

BG-Regeln

Safety and health protection regulation for aircraft maintenance work

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Überreicht durch:



BGF

Berufsgenossenschaft
für
Fahrzeughaltungen

Die Verpflichtungen aus der Richtlinie 98/34/EG des Europäischen Parlaments und des Rates vom 22. Juni 1998 über ein Informationsverfahren auf dem Gebiet der Normen und technischen Vorschriften (Abl. EG Nr. 204 S. 37) sind beachtet worden.

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Foreword

These regulations are a compilation of existing statutory provisions and those of the employers' liability insurance associations, as well as acknowledged regulations and explanatory notes relating to safety engineering in the field of aircraft maintenance. In addition to these regulations, further provisions are contained, for example, in the construction codes of the individual Federal states [Länder]. Transitional and implementing rules, if applicable, are contained in the specifically cited regulations.

1 Area of application

These regulations apply to the maintenance, modification and refitting of aircraft, and to the installations and facilities used for this.

2 Definition of terms

- 2.1 In these regulations, "**aircraft**" means aeroplanes, rotary-wing craft, airships, gliders, hang gliders, microlight craft, free balloons and moored balloons.

Refer to Art. 1 of the Aviation Act.

- 2.2 In these regulations, "**maintenance**" means all actions for the purpose of maintaining and restoring the desired condition and for ascertaining and assessing the actual condition.

Refer to DIN 31 051: "Maintenance; definitions and actions".

- 2.3 In these regulations, "**inspection**" means actions for ascertaining and assessing the actual condition.

Refer to DIN 31 051: "Maintenance; definitions and actions".

- 2.4 In these regulations, "**repair**" means all actions for restoring aircraft to an airworthy condition.

Refer to DIN 31 051: "Maintenance; definitions and actions".

- 2.5 In these regulations, "**servicing**" means all actions for keeping aircraft in airworthy condition.

Refer to DIN 31 051: "Maintenance; definitions and actions".

- 2.6 In these regulations, "**modification and refitting**" means the work by which the original condition of aircraft is modified or supplemented.

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- 2.7 In these regulations, "**elevating platforms**" means elevating equipment with guided load-carrying devices, even if guidance is performed solely by the supporting structure.
- 2.8 In these regulations, "**dock facilities**" means stationary or mobile scaffold-type assemblies with work levels which match the contours of aircraft or can be adapted to do so.
- 2.9 In these regulations, "**maintenance hangars/shops**" means enclosed working areas used for accommodating aircraft for maintenance purposes.
- 2.10 In these regulations, "**dangerous substances and dangerous preparations**" means substances and preparations which are
- explosive,
 - incendiary,
 - extremely flammable,
 - highly flammable,
 - flammable,
 - very toxic,
 - toxic,
 - slightly toxic,
 - corrosive,
 - irritant,
 - sensitizing,
 - carcinogenic,
 - embryotoxic
- or
- mutagenic
- or
- possess other chronically harmful properties
- or
- are environmentally hazardous;
- this excludes hazardous properties of ionizing radiation.

Also refer to the Chemicals Act.

- 2.11 In these regulations, "**waste materials**" means objects, particularly including movable items, the possessor of which wishes to dispose of them, or the proper special disposal of which is required for the safeguarding of the public wellbeing, particularly the protection of the environment.

Also refer to the Waste Materials Act [Abfallgesetz] and other legislative provisions.

3 General criteria

- 3.1 Aircraft maintenance facilities must be constituted, operated and tested in accordance with the provisions of these regulations and furthermore with generally acknowledged technical standards. Deviation from the generally acknowledged technical standards is permissible if the same level of safety is ensured in a different manner.

Examples of generally acknowledged technical standards are EC directives, DIN EN standards, ISO standards, VDE regulations; also refer to Annex 4.

- 3.2 The technical regulations contained in this compilation of regulations do not preclude other equally safe solutions that are to be found in the technical regulations of other EC member states or other states signatory to the Treaty on the European Economic Area.
- 3.3 Test reports from test laboratories which are licensed in other EC member states or other states signatory to the Treaty on the European Economic Area will be taken into account in the same way as German test reports if these agencies' reports are based on tests, test procedures and engineering criteria equivalent to those of the German agency. This category of agency particularly includes those which fulfil the criteria laid down in the EN 45 000 series of standards.

4 Structures and equipment

4.1. General remarks

- 4.1.1 Structural installations and facilities erected after 1 May 1976 must comply with the Workplace Ordinance [Arbeitsstättenverordnung] and "General regulations for accident prevention" (VBG 1).
- 4.1.2 Lighting equipment in maintenance hangars/shops must be arranged and designed in such a way that the nominal illuminance required by law is achieved.

Refer to Art. 7 para 3 of the Workplace Ordinance, the "Workplace guidelines on safety lighting" (ASR 7/4) and Regulation 19 para 2 of the "General regulations for accident prevention" (VBG 1).

- 4.1.3 Working areas for aircraft maintenance must be equipped with earthing points.

Refer to Section E 2.3.6 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10) and Section 6.3 of the "Guidelines for the prevention of ignition hazards resulting from

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electrostatic charges” (“Guidelines on static electricity” (ZH 1/200).

- 4.1.4 Structural installations and facilities must be designed in such a way – with regard to their material, spaciousness, solidity, stability, surface, safety for walking, illumination, noise reduction and elimination of harmful environmental influences and risks originating from third parties – that accidents at work are prevented.

Refer to Reg. 2 para 1 of the “General regulations for accident prevention” (VBG 1) and the “Accident prevention regulations concerning noise” (VBG 121).

- 4.1.5 Structural installations and facilities must be designed in such a way that waste materials can be collected and disposed of without endangering the environment and the health of personnel.

Refer to Art. 2 of the Waste Materials Act [Abfallgesetz].

4.2 Floors, traffic routes

- 4.2.1 Floors in maintenance hangars/shops must be even and of anti-slip design.

With regard to evenness, refer to DIN 18 202 “Tolerances in building construction; structures”; with regard to anti-slip design, refer to “Guidelines for floors in workrooms and working areas where the risk of bad traction exists” (ZH 1/571).

Also refer to Reg. 18 and 20 of the “General regulations for accident prevention” (VBG 1).

- 4.2.2 Traffic routes in maintenance hangars/shops must be present in sufficient numbers and laid out in such a way that they can be used without risk.

Refer to Reg. 24 and 25 of the “General regulations for accident prevention” (VBG 1) and the “Workplace guidelines on traffic routes” (ASR 17/1,2).

- 4.2.3 Sufficient safety lighting must be present for traffic routes in maintenance hangars/shops where a risk of accident may occur in case of malfunction of the general lighting system.

Refer to Art. 7 para 4 of the Workplace Ordinance, the “Workplace guidelines on safety lighting” (ASR 7/4) and Reg. 19 para 3 of the “General regulations for accident prevention” (VBG 1).

4.3 Exits

- 4.3.1 Maintenance hangars/shops must have exits which, by virtue of their type, number and location, permit the facility to be vacated rapidly in case of danger.

Also refer to Reg. 28 para 1 and Reg. 30 paras 1 and 2 of the "General regulations for accident prevention" (VBG 1).

- 4.3.2 In maintenance hangars/shops, any powered or large, manually operated doors which cannot be opened sufficiently quickly in case of power loss must be fitted with additional doors or escape doors if the number of emergency exits is insufficient.

Refer to Reg. 30 of the "General regulations for accident prevention" (VBG 1) and the "Workplace guidelines on doors and gates" (ASR 10/1).

- 4.3.3 Escape routes and emergency exits must be marked as such in a recognizable and permanent manner. Doors of emergency exits must be easily openable from inside at any time.

Refer to Art. 19 of the Workplace Ordinance and Reg. 30 of the "General regulations for accident prevention" (VBG 1).

With regard to markings, refer to the "Accident prevention regulations for safety signs at the workplace" (VBG 125).

4.4 Crush hazards at doors/gates and vehicle entrances/exits

It must be impossible for any person to be crushed between moving and fixed parts when passing a door/gate or vehicle entrance/exit.

This requirement is met if the width of doors/gates and entrances/exits is such that there is a safety distance of at least 500 mm on either side of the largest expected aircraft, AGE, materials handling equipment or other vehicle.

Refer to Art. 17 paras 1 and 2 of the Workplace Ordinance, the "Workplace guidelines on traffic routes" (ASR 17/1,2) and Reg. 25 of the "General regulations for accident prevention" (VBG 1).

4.5 Manually operated windows, doors and gates

- 4.5.1 The wings of manually operated doors/gates must be safeguarded against unintentionally coming out of the guide devices and must not be able to run beyond their limit of travel.

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For wings of doors/gates fitted with rollers running on rails, this requirement is met if derailment is precluded, e.g. by shaped retaining devices.

Refer to Art. 10 para 6 of the Workplace Ordinance, the "Workplace guidelines on protection against the unhinging, falling out and falling down of doors and gates" (ASR 10/6) and Reg. 28 of the "General regulations for accident prevention" (VBG 1).

- 4.5.2 The wings of manually operated doors/gates must be safeguarded by special devices to prevent them from unintentionally slamming shut. These devices must not pose a risk that any person might trip or stumble.

The hazards occurring at manually operated doors/gates may be the same as at comparable powered doors/gates.

Refer to Reg. 20 para 1 of the "General regulations for accident prevention" (VBG 1) and Reg. 1 para 2 and Reg. 4 of the "Accident prevention regulations for power-driven appliances" (VBG 5).

- 4.5.3 If the wings of manually operated windows, doors and gates are balanced by counterweights, the track of these in working areas and traffic areas must be encased, unless injuries from counterweights are precluded in other ways.

Refer to Reg. 33 para 4 of the "General regulations for accident prevention" (VBG 1)

- 4.5.4 Edges of rotating parts on manually operated folding doors/gates must be designed in such a way that crushing and shearing hazards are prevented.

This requirement is met if, for example, the edges are covered in such a way that no person can reach between them, or if sufficiently wide elastic sealing strips are fitted to make crushing impossible, or if the doors/gates have handles enabling them to be closed safely.

Also refer to the explanatory notes at sub-para 4.5.2.

- 4.5.5 Manually operated doors and gates must be equipped with operating devices enabling the wings to be moved safely.

Examples of operating devices are handles, cranks, manually operated winches. The devices are regarded as enabling safe manual movement of the wings if no crushing or shearing points are formed between these devices and fixed or moving parts and if the devices can be operated from floor level or another location where a person can safely stand.

