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<p style="text-align: center;">Technical Rules for Hazardous Substances</p>	<p style="text-align: center;">Activities involving high- temperature wool</p>	<p style="text-align: center;">TRGS 558</p>
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The Technical Rules for Hazardous Substances (TRGS) reflect the state of technology, occupational safety and 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)

compiles or adapts the rules and they are announced by the Federal Ministry of Labour and Social Affairs (BMAS) according to § 21 Subs. 4 of the Hazardous Substances Ordinance in the Joint Mineral Gazette (GMBI).

This TRGS concretizes within its scope the requirements of the Hazardous Substances Ordinance. Provided the Technical Rules are complied with the employer may assume that the relevant requirements of the Ordinance 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.

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1 Scope

(1) This TRGS applies to the protection of workers and other persons engaged in activities involving fibre dusts classified as carcinogenic which may be released during activities involving high-temperature wools (HTW).

(2) This TRGS must always be applied in the case of activities with products of aluminium silicate wools (ASW wools).

(3) This TRGS must also be applied if various products of high-temperature wools are used, processed or reworked in parallel at workplaces and hence dust mixtures

can arise.

(4) If work is carried out exclusively with polycrystalline wools (PCW), it is recommended that the measures described in this TRGS should also be applied.

(5) This TRGS does not apply to AES wools (e.g. wool of calcium-magnesium silicate fibres; CMS wool). In the case of activities involving such wools the basic protective measures for the prevention of risks according to § 8 GefStoffV in conjunction with number 4 of TRGS 500 "Protective measures" shall apply.

(6) This TRGS does not apply to old mineral wool insulation materials (glass wool, stone wool). For activities involving old mineral wool in demolition, refurbishment and maintenance work where fibre dusts classified as carcinogenic are released, the TRGS 521 "Demolition, refurbishment and maintenance work involving old mineral wool" shall apply.

(7) This TRGS concretizes the requirements for the protection of workers and other people according to the Hazardous Substances Ordinance and in particular in its annex III No. 2 "Particulate hazardous substances". If there is a deviation from these provisions, at least equivalent protective measures must be taken. The deviation must be justified in the documentation of the risk assessment.

(8) If the substance- and activity-related specifications of this TRGS are applied for the risk assessment and protective measures, the employer may assume for these items compliance with the specifications of the Hazardous Substances Ordinance.

2 Definitions

2.1 High-temperature wools

(1) The term high-temperature wools (HTW) is used to cover products of artificially produced mineral wools suitable for use as heat insulation material at temperatures above 600°C. High-temperature wool (HTW) is an accumulation of fibres of differing length and diameter which is made synthetically from mineral raw materials. The term high-temperature wool does not cover mineral wool insulation materials which, on account of their high biosolubility, satisfy the exclusion from liability criteria according to annex IV Number 22 Para 2 Nos. 1 to 3 GefStoffV.

(2) The group of high-temperature wools includes amorphous alkaline-earth-silicate wool/high-temperature glass wools (AES wools), aluminium silicate wools (ASW; former designation = ceramic fibres; Index Number 650-017-00-8 in annex VI part 3 table 3.1 and table 3.2 of the Regulation (EC) No. 1272/2008) as well as polycrystalline wools (PCW) with a classification temperature of > 1000 °C (see also VDI 3469; DIN-EN 1094).

2.2 Fibre dusts

Fibre dusts within the meaning of this TRGS are dusts which may be released from products of high-temperature wools. Fine dust particles with a length greater than 5 µm, a diameter smaller than 3 µm and a length-to-diameter ratio greater than 3 to 1 (WHO fibres) are regarded as alveolar.

2.3 Products

Products are substances, preparations and articles of HTW.

2.4 Thermal loading

(1) Products made of amorphous HTWs are subject to thermal load when they are exposed to a temperature, which has an adverse effect on the dust formation behaviour.

(2) When high-temperature insulation materials which have been exposed to temperature of above 900 °C are being removed, it must be expected that there will be a risk from silicogenic dust, especially cristobalite, in the case of aluminium silicate and AES wools, as well as other refractory linings (stones and compounds). The Technical Rule TRGS 559 "Mineral dust" must also be considered in such cases.

2.5 Dust formation behaviour

The dust formation behaviour describes the characteristic of products with regard to a possible release of fibre dusts and other particulate dusts.

