IRMA

Initiative for Responsible Mining Assurance

EXCERPT FROM THE

IRMA Standard

for

Responsible Exploration, Extraction, and Processing of Minerals

2nd DRAFT

for public consultation

CHAPTER 4.5 – **Air Quality and Dust Management**

IRMA Standard v2.0 DRAFT 2

July 2025

English Version

Disclaimer and Context on this Draft

The 2nd DRAFT Version of the IRMA Standard for Responsible Exploration, Extraction, and Processing of Minerals V2.0 (hereafter referred to as the "2nd DRAFT") is being released for public consultation, inviting the world to join once again in a conversation around expectations that drive value for greater environmental and social responsibility in mining and mineral processing.

The 2nd DRAFT does not represent content that has yet been formally endorsed by IRMA's equally-governed multi-stakeholder Board of Directors. IRMA's Board leaders seek the wisdom and guidance of all readers to inform this through an inclusive revision process one more time, to improve the Standard.

This draft document builds on the 1st DRAFT Version published in October 2023, and invites a global conversation to improve and update the 2018 IRMA Standard for Responsible Mining V1.0. This 2nd DRAFT is intended to provide as final of a look-and-feel as possible, although input from this consultation will result in final edits, and consolidation to reduce overall number of requirements (more on this on page 6), for a version that will be presented to IRMA's equally-governed multi-stakeholder Board of Directors for adoption and implementation.

This 2nd DRAFT has been prepared and updated by the IRMA Secretariat based on:

- learnings from the implementation of the current IRMA Standard (V1.0)
- experience from the first mines independently audited (as of July 2025, 24 sites have completed audits or are in the process of being audited)
- evolving expectations for best practices in mining to reduce harm
- comments and recommendations received from stakeholders and Indigenous rights-holders
- the input of subject-specific Expert Working Groups convened by IRMA between 2022 and 2024
- all comments and contributions received during the public-comment period of the 1st DRAFT version (October 2023-March 2024)

Please note that Expert Working Groups were created to catalyze suggestions for solutions on issues we knew most needed attention in this update process. They were not tasked to come to consensus nor make formal recommendations. Their expertise has made this consultation document wiser and more focused, but work still lies ahead to resolve challenging issues. We encourage all readers to share perspectives to improve how the IRMA system can serve as a tool to promote greater environmental and social responsibility, and create value for improved practices, where exploration, extraction, and processing of minerals happens.

IRMA is dedicated to a participatory process including public consultation with a wide range of affected people globally and seeks feedback, comments, questions, and recommendations for improvement of this Standard. IRMA believes that diverse participation and input is a crucial and determining factor in the effectiveness of a Standard that is used to improve environmental and social performance in a sector. To this end, every submission received will be reviewed and considered.

This current 2nd DRAFT is based on content already in practice in the IRMA Standard for Responsible Mining V1.0 (2018) for mines in production, and its accompanying normative Guidance document and Supplementary Guidance, combined with the content drafted in the IRMA Standard for Responsible Mineral Development and Exploration ('IRMA-Ready' Standard – Draft v1.0 December 2021) and in the IRMA Standard for Responsible Minerals Processing (Draft v1.0 June 2021), and offers an updated version of the 1st DRAFT Version of the IRMA Standard V2.0 that received over 2,500 unique points of comments between 2023 and 2024.

Please note: The IRMA Standard V2.0 is new in its approach in that it now covers more phases of the mining and mineral supply chain, from exploration and development, through mining, closure, and mineral processing. IRMA also, separately, oversees a Chain of Custody Standard for tracking materials through the supply chain from mine-to-market end use products.

Disclaimer on Language and Corrections

For this public consultation, only an English version is available. A Glossary of Terms used in this Standard is provided at the end of the full version of the document (see below). IRMA reserves the right to publish corrigenda on its web page, and readers of this document should consult the corresponding web page for corrections or clarifications.

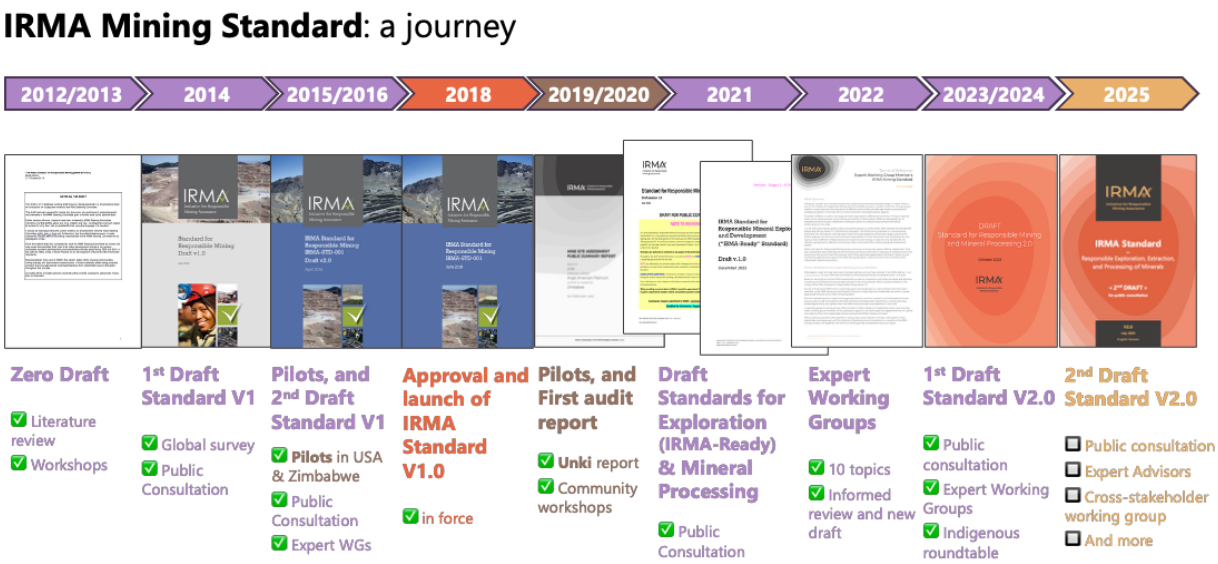
This document provides only one chapter excerpt from the IRMA Standard v2.0 DRAFT 2.

