Technical Assistance Document
for the Reporting of Daily Air Quality –
the Air Quality Index (AQI)

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for the Reporting of Daily Air Quality –
the Air Quality Index (AQI)**

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This guidance is designed to aid local agencies in reporting the air quality using the Air Quality Index (AQI) as required in Part 58.50 of 40 CFR and according to Appendix G to Part 58 of 40 CFR.

Do I have to report the AQI?

Part 58.50 states that Metropolitan Statistical Areas (MSAs) with a population of more than 350,000 are required to report the AQI daily to the general public. Table A-1 in the Appendix lists all metropolitan areas with a population of more than 350,000.

How often do I report the AQI?

Appendix G states that MSAs must report the AQI on a daily basis. The appendix further defines daily as at least five times each week. This definition allows for days when personnel are not available to provide the AQI report or for equipment failures.

How do I provide the AQI report to the general public?

You may distribute the report to the local media (newspapers, radio, television), provide a recorded telephone message, or publish the report on a publicly accessible Internet site. Other efforts, including real-time data reporting and community action programs (e.g., ozone action day programs) that provide timely air quality information to the public, may be used to meet reporting requirements.

What is in my AQI report?

Your AQI report must contain:

- The reporting area(s),
- The reporting period,
- The critical pollutant,
- The AQI,
- The category descriptor and, if reported in a color format, the associated color.[1] Use only the following names and colors for the six AQI categories:

For this AQI....	use this descriptor...	and this color
0 to 50	"Good"	Green
51 to 100	"Moderate"	Yellow
101 to 150	"Unhealthy for Sensitive Groups"	Orange
151 to 200	"Unhealthy"	Red
201 to 300	"Very Unhealthy"	Purple
301 and above	"Hazardous"	Maroon

- Statements cautioning sensitive groups for all pollutants with an index value over 100. Use Table 1 on page on the following page to caution sensitive groups. Statements may be combined so that each group is mentioned only once.

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[1] Although a recorded phone message or a radio broadcast can't show colors, it can name a color in the report (e.g. this is a "red" air quality day).

Table 1: Pollutant Specific Sensitive Groups

When this pollutant has an index above 100…	Report these Sensitive Groups
Ozone	People with lung disease, children, older adults, and people who are active outdoors are the groups most at risk
PM2.5	People with heart or lung disease, older adults, children, and people of lower socioeconomic status (SES) are the groups most at risk
PM10	People with heart or lung disease, older adults, children, and people of lower socioeconomic status are the groups most at risk
CO	People with heart disease are the group most at risk
NO2	People with asthma, children, and older adults are the groups most at risk
SO2	People with asthma, children, and older adults are the groups most at risk

An AQI report may also contain, but does not require:
- The name and index value for other pollutants, particularly those with an index value greater than 100,
- The index for sub-areas of the reporting area,
- Actual pollutant concentrations,
- Causes for unusual AQI values,
- Health effects and cautionary language,
- Statements that "blend" health effects and cautionary information for more than one pollutant, if there is more than one pollutant with an index value greater than 100.

It is important to inform the public when the AQI is above 100. This is why EPA strengthened the reporting provisions in section 6 of Appendix G in 1999. In particular, whenever the AQI exceeds 100, reporting agencies should expand reporting to all major news media, and at a minimum, should include notification to the media with the largest market coverage for the area in question.

What does an AQI report look like?

Example 1. Newspaper short form in color

Air Quality for Raleigh, N.C.

Air Quality Index
Yesterday's report: **66**
Main pollutant: **Particulate Matter**

▼

0-50 Good	51-100 Moderate	101-150 Unhealthy, Sensitive groups	151-200 Unhealthy	201-300 Very unhealthy

▲

Today's ozone forecast : **38**

Example 2. Newspaper short form in black and white

Chicago Tribune
AIR QUALITY
Illinois EPA's air quality index (AQI):
0-50 is good; 51-100 moderate; 101-150 unhealthy
for sensitive groups; 151-200 unhealthy; 200+
very unhealthy

Tuesday's reading	na
Wednesday's forecast	**Good**
Critical pollutant	**Particulate Matter**

Example 3. Newspaper longer form

The Air Quality in Baltimore Yesterday

The AIR QUALITY yesterday in Northeast Baltimore was Unhealthy for Sensitive Groups due to ozone. Groups likely to be sensitive to ozone include active children and adults, and people with respiratory disease such as asthma. The Air Quality Index was 109 resulting from an ozone concentration of 0.079 ppm. Elsewhere in Baltimore, the air quality index was 87 or Moderate. Since today's air quality is expected to be much the same, sensitive groups should consider limiting prolonged or heavy outdoor exertion.

▶

GOOD

MODERATE

UNHEALTHY for SENSITIVE GROUPS

UNHEALTHY

VERY UNHEALTHY

HAZARDOUS

3

TELEVISION

The following is a short script that could be used for a television evening news/weather report. The graphics used in the report could be much the same as the graphics used in newspaper reports. The weathercaster must use the descriptors and, if a color format is used, colors for the categories that are listed above.

Example 4. A short form for television (morning)

"Yesterday the air quality was unhealthy due to ozone, and we expect similar air quality today – in the red range or around an index of 160, which is unhealthy. Active adults and children and people with asthma or other respiratory diseases should avoid prolonged physical exertion outside today. In fact, everyone should consider limiting the time they spend on outdoor exercise or those outside jobs..."

Example 5. A short form for television (evening)

"The air quality index today was 156, a red air quality day. The air stagnation caused a buildup of ozone to unhealthy levels."

Example 6. Two long forms for television (evening)

"Air quality today was unhealthy due to ozone, with an index value of 156. The cool front we expected to come through here tomorrow and blow all this ozone away isn't going to make it, so the stagnant air will still be here, making air quality unhealthy. Active children and adults and people with asthma or other respiratory diseases should avoid prolonged exertion outside tomorrow. In fact, everyone should consider limiting the time they spend on outdoor exercise or those outside jobs..."

