

MIXING HEIGHT, TRANSPORT WIND, and CATEGORY DAY

While the Oklahoma Dispersion Model has to do with surface dispersion conditions for downwind distances of up to several miles, another system exists for dealing with the ability of the atmosphere to mix and transport smoke throughout the boundary layer (which can extend upwards of 5000 feet above the surface) and over large distances. “Mixing Height” or “Mixing Depth” (ft or m) signifies the height above the surface throughout which a pollutant such as smoke can be dispersed. During times of surface temperature inversions (typically nighttime with clear skies), the mixing height goes to zero and smoke dispersion is minimal. “Transport Wind” signifies the average wind speed (knots or m/s) throughout the depth of the mixed layer. “Ventilation Rate” (VR) equals the product of the two (knot-foot or m*m/s) and represents the ability of the boundary layer to get rid of the smoke. When VR values are low, there is not much mixing potential and surface air quality suffers. When VR values are consistently low (day and night), it is possible to “smoke in” large areas for several days.

$$\text{Ventilation Rate (m*m /s)} = \text{Mixing Height (m)} \times \text{Transport Wind (m/s)}$$



Based on these variables, a “Category Day” system has been developed relating ventilation rate to smoke dispersal. A set of burning guidelines based on VR and Category Day has been developed and is shown below:

<u>Category Day</u>	<u>Ventilation Rate (m*m/s)</u>	<u>Burning Guidelines</u>
1	< 2,000	No burning
2	2,000 - 4,000	No burning until 11 a.m. and not before surface inversion has lifted; fire out by 4 p.m.
3	4,000 - 8,000	Daytime burning only after surface inversion has lifted.
4	8,000 - 16,000	Burning anytime. For night burns use backfires with surface wind speeds greater than 4 mph.
5	> 16,000	Unstable and windy. Excellent smoke dispersal but burn with caution !

Typically this chart is used with afternoon ventilation rate values (using afternoon mixing heights, after any surface temperature inversion has dissipated). Note that on nights with surface temperature inversions, the mixing height goes to zero and so does the ventilation rate. Situations to be avoided are successive days with afternoon Category Day values 2 and below (or even 3 and below), as these scenarios can lead to “smoke-out” situations.

The National Weather Service (NWS) offices covering Oklahoma (Amarillo, Norman, Tulsa, and Shreveport) offer forecasts of Ventilation Rate and Category Day in their fire weather forecasts. These fire weather forecasts can be found in two different sections of the OK-FIRE site. One can go to the “FIRE” section and click on “Fire Weather Forecasts”. Choose the NWS office covering your area. One can also go to the “SMOKE” section, click on “Forecast Boundary-Layer Dispersion”, and then on the NWS office covering your area.

In either section, one can also go to the “MM5 Fire Weather Forecasts” (in the FIRE section) or “MM5 Dispersion Forecasts” (in the SMOKE section) for animated forecast maps of mixing height, transport wind, and ventilation index. At their main page, click on “State Maps” on the left. You can then choose the state of interest, which variable(s) to plot, and animate the maps through a 72-hour period. Note that the forecast model used to provide these predictions is the MM5 model, a different model than the NAM model used in OK-FIRE.