The full version contains 27 Chapters, click here to view it.

Objectives of this 2nd public consultation

Following the release of a 1st DRAFT of the IRMA Standard V2.0 in October 2023 for a 90-day public consultation, the IRMA Secretariat received more than 2,500 points of comments from 82 organizations, then organized additional engagement with stakeholders and Indigenous rights-holders, and solicited complementary guidance from multiple topic-specific Expert Working Groups.

We anticipated release of this 2nd DRAFT for a second round of public consultation as early as Q3 2024, then subsequently announced that more time was needed to support engagement of diverse stakeholders; the revised release date was July 2025. We provided more detailed explanation for the extended process here and here.



The release of this 2nd DRAFT marks a significant milestone on the road to the revision of the IRMA Standard: this public consultation will be the last of this revision cycle on V2.0.

Informed by the outcomes of this public consultation, along with guidance from Expert Advisors and IRMA Working Groups (see more below), and additional engagement with Indigenous rights-holders and stakeholders as requested, the IRMA Secretariat will prepare a final version. This final version will be discussed by the IRMA Board and refined to reach consensus for adoption by all six governing houses of IRMA: Affected Communities including Indigenous Rightsholders; Environmental and Social NGOs; Organized Labor; Finance and Investment Professionals; Mining Companies; Purchasers of Mined Materials.

In IRMA's strategic decision-making, Board members work to achieve consensus. IRMA believes a majority vote is not a model of equal governance. Instead, any motion that results in both of the two representatives from the same governing house voting "no" must go back to the full group for further discussion. In other words, a proposed course of action cannot proceed if both representatives from one of our six governing houses are opposed. Board members will keep talking until a resolution that works for all groups is found. It is a model that has worked for IRMA for nearly two decades and is fundamental to IRMA's credibility, accountability and service to all six houses of governance.

What is IRMA seeking guidance on?

Comments, feedback, and suggestions are welcome on any aspect of this 2nd DRAFT version (including intent and text of the requirements, endnotes, annexes, format and structure, design, readability, etc.).

IRMA is particularly interested in hearing the views of rights-holders and stakeholders on **the provisions in the Standard that are substantially new compared to the IRMA Standard for Responsible Mining V1.0.** These provisions (requirements or at a sub-requirement level) are highlighted in yellow throughout this Draft, to ensure they are easily identifiable.

We ask readers to assist us in weighing these potential new provisions, and also hold awareness that, prior to adoption of the final version, many of these will be consolidated and reduced in overall number.

Although these new requirements have each been drafted in response to lessons learned, the current state of best practices, emerging expectations, and/or in response to requests and suggestions made during the previous public consultation, collectively they represent substantive increased expectations for both implementing entities and audit firms. The IRMA Board of Directors seeks to ensure that the IRMA Standard, while recognized the world's most rigorous and comprehensive mining standard, continue to welcome and support uptake of newcomer companies engaging from the mineral supply chain around the world.

Thus, in this consultation, we seek guidance from all on **the new provisions that seem most urgent** to be integrated in the final version of the Standard V2.0, so that the revised Standard's expectations are paced at a realistic level to support engagement of mineral operations of a range of sizes, materials and global contexts.

It is important to note that all new requirements and sub-requirements, including those not retained in the final V2.0, will serve as the basis for the ongoing review process once the V2.0 is approved and released by our Board, and will provide fodder for future revisions, when it is decided that a V2.1 or V3.0 is needed.

Chapter 4.5
Air Quality and Dust Management

SECOND DRAFT (JULY 2025): SUMMARY OF CHANGES

- Added "Dust Management" to the title, to reflect its scope.
- Removed mentions of beneficiation as this is now considered part of mineral processing.
- Added references to endnotes to support air quality monitoring.
- Clarified expectations around dust management and monitoring.
- Moved two requirements under Air Quality Management to Continuous Improvement (which is a new section). The requirements relate to corrective measures and evaluating the effectiveness of mitigation measures.
- Fixed the confusing mistake between limit values for air emission versus ambient air quality. The Standard requires to demonstrate compliance for ambient air, not air emissions. We are not aware of applicable limit values for emissions at the source, e.g. exhaust, stack or chimney outlet, in the mining sector to draw upon, largely because this is too context-specific.
- The European Parliament has now adopted a revised law that will substantially lower ambient air quality limits by 2030. The former Table 4.3 (now Annex 4.5-A) is modified to include limits and permitted exceedances/year for EU values required to be met by 2030. Annex 4.5-B (WHO's AQG limits) is included for comparison. Most of WHO's AQGs are lower (more stringent) than those in Annex 4.5-A. However, WHO doesn't have air quality limits for the metals in Annex 4.5-A, so for consistency, EU's limit values and allowable exceedances are recommended to be used.
- Created a Table for IRMA Dust Deposition Criteria (Annex 4.5-C), based on the reference used in the 2018 IRMA Standard V1.0, complemented with additional, more recent, sources from various countries.

