DOF: 01/25/2024

Official Mexican Standard NOM-172-SEMARNAT-2023, Guidelines for obtaining and communicating the air quality index and health risks.

On the margin, a seal with the National Coat of Arms, which says: United Mexican States.- Secretariat of Environment and Natural Resources.

ALONSO JIMÉNEZ REYES, Undersecretary of Environmental Regulation of the Secretariat of Environment and Resources. Natural Resources and President of the National Advisory Committee on Environmental and Natural Resources Standardization, based on the provisions of articles 1, 4, fourth and fifth paragraphs, and 6 of the Political Constitution of the United Mexican States; 32 Bis, sections IV, V, XIV, and XVII of the Organic Law of the Federal Public Administration; 5, sections V, XVI, XVII, and XIX; 7, sections XIII, XIV, and XV, 8, sections XII and XIII, 9, 36, section II, 37 TER, 110, section I, 111, section I, 159 BIS, 159 BIS 3, and 159 BIS 6 of the General Law of Ecological Balance and Environmental Protection; 117 of the General Health Law; 10, sections I and VIII, 24, 30, 34, 35, sections VI, VII, VIII, IX, and X, 39, and 41, section V of the Quality Infrastructure Law; 13, section I of the Regulation of the General Law of Ecological Balance and Environmental Protection in Matters of Prevention and Control of Atmospheric Pollution; 28 and of the Regulation of the Federal Law on Metrology and Standardization and 17, sections VII, VIII, and IX, of the Internal Regulation of the Secretariat of Environment and Natural Resources, and

CONSIDERING

Air pollution represents the greatest environmental risk to health (WHO, 2016). Various experimental studies, as well as epidemiological studies in humans, have indicated that exposure to pollutants in ambient air is associated with a wide range of adverse effects that affect the quality of life of the general population and sensitive individuals, mainly people under 12 years old, over 60 years old, and pregnant individuals, especially if they suffer from pre-existing diseases.

Scientific literature has documented a wide range of health effects caused by exposure to pollutants. in the air, such as: asthma, bronchitis, reduced lung capacity, heart diseases, cardiovascular, cerebrovascular, reproductive, neurological diseases, premature births, intrauterine growth retardation, low birth weight, sudden infant death syndrome, and infant mortality (Kampa, 2008; Anderson, 2012 and Kim, 2015), as well as early onset of Alzheimer's, among others (Calderón-Garcidueñas et al., 2020).

The global burden of disease study published by the Institute for Health Metrics and Evaluation in 2019 shows that exposure to ozone (O3) and PM2.5 in outdoor air was the cause of 4.06 million deaths worldwide (Institute of Health Metrics 2020). For Mexico, outdoor air pollution caused more than 36,000 deaths from PM2.5 and more than 2,400 from ozone (Health Effects Institute, 2020).

According to information provided by the National Institute of Public Health regarding epidemiological evidence. national on the adverse health effects of exposure to particulate matter, ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide and the results of international studies specifically focused on the evaluation of concentration-response functions for mortality and morbidity associated with exposure to these pollutants, air pollution has various adverse effects on health and affects the quality of life of those who mainly live in urban areas of our country. Due to the levels of air pollution present in the different cities or metropolitan areas where air quality monitoring is carried out in our country, it is advisable for the inhabitants of these areas to make significant changes in their habits to reduce their exposure and reduce health risks.

In this general context, air quality monitoring takes on fundamental importance to provide information necessary in order to know the air quality of each region, and to inform the population about the conditions of air pollution, its possible impact on health, as well as recommendations to reduce the risk of impact on it. To this end, air quality indices are developed which represent one of the management tools most used by governments around the world to facilitate ongoing communication of the risk from exposure to pollution.

According to the National Air Quality Report 2019, prepared by the National Institute of Ecology and Climate Change Climate Change (INECC), in that year only in five of the 63 cities and metropolitan areas with the capacity to measure PM10, the permissible limit value for acute exposure established in NOM-025-SSA1-2014 was met. In the case of PM2.5, of the 53 cities and metropolitan areas with the capacity to measure this pollutant, none met the permissible limit value for acute exposure established in NOM-025-SSA1-2014. Finally, only in seven of the 53 cities and metropolitan areas with the capacity to measure O3 was the permissible limit value for acute exposure established in NOM-020-SSA1-2014 met (INECC, 2020).

For the above reasons, it is warned that to uphold the right of the population to health and a healthy environment in which ensures protection for all sectors of the population, it is required, first of all, that the legal system provides the existence of mechanisms and institutions that allow guaranteeing the rights holder access to information.

The right to environmental information commits the State to communicate and the Federal Law on Transparency and Access to the Public Information, in its article 2, section II, states that one of the ways to access information is through its dissemination.

In the Political Constitution of the United Mexican States, the human right to health and to a healthy environment is enshrined, it is necessary for Mexican regulations to evolve to protect these interrelated rights.

That the Principle of Progressivity consists of the obligation of the State to generate at each historical moment, a greater and better protection and guarantee of human rights, in such a way that they are always in constant evolution and under no justification for regression.

As a result of the above, it is established that there is an obligation on the part of the State to monitor air quality and to communicate the results to the population and that this information is more useful if linked to health, expressed in the risk levels associated with air quality. In this way, the general population and particularly those considered sensitive can effectively use the information provided to take protective measures.

As described above, the Ministry of Environment and Natural Resources (SEMARNAT) issued the Official Standard Mexican NOM-172-SEMARNAT-2019 Guidelines for obtaining and communicating the Air Quality Index and Health Risks, which was published in the Official Gazette of the Federation on November 20, 2019, and its entry into force was 90 calendar days following its publication in the Official Gazette of the Federation.

With the implementation of the guidelines contained in the Official Mexican Standard for obtaining and communicating the Air Quality Index and Health Risks, a unique calculation method is established and the dissemination guidelines that state or municipal governments responsible for monitoring air quality must apply, achieving a significant advance in access to information and health protection.

That the United Nations (UN) approved the 2030 Agenda for Sustainable Development and in its Goal 3: Ensure healthy lives and promote well-being for all at all ages, establishes in its target 3.9: by 2030, substantially reduce the number of deaths and illnesses caused by hazardous chemicals and air, water, and soil pollution, also in target 3.d it establishes: to strengthen the capacity of all countries, particularly developing countries, in early warning, risk reduction, and management of risks to national and global health.

That the importance and relevance of the Air Quality Index and Health Risks lies in the fact that it not only informs the population about the state of air quality (good, acceptable, bad, very bad, and extremely bad), but also about the associated risk level (possible health damage, depending on whether the risk is low, moderate, high, very high, or extremely high) and the recommendations for actions to be taken (measures to reduce exposure); that is, it seeks for the information received by the population to not only refer to air quality at a specific moment but to allow them to act in a timely manner to protect their health.

That since the last global update made by the WHO, it has lowered almost all reference levels of the air quality and warns that exceeding the new levels is associated with significant health risks. (WHO, 2021).

The health emergency generated by the SARS-CoV2 virus (COVID-19) revealed how air pollution can modify the severity of the disease. Studies conducted in various cities around the world, including Mexican cities, showed that COVID-19 mortality rates were higher in urban centers with higher average annual concentrations (Cabrera-Cano, 2021 and López-Feldman, 2021).

That the WHO air quality guidelines recommend air quality levels regarding six pollutants for which the most recent data regarding their effects on health is available, so action is taken on these criteria pollutants, suspended particles (PM10 and PM2.5), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO) (WHO, 2021).

That the fourth transitional article of the Official Mexican Standard NOM-172-SEMARNAT-2019, Guidelines for obtaining and communication of the Air Quality Index and Health Risks, establishes that it will be subject to periodic review of the technical and scientific bases that support it, for its update according to the results of epidemiological and toxicological research, reports from international health agencies, studies evaluating the social impacts achieved through effective communication of the state of air quality, probable damages, and protective measures.

