

Air Pollution Control



# Air Recirculation in Fume and Dust Extraction Systems

Status: March 2015



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## Introduction

Air recirculation is an issue that is gaining increasing significance – ideally, the heat removed during extraction should be reused for reasons of energy efficiency. Here the operator of a system treads a narrow path between occupational health and safety requirements on one hand, and energy savings and thus, climate protection, on the other. In principle and according to existing rules and regulations, occupational health and safety always takes precedence. Where air is routed to atmosphere, the stipulations of the Federal Immission Control Ordinances (BImSchV) need be observed.

The VDMA Dust Extraction Working Group, which is formed by manufacturers of extraction systems and units for all kinds of smokes, fumes and dusts, has decided to publish a brochure on air

recirculation in consultation with the Institute for Occupational Health and Safety (IFA) of the German Social Accident Insurance. The purpose of this brochure is to describe the current state (March 2015) of the relevant rules and regulations so as to facilitate handling in practice.

The brochure is a revised and updated version of the first edition published in 2009.

# 1. Scope

In Germany, recirculation of air from fume and dust extraction systems is governed by the Hazardous Substances Ordinance (GefStoffV). Air recirculation is permitted for all substances except for carcinogenic, mutagenic and reprotoxic substances of category 1 or 2 (CMR<sub>F</sub> (1,2)-substances). A revised version of the Hazardous Substances Ordinance will be published in the course of 2015. The revision also includes changes to the German terminology: “krebserzeugend” (causing cancer) is replaced by “karzinogen” (carcinogenic), “erbgutverändernd” (causing genetic defects) by “mutagen” (mutagenic) and “fruchtbarkeitsgefährdend” (threatening fertility) by “reproduktionstoxisch” (toxic for reproduction or reprotoxic). Furthermore, changes are made to the classification into categories 1, 2 and 3 for “substances known to cause cancer in humans” (category 1, in future 1A), “substances which should be regarded as causing cancer in humans” (category 2, in future 1B) and “substances which cause concern owing to possible carcinogenic effects in humans but for which available information is insufficient to allow an adequate assessment” (category 3, in future 2).

There are exceptions from the general ban on air recirculation of CMR<sub>F</sub> (1,2)-substances, which are described in Section 10 (5) GefStoffV and explained in detail in TRGS 560.

Substances for which air recirculation is permitted must be maintained within the occupational exposure limits (OELs, German: AGW). They are specified in TRGS 900 and are compiled, along with the EU-wide classifications of the EU-GHS (CLP)-Regulation 1272/2008 and the recommendations of the “MAK Commission”, in the IFA Report “List of Limit Values”.

The EU classifications and the values/classifications specified in TRGS 900 “Occupational exposure limits”, in TRGS 905 “List of carcinogenic, mutagenic or reprotoxic substances” and in TRGS 906 “List of carcinogenic activities or procedures according to Section 3 Subs. 2 No. 3 GefStoffV” are legally binding.

If a substance is not mentioned in any of these rules and regulations, further criteria can be used. These include the recommendations of the “MAK Commission” (MAK list), but also international limit values, DNELs (derived no-effect levels), or the former technical reference concentrations (“TRK-Werte”), which are no longer applicable. At any rate, dusts and smokes/fumes, even without specific effect, are subject to the “General dust limit value” specified in TRGS 900 for the respirable dust fraction (A-dust, 1.25 mg/m<sup>3</sup>) and the inhalable dust fraction (E-dust, 10 mg/m<sup>3</sup>).

Where air recirculation of CMR<sub>F</sub> (1,2)-substances has been permitted in exceptional cases, the exposure-risk relationships (“ERB-Werte”) as per TRGS 910 “Risk-related concept of measures for activities involving carcinogenic hazardous substances” must be observed at the workplace.

Further information on ventilation is provided in VDI 2262 Part 3 “Workplace air – Reduction of exposure to air pollutants – Ventilation technical measures” and BGR 121 “Workplace ventilation – Ventilation measures” (DGUV Rule 109-002).

Hazards due to biological or microbiological (viral or bacterial) agents must be taken into account but are not addressed in this brochure. For further information, see e.g., Biological Agents Ordinance, “yellow information sheets” on biotechnology.

## 2. Rules and regulations

### **Hazardous Substances Ordinance (GefStoffV) (as of July 2013)**

The Hazardous Substances Ordinance describes protective measures and activities involving hazardous substances. The ordinance is also applicable to activities involving carcinogenic, mutagenic and reprotoxic substances (CMR<sub>F</sub> (1,2)-substances).

Teratogenic substances, R<sub>E</sub>, are not addressed in the GefStoffV. This brochure can be applied to R<sub>E</sub>-substances by analogy.

The stipulations of the Hazardous Substances Ordinance are binding and must be complied with.

They are specified in detail in the technical rules (TRGS). However, it is also permissible to achieve the protection goals described therein using other procedures than those described.

Standards and guidelines (e.g. DIN, VDI) show possible methods for achieving the protection goals.

### **Technical Rule for Hazardous Substances: TRGS 402 (as of April 2014)**

TRGS 402 "Identification and assessment of the risks from activities involving hazardous substances: inhalation exposure" describes methods for identifying exposure levels. This includes both measurement and non-measurement techniques. The methods for assessing the exposure and the effectiveness of (technical) protective measures are described. Furthermore, requirements are specified which are to be met by testing bodies that perform exposure identification and assessment.

