



CONFINDUSTRIA CERAMICA

# Crystalline Silica and Ceramics: Safety and Management

A practical guide to definitions, materials, best practices and solutions

January 2025

## Introduction

Despite its widespread presence in nature and its relevance across numerous industrial sectors, crystalline silica can pose health and occupational safety concerns. However, the topic remains complex, and the actual risks associated with exposure must be assessed in relation to specific workplace conditions. **Crystalline silica is not inherently hazardous:** the health risk does not stem from direct contact with the material itself, but rather from the generation of dust and the prolonged inhalation of its finest fraction.

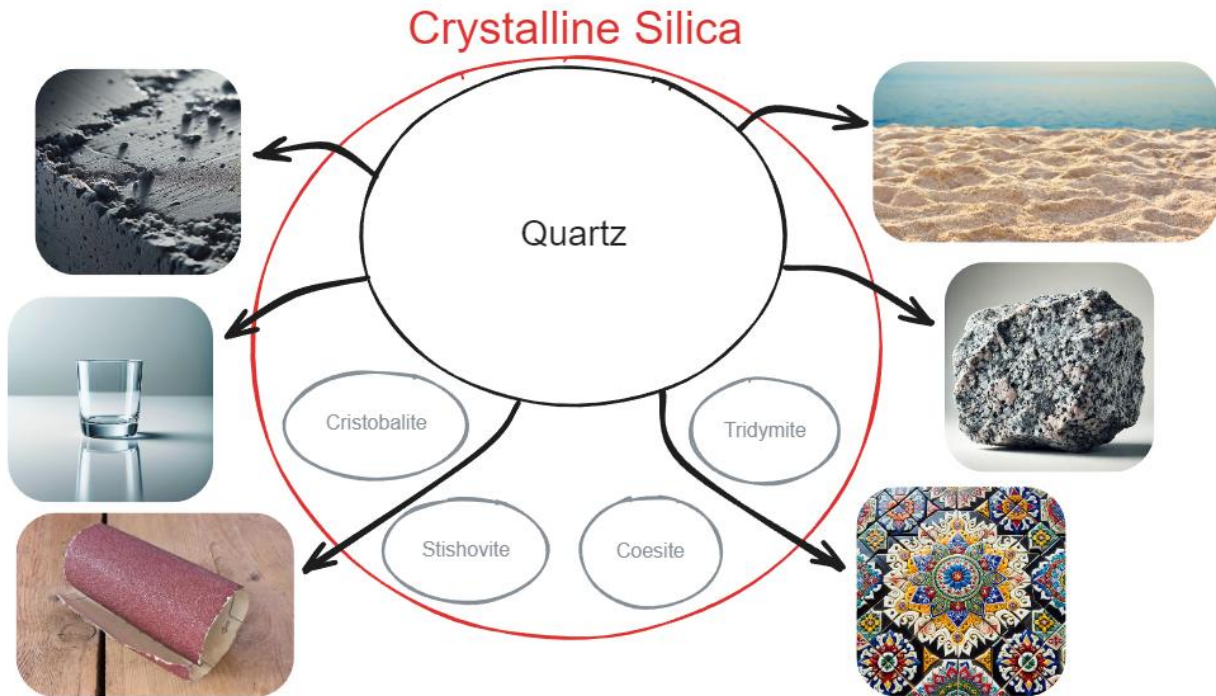
In ceramic tile manufacturing, **potential exposure typically occurs during the grinding of raw materials and cutting operations**, both in production and installation phases. However, to prevent any health-related issues, **there are simple and effective preventive and protective measures that allow workers to operate in complete safety**. These include the use of **wet cutting techniques, split cutting methods and appropriate filtering face masks**.

The aim of this paper is to provide a comprehensive overview of crystalline silica: its definition, the materials that contain it, the implications of its respirable form and the effective safety measures that help minimize exposure.

The study also explores silica-related issues in the ceramic industry, focusing on cutting techniques, highlighting the most appropriate ones and presenting the research conducted in recent years by Confindustria Ceramica on crystalline silica.