"Tomorrow will be a code red air quality day for Center City. The cold winter air, morning traffic, and wood smoke are expected to cause particle pollution to rise to unhealthy levels. People with heart or lung disease, older adults, and children should avoid strenuous activities."

TELEPHONE

Recorded telephone messages can be used to give more up-to-date information on the air quality. For example, the following script has been used:

Example 7. A script for telephone

"As of 10:00 a.m., the air quality index is 45 which is a good or "green" air quality day. The responsible pollutant is ozone."

INTERNET

Most State and local agencies report the AQI on their public Web sites. The data available on the Web site are typically up to the most recent hour. Links to these sites can be found in the "Where I Live" section of the AirNow Web site, at www.airnow.gov.

Example 8. A short form for a Web page

Air Quality Index for St. Louis, MO

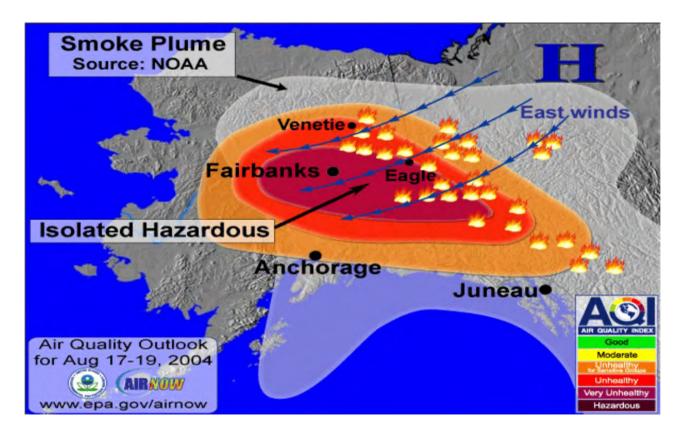| Time of this report:	1:00PM	**AQI:**	110	**Code:**	Orange
Responsible pollutant:	Ozone	**Category:**		Unhealthy for Sensitive Groups	

Example 9. A long form for a Web page- ozone

Air Quality Index for Chicago, IL for August 2

Report as of:	2:00PM	**AQI:**	162	**Responsible pollutant:**	Ozone

Code:	Red	**Category:**	Unhealthy

Sensitive groups:	Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy outdoor exertion.
Health effects:	Greater likelihood of respiratory symptoms and breathing difficulty in sensitive groups, possible respiratory effects in the general population.
HEALTH ADVISORY	Children and adults who are active outdoors, and people with lung disease, such as asthma should avoid moderate exertion outdoors, everyone else (especially children) should limit prolonged or heavy outdoor exertion.

Air Quality in South Chicago - Gary, IL	AQI:	122	(Unhealthy for Sensitive Groups)

Tomorrow's air quality in Chicago is predicted to be:	Unhealthy for Sensitive Groups	Code:	Orange

Example 10. A long form for a Web page- particulate matter

Anchorage, Alaska

Alaska Department of Environmental Conservation (DEC) Issues Statewide Air Quality Advisory-

The AQI levels have been steadily increasing from Moderate to Unhealthy. Dense smoke advisory has been issued by the National Weather Service for the Fairbanks area for today and tonight. Poor air quality conditions are expected to persist for the next several days as a high pressure system to the northeast drives easterly winds and smoke to the Fairbanks area.

Health Tip: Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly, and children should remain indoors.

Source: Alaska Department of Environmental Conservation and United States Environmental Protection Agency.

What colors do I use in my AQI report?

If you report the Air Quality Index in a color format, the appropriate colors are specified in Appendix G as the following:

For this category ...	... use this color
Good	Green
Moderate	Yellow
Unhealthy for Sensitive Groups	Orange
Unhealthy	Red
Very Unhealthy	Purple
Hazardous	Maroon

Specific colors are defined in the table below for red, green, blue (RGB) and cyan, magenta, yellow, and black (CMYK) color formulas:

Color	R	G	B	C	M	Y	K
Green	0	228	0	40	0	100	0
Yellow	255	255	0	0	0	100	0
Orange	255	126	0	0	52	100	0
Red	255	0	0	0	100	100	0
Purple	143	63	151	51	89	0	0
Maroon	126	0	35	30	100	100	30

Notes: The RGB model is traditionally used for screen colors, while CMYK is traditionally used for printing processes. The color models are based on a 0 - 255 scale (e.g. 50% is 126).

What health effects and cautionary statements should I use in my report?

The most recent health effect information used with the AQI is pollutant-specific. The following table lists the different health effects messages, sensitive groups, and cautionary statements for each pollutant in the AQI.

Pollutant-Specific Sub-indices and Health Effects Statements
for Guidance on the Air Quality Index (AQI)