### **Technical Rule for Hazardous Substances: TRGS 517 (as of March 2014)**

TRGS 517 "Activities with potentially asbestos-containing mineral raw materials and preparations and articles manufactured from them" describes the extraction, working, processing and the treatment as well as recycling of potentially asbestos-containing mineral raw materials. Although the majority of raw materials have an asbestos content below 0.1 % by mass, high concentrations of asbestos fibres (in fibres per m<sup>3</sup> of air) can occur at the workplace. Asbestos concentrations are subject to tolerance limits (100.000 F/m<sup>3</sup>) and acceptance limits (10.000 F/m<sup>3</sup>). The action plans – including, e.g., breathing protection – are matched to these risks. Moreover, blower-assisted breathing protection is required for activities involving asbestos concentrations in excess of 300.000 F/m<sup>3</sup>.

### **Technical Rule for Hazardous Substances: TRGS 519 (as of January 2014)**

TRGS 519 "Asbestos: Demolition, reconstruction or maintenance work" deals with the requirements to be met by persons carrying out such work (only specific activities being permitted) and with the protective measures to be observed to ensure that neither employees nor the environment are exposed to hazardous asbestos-containing dust. Here, too, the acceptance and tolerance concentrations for asbestos specified in TRGS 517 are used to derive protective measures. Furthermore, the requirements regarding ventilation measures, ventilation and air-conditioning systems, industrial vacuum cleaners and dust extractors are described.

**Technical Rule for Hazardous Substances:  
TRGS 521 (as of February 2008)**

TRGS 521 “Demolition, reconstruction and maintenance work with biopersistent mineral wools” describes work with biopersistent mineral wools (manufactured until approximately 1996) which can release fibrous dusts classified as carcinogenic. Depending on which type of work is performed, the activities are distinguished into three exposure categories. In exposure category 1, where no or only very limited exposure to fibres occurs, the fibrous-dust concentration is below 50.000 F/m<sup>3</sup>. Even with this concentration, a cancer risk cannot be excluded. Therefore, further minimisation measures must be aimed at. Specific protective measures are described for this exposure category as well as for exposure categories 2 (50.000 to 250.000 F/m<sup>3</sup>) and 3 (> 250.000 F/m<sup>3</sup>).

**Technical Rule for Hazardous Substances:  
TRGS 528 (as of February 2009)**

TRGS 528 “Welding work” addresses the hazards posed by smokes and fumes such as those arising during welding, thermal cutting, thermal spraying and soldering. This technical rule also describes measures according to the STOP principle (substitution, technical, organisational and personal protective measures). With regard to ventilation measures, extraction at the source is described as the first action to take. Various procedures can be used to this end, such as torch-integrated extraction, or extraction arms on mobile or stationary extraction systems. If these measures do not suffice, further ventilation measures can be taken. In doing so, it must be ensured that the air is sufficiently purified of welding fumes. Units used for this purpose must have a test certificate based on an individual measurement or must be certified for welding-fume separation class W2 or W3.

**Technical Rule for Hazardous Substances:  
TRGS 553 (as of August 2008)**

TRGS 553 “Wood dust” describes activities involving the release of wood dust and methods for capturing and separating such dust. If the air extracted is to be recirculated into the working area, it is required, among other things, that the filter penetration is 0.5 % or less and that the filter surface velocity does not exceed 150 m<sup>3</sup>/m<sup>2</sup>h.

**Technical Rule for Hazardous Substances:  
TRGS 559 (as of September 2011)**

TRGS 559 “Mineral dust” supplements the technical rules TRGS 517, 519 and 521, describing, among other things, activities involving the exposure of employees to respirable dusts of quartz and cristobalite. Here, too, the principle of exposure categories is used. Ventilation measures are described for the case when the primary measures have not resulted in sufficient reduction of the dust concentration. First, this includes the capture of dust at the point where it is released. If this does not suffice, workplace ventilation is to be provided, the latter being subject to stringent rules if the air is to be recirculated into the working area. The concentration of A-dust in the recirculated air shall not exceed 0.25 mg/m<sup>3</sup>; for E-dust, the maximum allowed concentration is 1 mg/m<sup>3</sup>. Moreover, the concentration of fine quartz dust shall not exceed 0.015 mg/m<sup>3</sup> and the fine-dust penetration through the filter system shall be less than 0.005 %.

**Technical Rule for Hazardous Substances:  
TRGS 560 (as of January 2012)**

TRGS 560 "Air recirculation during handling carcinogenic, mutagenic and reprotoxic dusts" applies to activities and procedures involving the possible occurrence of these substances in the form of suspended particulate matter (dusts, smokes/fumes).

It is not applicable to liquid aerosols and gaseous substances.

TRGS 560 distinguishes between carcinogenic and highly carcinogenic substances (see Appendix 3 of this brochure).

**Technical Rule for Hazardous Substances:  
TRGS 900 (as of December 2014)**

TRGS 900 "Occupational exposure limits" contains the list of occupational exposure limits (OELs/AGW) with the respective time-weighted average concentrations and associated short-term values.

**Technical Rule for Hazardous Substances:  
TRGS 905 (as of March 2014)**

TRGS 905 "List of carcinogenic, mutagenic or reprotoxic substances" contains a list of these substances.

