The point source algorithm is used to characterize emission releases from discrete points such as stacks or “forced-flow” vents whose exit velocity is controlled by a fan or other mechanical device. The release parameters for a point source are based upon the physical design and operational characteristics of the stack or vent being modeled. Specific elements must be determined for each point source release prior to model execution: emission rate, stack height, exit temperature, exit velocity and diameter. The following paragraphs provide an overview of each release parameter and any special considerations that should be accounted for in the air quality analysis. *This paper does not address emission rate calculations. For additional information on emission rate calculations, please contact the department’s Air Pollution Control Program at (573)751-4817 and request to speak to a construction permit engineer.*

**Stack Height**

The stack height for each source is equal to the height of the release, in meters, above the ground. It is important to note that this is true for surface based stacks and stacks located on structures or rooftops as displayed in Figure 1.

![Stack Height Diagram](image)

**Exit Temperature**

The temperature for each source is equal to the exit temperature of the gas stream in degrees Kelvin. If the exit temperature is equivalent to the ambient temperature, the user may input a value of 0.0 in the model input file and the model will automatically adjust the gas temperature based upon the conditions contained within the meteorological data file.

**Exit Velocity**

The velocity for each source is equal to the gas exit velocity in meters per second. If the exit velocity is not known, it can be calculated from the flow rate of the gas stream through the use of the following equation:

\[
\text{Velocity} = \frac{\text{Flow Rate}}{(\pi \times \text{stack radius}^2)}
\]

It is important to note that the flow rate used in the calculation of the exit velocity should be based upon the actual cubic feet per minute, acfm, flow rate rather than the standard cubic feet per minute, scfm, flow rate. The primary difference between acfm and scfm is that the actual cubic feet per minute
flow rate is based upon the volume of gas after it is pressurized rather than the standardized set of atmospheric conditions that are used in the calculation of scfm (temperature, pressure and relative humidity).

**Stack Diameter**
The stack diameter is equal to the inside diameter of the stack in meters. If the stack is a dual flue, two point source releases should be modeled with the stack diameter based upon the inside diameter of each flue.

**Special Considerations**
The following stack types may require the user to adjust the release parameters that are assigned to each stack. The process of assigning the release parameters should be outlined in the modeling protocol for review and comment by personnel from the Construction Permit Modeling Unit prior to conducting the final air quality analysis.

**Rain Caps and Horizontal Stacks**
To account for the restriction of vertical air flow that occurs from horizontal stacks or stacks with rain caps, the exit velocity for each stack should be reduced to 0.001 meters per second in the model input file.

**Passive Bin Vents and Grain Silos**
Passive vents can be defined as a vent whose flow rate is variable and is directly dependent upon the displacement of air. For example, the flow of air out of a bin vent varies and is dependent upon the rate at which the bin is filled with grain. As the bin is filled, the volume of air within the bin is displaced and forced through the vent opening (s). If the bin is not being filled or emptied, the movement of air is dependent upon ambient conditions such as the air temperature. During these times, the flow of air from the vent is minimal.

Since the flow rate from a passive vent is difficult to define, the department’s Air Pollution Control Program requires applicants to model passive vents as a volume source. Guidance on the assignment of the release parameters can be found within the following document, “Volume Sources.”

**Cooling Towers**
Cooling towers are used to transfer waste heat that is generated during manufacturing to the atmosphere through the evaporation of water. Typically, cooling towers can be found at any facility that generates process waste heat that needs to be dissipated such as power plants, ethanol plants and chemical plants. Cooling towers at most industrial sites are made up of multiple cells rather than one large cell. For dispersion modeling purposes, each cooling tower cell should be modeled as an individual point source rather than one combined source.
Flares
Flares are a unique type of point source release that requires adjusted model inputs for the temperature, exit velocity, height and diameter to account for the buoyancy of plume. The following inputs, based upon the heat release of the flare, should be calculated and input into the air quality model.

- Effective Stack Exit Velocity = 20 Meters per Second
- Effective Stack Exit Temperature = 1,273 Degrees Kelvin
- Adjusted Stack Diameter = \[ D = 9.88 \times 10^{-4} \times (q_n)^{1/2} \]
  \[ q_n = \text{Net Heat Release from the Flare} = (0.45) \times q \]
  - \( q = \text{Gross Heat Release from the Flare in Calories per Second} \)
  - 0.45 = Percentage of Total Heat Released as Sensible Heat
- Adjusted Stack Height = \[ H_{\text{eff}} = H_s + 4.56 \times 10^{-3} \times q^{0.478} \]
  - \( H_s = \text{Flare Height} \)
  - \( q = \text{Gross Heat Release from the Flare in Calories per Second} \)

Building Downwash and Good Engineering Practice Stack Height
The presence of buildings can affect plume rise and the initial dispersion of pollutants within the atmosphere. Specific guidance on building downwash and good engineering practice stack height can be found within the following guidance document, “Building Downwash and Good Engineering Practice Stack Height.”

Modifications to Existing Stacks and Prohibited Dispersion Techniques
Facilities cannot avoid the installation of control devices or enforceable permit limits simply by altering the dispersion of the gas stream through the manipulation of the release characteristics of the stack. When modeling point source releases, the applicant cannot take credit for the following items in the air quality analysis:

1. That portion of a stack that exceeds good engineering practice stack height,
2. Operational limits based solely upon pollutant concentrations or atmospheric conditions,
3. Manipulation of exhaust plume rise by altering the release parameters of existing stacks, or by combining gas streams.

It is important to note that these conditions do not impact the actual physical height or characteristics of the stack at a facility. They merely limit the credit that can be taken within the air quality impact analysis. Specific information on the stack height requirements can be found in the following document, “Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations).”