AQI Categories: Index Values	Ozone (ppm)		Particulate Matter (µg/m³)		Carbon Monoxide (ppm) [8-hour]	Sulfur Dioxide (ppb) [1-hour]	Nitrogen Dioxide (ppb) [1-hour]
	[8-hour]	[1-hour]	PM$_{2.5}$ [24-hour]	PM10 [24-hour]			
Good (Up to 50)	0 - 0.059 None	-	0 – 12.0 None	0 – 54 None	0 – 4.4 None	0 - 35 None	0 - 53 None
Moderate (51 - 100)	0.060 - 0.075 Unusually sensitive individuals may experience respiratory symptoms.	-	12.1 – 35.4 Respiratory symptoms possible in unusually sensitive individuals, possible aggravation of heart or lung disease in people with cardiopulmonary disease and older adults.	55 – 154	4.4 – 9.4 None	36 - 75 None	54 - 100 None
Unhealthy for Sensitive Groups (101 - 150)	0.076 - 0.095 Increasing likelihood of respiratory symptoms and breathing discomfort in people with lung disease, such as asthma, children, older adults and outdoor workers.	0.125 - 0.164	35.5 – 55.4 Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease, older adults, and people of lower SES.	155 – 254	9.5 – 12.4 Increasing likelihood of reduced exercise tolerance due to increased cardiovascular symptoms, such as chest pain, in people with heart disease.	76 - 185 Increasing likelihood of respiratory symptoms, such as chest tightness and breathing discomfort, in people with asthma.	101 - 360 Increasing likelihood of respiratory symptoms, such as chest tightness and breathing discomfort, in people with asthma.
Unhealthy (151 - 200)	0.096 - 0.115 Greater likelihood of respiratory symptoms and breathing difficulty in people with lung disease, such as asthma, children, older adults, and outdoor workers; possible respiratory effects in general population.	0.165 - 0.204	55.5 – 150.4 Increased aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease, older adults, and people of lower SES; increased respiratory effects in general population.	254 – 354	12.5 – 15.4 Reduced exercise tolerance due to increased cardiovascular symptoms, such as chest pain, in people with heart disease.	186 - 304 Increased respiratory symptoms, such as chest tightness and wheezing in people with asthma; possible aggravation of other lung diseases.	361 - 649 Increased respiratory symptoms, such as chest tightness and wheezing in people with asthma; possible aggravation of other lung diseases.

Category							
Very Unhealthy (201 - 300)	0.116 - 0.374	0.205 - 0.404	150.5 – 250.4	355 – 424	15.5 – 30.4	305 – 604 [24-hour]	650 - 1249
	Increasingly severe symptoms and impaired breathing likely in people with lung disease, such as asthma, children, older adults, and outdoor workers; increasing likelihood of respiratory effects in general population.		Significant aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease, older adults, and people of lower SES; significant increase in respiratory effects in general population.		Significant aggravation of cardiovascular symptoms, such as chest pain, in people with heart disease.	Significant increase in respiratory symptoms, such as wheezing and shortness of breath, in people with asthma; aggravation of other lung diseases.	Significant increase in respiratory symptoms, such as wheezing and shortness of breath, in people with asthma; aggravation of other lung diseases.
Hazardous (301 - 500)	-	0.405 - 0.604	250.5 – 500.4	425 – 604	30.5 – 50.4	605 – 1004 [24-hour]	1249 - 2049
	Severe respiratory effects and impaired breathing likely in people with lung disease, such as asthma, children, older adults and outdoor workers; increasingly severe respiratory effects likely in general population.		Serious aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease, older adults, and people of lower SES; serious risk of respiratory effects in general population.		Serious aggravation of cardiovascular symptoms, such as chest pain, in people with heart disease; impairment of strenuous activities in general population.	Severe respiratory symptoms, such as wheezing and shortness of breath, in people with asthma; increased aggravation of other lung diseases; possible respiratory effects in general population.	Severe respiratory symptoms, such as wheezing and shortness of breath, in people with asthma; increased aggravation of other lung diseases; possible respiratory effects in general population.

Pollutant-Specific Sub-indices and Cautionary Statements for Guidance on the Air Quality Index (AQI)

AQI Categories (Index Values)	Ozone (ppm) [8-hour]	Ozone (ppm) [1-hour]	Particulate Matter (µg/m³) PM$_{2.5}$ [24-hour]	Particulate Matter (µg/m³) PM10 [24-hour]	Carbon Monoxide (ppm) [8-hour]	Sulfur Dioxide (ppb) [1-hour]	Nitrogen Dioxide (ppb) [1-hour]
Good (Up to 50)	0 - 0.059 None		0 – 12.0 None	0 - 54 None	0 – 4.4 None	0 - 35 None	0 - 53 None
Moderate (51 - 100)	0.060 - 0.075 Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion.		12.1 – 35.4 Unusually sensitive people should consider reducing prolonged or heavy exertion.	55 – 154	4.5 – 9.4 None	36 - 75 None	54 - 100 Unusually sensitive individuals should consider limiting prolonged exertion especially near busy roads.
Unhealthy for Sensitive Groups (101 - 150)	0.076 - 0.095 People with lung disease, such as asthma, children, older adults, and outdoor workers should reduce prolonged or heavy outdoor exertion.	0.125 - 0.164	35.5 – 55.4 People with heart or lung disease, older adults, children, and people of lower SES should reduce prolonged or heavy exertion.	155 – 254	9.5 – 12.4 People with heart disease, such as angina, should limit heavy exertion and avoid sources of CO, such as heavy traffic.	76 - 185 People with asthma should consider limiting outdoor exertion.	101 - 360 People with asthma, children and older adults should limit prolonged exertion especially near busy roads.

Category							
Unhealthy (151 - 200)	0.096 - 0.115	0.165 - 0.204	55.5 – 150.4	255 – 354	12.5 – 15.4	186 – 304	361 - 649
	People with lung disease, such as asthma, children, older adults, and outdoor workers should avoid prolonged or heavy outdoor exertion; everyone else should reduce prolonged or heavy outdoor exertion.		People with heart or lung disease, older adults, children, and people of lower SES should avoid prolonged or heavy exertion; everyone else should reduce prolonged or heavy exertion.		People with heart disease, such as angina, should limit moderate exertion and avoid sources of CO, such as heavy traffic.	Children, people with asthma, or other lung diseases, should limit outdoor exertion.	People with asthma, children and older adults should avoid prolonged exertion near roadways; everyone else should limit prolonged exertion especially near busy roads.
Very Unhealthy (201 - 300)	0.116 - 0.374	0.205 - 0.404	150.5 – 250.4	355 – 424	15.5 – 30.4 People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.	305 – 604 [24-hour] Children, people with asthma, or other lung diseases should avoid outdoor exertion; everyone else should reduce outdoor exertion.	650 - 1249 People with asthma, children and older adults should avoid all outdoor exertion; everyone else should avoid prolonged exertion especially near busy roads.
	People with lung disease, such as asthma, children, older adults, and outdoor workers should avoid all outdoor exertion; everyone else should reduce outdoor exertion.		People with heart or lung disease, older adults, children, and people of lower SES should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.				
Hazardous (301 - 500)	-	0.405 - 0.604	250.5 – 500.4	425 – 604	30.5 – 50.4 People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic; everyone else should limit heavy exertion.	604 – 1004 [24-hour] Children, people with asthma, or other lung diseases, should remain indoors; everyone else should avoid outdoor exertion.	1250 - 2049 People with asthma, children and older adults should remain indoors; everyone else should avoid all outdoor exertion.
	Everyone should avoid all outdoor exertion.		Everyone should avoid all physical activity outdoors; people with heart or lung disease, older adults, children, and people of lower SES should remain indoors and keep activity levels low.				