That the section "3. Normative References" of the aforementioned standard establishes that for its correct use "it is necessary to apply the following Official Mexican Standards, or those that replace them," among which the following Official Mexican Standards in the field of environmental health are included, which were modified as indicated below:

Official Mexican Standard NOM-020-SSA1-2021, Environmental health. Criteria for evaluating ambient air quality, regarding regarding ozone (O3). Regulated values for the concentration of ozone (O3) in ambient air, as a measure of protection for public health, published in the Official Journal of the Federation on October 28, 2021.

Official Mexican Standard NOM-021-SSA1-2021, Environmental health. Criteria for evaluating ambient air quality, regarding regarding carbon monoxide (CO). Regulated values for the concentration of carbon monoxide (CO) in ambient air, as a measure of protection for public health, published in the Official Journal of the Federation on October 29, 2021.

Official Mexican Standard NOM-022-SSA1-2019, Environmental health. Criteria for evaluating ambient air quality, regarding regarding sulfur dioxide (SO2). Regulated values for the concentration of sulfur dioxide (SO2) in ambient air, as a measure of protection for public health, published in the Official Journal of the Federation on August 20, 2019.

Official Mexican Standard NOM-023-SSA1-2021, Environmental health. Criteria for evaluating ambient air quality, regarding regarding nitrogen dioxide (NO2). Regulated values for the concentration of nitrogen dioxide (NO2) in ambient air, as a measure of protection for public health, published in the Official Journal of the Federation on October 27, 2021.

Official Mexican Standard NOM-025-SSA1-2021, Environmental health. Criteria for evaluating ambient air quality, regarding regarding suspended particles PM10 and PM2.5. Regulated values for the concentration of suspended particles PM10 and PM2.5 in ambient air, as a measure of protection for public health, published in the Official Journal of the Federation on October 27, 2021.

That the weighted moving average of 12 hours was developed in the United States of North America since 2013, with the purpose of having timely information on the hourly concentration of suspended particles. It is assumed to be a good approximation of the 24-hour average under stable atmospheric conditions and at the same time is capable of timely identifying abrupt changes in concentration under unstable atmospheric conditions. It is important to note that the time period under which the exposure studies to this pollutant and its effects on health are based is 24 hours.

That in NOM-172-SEMARNAT-2019 the use of the weighted moving average of 12 hours was established, instead of the average moving average of 24 hours, to disseminate timely information on the concentration of particles in the air and, with that, inform the population about times of high pollution to avoid their exposure to contaminated air.

That from the review of air quality information in various cities in Mexico, it has been observed that this average weighted moving average of 12 hours, as it has been used, generates a high number of incorrect warnings about health risks, even when the average concentrations of 24 hours are below the regulated limit of health protection established in the Official Mexican Standard NOM-025-SSA1-2021, which required adjusting the algorithm in the calculation to improve the performance of the indicator and make it functional in our country.

That numeral 5.3 of NOM-172-SEMARNAT-2019, Guidelines for obtaining and communicating the Air Quality Index of Air and Health Risks, establishes the classification of the bands of the AIR AND HEALTH Index that make up the AIR AND HEALTH Index, where it expressly states that the upper limits of the "Acceptable" air quality band correspond to the values established in the health standards issued by the Ministry of Health for the different regulated criterion pollutants, which are mandatory for federal and local authorities responsible for monitoring and evaluating air quality.

That based on the updates of the aforementioned environmental health standards and adhering to the general principle of certainty established in Article 5, section IV of the Quality Infrastructure Law, it is mandatory to make modifications to the Official Mexican Standard regarding the concentration values for the intervals of the AIR AND HEALTH Index bands as applicable to the criterion pollutant; the update of the base concentrations for the calculation of the AIR AND HEALTH Index for each pollutant establishing the base concentration in hourly and daily reports; the inclusion of concentration intervals for PM10 and PM2.5 pollutants gradually based on the entry into force of the standards issued by the Ministry of Health; the modification of the method of obtaining the AIR AND HEALTH Index for ozone (O3) considering the technical relevance of establishing only the ozone (O3) indicator for the average of one hour; the update of the risk description of the categories of the AIR AND HEALTH Index in order to achieve better communication of the information; the precision of the messages associated with the air quality categories and health risks, establishing specific recommendations for three population groups; the improvement of the informative annex A considering, among other aspects, the adjustment factor to the NowCast metric; the inclusion of the new Annex B (Informative) which describes the considerations for calculating pollutant concentrations based on the risk to human health; the establishment of a transitional article on the criteria and administrative guidelines for carrying out inspection tasks or visits to verify and evaluate compliance with the standard and the update of bibliographic sources, as well as the sources of information of the provisions of informative annexes A and B.

That the application of the AIR and HEALTH Index has represented a challenge for effective communication in the specific case of the ozone, since it contemplates the simultaneous use of two indicators regarding the state of air quality. One to communicate the state of air quality and the health risks associated with exposures to average concentrations of 1 hour and another to communicate the state of air quality and the health risks associated with exposures to average concentrations of 8 hours. This situation often leads to having to communicate to the population, for the same hour, that the condition of air quality may be bad, very bad, or extremely bad for one indicator, while for the other the condition may reflect a situation of good or acceptable air quality, which generates confusion among the public to make the best decisions in order to reduce their exposure to high concentrations of this pollutant, which is why only the one-hour index will be applied.

It is also based on compliance with the agreements and international treaties signed by the Mexican State, such as the Sustainable Development Goals (SDGs), particularly regarding SDG 11 Sustainable Cities and Communities in terms of air quality.

On the other hand, addressing Article 5, section XI of the aforementioned Law, as part of the National Infrastructure System of Quality, the proposed modification is based on the general principle of sustainability, which consists of the fact that standardization and conformity assessment activities are based on sustainable development, keeping in mind a positive impact on the economic and industrial sectors of the country.

That on July 1, 2020, the Law on Quality Infrastructure was published in the Official Journal of the Federation, which repealed the Federal Law on Metrology and Standardization, in which Article 10, sections I, VIII, and XIII establish as the purpose of the Official Mexican Standards the protection of legitimate public interest objectives related to the protection and promotion of health, environmental protection and climate change, and the protection of the right to information.

That the Project of Official Mexican Standard NOM-172-SEMARNAT-2023 was approved by the National Advisory Committee on Standardization of Environment and Natural Resources in its First Ordinary Session on February 24, 2023, with the purpose of submitting it to public consultation in accordance with Articles 35, section V, and 38 of the Law on Quality Infrastructure, and for interested parties, within sixty calendar days from the date of publication in the Official Journal of the Federation, to submit their comments to the aforementioned Committee, located at Avenida Ejército Nacional 223, floor 16, Anáhuac 1 section, Miguel Hidalgo, Mexico City, C.P. 11320 or at the email martha.nino@semarnat.gob.mx.

That on April 12, 2023, the PROJECT of Official Mexican Standard PROY was published in the Official Journal of the Federation, NOM-172-SEMARNAT-2023, Guidelines for obtaining and communicating the air quality index and health risks, and during the public consultation stage, comments were received regarding considering the values of the Air Quality Index of the Environmental Protection Agency of the United States government (US EPA) for the thresholds applicable to the pollutants sulfur dioxide (SO2) and carbon monoxide (CO), adjusting the definitions to use more understandable terms, modifying the messages issued to the population in order to use inclusive language, and incorporating the reasons for applying the adjustment factor in the formula for the 12-hour weighted average of particulate concentration in the air.

That the instrument that contemplates the regulatory impact aspects associated with this Official Mexican Standard was available at the address of the National Advisory Committee on Environmental and Natural Resources Standardization mentioned, as well as on the electronic portal of the National Commission for Regulatory Improvement, for consultation within the deadlines established for such purposes in the Quality Infrastructure Law and in the General Law on Regulatory Improvement.

That the responses to the comments received during the public consultation period were published on January 4, 2024, in the Official Journal of the Federation.

That having fulfilled the procedure established in the Quality Infrastructure Law for the preparation of Mexican official standards, the National Advisory Committee for Environmental and Natural Resources Standardization approved this Official Mexican Standard as definitive, in its Fifth Ordinary Session held on December 12, 2023.