**Technical Rule for Hazardous Substances:  
TRGS 906 (as of March 2007)**

TRGS 906 "List of carcinogenic activities or procedures according to Section 3 Subs. 2 No. 3 GefStoffV" contains a list of activities or procedures involving the release of carcinogenic substances.

**Technical Rule for Hazardous Substances:  
TRGS 910 (as of October 2014)**

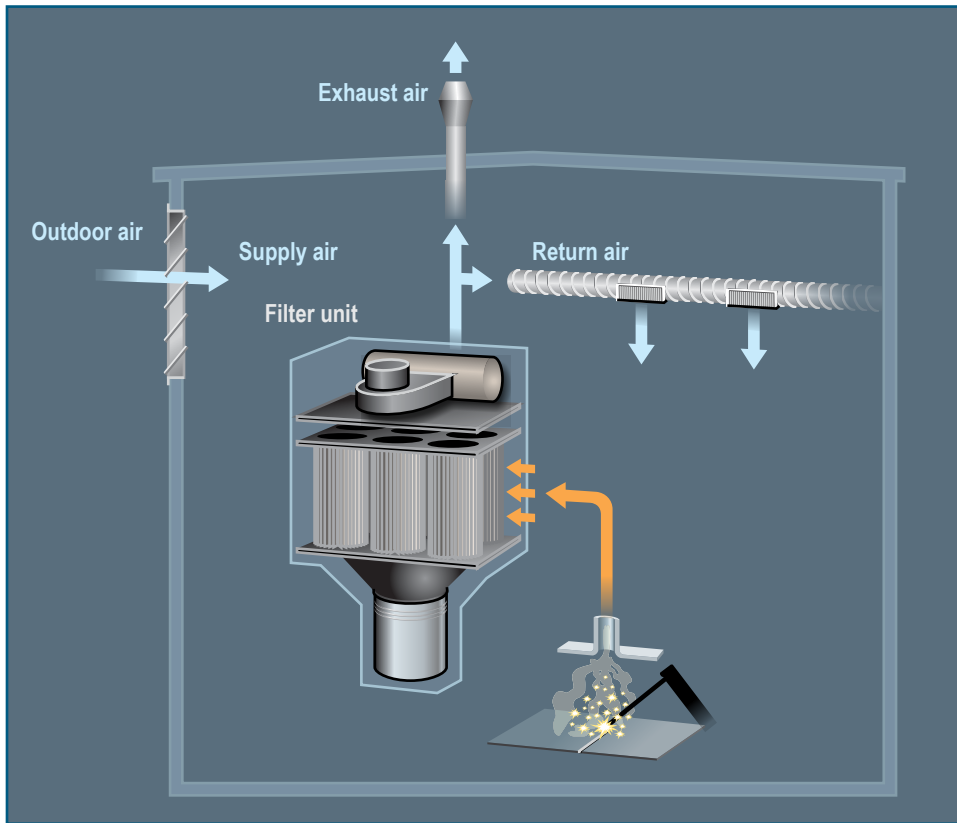
TRGS 910 "Risk-related concept of measures for activities involving carcinogenic hazardous substances" specifies in detail the minimisation requirement as per Section 7 GefStoffV. It applies to activities with carcinogenic substances.

TRGS 910 describes an acceptance risk and a tolerance risk. The risk of getting cancer is 4:1.000 for the tolerance risk and 4:10.000 for the acceptance risk. The acceptance risk is due to be lowered to 4:100.000 by 2018. The risks correspond to acceptance and tolerance concentrations which are specified in TRGS 910, Annex 1.

An overview of the relevant rules and regulations is given in Appendix 1.



### 3. Terms and definitions



**Working area (as per TRGS 402)**

The working area is that spatially or organisationally defined plant section to be assessed where one or several employees can perform activities involving hazardous substances. The working area can be comprised of one or of several workplaces or procedures.

**Occupational exposure limit (OEL/AGW)**

Limit value to be met by the concentration of a chemical hazardous substance in workplace air, specified in TRGS 900 since 2005.

**Outdoor air**

Airflow from outdoors through a ventilation unit or an opening in the room envelope

**Exhaust air**

Airflow routed to the atmosphere

**Supply air**

Airflow entering a room (or workspace)

**Return air**

Filtered airflow which is reintroduced into the room

### CMR substances

TRGS 905 lists substances which are carcinogenic, mutagenic or reprotoxic. The subscript letter “F” stands for fertility and subscript letter “E” for embryo (teratogenic). The figure in parentheses (1, 2, 3) indicates the respective category:

- Category 1 (new: 1A):  
Effect on humans has been demonstrated,
- Category 2 (new: 1B):  
Effect on humans is to be assumed on the basis of sufficient evidence,
- Category 3 (new: 2):  
Suspected to have an effect, but not classified in a higher category due to insufficient information.

### Air recirculation

Recirculation of extracted air which is returned into the working area following sufficient purification. The heat carried by the air and a residual content of hazardous substances are also returned into the working area.

### Safety filter

The safety filter is provided downstream of another filter separator. Should the latter fail, for example owing to damage, the safety filter will then perform the purification task. It is exclusively designed as a safeguard a function that usually requires monitoring by means of differential-pressure gauges.

