract).

Consult with the Area Maintenance Superintendent who will be maintaining the systems before finalizing the list of attenuators to be included in the contract.

1620.03(1) Low-Maintenance Category

Low maintenance devices have a higher initial cost, requiring substantial site preparation, including a backup or anchor wall in some cases, and cable anchorage at the front of the installation. However, repair costs are very low, with labor typically being the main expense. Maintenance might not be needed after minor side impacts with these systems.

Installation of a low-maintenance device is desirable at locations that meet at least one of the following criteria:

- Sites with an ADT of 25,000 or greater
- Sites with a history/anticipation of more than one impact-per year
- Sites with unusually challenging conditions, such as limitations on repair time, a likelihood of frequent night repairs, or narrow gore locations

Document the decision in the DDP to use any device other than a low-maintenance device at locations meeting at least one of the criteria above.

The HQ Design Office conducts a periodic review of maintenance records to consider which devices should be included in the Low-Maintenance category. For a description of requirements that need to be met in order to be included in the Low-Maintenance category, see:

www.wsdot.wa.gov/publications/fulltext/design/roadsidesafety/low_maint.pdf

1620.03(2) Documenting Attenuator Selection

As the factors discussed previously are analyzed, identify inappropriate systems and eliminate them from further consideration. List the systems that are not eliminated in the contract. When the site conditions vary, it might be necessary to have more than one list of acceptable systems

within a contract. Acceptable systems cannot be eliminated without documented justification as to why they should not be used. Also, wording such as “or equivalent” is not to be used when specifying these systems. If it’s determined that MASH-compliant system is not available for a specific configuration, NCHRP 350 systems may be used, with Assistant State Design Engineer approval.

Document attenuator selection using the Attenuator Selection Template found at:

http://www.wsdot.wa.gov/publications/fulltext/design/ProductFolder/Impact_attenuator_selection_template.xlsx

1620.04 Transportable Attenuators (Truck-Mounted and Trailer-Mounted)

Truck Mounted Attenuators and Trailer-Mounted Attenuators are portable systems mounted on trucks or trailers. They are intended for use in work zones and for temporary applications.

1620.05 Older Systems

Many older systems are in use on Washington State highways and may be left in place or reset with concurrence of the WSDOT Area Maintenance Superintendent who maintains the system. New installations of these systems are not allowed.

For a list of older systems see:

http://www.wsdot.wa.gov/publications/fulltext/design/ProductFolder/PENDING_Impact_Attenuator_Design.docx.

1620.06 Inertial Barrier Systems (Sand Barrels)

Inertial barrel systems (sand barrels) commonly provide advantages in temporary installations where the locations change and there is sufficient space available or in permanent locations where there is a lower risk of collisions and where the debris, from the initial barrier when hit, will have a minimal impact to traffic. Refer to the manufacturer for system dimensions and specifications.