For the reasons stated and founded, I have deemed it appropriate to issue the following:

OFFICIAL MEXICAN STANDARD NOM-172-SEMARNAT-2023, GUIDELINES FOR THE OBTAINING AND COMMUNICATION OF THE AIR QUALITY INDEX AND HEALTH RISKS

PREFACE

In the preparation of this Official Mexican Standard participated:

- NATIONAL METROLOGY CENTER
- THE POWER OF THE CONSUMER, A.C.
- FOUNDATION FOR AIR QUALITY RESEARCH, A.C. - REDSPIRA
- NATIONAL POLYTECHNIC INSTITUTE
  - or CENTER FOR RESEARCH AND ADVANCED STUDIES OF THE IPN
- OCCAMM CITIZEN OBSERVATORY, A.C.
- SECRETARY OF SUSTAINABLE DEVELOPMENT OF THE STATE OF MORELOS
- SECRETARY OF ENVIRONMENT OF THE STATE OF NUEVO LEÓN
- SECRETARY OF SUSTAINABLE DEVELOPMENT OF THE STATE OF QUERÉTARO
- SECRETARY OF ENVIRONMENT OF MEXICO CITY
- SECRETARY OF THE ENVIRONMENT OF THE STATE OF MEXICO
- SECRETARY OF ENVIRONMENT AND TERRITORIAL DEVELOPMENT OF JALISCO
- SECRETARY OF ENVIRONMENT AND LAND USE PLANNING OF GUANAJUATO
- SECRETARY OF ENVIRONMENT AND NATURAL RESOURCES
  - or MEGALOPOLIS ENVIRONMENTAL COMMISSION
  - or NATIONAL INSTITUTE OF ECOLOGY AND CLIMATE CHANGE
  - or UNDERSECRETARY OF ENVIRONMENTAL REGULATION
  - or FEDERAL PROSECUTOR'S OFFICE FOR ENVIRONMENTAL PROTECTION
- SECRETARY OF ENVIRONMENT AND NATURAL RESOURCES OF HIDALGO
- SECRETARY OF HEALTH
  - or FEDERAL COMMISSION FOR THE PROTECTION AGAINST SANITARY RISKS
  - or NATIONAL INSTITUTE OF PUBLIC HEALTH
- NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO
  - or INSTITUTE OF ATMOSPHERIC SCIENCES AND CLIMATE CHANGE

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Annex B (Informative) Considerations for calculating pollutant concentrations based on risk to human health

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1. Objective and scope of application

Establish guidelines for the daily and hourly collection and communication of the Air Quality Index and Risks to Health, in order to clearly, timely, and continuously inform about the state of air quality, the probable health damage it causes, and the measures that can be taken to reduce exposure.

This Official Mexican Standard applies throughout the national territory and is mandatory for state or municipal governments that operate air quality monitoring systems.

2. Legitimate objective of public interest

The proposed modification is based on Article 10, sections I and VIII of the Quality Infrastructure Law, regarding the purpose of the Official Mexican Standards to address the causes of problems identified by the Standardizing Authorities that affect or jeopardize the legitimate objectives of public interest considered, specifically in the protection and promotion of health, such as environmental protection and climate change.

Specifically, the proposed Official Mexican Standard NOM-172-SEMARNAT-2022 is a policy instrument that seeks to operationalize these legitimate objectives of public interest, through the updating of concentration values associated with each air quality band and health risk, taking as a starting point the health protection limits established in the Official Mexican Standards for environmental health.

3. Normative references

For the correct use of this Official Mexican Standard, it is necessary to apply the following Official Mexican Standards or those that replace them:

3.1 Official Mexican Standard NOM-034-SEMARNAT-1993, which establishes the measurement methods to determine the concentration of carbon monoxide in ambient air and the procedures for calibrating measurement equipment. Published in the Official Journal of the Federation on October 18, 1993.

3.2 Official Mexican Standard NOM-036-SEMARNAT-1993, which establishes the measurement methods to determine the concentration of ozone in ambient air and the procedures for calibrating measurement equipment. Published in the Official Journal of the Federation on October 18, 1993.

3.3 Official Mexican Standard NOM-037-SEMARNAT-1993, which establishes the measurement methods to determine the concentration of nitrogen dioxide in ambient air and the procedures for calibrating measurement equipment. Published in the Official Journal of the Federation on October 18, 1993.

3.4 Official Mexican Standard NOM-038-SEMARNAT-1993, which establishes the measurement methods to determine the concentration of sulfur dioxide in ambient air and the procedures for calibrating measurement equipment. Published in the Official Journal of the Federation on October 18, 1993.

3.5 Official Mexican Standard NOM-020-SSA1-2021, Environmental health. Criteria for evaluating ambient air quality, regarding ozone (O3). Regulated values for the concentration of ozone (O3) in ambient air, as a measure of protection for the health of the population, published in the Official Journal of the Federation on October 28, 2021.

3.6 Official Mexican Standard NOM-021-SSA1-2021, Environmental health. Criteria for evaluating ambient air quality, regarding carbon monoxide (CO). Regulated values for the concentration of carbon monoxide (CO) in ambient air, as a measure of protection for the health of the population, published in the Official Journal of the Federation on October 29, 2021.

3.7 Official Mexican Standard NOM-022-SSA1-2019, Environmental health. Criteria for evaluating ambient air quality, regarding sulfur dioxide (SO2). Regulated values for the concentration of sulfur dioxide (SO2) in ambient air, as a measure of protection for the health of the population, published in the Official Journal of the Federation on August 20, 2019.

3.8 Official Mexican Standard NOM-023-SSA1-2021, Environmental Health. Criteria for evaluating ambient air quality, with regarding nitrogen dioxide (NO2). Regulated values for the concentration of nitrogen dioxide (NO2) in ambient air, as a measure of protection for public health, published in the Official Journal of the Federation on October 27, 2021.

3.9 Official Mexican Standard NOM-025-SSA1-2021, Environmental Health. Criteria for evaluating ambient air quality, with regarding suspended particles PM10 and PM2.5. Regulated values for the concentration of suspended particles PM10 and PM2.5 in ambient air, as a measure of protection for public health, published in the Official Journal of the Federation on October 27, 2021.

3.10 Official Mexican Standard NOM-156-SEMARNAT-2012, Establishment and operation of air quality monitoring systems. Air quality. Published in the Official Journal of the Federation on July 16, 2012.

4. Terms and definitions

For the purposes of this Official Mexican Standard, the definitions contained in the General Law of Ecological Balance are considered Ecological and Environmental Protection, its Regulation on Prevention and Control of Atmospheric Pollution, those contained in the Official Mexican Standards of chapter 3. Regulatory references of this Official Mexican Standard, as well as the following:

4.1 Bands of the AIR AND HEALTH index: intervals of pollutant concentrations that qualify the level of air pollution and its likelihood of affecting human health.

4.2 Air quality: state of the concentration of different atmospheric pollutants over a specific period of time and place determined.

4.3 Data completion: minimum amount of data required to perform a representative statistical analysis.

4.4 Base concentration: statistic of the concentration of the pollutant of interest from which the band of the AIR AND HEALTH Index.

4.5 Hourly average concentration, hourly data or hourly average: the average or arithmetic mean of the concentrations recorded in the 60-minute time interval bounded by minutes 0 and 59 of the hour.

4.6 Average 8-hour moving concentration: the average of 8 continuous hours, representing the average of the hour of interest and the 7 previous hours, whether they correspond to the same day or the previous day.

4.7 Average 24-hour concentration: the average or arithmetic mean of 24 continuous hours, starting from 00:00 hours. 4.8 Weighted average moving concentration of 12 hours: the average of 12 continuous hours, representing the average of the hour of interest and the 11 previous hours, whether they correspond to the same day or the previous day, and in which the data of each hour has a weight or relative importance compared to the other data.

4.9 Pollution: it is the presence in the ambient air of one or more pollutants or their combination.

4.10 Pollutant: any matter or energy in any of its physical states and forms, which when incorporated and acting in the atmosphere alters or modifies its composition and natural condition.