## 1. What is crystalline silica and where is it found

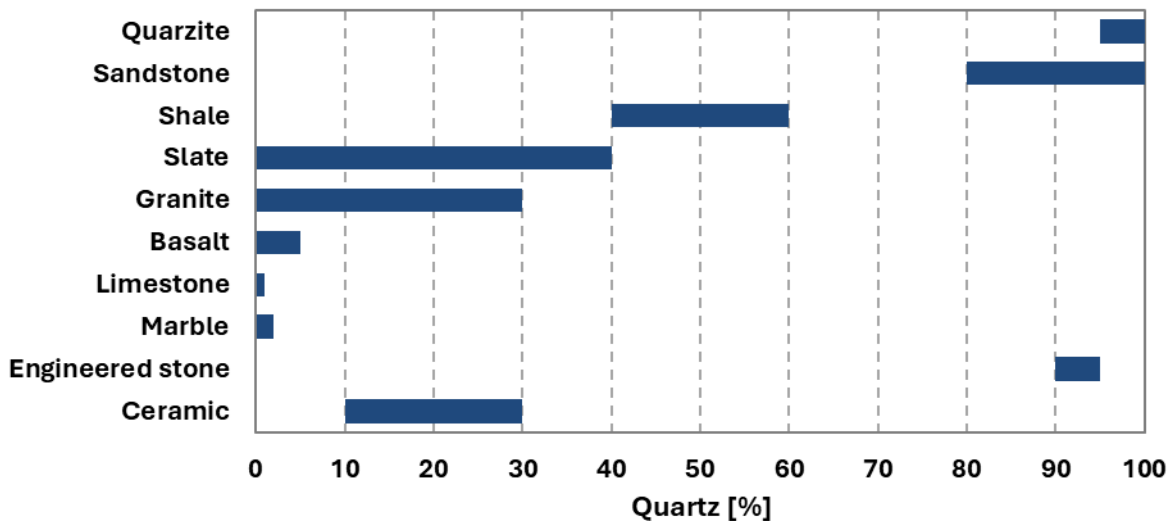
The term "crystalline silica" refers to a group of minerals, the most common of which is quartz. This mineral is **one of the most abundant in the Earth's crust** and is found in many materials, both natural and man-made. For example, beach sand is primarily composed of quartz; it is also present in granite, concrete, glass, ceramics, abrasive products and numerous other materials. Additionally, **it naturally occurs in all raw materials used in ceramic production.**



Silica is the name given to silicon dioxide ( $\text{SiO}_2$ ), which can exist in two different forms: **crystalline and amorphous**. The crystalline form has a well-ordered lattice structure, while the amorphous form lacks a precise three-dimensional structure.

**Within ceramic products, crystalline silica is a fundamental and essential component**, necessary for the formation of the skeleton and the development of dimensional stability and mechanical strength. Scientific literature indicates that ceramic products contain a stable percentage of crystalline silica, ranging from 10% to 30%. These values align with data collected by Confindustria Ceramica regarding Italian ceramic products (see paragraph 5), which also show that the **quartz content is minimally affected by the size or thickness of the ceramic product**.

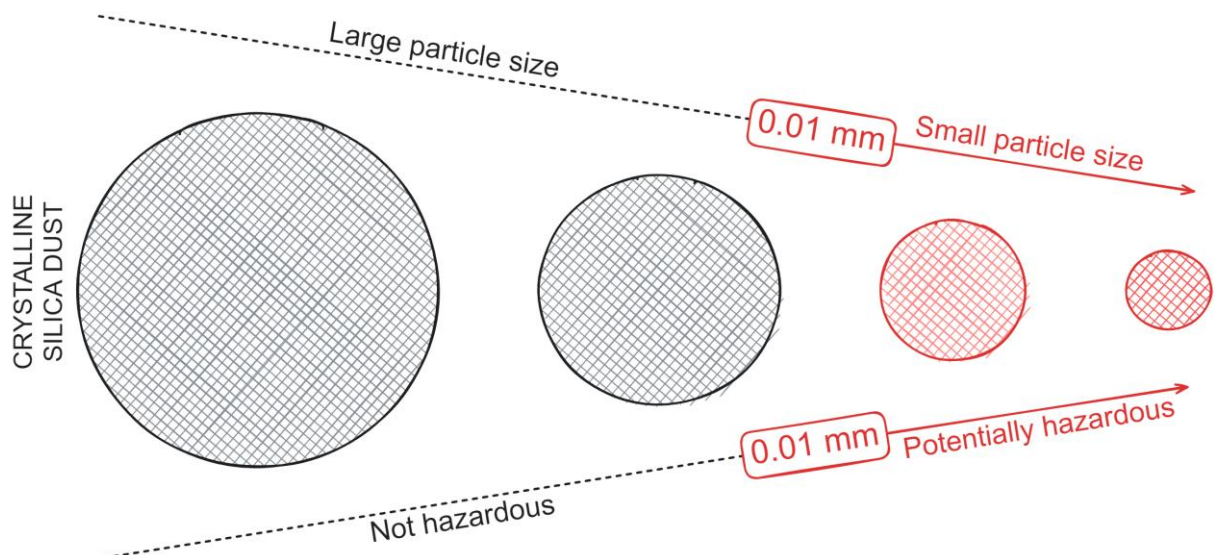
In addition to ceramics and natural stones, silica is also present in **engineered stone** (also known as artificial stone), which is primarily composed of quartz (90-95%) and an organic binder, typically a polymer resin. Due to the very high quartz content and the lack of adequate safety and protective measures taken by operators working with these materials, emergency regulations have been introduced in certain markets, such as Australia and California, to govern the sale and processing of these products.



