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Technical Rules for Hazardous Substances	Mineral Dust	TRGS 559
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The Technical for Hazardous Substances (TRGS) reflect the state of technology, occupational health and occupational hygiene as well as other scientific knowledge for activities involving hazardous substances including their classification and labelling. The

Committee on Hazardous Substances (AGS)

with participation of the Committee for Occupational Medicine (AfAMed) establishes the rules and adapts them. The TRGS rules are announced by the Federal Ministry of Labour and Social Affairs (BMAS) in the Joint Ministerial Gazette (GMBI).

This TRGS concretises within its scope the requirements of the Hazardous Substances Ordinance and the Ordinance on Occupational Health Care. Provided the TRGS rules are complied with, the employer may assume that the relevant requirements of the Ordinances have been met. If the employer chooses a different solution, he must at least attain the same degree of safety and health protection for the workers.

The TRGS "Mineral Dust" is based on BG Rule 217 "Handling mineral dust" of the "Industrial Rocks and Minerals" expert committee of the German Social Accident Insurance (DGUV).

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1 Scope

- (1) This TRGS applies to the protection of workers and other people during activities where mineral dust may occur.
- (2) This TRGS does not apply to activities involving asbestos or other fibrous mineral dusts. TRGS 519 “Asbestos: demolition, reconstruction or maintenance work” applies to activities involving asbestos. TRGS 521 “Demolition, reconstruction and maintenance work involving old mineral wool” applies to activities involving other fibrous dusts. TRGS 517 “Activities involving potentially asbestos-containing mineral raw materials and preparations and articles manufactured from them” applies to activities involving asbestos-containing mineral raw materials and articles. It does also not apply to companies engaged in underground mining and which are subject to mining law.
- (3) This TRGS contains special protective measures for activities involving mineral dust. It concretises the general requirements for the protection of workers and other people according to the Hazardous Substances Ordinance and in particular in its Annex III No. 2.3 “Supplementary protective measures for activities with exposure to inhalable dusts”.
- (4) Activities or processes where workers are exposed to alveolar dusts of crystalline silicon dioxide in the form of quartz and cristobalite are deemed to be carcinogenic according to TRGS 906 “List of carcinogenic activities or procedures according to Article 3 (2) No. 3 GefStoffV”.
- (5) Even if the actual exposure values fall below the exposure value ranges for alveolar quartz dust at the workplace as given in annex 1, it is not possible given the present state of the art in science to discount a cancer risk. Further measures to reduce the fine quartz dust exposure are therefore to be aimed at.

2 Definitions

This TRGS uses terms as they are defined in the “Begriffsglossar zu den Regelwerken der Betriebssicherheitsverordnung (BetrSichV), Biostoffverordnung (BioStoffV) und der Gefahrstoffverordnung (GefStoffV)”¹ [“Glossary of terms for the regulations of the Plant Safety Ordinance (BetrSichV), Biological Agents Ordinance (BioStoffV) and the Hazardous Substances Ordinance (GefStoffV)"] of ABAS, ABS and AGS. Furthermore terms with the following meanings are used in the present TRGS:

2.1 Alveolar and inhalable dust (A and E dust)

- (1) Dust is a dispersal of solid substances in the air which arises in particular due to mechanical processes or by being swirled up. A distinction is drawn between the alveolar dust fraction (A fraction, A dust, formerly: fine dust) and the inhalable (E fraction, E dust, formerly: total dust) dust fraction.

¹ www.baua.de/cln_104/de/Themen-von-A-Z/Gefahrstoffe/Glossar/Glossar.html

(2) The inhalable fraction is the mass fraction of dusts in the respiration area which can be taken in through the respiratory system. The alveolar fraction is the mass fraction of inhalable dusts which can reach the alveoli and bronchioles. The inhalable (E) or the alveolar (A) fraction is determined following the sampling conventions according to DIN EN 481.

(3) For dust which does not exhibit any mutagenic, carcinogenic, fibrogenic, allergising or toxic effect, the general dust limit value for A dust (occupational exposure limit (OEL) for the alveolar dust fraction) of 3 mg/m^3 . For E dust the OEL for the inhalable dust fraction of 10 mg/m^3 of TRGS 900 applies.

2.2 Mineral dust

Mineral dust is dust or mixed dust which arises during activities involving naturally occurring minerals and rocks, especially during winning, working and processing, or during activities involving substances, preparations and articles from these.

2.3 Fine quartz dust

Fine quartz dust is the alveolar dust fraction (A fraction, A dust) of crystalline silicon dioxide in the modifications quartz, cristobalite or tridymite. Crystalline silicon dioxide is also called crystalline silicic acid.

2.4 Quartz-bearing dust

Quartz-bearing dust (silicogenic dust) is mixed dust which may contain up to 100 per cent fine quartz dust in the alveolar dust fraction (A fraction, A dust). Quartz-bearing dust can also be released during the working and processing of substances, preparations and articles without grain size fractions of $< 100 \mu\text{m}$ which contain crystalline silicon dioxide. Mineral dust is considered to be quartz-bearing dust if a fine quartz dust fraction is demonstrated within the framework of an exposure measurement in the air at the workplace using standard methods recognised by the authorities or the Berufsgenossenschaften (institutions for statutory accident insurance and prevention).

2.5 Dustiness

(1) Dustiness is the property of bulk materials (substances, preparations and articles) to develop and release airborne dusts during a certain kind of activity.

(2) Reference must be made to the characteristics of the dust development for the evaluation of the dustiness, normally the dust characteristics for the alveolar fraction and the inhalable fraction.

(3) The dustiness can also be estimated using other methods, e.g. according to the "BVT-Merkblatt über die besten verfügbaren Techniken zur Lagerung gefährlicher Substanzen und staubender Güter" [*BVT factsheet on the best available techniques for the storage of dangerous substances and dusty goods*] (BREF "Emissions from Storage") by determining the "dispersiveness class" found there.

2.6 Dustiness coefficient

The dustiness coefficient is the quotient from the respective A or E dust mass (mg) released in the dustiness test and the mass (mg) of the input materials.²

2.7 Emission rate

The emission rate indicates the mass of dust given off by a machine or device per time unit into the surrounding area.

2.8 Ventilation measures

Ventilation measures taken to reduce the exposure to air pollutants at the workplace:

1. Capture of the substances at the source and outlet,
2. Workplace ventilation, i.e. displacement or dilution of air pollutants in the working area. A distinction must be drawn between
 - a) technical (mechanical) ventilation and
 - b) free (natural) ventilation.

2.9 Stationary workplaces

Stationary workplaces are characterised by the fact that there is stationary operating equipment, stationary operating circumstances and that the ambient conditions largely remain constant (room size, ventilation etc.).

2.10 Non-stationary workplaces

Non-stationary workplaces are characterised by the fact that changing places of work, operating equipment and ambient conditions (room size, ventilation) are involved. Non-stationary workplaces include, for example, construction sites and changing work locations within a place of work.

² DIN EN 15051 Workplace exposure – Measurement of the dustiness of bulk materials – Part 1: Requirements and choice of test methods; German version EN 15051:2006

2.11 Materials

Materials within the meaning of this TRGS are substances, preparations or articles.

3 Information gathering and risk assessment

3.1 General requirements

(1) Under §§ 5 and 6 Occupational Safety and Health Act, § 3 General Federal Mining Ordinance and Article 7 Hazardous Substances Ordinance the employer shall draw up a risk assessment or equivalent safety and health protection document. This is concretised in TRGS 400 "Risk assessment for activities involving hazardous substances" and, where inhalation exposure is concerned, in TRGS 402 "Identification and assessment of the risks from activities involving hazardous substances: inhalation exposure". For this purpose he shall establish prior to commencement of the work, whether mineral dust is released during activities or processes. The employer may only commence an activity after a risk assessment has been undertaken and the required protective measures have been taken.

(2) The following steps must be observed:

1. identification of the dust-polluted working areas or activities,
2. identification of the substance- and activity-related information,
3. assessment of the risks,
4. establishment of protective measures,
5. check of the effectiveness of the protective measures and
6. documentation.

3.2 Steps for the risk assessment

3.2.1 Identification of dust-polluted working areas or activities

To identify the dust-polluted working areas or activities, work sequences, processes, and working and ambient conditions must be considered. Working areas can be established with a view to spatial or organisational aspects and may contain one or more activities involving mineral dust. Where the activities are carried out at changing workplaces (e.g. maintenance and repair work) the individual jobs may be assessed in combination.

3.2.2 Identification of type and quantity of mineral dusts and the activity-related information

(1) In the risk assessment not only the quantity but also the chemico-physical properties of the dust and the related health risks must be considered. For this

purpose data from the safety data sheet can be used or, if this is not available, equivalent information can be gathered from the manufacturer or the legal entity responsible for placing on the market or from substance databases. In particular the dustiness of the material used must also be included.

(2) In the risk assessment the exact work sequences, the working procedures used and the working and ambient conditions prevailing at the workplace are to be included.

3.2.3 Assessment of risks

(1) On the basis of the information gathered under number 3.2.2 the risks must be assessed.

(2) The exposure to mineral dusts in the working areas concerned must be identified by measurements or qualified estimates. Measurements can be dispensed with if measuring results obtained for comparable workplaces or provided risk assessments can be referred to for an assessment of the risks and for qualified estimates.

(3) The risk assessment is simplified if the assessment and the establishment of protective measures are specified by standardised work procedures: these include

1. a provided risk assessment (pra) of the manufacturer or the legal entity responsible for placing on the market,
2. a substance- or activity-related TRGS, in particular process- and substance-specific criteria (VSK) according to TRGS 420 and
3. the specific measures or procedures of a sector-specific or activity-specific aid (e.g. BGR, BGI, practical instructions) which correspond to the specifications of TRGS 400 annex 2.

If no standardised work processes are available, or if they are not applicable, the risks must be derived and established within a risk assessment.

(4) If a measurement is required to assess mineral dusts it may only be conducted by measuring bodies which have the necessary knowledge and necessary equipment. The employer engaging an accredited measuring body can assume that the knowledge established by this body is relevant.³

3.2.4 Concept of the exposure categories

(1) The typical activities from various sectors as listed in Table 1 have each been assigned to one of three exposure categories (1 to 3).