### Heat recovery

Heat recovery is the reuse of heat through heat exchange between exhaust air and supply air via special heat recovery systems. For process-inherent reasons, no hazardous substances are recirculated (except in the case of rotary heat exchangers).

Abbreviation	Definition	Link
AGW/OEL	Occupational Exposure Limit	<a href="http://www.dguv.de/ifa/Fachinfos/Arbeitsplatzgrenzwerte/index.jsp">http://www.dguv.de/ifa/Fachinfos/Arbeitsplatzgrenzwerte/index.jsp</a>
A-dust	Respirable fraction	<a href="http://www.dguv.de/staub-info/Was-ist-Staub/A-Staub/index.jsp">http://www.dguv.de/staub-info/Was-ist-Staub/A-Staub/index.jsp</a>
BGR	Rule of a German statutory accident insurance institution	<a href="http://www.dguv.de">http://www.dguv.de</a>
BImSchV	Ordinances implementing the Federal Immission Control Act	<a href="http://www.bmub.bund.de">http://www.bmub.bund.de</a>
DGUV	German Social Accident Insurance	<a href="http://www.dguv.de">http://www.dguv.de</a>
DIN	German Institute for Standardisation	<a href="http://www.din.de">http://www.din.de</a>
DNEL	Derived no-effect level	<a href="http://www.dguv.de/ifa/Gefahrstoffdatenbanken/GES-TIS-DNEL-Datenbank/Was-sind-DNELs/index.jsp">http://www.dguv.de/ifa/Gefahrstoffdatenbanken/GES-TIS-DNEL-Datenbank/Was-sind-DNELs/index.jsp</a>
ERB	Exposure-risk relationship	<a href="http://www.dguv.de/ifa/Fachinfos/Exposition-Risiko-Beziehung-(ERB)/index.jsp">http://www.dguv.de/ifa/Fachinfos/Exposition-Risiko-Beziehung-(ERB)/index.jsp</a>
E-dust	Inhalable fraction	<a href="http://www.dguv.de/staub-info/Was-ist-Staub/E-Staub/index.jsp">http://www.dguv.de/staub-info/Was-ist-Staub/E-Staub/index.jsp</a>
GefStoffV	Hazardous Substances Ordinance	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/Rechtstexte/Gefahrstoffverordnung.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/Rechtstexte/Gefahrstoffverordnung.html</a>
IFA	Institute for Occupational Health and Safety	<a href="http://www.dguv.de/ifa">http://www.dguv.de/ifa</a>
CMR	Carcinogenic, mutagenic or reprotoxic (terms used as of mid-2015)	<a href="http://www.dguv.de/ifa/Fachinfos/KMR-Liste/index.jsp">http://www.dguv.de/ifa/Fachinfos/KMR-Liste/index.jsp</a>
MAK	Maximum workplace concentration	<a href="http://www.bfga.de/arbeitschutz-lexikon-von-a-bis-z/fachbegriffe-j-r/mak-wert-fachbegriff">http://www.bfga.de/arbeitschutz-lexikon-von-a-bis-z/fachbegriffe-j-r/mak-wert-fachbegriff</a>
TA Luft	Technical Instructions on Air Quality Control	<a href="https://www.umweltbundesamt.de/sites/default/files/medien/1/dokumente/taluft_stand_200207241.pdf">https://www.umweltbundesamt.de/sites/default/files/medien/1/dokumente/taluft_stand_200207241.pdf</a>
TRGS	Technical Rule for Hazardous Substances	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRK	Technical reference concentration	<a href="http://www.bfga.de/arbeitschutz-lexikon-von-a-bis-z/fachbegriffe-s-u/trk-wert-fachbegriff">http://www.bfga.de/arbeitschutz-lexikon-von-a-bis-z/fachbegriffe-s-u/trk-wert-fachbegriff</a>
VDI	The Association of German Engineers	<a href="http://www.vdi.de">http://www.vdi.de</a>

## 4. Principles of air recirculation

Air recirculation is possible with all substances that are not carcinogenic, mutagenic or reprotoxic (category 1 or 2 in each case).

Under strict exceptional conditions, air recirculation is also possible with CMR<sub>F</sub> (1,2)-substances. The airflow must then be directed in such a manner that CMR<sub>F</sub> (1,2)-substances do not enter the air inhaled by employees.

VDI 2262 Part 3 stipulates a maximum limit of 0.6 mg/m<sup>3</sup> for the residual dust content in purified air.

The issue of air recirculation is governed by the Hazardous Substances Ordinance, Section 10 (5), and the details of the regulation are specified in TRGS 560.

### 4.1 General requirements

#### VDI 2262 Part 3:2011-06

Where air recirculation is permissible, the fraction of recirculated air in the total supply air shall not exceed 70 %. Per 1.000 m<sup>3</sup>/h of return air, at least 430 m<sup>3</sup>/h of outdoor air shall be additionally supplied to the room. If the supply air occurs by means of natural ventilation through windows, doors and gates, it can be assumed as a reference value, as simple air changes per hour. This means that the air volume is replaced in the room once per hour. In modern (dense) buildings air exchange can be considerably lower. Each individual case, however, needs be considered.

#### Mobile dust extractors/industrial vacuum cleaners

The requirements regarding mobile dust extractors and industrial vacuum cleaners with air recirculation into the working area depend on the substances to be extracted.