RESPONSE TO CONSULTATION QUESTIONS OUTLINED IN FIRST DRAFT

Question #	Question	Feedback and Decision
4.3-01 (4.3.1)	**Question**: Do you agree with the two requirements proposed below? Would you add any potential sources or categories of contaminants of potential concern? 4.3.1.1. The ENTITY identifies all potential sources of air emissions (including fugitive emissions) from the project/operation and associated facilities, including, as relevant:… 4.3.1.2. For each air emission source, the ENTITY identifies the contaminants of potential concern (COPCs), including…	**Feedback:** (4): 1 mining: Yes, remove ozone and add HAPS. 1 purchaser: add CO_2. 1 consultant: add leaching and tailings facilities. 1 mining: agrees with both. **Proposed decision**: Based on input from stakeholders, we propose to retain the proposed 4.3.1.1. and 4.3.1.2 (now 4.5.1.1.a and b). In the list of COPCs in 4.5.1.1.b we will retain ozone because smelting, certain processing operations, and fuel combustion can generate ozone emissions. The HAPS list would add 188 pollutants, most of which are not relevant for mining and mineral processing operations, so they are not included. Mercury will be added to Table 4.3 (Now Annex 4.5-A). We will not add CO_2 e (carbon dioxide equivalent) as it does not have numeric limits in the standards or guidelines that we have found. We will add mine haul roads and service and access roads to guidance as examples of Roads in 4.5.1.1.a.
4.3-02 (4.3.6.1)	**Question**: We are proposing that all entities measure their air quality emissions against the standards in Table 4.3, so that there is comparability between sites, but then offer a menu of how they might mitigate any exceedances of the air quality limits. The options align with the options that were proposed in the 2018 Mining Standard. Do you agree with this approach? NOTE THAT 4.3.6.1 REFERS TO AMBIENT AIR QUALITY MEASUREMENTS, NOT AIR QUALITY EMISSIONS. See disclaimer opposite.	**Disclaimer:** The wording in this consultation question is in error – it refers to emissions generated by the site, but the criteria in Table 4.3 (now Annex 4.5-A) are for ambient air quality monitoring. This was unfortunately a mistake in the IRMA 2018 Standard too, as expectations were confusing and contradictory between direct emissions and ambient air. ***Feedback**: 5 responses received (3 mining, 1 finance, 1 consultant). Four agree, while 1 disagrees – arguing that this approach is too cumbersome and would require modeling. The same respondent suggests to use EPA's National Ambient Air Quality Standards (NAAQS) as the requirement instead of the EU standards in Annex 4.5-A.* **Note**: The pollutants listed in Table 4.3 (now Annex 4.5-A) that are not in EPA's NAAQS list are benzene, As, Cd, Ni, and PAHs. Note that all but benzene are target values, not limit values. EU guidance says that "For a target value, the obligation is to take all necessary measures that do not entail disproportionate costs to ensure that it is attained, and so it is less strict than a limit value." Also, Pb seems to be the only parameter that is measured "in the immediate vicinity of specific, notified industrial sources." (see https://environment.ec.europa.eu/topics/air/air-quality/eu-air-quality-standards_en). However, for the updated EU limits (to be met by 2030), all are for ambient air quality monitoring. We are not aware of applicable limit values for emissions at the source, e.g. exhaust, stack or chimney outlet, in the

		mining sector to draw upon, largely because this is too context-specific. **Proposed decision:** The monitoring and compliance sections of the chapter (4.5.4 and 4.5.7, respectively) have been refocused on ambient air quality, and therefore the alternative risk-bases approach to address air emissions (at the sources) has been removed. Continue to align IRMA air quality criteria with EU standards (see Annex 4.5-A), with addition of mercury.
4.3-03 (4.3.7.1)	**Question**: In addition to disclosure requirements, some IRMA chapters require annual reporting to stakeholders on the ENTITY's management of the issues. In some cases, the reporting is to stakeholders generally (e.g., reporting on human rights due diligence), and in other cases, it involves more active discussion with relevant stakeholders, which tend to be the affected communities, on the issues (e.g., annual discussions on water management). Should IRMA require that entities report to stakeholders, or that they meet with and discuss air quality issues with affected communities? Or should IRMA not require this (and assume that if it is an important issue to stakeholders, that they will request such meetings with the ENTITY)?	**Responses** (7): Four say it should not be a requirement (3 mining + 1 finance), and three say it should (1 mining + 1 purchaser + 1 consultant). 1 finance and 1 mining had identical responses – could report air quality data annually if also holding annual discussion on other environmental topics but should not be mandatory. 1 mining suggests air emissions data could be reported annually but not ambient air quality data. 1 purchaser + 1 consultant say should be required if air quality impact is significant according to risk assessment. **Proposed decision**: If ambient air quality monitoring data exceed the IRMA Air Quality Criteria provided in Annex 4.5-A as a result of the project, or a dust deposition from project activities exceeds the value provided in Annex 4.5-C, the ENTITY is required to meet with the affected communities annually. This requirement is now 4.5.9.1.

BACKGROUND

Mine and mineral processing sites can release significant quantities of air contaminants such as gases, fumes, vapors, and dust. By volume, the great majority of air contaminants from mine sites is in the form of particulate matter, such as dust from blasting, conveyors, and ore crushing. Mineral processing facilities, which often use high temperature processes, may also generate large volumes of gaseous emissions, including fine particulates that can carry metals and metalloids. Particulate matter and other emissions such as organic pollutants and sulfur can adversely affect human health and the environment.

Mines and processing sites may emit contaminants from diffuse sources, such as fugitive dust emitted by blasting or truck traffic, or wind-blown dust from exposed surfaces such as roads, pits, and waste piles, and the dried surfaces of tailings impoundments. Some releases can be controlled with reasonably inexpensive measures. However, a mine's typically large geographic footprint makes control especially important and sometimes difficult. The most common method of dust control is spraying water - such as by truck on roads and near blasting activities. Chemical additives, such as magnesium chloride, may be added to increase the effectiveness and durability of dust suppression on mine roads.

Mineral processing, smelting and refining operations can produce more localized air emissions from include units that involve pyrometallurgical, hydrometallurgical and electrometallurgical processes. The range of contaminants contained in off-gases and other process emissions depend on the commodity being processed, impurities present in the feed, and mineral processing method employed. Off-gases and other emissions may be generated in an enclosed environment (where capture for subsequent treatment is less challenging) or in an open environment (where capture may be difficult or incomplete). The control mechanisms for process emissions are often expensive and technically complex. The common methods for controlling these emissions include technologies such as acid plants (specifically for the capture of sulfur dioxide), bag houses, electrostatic precipitators, and wet and dry scrubbers.

KEY REFERENCES

This chapter strongly builds on, or aligns with, the following international or multilateral frameworks, conventions, and guidance:

- Convention on Persistent Organic Pollutants (Stockholm Convention), 2001

OBJECTIVES/INTENT OF THIS CHAPTER

To protect human health and the environment from airborne contaminants and dust.