3 Information gathering and risk assessment

3.1 General remarks on the risks of cancer with activities involving aluminium silicate and polycrystalline wools

(1) The extended form of particles is a carcinogenic active principle where the particles are sufficiently long, thin and bioresistant. Fibres which are at least 5 µm long, at the most 3 µm thick and for which the length-to-diameter ratio is at least 3 to 1 are assessed as being sufficiently long and thin (critical fibres).

(2) In the case of activities involving aluminium silicate and polycrystalline wools, fibre dusts with a carcinogenic mode of action may, according to this definition, be released.

(3) According to the current state of scientific knowledge it is not possible to discount a risk of cancer when these fibre dusts are inhaled. The fibre dusts released are evaluated as carcinogenic according to TRGS 905 "List of carcinogenic, mutagenic or toxic-to-reproduction substances".

(4) According to this fibre dusts of aluminium silicate wools (ASW) are to be assessed as carcinogenic in category 2¹ (substances which are to be regarded as carcinogenic for people. There are sufficient indications for the assumption that exposure of a human to the substance may cause cancer).

¹ Carcinogenic Category 2 according to Annex VI No. 4.2.1 of the Directive 67/548/EEC (Dangerous Substances Directive) or Category 1B according to Annex I No. 3.6 of the Regulation (EC) 1272/2008 (CLP Regulation)

- (5) Fibre dusts of polycrystalline wools (PCW) are to be evaluated within the meaning of TRGS 905 under the term "all other inorganic fibre dusts" (Number 2.3 Para 6 of TRGS 905) as carcinogenic in category 3² (substances are of concern because of the possible carcinogenic effect on people, but about which there is insufficient information for a satisfactory assessment. Suitable animal experiments have yielded a number of indications, but this is not sufficient to evaluate a substance as belonging to category 2).
- (6) Fibre dusts of AES wools (alkaline earth silicate wools) are not classified as carcinogenic.
- (7) For the assessment of the health risk with activities involving fibre dusts classified as carcinogenic within the framework of the risk assessment, not only the carcinogenic classification but also the intensity of the carcinogenic effect of fibre dusts is significant. The Committee on Hazardous Substances (AGS) has compiled substance-specific concentrations and an exposure-risk relationship (ERR) for aluminium silicate fibres³.
- (8) The exposure-risk relationship (ERR) for mineral fibres obtained for aluminium silicate wools (ASW; former designation = ceramic fibres), on which this TRGS is based, involves considerable uncertainties. Since, however, in the foreseeable future no additional knowledge concerning the intensity of the carcinogenic effect of aluminium silicate wools can be expected, no reduction can be expected in the uncertainties of the ERR either. For precautionary reasons the AGS has therefore decided, despite the uncertainties mentioned, to orient itself on the ERR when fixing the protective measures in the present TRGS.

3.2 General remarks on the risk assessment

- (1) Prior to commencement of the work the employer must conduct a risk assessment. The employer must first establish whether the workers carry out activities where fibre dusts classified as carcinogenic may be released. Operating and monitoring activities also have to be considered, for example, where they may lead to a risk to workers at work from fibre dusts classified as carcinogenic.
- (2) The employer must acquire the necessary information for the risk assessment from the persons placing the products on the market, the clients or other accessible sources. This includes in particular data from the safety data sheet.
- (3) The risk assessment must be conducted in relation to the specific activity by a knowledgeable person. The following points must be considered:
1. type, extent and duration of the inhalation exposure,
 2. working conditions and processes including the work equipment and quantity of products of high-temperature wool,
 3. requisite protective measures,
 4. protection against irritation to eyes, skin and mucous membranes,

² Carcinogenic Category 3 according to Annex VI No. 4.2.1 of the Directive 67/548/EEC (Dangerous Substances Directive) or Category 2 according to Annex I No. 3.6 of the Regulation (EC) 1272/2008 (CLP Regulation)

³ See Announcement on Hazardous Substances 910; www.baua.de

5. stipulations concerning the effectiveness check of the protective measures taken.

(4) Within the framework of the risk assessment the employer must systematically identify and evaluate the relevant risks to workers and lay down the necessary measures for their safety and health.