Classifications and cautionary statements in Spanish:

Use estas tarjetas para entender los efectos de la contaminación del aire cuando escuche las noticias del Indice de la Calidad del Aire.

Valores del Índice	Clasificación	Precauciones para Protegerse del Ozono
0 a 50	**Buena**	Ninguna.
51 a 100	**Moderada**	Las personas extraordinariamente sensitivas deben considerar limitar los esfuerzos prolongados al aire libre.
101 a 150	**Dañina a la Salud de los Grupos Sensitivos**	Los niños y adultos activos, y las personas con enfermedades respiratorias, tales como el asthma, deben limitar los esfuerzos prolongados al aire libre.
151 a 200	**Dañina a la Salud**	Los niños y adultos activos, y las personas con enfermedades respiratorias, tales como el asthma, deben evitar el esfuerzo prolongado al aire libre; todos los demás, especialmente los niños, deben limitar el esfuerzo prolongado al aire libre.
201 a 300	**Muy Dañina a la Salud**	Los niños y adultos activos, y las personas con enfermedades respiratorias tales como el asthma, deben evitar cualquier esfuerzo al aire libre; todos los demás, especialmente los niños, deben limitar los esfuerzos al aire libre.

Se ha asignado un color específico a cada categoría de AQI. Por ejemplo, el rojo significa condiciones "dañinas a la salud" y el púrpura significa condiciones "muy dañinas a la salud". Este esquema de colores puede ayudarle a determinar rápidamente si los contaminantes del aire están alcanzando niveles muy dañinos a la salud en su zona.

How do I calculate the AQI from pollutant concentration data?

The AQI is the highest value calculated for each pollutant as follows:

a. Identify the highest concentration among all of the monitors within each reporting area and truncate as follows:

> Ozone – truncate to 3 decimal places
>
> PM2.5 – truncate to 1 decimal place
>
> PM10 – truncate to integer
>
> CO – truncate to 1 decimal place
>
> SO2 – truncate to integer
>
> NO2 – truncate to integer

b. Using Table 2, find the two breakpoints that contain the concentration.

c. Using Equation 1, calculate the index.

d. Round the index to the nearest integer.

Equation 1:

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{HI} - BP_{Lo}} (C_p - BP_{Lo}) + I_{Lo}.$$

> Where I_p = the index for pollutant p
>
> C_p = the rounded concentration of pollutant p
>
> BP_{Hi} = the breakpoint that is greater than or equal to C_p
>
> BP_{Lo} = the breakpoint that is less than or equal to C_p
>
> BP_{Hi} = the breakpoint that is greater than or equal to C_p
>
> I_{Hi} = the AQI value corresponding to BP_{Hi}
>
> I_{Lo} = the AQI value corresponding to BP_{Lo}

Table 2: Breakpoints for the AQI

These Breakpoints...							...equal this AQI	...and this category
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	PM_{10} ($\mu g/m^3$) 24-hour	$PM_{2.5}$ ($\mu g/m^3$) 24-hour	CO (ppm) 8-hour	SO_2 (ppb) 1-hour	NO_2 (ppb) 1-hour	AQI	
0.000 - 0.059	-	0 - 54	0.0 – 12.0	0.0 - 4.4	0 - 35	0 - 53	0 - 50	Good
0.060 - 0.075	-	55 - 154	12.1 - 35.4	4.5 - 9.4	36 - 75	54 - 100	51 - 100	Moderate
0.076 - 0.095	0.125 - 0.164	155 - 254	35.5 - 55.4	9.5 - 12.4	76 - 185	101 - 360	101 - 150	Unhealthy for Sensitive Groups
0.096 - 0.115	0.165 - 0.204	255 - 354	(55.5 - 150.4)[3]	12.5 - 15.4	(186 - 304)[4]	361 - 649	151 - 200	Unhealthy
0.116 - 0.374	0.205 - 0.404	355 - 424	(150.5 - (250.4)[3]	15.5 - 30.4	(305 - 604)[4]	650 - 1249	201 - 300	Very unhealthy
([2])	0.405 - 0.504	425 - 504	(250.5 - (350.4)[3]	30.5 - 40.4	(605 - 804)[4]	1250 - 1649	301 - 400	Hazardous
([2])	0.505 - 0.604	505 - 604	(350.5 - 500.4)[3]	40.5 - 50.4	(805 - 1004)[4]	1650 - 2049	401 - 500	Hazardous

[1] Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone value may be calculated, and the maximum of the two values reported.

[2] 8-hour O_3 values do not define higher AQI values (≥ 301). AQI values of 301 or higher are calculated with 1-hour O_3 concentrations.

[3] If a different SHL for PM2.5 is promulgated, these numbers will change accordingly.

[4] 1-hour SO_2 values do not define higher AQI values (≥ 200). AQI values of 200 or greater are calculated with 24-hour SO_2 concentrations.