4.11 Criteria pollutants: regulated pollutants for which a maximum concentration limit has been established in the ambient air in order to protect human health. These are ozone (O3), carbon monoxide (CO), sulfur dioxide (SO2), nitrogen dioxide (NO2), lead (Pb), suspended particles equal to or less than 10 micrometers (PM10) and suspended particles equal to or less than 2.5 micrometers (PM2.5), for the purposes of this Official Mexican Standard, lead (Pb) is excluded.

4.12 Automatic monitoring station: a facility that consists of a booth containing automatic analyzers, monitors and/or meteorological sensors, among others, intended to measure in real time the concentrations of one or more air pollutants and, generally, some meteorological parameters; in order to assess air quality in a specific area.

4.13 Documentary evidence: Official physical or digital documentation that according to the procedures established by the Air Quality Monitoring Systems, are duly formalized.

4.14 Exposure: contact of a human being with a chemical, physical, or biological agent through inhalation, oral, or dermal routes.

4.15 Sensitive individuals: individuals who have a higher probability of experiencing negative health effects due to the exposure to atmospheric pollutants. For the purposes of this standard, sensitive individuals are considered to be those under 12 years of age, over 60 years of age, pregnant individuals, and individuals of any age suffering from cardiovascular and/or respiratory diseases such as COPD or asthma.

4.16 Risk: it is the probability of the occurrence of an adverse effect upon exposure to a biological, chemical, or physical agent or another threat.

4.17 Health risk: it is the probability of the occurrence of an adverse effect on the human population upon exposure to a pollutant.

4.18 Air quality monitoring system: an organized set of human, technical, and administrative resources employed to operate one or a set of monitoring stations that measure air quality in a specific area or region.

5. Specifications

5.1. Management guidelines.

5.1.1 The governments of the federal entities or municipalities that operate air quality monitoring systems, must disseminate the Air Quality Index and Health Risks in the areas where these systems operate, hourly and daily, and must do so mandatorily through an electronic platform and preferably in as many media as possible.

5.1.2 The Air Quality Index and Health Risks will be called the AIR AND HEALTH Index, which will present the following considerations:

5.1.2.1 The dissemination of the AIR AND HEALTH Index must adhere to the Basic Graphic Identity Manual of the AIR AND HEALTH Index, which establishes the typography, color definition, and proportions.

5.1.2.2 It will have informative purposes regarding the state of air quality, health risks, and protective measures. that must be disseminated to the population.

5.1.2.3 It will be calculated and reported hourly for the following criteria pollutants: ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), suspended particles equal to or less than 10 micrometers (PM10) and suspended particles equal to or less than 2.5 micrometers (PM2.5); and its dissemination to the public will be done every hour with a maximum delay of 15 minutes.

The daily report will take into account the 24 hours of the day to obtain the daily value of the AIR AND HEALTH Index, that is, values hourly throughout the day for suspended particles or a maximum of 1 or eight hours for other pollutants, so that information is provided about the air quality status of the previous day.

5.1.2.4 It will be calculated for each of the monitoring stations that make up the Air Quality Monitoring System, when the station aims to assess the exposure levels of the population.

5.1.2.5 It must be disseminated by monitoring station and when possible, information about the scale of representativeness of each station. In the event that it is desired to inform, hourly, about the air quality situation of a specific area, whether of a city or settlement, the AIR AND HEALTH Index indicating the greatest deterioration of air quality and the associated health risk must be presented.

5.1.2.6 When a monitoring station used to report the AIR AND HEALTH Index is out of operation, the Index AIR AND HEALTH that will be disseminated will be replaced by the legends "Out of operation" or "Maintenance", as the case may be.

5.2 Guidelines for data management.

5.2.1 The concentrations of PM10 and PM2.5 must be reported under local conditions as long as there is no regulation that defines the measurement methods in ambient air. In the case of ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), and sulfur dioxide (SO2), the reporting of concentrations will be done according to the current Official Mexican Standards, or those that replace them, which establish reference or equivalent methods and procedures for the

calibration of measurement equipment for each pollutant, which are indicated in Table 1 of this Official Mexican Standard.

Table 1. Regulations for measuring the concentrations of pollutants

PollutantMeasurement method and calibration procedures NOM	
ozone (O3)NOM-036-SEMARNAT-1993	
nitrogen dioxide (NO2)NOM-037-SEMARNAT-1993	
sulfur dioxide (SO2)NOM-038-SEMARNAT-1993	
carbon monoxide (CO)NOM-034-SEMARNAT-1993	

5.2.2 For the calculation of base concentrations, it will start from hourly average concentrations reported by the monitoring stations, taking into account the significant decimal figures and the units of measurement indicated in Table 2 of this Official Mexican Standard, for each pollutant; estimated under the criteria established by the data completion described in point 5.2.4.

Table 2. Significant decimal figures and units of measurement

PollutantUnit of measurementSignificant decimal figures		
PM10mg/m^{3}0		
PM2.5mg/m^{3}0		
ozone (O3)ppm3		
nitrogen dioxide (NO2)ppm3		
sulfur dioxide (SO2)ppm3		
carbon monoxide (CO)ppm2		

5.2.3 Base concentration.

For the calculation of the AIR AND HEALTH Index, it will start from the base concentrations indicated in Table 3 of this Standard Official Mexican.

Table 3. Base concentrations for calculating the AIR AND HEALTH Index for each pollutant

Pollutant	Base concentration	
	Hourly reportDaily report	
PM10	Weighted moving average of 12 hours	24-hour average
PM2.5		
carbon monoxide (CO)	8-hour moving average	Maximum of the moving averages of 8 hours recorded in the day
nitrogen dioxide (NO2)	Hourly average	Maximum of the hourly averages recorded in the day
ozone (O3)		
sulfur dioxide (SO2)		

In the specific case of suspended particles (PM10 and PM2.5), it is appropriate to point out that the epidemiological evidence on the effects of these pollutants on human health is based on average concentrations of 24 hours, so NOM-025-SSA1-2021, Environmental health. Criterion for evaluating ambient air quality, regarding suspended particles PM10 and PM2.5, establishes permissible limit values for the concentration of suspended particles in ambient air as a measure for the protection of human health calculated as a 24-hour average and as an annual average. An average of this nature prevents timely information to the population about the risks of exposure to high levels of pollution from this pollutant, which is why to report the state of air quality every hour, the weighted moving average of 12 hours will be used. This calculation method is known in the United States as NowCast, was formulated and used by the Environmental Protection Agency of that country in the calculation and communication of its real-time Air Quality Index for these pollutants, giving the population the possibility to take timely measures to reduce their exposure and protect their health (Technical Assistance Document for the Reporting of Daily Air Quality - the Air Quality Index (AQI).https://nepis.epa.gov/Exe/ZyPDF.cgi/P100P29X.PDF?Dockey=P100P29X.PDF). The basic principle of this indicator is that if the population can reduce its exposure during the hours of highest concentration of the pollutant, then it will reduce its average exposure of 24 hours, thus reducing the risks of suffering impacts on their health.

The hourly average concentrations used for the calculation and reporting of the AIR AND HEALTH Index may vary once they are subjected, for other purposes, to the validation processes applied by each Air Quality Monitoring System.

5.2.4 Rounding.

The base concentrations calculated for each of the pollutants must be rounded to the decimal figures significant figures specified in Table 2 of this Official Mexican Standard, applying the following rules:

a) For ozone (O3), nitrogen dioxide (NO2), and sulfur dioxide (SO2), if there are 4 or more decimal places, the following rounding will be applied: the following rounding will be applied: if the fourth decimal place is a number between 0 and 4, the third decimal place will not be increased; but if that fourth digit is greater than or equal to 5, the third decimal place will be increased to the next higher number. For example, the rounding of the figure 0.0955 is 0.096 and that of the figure 0.0954 is 0.095;

b) For PM10 and PM2.5, if there is one or more decimal places, the following rounding will be applied: if the first digit is a number between 0 and 4, the integer value will not be increased; but if it is greater than or equal to 5, the integer value will be increased to the next higher number. For example, the rounding of the figure 9.4 is 9 and that of the figure 9.5 is 10.

c) For carbon monoxide (CO), if there are three or more decimal places, the following rounding will be applied: if the third decimal place is a number between 0 and 4, the second decimal place will not be increased; but if the third decimal place is greater than or equal to 5, the second decimal place will be increased to the next higher number. For example, the rounding of the figure 11.324 is 11.32 and that of the figure 11.035 is 11.04.