Refer to Reg. 28 para 2 of the "General regulations for accident prevention" (VBG 1)

- 4.5.6 Wings of doors and gates which are raised above the entrance during normal operation must be secured against falling.

This requirement is met if, for example, no injury to persons is expected to result from the maximum possible kinetic energy developed in the falling of moving parts.

Falling is also taken to mean, for example, the uncontrolled descent of roller, segmented or up-and-over doors/gates.

Refer to Art. 10 para 6 of the Workplace Ordinance, the "Workplace guidelines on protection against the unhinging, falling out and falling down of doors and gates" (ASR 10/6) and Reg. 28 of the "General regulations for accident prevention" (VBG 1).

4.6 **Powered windows, doors and gates**

Powered windows, doors and gates must comply with the "Guidelines for powered windows, doors and gates" (ZH 1/494).

Also refer to sub-para 3.2.

4.7 **Electrical equipment and appliances**

- 4.7.1 Electrical equipment and appliances must satisfy the operational and locally applicable safety criteria.

With regard to appliances and safety criteria, refer to Reg. 3 of the "Accident prevention regulations for electrical equipment and appliances" (VBG 4).

Specific criteria for the construction and fitting out of electrical equipment and appliances are applicable, depending on the type of operating conditions, e.g. impact, jolting, pressure, airborne particulates, moisture, heat, aggressive substances, or use in potentially explosive atmospheres. These criteria are specifically laid down in the DIN VDE regulations.

Attention is also to be paid to the regulations of the electricity supply company responsible for the local area concerned. These regulations specify, for example, what kind of measures are required in case of indirect contact (protective insulation, protection by means of low voltage, shutdown or fault indication, fault-current protective devices and isolation by transformer), and which conductor cross-sections and which type of installation are required.

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- 4.7.2 Hangars/shops and working areas in which flammable liquids of hazard classes A I, A II or B are used are regarded as locations with potentially explosive atmospheres.

For protection against explosion, attention is to be paid to the following:

- Hazard classes in accordance with Art. 3 of the Flammable Liquids Ordinance (VbF),
- DIN VDE 0165 "Installation of electrical equipment in areas with potentially explosive atmospheres",
- DIN EN 50014/VDE 0170/0171 Part 1 to DIN EN 50020/VDE 0170/0171 Part 7 "Electrical equipment for areas with potentially explosive atmospheres" and DIN VDE 0105 Part 9 "Operation of power installations; supplementary specifications for areas with potentially explosive atmospheres".

Corresponding provisions relating to protection against explosion are contained in the "Ordinance on electrical equipment in locations with potentially explosive atmospheres" (ElexV) and the general administrative regulations issued with regard to the Ordinance. Refer to Reg. 44 of the "General regulations for accident prevention" (VBG 1) and sub-para 7.1.4 of the compendium of examples in the "Guidelines for preventing hazards arising from potentially explosive atmospheres, with various examples – Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 4.7.3 Hangars/shops and working areas in which aircraft are washed are regarded, within the meaning of the VDE regulations, as humid and wet.

With regard to the type of electrical installation, refer to DIN VDE 0100 Part 737 "Erection of power installations with rated voltages up to 1000 V; humid and wet areas and locations; outdoor installations".

- 4.7.4 Portable lamps (including low-voltage portable lamps) must comply with DIN VDE 0711 Part 208 "Lamps; Part 2; particular requirements; Section 8: portable lamps; German version EN 60598-2-8:1989".

4.8 Elevating devices, supporting devices

- 4.8.1 Elevating and supporting devices must be made in such a way that they comply with the accident prevention regulations which apply to them.

These include:

- "Hoists, lifting and hauling equipment" (VBG 8),
- "Cranes" (VBG 9),

- “Load suspension devices for use with hauling equipment” (VBG 9a),
 - “Elevating platforms” (VBG 14),
 - “Aviation” (VBG 78).
- Also refer to sub-para 3.2.

- 4.8.2 Elevating devices must be set up in such a way that crush hazards are avoided in the movement area of the load suspension device or the load.

This requirement is met in case of compliance with the safety distances specified in DIN 31 001 Part 1 “Safety design of technical products; safety devices; concepts, safety distances for adults and children” and DIN EN 294 “Safety of machinery; safety distances to prevent upper limbs from reaching hazard points; German version EN 294:1992”.

- 4.8.3 Elevating or supporting devices must bear clearly recognizable and permanent markings which show the designated load capacity or aircraft type to be supported.

Refer to Reg. 40 of the “General regulations for accident prevention” (VBG 1).

4.9 Filling of pneumatic tyres

- 4.9.1 For the filling of pneumatic tyres, safety devices must be available if there is a risk that the wheel or parts of it might fly off.

This requirement is met if, for example, protective stands into which the wheel can be placed, or securing hoops or chains anchored to the ground, are available as safety devices.

Also refer to Reg. 42 of the “General regulations for accident prevention” (VBG 1).

- 4.9.2 Sub-para 4.9.1 does not apply to pneumatic tyres mounted on the aircraft.

4.10 Safety devices for preventing falls

- 4.10.1 During maintenance work on or in aircraft, safety devices for preventing personnel from falling must be present if there is a drop of more than 1.0 m.

This requirement is met if working locations and traffic routes at high level are equipped, in accordance with Reg. 33 of the “General regulations for accident prevention” (VBG 1), with safety devices for preventing personnel from falling. This includes walkways from high-level working locations to aircraft and to floor hatches and other openings.

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Refer to Reg. 50 para 2 of the "Accident prevention regulations for aviation" (VBG 78) for information on devices for preventing falls from maintenance stairs.

- 4.10.2 If the nature of the working location or the work to be performed does not permit the use of permanent railings or scaffolding as safety equipment, devices for preventing personnel from falling must be present.

This requirement relates, for example, to work performed on the upper side of the fuselage, the wings, the tail assembly or, where the floor has been dismantled, inside the aircraft fuselage.

Refer to Reg. 33 para 3 of the "General regulations for accident prevention" (VBG 1).

- 4.10.3 If work involving the risk of falling is being performed, personal safety devices must be present.

For work involving the risk of falling, this safety requirement is met if harnesses complying with DIN 7478 "Safety harnesses; safety belts for the mining industry" are used in conjunction with energy absorbers complying with EN 355: "Personal protective equipment against falls from a height; energy absorbers; German version EN 355:1992".

The use of safety belts complying with DIN 7470 "Safety harnesses; safety belts; safety requirements, testing" is only permitted if the working line is sufficiently short to keep the person concerned from reaching the edge of the drop.

Refer to Reg. 33 para 3 of the "General regulations for accident prevention" (VBG 1), and to "Regulations on the use of personal protective equipment for preventing falls" (ZH 1/709) and "Regulations on the use of personal protective equipment for retention and rescue" (ZH 1/710).

- 4.10.4 Facilities with high-level workplaces (where the aircraft or other equipment forms the safeguard against falling from the edge at which work is performed) must be securable against access.

This includes, for example, dock facilities, scaffolding, work platforms, maintenance stairs.

Refer to Reg. 33 para 1 of the "General regulations for accident prevention" (VBG 1).

- 4.10.5 High-level workplaces must be provided with equipment for preventing objects from falling off.

This requirement is met if, for example, toe boards, wire grilles, safety nets or other devices are present.

Refer to Reg. 33 para 4 of the "General regulations for accident prevention" (VBG 1).

4.11 Stationary dock facilities

- 4.11.1 Stationary dock facilities must be built in such a way that they enable work to be performed safely.

Also refer to DIN 4420 Part 1 "Work and guard scaffoldings; general regulations; safety requirements, tests" and DIN 4420 Part 2 "Work and guard scaffoldings; ladder scaffoldings; safety requirements".

Refer to the "Workplace guidelines on traffic routes" (ASR 17/1,2) with regard to width of routes.

- 4.11.2 Auxiliary platforms with a height of > 1.0 m must be equipped with safety devices for preventing personnel from falling, as specified in Section 4.10.

Refer to Reg. 33 para 1 of the "General regulations for accident prevention" (VBG 1).

- 4.11.3 To enable personnel to enter and leave dock facilities safely, these facilities must be equipped with an adequate number of stairways.

The number of stairways will be in accordance with the expected type of work, number of personnel working at the dock, size of dock.

Also refer to Reg. 25 para 1 of the "General regulations for accident prevention" (VBG 1) and the "Workplace guidelines on traffic routes" (ASR 17/1,2).

Where flammable liquids with a flashpoint of < 21°C are used, this requirement is met if each area of the dock (e.g. left bow dock, right bow dock, left stern dock, right stern dock) is equipped with at least one stairway.

- 4.11.4 Stairs must be safely usable.

This requirement is met if stairs are constructed in accordance with DIN 18 065 "Stairs in buildings: principal dimensions".

The gradient, i.e. the ratio of step height (s) to tread width (a), is of decisive importance to the safety of stairs.

The most favourable ratio is given by the "safety formula":

$$s + a = 460 \pm 10$$

For this purpose, the riser is to be between 14 cm and 19 cm high, the tread is to be between 26 cm and 32 cm wide. All the steps of a stairway are to have identical dimensions.

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Stairs with a pitch of > 38° are not regarded as safely usable traffic routes.

Refer to the "Workplace guidelines on traffic routes" (ASR 17/1,2) and the "Leaflet concerning stairs" (ZH 1/113).

4.12 **Mobile dock facilities**

- 4.12.1 Mobile dock facilities must be built in such a way that they enable work to be performed safely.

Also refer to DIN 4422 Part 2 "Mobile service platforms (staging on wheels) made from prefabricated elements; use; safety requirements; instructions for construction and use".

- 4.12.2 Mobile dock facilities must be safely movable.

This requirement is met if

- dock facilities to be moved manually are fitted with handles,*
- towable dock facilities are fitted with suitable towing devices.*

Also refer to Reg. 11 of the "Accident prevention regulations for materials handling equipment" (VBG 12a).

- 4.12.3 Mobile dock facilities must be securable against accidental movement.

Devices for preventing accidental movement include

- brakes*
- supports*
- attachments to stationary facilities.*

Refer to Section 7.1 para d) of DIN 4422 Part 2.

- 4.12.4 Mobile dock facilities must be equipped with an adequate number of stairways. This also applies to mobile parts of stationary dock facilities.

Refer to Reg. 25 para 1 of the "General regulations for accident prevention" (VBG 1).