How do I use the table and the equation and my concentration data to calculate the AQI?

Suppose you have an 8-hour ozone value of 0.08753333. First, round off the value to 0.087. Then refer to the 8-hour ozone in table 2 for the values that fall above and below your value (0.076-0.095). In this case, the 0.087 value falls within the index values of 101 to 150. Now you have all the numbers needed to use the equation.

$$\frac{(150-101)}{(.095-.076)}(.087-.076)+101 = \frac{49}{.019}.011+101 = 129.368 = 129$$

So an 8-hour value of 0.08753333 corresponds to an index value of 129.

What if I have values for more pollutants?

Suppose you have an 8-hour ozone value of 0.077 ppm, a $PM_{2.5}$ value of 35.9 µg/m³, and a CO value of 8.4 ppm. You apply the equation 3-times:

$$O_3: \quad \frac{(150-101)}{(.095-.076)}(.077-.076)+101 = 104$$

$$PM: \quad \frac{(150-101)}{(55.4-35.5)}(35.9-35.5)+101 = 102$$

$$CO: \quad \frac{(100-51)}{(9.4-4.5)}(8.4-4.5)+51 = 90$$

The AQI is 104, with ozone as the responsible pollutant.

How do I use both ozone 1-hour and 8-hour values?

You must calculate the 8-hour values, and you may also calculate the 1-hour values. If you calculate both, you must report the higher AQI value.

Suppose you had a 1-hour value of 0.162ppm and an 8-hour value of 0.141 ppm. Then you apply the equation twice:

$$1-hr: \quad \frac{(300-201)}{(.404-.155)}(.162-.155)+201 = 204$$

$$8-hr: \quad \frac{(300-201)}{(.374-.116)}(.141-.116)+201 = 211$$

In this case, the index is 211 (the maximum of 204 and 211) and the responsible pollutant is ozone.

How do I calculate AQI values for SO2?

EPA strengthened the primary standard for SO2 in 2010. Because there was not enough health information to inform changing the upper end of the AQI for SO2, the upper end continues to use the 24-hour average SO2 concentration. The lower end of the AQI uses the new daily max 1-hour SO2 concentration.

If you have a daily max 1-hour SO2 concentration below 305 ppb, then use the breakpoints in Table 2 to calculate the AQI value.

If you have a 24-hour average SO2 concentration greater than or equal to 305 ppb, then use the breakpoints in Table 2 to calculate the AQI value. If you have a 24-hour value in this range, it will always result in a higher AQI value than a 1-hour value would.

On rare occasions, you could have a day where the daily max 1-hour concentration is at or above 305 ppb but when you try to use the 24-hour average to calculate the AQI value, you find that the 24-hour concentration is not above 305 ppb. If this happens, use 200 for the lower and upper AQI breakpoints (ILo and IHi) in Equation 1 to calculate the AQI value based on the daily max 1-hour value. This effectively fixes the AQI value at 200 exactly, which ensures that you get the highest possible AQI value associated with your 1-hour concentration on such days.

What do I do with concentrations for pollutants that have blank places in the table for Breakpoints for the AQI?

Disregard those numbers. Suppose you had a 1-hour ozone value of 0.104ppm and an 8-hour ozone value of 0.087ppm. First you disregard the 1-hour ozone value because it is less than 0.125ppm. Then you calculate the index for the 8-hour ozone value as before:

$$\frac{(150-101)}{(.095-.076)}(.087-.076)+101 = 129.368$$

This value rounds to 129.

Are there exceptions to these reporting requirements?

Yes. When you have low index values that meet the following criteria, you do not have to meet all the requirements. If the index for a specific pollutant remains below 50 for an extended period of time (for example, for that particular season), then you are not required to include this pollutant in the calculation of the AQI.

The final rule allows agencies to discontinue reporting for any pollutant if index values for that pollutant have been below 50 for an entire season or a year. However, this does not hold if in subsequent years' pollutant levels rise so that index values for that pollutant would be above 50 and the criteria for an exemption are no longer met. In these cases, section 8 of appendix G now requires that the responsible agency must again report the AQI.

Do I have to forecast pollutant concentrations for the AQI report?

Although not required, you are encouraged to forecast values at least 24 hours in advance. The AQI is designed to inform members of sensitive groups and the general population so that they may choose to reduce or avoid exposure to certain levels and types of air pollution. If the information is not timely, the public cannot make this choice. However, good forecasts may require data, computational resources and expertise that may be unavailable to you. The EPA provides guidance if you are interested in starting a forecasting program for AQI reporting in your Metropolitan Statistical Area (MSA).

Since ozone is a dominant pollutant in AQI reporting and the form of the ozone standard is an 8-hour average, the timing of how the public is informed is an important issue, even if you have decided not to forecast 24 hours in advance. In order for potentially affected people to take advantage of this information, it is necessary to consider at least a short term forecast or prediction of 8-hour ozone levels for the purposes of reporting the AQI. You can do this with very little additional resources; the method you can use relies on the high correlation between daily maximum of 8-hour ozone and 1-hour ozone values. A simple linear regression can be calculated on daily max data at any site. From this regression, you can predict that the 8-hour ozone maximum for a day will be at least the corresponding maximum 8-hour value, given the present 1-hour value. From this information, you can estimate the AQI without having to wait for the full 8-hour maximum to be observed.

What if the correlation at my site is low- can I still forecast the AQI?

The lowest observed correlation at any site reporting to AIRS data was 0.86, which is adequate to predict the maximum 8-hour values from the maximum 1-hour for reporting the AQI. However, if you feel uncomfortable from either a public health or cost viewpoint, you may want to use a confidence interval for the decision you make based on the predicted 8-hour maximum. For example, if your ozone action day is declared when you reach the unhealthy category and you predict an unhealthy day but are unsure whether or not you should call an "ozone action day" based on this prediction, you can use the confidence interval of the predicted value to trigger your decision. If you are concerned about public health, you might consider calling an "ozone action day" as soon as the upper bound of the confidence interval is greater than the AQI cut-point for the unhealthy category. If you are concerned with the cost of calling an "ozone action day" unnecessarily, then you might consider calling an ozone action day only when the lower bound of the confidence interval is above the cut-point for the unhealthy category.