(5) The basis of establishing the measures for activities involving classified high-temperature wools is identification of the type and extent (level) of exposure of the workers and its duration, as well as an assessment of the inhalation risk involved in the activity with respect to the fibre dusts released. For fibre dusts the concentration is given in fibres/m³ (F/m³).

(6) Measuring results for comparable activities can be referred to in the risk assessment if the information gathering, the measuring procedure and the measuring result have been recorded in accordance with TRGS 402 "Identification and assessment of the risks from activities involving dangerous substances: inhalation exposure".

(7) If measurements are required to identify the exposure level (fibre dust concentration), the only measuring bodies which may be engaged for the purpose are those which have the necessary knowledge. The measuring results must be recorded and retained by the employer as personnel documents. In the case of company closures the measuring results must be handed over to the competent accident insurance institution. The measuring procedures are described in BGI 505-46.

(8) The laying down of measures (technical, organisational or personal) serves the purpose of eliminating the intake of fibre dusts by workers or minimising it.

(9) It must be checked whether the working procedures for the respective application have been selected in such a way that the release of fibre dusts is as low as possible.

(10) The employer must assess the effectiveness of the protective measures laid down in the risk assessment.

(11) According to the state of the art there are at present no procedures or activities available for the known applications of high-temperature wools which completely prevent the release of fibre dusts.

(12) The employer documents in the risk assessment under number 8 of TRGS 400 "Risk assessment for activities involving hazardous substances" among other things the workplaces at which risks to the respiratory tracts may arise due to high-temperature wools, the level of exposure, and what measures he has taken to minimise them and with respect to their effectiveness. If there is a deviation from the provisions of the present TRGS, at least equivalent protective measures must be taken. The deviation must be justified in the documentation of the risk assessment.

3.3 Concept of exposure categories (risk areas)

(1) The employer must lay down according to the level of risk from carcinogenic fibre dusts at the workplace the necessary protective measures. For carcinogenic hazardous substances a concept of graduated risk control is described in the Announcement on Hazardous Substances 910 "Risk figures and exposure-risk relationships for activities involving carcinogenic hazardous substances".

(2) Depending on the level of risk Announcement 910 mentions three risk areas: low, medium and high risk (= hazard area).

(3) The level of risk for activities involving carcinogenic fibre dusts is obtained from the level of fibre dust exposure and the duration and frequency of the activity.

(4) For many activities involving high-temperature wools the level of fibre dust exposure at the workplace and the duration and frequency of the activities are known.

(5) On this basis it is possible to assign to various activities a low, medium or high risk as well as the necessary, graduated protective measure categories.

(6) Evaluations of available exposure measurements⁴ from the years 2005 to 2009 testify to the fact that in the production, further processing and dismantling of high-temperature wool, fibre dust concentrations substantially above 100,000 F/m³ arise.

(7) In view of residual uncertainties it is possible that the scientifically acquired, substance-specific concentration figures for the acceptance risk and the tolerance risk for aluminium silicate fibres according to Announcement 910 may be both fallen below and exceeded by a factor of 2 when fixing the protective measures. The fibre dust concentrations given in Paras 8, 9 and 10 below are laid down as shift averages.

(8) Measures in the area of high risk – exposure category 3

1. Exposures with high risk apply when fibre dust concentrations in accordance with the tolerance risk are exceeded at the workplace.
2. If no exposure measurements are available, this must be assumed for activities lasting more than 40 days per year.
3. The protective measures listed in Numbers 4.3, 4.4 and 4.5 or 4.6 and the activity-specific measures in the annex of this TRGS must be taken.

(9) Measures within the area of medium risk – exposure category 2

1. Exposures in a medium risk apply when fine dust concentrations are present at the workplace in the range between tolerance and acceptance risk.
2. If no exposure measurements are available, this must be assumed for activities lasting more than 40 hours but less than 40 days in a year.
3. Where exposure peaks occur, e.g. when cutting strips of insulation wool, respirators must be worn (e.g. particle-filtering half-face masks FFP2).

Protective measures given in Numbers 4.3 and 4.4 and the activity-specific measures given in the annex to this TRGS must be taken.