SCOPE OF APPLICATION

This chapter is applicable to all exploration, mining and mineral processing projects and operations. For each requirement, the following colors are displayed in the margin to indicate the phases for which it is required:

E1	Exploration – Stage 1
E2	Exploration – Stage 2
E3	Exploration – Stage 3
D	Project Development and Permitting
M	Operating Mine
P	Operating Mineral Processor

CRITICAL REQUIREMENTS IN THIS CHAPTER

Throughout the Standard, critical requirements are identified using a red frame.
There is one (1) **critical requirement** in this Chapter.

OPTIONAL IRMA+ REQUIREMENTS IN THIS CHAPTER

Throughout the Standard, optional IRMA+ requirements are identified using a dotted blue frame. There is no (0) optional IRMA+ requirement in this Chapter.

In this second draft, IRMA introduces a new category of requirements: IRMA+. These requirements are aspirational and forward-looking. They reflect emerging expectations and recommendations from stakeholders, but currently go above and beyond existing and established best practice. IRMA+ requirements are entirely optional, and they will not affect the scores and achievement levels obtained by the entities choosing to be assessed against them.

IRMA Requirements

4.5.1 Characterization and Scoping

E3 D M P

4.5.1.1 A characterization process (or equivalent) is undertaken and documented by competent professionals to characterize sources of air emissions from the site and its associated facilities, and associated Contaminants of Potential Concern (COPCs) as follows:

a. The process identifies and describes all potential sources of air emissions (including fugitive emissions) from the site and associated facilities, including, as relevant[1]: 1) Mining, ore handling and transportation, grinding, crushing; 2) Mineral processing, including thermal treatments and electrolytic processes; 3) Mobile equipment; 4) Stationary equipment; 5) Power plants, and, if relevant, fuel handling and transportation[2]; 6) Water treatment plants; 7) Waste handling, treatment, and disposal[3]; and 8) Roads;

b. It identifies and describes the COPCs, including, as relevant[4]: 1) Particulate matter (PM_{10}, $PM_{2.5}$); 2) Sulfur dioxide[5]; 3) Nitrogen oxides (NO and NO_2); 4) Carbon monoxide; 5) Ozone; 6) Polycyclic Aromatic Hydrocarbons (PAH); 7) Volatile organic compounds (including benzene); 8) Acids; 9) Persistent organic pollutants;[6] 10) Metals and metalloids[7]; and 11) Radionuclides[8]; and

c. It uses credible methodologies, and the methodologies are documented.

E3 D M P

4.5.1.2 A scoping process (or equivalent) is undertaken and documented by competent professionals, in collaboration with affected rights-holders and stakeholders, to identify potential receptors and potential values that may be affected by air contaminants or dust from the site and its associated facilities, and to identify the sources of air emissions that are 'significant', as follows: It includes the following potential receptors and values:

a. It identifies individuals, communities, soils, water bodies, or cultural heritage sites that may be affected by emissions, deposition or dispersion of the identified COPCs;

b. It identifies potentially underserved and/or marginalized people within nearby affected communities, or individuals in nearby residences, who may be **particularly sensitive receptors** of the identified COPCs[9];

c. It identifies plants, animals, or fungi with known sensitivity to the identified COPCs;

d. It identifies receptors that may be affected by dust or odors;

e. It identifies individuals, animals, cattle, plants, crops, water bodies, and cultural heritage sites that may be affected by dust and dust deposition;

f. It identifies areas with scenic values that may be affected by haze;

g. It defines the criteria used to identify levels of significance of air emissions;

h. It estimates emissions of COPCs identified in 4.5.1.1.b from each potential emissions source identified in 4.5.1.1.a, based on proposed or actual operational characteristics, using credible methodologies; and

i. It documents the rationale for why certain facilities, activities or processes are considered to be minor or insignificant sources of emissions of air contaminants or dust.

4.5.2 Baseline/Background Data

E3 D M P **4.5.2.1** Data on baseline (or background) air quality are gathered by competent professionals, as follows:

a. Data are gathered in sufficient detail to reliably determine the sources of air contamination that are related to the site and its associated facilities, and the changes in air quality that are unrelated to the site and its associated facilities; and

b. Data include measurement of the ambient concentrations of all identified COPCs[10].

4.5.3 Risk and Impact Assessment

E3 D M P **4.5.3.1** If the scoping required in 4.5.1.2, or any other credible information[11], indicates that air emissions and/or dust deposition from the site or its associated facilities may adversely impact human health, quality of life, livelihoods, or the environment, a risk and impact assessment is carried out and documented by competent professionals, in collaboration with affected rights-holders and stakeholders, to identify and assess, for each identified risk and impact:

a. The level of risk posed to, and the magnitude of impact on, health, quality of life, and livelihoods;

b. The level of risk posed to, and the magnitude of impact on, the environment; and

c. This risk and impact assessment uses a credible methodology, and the methodology used is documented.

E3 D M P **4.5.3.2** This risk and impact assessment is informed by a modelling of the emissions, deposition, and dispersion of COPCs which:

a. Includes estimation of potential emissions on a contaminant-by-contaminant basis, and under various operational scenarios including maximum emissions during maximum production levels;

b. Includes estimation of potential emissions at potentially sensitive receptors (e.g., residences, water bodies, ecosystems) under the worst-case dispersion conditions; and

c. Is evaluated annually and updated, as necessary, through an iterative process using the results of the ambient air quality and dust monitoring program (see 4.5.4)[12].