According to DIN EN 60335-2-69, the following requirements apply to mobile dust extractors and industrial vacuum cleaners:

- Substances for which OEL > 1 mg/m<sup>3</sup>:  
arrestance > 99 % (dust class L),
- Substances for which OEL ≥ 0.1 mg/m<sup>3</sup>:  
arrestance > 99.9 % (dust class M),
- Substances for which OEL < 0.1 mg/m<sup>3</sup> and carcinogenic hazardous substances:  
arrestance > 99.995 % (dust class H).

#### Chip and dust extraction systems with fixed installation

According to DIN EN 12779 (2015), which is addressed to the manufacturer, chip and dust extraction systems with fixed installation designed to use return air shall meet, e.g., the following requirements/residual dust contents:

- Residual dust content < 0.1 mg/m<sup>3</sup>,
- Continuous monitoring of residual dust in the return air and possibility to change over to exhaust air:
  - When the residual dust content lies between 0.1 mg/m<sup>3</sup> and 0.3 mg/m<sup>3</sup>, a warning signal (optical and/or acoustic alarm) must be given.
  - When the residual dust content exceeds 0.3 mg/m<sup>3</sup>, a malfunction alarm must be tripped, and the extraction system must either change over from return air to exhaust air or must stop automatically.

In case of hazards posed by biological or microbiological (viral or bacterial) agents, the extraction system must be designed in such a manner that air recirculation is impossible.

#### Chip and dust extraction systems for indoor installation

According to DIN EN 16770 (2015), which is addressed to the manufacturer, chip and dust extraction systems for indoor installation shall meet, amongst other requirements, a residual dust content < 0.1 mg/m<sup>3</sup>.

## 4.2 Requirements for CMR<sub>F</sub> (1,2)-substances not governed by specific regulations

### Hazardous Substances Ordinance/TRGS 560

According to Section 10 (5) GefStoffV, air extracted from working areas in which activities involving CMR<sub>F</sub> (1,2)-substances are performed shall not be reintroduced into these areas.

By way of derogation, recirculation of the air extracted from a working area is permissible provided that the air has been sufficiently purified of such substances using procedures or equipment approved by the authorities or by the statutory accident insurance institutions.

The requirements as per Section 10 GefStoffV can also be met by applying Technical Rules for Hazardous Substances (TRGS) and the protective measures contained therein. Examples of such substance-specific TRGS which describe activities involving CMR<sub>F</sub> (1,2)-substances include:

- TRGS 517 “Activities with potentially asbestos-containing mineral raw materials and preparations and articles manufactured from them”
- TRGS 519 “Asbestos: Demolition, reconstruction or maintenance work”
- TRGS 521 “Demolition, reconstruction and maintenance work with biopersistent mineral wools”
- TRGS 528 “Welding work”
- TRGS 553 “Wood dust”
- TRGS 559 “Mineral dust”.

If none of the aforementioned TRGS are applicable, the stipulations of TRGS 560, which describes the air recirculation of CMR<sub>F</sub> (1,2)-substances, shall apply. Air recirculation is prohibited for hazardous substances as per Appendix II No. 2 and No. 6 GefStoffV, which are also listed in Appendix 3 of this brochure.

TRGS 560 exclusively applies to fumes and dusts, excluding liquid aerosols and gases. It only applies to the recirculation of air that has previously been captured and purified systematically: ventilation and air-conditioning systems are not addressed.

If the operating conditions permit and the effort is reasonable, the captured and purified air shall be discharged outdoors. If the operating conditions forbid exhaust-air operation, units with an arrestance in excess of 99.995 % (e.g. dust class H) shall be used for air recirculation.

According to GefStoffV Annex I No. 2, the dusts shall be captured as fully as possible at the point of release or at the source.

The relevant details are specified in TRGS 560: Where the capture efficiency is below 85 %, improving capture is the highest priority. This factor then determines the dust content in the breathing air.

Where air recirculation is permissible, the fraction of recirculated air in the total supply air shall not exceed 50 %. Per 1.000 m<sup>3</sup>/h of return air, at least 1.000 m<sup>3</sup>/h of outdoor air shall be additionally supplied to the room (with respect to the supply air by natural ventilation, see Section 4.1, text of VDI 2262).

Proper functioning and effectiveness of capture and separation units must be checked prior to initial commissioning, after substantial changes and at least once a year.

Moreover, the following activities shall be carried out:

- inspection on each working day,
- periodic maintenance as per manufacturer’s instructions and
- any repair work shown to be necessary as a result of such inspection or maintenance.

#### **Mobile dust extractors/industrial vacuum cleaners**

For mobile dust extractors and industrial vacuum cleaners (except those for wood dust), the requirements as per DIN EN 60335-2-69 apply:

- carcinogenic hazardous substances: arrestance > 99.995 % (dust class H).

#### **Welding fumes**

According to TRGS 528, welding fumes containing carcinogenic hazardous substances such as, e.g., nickel oxide or chromium(VI) compounds shall be extracted using exclusively such units for the capture of welding fumes which conform to welding-fume separation class W2 (separation efficiency  $\geq 98\%$ ) or W3 (separation efficiency  $\geq 99\%$ ) as per DIN EN ISO 15012-1:2005-03. The new, 2013 edition of said standard has been revised to only describe units of welding-fume separation class W3.