(10) Measures in the area of low risk – exposure category 1

1. Exposures with a low risk apply when fine dust concentrations at the workplace at the level of the acceptance risk are fallen below.
2. Experience shows that this is the case when activities lasting less than 40 hours in a year are carried out, and with the
 - a) manufacture and recycling of catalytic converters and diesel soot particle filters
 - b) operating and monitoring activities for industrial furnaces

⁴ See Literature Nos. 33, 34 and 35 in Number 6 of this TRGS

- c) sale and distribution of products of aluminium silicate and polycrystalline wools.

The protective measures listed in Number 4.3 and the activity-specific measures given in the annex to this TRGS must be taken.

3.4 Effectiveness check

(1) As a result of the risk assessment methods for checking the effectiveness of the existing protective measures and those still to be taken must be laid down. In this way it is intended to ensure that the protective measures reduce over the period of the activities the exposure by the degree required for the safety and health of the workers.

(2) In the effectiveness check the employer must identify:

1. whether the protective measures have reduced the fibre dust exposure to the required degree,
2. whether the effectiveness of the protective measures is also assured over the period of the activity.

Re 1.: The check of the effectiveness of the protective measures taken or those still to be taken can be conducted as follows, for example:

- a) measurements of the air-borne fibre dust concentration at the workplace,
- b) check of the air flow through smoke tubes,
- c) check of the extraction capacity,
- d) use of machines which have been tested with respect to extraction and separation capacity,
- e) leak tests.

Re 2.: The effectiveness of the protective measures taken is ensured over the period of the activity by the following measures, for example:

- a) identification of the fibre dust exposure, e.g. by regular measurements of the exposure,
- b) periodic checks to ensure the effectiveness of the technical protective measures according to the advances in the state of the art, taking account of the details from the manufacturer and the requirements of the German Equipment and Product Safety Act (GPSG),
- c) regular check of technical parameters, such as the air speed of extraction systems, air exchange rate,
- d) regular change of filter,
- e) regular check, e.g. using smoke tubes, of whether the extractors are correctly positioned,
- f) regular servicing to maintain the functioning and effectiveness of the technical installations,
- g) check as to whether the technical installations are used, cleaned and serviced correctly,

h) leak test.

(3) Technical protective measures, e.g. ventilation and extraction equipment, must be checked regularly to establish their proper functioning and effectiveness. Other technical equipment to protect against inhalable dusts must be tested at least annually. The employer can lay down the intervals himself within this specified framework. The manufacturer's information and other statutory specifications must be complied with. The result of the check must be recorded and documented.

(4) The employer must ensure that the necessary technical and organisational measures laid down in the risk assessment are implemented; the workers must use the personal protective equipment according to the operating instructions.

(5) To check whether the technical and organisational measures taken are sufficiently effective in the exception areas, the exposure must be identified according to the state of the art after the protective measures have been implemented.

(6) The exposure identified must be assessed with a view to the risk for the 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 can be expressed as follows:

1. Protective measures adequate,
2. Protective measures not adequate.

If the finding is "not adequate" additional measures are needed to reduce the fibre dust exposure in order to attain the finding "Protective measures adequate".

4 Protective measures

4.1 General remarks

(1) With activities involving classified HTWs the employer must conduct a substitution test in accordance with GefStoffV, Article 7 (1) No. 5 and Article 9 (1) and document this test within the framework of the risk assessment. TRGS 619 "Substitute materials for aluminium silicate wool products" contains criteria according to which a substitution test and its documentation can be conducted.

(2) Where it is not possible to conduct a substitution for concrete applications according to TRGS 619 and TRGS 600 "Substitution", suitable forms of product or working procedures must be used in order to minimise the exposure to fibre dusts during the activity:

1. Suitable forms of product include, for example:
 - a) preassembled products,
 - b) laminated products,
 - c) shaped parts,
 - d) products involving little dust formation.
2. Suitable working procedures include, for example:
 - a) procedures described in greater detail in this TRGS,

- b) other working procedures by the Berufsgenossenschaften (institutions for statutory accident insurance and prevention) or approved by the authorities
- c) the use of work equipment and procedures which produce little dust,
- d) wetting in the case of demolition work (where technically possible).

(3) The aim should always be the reduction of exposure (level and duration); the necessary technical and organisational measures must be carefully implemented.

(4) With activities involving thermally loaded vitreous HTW (> 900 °C) silicogenic dusts – especially cristobalite – may be released⁵. This only applies to servicing, repair and dismantling.