4.5.4 Ambient Air Quality and Dust Monitoring Program

E3 D M P **4.5.4.1** Building on 4.5.3, an air quality monitoring program (or equivalent) is developed and implemented by competent professionals to monitor relevant COPCs in ambient air, and/or to monitor dust deposition[13], as follows:

a. The locations of the ambient air quality and dust monitoring stations are in sufficient number to provide reliable data on air quality/contamination, and dust deposition, across the site' area of influence and relevant transportation routes;

b. The monitoring locations[14] provide a representative sampling of air quality and dust deposition sufficient to detect air quality and dust impacts on affected receptors and values; and

c. The monitoring stations are equipped to monitor all contaminants or dust deposition levels that have a reasonable potential to adversely affect identified receptors and values, and are capable of measuring parameters at the appropriate levels described in the IRMA Air Quality Criteria Table (see Annex 4.5-A)[15]

E3 D M P **4.5.4.2** If mercury is detected in ore, concentrate, or mining facilities (including tailings, heap leaches, waste rock), as determined in 4.1.2.1 and/or 4.5.1.1, the ENTITY has a system in place to ensure that:

a. Best available techniques (BAT) and best environmental practices (BEP) are used to control fugitive gaseous and dust emissions associated with crushing, grinding, handling, and transporting of ore, concentrate and/or disposal of waste materials containing mercury, unless the ENTITY can demonstrate that fugitive emissions (gaseous and dust) from certain sources are unlikely to pose a significant risk to human health or the environment;

b. These BAT and BEP are Implemented at mineral processing or smelting facilities that use thermal processes[16], unless the ENTITY can demonstrate that air emissions (gaseous and dust) from the facility are unlikely to pose a significant risk to human health or the environment[17];

c. Mercury is included in the ambient air monitoring program;

d. Direct releases of mercury to the atmosphere from ore treatment and/or mineral processing or smelting facilities that use thermal processes[18] are monitored and documented;

e. Fugitive emissions are monitored and documented[19], or the ENTITY provides best estimates for these emissions;

f. The amount of mercury recovered or captured as by-product in mercury emission control systems is monitored and documented;

g. The concentrations of mercury in soils, water, sediment, and biota downwind of the emissions sources[20] are monitored and documented; and

h. The ENTITY collaborates with affected rights-holders and stakeholders to develop and implement a mercury monitoring plan (or equivalent) to monitor and document mercury levels in their blood, urine, and hair, and in any significant food sources that may be affected by the emissions;

4.5.5 Air Quality Management

E3 D M P

4.5.5.1 Building on 4.5.3 and 4.5.4, if significant potential or actual impacts on air quality are identified, an air quality management plan (or equivalent) is developed and documented by competent professionals as follows:

a. The plan outlines mitigation measures that strictly align with the mitigation hierarchy to first avoid and, where that is not possible, minimize adverse impacts on human health and the environment (including impacts to land, soil, water, and vegetation);

b. It identifies key air quality indicators that will best characterize the potential effects, and includes trigger levels to provide early warning of ambient air pollution[21];

c. It includes general responsive (adaptive management) measures to be taken if trigger levels or other thresholds are reached, and estimated timelines for completion of measures;

d. It assigns implementation of measures to responsible staff with adequate skills and expertise;

e. It assigns responsibility to its top management level to oversee plan implementation, monitoring, and recordkeeping[22];

f. It has an implementation schedule in place;

g. It specifies annual, or more frequent, reviews of the effectiveness of the measures implemented;

h. It maintains estimates of human resources and budget required; and

i. It includes a financing plan to ensure that funding is available for the effective implementation of the plan.

E3 D M P

4.5.5.2 The air quality management plan required in 4.5.5.1 includes the creation of an action plan (or equivalent) if exceedance of IRMA Ambient Air Quality Criteria (see 4.5.4.1) or other applicable thresholds is confirmed, as follows:

a. Determination of the areal extent of the impacts, and investigation of the cause/source of the exceedance;

b. If the cause/source is located in an airshed where baseline air quality was already degraded beyond the IRMA Ambient Air Quality Criteria (see Annex 4.5-A), determination of the extent to which emissions from site-related activities, alone, exceed the IRMA Ambient Air Quality Criteria (or not);

c. Evaluation and selection of adaptive management measures developed as per 4.5.5.1.c, and/or development of additional or different measures that are likely to correct the exceedance or minimize adverse impacts (or, where baseline air quality was already degraded, to make incremental improvements to the air quality in the airshed that are at least equivalent to the site's own emissions), and documentation in a corrective action plan[23];

d. Development of estimated timeline and budget needed to implement these corrective measures, and a financing plan to ensure that funding is available for effective implementation of the corrective measures; and

e. Implementation of those corrective measures.

E3 D M P

4.5.5.3 The ENTITY has a system in place to ensure that air pollution control equipment is inspected and calibrated on a regular basis, by competent professionals:

a. To verify that the equipment was installed and is being maintained in accordance with vendor instructions;

b. To verify that the equipment is operating as expected; and

c. Inspection dates and observations are documented and recorded by the ENTITY.

E3 D M P

4.5.5.4 The ENTITY has a system in place for unwanted events related to air quality[24] that is carried out by competent professional, as follows:

a. Taking and documenting corrective measures to minimize air emissions from unwanted events, and additional ambient air quality and dust sampling and analyses to determine potential exceedance of ambient air quality and dust levels as per Annex 4.3-A and 4.3-C respectively;

b. For high-potential incidents (HPI) or incidents that exceed the air quality levels (as determined in a.), carrying out and documenting a root cause-analysis to determine the cause[25] of the unwanted event; and

c. Closing out actions from the root cause analysis, and updating the air quality management plan (or equivalent) to prevent similar occurrence of high-potential incidents or incidents that exceed the air quality levels.

4.5.6 Dust Management

E3 D M P

4.5.6.1 Building on 4.5.4, if significant potential or actual impacts related to dust emission or deposition are identified, or monitoring in 4.5.4.1 confirms an exceedance of the IRMA Dust Deposition Criteria in Annex 4.5-C, a dust management plan (or equivalent) is developed and documented by competent professionals, as follows:

a. It outlines mitigation measures that strictly align with the mitigation hierarchy to first avoid and, where that is not possible, minimize adverse impacts on individuals, animals, cattle, plants, crops, water bodies, or cultural heritage sites,;

b. It identifies key dust indicators that will best characterize the potential effects;

c. It assigns implementation of measures to responsible staff with adequate skills and expertise;

d. It assigns responsibility to its top management level to oversee plan implementation, monitoring, and recordkeeping[26];

e. It has an implementation schedule in place;

f. It specifies annual, or more frequent, reviews of the effectiveness of the measures implemented;

g. It maintains estimates of human resources and budget required; and

h. It includes a financing plan to ensure that funding is available for the effective implementation of the plan.

