Stack and Vent Modeling Guidance

This guidance describes the appropriate method for modeling various types of stacks and is applicable to PSD, non-PSD, and SIP modeling analyses conducted in the State of Iowa. Beginning with AERMOD version 16216, POINTCAP and POINTHOR source types supplement the standard POINT source. Per the AERMOD Implementation Guide[1] these source types provide appropriate procedures for modeling capped/vertically obstructed and horizontal stack discharges in AERMOD. The following four source types should be used to model stacks and vents.

Vertical

Any stack or vent where the exhaust is directed vertically at the point of release to the atmosphere. Stacks with rain guards that do not obstruct the exhaust at the point of release to the atmosphere are considered vertical (refer to the Table 1 for visual examples of unobstructing rain guards and corresponding modeled source parameters). Tilted stacks with an angle 30 degrees or more above horizontal can be considered vertical for permitting purposes but should be modeled using a prorated exit velocity as described in the special considerations below. Vertical stacks and vents should be modeled using the POINT source type.

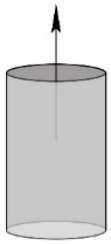


Figure 1 - Vertical Release

Obstructed

Any stack or vent that would otherwise be considered vertical but where the exhaust is redirected in a non-vertical fashion by a rain guard or other obstruction at the point of release to the atmosphere. Examples include traditional rain caps and inverted cones with an overhanging edge. Obstructed stacks and vents should be modeled using the POINTCAP source type and the actual exit velocity of the exhaust stream.

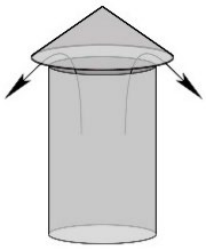


Figure 2 - Traditional Rain Cap

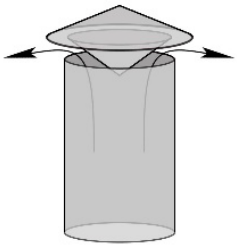


Figure 3 - Inverted Cone with Overhanging Edge

[1] https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf

Horizontal

Any stack or vent where the exhaust is directed between 30 degrees above and 30 degrees below horizontal at the point of release to the atmosphere. Horizontal stacks and vents should be modeled using the POINTHOR source type and the actual exit velocity of the exhaust stream. Building downwash must be applied to POINTHOR sources in AERMOD. Sensitivity tests conducted by the DNR indicate that POINTHOR sources modeled without downwash produce an under-prediction bias.

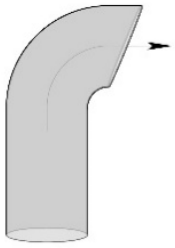


Figure 4 - Horizontal Release

Downward

Any stack or vent where the exhaust is directed 30 degrees or more below horizontal at the point of release to the atmosphere. Downward stacks and vents should be modeled using the POINT source type and the exit velocity should be set to the nominally low value of 0.001 m/s in order to suppress momentum plume rise[2].

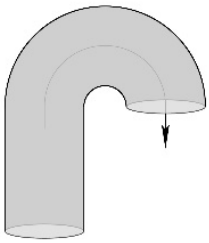


Figure 5 - Downward Release

Special Considerations

Tilted Stacks

Tilted vertical stacks should be modeled using an exit velocity equal to the vertical component of the actual velocity. To calculate the vertical component multiply the actual exit velocity by the sin of the angle above horizontal. For example: a stack tilted at an angle of 30 degrees above horizontal with an exit velocity of 10 m/s would be modeled at (sin 30 * 10 m/s) = 5 m/s. A tilted obstructed stack should be modeled as an obstructed stack.