- 4.12.5 Stairs must be safely usable.

Refer to Reg. 50 para 1 of the "Accident prevention regulations for aviation" (VBG 78) and the notes relating to sub-para 4.11.4 of these regulations.

- 4.12.6 If stairs complying with sub-para 4.12.5 cannot be integrated into the dock facility, other safe means of access must be present.

This requirement is met if, for example, maintenance stairs can be used for access.

Refer to Reg. 25 para 1 of the "General regulations for accident prevention" (VBG 1).

4.13 Ventilation of working areas

- 4.13.1 Mechanical ventilation facilities must be provided in working areas where the occurrence of a potentially explosive atmosphere is to be expected and natural exchange of air is not ensured.

The performance of mechanical equipment is adequate if the hourly air change rate is at least three times the volume of the room.

For criteria relating to natural and mechanical ventilation, refer to "Safety regulations for systems for ensuring clean air at workplaces" (ZH 1/140).

For prevention of potentially explosive atmospheres, refer also to "Guidelines for preventing hazards arising from potentially explosive atmospheres, with compendium of examples Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 4.13.2 Mechanical ventilation facilities must be provided in working areas where the occurrence of harmful gases, vapours or airborne particulates is to be expected.

Refer to Art. 19 para 2 of the Dangerous Substances Ordinance, and to Section 4.2.2 of the "Safety regulations for systems for ensuring clean air at workplaces" (ZH 1/140).

The air flow rate should not exceed the comfort limit specified in relation to air temperature.

Refer to the "Workplace guidelines on ventilation" (ASR 5).

The mechanical ventilation is adequate if the values for the workplace air do not exceed those specified in TRGS 900 (Technical Regulations for Dangerous Substances) on "Threshold values".

In case of multiple pollutants, the calculation of exposure is to be made in accordance with TRGS 403 (Technical Regulations for Dangerous Substances) on "Assessment of mixtures in workplace air".

If any materials result in bad odours, these should also be removed by forced-air equipment.

If the gases, vapours and airborne particulates to be discharged contain carcinogenic substances, attention is to be paid to the "Accident prevention regulations for the handling of carcinogenic dangerous materials" (VBG 113) and the Dangerous Substances Ordinance.

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- 4.13.3 If high concentrations of flammable, toxic or harmful gases, vapours or airborne particulates occur at the workplace, these substances must be extracted at the point of origin.

Workplaces in this category include:

- *paint stripping jobs*
- *cleaning jobs*
- *welding jobs.*

Also refer to "Safety regulations for systems for ensuring clean air at workplaces" (ZH 1/140).

High concentrations can occur, for example, during the following work:

- *application and removal of coatings*
- *gluing*
- *welding*
- *cleaning*
- *corrosion-proofing.*

Refer to Reg. 45 para 2 of the "General regulations for accident prevention" (VBG 1).

- 4.13.4 Separate forced-draught equipment must be present for extracting flammable gases and vapours and for combustion engine exhaust gases.

In order to prevent explosion, the extract ducts for flammable gases and vapours must be separate from those for exhaust gases.

Refer to Reg. 44 of the "General regulations for accident prevention" (VBG 1).

- 4.13.5 Exhaust gases from stoves and other furnace systems must be safely dischargeable into the open air, unless official permission is given for the operation of stoves and furnace systems without exhaust systems.

Examples of other furnace systems are mobile heaters for workshops, or oil-fired burners.

Also refer to the construction laws of the Länder (Federal states) and the Technical Directive on Air Pollution Control (TA-Luft).

- 4.13.6 Charging areas for storage batteries must have facilities ensuring adequate ventilation to prevent the risk of explosion. Charging areas must be clearly marked.

The requirement for adequate ventilation is met if, for example, the fresh air enters the charging area near floor level and the outgoing air can escape to the outside at a point as high as possible over the charging location on the opposite side of the room

(cross-ventilation) or if forced-draught equipment safely ensures that the lower explosion limit is not exceeded.

Also refer to DIN VDE 0510 "VDE specification for storage batteries and battery plants".

Also refer to Reg. 44 and 45 of the "General regulations for accident prevention" (VBG 1).

4.14 Containers for working materials and wastes

- 4.14.1 Indestructible, non-combustible, conductive (for containers > 5 litres capacity), lockable containers must be provided for flammable liquids of hazard classes A I, A II or B. The containers must bear clearly recognizable, permanent markings indicating their type and content.

Refer to Reg. 49 of the "General regulations for accident prevention" (VBG 1), the "Accident prevention regulations for safety signs at the workplace" (VBG 125) and to TRbF 143 ("Technical Regulations for Flammable Liquids") concerning "Movable containers".

- 4.14.2 Acids and alkaline solutions for storage batteries must be stored in appropriately marked vessels which are unbreakable or protected against breakage. There must be facilities for preventing the splattering and spillage of acids and alkaline solutions during decanting.

This requirement is met if synthetic vessels or vessels protected against impact (carboys) and acid syphons or carboy filters are used.

Refer to Art. 24 of the Dangerous Substances Ordinance.

- 4.14.3 Lockable, non-combustible containers must be provided for used cleaning materials and flammable wastes.

Refer to Art. 25 of the Workplace Ordinance and Reg. 43 and 49 of the "General regulations for accident prevention" (VBG 1).

With regard to flammable liquids, refer also to Art. 8 to 11 of the Flammable Liquids Ordinance (VbF) and to TRbF 143 ("Technical Regulations for Flammable Liquids") concerning "Movable containers".

- 4.14.4 Containers for flammable cleaning liquids of hazard classes A I, A II or B must be marked and lockable. The lids of containers for cleaning materials must close automatically.

Refer to Section 4.7 of the "Guidelines for facilities for cleaning workpieces by means of solvents" (ZH 1/562).

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- 4.14.5 Containers for dangerous materials, used cleaning materials and wastes must bear clearly recognizable permanent markings.

This requirement for marking also includes containers with smaller quantities of materials for use at the workplace.

Refer to Art. 23 of the Dangerous Substances Ordinance.

- 4.14.6 Containers which may be mistaken for food containers because of their shape or marking of contents must not be used for the keeping, storing or utilization of dangerous materials.

Refer to Art. 24 of the Dangerous Substances Ordinance and Reg. 48 of the "General regulations for accident prevention" (VBG 1).

4.15 **Maintenance work on non-degasified tanks and vessels**

If aircraft with non-degasified tanks or other non-degasified containers for flammable liquids of hazard classes A I, A II or hazard class B for flammable gases are to be brought into maintenance areas and workshops, the area in which the risk of explosion exists must be free from ignition sources. If this cannot be ensured as the work progresses, gas alarm devices must be present to give visual and acoustic warning of potentially explosive atmospheres before the lower explosion limit is reached. The warning signal must be followed by protective measures.

Protective measures, including emergency actions, may be initiated automatically by the gas alarm device, or manually. For safety reasons, the automatic initiation of protective measures is to have priority.

Refer to "Safety regulations on criteria for the characteristics of stationary gas alarm devices for protection against explosion" (ZH 1/8),

"Principles for testing the operability of stationary gas alarm devices for protection against explosion" (ZH 1/8.1),

"Use of stationary gas alarm devices for protection against explosion" (ZH 1/8.3),

"Safety regulations on criteria for the characteristics of non-stationary gas alarm devices for protection against explosion" (ZH 1/108) and

"Principles for testing the operability of non-stationary gas alarm devices for protection against explosion" (ZH 1/108.1).

4.16 **Marking of working areas**

- 4.16.1 Working areas in which flammable liquids of hazard classes A I, A II or B are used or in which flammable gases or vapours are expected to occur must be marked with a sign stating "No smoking. No naked lights". The sign must conform with the "Accident prevention regulations for safety signs at the workplace" (VBG 125).

Refer to Art. 23 of the Dangerous Substances Ordinance and Reg. 43 and 44 of the "General regulations for accident prevention" (VBG 1).

- 4.16.2 Working areas in which dangerous materials are handled must be marked with a "No smoking" sign and an additional sign stating "No eating in this area". The signs must conform with the "Accident prevention regulations for safety signs at the workplace" (VBG 125).

4.17 **Fire-extinguishing systems**

Suitable fire extinguishers must be present in adequate numbers at easily reachable locations. Fire blankets or other suitable fire-fighting equipment for extinguishing clothing fires must also be present.

Refer to the "Workplace guidelines on fire-fighting equipment" (ASR 13/1.2) and the "Regulations on the provision of fire extinguishers at workplaces" (ZH 1/201).

An example of "other suitable fire-fighting equipment" is an emergency shower.

Also refer to Art. 13 of the Workplace Ordinance, Reg. 43 of the "General regulations for accident prevention" (VBG 1) and Reg. 6 of the "Accident prevention regulations for the application of coating materials" (VBG 23).

5 **Operation**

5.1 **General remarks**

The employer is to give instructions and take the necessary measures for ensuring operational safety.

Refer to Reg. 120a para 4 of the Industrial Code [Gewerbeordnung] and Reg. 2 para 1 of the "General regulations for accident prevention" (VBG 1).

5.2 **Employment restrictions**

- 5.2.1 For maintenance work the employer is only permitted to employ personnel who are at least 18 years of age and are familiar with the equipment and procedures.

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Refer to Art. 15a and 15b of the Dangerous Substances Ordinance, Reg. 36 para 1 of the "General regulations for accident prevention" (VBG 1), Reg. 21 of the "Accident prevention regulations for materials handling equipment" (VBG 12a) and Reg. 2 para 1 of the "Accident prevention regulations on occupational health check-ups" (VBG 100).

- 5.2.2 Sub-para 5.2.1 does not apply to the employment of juveniles over 16 years of age if
1. this is necessary for achieving the purpose of their training and
 2. their protection is ensured by a supervisor.

5.3 **Operational instructions**

The employer is to draw up operational safety instructions and is to make these known to personnel. The personnel are to comply with the operational instructions.

Refer to Art. 20 para 1 of the Dangerous Substances Ordinance and Reg. 55 of the "Accident prevention regulations for aviation" (VBG 78).

Also refer to Reg. 40 of the "General regulations for accident prevention" (VBG 1).

Also refer to Reg. 29 para 1 of the "Accident prevention regulations for oxygen" (VBG 62).

5.4 **Briefing of personnel**

The employer is to brief personnel on the hazards that occur during their work and the measures for preventing them; the briefings are to be given on commencement of employment and thereafter at appropriate intervals, but at least once a year.