Source: NEPSI, Good Practice Guide, (2020)

## 2. The respirable fraction of crystalline silica

Crystalline silica is not inherently hazardous; **the health risk arises only when inhaling fine dust particles (smaller than 0.01 mm)**. Furthermore, biological damage occurs exclusively if the individual is exposed **without protection in an intense and continuous manner over time** (expressed in TWA, Time Weighted Average, i.e., the average over an 8-hour workday).



Crystalline silica, **in its respirable fraction**, is classified by the IARC (International Agency for Research on Cancer) as a Group 1 carcinogen. It is important to emphasize the term "respirable fraction," which refers to the size that must be present for it to be potentially harmful. Hardwood dust is also an example of another material classified as a Group 1 carcinogen if inhaled in high

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concentrations and over an extended period. Unlike crystalline silica, **amorphous silica dust has not been classified as a carcinogenic substance.**

	Crystalline Silica	Amorphous Silica
<b>Non-respirable fraction (&gt; 0.01 mm)</b>	<b>NOT</b> hazardous	<b>NOT</b> hazardous
<b>Respirable fraction (&lt; 0.01 mm)</b>	<b>POTENTIALLY</b> hazardous	<b>NOT</b> hazardous

**Occupational exposure limits** vary by country, and in the European region, they are **typically between 0.05 and 0.15 mg/m<sup>3</sup>**. Additionally, ACGIH (American Conference of Governmental Industrial Hygienists) and OSHA (Occupational Safety and Health Administration) have established an **action level** (the exposure below which there is no health risk, even with continuous exposure), setting it at **0.025 mg/m<sup>3</sup>**.

	EU Directive 2017/2398	ACGIH	OSHA	NIOSH*	Australia	California
<b>Exposure limits [mg/m<sup>3</sup>]</b>	0.1	-	0.05	0.05	0.05	0.05
<b>Action level [mg/m<sup>3</sup>]</b>	-	0.025	0.025	-	-	0.025

\* National Institute for Occupational Safety and Health

## 3. Characteristics of crystalline silica dust that mitigate the risk

**Current regulations and defined exposure limits specifically apply to pure crystalline silica dust**, meaning particles made entirely of quartz. However, if the particle is partially constituted of other materials, the associated health risk from inhalation is necessarily reduced.

Engineered stone and ceramics represent the extremes of the composition spectrum, with engineered stone containing up to 95% quartz and ceramics containing between 10% and 30%. For example, **porcelain stoneware contains 60-70% amorphous phase, which incorporates and binds all minerals in the ceramic structure, including quartz. During mechanical processing, such as cutting, mixed particles are generated, consisting of a variety of different phases.**

Moreover, there are several **other factors that contribute to reducing the hazard of crystalline silica:**

- Smooth particle surface;
- More hydrophobic (water-repellent) particles;
- Presence of aluminium (as in ceramics);
- Presence of clays (as in ceramics);
- Larger particle sizes;
- Aged particles.