(5) If, during activities, activity-specific exposures which are elevated for short periods occur and if technical protective measures are not appropriate, the exposure of the workers must invariably be minimised by the wearing of respiratory protective equipment (FFP2) in all exposure categories (e.g. pouring into the mixer, brief cutting of expansion strips, short-term servicing and maintenance work with fibre dust exposure, cleaning of filters).

4.2 Organisational measures

(1) Activities involving high-temperature wools may only be carried out if it has been ensured that the company has available the personnel and safety equipment for such work and that this is suitable. These requirements also apply with respect to waste disposal.

(2) The employer may only have activities involving high-temperature wools carried out by workers who are suitable for the purpose, who have been given instruction on the hazards arising and are familiar with the protective measures and the response in an emergency.⁶

(3) The number of workers in the working areas concerned must be restricted to the minimum necessary to perform the work envisaged.

(4) Alongside the workers directly carrying out activities involving high-temperature wools, other workers or other persons must be included in the risk assessment where their safety and health may be at risk as a direct consequence of the activity and their presence in the risk area is indispensable.

(5) With servicing and repair work and the rectification of malfunctions the employer may only assign persons who have been trained in possible risks and protective measures and who can apply this knowledge independently.

(6) Working areas in which activities involving high-temperature wools are carried out must be clearly marked off from other working areas and may only be made accessible to workers who have to enter them to perform their work or certain tasks. Unauthorised persons must be prohibited from entering such areas by means of prohibition signs bearing the text »Stop, No Entry« in accordance with the Workplace Rule ASR A 1.3 "Safety and health signs and labels".

⁵ TRGS 559 "Mineral dust" must also be complied with.

⁶ see Article 7 Occupational Safety and Health Act

(7) Organisational and hygienic measures must be taken to prevent the entrainment of fibres into areas not subject to such exposure and this must be laid down in the operating instructions.

(8) Workers who carry out activities involving high-temperature wools may not eat or drink any food and beverages at their working premises or at their workplaces in the open. For such workers areas (recreation areas) must be installed where they may eat or drink food and beverages without any impairment to their health.

4.3 Basic measures for exposure category 1 during manufacture, processing and dismantling

(1) For activities of exposure category 1 the provisions of number 4 of TRGS 500 must basically be complied with. As these generally applicable measures are being implemented, it must also be ensured that protection is provided against irritation to eyes, skin and mucous membranes from thin fibres.

(2) Activities involving classified high-temperature wools must be included on a one-off basis in the company's hazardous substances list in relation to the company and the site.

(3) Minimisation of exposure is recommended. The working procedure and the quantity of substance must be optimised by the employer with respect to minimum exposure duration and minimum number of persons exposed. Works agreements can be concluded to cover this.

(4) The working procedure must be selected in accordance with the state of the art in such a way that as little fibre dust as possible is released. This requires careful, low-dust working.

(5) If possible only products which are preassembled and cut to fit may be used.

(6) Products are to be unpacked carefully only after they have arrived at the place of installation or processing; any unnecessary handling of the products must be avoided.

(7) Cutting to size must be performed as far as possible manually with a knife or scissors. If it is not possible to cut to size manually (e.g. large shaped parts, high density of the products, etc.), band saws should be used with an extractor and slow-running, non-set saw blade (with serrations).

(8) It must be arranged that all rooms, installations and devices are regularly cleaned. The working areas affected must be designed – as far as possible – that they can be cleaned at any time.

(9) For cleaning work suitable dust collection appliances must be used (industrial vacuum cleaners or mobile dust removers (at least dust class M⁷), central extraction systems) or wet cleaning procedures must be applied according to the state of the art (e.g. wet sweeping machines).

(10) Working instructions must be drawn up in accordance with TRGS 555 "Working instructions and information for workers" and they must describe the risks, rules of

⁷ See DIN EN 60335-2-69 Annex AA. A positive list of tested, dust-removing machines is published regularly in the BIA Manual, No. 510210.

conduct and protective measures for activities involving high-temperature wools in relation to the specific workplaces and activities.

(11) The workers must be given oral instruction on the basis of the working instructions prior to commencement of the activity and subsequently at regular intervals, but at least once a year. The course of instruction must be documented.