(2) The basis for the assignment of the activities in annex 1 to the exposure categories is the results obtained from exposure measurements and evaluations of the literature. The assessment of the exposure level for the respective activity is based on exposure measurements and experience gained from practice (expert

³ For accredited measuring bodies see BUA, Bundesverband der Messstellen für Umwelt- and Arbeitsschutz e.V., <http://www.bua-verband.de>

estimation).

(3) After he has gathered his activity-related information the employer will take the exposure category from Table 1.

(4) For activities not included in Table 1 or for activities listed without assignment of exposure value ranges, the employer must conduct appropriate research. If it is not possible to research any quality-tested, activity-related exposures for comparable workplaces, the employer must determine exposures himself (alveolar and inhalable dust as well as quartz, if quartz-bearing dust is present). The respective exposure category is assigned using the exposure value ranges of the table below.

(5) On the basis of the exposure category determined for the activity, the protective measures for the exposure category are selected using the table in annex 2.

Exposure category	Criteria
Exposure category 1	<p>Identification of the exposure before and after the establishment of protective measures</p> <p>Low exposure, see number 3.3.</p> <p>General hygiene measures/basic measures adequate</p>
Exposure category 2	<p>Identification of the exposure before the establishment of protective measures:</p> <p>Moderate exposure</p> <p>Technical measures necessary</p> <p>Identification of the exposure after establishment of protective measures</p> <p>Finding "Protective measures adequate"⁴1).</p> <p>Criteria may be: state of the art fulfilled, general dust limit value with mineral dust, substance-specific OEL complied with Portland cement.</p>
Exposure category 3	<p>Identification of the exposure after establishment of protective measures:</p> <p>High exposure</p> <p>Technical protective measures not adequate, organisational and personal protective measures necessary</p> <p>Finding "Protective measures not adequate"⁴</p> <p>Criteria may be: general dust limit value with mineral dust, substance-specific OEL exceeded with Portland cement, further measures necessary with quartz-bearing dust.</p>

3.2.5 Establishment of protective measures

(1) In the case of activities involving exposure to inhalable dusts for which no substance-related occupational exposure limit has been established, the protective measures must be laid down in accordance with the risk assessment in such a way that at least the general dust limit value both for the inhalable and for the alveolar dust fractions is complied with. For quartz-bearing dust number 3.2.7 paras. 7 and 8 must also be complied with. If the dust contains substances for which the

⁴ See TRGS 402 "Identification and assessment of the risks from activities involving hazardous substances: inhalation exposure"

occupational exposure limits or exposure risk relations have been laid down or substances mentioned in TRGS 905 or TRGS 906 for which no occupational exposure limits or exposure risk relations have yet been laid down, one must proceed in each case as appropriate. The risk from dusts with different constituents must be identified and assessed in accordance with TRGS 402.

(2) When establishing the protective measures the following order of priorities must be observed:

1. Design of the working procedure and use of suitable work equipment (technical measures).
2. Performance of collective protective measures at the risk source, such as appropriate ventilation and venting.
3. Performance of suitable organisational measures, such as the establishment of access restrictions, working time regulations, and cleaning and hygiene measures.
4. Performance of individual protective measures including the application of personal protective equipment and personal hygiene measures if a risk cannot be prevented by measures under numbers 1 and 2.

(3) The assignment of protective measures to the exposure categories is described in annex 2.

(4) Instructions for appropriate dust control measures in installations and during activities are also to be found in the "Practical guide for fine quartz dust" and in the "Practical instructions for good working practice – Protection of workers against dusts and aerosols at foundry workplaces".

3.2.6 Exposure categories and protective measures for activities involving mineral dust

(1) Protective measures for exposure category 1 apply to activities which experience shows lead to no or only low dust exposure given the state of the art and taking into account the protective measures described.

(2) Protective measures for exposure category 2 apply to activities which may cause a low to moderate dust exposure given the state of the art and taking account of the protective measures described and the type of activity.

(3) Protective measures for exposure category 3 apply to all activities which may cause a high dust exposure given the state of the art.

3.2.7 Check of the effectiveness of the protective measures

(1) The employer must establish,

1. whether the measures laid down have been taken and
2. whether the measures are suitable and adequately effective.

(2) If it has been established that the measures are not adequately effective the risk assessment must be repeated.

(3) As a result of the risk assessment methods must also be laid down for checking the effectiveness of the existing protective measures and those to be taken. This is intended to ensure that the protective measures reduce over the period of the activities the exposure to the degree required for the safety and health of the workers.

(4) To check whether the protective measures taken are adequately effective the exposure must be identified after the implementation of the protective measures given the state of the art.

(5) The exposure identified must be assessed with a view to any risk to workers and the effectiveness of the protective measures. The result of this assessment is the finding. The finding must be justified and documented. The finding may be:

1. protective measures adequate,
2. protective measures not adequate.

(6) For substances which have a binding limit value this must be referred to as an assessment criterion. For the assessment of the exposure to mineral dust the general dust limit value according to TRGS 900 (3 mg/m³ for the alveolar fraction (A dust) and 10 mg/m³ for the inhalable fraction (E dust) must be referred to.

(7) For substances which do not have a binding limit value, as is the case with quartz-bearing mineral dusts, different assessment criteria must be referred to in accordance with TRGS 402 Number 5.3 to evaluate the exposure. These can provide among other things information on the state of the art. Such assessment criteria are not occupational exposure limits within the meaning of Article 3 (6) of the Hazardous Substances Ordinance. The employer must therefore lay down the criteria for assessing the inhalation exposure on his own responsibility.

(8) There is at present no health-based occupational exposure limit (OEL) for fine quartz dust. To establish the finding as to whether the protective measures taken regarding exposure to quartz-bearing mineral dusts are state of the art and are adequate under the present TRGS, the data given in the table ("Exposure value range quartz") in annex 1 of the present TRGS is referred to as an assessment criterion. The operational exposures must be minimised as far as possible according to the state of the art taking account of the exposure value ranges listed in annex 1.

(9) The concentrations identified within the framework of the effectiveness check must be compared with the relevant exposure value range. In the comparison with the figures of the exposure value range an assessment is now made as to whether the technical protective measures are adequate or further measures are necessary. This objective is achieved when the concentration identified for mineral dust is within the value ranges given for exposure categories 1 and 2, for quartz-bearing dust within the value ranges for exposure category 1 and below the arithmetic mean for quartz of exposure category 2.

3.2.8 Documentation

- (1) The result of the risk assessment must be documented prior to commencement of the activity according to number 8 of TRGS 400 "Risk assessment for activities involving hazardous substances". If, during activities with materials, mineral dusts arise these materials must be included in the hazardous substance list on a one-off basis in relation to the company. This does not apply to non-quartz-bearing mineral dusts which occur during activities and which are to be assigned to exposure category 1.
- (2) Where there are major changes the risk assessment must be conducted anew.

3.3 Criteria for the exposure category 1

- (1) For activities during which the workers are exposed to mineral dusts both the dusts with no substance-specific limit value, i.e. those which fall within the scope of the general dust limit value (A and E dust), and dusts with no limit value (e.g. quartz-bearing dust) the measures according to exposure category 1 may under certain conditions be adequate.
- (2) Activities involving low exposure are present if
 1. a release of substances into the air at the workplace is not possible or
 2. the release capability is low because of the properties of the substance (e.g. low dustiness),
 3. only small quantities are being used and
 4. only low emissions are possible, e.g. on account of the small areas of the sources or the short duration of the activity (< 15 minutes).
- (3) To assess a low exposure the dustiness, the substance quantities used and the emissions must be considered together.
- (4) The following assessment criteria can be referred to:
 1. Dustiness
 - a) The quantity of dust released depends on the dustiness and the respective working conditions. Low dustiness within the meaning of exposure category 1 applies where:
 - lumpy solids, slurries, pastes and waxes are used,
 - a maximum of 10 kg granulate/pellets is used,
 - solids are worked using wet or moist, or otherwise low-dust processes,
 - activities are carried out with earth-moist or permanently moist material in the open air.
 - b) The dustiness can be determined quantitatively using a quality-assured or standardised measuring procedure⁵ or qualitatively by evaluation on the

⁵ DIN EN 15051 [Workplace atmospheres - Measurement of the dustiness of bulk materials -](#)

basis of the condition of the material.

2. Dustiness coefficients obtained from these measuring procedures make it possible to make a relative estimate of the dustiness of comparable bulk materials (products) and can be obtained on request from manufacturers and specialist bodies. Dustiness coefficients can be identified for the inhalable and alveolar fraction. For activities involving quartz-bearing materials the dustiness coefficient relates to the fine quartz dust released.
3. If the dustiness coefficient of the material used is not known, the dustiness can be estimated using the following table:

Dustiness	Condition of material	Dust development
Low-dust/minor dustiness	lumpy solid, pellets, granulate, wax, pastes, slurries	no or only little visible dust development
dusty	coarse-grained, coarse-powdered or lumpy, slightly abrasive material	visible, but quickly settling dust clouds, visible dust deposits
strongly dusty	fine-powdered or floury material*	visible dust clouds which can persist in the air for a period of minutes or longer

*Note: It must be noted that due to agglomeration fine-powdered or floury material may exhibit low-dust or low dustiness.

(5) The substance quantities used per shift can be classified into the following categories with respect to a combined assessment:

1. low quantity ≡ gram range (g),
2. medium range ≡ kilogram range (kg) and
3. high quantity ≡ tonne range (t)

(6) For a combined assessment of dustiness, substance quantity and emissions, a classification into exposure category 1 can be made according to the following matrix, assuming low exposure:

Dustiness Substance quantity	Low-dust/minor dustiness	Dusty	Strongly dusty
low (gram range)	exposure category 1	exposure category 1	exposure category 1 ¹⁾
medium (kilogram range)	exposure category 1	²⁾	²⁾
high (tonne range)	²⁾	²⁾	²⁾

Notes:

- ¹⁾ Under certain conditions (e.g. duration of the activity 1h/shift max., adequate room ventilation)
- ²⁾ Identification of the exposure category according to number 3.2

3.4 Activities of exposure categories 1 to 3

Activities of exposure categories 1 to 3 can for example be taken from the table in annex 1.

