

Proposed Method to Assign Respirators to Workers
Exposed to Airborne Biological Contaminants at
Human, Animal and Plant Waste Operations

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Inhaled Particles XII

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What are airborne biological contaminants?

Primary sources of information:

American Conference of Governmental Industrial Hygienists

Threshold Limit Value Guide 2016

Bioaerosols Committee

Biologically derived airborne contaminants

Biological agent is a substance of biological origin capable of producing an adverse effect e.g.

Infection

Hypersensitivity

Irritation

Inflammation or other response in a worker

ACGIH

Airborne biological contaminants are called biological aerosols or bioaerosols

Bioaerosols include microorganisms, toxins and particulate waste products from all varieties of living things.

There are no TLVS or threshold limit values against which to compare environmental air concentrations of most materials of biological origin.

Methods for Selecting Respiratory Protection Devices

National Institute for Occupational Safety and Health (NIOSH)

NIOSH Respirator Decision Logic 2004

It (RDL) is not intended to be used for selection of respirators for protection against infectious agents

American National Standards Institute (ANSI) Z88.2 2015

Definition

Bioaerosol is a liquid droplet or solid particle suspended in the air that is living or originates from living organisms

Bioaerosols include living or dead microorganisms, fragments, toxins and particulate waste products from all varieties of living things.

ANSI Z88.2-2015

They (bioaerosols) are capable of causing infections, adverse or allergic responses potentially leading to disease.

NOTE: Individual bioaerosols most often range in diameter from 0.01 microns(μ) to 100 μ .

7.2.3 For respirator selection for bioaerosols refer to CSA Z94-2010.

ANSI guidance on bioaerosols?

Z88.12 Respirator Selection for Infectious Agents

Final draft issued by Committee 2011

Canadian Standards Association (CSA) Z94.4-11-2011 Selection of Respirators

The definition of bioaerosol is the same as in Z88.2-2015 except

Size range: < 0.01 μ

Additional definitions related to bioaerosols:

Particulate: any liquid or solid airborne contaminant other than gas or vapor including dusts, mists, spores and bioaerosols

Pathogen: a living organism such as bacteria, viruses, fungi, mould that causes (human) disease.

Respirator Selection for protection against bioaerosols

Clause 7.3.2 addresses selection of respirators for BA that are capable of causing infection or adverse or allergic response but for which no Occupational Exposure Limit (OEL) has been established.

Basis for the CSA approach

Nicole McCullough and Lisa Brosseau

Selecting Respirators for Control of Worker
Exposure to Infectious Aerosols

Infection Control and Hospital Epidemiology

February 1999

IRSST (CA) Guide on Respiratory Protection Against Bioaerosols: Recommendations on Selection and Use

In July 2007, the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST) published the Guide.

IRSST Development of a Control Banding Method for Selecting Respiratory Protection Against Bioaerosols

In 2013, the IRSST published this Guide stating

The present approach has been based on control banding models applied to chemical substances, nanoparticles, the work of McCullough and Brosseau, the new CSA Standard Z94.4-11 as well as the classification of microorganisms according to pathogenic character.

Summary statement

In 2017, the primary reference document for assigning the correct respirator to workers is the IRSST Report R-804 2013.

In 2017, the OH has 3 methods to select one of 8 types of air purifying respirators to protect workers from the adverse effects of bioaerosols.

Qualitative: expert opinion

Semi-quantitative:

Quantitative:

Protection factors and respiratory protective devices (RPD)

Protection factor is the ratio of the concentration outside the respirator to the concentration inside the respirator.

Assigned protection factors vary from 5 to 10,000.

If the concentration of the contaminant is 10 000 units outside then to reduce to 1 inside the OH will select an APF of 10 000.

Assigned Protection Factors for Respiratory Protective Devices

Air purifying respirators

Single use DFFR 10

Half-mask elastomeric 10

Full-facepiece 100

PAPR loose fitting 25

PAPR half mask 50

PAPR hood helmet 1000

PAPR full facepiece tight 1000

Level of respiratory protection

CSA 7.3.2.3.8

Step 1 identify the known or suspected bioaerosol

Step 2 Confirm that a risk of transmission of disease, infection or adverse health effect is produced from inhalation.

Step 3 Select control banding wheel:HC or industry

CSA step by step method

Step 4 determine aerosol risk group

Step 5 determine the generation rate

Step 6 determine the control level

Step 7 select respirator based on chart
intergating R G and C fators

Are sewer workers at risk of disease from bioaerosols?

Are bioaerosols present?

1970 Science

Adams and Spendlove

An investigation of aerosols emitted by trickling filter STP revealed that coliforms were indeed emitted and have been sampled to a distance of 0.8 km.

The variety of organisms aerosolized almost unlimited

Do sewer workers develop diseases due to biological agents?

Health Safety Executive 1996
Health risks to sewer workers

Gastroenteritis

Leptospirosis

Hepatitis

Occupational asthma

Skin or eye infections

Allergic alveolitis

Routes of exposure in STP

Contact

Ingestion

Skin and mucous membrane and

*Inhalation through nose and mouth

Selection of respirators

1994

Johnson, B.

Challenged respirators with 10^5 - 10^6 bacterial spores

PAPR	FF	1900	99.95 % of 0.8 u b spores
HE	FF	1320	
DM	FF	4.6	
SM	FF	2.96	

PAPR positive pressure prevents leakage, exceeds inhalation rate and face shield provides eye prot

Airborne gastrointestinal agent

Recent study indicates that persons with Norovirus emit aerosols containing virus which are detectable several meters away in concentrations capable of causing disease by impaction on upper airways and swallowing the agent.

Conclusion

1. Sewer workers are exposed to bioaerosols that contain numerous agents that cause disease.
2. Respirators are not recommended for sewer workers by many agencies and associations.
3. The CSA and IRSST methods for selecting respirators use severity of disease as a factor in respirator selection. It is proposed that particle size replace RG in the assessment of whether a reduction of 10 or 1000 or 10 000 is needed to protect the worker from any adverse health effect.