5.2.5 Data completion criterion and calculation of base concentrations.

5.2.5.1 Hourly average concentration.

To calculate it, it is necessary to have at least 75% of the records for the hour; that is, the average concentration of one hour must be calculated by averaging the concentrations recorded for at least 45 minutes.

5.2.5.2 8-hour moving average concentration.

To calculate it, at least 75% of the hourly average concentrations will be required. In this way, the moving average of eight hours for the calculation of carbon monoxide (CO) requires a minimum of six hours of information on hourly average concentrations. The 8-hour moving averages are calculated from the hourly average concentrations, taking the average of the selected hour with the seven concentrations recorded in the previous hours. For example, to estimate the 8-hour moving average at 1:00 PM, the average of the hourly concentrations recorded for a minimum of six hours between 6:00 AM and 1:00 PM is calculated.

5.2.5.3 Weighted 12-hour moving average concentration.

To calculate it, the hourly averages of at least two of the three most recent hours of the 12 involved will be required in the calculation. The calculation of the weighted 12-hour moving average concentration is obtained by applying the following formula:

$$\overline{C} = \left[\frac{\sum_{i=1}^{N} C_i \, W^{i-1}}{\sum_{i=1}^{N} W^{i-1}}\right][FA]$$

Where:

$$W = \begin{cases} w & si\ w > 0.5 \\ 0.5 & si\ w \leq 0.5 \end{cases} \quad y \quad w = 1 - \frac{C_{max} - C_{min}}{C_{max}}$$

$\overline{C}$ = Weighted moving average concentration

N = 12

FA = Adjustment factor

$$FA = \begin{cases} 0.694 & si\ C_i\ corresponde\ a\ PM_{2.5} \\ 0.714 & si\ C_i\ corresponde\ a\ PM_{10} \end{cases}$$

Ci = Hourly average concentration of hour i,

i = consecutive measurement hour (the most recent measurement hour is hour 1 and the first measurement hour in the set of data considered in the calculation would be hour 12)

W = Weighting factor rounded to two decimal places

Cmax = Maximum hourly average concentration in the 12-hour period

Cmin = Minimum hourly average concentration in the 12-hour period

Note:

To apply this calculation methodology, it is necessary to comply with the following two conditions:

a) Have data for at least two of the three most recent measurement hours. If this condition is not met, the calculation of the corresponding sub-index for that hour should not be performed.

b) The value of i (consecutive measurement hour) must be maintained even in situations where there are hours in which no count on measured concentrations. This is for example, if from the three most recent measurement hours we only have concentration records for hour 1 and 3, the weighting of the concentration for hour 1 should be C1(w)0 and for hour three C3(w)2 and not C2(w)1. That is, the measurement for hour three corresponds to i=3, not i=2.

For greater clarity on the procedure for calculating the 12-hour weighted moving average, see examples described in Annex A.

5.2.5.4 Average concentration over 24 hours

For its calculation, at least 75% of the average hourly concentrations will be required. In this way, the concentration average over 24 hours for the calculation of suspended particulate concentration (PM10 and PM2.5) requires a minimum of 18

hours of information on average hourly concentrations. The 24-hour averages are calculated for a continuous period of 24 hours, starting from 00:00 hours.

5.3 Classification of bands of the AIR AND HEALTH Index.

The bands of the AIR AND HEALTH Index that make up the AIR AND HEALTH Index will be constructed considering the intervals of concentration indicated in tables 4, 5, 6, 7, 8, and 9 of this Official Mexican Standard, as applicable to the criterion pollutant. Particularly, the upper limits of the "Acceptable" band interval match the values established in the Official Mexican Standard NOM-020-SSA1-2021, Environmental health. Criterion for evaluating ambient air quality, regarding ozone (O3). Regulated values for the concentration of ozone (O3) in ambient air, as a measure of protection for public health; the Official Mexican Standard NOM-021-SSA1-2021, Environmental health. Criterion for evaluating ambient air quality, regarding carbon monoxide (CO). Regulated values for the concentration of carbon monoxide (CO) in ambient air; the Official Mexican Standard NOM-022-SSA1-2019, Environmental health. Criterion for evaluating ambient air quality, regarding sulfur dioxide (SO2). Regulated values for the concentration of sulfur dioxide (SO2) in ambient air, as a measure of protection for public health; the Official Mexican Standard NOM-023-SSA1-2021, Environmental health. Criterion for evaluating ambient air quality, regarding nitrogen dioxide (NO2). Regulated values for the concentration of nitrogen dioxide (NO2) in ambient air, as a measure of protection for public health and the Official Mexican Standard NOM-025-SSA1-2021, Environmental health. Criterion for evaluating ambient air quality, regarding suspended particles PM10 and PM2.5. Regulated values for the concentration of suspended particles PM10 and PM2.5 in the air.
environment, as a measure of protection for public health.

Table 4. Obtaining the AIR AND HEALTH Index for PM10.

Air qualityRisk level. associated.	PM10 interval (µg/m3). weighted moving average of 12 hours.		
	Upon entering into force the. NOM.	Starting from January of. 2024	Starting from January. of 2026.
GoodLow<45<45<45.	_	_	_
AcceptableModerate>45 to 70>45 to 60>45 to 50.			
BadHigh>70 to 132>60 to 132>50 to 132.			
Very BadVery High>132 to 213>132 to 213>132 to 213.			
Extremely Bad.	Extremely High>213>213>213.		

Table 5. Obtaining the AIR AND HEALTH Index for PM2.5.

Air qualityRisk level. associated.	PM2.5 interval (µg/m3). weighted moving average of 12 hours.		
	Upon entering into force the. NOM.	Starting from January of. 2024	Starting from January. of 2026.
GoodLow<15<15<15.	_	_	_
AcceptableModerate>15 to 41>15 to 33>15 to 25.			
BadHigh>41 to 79>33 to 79>25 to 79.			
Very BadVery High>79 to 130>79 to 130>79 to 130.			
Extremely Bad.	Extremely High>130>130>130.		

The health risk level to the population, regarding PM10 and PM2.5 is referred to the 24-hour average, the average. weighted moving average of 12 hours is an approximation to this and at the end of the day they may not match exactly. However, it is used with a preventive character to timely inform about the state of air quality and induce a lower exposure of the population during hours with higher concentrations of this pollutant.

Table 6. Obtaining the AIR AND HEALTH Index for ozone (O3).

Air qualityAssociated risk levelOzone interval (O3).	one-hour average (ppm).
GoodLow<0.058.	_
AcceptableModerate>0.058 to 0.090.	
BadHigh>0.090 to 0.135.	
Very BadVery High>0.135 to 0.175.	
Extremely BadExtremely High>0.175.	

Table 7. Obtaining the AIR AND HEALTH Index for nitrogen dioxide (NO2)

Air qualityRisk level associated	Nitrogen dioxide (NO2) range one hour average (ppm)
GoodLow	<0.053
AcceptableModerate	>0.053 to 0.106
BadHigh	>0.106 to 0.160
Very BadVery High	>0.160 to 0.213
Extremely BadExtremely High	>0.213

Table 8. Obtaining the AIR AND HEALTH Index for sulfur dioxide (SO2)

Air qualityRisk level associated	Sulfur dioxide (SO2) range one hour average (ppm)
GoodLow	< 0.035
AcceptableModerate	>0.035 to 0.075
BadHigh	> 0.075 to 0.185
Very BadVery High	>0.185 to 0.304
Extremely BadExtremely High	>0.304

Table 9. Obtaining the AIR AND HEALTH Index for carbon monoxide (CO)

Air qualityRisk level associated	Carbon monoxide (CO) range 8 hour moving average (ppm)
GoodLow	<5.00
AcceptableModerate	>5.00 to 9.00
BadHigh	>9.00 to 12.00
Very BadVery High	>12.00 to 16.00
Extremely BadExtremely High	>16.00

5.4 Guidelines for disseminating the AIR AND HEALTH Index.

5.4.1 The AIR AND HEALTH Index will be made available to the public mandatorily on the website and any other means of dissemination that the authority responsible for each Air Quality Monitoring System establishes for this purpose.