4 Protective measures

4.1 Substitute substances and substitute processes

(1) Prior to the commencement of activities involving materials from which mineral dusts may be released, a check should be made to establish whether such materials can be substituted for by materials with a lower health risk. If the employer has the opportunity to select materials, he must use the substitute substance where this is possible according to the state of the art.

(2) Prior to the commencement of activities involving materials from which mineral dust may be released, a check should be made to establish whether the occurrence of dust can be prevented or reduced by changing the working procedure. Dust development can be reduced for example by using materials in low-emission forms with low dustiness coefficients in relation to the inhalable and alveolar dust fractions.

(3) When quartz-bearing dust occurs, these changes must be implemented according to the state of the art.

(4) Abrasive blasting agents may not contain more than 2 per cent of their weight (2 % by weight) in crystalline silicon dioxide.

(5) Grinding tools whose abrasive agents consist in whole or in part of crystalline silicon dioxide may not be used. This does not apply to grinding blocks of natural stone.

(6) The client and contractor must collaborate and consult one another in the conduct of the risk assessment. This applies in particular to the selection of materials and processes, the co-ordination of various activities and the establishment and implementation of the required protective measures.

4.2 Low-dust work processes

(1) Work processes must be selected and implemented in such a way that as little dust as possible is released. For activities involving dust exposure any spread of the dust to unpolluted working areas must be avoided in accordance with the state of the art.

(2) This is achieved, for example, by

1. not storing or shifting dust-generating materials openly in the proximity of workplaces,
2. keeping as low as possible the clear dropping height for heaps, stockpiles and transfer points of conveyer belts,
3. preventing the occurrence of dusts when charging silos,

4. equipping conveyor belt transfer points with heavy dust development with a dust extraction or water spray system,
 5. using wet or moist working processes instead of dry working processes,
 6. storing and transporting heavily dust-generating raw materials, products and waste, such as powdered products; in closed systems, e.g. storage in closed silos, sealed bags, big bags, covered containers, conveyance in closed piping systems,
 7. keeping heavily dust-generating raw materials, products and waste moist,
 8. selecting for shotcreting work procedures which involve low dust release, e.g. wet spraying procedures,
 9. selecting for abrasive blasting work procedures involving low dust release, e.g. wet or moist blasting procedures,
 10. wetting the work location with water during demolition work,
 11. ensuring the availability of collection devices for waste material when working compounds such as discharging casting slurries or press granulate,
 12. using coarse-cutting production processes.
- (3) Production residues must be handled in such way that as little dust as possible is released.

4.3 Machines and devices

- (1) Machines and devices must be selected and operated in such a way that as little dust as possible is released. Dust-emitting installations, machines and devices must be fitted with an effective extraction system which is state of the art where the release of dust is not prevented by other measures.
- (2) This may be achieved, for example, by using machines and devices
1. whose emission rate is in accordance with the state of the art,
 2. whose dust sources are encased,
 3. for which the dust is extracted at work openings, source points and outlets,
 4. which are cladded and
 5. for which adequate dust reduction is achieved by wetting or a water feed.
- (3) Furthermore this is achieved by
1. using closed instead of open means of conveyance,
 2. avoiding open material transfer points and
 3. operating machines and devices under (partial) vacuum.
- (4) When machines and devices which are approved with respect to dust emissions are used it may be assumed that the emission rate is in accordance with the state of the art applying at the time the approval test was conducted.

(5) When masonry saws are being used with which dust is to be reduced by feeding water and where the water is fed in a circulation system without treatment, the circulating water must be replaced daily.

(6) When machines with enclosed operator cabins are being used and they are fitted with a filter to clean the outside air (this is normally the case for air-conditioned cabins), the doors and windows must be kept shut during operation.

4.4 Work rooms

(1) Work rooms where dust may arise must be designed and maintained in such a way that

1. walls and ceilings are smooth to avoid the adhesion of dust,
2. surfaces where dust will deposit are avoided,
3. floors and surfaces are easy to clean and
4. work rooms with different dust concentrations are separated from one another by means of structural measures.

(2) Deposit surfaces are avoided, for example, by making them inclined or cladding them.

(3) Paragraphs 1 and 2 shall not apply to non-stationary workplaces outside a workshop.

4.5 Dust collection and workplace ventilation

(1) If it is not possible to prevent the release of dust, the dust must be collected as completely as possible at the outlet or place of origin and disposed of safely. The air extracted must be managed such that as little dust as possible passes into breathing air. If the complete collection of dust is not possible, further air-related measures, such as workplace ventilation systems, are necessary. The air must be managed in such a way that as little dust as possible remains in breathing air. Air-related measures must therefore lead neither to a distribution of the dust nor to a dust hazard at some other location. This is achieved, for example, if cabins with as far as possible dust-free cabins are created for workplaces.

(2) Facilities for collecting, depositing and separating dusts and air-related measures must be in accordance with the state of the art. For the first start-up of such facilities evidence must be provided of their adequate effectiveness.

(3) Evidence of adequate effectiveness can, for example, take the form of manufacturer's information, a workplace measurement or compliance with the workplace conditions in accordance with a process and substance-specific criterion.

4.6 Clean air return

(1) Air extracted which contains mineral dust may only be returned to the working area when it has been effectively cleaned.

(2) This is achieved with ventilation installations if the dust concentration in the clean air returned (return air) does not exceed 1/5 of the general dust limit value (A dust) and the proportion of return air in the supply air is not more than 70 per cent. The E dust concentration in the return air may not exceed 1 mg/m³.⁶

(3) For quartz-bearing dust the ventilation system must be designed in accordance with the criteria of the authorities or the Berufsgenossenschaften (institutions for statutory accident insurance and prevention). These are specifically:

1. the dust concentration in the clean air returned (return air) may not exceed a residual dust concentration of 0.015 mg/m³ related to fine quartz dust⁷ and
2. the permeation degree of the filter system must be < 0.005 % in relation to the fine dust concentration in the untreated gas.

The requirements of TRGS 560 "Clean air return" is not affected.

(4) Effective dust removal may be assumed if

1. evidence has been provided in the form of a type approval test under the Equipment and Product Safety Act or by an on-site test of the facility that the facility effectively cleans the air extracted and
2. the facility is used as intended.

(5) For requirements concerning industrial vacuum cleaners and dust removal equipment see number 4.8.

4.7 Maintenance and testing

Facilities for collecting, depositing and separating dusts and ventilation systems must be tested to establish good functioning, in accordance with the results of the risk assessment, maintained and where relevant repaired, observing the intervals indicated by the manufacturer, but at least once a year. The tests must be conducted and documented by a qualified person. A qualified person is someone who has the requisite knowledge to test work equipment on the basis of his occupational training, occupational experience and recent occupational work. The documents concerning the test must be retained at least until the next test.

4.8 Cleaning of operating equipment

(1) Deposits of dusts must be avoided. If this is not possible, work rooms, workplaces, transport routes, operating installations, machines and devices must be cleaned regularly. The cleaning work must be performed in such a way that the release and swirling of dust is minimised, e.g. using moist or wet procedures which are state of the art or by suction using suitable vacuum cleaners or dust removers.

⁶ VDI 2262 Luftbeschaffenheit am Arbeitsplatz; Minderung der Exposition durch luftfremde Stoffe
[Workplace air; reduction of exposure to air pollutants]

⁷ Minimum determination limit of the measuring procedure used for the test

- (2) This is achieved, for example if
1. permanently installed vacuum cleaning systems, or dust-removal machines or devices are used,
 2. moist wiping or wet cleaning is applied,
 3. when sweeping, the swept material is adequately combined with binding agent (such as water, white oil or magnesium chloride) and
 4. paved transport routes are swept with mechanical sweepers which also take up the material swept.
- (3) Suitable equipment here includes dust-removal machines or devices, such as dust removers, industrial vacuum cleaners, mechanical sweepers with suction facility, provided they have been type-approved by a licensed testing body. They must be at least of dust class M.
- (4) Dust removers and industrial vacuum cleaners are also available in the higher dust class H (formerly use category K 1). Mechanical sweepers with suction facility are only available in dust class M (formerly use category G).
- (5) It is basically not permitted to clean the working area by employing dry sweeping or blowing of dust deposits using compressed air. The cleaning of workpieces by blowing with compressed air is only permissible using special protective measures, e.g. with combined blowing/suction devices.
- (6) Unpaved roads which cannot be cleaned must be regularly wetted to avoid dust swirling up. Wetting can be dispensed with if there are no persons in the areas of roads subject to dust pollution and the driving personnel is protected in the cabin from the impact of dust. In addition to wetting other suitable measures may be applied in practice in order to prevent dust swirling up.

4.9 Cleaning of work clothing, washrooms

- (1) Dusty work clothing must be washed regularly. It is only permitted to subject the clothing to blowing if suitable facilities are used, such as special air shower cubicles.
- (2) Washrooms must be provided for workers. In the case of non-stationary workplaces with a small number of workers washing facilities are sufficient.

4.10 Organisational measures

Suitable organisational measures (e.g. prohibition of eating and drinking at the workplace; prohibition of entry to recreation and standby rooms and to dust-protected cabins such as control operation and consoles wearing soiled work clothing) must be taken in order to reduce the number of workers exposed to dust and the extent of exposure as far as possible.

4.11 Operating instructions and information

4.11.1 Operating instructions

For activities involving mineral dust operating instructions relating to the working area or activity must be drawn up and such instructions must take due account of the risk assessment.

4.11.2 Information

(1) The employer must give oral information on the basis of the operating instructions to workers exposed to dust teaching them about risks arising and on the protective measures. The information must be given prior to commencement of the work and then at least once a year on a workplace-related basis. The content and date of the information must be documented and confirmed by signature of those receiving the training.

(2) The employer must ensure that all workers performing activities involving hazardous substances receive general occupational medical and toxicological advice. This advice should be given within the framework of the information laid down in para. 1. The workers are to be instructed on voluntary examination available under the Ordinance on Occupational Health Care and on special health hazards relating to activities involving certain hazardous substances. The consultation where advice is given must be conducted in the presence of the doctor according to § 7 para. 1 of the Ordinance mentioned in sentence 3 if this is required for occupational medical reasons.