Refer to Art. 20 para 2 of the Dangerous Substances Ordinance and Reg. 7 para 2 of the "General regulations for accident prevention" (VBG 1).

Also refer to Reg. 29 paras 2 and 3 of the "Accident prevention regulations for oxygen" (VBG 62).

5.5 **Personal protective equipment, working clothes, skin protection, skin care and skin cleansing products**

- 5.5.1 The employer is to provide suitable personal protective equipment if operational engineering measures do not preclude exposure of personnel to health hazards or the risk of accident.

*Refer to Reg. 4 paras 1 to 3 of the "General regulations for accident prevention" (VBG 1),
the "Leaflet on eye protection" (ZH 1/192),
the "Regulations on the use of protective clothing" (ZH 1/700),
the "Regulations on the use of respiratory protection equipment" (ZH 1/701),
the "Regulations on the use of foot protection" (ZH 1/702),
the "Regulations on the use of industrial safety helmets" (ZH 1/704),
the "Regulations on the use of ear protectors" (ZH 1/705),
the "Regulations on the use of protective gloves" (ZH 1/706),
the "Regulations on the use of skin protection" (ZH 1/708),
the "Regulations on the use of personal protective equipment for preventing falls" (ZH 1/709),
the "Regulations on the use of personal protective equipment for retention and rescue" (ZH 1/710);
also refer to Annex 1 of these regulations.*

- 5.5.2 The employer is to ensure the timely replacement and necessary cleaning of the personal protective equipment that is provided.

Refer to Reg. 4 of the "General regulations for accident prevention" (VBG 1).

- 5.5.3 During aircraft maintenance, personnel are to make proper use of the personal protective equipment provided to them.

Refer to Reg. 14 of the "General regulations for accident prevention" (VBG 1).

- 5.5.4 The employer is to provide conspicuous working clothes for personnel who have to perform maintenance work on the ramp.

Refer to Reg. 5 of the "Accident prevention regulations for aviation" (VBG 78).

- 5.5.6 The employer is to provide suitable skin protection, skin care and skin cleansing products for personnel.

This requirement is met if, for example, skin protection products are available for work involving the handling of

- oils and greases,*
- paints and waxes,*

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- fuels,
- organic solvents (cold cleaners),
- substances which soil the skin.

Experience has shown the value of establishing and implementing a skin care plan, with the advice of occupational health specialists, for the protection, care and cleansing of the skin.

Refer to Art. 35 of the Workplace Ordinance and Reg. 22 para 3 of the "Accident prevention regulations for the application of coating materials" (VBG 23).

5.6 Traffic routes, escape routes, emergency exits

- 5.6.1 Traffic routes, escape routes and emergency exits must always be kept clear. Escape routes and emergency exits must not be made narrower.

This also means that traffic routes must not be used, even temporarily, as parking areas or holding areas.

Refer to Reg. 24 and 30 of the "General regulations for accident prevention" (VBG 1).

- 5.6.2 Supply lines are to be laid in such a way that personnel are not at risk of tripping or stumbling.

Examples of supply lines are

- compressed-air hoses,
- hydraulic hoses,
- electric cables.

The permanent installation of lines can reduce the hazards posed by unsecured hoses and cables lying around.

Also refer to Reg. 20 of the "General regulations for accident prevention" (VBG 1).

- 5.6.3 Corners and edges projecting into traffic routes and working areas are to be safeguarded against collision and must be marked.

Examples of precautionary measures are the use of yellow/black upholstered covers, barriers or tactile warning devices.

Also refer to Reg. 3 of the "Accident prevention regulations for safety signs at the workplace" (VBG 125).

5.7 Prevention of falls

Working areas and traffic areas must have safety equipment to prevent personnel from falling, if the possible height of the drop is more than 1.0 m.

This requirement is met if

- *folding, insertable or swivelling railings at high-level workplaces have been put into the safety position before the start of work,*
- *devices (for preventing falls) as required under sub-para 4.10.1 are used at openings.*

Also refer to Reg. 33 of the "General regulations for accident prevention" (VBG 1).

5.8 **Flammable, toxic and noxious gases, vapours or airborne particulates**

5.8.1 Ventilation or forced-draught extraction equipment must be put into operation at the start of work in workshops and areas where flammable, toxic or noxious gases, vapours and airborne particulates may occur.

This applies, for example,

- *to work on aircraft fuel systems; also refer to sub-para 5.23,*
- *to the cleaning of parts by means of flammable liquids of hazard classes A I, A II or B*
- *after spillage of such substances, or if they are kept in open containers. Also refer to Reg. 47 of the "General regulations for accident prevention" (VBG 1).*

Vapours that are flammable even at ambient temperature arise particularly from liquids of hazard classes A I or B; also refer to Reg. 44 para 1 and Reg. 45 para 2 of the "General regulations for accident prevention" (VBG 1).

As the vapours of flammable liquids (e.g. gasoline, solvents and cleaning agents) are heavier than air, they accumulate at the lowest points of working areas (pits, shafts, drains) and may form potentially explosive mixtures when mingled with the air of the room. These vapours and gases must therefore be removed from the working areas by extraction or adequate ventilation; also refer to sub-para 4.13.

Flammable gases may particularly gather in drains which have been unused and covered over for a lengthy period, as there is no natural exchange of air in these channels.

Owing to the diversity of possible ignition sources it is not feasible to state a precise boundary for the danger zone. In each case, a decision on this is therefore to be taken by the person responsible for the work. For example, if grinding or welding work is being performed simultaneously at adjacent workplaces, particular account is to be taken of the fact that sparks and welding beads may fly considerable distances.

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Examples of safety distances are given in the "Accident prevention regulations for the application of coating materials" (VBG 23) and the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 5.8.2 Exhaust gases from combustion engines must be discharged from workshops and working areas. This does not apply to brief emissions of exhaust gas, e.g. during the parking of a vehicle or item of AGE equipment.

When discharge of exhaust gases occurs, an extraction device is generally required at the point of emission. For example, exhaust gases can be conducted to the open air by a hose or pipe attached to the exhaust pipe, or by a special extraction device.

Also refer to Reg. 45 para 2 of the "General regulations for accident prevention" (VBG 1).

- 5.8.3 The mechanical extraction of flammable gases and vapours must be separate from that of combustion engine exhaust gases.

Also refer to Section E 1.3.4.2 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 5.8.4 Suitable protective measures must be taken for working processes with dangerous materials in which ventilation is not feasible.

This may be the case, for example, during disinfection, fumigation and work performed in aircraft tanks.

Also refer to TRGS 512 (Technical Regulations for Dangerous Substances) on "Fumigation".

With regard to personal protective equipment, also refer to sub-para 5.5.1 in conjunction with Annex 1.

- 5.9 **Handling of flammable liquids, airborne particulates, cleaning materials, cleaning work**

- 5.9.1 In case of risk that leakage of flammable liquids of hazard classes A I, A II or B may occur during the performance of work, all ignition sources which may ignite the flammable vapours of these liquids must be eliminated before this work starts.

Sources of ignition occur, for example, from smoking, welding work, electrostatic charging, emission of sparks by electrical equipment, use of tools that generate sparks, automatic ignition devices, fans, hot internal and external surfaces of gas-fired, coal-fired, oil-fired or electric heating units, electric storage heaters or open flames.

Fuels or solvents are examples of flammable liquids of hazard classes A I, A II or B.

Also refer to Reg. 43 and 44 of the "General regulations for accident prevention" (VBG 1), Reg. 8 of the "Accident prevention regulations for welding, cutting and related techniques" (VBG 15), Section E 2.3 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10) and the "Guidelines for the prevention of ignition hazards resulting from electrostatic charges" ("Guidelines on static electricity") (ZH 1/200).

- 5.9.2 Leakages or spillages of flammable liquids of hazard classes A I, A II or B are to be picked up immediately, removed from the working area and stored at a suitable location pending ultimate disposal.

The vapours emanating from flammable liquids of hazard classes A I, A II or B combine with the ambient air to form potentially explosive mixtures. Special ventilation measures may therefore become necessary.

Also refer to Section 4.13 and Art. 11 of the Flammable Liquids Ordinance (VbF).

- 5.9.3 Liquids that have leaked are to be removed in a suitable manner (e.g. by means of absorbent materials, cleaning appliances) in order to reduce the risk of slippage.

Sawdust is not a suitable absorbent material, as it may tend to self-ignite when combined with flammable liquids.

Also refer to Reg. 20 of the "General regulations for accident prevention" (VBG 1).

- 5.9.4 Airborne particulates not collected by the equipment specified under sub-para 4.13 must be disposed of separately.

The reduction of dust contamination at the workplace is intended to prevent harmful effects to the respiratory organs.

Also refer to Reg. 46 of the "General regulations for accident prevention" (VBG 1).

- 5.9.5 In working areas, any used cleaning material, waste material and residues are to be stored in lockable, non-combustible containers pending proper disposal each working day.

Also refer to Art. 25 para 2 of the Workplace Ordinance and Reg. 43 of the "General regulations for accident prevention" (VBG 1).

With regard to residues of flammable liquids, refer also to Art. 11 of the Flammable Liquids Ordinance (VbF).

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- 5.9.6 Cleaning work must not be performed with flammable liquids of hazard classes A I, A II or B, nor with toxic liquids.

Non-combustible cleaning materials or those which pose less risk of fire are recommended, e.g.

1. water-soluble, non-combustible detergents, such as liquid soaps, neutral and alkaline high-temperature and high-pressure cleaning agents,

2. water-soluble cold cleaners.

“Cold cleaners” are frequently mixtures of (flammable) solvents and sometimes also contain chlorinated hydrocarbons (CHCs). Refer to the “Guidelines for facilities for the cleaning of work-pieces by solvents” (ZH 1/562) and the “Leaflet on cold cleaners” (ZH 1/425).

In accordance with Annex II sub-para 1.3.4 of the Dangerous Substances Ordinance, the use of gasoline as a cleaning agent is forbidden because of the highly flammable nature of this fuel and the risk of cancer resulting from the benzene it contains.

Also refer to the “Leaflet on the protection of health during the handling of gasoline” (ZH 1/466).

- 5.9.7 Notwithstanding sub-para 5.9.6, cleaning work may be performed with flammable liquids of hazard classes A I, A II or B (but not with gasoline), if this work

1. is performed in a special, separate room; this room is regarded as a potentially explosive area and is to be marked as such

or

2. has to be performed as an urgent necessity in other rooms on account of particular circumstances. In these cases the use of the cleaning agents is to be ordered, on a case-by-case basis, by a supervisor with competence to do so; the quantities of liquid used are to be kept as small as possible.