(12) The employer must ensure that for all workers general occupational medical and toxicological advice is provided in accordance with the Hazardous Substances Ordinance. The workers must be taught about the voluntary examinations on offer and the special health risks involved in the inhalation of classified fibre dusts. In this context information must be given on the personal protective equipment (respirators) available.

(13) For the activities the workers should wear loose-fitting working clothes and protective gloves of leather or nitrile-coated cotton gloves. If the worker has sensitive skin, a skin care agent should be applied after the work has been performed.

(14) It is recommended that personal protective equipment (respirators – at least particle-filtering half-face masks FFP2, goggle in the case of overhead work) be provided. If activities are carried out where exposure peaks may occur (e.g. cutting individual strips of insulation), respiratory protective equipment must be worn.

(15) Workers who wear burdensome respiratory protective equipment must be given an occupational medical examination in accordance with ArbMedVV.

(16) A washing facility with running water, facilities for hygienic hand drying and agents of cleaning the skin must be provided.

(17) The product, residues, waste and material waste from cutting may not be thrown. Any dust and dust deposits arising may not be blown using compressed air or swept up dry, but taken up with industrial vacuum cleaners (category M) or wet cleaning.

(18) Cutting waste, residues and packaging of high-temperature wools may not be stored openly in the working areas. The employer must provide dust-tight, labelled containers in sufficient quantities for this purpose and must ensure that they are disposed of safely and in an orderly fashion.

(19) Waste must be packaged in a dust-tight fashion at the place of origin, if necessary moistened and labelled. Closed containers (e.g. barrels, tear-resistant polyethylene bags, big bags) must be used for transport purposes.

(20) In order to fix the permissible disposal route, waste must be assigned to the types of waste of the European Waste Catalogue (EWC). According to the national Waste Catalogue Ordinance (AVV) waste of high-temperature wool not subject to load (e.g. production waste) have the waste code number 170603*. In the case of waste from thermally loaded high-temperature wool the waste code numbers must be selected with a view to their area of application.

4.4 Measures for exposure category 2 in manufacture, processing and assembly

(1) All measures of exposure category 1 must be taken. In addition, the following measures are necessary.

(2) The employer must take mandatory technical measures according to the state of the art. This includes at least the measures listed in annex 1 of the present TRGS for the respective activities.

(3) The employer must submit to the competent supervisory authority on request the risk assessment and a plan of measures for reducing the exposure level.

(4) The plan of measures describes how a further reduction in exposure is to be achieved. The description must take into account the following aspects:

1. in what periods
2. to what extent and
3. on the basis of which measures

the reduction is to be achieved.

(5) If it is not possible to prevent the release of fibre dusts, they must be completely collected by ventilation means at the point of exit or origin where this is possible and then safely disposed of.

(6) Workplaces must be spatially separated to prevent any exposure of workers in other adjacent working areas to fibres released.

(7) In working areas in which activities are carried out which involve fibre dusts of category 2 classified as carcinogenic, air extracted there may not be returned. As a deviation from sentence 1 air extracted in a working area may be returned there if it has been adequately purified of such substances using procedures or devices approved by the authorities or the Berufsgenossenschaften (institutions for statutory accident insurance and prevention). The air must then be conducted or purified in such a way that these fibre dusts do not pass into the breathing air of other workers. With regard to the return of air TRGS 560 "Air return when handling carcinogenic substances" must be adhered to.

(8) If exposure peaks occur, the employer must lay down as mandatory the use of respiratory protective equipment by the workers. Furthermore he must provide them with respiratory protective equipment. Suitable respirators are half-face masks with P2 filter or particle-filtering half-face masks FFP2. It is recommended that respirators with blower support be used (type TM 2P, from case to case also blower-assisted helmets of the type TH 2P). In the case of systems with blower support the limitations on wearing times of BGR 190 no longer apply.

(9) The employer must organise the cleaning or disposal of the working or protective clothing.

(10) Washing facilities or washrooms and rooms with separate storage facilities (lockers) for street and working clothing must be provided.

4.5 Measures for exposure category 3 in manufacture, processing and assembly

(1) All measures of exposure categories 1 and 2 must be carried out. Furthermore additional measures must be taken to reduce exposure.