4.12 Supplementary measures for exposure category 3

4.12.1 Further organisational measures

(1) For activities involving quartz-bearing dust of exposure category 2 where the state of the art cannot be adhered to and for activities of exposure category 3, suitable organisational measures must be taken in order to restrict the duration of exposure as far as possible. The danger area must be delimited and marked. Smoking must be prohibited in the danger area.

(2) Marking shall be by means of the prohibition signs laid down in the Technical Workplace Rules (ASR) A1.3

1. P006 "No access for unauthorised persons" and
2. P001 "Smoking prohibited"

(3) The employer must provide separate storage facilities for work clothing and street clothing and these must be used by the workers.

(4) In the risk assessment a plan of action must be included in which the scheduled measures for the future improvement of the dust exposure conditions are described.

4.12.2 Personal protective equipment

If the risk assessment reveals that substance-related occupational exposure limits or the general dust limit value are not complied with, or if there are activities involving quartz-bearing dust of exposure category 2 where the state of the art cannot be adhered to or they are to be assigned to exposure category 3, the employer must provide suitable personal protective equipment (respiratory protective equipment, goggles, protective gloves and overalls). This equipment is to be worn by the workers for as long as the risk persists.

4.12.3 Provision and use of respiratory protective equipment

(1) If the breathing air cannot be adequately kept free of mineral dust by technical dust protective measures for operational reasons, suitable, individually fitting respiratory protective equipment which meets ergonomic and health requirements must be provided. Only certified respiratory protective equipment may be used, i.e. devices bearing a CE mark, and such equipment will show alongside the CE mark in addition the four-digit number of a notified body.

(2) Operational reasons may, for example, apply in the case of jobs of short duration such as

1. cleaning filter systems,
2. emptying dust chambers and dust collection containers and
3. inspection rounds in treatment facilities.

(3) The respiratory protective equipment must

1. be stored in accordance with manufacturer's instructions,
2. maintained and tested by the employer in the case of scheduled re-use and
3. replaced if it is damaged or re-use is not permissible (equipment labelling NR).

(4) In particular it must be ensured that respiratory protective equipment is kept in dust-free and dry conditions at the place of use.

(5) To protect against dusts, filter or insulation devices must be used in accordance with the exposure conditions at the workplace, preferably devices with hood or helmet since these do not generate any health burdens for the wearer.

(6) Suitable filter devices may be, for example

1. filter devices with respirator connections (normally masks, hoods or helmets) and separable particle filters (e.g. half-face mask with P2 filter or helmet with blower and TH2P particle filter),
2. filter devices as particle-filtering half-face masks, e.g. FFP2, and
3. insulation devices.

(7) The insulation devices used may be hose devices (e.g. of the type SG 2A/2B, SG 3A/3B, SG 4A/4B) with helmet or hood, or half-face or full-face mask.

(8) The respiratory protective equipment to protect workers against particles may be selected according to the type of device, filter class and level of exposure (dust pollution) according to annex 3.

(9) Normally respiratory protective equipment of filter class P2 or comparable design will be sufficient; see annex 3.

(10) The respiratory protective equipment provided must be used for activities where the substance-related occupational exposure limits or the occupational exposure limit for inhalable and alveolar dust cannot be adhered to, as long as the risk persists. The wearing of burdensome personal protective equipment as a constant measure is not permissible. The wearing of personal protective equipment may not be a substitute for technical or organisational protective measures. The wearing time restrictions must be observed. When determining the wearing time, recuperation time, the uses per shift and the shifts per week for a respiratory protective equipment, it must be noted that loads due to heavy nature of the work and the ambient climate as well as the characteristics of the clothing may shorten the wearing time listed in addition by adjustment factors.

(11) Wearers of respiratory protective equipment must be practised in handling the devices and must receive relevant instruction at least once a year. The instruction will encompass in particular proper use, inspection for visibly evident defects and the proper storage of the respiratory protective equipment at the place of use.

(12) The provision and wearing of respiratory protective equipment may be dispensed with if the risk assessment yields an exposure category 1. If exposure categories 2 and 3 apply, the employer must provide the workers affected with respiratory protective equipment in accordance with annex 2. If exposure category 3 applies, the respiratory protective equipment must be worn. The same applies to activities involving quartz-bearing dust of exposure category 2, provided this has been laid down by the employer on his own responsibility in the context of the risk assessment according to TRGS 402 number 5.3.

5 Preventive occupational health care

(1) In the case of activities involving mineral dust, preventive occupational health care normally encompasses participation by the occupational physician in the risk assessment, the general occupational medicinal consultation and the occupational health care. For the risk assessment knowledge of the intake routes and the action of the dusts on the human organism is required. The dust dose deposited in the lung depends not only on the airborne concentration, but also on the quantity of air inhaled (respiratory minute volume) and hence on the physical load. The heavy nature of the work must therefore be included in the assessment of the inhalation exposure.

(2) Within the framework of the occupational medical and toxicological advice reference must be made, among other things, to the fact that

1. the risk of lung cancer is increased among other things by the deposition of quartz-bearing dust in the lung,

2. inhalable and alveolar dust (see number 2.1) leads, depending on the dose, to permanent damage to the bronchial system, which may appear after years of exposure as chronic inflammation of the respiratory tract with a measurable impairment of pulmonary function,
3. deposition of quartz-bearing and other fibrogenic dusts in the lung tissue may lead to permanent modification of the lung tissue, which can progress without further exposure,
4. continued inhalative cigarette smoking will cause a massive strengthening of the adverse effects of inhalable dusts (lung cancer, chronic inflammation of the respiratory tract, pneumoconiosis) by permanently impairing the lung's self-cleaning mechanism, and that therefore general preventive efforts to give up smoking are particularly effective for workers exposed to dust,
5. the implementation of the protective measures laid down in the operating instructions (see number 4) can substantially reduce the health risks,
6. in particular the proper handling and use of tools (see numbers 4.2 and 4.3) can substantially reduce these risks and there is an obligation to use and care for personal protective equipment.

(3) Under the Ordinance on Occupational Health Care (ArbMedVV) the employer must ensure within the framework of the occupational health preventive measures that there is appropriate occupational health care. The organisation of the occupational health care including the medical examinations imposes an obligation on the employer. If obligatory examinations under the annex of ArbMedVV must be organised the employer will keep a health register. This register must, in accordance with § 4 para. 3 of ArbMedVV, include details of the reason, date and result of each examination.

(4) If, for activities within the scope of the present TRGS, there is exposure to inhalable or alveolar dust, the employer must offer preventive medical examinations in accordance with the annex to ArbMedVV on the basis of the risk assessment. These examinations must be organised as compulsory examinations if the occupational exposure limits for inhalable dust (E dust) or alveolar dust (A dust) cannot be adhered to. The presence of quartz-bearing dust (silicogenic dust) at the workplace leads to a situation where the employer must offer the workers voluntary examinations under § 5 para. 1 in combination with annex part 1 para. 2 ArbMedVV where they are subject to exposure by inhalation.

(5) In the case of voluntary examination the employer is obliged to publicise the availability of the examinations; any contravention shall be subject under § 10 para. 1 No. 4 ArbMedVV to an administrative fine or under § 10 para. 2 ArbMedVV to a penalty. In the case of activities involving exposure to silicogenic dust it is urgently advisable to conduct preventive medical examinations according to occupational medical knowledge; the workers should therefore be made aware in an appropriate way of the preventive medical examinations available.

(6) Preventive medical examinations do not have to be offered if the conditions according to Article 6 (11) of GefStoffV apply.

(7) In the case of activities which require the wearing of respiratory protective equipment of group 1, preventive medical examinations must be offered in accordance with annex part 4 of ArbMedVV. If the wearing of respiratory protective

equipment of group 2 or 3 is required, preventive medical examinations must be organised in accordance with annex part 4 of ArbMedVV (compulsory examinations).

(8) Inhalable quartz may cause cancer of the respiratory tracts. The employer must therefore offer workers and former workers investigative examinations according to § 2 para. 6 No. 3 in combination with annex part 1 para. 3 ArbMedVV if they are exposed to quartz-bearing dust (silicogenic dust). After the termination of the employment the employer may transfer this obligation with the consent of the individual affected to the competent accident insurance institution.

Annex 1 to TRGS 559:**Assignment of activities involving mineral dusts to the exposure categories**

(1) Once the employer has identified the dust-polluted working areas and activities within the framework of the risk assessment, the protective measures required for these activities must be laid down. For this purpose the table in this annex should be referred to.

(2) In the table the column "Activities" lists typical activities where mineral dust arises or is released. One of three exposure categories is assigned to these activities in the column "Exposure categories".

(3) On the basis of the exposure category shown for the activity the protective measures are selected for the exposure category using the table in annex 2.

(4) After all the necessary protective measures which can be meaningfully implemented, lead to a reduction of the dust exposure and are listed in the table in annex 2 for the respective exposure category have been implemented, the employer will identify within the framework of the effectiveness check the exposure to mineral dust arising at the workplace.

(5) To assess whether the protective measures are adequately effective, the general dust limit value (OEL) can be referred to in relation to the A dust or E dust as the assessment criterion. When the OEL is exceeded further measures must be included according to the table in annex 2 of the same or the next highest exposure category.

(6) To assess the effectiveness of the protective measures for activities involving quartz-bearing mineral dusts the information available to date on the exposure for these activities must be used. The table in this annex gives information in the column "Exposure value range for quartz" concerning the concentrations identified for various activities.

(7) In addition to the 10% value (i.e. 10% of all measured values are below this value) and the 90% value (i.e. all measured values are below this value) the arithmetic mean (AM) of all measured values is listed. For some activities value ranges or approximate values are given because of the small number of measured values obtained, and for some activities the classification was determined on the basis of expert estimates.