5.4.2 The AIR AND HEALTH Index that will be disseminated to the public will be the one indicating the greatest deterioration of air quality and the associated health risk, for each of the stations that make up the Air Quality Monitoring System.

5.4.3 The dissemination of risks related to the AIR AND HEALTH Index will consist of establishing five bands of the Index AIR AND HEALTH that will be associated with five colors - green, yellow, orange, red, and purple - as described in Table 10 of this Official Mexican Standard. The AIR AND HEALTH Index is for informational purposes only to warn the population in a city or locality at a specific time.

Table 10. Categories of the AIR AND HEALTH Index

Air qualityRisk level associated	Risk descriptionColor		
	Population in General	Sensitive Population	
GoodLowHealth risk is minimal or none.		Health risk is minimal or none.Green	
AcceptableModerateHealth risk is minimal.		People who are sensitive to ozone (O3) or particulate matter (PM10 and PM2.5) may experience irritation of the eyes and respiratory symptoms such as respiratory tract irritation,	Yellow

			coughing up phlegm, difficulty breathing or wheezing.	
BadHighIt is unlikely		that it will be affected.	Increase in the risk of having respiratory symptoms and/or decrease in lung function.	Orange
Very BadVery HighHealth damage may occur.			They may experience a worsening of asthma, chronic obstructive pulmonary disease or cardiovascular events and an increase in the probability of premature death in people with chronic obstructive pulmonary disease and heart disease.	Red
ExtremelyBad	ExtremelyHigh	It is more likely that any person will be affected by serious health effects.	It is more likely that any person will be affected by serious health effects.	Purple

Colors are defined based on RGB (red, green, and blue) and CMYK (cyan, magenta, yellow and black) as shown in Table 11 of this Official Mexican Standard:

Table 11. Color formulas for the AIR AND HEALTH Index

ColorRGBCMYK	
Green022804001000	
Yellow2552550001000	
Orange25512600511000	
Red2550001001000	
Purple14363151518900	

Note: Traditionally, the RGB formula is used for colors projected on screen, while CMYK is used for printed materials. Color models are based on a scale of 0 - 255. In case of stations under maintenance and/or without information, the associated color will be white.

5.4.4 The messages accompanying the risk categories and colors of the AIR AND HEALTH Index will include recommendations for actions to be taken, considering the health condition and sensitivity of individuals, according to Table 12 of this Official Mexican Standard:

Table 12. Messages associated with air quality categories and health risks.

Category Air Quality/Risk	People with diseases cardiovascular or respiratory[a] and over 60 years old	Under 12 years old and pregnant individuals	General population general
Good/LowEnjoy outdoor activities			
Acceptable/ModerateIt is possible to engage in outdoor physical activities such as light jogging, brisk walking or cycling, scooter, skating and skateboarding.Reduce vigorous outdoor physical activities such as aerobic exercises, playing soccer, basketball, volleyball, athletics, competitive cycling or running.If you experience any symptoms or discomfort or have questions, seek your doctor's advice.Stay informed about the evolution of air quality.		Enjoy outdoor activities.Stay informed about the evolution of air quality.	
Bad/HighReduce vigorous outdoor physical activities such as aerobic exercises, playing soccer, basketball, volleyball, athletics, competitive cycling or running, light jogging, brisk walking or		It is possible to engage in outdoor physical activities such as light jogging, brisk walking or cycling, scooter, skating	It is possible to engage in outdoor activities freely. If you experience symptoms such as cough or shortness of breath, take more breaks and

	to move by bicycle, scooter, skates and skateboards. If you have any symptoms or discomfort or have doubts, seek the advice of your doctor. Stay informed about the evolution of air quality.	and skateboards; increase rest periods. Reduce activities vigorous physical activities outdoors such as exercises aerobics, playing soccer, basketball, volleyball, athletics, cycling sports, etc. If respiratory or cardiac symptoms occur, suspend the activity and consult your doctor. Stay informed about the evolution of air quality.	perform activities less vigorous. Stay informed about the evolution of the air quality.
Very bad/Very high It is possible in indoor spaces,	to perform physical activities as long as it is a smoke-free space. Avoid physical activities vigorous and moderate, as well as the time spent outdoors. If you have any symptoms or discomfort or have doubts, seek the advice of your doctor. Stay informed about the evolution of air quality.	Reduce outdoor physical activities and preferably perform them in indoor spaces, as long as it is a smoke-free space. Avoid vigorous or prolonged physical activity outdoors. Stay informed about the evolution of air quality.	
Extremely bad/Extremely high	Stay indoors where you can perform physical activities, reschedule your outdoor activities, and if you have respiratory and/or cardiac symptoms, consult a doctor. Stay informed about the evolution of air quality.		

[a] People with asthma or other respiratory/cardiovascular diseases must medically manage their condition and follow their doctor's instructions.

6. Conformity Assessment Procedure.

6.1 The conformity assessment of this Official Mexican Standard includes the technical process that allows to demonstrate compliance with various legal provisions, which will be carried out in accordance with the provisions of the Quality Infrastructure Law and the Federal Law on Metrology and Standardization or, as the case may be, the document that replaces it, in addition to the following:

6.1.1 The conformity assessment procedure will be carried out by the competent authorities directly or through an Inspection Unit accredited by an accreditation entity and approved by the Standardization Authority.

6.1.2 Only when there are no accredited and approved Inspection Units, or they are in the process of partial or total suspension, cancellation of their accreditation or approval, or according to the level of risk or protection necessary to safeguard the legitimate objectives of public interest that are intended to be addressed, one may resort to research and higher education institutions specialized in the subject or sector covered by the standard, as well as any other entity recognized by SEMARNAT to carry out the conformity assessment in question.

6.1.3 To demonstrate compliance with the specifications established in this standard, evidence must be presented documentary evidence in printed and/or electronic format for the following items: 5.1.2.1, 5.1.2.3, 5.1.2.5, 5.1.2.6, 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.2.5, 5.3, 5.4.1, 5.4.2, 5.4.3 and 5.4.4.

During the verification visit, the Inspection Unit will verify compliance with the provisions of this Official Mexican Standard established according to the means of verification established in Table 13 of this Official Mexican Standard:

Table 13. Means of verification of compliance with specifications

Provision	Verification means
5.1.2.1	Documentary evidence that the dissemination adheres to the basic graphic identity manual of the AIR AND HEALTH Index.
5.1.2.3	Documentary evidence of the hourly information calculation and its dissemination every hour with a maximum delay of 15 minutes.
5.1.2.5	Documentary evidence that the dissemination of the AIR AND HEALTH index by monitoring station and/or, if applicable, for a specific area, whether a settlement or city, is presented in a timely manner and indicates the greatest deterioration of air quality according to the pollutants measured and that present a greater risk to health. If applicable, documentary evidence that the dissemination includes information on the scale of representativeness of each station.