During cleaning work of this kind there is a particular risk that working clothes moistened or saturated by the cleaning fluid may be set on fire by sparks.

Refer to Reg. 44 of the “General regulations for accident prevention” (VBG 1) and the “Accident prevention regulations for safety signs at the workplace” (VBG 125).

- 5.9.8 Flammable liquids of hazard classes A I, A II or B used for cleaning work on aircraft must be in safety containers which are effective in preventing any unintentional spillage of the liquid.

Refer to Art. 25 para 2 of the Workplace Ordinance and Reg. 43 of the "General regulations for accident prevention" (VBG 1).

- 5.9.9 Cleaning agents of hazard classes A I, A II or B are to be stored safely after completion of the cleaning work. Cleaning agents which are no longer usable must be stored in waste disposal containers.

Also refer to Art. 11 of the Flammable Liquids Ordinance (VbF).

- 5.9.10 Cleaning tanks are to be set up in such a way that
1. they cannot be heated up by solar radiation or other sources of heat in an inadmissible manner,
 2. they cannot be overturned,
 3. they do not stand near working locations at which welding or grinding work is performed.

Also refer to Reg. 44 of the "General regulations for accident prevention" (VBG 1).

- 5.9.11 Cleaning work with flammable liquids of hazard classes A I, A II or B is only to be carried out at an adequate distance from ignition sources.

Also refer to Section E 2 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 5.9.12 For cleaning work on aircraft, brushes with metal parts must not be used if flammable liquids of hazard classes A I, A II or B are utilized.

Also refer to Section E 2.3.6 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 5.9.13 If noxious breathable aerosols or vapours occur during washing work, personnel must wear suitable respiratory protection equipment, eye protection and protective clothing. Refer to sub-para 5.5 in conjunction with Annex 1.

Also refer to Reg. 14 of the "General regulations for accident prevention" (VBG 1).

- 5.9.14 Cleaning agents are only to be mixed in accordance with the manufacturer's instructions and must be used in the specified manner.

If different cleaning agents are mixed, uncontrollable reactions may occur.

Refer to advice from manufacturer.

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- 5.9.15 For the atomizing of flammable cleaning agents, liquid-jet sprayers must not be used.

Aerosol generation leads to increased risk of fire and explosion. Refer to Section 4.7 of the "Guidelines for liquid-jet sprayers" (ZH 1/406).

- 5.9.16 When performing large-scale cleaning and adhesive work using highly volatile, flammable solvents (A I, A II or B), personnel must comply with the following requirements:

1. The solvents are only to be transported and stored in safety containers, which are to be marked in accordance with the Dangerous Substances Ordinance. Open containers are not permitted. During decanting, the containers must be earthed.
2. Locations and areas in which solvents and adhesives are openly handled are regarded as explosion hazard zones.
3. Solvents must not be used for sprinkling or rinsing. Surplus quantities and residues are to be removed immediately.
4. Cleaning rags saturated with solvents are to be kept in containers as specified in sub-para 4.14.3.
5. During the handling of solvents and adhesives, the necessary personal protective equipment is to be used; refer to sub-para 5.5.1 in conjunction with Annex 1.
6. During the work, personnel not wearing respiratory protection equipment must be working at a distance of least 10 m. The danger zone is to be marked accordingly. If deviation from this safety distance is imperative, measurements are to be carried out in order to check whether the permissible concentrations of noxious substances are being exceeded.

With regard to safety zones and safety distances, refer to the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

The maximum permissible concentrations of noxious substances in the breathing air are less than the lower explosion limit.

Also refer to Reg. 14 and 18 of the "General regulations for accident prevention" (VBG 1) and Reg. 9 to 20 of the "Accident prevention regulations for processing of adhesives" (VBG 81).

5.10 **Maintenance work on containers for flammable liquids**

- 5.10.1 For maintenance work (not including work performed with open flame) on containers for flammable liquids of hazard classes A I, A II or B or for flammable gases it is to be ensured

1. that only degasified containers or those bearing a valid certificate of nil gas content are taken into workshops,

2. that non-degasified containers taken into workshops are monitored by means of gas warning devices as specified in sub-para 4.15,
3. or that non-degasified containers are taken into an explosionproof room of the workshop.

Aircraft fuel tanks can also be regarded as containers.

Refer to Section E 2 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 5.10.2 When gas warning devices are in use, it must be ensured that the concentration does not exceed a safe level which lies below the lower explosion limit (LEL).

This requirement is met if two warning stages are observed during the work, as follows:

1. *At 10% of the LEL an acoustic and visual warning is given. The fault must be located. At the same time, ventilation measures must be initiated (e.g. opening of the hangar doors).*
2. *At 25% of the LEL the warning changes. The working area must be converted to an explosionproof area (e.g. shutdown of the electrical system; no use of tools which generate sparks).*
3. *All-clear is given when the concentration falls below 10 % of the LEL.*

Refer to Section E 1.4.1 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

5.11 **Work performed with open flame**

- 5.11.1 Work performed with an open flame – this includes welding – and work during which sparks may occur must not be carried out near working locations at which combustible substances are present.

Examples of combustible substances are packaging materials, plastics, flammable liquids.

Also refer to Sections 5.8 and 5.9 and Reg. 43 and 44 of the "General regulations for accident prevention" (VBG 1) and Reg. 30 of the "Accident prevention regulations for welding, cutting and related techniques" (VBG 15).

- 5.11.2 Work performed with an open flame and work during which sparks may occur is only permitted to be performed on aircraft if it is ensured that combustible vapour/air mixtures or gases are unable to ignite.

The danger of ignition of fuel vapours or gases can be eliminated by, for example, emptying the tank, providing ventilation, and monitoring that no gas is present.

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The risk of fuel loss from partially dismantled lines can be remedied, e.g. through removal of the fuel by suction.

Refer to Reg. 30 of the "Accident prevention regulations for welding, cutting and related techniques" (VBG 15).

- 5.11.3 Before the start of work with an open flame on fuel tanks it must be ensured that the tank does not contain any potentially explosive vapour/air mixture.

Refer to Reg. 31 para 1 of the "Accident prevention regulations for welding, cutting and related techniques" (VBG 15).

- 5.11.4 If safety measures in accordance with Reg. 31 of the "Accident prevention regulations for welding, cutting and related techniques" (VBG 15) are implemented, a competent person is to check and confirm in writing – before the start of work performed with open flame – that the tank(s) contain(s) no potentially explosive vapour/air mixture.

Refer to Reg. 31 para 2 of the "Accident prevention regulations for welding, cutting and related techniques" (VBG 15).

- 5.11.5 Before the start of work with an open flame in the vicinity of aircraft, the employer is to take at least the following measures:

1. The place, duration and scope of the necessary safety measures are to be specified in written working instructions. Personnel are to be briefed accordingly.
2. The work is not to be started until it has been ensured that the safety measures have been taken and are effective. The effectiveness of the safety measures is to be monitored throughout the period of work. The employer or his designated representative are not to cancel the specified safety measures until the maintenance work has been completed and any dangers have ceased to exist.

Also refer to Reg. 31 para 1 of the "Accident prevention regulations for welding, cutting and related techniques" (VBG 15), Reg. 6, 7, 36, 39, 41 and 47 of the "General regulations for accident prevention" (VBG 1) and

Section E 4 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

In addition to the above-mentioned regulations and guidelines, the following regulations must be taken into account in the preparation of the working instructions:

- *Dangerous Substances Ordinance, with Annexes I to V,*
- *Technical Regulations for Dangerous Substances (TRGS),*
- *Regulations for the provision of fire extinguishers at workplaces (ZH 1/201),*

- Leaflet on fire protection during welding and cutting work (ZH 1/117).

The working instructions must contain the following information:

- the name of the person responsible for supervising the work,
- fire prevention measures,
- fire-fighting equipment to be provided,
- action in case of fire and disaster,
- special requirements for aircraft hangars and ramps,
- the instruction that flammable liquids of hazard classes A I, A II or B are to be removed from the danger area,
- the warning that work with open flame is not permissible if:
aircraft tanks are open and cannot be entered,
drainage work is being carried out,
aircraft tanks are entered by personnel,
work is being carried out on the fuel system,
the work of applying or removing paint is being performed on or in the aircraft.

5.12 Processing and application of coating materials

- 5.12.1 The employer is to ensure that special protective measures for preventing fires, explosions and health damage are taken during the application of coating materials. The application of liquid coating materials containing dangerous substances is always to be performed in separate rooms or areas. During the application of coating materials in aircraft or in enclosed spaces within aircraft, attention is to be paid to TRGS 507 (Technical Regulations for Dangerous Substances) on "Surface treatment in rooms and containers".

Also refer to the "Accident prevention regulations for the application of coating materials" (VBG 23) and the "Accident prevention regulations for driers for coating materials" (VBG 24).

- 5.12.2 Deviations from the second sentence of sub-para 5.12.1 are permissible if risks to personnel are prevented in other ways, e.g. by the following measures:

1. performing the work outside normal working hours,
2. cordoning off a wide area around the working location,
3. paying attention to wind direction,
4. ensuring natural ventilation,
5. extinguishing all naked lights and flames,
6. complying with smoking bans,
7. switching off other sources of ignition (e.g. infra-red emitters, non-explosionproof electric motors),

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8. using electrical and electrostatic spraying equipment in accordance with Reg. 11 of the "Accident prevention regulations for the application of coating materials" (VBG 23),
9. using explosionproof electrical appliances and machinery,
10. keeping fire extinguishers and fire blankets in readiness,
11. using respiratory protection appliances; refer to sub-para 5.5 in conjunction with Annex 1,
12. using suitable spraying techniques producing little vapour and
13. using local exhaust equipment.

Cordoning off a wide area may involve, for example, the stopping of access to all or part of a hangar. In case of doubt, the concentration is to be ascertained by measurement.

Also refer to Reg. 13 of the "Accident prevention regulations for the application of coating materials" (VBG 23).

- 5.12.3 Small-scale application of coating materials by spraying may be carried out at the same time as other work if the following conditions are met:
1. a cordon with a radius of at least 5 m around the working location,
 2. use of not more than one spray gun,
 3. maximum period of 2 minutes for continuous spraying,
 4. not more than 500 cm² to be applied per individual spray job,
 5. adequate vapour dispersal periods between the individual spray jobs.