(8) The concentrations identified in the effectiveness check must be compared with the relevant exposure value range. When comparing with the values of the exposure value range an assessment is now conducted of whether the technical protective measures are adequate or whether further measures are required. This aim is achieved when the concentration identified for mineral dust is within the value ranges indicated for the exposure categories 1 and 2, for quartz-bearing dust within the value ranges of exposure category 1 and below the arithmetic mean for quartz of exposure category 2 (see also number 3.2.7 para. 9).

(9) But the table in this annex does not indicate exposure value ranges for all activities. In part the activities are assigned to exposure categories by means of expert estimates although a sufficient quantity of measured data is not available for them. In such a case the effectiveness check by the procedure described in

paragraph 7 is not possible.

(10) In the case of individual activities, it is possible with the evaluation of the time portion of the activity in relation to the work shift to classify it in a lower exposure category.

(11) Activity values were obtained as the activity was being performed. No evaluation was conducted on the basis of the time portion of the activity in relation to the total exposure during a work shift.

(12) The following table also lists activities of exposure category 3 for comparison purposes which are not state of the art and are therefore inadmissible. The corresponding activities or machines must be included in a plan of measures and must be improved or retrofitted within a reasonable transitional period.

(13) When average values are given (without a range) the classification in an exposure category is based on the qualified estimate with reference to a small number of measured values and comparisons.

(14) The following table is not an exhaustive list, but can be added to and updated if required.

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
1	Concrete industry					
1.1	Packaging, storage, palleting and transport of concrete products	2	10% 0.003-90% 0.03; AM: 0.02	10% 0.09-90% 1.08; AM: 0.47	10% 0.19-90% 3.96 AM: 2.66	10: Table 42
1.1.1	In separate working areas, without activities due to dust release, regular cleaning of the working area	1	≈ 0.003	≈ 0.09		15:
1.1.2	With dust-polluted activities, such as displacement from areas with dust release	2	≈ 0.03	≈ 1.08		15:
1.2	Manufacture of concrete and precast concrete parts without post-working (shuttering and concreting work)	1	0.001-0.005 AM: 0.003	0.09-0.34 AM: 0.15		14:
1.3	Manufacture of large-format precast concrete parts	2	10% 0.003-90% 0.1 AM: 0.03	10% 0.14-90% 1.38 AM: 0.66		10: Table 39
1.4	Mixing of concrete	2	10% 0.003-90% 0.05 AM: 0.02	10% 0.18-90% 1.64 AM: 0.73		10: Table 36
1.5	Manufacture of concrete goods (concrete slabs, shafts, rings)	3	10% 0.01-90% 0.3 AM: 0.14	10% 0.31-90% 5.47 AM: 2.2	10% 0.31-90% 26.64 AM 8.7	10: Table 38
1.5.1	Shafts, rings	2	0.017-0.133 AM: 0.071			15:
1.5.2	Ceiling, walls	1	0.004-0.01 AM: 0.006			15:
1.5.3	Slab press, with extraction at hammer mechanism	3	0.019-0.21 AM: 0.076			15:
1.5.4	Boardmaker	3	0.003-0.62			15:
1.5.4.1	Boardmaker without sanding	2	0.003-0.13 AM: 0.031			15:
1.5.5	Vibration table	3	0.022-0.24 AM: 0.073			15:

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
1.5.6	Sliding table maker, mould cleaner with suction blower	1	0.004-0.054 AM: 0.025			15:
1.5.7	Floor maker	1	0.004-0.02 AM: 0.009			15:
1.5.8	Pipe maker	2	0.009-0.093 AM: 0.038			15:
1.6	Working and post-working of concrete in concrete factories					
1.6.1	Wet sawing	3	0.001-0.545 AM: 0.070			15:
1.6.2	Dry sawing, with extractor	3	0.009-0.203 AM: 0.071			15:
1.6.3	Wet grinding	3	0.02-0.132 AM: 0.085			15:
1.6.4	Dry grinding, with extractor	1	0.002-0.054 AM: 0.030			15:
1.6.5	Abrasive blasting system	3	0.001-0.272 AM: 0.047			15:
1.6.6	Bush hammer installation	2	0.005-0.097 AM: 0.053			15:
1.6.7	Concrete cosmetics	3	0.033-0.272 AM: 0.123			15:
1.6.8	Lining, sawing concrete shafts etc.	3	0.019-0.18 AM: 0.083			15:
1.6.9	Drilling of concrete ceilings, without extractor	2	0.033-0.13 AM: 0.066			15:
1.7	Manufacture of roofing tiles	2	10% 0.003- 90% 0.01 AM 0.01	10% 0.13- 90% 0.66 AM 0.35	10% 0.65- 90% 7.3 AM 3.35	10: Table 40 15:
2	Ceramic and glass industry					
2.1	Craft manufacture of practical and artistic ceramics (alternating activities, working only by kneading and mixing operations)	2	10% 0.003-0.04	10% 0.23-1.5	10% 0.15	10: Table 52 12.

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
			90% 0.03-0.1 AM: 0.03	90% 0.2-1.6 AM: 0.86	90% 1.7 AM: 0.5	
2.2	Wet working of fine ceramic compounds (no addition of bagged goods or dry material); e.g. stirrer, dissolver, slurry production, filter presses	2	10% 0.002-0.01 90% 0.06-0.15 AM.: 0.07	10% 0.14-0.28 90% 0.8-2.3 AM: 0.82		10: Tables 51. 53. 54
2.3	Working and preparation of quartz-bearing ceramic compounds (e.g. of porcelain, tiles, refractory products on a quartz base, earthenware, stoneware, brickwork products, glazes and enamel); old installations					
2.3.1	Old installations	3	10% 0.002-0.03 90% 0.09-0.47 AM: 0.11	10% 0.14-0.36 90% 1.0-2.3 AM: 0.99	90% 1.9-16.9	10: Tables 46 -54 12
2.3.2	New installations	2	10% 0.006 90% 0.12 AM 0.06	10% 0.18 90% 1.22 AM 0.72	10% 1.1 90% 8.5 AM 5.1	10: Tables 46 -54 12
2.4	Presses for tiles using dry compound (granulate)	2	10% 0.02- 90% 0.12 AM: 0.05	10% 0.2 - 90% 2.4 AM: 0.7	10% 0.4- 90% 6.0 AM: 1.5	13:
2.5	Firing of rough ceramic products, loading and unloading of kiln cars (bricks except for 2.6, large stoneware, split tiles and refractory products)	2	10% 0.002-0.01 90% 0.03 - 0.14 AM: 0.04	10% 0.12-0.21 90% 0.5 - 1.8 AM: 0.45	10% 0.04 90% 1.9 AM: 1.0	10: Table 47. 48. 49 12
2.6	Production of clinker (sanding installations and furnace area)	3	90% 0.15-0.22 AM: 0.14	90% 1.0-1.3 AM: 0.82	90% 1.8-17.0 AM: 8.8	12
2.7	Post-working of fired and glazed fine-ceramic products					

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
2.7.1	without machining, such as grading, painting, imprinting, Storage or packaging	1	10% 0.001-0.002 90% 0.01-0.04 AM: 0.015	10% 0.12-0.14 90% 0.23-0.7 AM: 0.28	90% 0.3 - 0.8	10: Tables 51. 52 12:
2.7.2	With machining in dry processes (e.g. grinding and cutting installations), with effective extraction	2	10% 0.001-0.005 90% 0.04-0.1 AM: 0.03	10% 0.11-0.17 90% 0.4-1.15 AM: 0.4	10% 0.2 90% 2.0 AM: 1.26	10: Tables 51. 53. 54 12
2.8	Production of technical, non-silicate ceramics (e.g. steatite, aluminium oxide, zirconium oxide, silicon carbide, silicon nitride)	2	10% 0.001- 90% 0.06 AM: 0.02	10% 0.18 90% 0.9 AM: 0.46	10% 0.08- 90% 2.2 AM: 1.16	12
2.9	Production of lime sand bricks					
2.9.1	Forming (pressing and entry into autoclaves)	3	10%: 0.003 90%: 0.05 AM: 0.01	10%: 0.18 90%: 2.8 AM: 1.24	10%: 0.5 90%: 16.7 AM: 6.26	10: Table 56 12
2.9.2	All other working areas except for forming	2	10%: 0.002 90%: 0.06 AM: 0.02	10%: 0.2 90%: 1.05 AM: 0.47	10%: 0.15 90%: 1.9 AM: 1.83	10: Table 56 12
2.10	Production and laying in of glass batches using quartz flour					
2.10.1	Old installations	3	90% 0.03-0.13	90% 0.3-3.3		13
2.10.2	Modern installations (largely closed systems or effectively extracted dust sources, regular cleaning of the working area)	2	10% 0.001-0.002 90% 0.01-0.06 AM: 0.007	10% 0.1-0.12 90% 0.2-1.3 AM: 0.5	10% 0.15 90% 6.7 AM: 4.56	10: Table 55 12
3	Gravel and sand industry, winning and preparation					
3.1	Winning of gravel and sand: transport and conveying as well as comparable activities					

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
3.1.1	Without comminution, such as by crushers or mills	2	10% 0.003-90% 0.08 AM: 0.04	10% 0.19-90% 1.42 AM: 0.83		10: Table 31
3.1.2	Excavated material from building pits, soils stored with medium density, mechanical and manual excavation	2	0.002-0.005 AM: 0.003	0.09-0.34 AM: 0.16		14: T
3.1.3	Loading/tipping of sand and gravel, closed driver cabin, with interior filter exposure category 1	2	0.00-0.02 AM: 0.01	0.01-1.24 AM: 0.46		14: T
3.1.4	Loading / tipping sand and gravel, open driver cabin	2	0.02-0.08 AM 0.04	0.21-1.54 AM 0.89		14: T
3.2	Preparation of gravel and sand, classification	3	10% 0.003-90% 0.35 AM: 0.14	10% 0.18-90% 1.52 AM: 0.75	10% 0.4-90% 6.92 AM: 2.87	10: Table 31 15:
3.2.1	Classification (screening) wet, inside an encased installation	2	≈ 0.1	≈ 0.75		15: ≈ 20% quartz fraction
3.2.2	Classification (screening) wet, open installation	2	≈ 0.003	≈ 0.18		15:
3.2.3	Classification (screening) dry, inside encased installation	3	≈ 0.35	≈ 1.52		15:
3.2.4	Classification (screening) dry, open installation	2	≈ 0.005	≈ 0.25		15:
3.2.5	Control panel, closed, air-conditioned, external ventilation	1	< detection limit	< detection limit	< detection limit	15:
3.3	Preparation of gravel and sand, comminution (crushing, grinding)	3	10% 0.01--90% 0.4 AM:0.14	10% 0.09-90% 2.26 AM: 1.09	10% 0.33-90 % 5.55 AM: 2.92	10: Table 31
3.3.1	With extractor	3	0.002--0.885 AM 0.276			15:
3.3.2	With spraying of the material / the crusher with water, (exposure time up to two hours)	3	0.006-0.95 AM 0.339			15:
3.3.3	Control panel closed, external ventilation, air-conditioned	1	< detection limit			15:
3.3.4	Supervisory personnel (on-site inspectors) outside control panel	3	0.242-1.4 AM 0.821			15:
3.3.5	With comminution, e.g. by crushers or mills, but without technical dust control measures (verified, effective extraction equipment or without spraying the material/crusher)	3	0.042-2.6 AM 0.977	2.26		15:
3.4	Winning and preparation of quartz sand					