Is there anything else I should know about reporting the AQI?

For further information, go to **www.epa.gov/airnow.** Under "Publications," there are several informative documents to help you report the AQI, including the ones listed:

- AQI brochure
- AQI calculator program
- Forecasting guidance
- Air quality guides for:
    -Ozone
    -Particle pollution

- Pamphlets:
    -Ozone Pollution and your Health
    -Particle Pollution and your Health
    -Smog: Who does it Hurt?
- Medical poster
- Ozone web course for health care providers

How do I calculate the upper and lower bounds of the confidence interval for the predicted maximum 8-hour ozone value?

Most computer regression programs include the error variance, or the residual variance, or the variance of "Y given X" as part of the output. Call this S_e^2. Then you calculate the upper and lower bounds of the predicted value as:

$$upper: \quad \hat{Y} + t_{1-\alpha/2, n-2} \sqrt{S_e^2 \left(1 + \frac{1}{n} + \frac{(x' - \bar{x})^2}{(n-1)S_x^2} \right)}$$

$$lower: \quad \hat{Y} - t_{1-\alpha/2, n-2} \sqrt{S_e^2 \left(1 + \frac{1}{n} + \frac{(x' - \bar{x})^2}{(n-1)S_x^2} \right)}$$

Where:

$\hat{Y}$ is the predicted 8-hour ozone maximum,

$t_{1-\alpha/2,n-2}$ is a tabulated Student's-T value corresponding to a two sided $(1-\alpha)100\%$ confidence interval with n-2 degrees of freedom,

S_e^2 is the error variance described above,

x' is the 1-hour value used to predict the 8-hour value,

$\bar{x}$ is the average of the 1-hour values, and

S_x^2 is the variance of the 1-hour values.

The value α is arbitrary, but conventionally it is set to 0.05 corresponding to a 95% confidence interval.

APPENDIX

Table 3: Metropolitan Statistical Areas with over 350,000 population (2010 Census)

CBSA code	Geographic Area	2010 Census
10420	Akron, OH	703,200
10580	Albany-Schenectady-Troy, NY	870,716
10740	Albuquerque, NM	887,077
10900	Allentown-Bethlehem-Easton, PA-NJ	821,173
11260	Anchorage, AK	380,821
11700	Asheville, NC	424,858
12060	Atlanta-Sandy Springs-Marietta, GA	5,268,860
12260	Augusta-Richmond County, GA-SC	556,877
12420	Austin-Round Rock-San Marcos, TX	1,716,289
12540	Bakersfield-Delano, CA	839,631
12580	Baltimore-Towson, MD	2,710,489
12940	Baton Rouge, LA	802,484
13140	Beaumont-Port Arthur, TX	388,745
13820	Birmingham-Hoover, AL	1,128,047
14260	Boise City-Nampa, ID	616,561
14460	Boston-Cambridge-Quincy, MA-NH	4,552,402
14860	Bridgeport-Stamford-Norwalk, CT	916,829
15180	Brownsville-Harlingen, TX	406,220
15380	Buffalo-Niagara Falls, NY	1,135,509
15940	Canton-Massillon, OH	404,422
15980	Cape Coral-Fort Myers, FL	618,754
16700	Charleston-North Charleston-Summerville, SC	664,607
16740	Charlotte-Gastonia-Rock Hill, NC-SC	1,758,038
16860	Chattanooga, TN-GA	528,143
16980	Chicago-Joliet-Naperville, IL-IN-WI	9,461,105
17140	Cincinnati-Middletown, OH-KY-IN	2,130,151
17460	Cleveland-Elyria-Mentor, OH	2,077,240
17820	Colorado Springs, CO	645,613
17900	Columbia, SC	767,598
18140	Columbus, OH	1,836,536
18580	Corpus Christi, TX	428,185
19100	Dallas-Fort Worth-Arlington, TX	6,371,773
19340	Davenport-Moline-Rock Island, IA-IL	379,690
19380	Dayton, OH	841,502
19660	Deltona-Daytona Beach-Ormond Beach, FL	494,593
19740	Denver-Aurora-Broomfield, CO	2,543,482
19780	Des Moines-West Des Moines, IA	569,633
19820	Detroit-Warren-Livonia, MI	4,296,250
20500	Durham-Chapel Hill, NC	504,357
21340	El Paso, TX	800,647
21660	Eugene-Springfield, OR	351,715
21780	Evansville, IN-KY	358,676
22180	Fayetteville, NC	366,383
22220	Fayetteville-Springdale-Rogers, AR-MO	463,204
22420	Flint, MI	425,790
23060	Fort Wayne, IN	416,257
23420	Fresno, CA	930,450
24340	Grand Rapids-Wyoming, MI	774,160