## **5. Summary**

Air recirculation is possible provided that relevant rules and regulations are observed (see Appendix 2).

For CMR<sub>f</sub> (1,2)-substances, air recirculation is not generally permitted.

However, there are exceptions to this general rule. Either the authority (e.g. occupational health and safety inspectorate) grants a permit in the individual case, or a procedure is chosen which complies with the conditions outlined in substance-specific TRGS or in TRGS 560.

# Appendix 1

## Compilation of rules and regulations

Regulations and technical rules	Title	Link
EU Chemicals Directive	67/548/EEC	<a href="http://eur-lex.europa.eu/legal-content/de/ALL/;ELX_SESSIONID=G15JTrFQLP4l7xJnCGT2nsY1sQT51v-J7KDNnTL2ZwpY2IbXGWgCpI-905312744?uri=CELEX:32006R1907">http://eur-lex.europa.eu/legal-content/de/ALL/;ELX_SESSIONID=G15JTrFQLP4l7xJnCGT2nsY1sQT51v-J7KDNnTL2ZwpY2IbXGWgCpI-905312744?uri=CELEX:32006R1907</a>
EU-GHS(CLP) Regulation 1272/2008	REGULATION (EC) NO. 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No. 1907/2006	<a href="http://www.reach-clp-biozid-helpdesk.de">http://www.reach-clp-biozid-helpdesk.de</a>
GefStoffV	Hazardous Substances Ordinance	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 402	Identification and assessment of the risks from activities involving hazardous substances: inhalation exposure	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 517	Activities with potentially asbestos-containing mineral raw materials and preparations and articles manufactured from them	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 519	Asbestos: demolition, reconstruction or maintenance work	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 521	Demolition, reconstruction and maintenance work with biopersistent mineral wools	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 528	Welding work	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 553	Wood dust	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 559	Mineral dust	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 560	Air recirculation during handling carcinogenic hazardous substances	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 900	Occupational exposure limits	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 905	List of carcinogenic, mutagenic or reprotoxic substances	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>

Regulations and technical rules	Title	Link
TRGS 906	List of carcinogenic activities or procedures according to Section 3 Subs. 2 No. 3 GefStoffV	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
TRGS 910	Risk-related concept of measures for activities involving carcinogenic hazardous substances	<a href="http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html">http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html</a>
DGUV 109-002 (former: BGR 121)	Workplace ventilation – Ventilation measures	<a href="http://www.dguv.de">http://www.dguv.de</a>
DIN EN ISO 15012-1	Health and safety in welding and allied processes – Equipment for capture and separation of welding fume – Part 1: Requirements for testing and marking of separation efficiency	<a href="http://www.beuth.de">www.beuth.de</a>
DIN EN 12779	Safety of woodworking machines – Chip and dust extraction systems with fixed installation – Safety requirements	<a href="http://www.beuth.de">www.beuth.de</a>
DIN EN 16770	Safety of woodworking machines – Chip and dust extraction systems for indoor installation – Safety requirements	<a href="http://www.beuth.de">www.beuth.de</a>
DIN EN 60335-2-69	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, modified)	<a href="http://www.beuth.de">www.beuth.de</a>
VDMA 24179-2	Wood dust and chip extraction systems – Requirements regarding design and operation	<a href="http://www.beuth.de">www.beuth.de</a>
VDI 2262-3	Workplace air – Reduction of exposure to air pollutants – Ventilation technical measures	<a href="http://www.beuth.de">www.beuth.de</a>
GESTIS-Substance database	Information system on hazardous substances of the German Social Accident Insurance	<a href="http://www.dguv.de/bgja/stoffdatenbank">http://www.dguv.de/bgja/stoffdatenbank</a>



## Appendix 2

# Compilation of requirements

A distinction is to be made between manufacturer's and operator's duties. The relevant list is set out below:

Rules and regulations	Operator's duties		Manufacturer's duties
	Technical Rules for Hazardous Substances	Fraction of recirculated air in total supply air as per VDI 2262 Part 3	Standard
<b>Hazardous substances</b>			
Activities with potentially asbestos-containing mineral raw materials and preparations and articles manufactured from them	TRGS 517: stipulations of TRGS 560 arrestance min. 99.995 %, e.g. dust class H	≤ 50 %	DIN EN 60335-2-69: dust class H
Asbestos: demolition, reconstruction or maintenance work	TRGS 519: dust class H + Attachment 7 of TRGS 519	≤ 50 %	DIN EN 60335-2-69: dust class H
Demolition, reconstruction and maintenance work with biopersistent mineral wools	TRGS 521: industrial vacuum cleaners min. dust class M	≤ 50 %	DIN EN 60335-2-69: dust class H
Welding work – carcinogenic	TRGS 528: welding-fume separation class W2 or W3	≤ 50 %	DIN EN ISO 15012-1: welding-fume separation class W3
Welding work – not carcinogenic	TRGS 528: welding-fume separation class W2 or W3, or units certified based on individual measurement	≤ 70 %	DIN EN ISO 15012-1: welding-fume separation class W3
Wood dust – carcinogenic	TRGS 553: arrestance min. 99.5 %, filter surface velocity max. 150 m <sup>3</sup> /m <sup>2</sup> h, Industrial vacuum cleaners conforming to dust class M	≤ 50 %	– DIN EN 12779: monitored residual dust content max. 0.1 mg/m <sup>3</sup> and return-air shutoff – DIN EN 16770: residual dust content max. 0.1 mg/m <sup>3</sup> – DIN EN 60335-2-69: dust class H