The vapour dispersal period is adequate when measurements fall below the threshold limit value (MAK/TRK).

Also refer to Reg. 13 para 3 of the "Accident prevention regulations for the application of coating materials" (VBG 23).

- 5.12.4 After the application of coating materials, permission for other work (follow-up work) in the area can only be given if
- the area has been cleaned and the dust, which may contain carcinogenic constituents, has been removed by a vacuum cleaner and
 - an adequate vapour dispersal period has been given.

Also refer to Reg. 14 of the "Accident prevention regulations for the application of coating materials" (VBG 23) and Reg. 13 of the "Accident prevention regulations for the handling of carcinogenic dangerous substances" (VBG 113).

- 5.12.5 The employer is to ensure that the cleaning of spraying equipment is performed safely.

An example of a safe cleaning method is as follows:

The paint or solvent is discharged, via a tightly-closing special funnel with pipe socket, into an earthed metallic container in such a way that no solvent vapours can form. When this method is used with an electrostatic spray unit, the unit's high-voltage generator is to be switched off.

Also refer to Reg. 11 of the "Accident prevention regulations for the application of coating materials" (VBG 23).

- 5.12.6 The employer is to ensure that special protective measures for preventing health damage are taken during the removal of coating materials from aircraft. The use of liquid paint-stripping agents (mordants) containing dangerous substances is always to be performed in separate rooms or areas.

During the application of paint-stripping agents in aircraft or in enclosed spaces within aircraft, attention is to be paid to TRGS 507 (Technical Regulations for Dangerous Substances) on "Surface treatment in rooms and containers".

Also refer to sub-para 5.12.1.

- 5.12.7 To prevent bad traction and reduce carry-over, the employer is to ensure that residues of coating materials and paint-stripping agents are immediately removed from floors, dock facilities and other working areas.

Refer to Reg. 20 of the "Accident prevention regulations for the application of coating materials" (VBG 23).

- 5.12.8 Deviations from the first sentence of sub-para 5.12.6 are permissible if risks to personnel are prevented in other ways, e.g. by the following measures:

1. performing the work in such a way that personnel are not at risk,
2. cordoning off a wide area around the working location and marking it in a clearly recognizable manner,
3. ensuring natural ventilation and using local extract systems,
4. complying with smoking bans,
5. using suitable personal protective equipment,
6. using suitable application techniques producing little vapour.

Cordoning off a wide area may involve, for example, the stopping of access to all or part of a hangar. For large-scale paint-stripping activities, a working area of 20 m around the point of

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use is to be closed to all personnel not involved in the paint-stripping work.

For small-scale paint-stripping work (up to 8 m²), the safety distance is to be 10 m.

In case of doubt, the concentration is to be ascertained by measurement.

With regard to markings, refer to the "Accident prevention regulations for safety signs at the workplace" (VBG 125).

With regard to personal protective equipment, refer to sub-para 5.5 in conjunction with Annex 1.

Also refer to Reg. 47 of the "General regulations for accident prevention" (VBG 1).

- 5.12.9 During the removal of coating materials by means of the combined chemical/mechanical technique, sub-paras 5.12.6 and 5.12.7 are to be appropriately applied to the use of the removing material.

The fitments and use of the spraying unit are laid down in the "Regulations for liquid spraying units" (ZH 1/406).

- 5.12.10 The employer is to ensure compliance with the following conditions during grinding work on aircraft:

1. Appliances for direct extraction of the abrasive dust are to be used during the grinding work. The extraction device must be officially approved for the removal of harmful dusts.
2. Suitable respiratory protection equipment is to be worn within a radius of at least 2.5 m around the location of the grinding work.
3. The performance of other work below the grinding location is only permitted outside a safety zone with a radius of 5 m. The safety zone is to be marked.
4. Vacuum cleaners officially approved for removing harmful dusts ("C" certification mark) are to be used for cleaning the working areas that are contaminated with abrasive dust. The working area in which grinding is carried out is to remain closed until cleaning has been completed.

For tested dust-removal equipment, refer to "Devices for separation of hazardous dusts with recycling of clean air into workrooms (small dust removers – industrial vacuum cleaners – scavenging machines) – efficiency criteria" (ZH 1/487).

With regard to respiratory protection, refer also to sub-para 5.5 in conjunction with Annex 1.

Also refer to Reg. 44 and 45 of the "General regulations for accident prevention" (VBG 1).

5.13 **Hygiene measures during processing and application of coating materials**

5.13.1 The employer is to ensure compliance with the following hygiene measures for soiled working clothes:

1. Working clothes heavily contaminated with solvent are to be changed immediately; this measure also serves as a precaution against fire.
2. Clothing contaminated with dust containing carcinogenic substances is to be taken off at suitable workplace locations after completion of the work and is to be disposed of in bins provided for this purpose.
3. Personnel wearing working clothes contaminated with dust containing carcinogenic substances are not permitted to enter break rooms or other areas of the facility (e.g. canteen).

Refer to Reg. 24 of the "Accident prevention regulations for the handling of carcinogenic dangerous substances" (VBG 113).

5.13.2 The consumption and storage of food and drink at the workplace is not permitted.

Also refer to Art. 22 of the Dangerous Substances Ordinance.

5.14 **Ban on smoking**

Smoking is forbidden in rooms and areas specified in sub-para 4.16.

Refer to Reg. 43 para 3 of the "General regulations for accident prevention" (VBG 1).

5.15 **Handling of fire-extinguishing devices**

The employer is to ensure that fire-extinguishing devices are kept in working order and that they can be easily reached at any time. He is to instruct personnel in how to handle the fire-extinguishing devices.

Refer to Reg. 43 of the "General regulations for accident prevention" (VBG 1), Reg. 6 of the "Accident prevention regulations for the application of coating materials" (VBG 23) and the "Regulations for the provision of fire extinguishers at workplaces" (ZH 1/201).

5.16 **Securing of aircraft to prevent movement**

Before the start of maintenance work, the employer is to ensure that the aircraft is secured against accidental movement.

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Refer to Reg. 62 of the "Accident prevention regulations for aviation" (VBG 78).

5.17 **Electrical earthing of aircraft**

The employer is to ensure that, before the start of work of any kind on an aircraft, the earthing point of the aircraft is electrically connected to the standing location by at least one earth cable with a cross section of 16 mm² copper.

Refer to Reg. 63 para 2 of the "Accident prevention regulations for aviation" (VBG 78).

5.18 **Work on raised aircraft**

- 5.18.1 The employer is to ensure that aircraft jacks and other hoisting and supporting devices are operated in such a way that, when these are used properly, the raised aircraft is held securely.

To ascertain how to use the equipment properly refer, for example, to the operating instructions from the manufacturer of the aircraft jack.

Also refer to Reg. 7 and 15 of the "General regulations for accident prevention" (VBG 1) and Reg. 25 of the "Accident prevention regulations for power-driven appliances" (VBG 5).

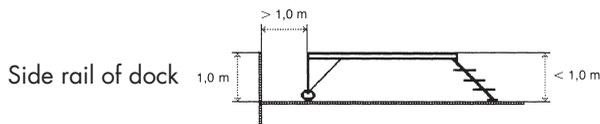
- 5.18.2 The employer is to ensure that work on, in or under raised aircraft is not carried out until the hoisting device has been secured against accidental lowering or until sufficiently secure support has been provided and any tilting of the aircraft is precluded.

Also refer to Reg. 41 of the "Accident prevention regulations for aviation" (VBG 78).

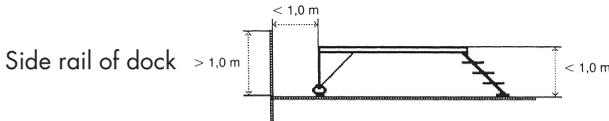
5.19 **Work involving the risk of falling**

- 5.19.1 For personnel at risk of falling when working on and in aircraft, the devices specified in sub-para 4.10 must be used.

If a platform or stairway (height < 1.0 m) without side rails is used on a dock with side rails of 1.0 m in height, the platform must be at a distance of at least 1.0 m from the side rail of the dock.



If a platform or stairway of less than 1.0 m high is positioned closer than 1.0 m to the side rail, the height of this rail must be increased. If the platform or stairway stands directly next to the side rail, the height of this rail is to be increased by the height of the platform (but not by more than 1.0 m).



Also refer to Reg. 33 para 1 of the "General regulations for accident prevention" (VBG 1).

- 5.19.2 If the risk of falling cannot be entirely precluded by the devices specified in sub-para 4.10, personal safety equipment must be used for preventing falls.

Also refer to "Regulations for the use of personal protective equipment for preventing falls" (ZH 1/709).

5.20 Filling of pneumatic tyres

- 5.20.1 The employer is to ensure that, during the filling of pneumatic tyres, the following measures are taken to prevent injury resulting from wheels or parts which fly off:

1. service instructions on proper mounting,
2. checks for visible damage to wheels, rims and tyres,
3. compliance with the permitted filling pressure,
4. use of safety devices for intercepting wheels or parts which fly off.

Refer to sub-para 4.9.1 for details of safety devices.

Refer to sub-para 4.9.2 for refilling of tyres on aircraft.

Also refer to Reg. 14 of the "General regulations for accident prevention" (VBG 1).

5.21 Work on aircraft oxygen systems

- 5.21.1 The employer is to ensure that work on oxygen systems is performed by trained personnel only. He is to make certain that the protective measures laid down in service instructions are carried out.

Work on oxygen systems also includes the filling of oxygen systems and the changing of oxygen bottles.

Service instructions are to draw attention to the special protective measures required during work on oxygen systems, e.g. that

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- hands, clothing, tools and connections must be free from oil, grease and dirt,
- no other work is to be carried out in the surrounding area,
- a strict ban on smoking is to be observed,
- means of escape are to be kept clear and must be used,
- when aircraft oxygen systems are being filled with oxygen, no refuelling and no electrical switching operations are to be carried out,
- during the oxygen filling procedure, the aircraft and the oxygen supply vehicle are electrically connected to one another at the earthing points provided for this purpose.

Also refer to Reg. 27 to 48 of the "Accident prevention regulations for oxygen" (VBG 62) and Section 4.9 of the "Guidelines on static electricity" (ZH 1/200).

5.22 X-ray work on aircraft

A permit under the X-ray Ordinance (Röntgenverordnung) is required for the operation of an X-ray system. The person responsible for radiation protection is to appoint radiation protection superintendents to ensure operational safety.