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
3.4.1	Open cast mining, underground mine, winning, transport in works	3	10% 0.02- 90% 0.41 AM: 0.19	10% 0.19- 90% 1.17 AM: 0.62		10: Table 16
3.4.2	Wet preparation	3	10% 0.003- 90% 0.3 AM: 0.11	10% 0.11- 90% 0.56 AM: 0.37		10: Table 16
3.4.3	Dry preparation	3	10% 0.003- 90% 0.18 AM: 0.1	10% 0.05- 90% 0.85 AM: 0.34		10: Table 16
3.4.4	Grinding	3	10% 0.01- 90% 0.33 AM: 0.17	10% 0.05- 90% 0.9 AM: 0.39		10: Table 16
3.4.5	Bagging	3	10% 0.005- 90% 0.37 AM: 0.18	10% 0.09- 90% 0.93 AM: 1.48	10% 0.3- 90% 4.29 AM: 1.99	10: Table 16 15:
3.4.6	Transport, loading (product)	3	10% 0.01- 90% 1.35 AM: 0.41	10% 0.08- 90% 3.64 AM: 1.17		10: Table 16
3.4.7	Laboratory	2	10% 0.003- 90% 0.12 AM: 0.06	10% 0.09- 90% 0.42 AM: 0.24		10: Table 16
3.4.7.1	Laboratory (closed systems)	1	≈ 0.003	≈ 0.09		15:
3.4.8	Activities (e.g. conveying, weighing, packaging, charging, bagging, decanting) with dry quartz sand and quartz flour					
3.4.8.1	In separated working areas without further background pollution, with regular cleaning of the working area and verified effective extraction devices	(1)				4
3.4.8.2	In working areas not separated off with background pollution, without regular cleaning of the working area, with verified effective extraction devices	2				5
3.4.8.3	In working areas not separated off with background pollution, without regular cleaning of the working area and without	3				4. 5

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
	effective extraction devices					
4	Winning and preparation of quartz-bearing hard rocks in open-cast mining					
4.1	Winning, clearance and conveyance of quartz-bearing hard rocks in open-cast mining					
4.1.1	Winning, clearance and conveyance using earth-moving machines whose driver cabin has an air-conditioner with fresh air feed and adequate, functioning dust filter against alveolar dust particles which is always enclosed during winning and loading activities. Use of earth-moving machines with supply of breathing air according to BGI 581 In dry weather use of functioning spraying devices to suppress dust on site and on transport routes. Drill with dust suppression using water or foam	1				6
4.1.2	Winning, clearance and conveyance using earth-moving machines whose driver cabin has an air-conditioner with fresh air feed and adequate, functioning dust filter against alveolar dust particles, which is not always enclosed during winning and loading activities. With dry weather no adequate dust suppression on site and on transport routes. Drill with dust suppression using local air extraction	2	10% 0.003- 90% 0.14 AM: 0.06	10% 0.09- 90 % 0.96 AM: 0.49		7 10: Table 26 (corrected)
4.1.3	Winning, clearance and conveyance with use of earth-moving machines without air-conditioned or adequately externally ventilated driver cabin, without dust filter. In dry weather no dust suppression on site and on transport routes.	3				6. 7

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
	Drill without dust suppression at drill head.					
4.2	Preparation and loading of quartz-bearing hard rocks in open cast mining operations					
4.2.1	Comminution, e.g. by crusher or mills, screening, with verified, effective extraction devices/spraying with water Transport in enclosed systems (piping systems, encased belt system), regular cleaning of working areas.	2				8
4.2.1.1	In dry weather use of functioning spraying devices to suppress dust, e.g. on transport routes.	2				
4.2.2	Comminution, e.g. by crusher or mills, screening, with verified, effective extraction devices. Transport via open belt systems, with verified, effective extraction devices in the area of the transfer and discharge points, regular cleaning of working areas. In dry weather, no adequate use of spraying devices to suppress dust, e.g. on transport routes.	2				
4.2.3	Comminution, e.g. by crusher or mills, screening, transport via open belt systems, without verified, effective extraction devices in the area of transfer and discharge points, no regular cleaning of working areas In dry weather no use of spraying devices to suppress dust, e.g. on transport routes	3				
5	Natural stone industry					
5.1.	Preparation (crushing, grinding, classifying)	3	10% 0.01- 90% 0.65 AM: 0.2	10% 0.22- 90% 2.87 AM:1.25	10% 0.73- 90% 13.64 AM: 5.56	10: Table 27
5.1.1	Coarse comminution processes (jaw crushers), with extraction, water spraying	2				15:
5.1.2	Coarse comminution processes (jaw crushers), without extraction, water spraying	3				15:

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
5.1.3	Fine comminution processes (impact crushers, cone crushers)	3				15:
5.1.4	Control panel, closed, air-conditioned, externally ventilated	1	< detection limit	< detection limit	< detection limit	15:
5.2	Winning: clearance and conveyance, e.g. with excavator, wheeled loader, dumper	2	10% 0.003- 90% 0.14 AM 0.06	10% 0.09- 90% 0.96 AM 0.49	10% 0.18- 90% 4.67 AM 2.7	10: Table 26 (corrected) 15:
5.2.1	Closed, externally ventilated, air-conditioned cabin	1	≈ 0.03			15:
5.2.2	Without air-conditioning, windows, doors open	2	≈ 0.14			15:
6	Tunnelling in quartz-bearing rock					
6.1.1	Use of tunnelling machines (TBM) with effective systems for water atomisation, dust collection at drill head, dust removal at conveyor belt of material loading system and where relevant the tunnel belt system	1				9
6.1.2	Use of selective cut heading machine (TSM) with effective spraying and dust collection at the cutting head. Effective installation of the airducts at the cutting head or face (distance, suction capacity).	2				9
6.1.3	Use of earth-moving machines whose driver cabins do not have an air-conditioning system with fresh air feed and adequate, functioning dust filter against alveolar dust particles which is always closed during loading activity. Earth-moist roadway condition.	1				9
6.1.4	Use of earth-moving machines with breathing air supply according to BGI 581	1				14
6.2.1	Use of tunnelling machines (TBM) with inadequately effective systems of water atomisation, dust collection at the drill head, dust removal of conveyor belts and where relevant of the tunnel belt system.	2				
6.2.2	Use of selective-cut heading machines (TSM) with inadequately effective spraying and dust collection at the cutting head. Inadequate installation of the airducts at the cutting head or the face (distance, suction capacity).	2				

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
6.2.3	Use of earth-moving machines whose driver cabins have an air-conditioning system with fresh air feed and adequate, functioning dust filter against alveolar dust particles which is not always closed during the loading activity. Not always earth-moist roadway condition.	2				
6.3.1	Use of tunnelling machines (TBM) with non-effective systems with water atomisation, dust collection at the drill head, dust removal of the conveyor belt for material loading and where relevant the tunnel belt installation.	3				
6.3.2	Use of selective-cut heading machines (TSM) with non-effective spraying and dust collection at the drill head. Non-effective installation of the airducts to the cutting head or face (distance, suction capacity).	3				
6.3.3	Use of earth-moving machines without air-conditioned and adequately externally ventilated driver cabin, without dust filter. Dry roadway condition.	3				
7	Construction industry					
7.1	Application of plaster, exterior	1	0.00-0.05 AM: 0.014	0.12-1.76 AM: 0.58	0.81-4.22 AM: 2.35	14: T
7.2	Knocking off of plaster, interior	3	0.24-0.41 AM: 0.31	4.89-15.17 AM: 0.34	>> 10	14: T
7.3	Demolition work					
7.3.1	Demolition work, closed driver cabin, with filter, in the case of dust-binding measures (wetting of the demolition location) exposure category 1 also possible	2	0.01-0.13 AM: 0.04	0.03-2.01 AM: 0.72	0.7-7.44 AM: 1.96	14: T
7.3.2	Demolition work, open driver cabin, in the case of dust-binding measures (wetting of the demolition location) exposure category 2 also possible	3	0.01-0.28 AM: 0.10	0.16-3.25 AM: 1.47	1.36-98.79 AM: 18.21	14: T
7.3.3	Use of earth-moving machines with breathing air supply according to BGI 581	1				14
7.4	Creation of level surfaces/compacting work, earth-moving	1	0.00-0.05	0.05-0.55		14:

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
	devices, earth-moist compounds, with earth-moving machines		AM: 0.01	AM: 0.23		T
7.4.1	Creation of level surfaces, compacting work, hand-held machines, according to earth moistness/material exposure category 1 or 2 possible	3	0.00-0.66 AM: 0.08	0.1-3.65 AM: 0.76	0.35-12.17 AM: 4.17	14: T
7.5	Laying of paving stones or slabs on prepared level surfaces, without working the materials with, for example, cutting or grinding machines, without vibration	2	0.004-0.007 AM: 0.005	0.16-1.02 AM: 0.44		14: T
7.6	Cutting of paving stones					
7.6.1	Paving work, dry cutting, with inadequately effective extraction (inadmissible!)	3	0.03-5.74 AM: 2.618	3.38-20.87 AM: 8.89	20.49-87.71 AM: 43.18	14: T
7.6.2	Paving work, wet cutting, rinsing with circulating water, inadequate exchange of water (inadmissible!)	3				14:
7.6.3	Paving work, wet cutting, rinsing with fresh water, effective aerosol binding	2				14:
7.7	Milling of asphalt					
7.7.1	Milling off of asphalt coverings without effective extraction device	3	0.00 - 7.9 AM: 0.86	0.11-47.10 AM: 8.08	0.47-8.21 AM: 3.92	14: T
7.7.2	Milling of asphalt coverings with effective extraction device	2	0.002-0.151 AM 0.041	0.12-0.97 AM 0.34	0.78-8.67 AM 3.61	16: 11 T
7.8	Grinding, cutting, separating, slitting, milling work with fast-running machines					
7.8.1	With verified, effective extraction device, according to material being worked (bricks) also exposure category 1	2		< 3 mg/m ³	<10 mg/m ³	2. T
7.8.2	With verified, effective extraction device, under unfavourable conditions in old buildings, e.g. plaster milling and wall grinding for plaster of varying hardness, defective adhesion and high surface waviness	3				2. T
7.9	Wet sawing of masonry blocks					
7.9.1	Wet sawing of masonry blocks over limited time (general masonry work, cutting to size by user)	2	10% 0.01- 90% 0.15	10% 0.18- 90% 1.93		10: Table 92

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
			AM: 0.05	AM: 0.93		
7.9.2	Wet sawing of masonry blocks over considerable amount of time (division of labour at the masonry saw), with circulating water	3	0.022-1.6 AM: 0.63	0.42-21.1 AM: 6.37		14: T
7.9.3	Wet sawing of masonry blocks, with aerosol binding, rinsing with fresh water	1				
7.10	Mixing of powered mineral products	3		2.68 - 5.39 AM: 3.69	11.3 - 19.3 AM: 14.87	14: T
7.11	Stonemason's cabin					
7.11.1	Stonemason's cabin (working mix, granite, sandstone, hand and electric tools with additional extraction)	1	0.019-0.042			15:
7.11.2	Stonemason's cabin (working mix, granite, sandstone, hand and electric tools without extraction)	3	0.495-0.85			15:
8	Production of dry construction materials					
8.1	Production of dry construction materials (total)	3	10% 0.003- 90% 0.08 AM 0.05	10% 0.22- 90% 3.03 AM: 1.39	10% 0.69- 90% 18.05 AM: 7.91	10: Table 44 15:
8.1.1	Mixing	3	10% 0.003- 90% 0.08 AM: 0.03	10% 0.24- 90% 3.34 AM: 1.54	10% 0.54- 90% 10.57 AM: 3.73	10: Table 44 15:
8.1.2	Filling and packaging	3	10% 0.003- 90% 0.09 AM: 0.04	10% 0.24- 90% 2.99 AM: 1.4	10% 0.84- 90% 17.64 AM: 7.92	10: Table 44 15:
8.1.3	Loading and transport	3	10% 0.004- 90% 0.06 AM: 0.04	10% 0.16- 90% 2.34 AM: 0.98	10% 0.64- 90% 19.2 AM: 11.89	10: Table 44 15:
9	Asphalt mixing installations					
9.1	Asphalt mixing installations (total)	2	10% 0.003- 90% 0.08 AM: 0.03	10% 0.1- 90% 1.57 AM: 0.7	10% 0.3- 90% 4.24 AM: 1.88	10: Table 43 15:

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
10	Construction material recycling installations					
10.1	Construction material recycling and grading installations (total)	2	10% 0.004- 90% 0.13 AM: 0.05	10% 0.13- 90% 1.49 AM: 0.73		10: Table 34
10.2	Operation of mobile crusher/semi-mobile crusher and wheel loading/excavator(construction rubble + road rubble total, with extraction and water spraying exposure category 2 also possible)	3	0.002- 90% 0.35 AM: 0.07	0.05- 90% 2.95 AM: 0.74	AM: 9.94	18:
10.2.1	Operation of mobile crusher (construction rubble)	3	0.007- 90% 0.45 AM: 0.16	0.10- 90% 3.30 AM: 1.30		19:
10.2.2	Crusher, mill, classifying, screening	3	10% 0.01- 90% 0.25 AM: 0.1	10% 0.17- 90% 2.94 AM: 1.11		10: Table 34
10.2.3	Excavator and wheel loader driver (construction rubble)	3	0.007- 90% 0.11 AM: 0.04	0.007- 90% 1.50 AM: 0.70	0.10- 90% 2.20 AM: 1.50	19:
10.2.4	Grading	2	10% 0.004- 90% 0.09 AM: 0.04	10% 0.19- 90% 1.41 AM: 0.75		10: Table 34
11	Dental laboratories					
11.1	Activities in the dental laboratory, total	2	10% 0.002- 90% 0.026 AM 0.02	10% 0.10- 90% 0.89 AM 0.41	10% 0.32- 90% 4.91 AM 2.13	20
11.1.1	Investing	2	10% 0.01- 90% 0.017 AM 0.012	10% 0.28- 90% 0.89 AM 0.44	10% 0.71- 90% 3.27 AM 2.47	20
11.1.2	Devesting	2	10% 0.004- 90% 0.048 AM 0.04	10% 0.11- 90% 0.91 AM 0.51	10% 0.66- 90% 7.32 AM 2.97	20

	Activities	Exposure category	Exposure value range quartz; arithmetic mean (AM) [mg/m ³]	Exposure value range A dust; arithmetic mean (AM) [mg/m ³]	Exposure value range E dust; arithmetic mean (AM) [mg/m ³]	Literature/other explanations X ¹ T: activity value
11.1.3	Other activities such as mixing, finishing etc.	2	10% 0.001- 90% 0.015 AM 0.01	10% 0.09- 90% 0.53 AM 0.32	10% 0.48- 90% 3.25 AM 1.45	20
12	Metal foundry					
12.1	Core moulding shape	2	10% 0.005 90% 0.05 AM 0.03	10% 0.1 90% 1.08 AM 0.56		10: Table 59
12.2	Moulding shop	2	10% 0.005 90% 0.08 AM 0.04	10% 0.38 90% 2.14 AM 1.11		10: Table 60
12.3	Melting shop	3	<0.01 - 0.15 AM 0.06	10% 0.28 90% 3.27 AM 1.38		Quarz: 21: Table 3 A dust: 10: Table 61
12.4	Casting shop (casting hall)	2	10% 0.005 90% 0.11 AM 0.05	10% 0.33 90% 2.31 AM 1.09		10: Table 62
12.5.1	Plastering and abrasive blasting	2	10% 0.003 90% 0.1 AM 0.05	10% 0.32 90% 2.23 AM 1.16		10: Table 63
12.5.2	Plastering	3	10% 0.005 90% 0.18 AM 0.08	10% 0.29 90% 4.03 AM 1.72		10: Table 63
12.6	Knocking off	3	10% 0.01 90% 0.54 AM 0.2	10% 0.46 90% 2.27 AM 1.31		10: Table 64

The table is not exhaustive and will be extended and updated in accordance with the state of knowledge regarding the activities and workplaces.

X¹: Instructions for appropriate dust control measures in installations and during activities can be found in the legend according to the numbering of the list.

*) Installations according to the state of the art, regular cleaning

Legend to the table, column "Literature/Further explanations":

1. Practical guidelines for fine quartz dust, 2.2.11, 2.2.12
2. Type I machines, information under www.gisbau.de
3. Practical guidelines for fine quartz dust 2.2.6, 2.2.16
4. Practical guidelines for fine quartz dust 2.1.1; 2.1.5; 2.1.6; 2.1.9; 2.1.11; 2.1.13; 2.1.17; 2.1.18; 2.2.3a; 2.2.3b; 2.2.8; 2.2.19; 2.2.22; 2.2.29; 2.2.34
5. Practical guidelines for fine quartz dust 2.1.5; 2.1.6; 2.1.9; 2.1.11; 2.1.13; 2.1.17; 2.1.18; 2.2.3a; 2.2.3b; 2.2.8; 2.2.19; 2.2.22; 2.2.29
6. Practical guidelines for fine quartz dust 2.2.28; 2.2.35
7. Practical guidelines for fine quartz dust 2.2.28; 2.2.35
8. Practical guidelines for fine quartz dust 2.1.1; 2.1.2; 2.1.5; 2.1.6; 2.1.9; 2.1.11; 2.1.13; 2.1.16; 2.1.17; 2.2.3a; 2.2.3b; 2.2.6; 2.2.16; 2.2.29
9. Practical guidelines for fine quartz dust 2.1.11; 2.2.8
10. BGI Report 8/2006 Quartz exposure at the workplace
11. The need for respiratory protective equipment can arise from a possible asbestos exposure, see TRGS 517
12. Special measuring programme of the Berufsgenossenschaft (institution for statutory accident insurance and prevention) in the ceramics and glass industry (now: Berufsgenossenschaft in the administrative sector (banks, insurance companies, administrations, liberal professions and special undertakings) for determining the state of the art 1998 – 2000
13. Data of the Berufsgenossenschaft in the administrative sector (formerly : Berufsgenossenschaft in the ceramics and glass industry) from Mega-DOK
14. Data of the Berufsgenossenschaft in the building trade
15. Data of the Berufsgenossenschaft the chemical industry (formerly: Berufsgenossenschaft in the quarrying industry) from Mega-DOK (own analysis)
16. BGI 790-20: Use of road millers with the extraction systems – Milling asphalt coverings
17. Low-dust products, information available at www.gisbau.de
18. Final report A 6051/05 of the Institute for Hazardous Substances Research (IGF) on the joint research project of the Duisburg Industrial Associations (including exposure measurements during construction material recycling) dated 19.05.2005
19. Project of the Ländermessstellen (Measuring Organisations of the States) "Dust exposure at workplaces for construction rubble treatment installations", 2003/2004
20. Data of the Berufsgenossenschaft in the energy, textile and electrical industry (BGETE) from Mega-DOK (own analysis)
21. Practical instructions for good working practice – "Protection of workers against dusts and aerosols at foundry workplaces "

Annex 2 to TRGS 559:**Assignment of protective measures to the exposure categories**

(1) Before assigning protective measures to the exposure categories the extent, type and duration of the exposure must be identified, evaluated and documented. The measures of the exposure categories must not be applied cumulatively, but selected in a targeted way with respect to the activity in such a way that the protection goal is achieved. Depending on the specific circumstances it is not invariably necessary to apply all the protective measures described to the purpose of complying with an OEL or – if there is no such value – minimising the exposure.