4.5.7 Monitoring and Evaluation

E3 D M P

4.5.7.1 To monitor and evaluate the effectiveness and appropriateness of its measures to prevent, mitigate, and remediate all risks and impacts to air quality and related to dust, at least annually, and building on the ambient air and dust monitoring program required in Section 4.5.4, the ENTITY:

a. Tracks and documents its performance on air quality and dust management, over successive time periods, against the key indicators and trigger levels defined in 4.5.5.1 and 4.5.6.1;

b. If applicable, tracks and documents the effectiveness of the measures implemented to correct all exceedance of any IRMA Ambient Air Quality Criteria or other applicable thresholds, as per 4.5.6.3 and

c. Encourages and facilitates joint monitoring and joint tracking with affected communities, in a manner that is inclusive of different genders, ages, ethnicities, and any potentially underserved and/or marginalized people, as per Chapter 1.2[27].

4.5.8 Continuous Improvement

E3 D M P

4.5.8.1 At least annually, but without undue delay after a significant change, the ENTITY collaborates with affected rights-holders and stakeholders to:

a. Review the ENTITY's ability to demonstrate that air quality parameters/contaminants measured at points of compliance are in compliance with relevant regulatory and permit requirements in the jurisdiction;

b. Review the ENTITY's ability to demonstrate that air quality parameters/contaminants measured at points of compliance are: 1) Being maintained at baseline or background levels for relevant parameters, which in some cases could exceed IRMA Ambient Air Quality Criteria (see Annex 4.5-A); or 2) Being maintained at levels that are protective of the identified receptors and values, as per the IRMA Ambient Air Quality (see Annex 4.5-A); or 3) Being maintained at levels or conditions compliant to country of operation's regulatory requirements that are more protective than IRMA Ambient Air Quality Criteria, or that fill gaps where no IRMA Ambient Air Quality Criteria exist;

c. Review the ENTITY's ability to demonstrate that dust deposition from project-related activities measured at points of compliance[28] does not exceed the IRMA Dust Deposition Criteria (See Annex 4.5-C);

d. Review the results of the monitoring and evaluation required in 4.5.7, and the effectiveness of the mitigation measures and management measures it implements;

e. Develop and implement time-bound corrective measures to update, if necessary[29], the risk and impact assessment, including the conception of numerical models, in accordance with Section 4.5.3;

f. Develop and implement time-bound corrective measures to update, if necessary[30], its ambient air and dust monitoring program, in accordance with Section 4.5.4; and

g. Develop and implement time-bound corrective measures to update, if necessary[31], its management plans to improve air quality and dust management outcomes, in accordance with Sections 4.5.5 and 4.5.6

4.5.9 Information-Sharing and Public Reporting

E3 D M P

4.5.9.1 **Critical Requirement**

The ENTITY:

a. Demonstrates publicly that it was able to maintain, for at least the last twelve months, all air quality and dust deposition parameters/contaminants measured at points of compliance: 1) in compliance with relevant regulatory and permit requirements in the jurisdiction; and 2) within one of the scenarios listed in 4.5.8.1.b for air quality, and listed in 4.5.8.1.c for dust deposition;

b. If, and whenever, exceedance of IRMA Ambient Air Quality Criteria or IRMA Dust Deposition Criteria, or another threshold is confirmed, it creates a report summarizing the corrective measures required in 4.5.5.3, their outcome, and needed changes to improve the effectiveness of implemented mitigation measures identified in Section 4.3.6; and

c. Makes and maintains publicly accessible this report, and proactively shares it with affected rights-holders and stakeholders in a timely, meaningful, accessible, and culturally appropriate way, in accordance with Section 1.2.3.

CROSS REFERENCES TO OTHER CHAPTERS

This table will be added when the new content for all chapters is finalized and approved.

CHAPTER ENDNOTES

Air quality standards and requirements were reviewed for various countries, focusing on the most expansive, standards (those of the European Union, Canada, Australia, and United States). With the goal in mind of adopting a standard that would evolve over time the decision was made to adopt the European Union's (EU) numeric air quality standards. The EU's stands out for its breadth of contaminants including some known to be released during mining and mineral processing (in particular, metal and metalloid contaminants such as nickel, lead, cadmium, arsenic).[32] Further, like many developed national standards, EU's air quality standards were developed to be comprehensive, transparent, and enduring. Finally, the EU's air quality standards are evolving and therefore predicating IRMA's air quality standard on them will ensure that IRMA's air quality standards also evolve.

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[1] This should have been done during ESIA for proposed projects. If not, then it needs to be done for operations. As per the rest of the Standard, the ENTITY must provide supporting evidence that demonstrates that a potential item is not relevant.

[2] E.g., coal, diesel, etc.

[3] This in mine wastes (e.g., tailings, waste rock), as well as non-hazardous and hazardous wastes produced by the project/operation.

[4] This should have been done during ESIA for proposed projects. If not, then it needs to be done for operations. As per the rest of the Standard, the ENTITY must provide supporting evidence that demonstrates that a potential item is not relevant.

[5] E.g., from sulfur in fuels and feed materials or from thermal treatment of sulfide ores.

[6] Persistent organic pollutants include, for example, polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxin, and dibenzofuran (PCDD/F), polychlorinated naphthalenes, and others. These may be by-products from industrial processes or combustion, including smelting (e.g., see: Yang et al. 2020. Concentrations and profiles of persistent organic pollutants unintentionally produced by secondary nonferrous metal smelters, Chemosphere. 255:126958. https://www.sciencedirect.com/science/article/abs/pii/S0045653520311516)

[7] Mining operations are notable with respect to the quantity of particulates generated, the global extent of the area impacted, and the toxicity of contaminants associated with metal and metalloid emissions. See, e.g., the following study (with case studies that focus on smelters and emissions of Lead Pb, Zinc Zn, Arsenic As, Mercury Hg, Copper Cu, Cadmium Cd, Selenium Se, and other metals and metalloids and their health and environmental impacts): Csavina et al., 2012. A review on the importance of metals and metalloids in atmospheric dust and aerosol from mining operations. Science of the Total Environment 433, 58-73. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3418464/

[8] Radionuclides may be present in ores, most notably those mined for uranium, but also may be present in polymetallic, gold, and copper ores, monazite sand (from which thorium, rare earth elements (REEs), and uranium can be recovered), and phosphate rock.