(2) The employer must provide workers with personal protective equipment (PPE). Suitable respirators are half-face masks with P3 filter or particle-filtering half-face

masks FFP3. It is recommended that respiratory protective equipment with blower support be used (type TM 3P, from case to case also blower-assisted helmets type TH 3P). In the case of systems with blower support the limitations on wearing times of BGR 190 no longer apply.

(3) For all jobs breathable protective suits must be worn (preferably single-use protective suits type 5 according to DIN EN ISO 13982). After use the protective suits must be collected in tightly sealed containers and disposed of. The employer must organise the cleaning and disposal of the protective clothing.

(4) The personal protective equipment provided must be used by the workers.

4.6 Additional measures during repair and dismantling work

(1) All measures of exposure categories 1, 2 and 3 must be taken. Furthermore additional measures must be taken to reduce the exposure.

(2) The working process must be selected according to the state of the art in such a way that as little fibre dust as possible is released, e.g. non-destructive removal, mobile extraction devices, wetting during demolition work.

(3) Organisational protective measures must be taken to reduce the number of exposed persons to a minimum. Only authorized persons may be granted access to the working areas (in a radius of approx. 6 m). The working areas affected must be marked in addition, e.g. using a barrier tape.

(4) Objects, machines and equipment in the area around the workplace (radius of approx. 6 m) which are difficult to clean must be covered if technically and organisationally possible.

(5) For filling purposes only use products which as far as possible do not release any (fibre) dusts (e.g. plastic compounds).

(6) Before and during the dismantling of furnace linings of high-temperature wool and other refractory material, the material to be removed should be moistened, if technically possible, by atomized water spray. The use of liquid jets is not permissible. To remove linings, low-dust, as far as possible directly extracted procedures must be used.

(7) Material of high-temperature wool which has been knocked out may not be left lying in the working areas, but must be collected in plastic bags or sealable and labelled containers.

(8) The working areas and the objects, machines and equipment located there and which were not covered during the work must be cleaned immediately after completion of the work. In the case of longer lasting activities cleaning must be performed at least at the end of each shift. The working areas to be cleaned are laid down within the framework of the risk assessment.

(9) For all thermally loaded refractory products above 900°C (HTW and refractory material in general) in linings it must be expected in addition that silicogenic dust, in modified form cristobalite, will arise because of the recrystallisation processes. This does not apply to polycrystalline wool.

5 Other regulations and factsheets

- [1] Ordinance on protection against hazardous substances (Hazardous Substances Ordinance – GefStoffV) of 23 December 2004, last amended on 18 December 2008
- [2] Ordinance on safety and health protection in the provision of work equipment and its use at work, on safety in the operation of plants subject to mandatory inspection and on the organisation of workplace occupational safety and health (Plant Safety Ordinance – BetrSichV)" of 27 September 2002 , last amended on 18 December 2008
- [3] Ordinance on workplaces (Workplaces Ordinance – ArbStättV) – of 12 August 2004; last amended on 18 December 2008
- [4] Ordinance on safety and health protection on construction sites (Construction Sites Ordinance - BaustellV) of 10.06.1998; last amended on 23 December 2004
- [5] TRGS 400 "Risk Assessment for Activities involving Hazardous Substances"
- [6] TRGS 402 "Identification and assessment of the risks from activities involving dangerous substances: inhalation exposure"
- [7] TRGS 500 "Protective measures"
- [8] TRGS 555 Working instructions and information for workers"
- [9] TRGS 560 "Air return when handling carcinogenic substances"
- [10] TRGS 619 "Substitute materials for aluminium silicate wool products"
- [11] TRGS 900 "Occupational exposure limits"
- [12] TRGS 905 "List of carcinogenic, mutagenic or toxic-to-reproduction substances"
- [13] TRGS 906 "List of carcinogenic activities or procedures according to Article 3 (2) No. 3 GefStoffV"
- [14] Announcement on Hazardous Substances 910 "Risk figures and exposure-risk relationships in activities involving carcinogenic hazardous substances "
- [15] Workplace Rule ASR A 1.3 "Safety and Health Signs and Labels"
- [16] Guidelines for the risk management of the AGS; annex II; Use of ceramic fibre products for the high-temperature insulation of industrial furnaces; pages 39 ff; Committee on Hazardous Substances - AGS (1998); www.baua.de
- [17] BG Rule: Use of protective clothing (BGR 189)
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Annex 1: Activity-related measures for the reduction of fibre dust exposure