(2) For the identification, assessment and documentation of risks see number 3.2 of the present TRGS.

No.	Measures	Exposure category 1	Exposure category 2	Exposure category 3	TRGS
1	Effectiveness check for the measures taken by - measurements (with documentation and disclosure) or process- and substance-specific criteria, or - recognised processes (BG/BGIA recommendations, LASI publications, sectoral regulations), or - representative measuring results (inventory, BGIA report "Quartz exposure at the workplace", conclusions by analogy, etc.)	X	X	X	3.2.7
2	Substitution check	X	X	X	4.1
3	Closed system or modification of the working process where possible given the state of the art taking account of the minimisation requirement	-	X	X	4.2 and 4.3
4	Selection and operation of machines and devices in such a way that as little dust as possible is released	X	X	X	4.3
5	Dust collection and workplace ventilation with verification of adequate effectiveness	(X) ¹	X	X	4.5
6	Fulfilment of the criteria when returning clean air	(X) ¹	X	X	4.6
7	Maintenance and testing of equipment for dust collection and workplace ventilations at least annually	(X) ¹	X	X	4.7
8	Regular cleaning of the operating equipment / avoidance of dust deposits	X	X	X	4.8
9	Prohibition of dry sweeping with a broom, instead wet cleaning or suction removal using suitable devices	X	X	X	4.8
10	Blowing off of dust deposits using compressed air only by using special protective measures (e.g. combined blowing/suction devices)	X	X	X	4.8
11	Regular cleaning of work clothing	X	X	X	4.9
12	Reduction in the number of dust-exposed workers and the extent of exposure	X	X	X	4.10
13	Operating instructions and courses of instruction	X	X	X	4.11
14	Shortening of the duration of exposure	-	(X) ²	X	4.12.1
15	Delimitation and marking of the hazard areas	-	(X) ²	X	4.12.1
16	Smoking prohibition at the workplace	-	(X) ²	X	4.12.1

No.	Measures	Exposure category 1	Exposure category 2	Exposure category 3	TRGS
17	Separate storage facilities for work clothing and street clothing	-	(X) ²	X	4.12.1
18	Plan of action for improving the dust exposure conditions	-	(X) ²	X	4.12.1
19	Provision and use of personal protective equipment in the case of risk	-	(X) ²	X	4.12.2
20	Making available of respiratory protective equipment (at least filter class P2 or FFP2 or TM1P or TH2P)	-	(X) ²	X	4.12.3
21	Use of respiratory protective equipment (at least filter class P2 or FFP2 or TM1P or TH2P) (see also annex 3)	-	(X) ³	X	4.12.3

(X)¹ If available after establishment of protective measures.

(X)² Applies only to quartz-bearing dust if the additional measures are required under number 3.2.7 para. 9 (or annex 1 para. 8).

(X)³ Applies only to quartz-bearing dust if laid down within the framework of the risk assessment according to TRGS 402 number 5.3.

Annex 3 to TRGS 559:**Selection of respiratory protective equipment**

Respiratory protective equipment against particles must be selected as a function of the level of dust exposure or the level of exposure to fine quartz dust according to the following table:

Level of dust exposure	Type and class of respiratory protective equipment		
	TH1P SG 1A/1B	FFP2, P2, TH2P, SG 2A/2B, TM1P	FFP3, P3, TH3P, SG 3A/3B, SG 4A/4B, TM2P
Exposure category 2	(X)	(X)	
Dust exposure M < 4 x OEL or Q < 0.6 mg/m ³		X	X
Dust exposure M < 10 x OEL or Q < 1.5 mg/m ³		X	X
Dust exposure M < 30 x OEL or Q < 4.5 mg/m ³			X

OEL = Occupational exposure limit (e.g. general dust limit value for A or E dust)

M = Mineral dust

Q = Quartz-bearing dust

(X) = Applies only to quartz-bearing dust if additional measures are required according to number 3.2.7 para. 9 (or annex 1 para. 8).

Normally half-face masks with particle filter of category P2 or filtering half-face masks FFP2 are sufficient; with higher dust exposures a higher equipment category may have to be selected. For work involving extreme dust exposure (M > 30 x OEL or Q > 4.5 mg/m³) full-face masks with particle filter of class P3 or insulation devices are required (e.g. when working in filtering systems).

Annex 4 to TRGS 559:

Further regulations

1 Acts, Ordinances and Technical Rules

- [1] Act on technical work equipment and consumer products (Equipment and Product Safety Act – GPSG),
- [2] Act on the performance of occupational safety and health measures to improve the safety and health protection of workers at work (Occupational Safety and Health Act – ArbSchG),
- [3] Act on the protection against hazardous substances (Chemicals Act – ChemG),
- [4] Ordinance on the protection against hazardous substances (Hazardous Substances Ordinance – GefStoffV) with related Technical Rules for Hazardous Substances (TRGS), especially
 - 1. TRGS 400 “Risk assessment for activities involving hazardous substances“
 - 2. TRGS 402 “Identification and assessment of the risks from activities involving hazardous substances: Inhalation exposure“,
 - 3. TRGS 420 “Process- and substance-related criteria (VSK) for the risk assessment“,
 - 4. TRGS 517 “Activities involving potentially asbestos-containing mineral raw materials and preparations and articles manufactured from them“
 - 5. TRGS 519 “Asbestos: demolition, reconstruction or maintenance work“,
 - 6. TRGS 521 “Demolition, reconstruction and maintenance work involving old mineral wool“,
 - 7. TRGS 555 “Working instructions and information for workers“
 - 8. TRGS 600 “Substitution“
 - 9. TRGS 900 “Occupational exposure limits“,
 - 10. TRGS 906 “List of carcinogenic activities or procedures according to Article 3 (2) No. 3 GefStoffV“.
- [5] Ordinance on occupational health care (ArbMedVV)
- [6] Ordinance on safety and health protection on construction sites (Construction Sites Ordinance - BaustellV),
- [7] Ordinance on workplaces (Workplaces Ordinance – ArbStättV) with related workplace directives (ASR), especially
- [8] ASR 34/1–5 "Changing rooms",
- [9] ASR 35/1–4 "Washrooms"
- [10] ASR 47/1–3,5 "Washrooms for construction sites"

2 Regulations, rules and information of the public accident insurance institutions

- [1] Accident Prevention Regulation "Principles of prevention" (BGV A1/GUV-V A1),
- [2] Accident Prevention Regulation "Construction work" (BGV C22/GUV-V C22),
- [3] BG-/GUV Rule "Principles of prevention" (BGR A1/GUV-R A1),
- [4] BG Rule "Workplace ventilation – ventilation measures" (BGR 121),
- [5] BG/GUV Rule "Use of respiratory protective equipment" (BGR 190/GUV-R 190),
- [6] BG Information "Mineral dust: Part 1: Quartz-bearing dust" (BGI 504-1-1),
- [7] BG Information "Dust exposure" (BGI 504-1-4),
- [8] BG Information "Code of practice for driver cabins with installations for supplying breathing air on earth-moving machines and special machines in foundation engineering" (BGI 581),
- [9] BG Information "BG/BGIA Recommendations for the risk assessment under the Hazardous Substances Ordinance, General Part" (BGI 790-001).

3 Standards

- [1] DIN EN 481 "Workplace atmospheres. Size fraction definitions for measurement of airborne particles",
- [2] DIN EN 1093-1 " Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods
- [3] DIN EN 15051 " Workplace atmospheres. Measurement of the dustiness of bulk materials. Requirements and reference test methods
- [4] VDI 2262 Workplace air; reduction of exposure to air pollutants
- [5] DIN EN 60335-2-69 / VDE 0700-69 Household and similar electrical appliances. Safety. Part 2-69: Particular requirements for wet and dry vacuum cleaners, including power brush, for commercial use (IEC 60335-2-69:2002, modified).

4. Other publications and information sources

- [6] GESTIS substances database (<http://www.dguv.de/ifa/gestis/index.jsp>),
- [7] BGIA Report 8/2006 "Quartz Exposure at the Workplace" (http://www.stbg.de/site.aspx?url=sich_ges/staub/nepsi/index.html),

- [8] Expert Committee Information „Praxisleitfaden Quarzfeinstaub, Leitfaden über bewährte Praktiken zum Gesundheitsschutz der Arbeitnehmer durch gute Handhabung and Verwendung von kristallinem Siliciumdioxid and dieses enthaltender Produkte“ [*Practical guide for fine quartz dust, guidelines on proven practices of health protection for workers through good handling and use of crystalline silicon dioxide and products containing this*] (http://www.stbg.de/site.aspx?url=sich_ges/staub/nepsi/index.html) (<http://www.nepsi.eu/good-practice-guide.aspx>),
- [9] Das Staubungsverhalten quarzfeinstaubhaltiger Produkte [*The Dust formation behaviour of products containing fine quartz*] – D. Dahmann, K. Möcklinghoff in: Gefahrstoffe – Reinhaltung der Luft 60 (2000) No. 5, pages 213 ff,
- [10] Umweltbundesamt (Herausgeber): Integrierte Vermeidung and Verminderung der Umweltverschmutzung, BVT-Merkblatt über die besten verfügbaren Techniken zur Lagerung gefährlicher Substanzen and staubender Güter, January 2005 [*Federal Environment Agency (publisher): Integrated avoidance and reduction of environmental pollution, BVT Factsheet on the best available techniques for the storage of dangerous substances and dusty goods*] (<http://www.bvt.umweltbundesamt.de/archiv/lagerung-gefaehlicher-substanzen.pdf>),
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