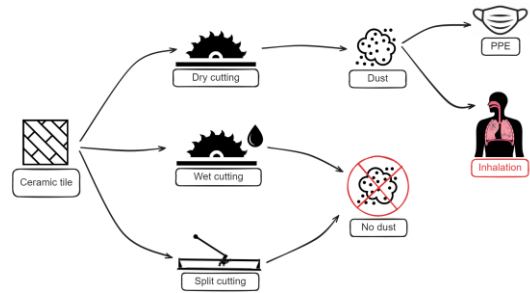
## 4. Cutting methods

During the installation of ceramic tiles, some tiles must be shaped to fit specific architectural requirements. Cutting can be performed in various ways; the most critical for health is dry cutting, as it generates a significant dispersion of dust into the environment. However, when effective **preventive and protective measures** are applied, the **risks associated with inhalation of crystalline silica dust are significantly reduced**. Examples of these measures include:

- Using **wet cutting** instead of dry cutting;
- **Split cutting**, using diamond cutters;
- Adopting **dust extraction and ventilation systems**;
- Using **personal protective equipment** (such as filtering facepieces).

Moreover, for ceramic tiles, even when dry cutting is used, wearing an FFP1 filtering facepiece is sufficient to reduce the operator's exposure levels below the limit value of  $0.05 \text{ mg/m}^3$ .

	Ceramic tile	Engineered stone
Dry cutting	X	X
Wet cutting	✓	X
Split cutting	✓	-
Dry cutting + FFP1	✓	X
Wet cutting + FFP1	✓	✓



Finally, it is essential to **provide proper training for workers** on the preventive and protective measures to be adopted, in order to ensure compliance with occupational exposure limits and to safeguard health and safety.

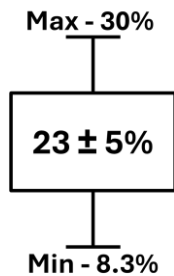
## 5. Italian ceramic: the product, the work environment, and installation

Confindustria Ceramica has conducted numerous studies and gathered an extensive set of data related to crystalline silica and Italian ceramics. **The industry recognizes the fundamental importance of health and safety issues and promotes an approach based on transparency**, as well as the sharing of knowledge and information among all involved stakeholders.

### Italian ceramic: THE PRODUCT

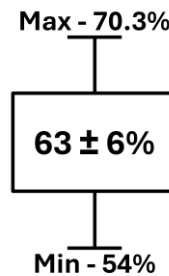
#### CRYSTALLINE SILICA

(POTENTIALLY hazardous)



#### AMORPHOUS PHASE

(NOT hazardous)



The content of crystalline silica is minimally dependent on the size and thickness.

### Italian ceramic: WORK ENVIRONMENT

For the correct implementation of the CMD directive, Confindustria Ceramica, in collaboration with the Region, AUSL, ACIMAC, and trade unions (FILCTEM CGIL, FEMCA CISL, UILTEC UIL), has developed a **memorandum of understanding** that identifies high-risk processes in the ceramic industry and defines best practices for the continuous improvement of safety. A study conducted by the Association highlighted that the **average exposure in sector companies is below the established action level**.

**585**

the personal samplings conducted during a monitoring study carried out by Confindustria Ceramica over a 3-year period.

**0.024 mg/m<sup>3</sup>**

the average exposure is below the action level established by OSHA and ACGIH.

### Italian ceramic: INSTALLATION

The installation operations of Italian ceramics, **performed according to the recommended best practices** – including wet cutting, split cutting, and the use of appropriate PPE – **ensure effective control of risks related to crystalline silica**. The recorded data shows that exposure levels remain well below the limit thresholds set by regulations and reference practices.

**0.03 mg/m<sup>3</sup>**

the exposure during **dry cutting (using an FFP1 mask)** of a ceramic tile is below the European and Italian limit set at 0.1 mg/m<sup>3</sup>.

**0.02 mg/m<sup>3</sup>**

the estimated exposure **during wet cutting** of a ceramic tile.

**0.002 mg/m<sup>3</sup>**

the estimated exposure during **wet cutting (using an FFP1 mask)** of a ceramic tile.

**For further details:**

- [Tesi di master - Crystalline silica in the Italian ceramic industry: workplace, finished product, and installation](#)
- [Protocollo d'intesa tra Confindustria Ceramica, Regione, AUSL, ACIMAC e sindacati \(FILCTEM CGIL, FEMCA CISL, UILTEC UIL\) sull'individuazione dei lavori comportanti esposizione a silice cristallina generata all'interno dell'industria ceramica italiana](#)
- [Scheda informativa del prodotto ceramico](#)