[9] What may constitute 'underserved and/or marginalized people' requiring additional focus depends on the context and the matter at hand. Entities should draw on stakeholder mapping, stakeholder interviews, project documentation, as well as site observations to determine whether all relevant stakeholders have been identified and included. For this requirement, those who may be vulnerable to air pollution include children, elderly, people with respiratory conditions like asthma, and others who may be a heightened risk due to exposure to air pollution.

[10] This is to establish the pre-project air quality conditions, and/or any existing air contaminants that are unrelated to the project/operation.

[11] E.g., independently and rigorously conducted scientific/technical studies that suggest that mining activities may adversely affect human health.

[12] This process includes comparing the predicted model results with actual monitoring data and set parameters for what constitutes acceptable versus unacceptable deviations between modeled and actual results. When predicted and actual results do not agree, models should be revised and predictions updated to ensure that air management practices are based on the best possible data.

[13] Relevant COPCs would be those that were identified as having a reasonable potential to adversely affect human health, quality of life, livelihoods, or the environment.

[14] Which must be situated around the site, associated facilities (if there are any emissions sources), relevant transportation routes and the surrounding environment (as per a.).

[15] For COPCs that were identified as having a reasonable potential to adversely affect human health, quality of life, livelihoods, or the environment but that are not covered in the Annex 4.5-A, the Entity must still ensure that the monitoring program can monitor their presence and measure their concentration levels.

[16] For example, an autoclave, roaster, carbon kiln, refining furnace, or other thermal processes.

[17] While many air emissions of many metals can be controlled using technologies that control emissions of particulate matter, some metals, like mercury, remain a vapor at ambient temperatures, and can pass through some control equipment. So alternative control

techniques and technologies must be used. (Source: IFC. 2007. Environmental, Health, and Safety Guidance. Base Metal Smelting and Refining. pp. 3, 4. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/605891489653831342/environmental-health-and-safety-guidelines-base-metal-smelting-and-refining)

[18] This could be carried out through continuous monitoring or measured at least annually if using sorbent trap systems, or. See, e.g., Envirotech. 2022. Mercury sorbent trap sampling for compliance in the U.S. https://www.envirotech-online.com/article/air-monitoring/6/ohio-lumex/mercury-sorbent-trap-sampling-for-compliance-in-the-us/3153

[19] To the extent technologically and economically feasible with air monitoring equipment.

[20] The ENTITY would need to sample for mercury (total and dissolved) and methyl mercury and sulfate in wetlands and water bodies located on or downwind of the mine site and carry out environmental sampling (e.g., fish tissue and sediment mercury levels) in locations that are most likely to promote mercury methylation, such as still waters, wetlands, and anaerobic sediment. This could be incorporated into the water sampling and analysis plan (see 4.3.5.2.b, and the accompanying footnote), or, along with the soils sampling, could be incorporated into a standalone mercury sampling and analysis plan.

[21] Trigger levels might include, for example, concentrations of contaminants in ambient air that are between baseline and a regulatory air quality criteria.

[22] If work is carried out by third party contractors, then there needs to be a staff employee responsible for overseeing the quality of work, timelines, etc.

[23] Once an exceedance is confirmed, there may be more or different actions needed than envisioned in the original adaptive management actions, because situations may not always unfold as expected, or more may need to be done than was originally anticipated.

The actions that can be implemented during operations would be added to the corrective action plan. The actions that can only take place after operations cease (i.e., during reclamation and closure) must be added to the reclamation and closure plan, and associated costs must be included in the calculation of financial assurance (see Chapter 2.7, requirements 2.7.1.4, 2.7.1.5 and 2.7.2.1).

[24] E.g., this could include, but is not limited to, loss of normal operation in air pollution control equipment.

[25] E.g., improperly designed equipment, lack of preventative maintenance, careless or improper operation, operator error, etc.

[26] If work is carried out by third party contractors, then there needs to be a staff employee responsible for overseeing the quality of work, timelines, etc.

[27] This is especially relevant for contexts where your business and (potentially) affected rights-holders are in dispute about a particular (potential) adverse impact, and rights-holders are unlikely to accept the business' own tracking of the effectiveness of its response to it.

[28] An exception to 4.5.8.1.c may be made for some points of compliance if demonstrating compliance is not reasonably possible through ordinary monitoring methods (e.g. an example of where exceptions might be appropriate are where roads are shared by external third parties, or operational and non-operational roads are so close to each other so as to make it impossible to distinguish their contributions). In such cases, the ENTITY must document its rationale, and is still required to implement best available/applicable practices (BAP) to minimize dust contamination, and incorporates the BAP measures into its air quality management plan.

[29] This will be informed by the monitoring and evaluation process required in the previous Section, and on the review process required in a. to d.

[30] This will be informed by the monitoring and evaluation process required in the previous Section, and on the review process required in a. to d.

[31] This will be informed by the monitoring and evaluation process required in the previous Section, and on the review process required in a. to d.

[32] The US EPA's Air Quality Standards are similar in many ways, however the EU includes contaminants not found in the US standards that may be released by mining and mining-related activities, such as arsenic, cadmium, and nickel.

