Computation of the Pollutant Standards Index (PSI)

The PSI is based on five pollutants for which primary National Ambient Air Quality Standards (NAAQS) have been established by the United States Environmental Protection Agency. These pollutants are particulate matter (PM10), sulphur dioxide (SO_2), carbon monoxide (CO), ozone and nitrogen dioxide (NO_2). For each pollutant a sub-index is calculated from a segmented linear function that transforms ambient concentrations onto a scale extending from 0 through 500 with 100 corresponding to the primary NAAQS.

The breakpoints used in defining each of the five pollutant sub-indices are listed as follows:

PSI Value	24-h PM10 ($\mu g/m^3$)	24-h SO_2 ($\mu g/m^3$)	8-h CO (mg/m^3)	8-h Ozone ($\mu g/m^3$)	1-h NO_2 ($\mu g/m^3$)
50	50	80	5	118	*
100	150	365	10	157	*
200	350	800	17	235	1,130
300	420	1,600	34	785*	2,260
400	500	2,100	46	980*	3,000
500	600	2,620	57.5	1,180*	3,750

(Note: *When 8-hour ozone concentration exceeds 785$\mu g/m^3$, the PSI sub-index is calculated using the 1-hour ozone concentration)

Each sub-index i, is calculated by using a segmented linear function that relates pollutant concentration, X_i to sub-index value, I_i. A segmented linear function consists of straight-line segments joining discrete co-ordinates (i.e breakpoints). For pollutant i and segment j, the co-ordinates of the jth breakpoint are represented by sub-index value $I_{i,j}$ and the concentration $X_{i,j}$ giving the ordered pair ($X_{i,j}$ $I_{i,j}$). If the observed concentration is X_i the corresponding sub-index value I_i is calculated using the following equation over the concentration range:

$$I_i = \frac{I_{i,j+1} - I_{i,j}}{X_{i,j+1} - X_{i,j}} (X_i - X_{i,j}) + I_{i,j}$$

$$\text{for } X_{i,j} \leq X_i \leq X_{i,j+1}$$

where X_i = Observed concentration for the ith pollutant

$I_{i,j}$ = PSI value for the ith pollutant and the jth breakpoint as given in the table

$I_{i,j+1}$ = PSI value for the ith pollutant and the (j+1)th breakpoint as given in the table

$X_{i,j}$ = Concentration for the ith pollutant and jth breakpoint as given in the table

$X_{i,j+1}$ Concentration for the ith pollutant and (j+1)th breakpoint as given in the table

Finally the overall index is calculated as the maximum of sub-indices:

$$PSI = \text{maximum } (I_1, I_2, I_3, I_4, I_5)$$

Example of computation.

Suppose a PM10 24-hour average concentration of 283 $\mu g/m^3$ is observed. Based on the table the observed concentration of X_i = 283 $\mu g/m^3$ lies between 150 and 350 $\mu g/m^3$ therefore the computation is carried out for the second segment (j=2). For this segment $X_{1,2}$ = 150 $\mu g/m^3$ and $X_{1,3}$ = 350 $\mu g/m^3$ with corresponding sub-index values for $I_{1,2}$ = 100 and $I_{1,3}$ = 200. The computation is as follows:

$$I_i = \frac{I_{i,j+1} - I_{i,j}}{X_{i,j+1} - X_{i,j}} (X_i - X_{i,j}) + I_{i,j} = \frac{200 - 100}{350 - 150} (283 - 150) + 100 = 167$$

Therefore, the PM10 sub-index is 167. If the four other pollutant sub-indices calculated in a similar manner from concentrations were I_2 = 5, I_3= 10, I_4= 50 and I_5= 75, then the overall index is reported as the maximum of these values as follows:

PSI = maximum (167, 5, 10, 50, 75) = 167