24660	Greensboro-High Point, NC	723,801
24860	Greenville-Mauldin-Easley, SC	636,986
25420	Harrisburg-Carlisle, PA	549,475
25540	Hartford-West Hartford-East Hartford, CT	1,212,381
25860	Hickory-Lenoir-Morganton, NC	365,497
26180	Honolulu, HI	953,207
26420	Houston-Sugar Land-Baytown, TX	5,946,800
26620	Huntsville, AL	417,593
26900	Indianapolis-Carmel, IN	1,756,241
27140	Jackson, MS	539,057
27260	Jacksonville, FL	1,345,596
28140	Kansas City, MO-KS	2,035,334
28660	Killeen-Temple-Fort Hood, TX	405,300
28940	Knoxville, TN	698,030
29460	Lakeland-Winter Haven, FL	602,095
29540	Lancaster, PA	519,445
29620	Lansing-East Lansing, MI	464,036
29820	Las Vegas-Paradise, NV	1,951,269
30460	Lexington-Fayette, KY	472,099
30780	Little Rock-North Little Rock-Conway, AR	699,757
31100	Los Angeles-Long Beach-Santa Ana, CA	12,828,837
31140	Louisville/Jefferson County, KY-IN	1,283,566
31540	Madison, WI	568,593
31700	Manchester-Nashua, NH	400,721
32580	McAllen-Edinburg-Mission, TX	774,769
32820	Memphis, TN-MS-AR	1,316,100
33100	Miami-Fort Lauderdale-Pompano Beach, FL	5,564,635
33340	Milwaukee-Waukesha-West Allis, WI	1,555,908
33460	Minneapolis-St. Paul-Bloomington, MN-WI	3,279,833
33660	Mobile, AL	412,992
33700	Modesto, CA	514,453
33860	Montgomery, AL	374,536
34980	Nashville-Davidson--Murfreesboro--Franklin, TN	1,589,934
35300	New Haven-Milford, CT	862,477
35380	New Orleans-Metairie-Kenner, LA	1,167,764
35620	New York-Northern New Jersey-Long Island, NY-NJ-PA	18,897,109
35840	North Port-Bradenton-Sarasota, FL	702,281
36260	Ogden-Clearfield, UT	547,184
36420	Oklahoma City, OK	1,252,987
36540	Omaha-Council Bluffs, NE-IA	865,350
36740	Orlando-Kissimmee-Sanford, FL	2,134,411
37100	Oxnard-Thousand Oaks-Ventura, CA	823,318
37340	Palm Bay-Melbourne-Titusville, FL	543,376
37860	Pensacola-Ferry Pass-Brent, FL	448,991
37900	Peoria, IL	379,186
37980	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	5,965,343
38060	Phoenix-Mesa-Glendale, AZ	4,192,887
38300	Pittsburgh, PA	2,356,285
38860	Portland-South Portland-Biddeford, ME	514,098
38900	Portland-Vancouver-Hillsboro, OR-WA	2,226,009

38940	Port St. Lucie, FL	424,107
39100	Poughkeepsie-Newburgh-Middletown, NY	670,301
39300	Providence-New Bedford-Fall River, RI-MA	1,600,852
39340	Provo-Orem, UT	526,810
39580	Raleigh-Cary, NC	1,130,490
39740	Reading, PA	411,442
39900	Reno-Sparks, NV	425,417
40060	Richmond, VA	1,258,251
40140	Riverside-San Bernardino-Ontario, CA	4,224,851
40380	Rochester, NY	1,054,323
40900	Sacramento--Arden-Arcade--Roseville, CA	2,149,127
41180	St. Louis, MO-IL	2,812,896
41420	Salem, OR	390,738
41500	Salinas, CA	415,057
41620	Salt Lake City, UT	1,124,197
41700	San Antonio-New Braunfels, TX	2,142,508
41740	San Diego-Carlsbad-San Marcos, CA	3,095,313
41860	San Francisco-Oakland-Fremont, CA	4,335,391
41940	San Jose-Sunnyvale-Santa Clara, CA	1,836,911
42060	Santa Barbara-Santa Maria-Goleta, CA	423,895
42220	Santa Rosa-Petaluma, CA	483,878
42340	Savannah, GA	347,611
42540	Scranton--Wilkes-Barre, PA	563,631
42660	Seattle-Tacoma-Bellevue, WA	3,439,809
43340	Shreveport-Bossier City, LA	398,604
44060	Spokane, WA	471,221
44140	Springfield, MA	692,942
44180	Springfield, MO	436,712
44700	Stockton, CA	685,306
45060	Syracuse, NY	662,577
45220	Tallahassee, FL	367,413
45300	Tampa-St. Petersburg-Clearwater, FL	2,783,243
45780	Toledo, OH	651,429
45940	Trenton-Ewing, NJ	366,513
46060	Tucson, AZ	980,263
46140	Tulsa, OK	937,478
46700	Vallejo-Fairfield, CA	413,344
47260	Virginia Beach-Norfolk-Newport News, VA-NC	1,671,683
47300	Visalia-Porterville, CA	442,179
47900	Washington-Arlington-Alexandria, DC-VA-MD-WV	5,582,170
48620	Wichita, KS	623,061
48900	Wilmington, NC	362,315
49180	Winston-Salem, NC	477,717
49340	Worcester, MA	798,552
49620	York-Hanover, PA	434,972
49660	Youngstown-Warren-Boardman, OH-PA	565,773

FREQUENTLY ASKED QUESTIONS

I want to buy an air purifier.   Are the purifiers that produce ozone helpful to my indoor air quality?

Some air cleaning devices, such as ozone generators and ionic air purifiers, can generate significant levels of ozone. Even at low levels, ozone triggers a variety of health problems, including aggravated asthma and increased susceptibility to respiratory illnesses. Additional information on the assessment of the effectiveness and health consequences of ozone generators that are sold as air cleaners can be found at http://www.epa.gov/iaq/pubs/ozonegen.html, and also at the California Air Resources Board Web site at http://www.arb.ca.gov/research/indoor/ozone_gen_fact_sheet-a.pdf.

If you're having issues with mold and moisture, solutions and preventative tips are offered at http://www.epa.gov/mold/index.html.   For additional questions about indoor air quality, please use the EPA Office of Indoor Air Quality hotline at 1-800-438-4318.

Why is my area not covered in the Air Quality Index?

Towns and cities with 350,000 or fewer inhabitants are not required to report the AQI. Also, AirNow is a voluntary program based upon state and local air quality monitoring networks. Some networks don't submit their data, or don't have any monitors in the area.