5.23 Work in aircraft fuel tanks and confined spaces

- 5.23.1 For work in fuel tanks and confined spaces, the employer is to implement special precautionary measures for preventing fire and explosion hazards, for preventing damage to health, and for rescue of personnel.

For the carrying out of work in tanks and confined spaces, refer to the "Guidelines for work in tanks and confined spaces" (ZH 1/77).

For work performed with open flame, refer to sub-paras 5.11.3 and 5.11.4.

For advice and explanations relating to special safety engineering measures, refer to Annexes 1 and 2.

- 5.23.2 Personnel are only permitted to enter a fuel tank if written permission (entry permit) for this has been given. The permit is to be issued by the person responsible.

Refer to Annex 1 of the "Guidelines for work in tanks and confined spaces" (ZH 1/77) for an example of an entry permit.

As soon as a person puts his head into a tank, the tank is regarded as entered.

Refer to sub-para 5.10.2 with regard to the use of gas alarm devices.

- 5.23.3 During work in aircraft fuel tanks and areas in which a risk of explosion exists, any electrostatic charge must be safely discharged by means of earthing.

Hazards resulting from electrostatic charging occur, for example, during the

- opening of fuel tanks,*
- transfer of fuel by pumping,*
- transfer of flammable liquids,*
- connection and disconnection of fuel lines.*

Also refer to the "Guidelines on static electricity" (ZH 1/200) and Section E 2.3.6 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10).

- 5.23.4 In conductive zones with limited freedom of movement in and on aircraft, electrical tools must be selected and operated in such a way that they do not result in any hazard to personnel.

A conductive zone with limited freedom of movement exists where

- the zone is bounded mainly by metal parts or conductive parts,*
- a person may come into extensive physical contact with the bounds of the zone, and*
- there are only limited possibilities of interrupting this contact.*

Zones with limited freedom of movement may exist around or in the aircraft, e.g. fuel tank and cargo bay, or the entire airframe may be such a zone.

For further explanation of the protective measures, refer also to DIN VDE 0100 Part 706 item 4 "Erection of power installations with rated voltages up to 1000 V; conductive areas with limited freedom of movement" and DIN VDE 0100 Part 410 "Erection of power installations with rated voltages up to 1000 V; protective measures; protection against shock current".

- 5.23.5 When working in an aircraft fuel tank, personnel must always have contact with a reliable safety lookout who is standing outside the tank/confined space. The lookout must be able to fetch help at all times.

This also means that auxiliary personnel and rescue equipment must be reachable at all times; also refer to Reg. 3 of the "Accident prevention regulations for first aid" (VBG 109).

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If visual contact is not feasible, continuous contact can also be maintained by other means, e.g. voice communication or signal lines.

Also refer to Section 10.1 of the "Guidelines for work in tanks and confined spaces" (ZH 1/77).

- 5.23.6 Openings giving access to fuel tanks are to be kept clear during the work.

Refer to Reg. 30 of the "General regulations for accident prevention" (VBG 1).

- 5.23.7 For the transfer of flammable liquids, only containers, funnels, lines and other decanting devices made from electrically conductive material are to be used.

- 5.23.8 The employer is to ensure that, during work on fuel systems in which fuel tanks are opened or fuel lines are disconnected, fire extinguishing equipment of sufficient capacity and suitable for at least fire category BC is easily reachable in the immediate vicinity and is kept ready for use.

For large aircraft, for example, an adequate fire-extinguishing capacity exists if a P 50 dry powder extinguisher is in readiness.

Also refer to Reg. 43 para 4 of the "General regulations for accident prevention" (VBG 1).

5.24 **Fuelling and defuelling of aircraft**

- 5.24.1 During the fuelling and defuelling of aircraft, measures for preventing fires and explosions are to be taken.

Also refer to the Flammable Liquids Ordinance (VbF) and the associated Technical Regulations for Flammable Liquids (TRbF) and the "Guidelines on protection against explosion" (EX-RL) (ZH 1/10).

Particular attention is drawn to the regulations relating to notification or mandatory licensing of storage, to technical equipment of tanks and filling facilities, and to safety measures during fuelling and defuelling.

Useful advice is also given in the petroleum companies' manuals on aircraft fuelling.

- 5.24.2 Vehicles and tanks used for fuelling and defuelling aircraft must be earthed so that static electricity is discharged; they must also be electrically connected to the aircraft. Existing earthing connections must be

used. The aircraft and the tanker vehicles or tanks are to be connected to the same earthing device.

This ensures that equalization of potential is maintained.

- 5.24.3 Earthing cables are to be connected first to the earthing point and then to the aircraft. Disconnection is to be performed in the reverse order.

Also refer to Section E 2.3.6 of the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10) and the "Guidelines on static electricity" (ZH 1/200).

5.25 Rescue from tanks

- 5.25.1 For work in aircraft fuel tanks, the employer is to provide a suitable number of easily accessible devices for rescuing personnel.

Examples of suitable devices are as follows:

- breathing appliances (self-contained apparatus) operating independently of the ambient air,*
- personal safety equipment for holding and rescuing,*
- carrying bags, carrying tubs, stretchers, tripods with hoisting devices, cranes.*

Rescue equipment may be kept in readiness by locally available rescue teams, e.g. Fire Brigade. In this case, before the start of work the supervisor is to check on the availability of the rescue equipment and the possibility of rapidly notifying the rescue teams.

Also refer to Reg. 3 of the "Accident prevention regulations for first aid" (VBG 109).

- 5.25.2 For work in fuel tanks of categories 3 and 4 (described in Annex 2), the employer is to ensure that suitable tools and trained personnel are available so that in an emergency any person incapable of moving can be rescued from the tank.

Examples of suitable tools are circular saws, siphons, crowbars, air supply for powering circular saws, air hoses, screwdrivers, pincers and protective leather covers.

It is advisable to keep the tools and first aid material in readiness near the location at which work on tanks is performed.

Also refer to Reg. 3 of the "Accident prevention regulations for first aid" (VBG 109).

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5.26 Occupational health check-ups

Personnel who perform work in aircraft fuel tanks and, in doing so, wear respiratory protection equipment or are exposed to dangerous materials in hazardous concentrations, must be monitored by means of occupational health check-ups before commencing this employment and during the course of it.

Work performed in aircraft fuel tanks makes heavy demands on physical performance. It must therefore be ensured that an employee's state of health does not preclude him from performing work in tanks.

Also refer to Reg. 3 of the "Accident prevention regulations on occupational health check-ups" (VBG 100).

6 Testing

Facilities, appliances and equipment used in aircraft maintenance are to be tested in accordance with the relevant regulations.

With regard to scope of testing and test deadlines, refer to Annex 3.

Also refer to sub-para 3.3.

7 Date of application

These regulations are to be applied with effect from 1 April 1994, except those provisions of the regulations with which compliance is already mandatory under existing legislation or as recognized technical regulations.

Annex 1

Operational requirements for personal protective equipment during aircraft maintenance work (sub-para 5.5 refers)

1. Examples of operational requirements for personal protective equipment are as follows:
 - a) **protective headgear**, such as safety helmets, impact prevention cap, hairnets
 - during work performed under suspended loads,
 - in areas where objects may oscillate, fall down, fall over or fly away,
 - in areas where a person's head is at risk of impact,
 - in areas where loosely dangling hair may become caught,
 - b) **protection for the eyes and face**, such as safety goggles, visors
 - during welding, cutting and grinding work,
 - during chiselling work,
 - during the handling of dangerous materials,
 - during overhead work on or in the aircraft;
 - c) **protection for the hands and body**, such as protective gloves and aprons
 - during welding and cutting work,
 - during the handling of dangerous materials,
 - during the handling of objects which may cause skin injuries (sharp and pointed objects);
 - d) **respiratory protection equipment** if threshold limit values are exceeded
 - during paint spraying work, paint removal work,
 - during the handling of dangerous materials,
 - in case of oxygen deficiency;
 - e) **conspicuous working clothes** during work performed on the apron;
 - f) **noise attenuation devices**, if a noise rating of 85 dB(A) is exceeded, e.g.
 - during work performed on the apron,
 - during structural work on the aircraft (riveting),
 - during work with impact wrenches;

refer to the "Accident prevention regulations concerning noise" (VBG 121)

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- g) personal safety equipment for preventing falls during work on aircraft, as described in sub-para 5.19.2

refer to Reg. 33 para 3 of the "General regulations for accident prevention" (VBG 1).

2. Personal protective equipment specifically required during the application of coating materials is as follows:

a) **Suitable protective clothing**

Refer also to the "Regulations for the use of protective clothing" (ZH 1/700).

When coating materials are applied, clothing contaminated with carcinogenic substances must be disposed of after use. This will prevent the carrying of very toxic materials into other areas.

- b) **Shoes** with electrically conductive soles. Volume resistance 105 to 108 ohm.

c) **Suitable respiratory protection equipment**

Breathing apparatus operating independently of the ambient atmosphere is regarded as unreservedly suitable.

If, for technical reasons, the use of breathing apparatus operating independently of the ambient atmosphere is not feasible, a full-face protective mask with combination filter A2 P3 must be used during the application of coating materials containing carcinogenic substances; for application of all other coating materials, combination filter A1 P2 is to be used.

To increase the effectiveness of a full-face protective mask the person concerned should wear, on his back, a coarse non-woven pre-filter.

During the application and vapour dispersal period, personnel are to put on respiratory protection equipment even before entering the danger zone concerned and are not to take it off again until after leaving the danger zone.

Respiratory protection is also to be worn for the cleaning of spraying equipment.

Personnel who wear respiratory protection are to be monitored by means of occupational health check-ups;

refer to Reg. 2 of the "Accident prevention regulations on occupational health check-ups" (VBG 100).

The maximum period of use for respiratory protection filters is given in the "Regulations for the use of respiratory protection equipment" (ZH 1/701).

3. Personal protective equipment specifically required during the removal of coating materials is as follows:

a) **Suitable protective clothing**

A chemical-resistant suit type II complying with DIN 32 763 is regarded as suitable.

Protective suits made from leather or polypropylene (disposable suits) with hood are regarded as being suitable to a limited extent.

Paint-removing agents contain substances which are resorptive by the skin; they may also contain phenol.

When the material for the protective clothing is selected, the greatest possible impermeability to phenol is to be ensured because even in the gaseous phase phenol can be resorbed by the skin.