Rules and regulations	Operator's duties		Manufacturer's duties
	Technical Rules for Hazardous Substances	Fraction of recirculated air in total supply air as per VDI 2262 Part 3	Standard
<b>Hazardous substances</b>			
Wood dust – not carcinogenic	TRGS 553: arrestance min. 99.5 %, filter surface velocity max. 150 m <sup>3</sup> /m <sup>2</sup> h	≤ 70 %	– DIN EN 12779: monitored residual dust content max. 0.1 mg/m <sup>3</sup> and return-air shutoff – DIN EN 16770: residual dust content max. 0.1 mg/m <sup>3</sup> – DIN EN 60335-2-69: dust class M
Mineral dust – carcinogenic	TRGS 559: ventilation system: arrestance min. 99.995 %, residual dust content: 0.015 mg/m <sup>3</sup> (for respirable quartz dust); industrial vacuum cleaners min. dust class M	≤ 50 %	DIN EN 60335-2-69: dust class H
Mineral dust – not carcinogenic	TRGS 559: ventilation system: residual dust content: 0.25 mg/m <sup>3</sup> (for A-dust), 1 mg/m <sup>2</sup> (for E-dust)	≤ 70 %	DIN EN 60335-2-69: dust class M
Other CMR <sub>F</sub> (1,2)-substances	TRGS 560: arrestance min. 99.995 %, e.g. dust class H	≤ 50 %	DIN EN 60335-2-69: dust class H
Other substances	-	≤ 70 %	DIN EN 60335-2-69: dust class L, M or H depending on the level of the limit value

## Appendix 3

# Ban on manufacture and particularly hazardous, carcinogenic substances

Manufacture of the following substances and preparations (mass fraction > 0.1 %) is banned according to GefStoffV Annex II No. 2:

- 2-Naphthylamine and its salts,
- 4-Aminobiphenyl and its salts,
- Benzidine and its salts,
- 4-Nitrodiphenyl.

Moreover, according to GefStoffV Annex II No. 6, the manufacture or use of the following particularly hazardous, carcinogenic substances is permissible only in enclosed facilities:

- 2-Amino-6-ethoxynaphthalene,
- Bis(chloromethyl) ether,
- Cadmium chloride (in inhalable form),
- Chloromethyl methyl ether,
- Dimethylcarbamoyl chloride,
- Hexamethylphosphoric triamide,
- 1,3-Propane sultone,
- N-Nitrosamine compounds unless appropriate tests have shown no evidence of carcinogenic effects,
- Tetranitromethane,
- 1,2,3-Trichloropropane,
- Dimethyl sulphate and diethyl sulphate,
- o-Toluidine.

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## VDMA Air Pollution Control Department

The Air Pollution Control Department is comprised of around 95 companies that manufacture extraction systems and units for a wide variety of user industries against the background of occupational health and safety and environmental protection. The air-handling and dust extraction sector continually develops innovative technical solutions for compliance with the legal requirements, offering a wealth of possibilities for separating dusts, smokes/fumes, aerosols and gases.

In doing so, the companies use the full range of separation methods, from the four classical separator types to adsorption, absorption and oxidation through to biological procedures. Depending on the application, the solution of the task is a combination of various methods and separator types. In this manner, the concentration of harmful substances is reduced to acceptable values in terms of occupational health and safety and environmental protection.

In accordance with the diverse fields of application (the use of extraction systems extending from waste management to the cellulose industry), the member companies cooperate in various working groups where they discuss technical, normative and economic issues, seeking joint solutions.

The following working groups presently exist:

### Working groups (WG) of the department:

- Air Pollution Control Managers Experience Exchange
- WG Dust Extraction, with the subcommittees (SC)
  - SC Air Recirculation Brochure
  - SC Machinery Directive
  - SC Welding Fume Extraction
- Revision of DIN EN 12779 'Stationary wood dust and dust extraction systems'
- Standardisation Project DIN EN 16770 'Chip and dust extraction systems for indoor installation'

- WG Aerosols, with the subcommittee
  - SC Manual Cooling Lubricants Brochure
- WG Smoke Extraction, with the subcommittees (SC)
  - SC Building Law Circle of Experts
  - SC Smoke Protection Pressure Systems
- WG Mechanical Smoke Extraction Systems

Additionally, the Department is responsible for managing various temporary working groups which are focused on specific issues and often serve to prepare VDMA Standard Sheets. For instance, the Subcommittee Building Law Circle of Experts addressed supporting measures for escape and rescue, fire-fighting operations, protection of property and environmental protection safety in buildings and infrastructures in the case of fire. The results were published in a policy paper on smoke extraction and presented to the public at the 4th conference on 'State of the art in smoke extraction' of the WG Smoke Extraction.

The representatives of the member companies use the working groups as platforms for the mutual exchange of information, for expanding their knowledge and devising joint public relations. Recognised experts are invited to join the working groups to deal with specific issues of concern.