5.1.2.6Documentary evidence that when a monitoring station used to report the AIR AND HEALTH Index is out of operation or under maintenance, the AIR AND HEALTH Index that will be disseminated must be replaced by the legend "Maintenance" or "Out of operation" as applicable.	
5.2.1Documentary evidence that the concentrations of PM10 and PM2.5 are reported to	local conditions as long as there is no regulation in Mexico that defines the measurement methods in ambient air. In the case of ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), and sulfur dioxide (SO2), the reporting of concentrations will be done according to the current Official Mexican Standards, or those that replace them, which establish the reference or equivalent methods and procedures for the calibration of measurement equipment for each pollutant, as indicated in Table 1 of this Official Mexican Standard.
5.2.2Documentary evidence of compliance with the units of measurement and significant decimal figures established in table 2.	
5.2.3Evidence of the consideration of the base concentrations indicated in table 3 and, if applicable, justify the variation.	
5.2.4Documentary evidence of the application of rounding criteria for calculating base concentrations for each of the pollutants.	
5.2.5Documentary evidence of compliance with data completion criteria and calculation of base concentrations.	
5.3Documentary evidence of compliance with the classification of bands of the AIR AND HEALTH Index for each criterion pollutant, according to tables 4, 5, 6, 7, 8, and 9.	
5.4.1Documentary evidence of the means of dissemination of the AIR AND HEALTH Index.	
5.4.2Documentary evidence that the AIR AND HEALTH Index disseminated to the population is the one or ones that represented the worst air quality situation and the associated health risk, for each of the stations that make up the Air Quality Monitoring System.	
5.4.3Documentary evidence of the application of colors to each band, according to the specifications of tables 10 and 11.	
5.4.4Documentary evidence of the dissemination of messages according to the risk categories and colors of each band, established in table 12.	

6.1.4 Verification and inspection must be carried out on all air quality monitoring systems operated by state or municipal authorities.

6.2 In the case of inspections carried out by the Inspection Units on the monitoring systems, the sample representative will be determined by the inspector and their review will be based on the documentary evidence generated by each monitoring system in logbooks, logs, records, and any other printed or electronic means intended for data processing, categorization, and dissemination of the AIR AND HEALTH Index. They must issue a verification report on compliance with this standard.

6.2.1 Compliance verification reports will be recognized by the competent authorities as part of the evaluation of compliance with this standard.

6.2.2 If as a result of the inspection a non-compliance verification report is generated, the Inspection Unit must notify the authority responsible for the monitoring system, within five business days following the date of its preparation.

The authority responsible for the monitoring system must rectify the non-compliances with the standard and send the evidence documentary to the Inspection Unit, within a period not exceeding sixty calendar days, counted from the notification of the non-compliance verification report. Otherwise, it must immediately suspend the publication of the index, placing in its place the legend "In non-compliance with NOM 172."

6.2.3 Until the compliance verification report is available, the AIR AND HEALTH Index cannot be considered in accordance with the standard. Only the result of the opinion (complies or does not comply with NOM-172) will be published on the official pages where the Index is disseminated or in the media defined by the Secretariat.

7. Compliance with International Standards.

This Official Mexican Standard is not equivalent (NEQ) to any International Standard, as the latter does not exist at the moment. of its preparation.

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Annex A

(Informative)

Examples of calculating the 12-hour weighted moving average for PM10 and PM2.5

(Sources: MINTZ, David; STONE, Susan; DICKERSON, Phill; DAVIS, Alison. Transitioning to a new NowCast Method Technical Slides for CETESB Provided by EPA-OAQPS. July 15, 2013.)

The following examples illustrate the procedure for calculating the 12-hour weighted moving average of PM10 and PM2.5, both when using a weighting factor of 0.5 and when using a higher one.

A.1 Example 1. Illustrates the use of a weighting factor of 0.5 for the 12:00 PM concentrations of PM2.5.

Table A1. Concentrations that condition the use of a weighting factor of 0.5.

Hour	Consecutive hour of measurement (i)	Concentration in micrograms per cubic meter of PM2.5

		(mg/m3)
01:001250		
02:001180		
03:001075		
04:00990		
05:00882		
06:00753		
07:00664		
08:00574		
09:00421		
10:00310		
11:00216		
12:00113		

A.1.1 The range is calculated between the maximum and minimum concentration values of the last 12 hours:

Cmax= 90

Cmin= 10

Range = Cmax - Cmin = 90 - 10 = 80µg/m3

A.1.2 The weighting factor is calculated by subtracting the scaled rate of change to 1. The weighting factor (W) must be in a range between 0.5 and 1. If w is less than or equal to 0.5 it is set to 0.5:

$$w = 1 - \frac{C_{max} - C_{min}}{C_{max}} = 1 - \frac{90 - 10}{90} = 0.11$$

Since w = 0.11 <= 0.5

The weighting factor is W = 0.5

A.1.3 Each hourly concentration is multiplied by the weighting factor raised to a power equal to the hours that have passed since the measurement of that data. The products are summed:

$$13(0.5)^0 + 16(0.5)^1 + 10(0.5)^2 + 21(0.5)^3 + 74(0.5)^4 + 64(0.5)^5 + 53(0.5)^6 + 82(0.5)^7 + 90(0.5)^8 + 75(0.5)^9 + 80(0.5)^{10} + 50(0.5)^{11} = 34.82$$

A.1.4 The weighted moving average concentration is calculated by dividing the previous sum by the sum of the weighting factor raised to a power equal to the hours that have passed since the measurement of that data and is multiplied by the adjustment factor corresponding to PM2.5:

$$\left[\frac{13(0.5)^0 + 16(0.5)^1 + 10(0.5)^2 + 21(0.5)^3 + 74(0.5)^4 + 64(0.5)^5 + 53(0.5)^6 + 82(0.5)^7 + 90(0.5)^8 + 75(0.5)^9 + 80(0.5)^{10} + 50(0.5)^{11}}{0.5^0+0.5^1+0.5^2+0.5^3+0.5^4+0.5^5+0.5^6+0.5^7+0.5^8+0.5^9+0.5^{10}+0.5^{11}}\right][0.694]$$

$$= \left[\frac{34.8193}{1.9995}\right][0.694] = [17.4139][0.694] = 12.0852466\,\frac{\mu g}{m^3}$$

A.1.5 Applying rounding, the 12-hour weighted moving average concentration for 12:00 hours is as follows: the following form:

$$\bar{C} = 12\,\frac{\mu g}{m^3}$$

A.2 Example 2. Illustrates the use of a weighting factor greater than 0.5 for the 12:00 hour concentrations of PM10.

Table A2. Concentrations that condition the use of a weighting factor of 0.5.

HourConsecutive hour of measurement (i)		Concentration in micrograms per cubic meter (µg/m3)
01:0012118		
02:001197		
03:0010130		
04:009142		
05:008146		
06:007144		
07:006141		
08:005134		

09:004147		
10:003150		
11:002141		
12:001103		

A.2.1 The range is calculated between the maximum and minimum concentration values of the last 12 hours:

Cmax = 150

Cmin = 97

Range = Cmax - Cmin = 150 - 97 = 53 µg/m3

A.2.2 The weighting factor is calculated by subtracting the scaled rate of change to 1. The weighting factor (W) must be in a range between 0.5 and 1. If w is greater than 0.5, w is taken as the weighting factor rounded to two decimal places.

$$w = 1 - \frac{C_{max} - C_{min}}{C_{max}} = 1 - \frac{150 - 97}{150} = 0.65$$

Since w = 0.65 > 0.5

The weighting factor is W = 0.65

A.2.3 Each hourly concentration is multiplied by the weighting factor raised to a power equal to the hours that have passed since the measurement of that data. The products are summed:

$$\begin{aligned} &103(0.65)^{0} + 141(0.65)^{1}_{7} + 150(0.65)^{2}_{8} + 147(0.65)^{3}_{9} + 134(0.65)^{4}_{10} + 141(0.65)^{5}_{11} + 144(0.65)^{6} \\ &+ 146(0.65)^{} + 142(0.65)^{} + 130(0.65)^{} + 97(0.65)^{} + 118(0.65)^{} = 366.2482 \end{aligned}$$

A.2.4 The weighted moving average concentration is calculated by dividing the previous sum by the sum of the weighting factor raised to a power equal to the hours that have passed since the measurement of that data and is multiplied by the adjustment factor corresponding to PM10:

$$\left[\frac{103(0.65)^{0}+141(0.65)^{1}+150(0.65)^{2}+147(0.65)^{3}+134(0.65)^{4}+141(0.65)^{5}+144(0.65)^{6}+146(0.65)^{7}+142(0.65)^{8}+130(0.65)^{9}+97(0.65)^{10}+118(0.65)^{11}}{0.65^{0}+0.65^{1}+0.65^{2}+0.65^{3}+0.65^{4}+0.65^{5}+065^{6}+0.65^{7}+0.65^{8}+0.65^{9}+0.65^{10}+0.65^{11}}\right][0.714]$$

$$\left[\frac{366.2482}{2.8409}\right][0.714] = [128.92][0.714] = 92.04888\frac{\mu g}{m^3}$$

A.2.5 Applying rounding, the 12-hour weighted moving average concentration for 12:00 hours is as follows:
the following form:

$$\overline{C} = 92\frac{\mu g}{m^3}$$

A.3 Handling of Missing Data.