Disposable suits are usually manufactured from materials which are permeable to phenol.

After any contact with paint-removing agent, the protective suit must be changed immediately.

b) **Protective headgear**

The head can be protected by means of the hood on the disposable suit or the hood attached to the full-face protective mask. It must be ensured that no paint-removing agent touches a person's head, even during removal of paint from the underside of the aircraft fuselage.

c) **Protective footwear**

The feet are to be protected by firmly fitting leather shoes; they are to be at least of Oxford shoe type (sandals are not permissible).

If paint-removing agent might fall or drip, the area between shoe and trousers must be protected; this is most easily achieved by using footwear with a tall leg.

d) **Protective gloves**

The gloves must provide adequate protection against the dangerous substances contained in the paint-removing agent (e.g. phenol). The glove must have a long cuff so that the area between glove and sleeve is protected. The interior of the glove must be of material compatible with the skin.

In the gaseous phase, phenol is absorbed through the skin to a considerably lesser degree than in the liquid phase. The same also applies to the phenol permeability of materials from which

physical protection equipment is made. The glove will come into intensive contact with the phenol (because in the area of the hand, contact with the paint-removing agent is inevitable during the removal of the dissolved coating); the phenol will therefore penetrate the material of the glove after a certain period.

e) Respiratory protection

Breathing apparatus operating independently of the ambient atmosphere is regarded as being unreservedly suitable.

If, for technical reasons, the use of breathing apparatus operating independently of the ambient atmosphere is not feasible, a full-face protective mask with a suitable filter must be used during the removal of coating materials. The selection of the suitable filter is a difficult matter owing to the composition of the dangerous substances concerned. The paint-removing agents contain not only acids and ammonia but also solvents - particularly those with a low boiling point.

The appropriate ABEK filters are only to be used if the following conditions are observed:

- Pay heed to the usable period of the filter. The filter must be changed after 1 hour.*
- Filters that have already been used must not be re-used.*
- Personnel must be aware of the times at which the filter is to be changed.*
- The mask must be checked to ensure that it is airtight and fits properly.*
- Occupational health check-ups in accordance with Code of Practice G 26 "Respiratory protection equipment" issued by the employers' liability insurance associations.*
- Training and instruction in respiratory protection must be carried out in accordance with Section 7.2 of the "Regulations for the use of respiratory protection equipment" (ZH 1/701).*
- Refer to Annex 3 with regard to care and testing of masks.*

4. Personal protective equipment specifically required during work in fuel tanks is as follows:

a) Suitable protective clothing

Owing to the danger arising from contact with fuel residues, it has proven beneficial to change all outer clothing and undergarments before starting the work.

Cotton is regarded as a suitable material for the clothing.

If work has to be performed in tanks in which highly toxic materials have been used for corrosion-proofing, hoods and hand protection (rubber gloves) are also to be worn. Contaminated working clothes must be disposed of separately.

- b) **Shoes** with electrically conductive soles. Volume resistance 105 to 108 ohm.
- c) **Suitable respiratory protection equipment**

Suitable respiratory protection equipment must be worn if the concentration of fuel vapours in the breathing air exceeds 100 ml/m³, or if the threshold limit values (MAK) of solvents are exceeded, or if highly toxic materials are used for corrosion-proofing.

Breathing apparatus operating independently of the ambient atmosphere is regarded as unreservedly suitable. If, for technical reasons, the use of breathing apparatus operating independently of the ambient atmosphere is not feasible, suitable filter devices may be used during work in fuel tanks if the following conditions are observed:

- 1. the concentration of harmful gas is < 1000 ml/m³ (0.1 vol.%),*
- 2. the duration of use is limited to not more than 1 hour, and*
- 3. the oxygen content is > 17 vol.%.*

A concentration of less than 100 ml/m³ fuel vapour in the tank can be achieved if the ventilation measures described in Sections 4 to 7 of Annex 2 are implemented.

However, the use of respiratory protection equipment is also recommended if a strong, irritating smell of fuel is noticed.

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Annex 2

Advice and protective measures for work in fuel tanks (sub-para 5.23 refers)

1. Before the start of work in a fuel tank, the type of tank must be ascertained so that suitable protective measures can be specified. Depending on their design, tanks are to be categorized as follows:

Category 1 Tanks which are directly accessible from outside but which cannot be fully "entered", i.e. with the entire body, owing to their small dimensions.

Category 2 Tanks which are directly accessible from outside and which can be fully "entered", i.e. with the entire body.

Category 3 Tanks which are not directly accessible from outside, but are entered through openings in splashboard walls or tank chambers, and are so large that a casualty can be adequately cared for by a first-aider within the tank.

Category 4 Tanks as in category 3, but with no means of access for a first-aider. A condition corresponding to that of category 2 can be achieved here by cutting open the wall of the tank.

Tanks of categories 1 and 2 are described as "directly accessible" and those of categories 3 and 4 as "indirectly accessible".

2. Before the start of work in a fuel tank, the grade of fuel contained by the tank must be ascertained.

Characteristics	Fuel grades	
	Wide cut gasoline Jet B	Kerosene Jet A-1
Flash point (1 bar)	-23 °C up to 1 °C	+38 °C up to +60 °C
Ignition temperature	251 °C	249 °C

The maximum permissible concentration of fuel vapour in the breathing air is 100 ml/m³.

Refer to TRGS 404 (Technical Regulations for Dangerous Substances) on the "Assessment of hydrocarbon vapours in the workplace air (hydrocarbonic and hydrogenous only)".

3. Before the start of work in a fuel tank, the dangerous materials within the tank must be ascertained.

Biobor is added to the fuel as protection against microbial infestation. According to information from the manufacturer, Bio-

bor is a substance which irritates the mucous membranes; contact with the eyes and prolonged contact with the skin is therefore to be avoided. In case of contamination the usual protective measures (such as rinsing the eyes and washing the skin) are specified. The use of suitable physical protection equipment (for eyes, skin, breathing) is recommended. The protective measures customary during the inspection of tanks are sufficient in this case.

Strontium chromate tablets may still be in use for corrosion-proofing in aircraft fuel cells. Strontium chromate, which may be present as a residue in the tank, is a highly toxic, carcinogenic substance.

During the handling of this substance it must be ensured that no strontium particles are swallowed or inhaled as dust and that they do not enter open wounds.

Protective suits with chromate residues are to be changed punctually, especially before breaks. Suitable containers must be available for the storage and transport of used protective suits.

4. Before and during work in fuel tanks, efforts must be made to provide adequate ventilation so that no gases, vapours, mists or dusts in harmful concentrations and no potentially explosive atmospheres or oxygen deficiencies can occur.

Ventilation can be performed by natural or mechanical means.

The effect of substances harmful to health is regarded as prevented if the ventilation ensures that, for example, the threshold limit values (MAK values) for the workplace are not exceeded; in case of mixtures of substances the evaluation procedures laid down in TRGS 403 (Technical Regulations for Dangerous Substances) on "Assessment of mixtures of substances in workplace air" are to be applied. (The maximum permissible concentration of jet fuel vapour is 100 ml/m³; see Section 2).

The occurrence of potentially explosive atmospheres is prevented if the air flow is directed in such a way as to ensure that no potentially explosive atmosphere can form in any place at any time.

5. Fresh air must be used for ventilation. Oxygen and air containing an increased proportion of oxygen must not be used.

The fresh air must be taken from the external open air or, if this is not feasible, from rooms having air which is free from harmful or flammable contaminating substances. These rooms must be directly connected to the open air by large openings. The incoming air must be heated if necessary.

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The incoming air flow is to be directed in such a way that the entire volume of the tank is thoroughly aerated and that personnel are working in the fresh air flow wherever possible.

If only mechanical inlet and outlet ventilation is provided, preference is to be given to removal of harmful substances by suction rather than by blowing them out, as exhaust by suction permits the controlled removal of such substances, thus avoiding hazards to personnel.

Mechanical ventilation is to comprise both the supply of fresh air and the removal of the contaminated air by suction.

Wherever possible, solvent vapours should be removed by suction at the point of origin or at the lowest point of the tank.

6. If it is to be expected that a hazardous concentration of harmful substances or a potentially explosive atmosphere is present in the exhaust air, the latter is to be removed in such a way that personnel are not endangered. The effectiveness of the ventilation is to be monitored.

This can be carried out, for example, by

- *continuous measurement of the concentration by automatic devices*
- *repeated individual measurements of the concentration,*
- *monitoring the maintaining of the air change rate.*

Competent persons are to be tasked to carry out the monitoring.

A competent person is a person who, owing to his specialist training and experience, has sufficient knowledge and is familiar to such an extent with the relevant national occupational safety regulations, accident prevention regulations, codes of practice and generally acknowledged regulations of engineering (e.g. DIN standards, VDE specifications, technical regulations of other EC member states or other states signatory to the Treaty on the European Economic Area) that he can assess the effectiveness of ventilation systems.

The measuring devices required for detecting potentially explosive atmospheres must be deemed suitable by a recognized testing agency.

Examples of recognized testing agencies are

- *Bundesanstalt für Materialprüfung (BAM),
Unter den Eichen 87, 12205 Berlin*
- *Physikalisch-Technische Bundesanstalt (PTB),
Bundesallee 100, 38116 Braunschweig
and*

- *DMT-Gesellschaft für Forschung und Prüfung GmbH, Fachstelle für Sicherheit - Prüfstelle für Grubenbewetterung, Franz-Fischer-Weg 61, 45307 Essen (address of testing agency)
Postal address: 44782 Essen.*

Also refer to sub-para 3.3 of these regulations.

7. If ventilation measures are not adequate, as a result of which harmful concentrations of gases, vapours, mists or dusts may occur, personal protective equipment is to be used; refer to sub-para 5.5.

If it is possible that potentially explosive atmospheres may develop, precautionary measures for preventing explosions are necessary.

In such cases, protective measures in accordance with the "Guidelines on protection against explosion (EX-RL)" (ZH 1/10) are required.

Work should not be performed in zone 0 (see EX-RL). However, if work in zone 0 cannot be ruled out, this work is only to be performed by persons specially trained for this and using only resources, tools and personal protective equipment licensed for zone 0.

Examples of work in zone 0 which cannot be ruled out are as follows:

- *skimming out of flammable liquid residues from fuel tanks,*
- *cleaning of internal surfaces in order to eliminate the risk of explosion,*
- *short-notice inspection work in tanks for flammable liquids which have not been entirely emptied or have not been cleaned.*