Activity	Additional activity-related measures for the reduction of fibre dust exposure, going beyond those measures described in the exposure categories
Forms of vacuum	
1. Pouring into the mixer	- Low-dust disposal of bags ("bag-in-bag principle").
2. Forms of vacuum and setting aside of wet parts	- Remove product splashes in wet state.
3. Dryer mode	<ul style="list-style-type: none"> - Conduct dryer exhaust air to the outside in accordance with TA Luft clean air directives. - Harmonise cleaning with the working sequences in dryer mode.
4. Remove shaped parts from drying grid and set aside	<ul style="list-style-type: none"> - Clean dry plates, dry grids and frames wet regularly. - Air-permeable dividing papers on the dry grids can reduce soiling.
5. Machining: turning, drilling, milling and sawing	<ul style="list-style-type: none"> - In the case of machining adapt local extraction to the machining operation. Enclosures on these operations can have a supporting effect. - In the case of manual working, use extraction benches or other extraction devices. - As far as possible use water cutting process.
6. Packing	<ul style="list-style-type: none"> - Adapt packing to size of shaped parts to avoid major abrasion. - Choose packing which prevents fibre dusts from arising during transport operations. - Avoid reworking of shaped parts when packing. - If technically possible extract at packing location.
Module production	
1. Cutting mats to size	- Adapt local extraction to machining operation.
2. Pressing of module strips	- Adapt local extraction individually to the press.
3. Handling (setting aside)	<ul style="list-style-type: none"> - Cautious handling (e.g. do not throw). - Avoid drafts. - If technically possible extract at workplace.
4. Trimming of modules	- Use dust-reducing work procedures, e.g. extracted band saw with serrations.
5. Packing of modules	- Adapt packing to the module size to avoid major abrasion.

Activity	Additional activity-related measures for the reduction of fibre dust exposure, going beyond those measures described in the exposure categories
	Punching
1. Laying on and feeding of materials for punching	<ul style="list-style-type: none"> - Careful laying on of materials. - Use local extraction.
2. Punching and removal of finished parts and punching residues	<ul style="list-style-type: none"> - Adapt local extraction individually to the punch.
3. Packing of the finished punched parts and punching residues	<ul style="list-style-type: none"> - Set aside punched parts and punching residues in low-dust fashion. - For further handling (e.g.: interim deposition) use extraction benches or other extraction devices. - Adapt packing to size of punched parts to avoid major abrasion.
	Catalytic converter and diesel soot particle filter
1. Manual assembly (punched parts, plate, monolith)	<ul style="list-style-type: none"> - Assembly on grate extraction benches or other suitable extraction devices. - Clean extraction bench or devices regularly when switched on.
2. Recycling	<ul style="list-style-type: none"> - Separation of components under enclosure with extraction. - Cut open the used catalytic converter with encapsulated band saw. - Carefully remove parts of HTW wool within the enclosure (e.g. mounting mat) and immediately place in a dust-tight container until appropriate disposal.
	Repair of kiln car
1. Disassembly	<ul style="list-style-type: none"> - Monitored removal of refractory materials. - Before and during disassembly wet refractory materials as far as possible with atomised water spray or water jet. - Adapt local extraction to the operation.
2. Assembly	<ul style="list-style-type: none"> - Use prefabricated products as far as possible.
2.1 Machining of products (cutting, drilling)	<ul style="list-style-type: none"> - Adapt extraction to machining operation.
2.2 Installation of new products	<ul style="list-style-type: none"> - Adapt local extraction to the operation.

Activity	Additional activity-related measures for the reduction of fibre dust exposure, going beyond those measures described in the exposure categories
	Products of aluminium silicate wools in industrial furnaces
1. Lining/Installation	<ul style="list-style-type: none"> - Assembly and removal of furnace parts and assembly in the open or well ventilated rooms. - Maintenance of joints in furnace interior with local extraction - Replacement of individual mats, modules or plates in the furnace interior with local extraction.
2. Disassembly	<ul style="list-style-type: none"> - Disassembly with local extraction. - Application of wet procedure (with complete soaking – if technically possible). - Application of atomised water spray if wet procedure not possible.