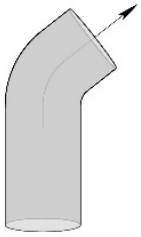


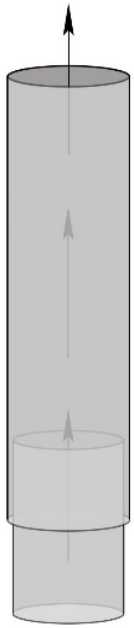
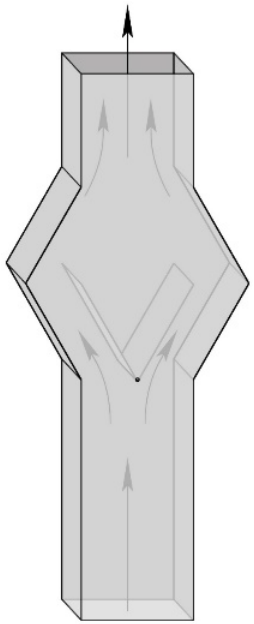
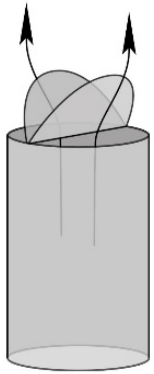
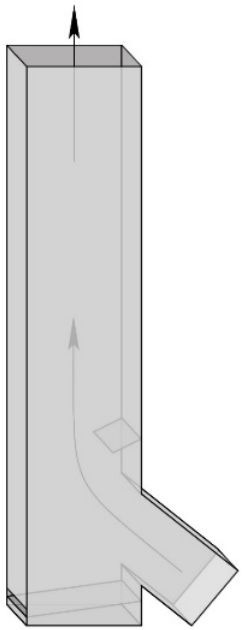
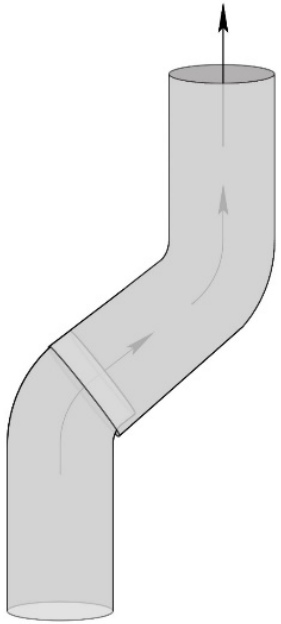
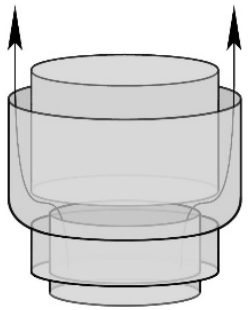
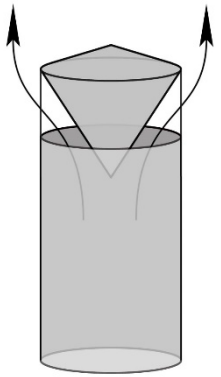
Figure 6 - Tilted Release

Square and Rectangular Stacks and Vents

A stack or vent with a rectangular opening should be modeled using an effective stack diameter. The effective diameter is the diameter of a circle with an area equal to the rectangular opening.

[2] https://gaftp.epa.gov/Air/aqmg/SCRAM/mchisrs/R1076_TIKVART_9_JUL_93.pdf

Table 1 - Unobstructing Rain Guards and Associated Model Parameters

	Stack-in-a-stack	Hexagonal	Hinged	Offset	Elbow Offset	Upblast	Inverted Cone (no overhang)
Diagram							
Height	Height of the top of the exterior stack	Height of the top of the stack	Height of the top of the stack (excluding hinged flaps)	Height of the top of the stack	Height of the top of the upper section of the stack	Height of the top of the exterior stack	Height of the top of the stack below the cone
Diameter	Actual or effective diameter of the exterior stack	Actual or effective diameter	Actual or effective diameter	Actual or effective diameter	Actual or effective diameter of the upper section of the stack	Actual or effective diameter of the exterior stack	Actual or effective diameter
Exit Velocity	Calculated based on flow rate (in acfm) and the exterior stack diameter	Calculated based on flow rate (in acfm) and the stack diameter	Calculated based on flow rate (in acfm) and the stack diameter	Calculated based on flow rate (in acfm) and the stack diameter	Calculated based on flow rate (in acfm) and the diameter of the upper section of the stack	Calculated based on flow rate (in acfm) and the area of the open portion of the stack	Calculated based on flow rate (in acfm) and the stack diameter