The other day, the air quality in my area was reported as green, or good air quality. However, it was pretty hazy outside. Why didn't the AQI report this accurately?

There are a couple of reasons why this may have occurred, depending on what was "reported." If this was an AQI forecast, there are still some parts of the United States that only forecast for ozone and not particle pollution. It is possible that the forecast ozone AQI was "GOOD" and the hazy conditions experienced were due to particle pollution. In this instance, the "reported" AQI forecast may have only represented ozone. As more and more areas begin forecasting for PM2.5 and ozone together, this discrepancy should diminish.

In the case of real-time data, the AirNow program provides separate maps for ozone and PM2.5 AQI. It is possible that the ozone AQI maps were showing "GOOD" conditions and the PM2.5 maps showing "MODERATE" or above conditions. It is important to check both maps for a specific geographical area to cover both primary pollutants. In the future, AirNow plans to have combined AQI maps of both ozone and PM2.5 that will eliminate this problem, but will continue to provide the separate pollutant AQI maps to allow for people to identify the pollutant of concern.

Finally, it should be noted that there are occasions where hazy conditions may be due primarily to high humidity and not pollution. On these days, it is still good to check the AQI maps and forecasts to make sure that pollution is not the primary cause of the haze.

How do I get my newspaper to publish the AQI?

Most newspaper weather pages and graphics are developed and produced by private weather service providers. We recommend that you direct your initial approach to the newspaper editors, since they are the customers of the weather provider company. In general, newspapers want to provide more health-based information to their readers. However, it may take some effort to educate decision makers about the importance of providing air quality information to the public. When you meet with the newspaper staff, bring along this guidance document or several examples showing how other

newspapers publish the AQI. In addition, most weather service providers already have access to the air quality data through AirNow, which makes it easier for them to acquire and publish the information. Space on weather pages is limited, so a small, compact graphic might be a better choice for a crowded weather page.

If the AQI reported in the newspaper is incorrect, what should I do?

Common problems with AQI reporting in newspapers include either reporting data values that are wrong or reporting pollutant concentrations instead of the AQI. Another frequent mistake is to report inconsistent AQI colors or terminology, as well as incorrect pollutant names. Establishing a good working relationship with the newspaper and educating them about how misleading or erroneous AQI information can impact their readers could help minimize potential problems. We recommend that you first notify the newspaper directly about any error so they can relay discrepancies to their weather service provider as a paying customer. If you have difficulty getting the newspaper to correct the issue, you could team with other health and nongovernmental organizations to approach the newspaper editor with a united message and request.

Should I report yesterday's observed value, today's forecast, or tomorrow's forecast to the newspaper?

Let's assume that today is Monday, and you are submitting data for Tuesday morning's paper. Let's also assume that the paper is willing to carry both the observed AQI and the forecast. In such a case:
- Send the paper the most recent observed AQI. If it's midnight to midnight, that means Sunday's data.
- Send the Tuesday forecast so there is a "day-of" forecast in the Tuesday paper.
- If you have the Wednesday forecast and they're willing to carry that, include it too.

My local newspaper has a deadline of 2 pm for the next day's paper. Should I report the AQI value through 1 pm, or report the forecast?

Again, since the true AQI is a midnight to midnight calculation, we recommend that you report tomorrow's forecast. If this is not possible, then report the AQI value through a certain time, but make sure the newspaper includes the reporting period to avoid confusion.

How do I get my local TV station to show the AQI?

Similar to the newspaper industry, television reporting reflects the culture of the local community and what competing stations show. Television stations use weather service providers to provide graphics and data support for their weathercasts. All of the weather service companies have access to the air quality data through AirNow, which makes it easy for them to acquire and provide these data to their television station customers. There are several questions that need to be addressed: Does the station want to show air quality information? Do other stations in your market show air quality information? Is the station news director on board with providing this information? Does the station have the proper software to access the air quality data?

For stations that have never shown these data on the air, you will need to establish a relationship and educate them about the benefits of providing air quality information to their viewers. Air quality is weather, news and health all in one. Once a station in your market begins to provide air quality information, chances are good that other stations will follow suit. However, even if the weathercasters want to provide this information in their weathercasts, the station news director controls the content of

what goes on the air. In addition, if the station wants to show the AQI on the air, they need to have the proper software version of weather graphics products to access and display the AQI. Keep in mind that air quality information could be displayed only during periods of high pollution levels, when it is considered more "newsworthy."

Can we still use the Pollutant Standards Index?

No. The Air Quality Index is required by law.

Does providing our data and forecasts to AirNow meet the AQI reporting requirements?

No. Even though the air quality information that you provide to AirNow is distributed on a national basis to the media and weather service provider companies, there is no guarantee that this information ends up within the media (newspaper, radio, or web site) in your local community as required.

Why doesn't the AQI cover toxic air pollutants or air toxics?

While the AQI is an excellent indicator of the air quality resulting from ozone and particulate matter, it does not directly include health implications from air pollutants such as air toxics. Adverse health effects from air toxics are generally not believed to be episodic in nature like ozone and particulate matter, and are usually evaluated on a longer term, or chronic, basis. For information on concentrations of air toxics, refer to EPA's National Air Toxics Assessment (NATA) Website at: http://www.epa.gov/ttn/atw/nata/.

Why does EPA issue AQI forecasts only for ozone and particle pollution?

AQI reporting is required for all criteria pollutants when they have an index value of 50 or above. Most cities forecast for ozone and particle pollution as these pollutants are the major sources of unhealthy air quality around 99% of the time. However, several cities forecast for all five pollutants- ground-level ozone, particle pollution, carbon monoxide, sulfur dioxide, and nitrogen dioxide.

Should I use particulate matter or particle pollution when speaking with the public?

Based on focus group testing by EPA, people better understand and prefer the term "particle pollution" than "particulate matter."