Awareness raising and public relations are considered by the Air Pollution Control Department to be among its key tasks. It issues a multitude of publications addressed to the customers of the member companies, providing guidance on technical matters and assisting in the interpretation of rules and regulations. All these publications have been prepared with the active participation of employees of the member companies, true to the motto "From practitioners for practitioners". One example is the VDMA brochure "Schweißen ohne Rauch – Absaugen, Erfassen und Filtern – Ein Leitfaden für mobile und stationäre Anlagen" (Welding without fume – Extraction, capture and filtration – Code of practice for mobile and stationary systems), published in October 2012.

## Publications

In addition to this brochure “Air Recirculation in Fume and Dust Extraction Systems”, the department (address overleaf) issues the following publications:

### General publications

Entstaubungstechnik: Liste relevanter Normen und Richtlinien (02/2015)  
(Dust extraction: List of relevant standards and guidelines)

Luftreinhaltung: Schutz für alle – BLUECOMPETENCE – Erfolgsgeschichten unserer Mitglieder (05/2014)  
(Air pollution control: BLUECOMPETENCE – Innovative success stories of Blue Competence partners)

Herstellernachweis “Air Pollution Control – Luftreinhaltung” (10/2006)  
(List of manufacturers “Air Pollution Control”)

ATEX Guidelines “Explosion protection in dust extraction systems – Filter separators” (03/2005); available in German and English

Forum “Biomasse-Verbrennung” (10/2002)  
(Biomass combustion)

### Industry-specific information – Dust extraction

Code of practice “Schweißen ohne Rauch – Erfassen, Absaugen und Filtern – Ein Leitfaden für mobile und stationäre Anlagen” (10/2012)  
(Welding without fume – Extraction, capture and filtration – Code of practice for mobile and stationary systems)

VDMA Air Filter Information – Overview of filter classes in ventilation, air-conditioning and dust extraction systems (02/2015)

Brochure “Capture of air pollutants – Fresh air at the workplace” (2010)

Prüfbuch Absaug- und Filteranlagen (07/2008)  
(Inspection of extraction and filtration systems)

Position paper on the ATEX Directive (wood dust), available in German, English and French (12/2007)

Auslegung von Absauganlagen für Holzstaub und –späne (05/2003)  
(Design of chip and dust extraction systems)

Folded brochure “Entstaubungsanlagen – Brand- und Explosionsschutz” (11/2002)  
(Dust extraction systems – Fire and explosion protection)

### Industry-specific information – Machine tools / Extraction systems / Aerosols

Brochure “Kühlschmierstoffe – Frische Luft am Arbeitsplatz” (10/2002)  
(Manual Cooling Lubricants Separating and Filtering) – currently under revision

### Industry-specific information – Smoke extraction

4<sup>th</sup> conference volume “Aktueller Stand der Entrauchung” (02/2014)  
(State of the art in smoke extraction)

Sicherheit in Gebäuden und Infrastruktureinrichtungen – Grundlagenpapier Entrauchung – Unterstützende Maßnahmen für Selbst- und Fremdrettung, Löschangriff, Sach- und Umweltschutz (09/2012)  
(Safety in buildings and infrastructure – Policy paper on smoke extraction – Supporting measures for escape and rescue, fire-fighting operations, protection of property and environmental protection)

Information sheet No. 1 “Nachströmung im Brandraum” (04/2002)  
(Additional airflow to areas on fire)

Information sheet No. 3 “Entrauchung von Räumen im Brandfall – Notwendige Zeiten für Entfluchtung, Rettung, Löschangriff” (03/2005)  
(Smoke extraction from areas on fire – Times required for evacuation, rescue, fire-fighting)

Information sheet No. 4 “Prinzipien zur Rauchableitung” (09/2007)  
(Principles of smoke removal)

Information sheet No. 5 „Stromversorgung in sicherheitstechnischen Anlagen – Maschinelle Rauchabzugsanlagen“ (02/2015)  
(Power supply in safety systems – Mechanical smoke extraction systems)

Position paper of the Smoke Extraction Working Group (11/2008)

#### **Product directories**

Components and systems for air pollution control (04/2014)

Chips and dust extraction systems and units (05/2007)

Smoke extraction (03/2015)

#### **VDMA Standard Sheets on Air Pollution Control**

VDMA 24177:2009-12 “Ventilatoren für Rauch- und Wärmefreihaltung von Gebäuden im Brandfall”  
(Fans for removing smoke and heat from buildings in the event of fire)

VDMA 24179-1:1985-05 “Absauganlagen für Holzstaub und -späne, Leistungsprogramm für die Wartung”  
(Suction plants for sawdust and wood shavings; performance programmes for maintenance)

VDMA 24179-2:2003-08 „Absauganlagen für Holzstaub und -späne – Anforderungen für Ausführung und Betrieb“  
(Wood dust and chip extraction systems – Requirements regarding design and operation)

VDMA 24180:2005-05 “Entstaubungsanlagen – Brand- und Explosionsschutz”  
(Dust extraction systems – Fire and explosion protection)

VDMA 24188:2011-06 “Rauchschutzmaßnahmen in Treppenträumen – Rauchableitung, Rauchverdünnung, Rauchfreihaltung”  
(Smoke protection measures for stairwells – Removal of smoke, dilution of smoke, smoke extraction)

All standard sheets can be obtained from Beuth Verlag, Berlin, at [www.beuth.de](http://www.beuth.de)





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