CHAPTER ANNEXES

ANNEX 4.5-A: IRMA Ambient Air Quality Criteria

Pollutant	Limit concentration values[i]	Averaging period	Permitted exceedances / year
Sulphur dioxide (SO_2)	350 µg/m^3	1 hour	3
	50 µg/m^3	24 hours	18
	20 µg/m^3	1 year	not applicable
Nitrogen dioxide (NO_2)	200 µg/m^3	1 hour	3
	50 µg/m^3	24 hours	18
	20 µg/m^3	1 year	not applicable
Fine particles (PM-2.5)	10 µg/m^3	1 year	not applicable
	25 µg/m^3	24 hours	18
PM-10	45 µg/m^3	24 hours	18
	20 µg/m^3	1 year	not applicable
Lead (Pb)	0.5 µg/m^3	1 year	not applicable
Carbon monoxide (CO)	10 mg/m^3 [ii]	Maximum daily 8-hour mean	not applicable
	4 mg/m^3	24 hours	18
Benzene	3.4 µg/m^3	1 year	not applicable
Ozone	120 µg/m^3	Maximum daily 8-hour mean	25 days averaged over 3 years
Arsenic (As)	6.0 ng/m^3	1 year	not applicable
Cadmium (Cd)	5.0 ng/m^3	1 year	not applicable
Nickel (Ni)	20 ng/m^3	1 year	not applicable
Polycyclic Aromatic Hydrocarbons	1.0 ng/m^3 (as concentration of Benzo(a)pyrene)	1 year	not applicable
Mercury (Hg) from production and processing of Zn, Ni, Cd	New sources: 0.2 mg/m3 Existing sources: 1.0 mg/m3	not applicable	not applicable
Mercury (Hg) from the recovery of metal from any form of scrap material by the application of heat	New sources: 0.05 mg/m3 Existing sources: 0.05 mg/m3	not applicable	not applicable

Sources: EU. Air Quality Standards (as of July 3, 2013). https://environment.ec.europa.eu/topics/air/air-quality/eu-air-quality-standards_en; and EU Air Quality Standards Table 1 – Limit values for the protection of human health to be attained by 1 January 2030. https://www.europarl.europa.eu/doceo/document/TA-9-2024-0319_EN.html; except for Mercury: South Africa, 2004 THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT (ACT NO. 39 OF 2004), STANDARDS AND REGULATIONS https://saaqis.environment.gov.za/Pagesfiles/NEM-AQA%20Booklet_10-09-2015.pdf

[i] Arsenic, cadmium, lead, nickel, and benzo(a)pyrene mean the total content of these elements and compounds in the PM10 fraction; sampling points measuring arsenic, cadmium, lead, mercury, nickel and polycyclic aromatic hydrocarbons shall, where possible, be co-located with sampling points for PM10

[ii] The maximum daily 8-hour mean concentration shall be selected by examining 8-hour running averages, calculated from hourly data and updated each hour. Each 8-hour average so calculated shall be assigned to the day on which it ends, i.e. the first calculation period for any 1 day shall be the period from 17.00 on the previous day to 1.00 on that day; the last calculation period for any 1 day shall be the period from 16.00 to 24.00 on that day.

ANNEX 4.5-B: Recommended Air Quality Guidelines (AQG), World Health Organization (for information only)

Pollutant	Averaging time	Interim target 1	Interim target 2	Interim target 4	Interim target 4	AQG level
PM2.5 (µg/m^3)	Annual	35	25	15	10	5
	24-hour	75	50	37.5	25	15
PM10 (µg/m^3)	Annual	70	50	30	20	15
	24-hour	150	100	75	50	45
O_3 (µg/m^3)	Peak season	100	70	--	--	60
	8-hour	160	120	--	--	100
NO_2 (µg/m^3)	Annual	40	30	20	--	10
	24-hour	120	50	--	--	25
SO_2 (µg/m^3)	24-hour	125	50	--	--	40
CO (mg/m^3)	24-hour	7	--	--	--	4

Source: World Health Organization. 2021. WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Table 0.1. https://apps.who.int/iris/handle/10665/345329.

ANNEX 4.5-C: IRMA Dust Deposition Criteria

Measurement Method	Limit value
According to TA Luft Standard, which includes both soluble and insoluble matter[iii]	10mg/m^2/hour 350 mg/m^2/day 30g/m^2/thirty-days
According to WA 2021 Guideline, which only includes insoluble matter[iv]	4 g/m^2/thirty-days (maximum) 2 g/m^2/thirty-days (above baseline/background)

Sources: US EPA guidance; TA Luft Standard; AFNOR NF X43-007; Government of Western Australia; NSW EPA 2016; and NZ MfE 2016.

[iii] IRMA has added a dust deposition limit because dust is not listed on EU list of contaminants as it is not strictly harmful to health rather it is a "nuisance" and can be problematic for communities, livelihoods, values, and ecosystems located near project sites. IRMA is not aware of any legal criteria in place in a mining country. However, US EPA guidance suggests, "a soiling of 10mg/m2/hour is generally considered to pose a soiling nuisance". This equates to 240mg/m2/day of Total Depositional Dust. The EPA recommends a maximum level of 350mg/m2 day of dust deposition when measured according to TA Luft standard, which includes both soluble and insoluble matter (i.e. EPA compliance monitoring is based on the TA Luft Method). This requirement is based on the German Technical Instructions on Air Quality Control (TA Luft) Regulation, 2022, which is the reference IRMA has used already in the 2018 IRMA Standard V1.0. (TA Luft Regulation available at : https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Luft/taluft_engl.pdf).

The monthly limit value comes from the French national standardization body (AFNOR) that has defined 3 categories of dust pollution based on monthly deposition values: 1) Lightly polluted area: Dust < 10 g/m^2/month; 2) Moderately polluted area: 10 g/m^2/month < Dust < 30 g/m^2/month; AND 3) Heavily polluted area: Dust > 30 g/m^2/month (Norm AFNOR NF X43-007).

[iv] In its updated 2021 Guideline for Dust emissions, the Department of Water and Environmental Regulation of the Government of Western Australia provides these alternatives limit values. These are based on existing recommendations from NSW EPA (Australia) and NZ MfE (New Zealand) (source: https://www.wa.gov.au/system/files/2022-03/Draft%20Guideline%20-%20Dust%20emissions.pdf)

In its 2012 Ambient Air Quality Criteria (AAQCs), the Ontario Ministry of the Environment (MOE) also includes a limit value for 'dustfall', set at 7g/m^2/thirdy-days, which seems to include only insoluble matter. IRMA has kept the more protective (and more recent) value used by the Government of Western Australia (Source: https://www.airqualityontario.com/downloads/AmbientAirQualityCriteria.pdf)

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