A.3.1 For the valid calculation of the 12-hour weighted moving average, data must be available for at least two of the three most recent hours.

If there is an omission of only one hour, there will be no interruption in the calculation.

Most recent consecutive measurement hour (i)	123456789101112											
Hourly data II X III III III III												
Weighted Average IIIIIIII												

I = Data

X = No data

A.3.2 If data is omitted for two of the three most recent hours, the calculation should be omitted.

Most recent consecutive measurement hour (i)	123456789101112											
Hourly data I X III III III III												
Weighted Average XX IIIIIIII												

Most recent consecutive measurement hour (i)	123456789101112											
Hourly data X IX III III III III												

Weighted AverageXIIIIIIIII												

Most recent consecutive measurement hour (i)	1	2	3	4	5	6	7	8	9	10	11	12
Hourly dataXXIIIIIIIII												
Weighted AverageXIIIIIIIII												

A.3.3 Example of the calculation if there is a missing data point in one of the three most recent hours. In example 2 of the PM10 concentrations, if in the second consecutive hour of the most recent measurement there was a missing data point, the formula is applied as follows:

$$\left[\frac{103(0.65)^{0}+150(0.65)^{2}+147(0.65)^{3}+134(0.65)^{4}+141(0.65)^{5}+144(0.65)^{6}+146(0.65)^{7}+142(0.65)^{8}+130(0.65)^{9}+97(0.65)^{10}+118(0.65)^{11}}{0.65^{0}+0.65^{2}+0.65^{3}+0.65^{4}+0.65^{5}+065^{6}+0.65^{7}+0.65^{8}+0.65^{9}+0.65^{10}+0.65^{11}}\right][0.714]$$

$$=\left[\frac{274.59817}{2.19089}\right][0.714]=89.490\,\frac{\mu g}{m^{3}}$$

$$\bar{C}=89\ \mu g/m^{3}$$

Annex B

(Informative)

Considerations for calculating pollutant concentrations based on the risk to the human health

The Air Quality Index and Health Risks evaluates the concentration of suspended particles with a diameter aerodynamic less than 10 microns (PM10), Particulate Matter with aerodynamic diameter less than 2.5 microns (PM2.5), Ozone (O3), Nitrogen Dioxide (NO2), Sulfur Dioxide (SO2) and Carbon Monoxide (CO). The index uses the concentrations and establishes categories for each pollutant separately and in order to facilitate understanding, in this update no dimensionless value was assigned.

This index classifies five categories of air quality, each with its associated color band: good (green), acceptable (yellow), bad (orange), very bad (red) and extremely bad (purple).

Its main strength is that it is calculated from concentration-response functions (CRF), which indicate the probability of occurrence of an impact on population health based on a given change in pollutant concentrations. The CRFs are represented by different measures of association, the most common being Relative Risk (RR), which are derived from epidemiological studies. A relative risk greater than 1 indicates a positive association, when it is equal to 1 there is no association, and when it is less than 1 it is a negative association.

Concentration-response functions to estimate risks

To select the CRFs applied to this index, meta-analysis studies developed to define the WHO air quality guideline values for 2021. These studies associate short-term exposure to air pollutants with the risk of mortality from all non-external causes, that is, all deaths excluding those caused by accidents and injuries. For PM10 and PM2.5, the study uses a 24-hour average exposure metric (Orellano et al., 2020). For ozone, the study by Peng et al. (2013) was used with a 1-hour exposure metric, and for calculations, the O3-1hr = O3-8hr ratio of 1.14 (Anderson and Bell, 2010) was employed. In the case of NO2, WHO evidence shows that there was no significant association at 1-hour exposure, but there was at 24-hours, so the study by Samoli et al. (2006) was considered. For SO2, the health outcome was due to respiratory causes since the association with non-external mortality did not show statistical significance (Orellano et al., 2021). Finally, in the case of CO, the study by Chen et al. (2021) was used with an 8-hour moving average exposure. The summary of the CRFs is shown in Table 1.

Table 1. Concentration-response functions for each 10 µg/m3 increase in pollutants, except for CO which is for each mg/m3.

Pollutant	Study	Risk Relative to	% increase in the risk of	Outcome in mortality
PM10 24h	Orellano 2020	1.0041	0.41	Non-external causes
PM2.5 24h	Orellano 2020	1.0065	0.65	Non-external causes
O3 1h	Peng 2013	1.0026	0.26	Non-external causes
NO2 1h	Samoli 2006	1.0027	0.27	Non-external causes
SO2 1h	Orellano 2021	1.0052	0.52	Respiratory causes
CO 8h	Chen 2021	1.0091	0.91	Non-external causes

Source: (Chen et al., 2021; Orellano et al., 2021; Orellano et al., 2020; Samoli et al., 2006)

To define the concentrations of each band, the excess risk of mortality is used, which is the increase in risk of death in a day, at a certain concentration of a pollutant, compared to a day at a reference concentration.

The reference concentration for PM10, PM2.5, O3, and NO2 is the long-term value of the air quality guidelines from the WHO, which corresponds to 15, 5, 60 (multiplied by 1.14, which is the conversion factor to 1-hour) and 10 µg/m3 respectively. While for CO the reference value is 0 mg/m3. In the case of SO2, the values from the Air Quality Index of the United States Environmental Protection Agency (US EPA) for the 5 bands were considered. Thus, for the orange, red, and purple bands, the FCR from the previously described systematic review studies were used and compared with the reference concentration.

As seen in Table 1, the FCRs are different for each pollutant, and therefore the shape or curve of the concentration-response relationship is varied, as is the reference value from which health risks are estimated, so for the construction of this index, risks are not standardized for all pollutants. Thus, the concentrations of the different pollutants for the AIR AND HEALTH Index categories are associated with a level of risk to human health that determines the health risk considered acceptable for exposure to each pollutant.

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9. Verification

The verification of this Official Mexican Standard is the responsibility of the Secretariat of Environment and Natural Resources, through the Federal Attorney for Environmental Protection, of the Governments of the Federal Entities, Municipalities, and Territorial Demarcations, according to their areas of competence.

Transitional provisions

FIRST. This Official Mexican Standard will come into effect 180 calendar days after its publication in the Official Journal of the Federation.

SECOND. The Secretariat of Environment and Natural Resources will make available to state or municipal governments, through its official website, the basic graphic identity manual referred to in numeral 5.1.2.1.

THIRD. The AIR AND HEALTH Index will be subject to periodic review of the technical and scientific bases that it they support, for its update according to the results of epidemiological and toxicological research, the reports from international health agencies, the studies evaluating the social impacts achieved through effective communication of the state of air quality, the probable damages, and the protective measures.

FOURTH. Within a period of 90 calendar days following the publication of this Official Mexican Standard, the Secretariat of Environment and Natural Resources through the Federal Attorney for Environmental Protection will establish in coordination with federal authorities, as well as with state entities, municipalities, and territorial demarcations of Mexico City, the criteria and administrative guidelines to carry out the tasks or visits or inspection operations to verify and evaluate compliance with the standard, as well as the follow-up on recommendations and violations or applicable safety measures in their case.

Mexico City, January 5, 2024.- The Undersecretary of Environmental Regulation of the Secretariat of Environment and Natural Resources and President of the National Advisory Committee for Standardization of Environment and Natural Resources, Alonso Jiménez Reyes.- Signature.