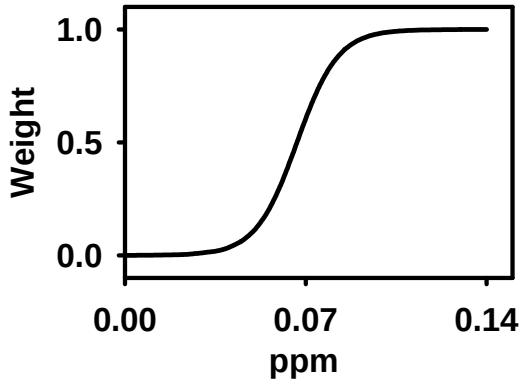
How is the W126 value calculated?

The W126 value is expressed as a sum of weighted hourly concentrations, cumulated over the 12-hour daylight period from 8:00 a.m. to 8:00 p.m. local standard time, during the consecutive 3-month period within the ozone monitoring season with the maximum index value. The 3-year average is computed by averaging the maximum 3-month sum from each year in a 3-year period.

Let's breakdown the calculation into 4 easy steps…

1. Compute the **Daily Index** value
2. Compute the **Monthly Index** value
3. Compute **3-month sums**
4. Compute the **3-year average**

Before we get started, take a look at how the hourly concentrations will be weighted



- Each hourly concentration will be weighted - lower concentrations receive less weight than higher concentrations

- The following slide will guide you through the calculation of the daily index value which applies this weighting technique

Step 1 - Compute the **Daily Index** value (D.I.)

- Preparation: Get a good scientific calculator. There is one online at http://web2.0calc.com/. For a given monitor, obtain the 12 hourly concentrations from 8am to 8pm. Apply the following steps to each hourly concentration, one at a time. Be sure to retain all decimal places in each step.

1. Multiply the hourly concentration by -126.
2. Compute e raised to the power of the result from step 1 by pressing the EXP button.
3. Multiply the result from step 2 by 4403.
4. Add 1 to the result from step 3.
5. Compute the inverse of the result from step 4 by pressing the 1/x button. (If your calculator doesn't have this button, divide 1 by the result from step 4.)
6. Multiply the result from step 5 by the original hourly concentration.
7. Repeat steps 1-6 for each of the 12 hourly concentrations
8. Sum the 12 values. Congratulations – you've just computed the Daily Index value (D.I.) below:

$$D.I. = \sum_{i=8am}^{7\,pm} O_{3i} * \left(\frac{1}{1+(4403 * e^{-126*O_{3i}})}\right)$$

Start hour (local standard time)	Concentration (ppm)	Weighted Concentration (ppm)
8:00 AM	0.045	0.002781
9:00 AM	0.060	0.018218
10:00 AM	0.075	0.055701
11:00 AM	0.080	0.067537
12:00 PM	0.079	0.065327
1:00 PM	0.082	0.071715
2:00 PM	0.085	0.077394
3:00 PM	0.088	0.082448
4:00 PM	0.083	0.073683
5:00 PM	0.081	0.069667
6:00 PM	0.065	0.029260
7:00 PM	0.056	0.011676

→ 0.625406 ppm-hours

TIP: You can use the following formula in Excel or SAS to compute the weighted concentrations resulting from steps 1 to 6: OZ*(1/(1+4403*EXP((OZ*(-126))))), where OZ is the hourly ozone concentration in ppm.

Step 2 - Compute the **Monthly Index** value (M.I.)

1. First, determine whether the month meets the 75 percent completeness criterion by adding the number of hourly values (8am to 8pm) in the month and dividing that sum by the number of possible reporting hours (8am to 8pm) for the month. Multiply by 100. If the result is 75 or greater, then the completeness criterion is met and you should go to step 3 (skip step 2). If the result is less than 75, then you should go to step 2.

2. For months with less than 75% data completeness, substitute the lowest hourly ozone concentration observed during daylight hours in the required ozone monitoring season of each year OR ½ the mdl of the instrument, whichever is higher, for enough missing hourly values to make the month 75% complete.

3. Sum all the daily index values in the month (including any substituted values from step 2).

4. Adjust for missing data (between 75 and 100% complete) by multiplying the number of days in the calendar month by 12 and dividing by the number of reported hourly values (8am to 8pm) in the month. Multiply the result from step 3 by this ratio. (Note: If the data are 100% complete, the ratio is 1.) You've just computed the Monthly Index value (M.I.).

$$M.I. = \left[\sum_{j=1}^{n} (D.I.) \right] * (n * 12)/v$$

where

M.I. = the adjusted monthly W126 index,
D.I. = the daily sum of the sigmoidally weighted daylight hourly concentrations,
n = the number of days in the calendar month,
v = the number of index hours (8:00 a.m. - 8:00 p.m. LST) in the month with valid hourly O3 concentrations

Step 3 - Compute **3-month sums** for every consecutive 3-month period by simply adding the 3 monthly index values

Step 4 - Compute the **3-year average** by adding the highest 3-month sum in each year, dividing by 3, and rounding the result to the nearest whole number. This is the W126 value!

Year 2004	April	May	June	July	August	September	October
Monthly Index	4.442	9.124	12.983	16.153	13.555	4.364	1.302
3-Month sum	na	na	26.549	38.260	**42.691**	34.072	19.221
Year 2005	April	May	June	July	August	September	October
Monthly Index	3.114	7.214	8.214	8.111	7.455	7.331	5.115
3-Month sum	na	na	18.542	23.539	**23.780**	22.897	19.901
Year 2006	April	May	June	July	August	September	October
Monthly Index	4.574	5.978	6.786	8.214	5.579	4.331	2.115
3-Month sum	na	na	17.338	**20.978**	20.579	18.124	12.025

W126 value = (42.691 + 23.780 + 20.978)/3 = 29.149666… rounds to **29 ppm-hours**