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GEMEINSCHAFT THERMISCHES SPRITZEN (GTS)

Occupational safety and environmental protection during thermal spraying

Technical Bulletin 2307

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DVS 2307-3 from January 1999
and DVS 2314 from November 2004

When applying and carrying out thermal spraying processes, in addition to the technical and economic issues an increasingly important part is played by the requirements for occupational safety and protection of the environment. This is why the previous leaflets DVS 2307-1 „Occupational safety when degreasing and shot blasting surfaces for thermal spraying", DVS 2307-2 „Occupational safety and environmental protection during thermal spraying" and DVS 2314 „Environmental protection during thermal spraying" have been combined to form a leaflet published jointly by DVS – Deutscher Verband für Schweißen und verwandte Verfahren e.V. and the German Association of Thermal Sprayers (GTS). This leaflet covers all the questions about this topic that a user may want answers to and also avoids overlaps and duplication.

Specifically to enable environmental protection requirements to be taken into account early on at the planning stage of a spraying facility or when changing to a different spraying process and running a spraying facility, relevant checklists are attached in an appendix to the leaflet.

The list of the laws, regulations, acts, guidelines, rules and leaflets named in this DVS/GTS has grown to a considerable length. Not all of these quoted publications apply to every application. The user of this leaflet should decide on which of them represent the requisite and correct choice for their application.

Content:

1 Introduction

This leaflet describes in bullet-point form the specific hazards for personnel and the environment during preparation for thermal spraying and during thermal spraying itself; it also includes a structured breakdown of the necessary and mandatory safety measures. The most important spraying processes – powder-, wire-, high-velocity oxy-fuel flame (HVOF)-, arc- and plasma spraying – can largely be covered jointly; any differences between these processes are highlighted under subheadings.

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Specific hazards for cold spraying are described separately. Hazards with rarely used spraying processes are not covered here. The abbreviations used for rules and regulations are explained in Section 14, „References".The Appendix includes checklists that aim to make it easier to comply with environmental protection requirements, especially when planning a spraying facility or when changing to a different spraying process. The checklists can also be used to check the state of the art of an existing spraying device or an applied process, especially as environmental protection is regarded as a continuous process for reducing pollution of the environment.

2 Surface pretreatment

2.1 Degreasing

Degreasing workpiece surfaces is usually the first step in pretreatment for thermal spraying, and is performed before shot blasting. Oils, greases and other contaminants (swarf, abrasive dust, etc.) are removed to ensure that surfaces that are to be coated are in a clean and grease-free state.

The most commonly used degreasing processes are:

- Immersion,
- Rinsing,
- Spraying,
- or combinations of the above,
- Steam degreasing.

Immersion or rinsing processes can be performed with or without the use of ultrasound.

The choice of degreasing processes and agents depends on the base material and on the dimensions and throughput of the parts to be treated. As regards the cleaning agents used, not only must they have good degreasing properties, they must also be safe for health and for the environment and also pose the minimum possible risk of fire or explosion.

Degreasing is usually carried out using organic solvents or aqueous, generally alkaline solutions. When steam is used, the dangers of scalding, touching hot parts and flying particles of dirt must be taken into account. BGR 500 in Section 2.36 provides information on the use of steam cleaning equipment.

The flammability (flash point) of the solvent must be considered when selecting the process. Degreasing agents with a high flash point should preferably be used to avoid the risk of explosion. The processing temperature should remain below the flash point to prevent an explosive atmosphere from forming. For the same reason solvents should not be sprayed.

For cleaning and degreasing small areas at room temperature, cold cleaners such as alcohols, ketones and other preparations are often used. Some of these preparations consist of non-combustible, hardly-combustible and combustible solvents. Continuous vaporisation of non-combustible or hardly-combustible constituents can result in the formation of explosive mixtures of vapour and air.

In the case of baths containing alkaline degreasing agents at operating temperatures of 60 °C to 90 °C there is a danger of scalding and alkali burns caused by liquid spraying or dripping from the bath. Particular care is called for when preparing such baths when the cleaning agents are mixed in as powders or concentrates.

Note: when using caustic solutions for degreasing, aluminium or magnesium may suffer significantly from aggressive action. A large amount of hydrogen may also be formed. Suitable extraction systems must be installed.

Organic degreasing agents from the group of halogenated hydrocarbons must not be used in enclosed systems since they are harmful both to health and the environment.

The containers, systems and equipment for degreasing agents that are combustible or injurious to health must conform to the requirements of BGR 180.

Because as a rule these degreasing agents fall into the category of water-polluting substances, any waste water produced in the cleaning process must be collected, treated and disposed of in the correct manner. The stipulations of the German Water Resources Act (WHG), the feed-in limit values of the regional water authorities and the supplementary legislation must be observed.

Depending on the storage quantity and the properties of the degreasing agent that is used, plants may need to provide notification and obtain authorisation in accordance with the German Operational Safety Regulation (BetrSichV).

Most degreasing agents and all the usual solvents are classified as or contain hazardous substances. The manufacturer/supplier must therefore supply an EU safety data sheet that describes the dangerous properties and includes details of appropriate safety measures for handling and using the substances concerned.

This EU safety data sheet thus forms the basis for the measures that need to be specified to comply with legal or official requirements such as the Hazardous Substances Directive (GefStoffV), the Federal Immission Control Act (BImSchG) or associated Federal Immissions Control Directive (BImSchV).

Operating procedures must be drawn up based on the endangerment assessment, the safety data sheets and the requirements of BGR 180.

2.2 Explosion protection document

If a plant operator has ascertained in the course of the endangerment assessment (§ 3 BetrSichV) that it is not possible to reliably prevent the formation of a dangerous, potentially explosive atmosphere then as the employer they must draw up an explosion protection document acc. to § 6 BetrSichV. Beyond this, other than determining and assessing the explosion hazards, precautions must be taken to prevent explosions; areas that are subject to explosion must also be subdivided into zones and minimum requirements in accordance with BetrSichV Appendix 4 must be met using organisational measures (instructions, operating procedures, signage) as well as general measures (warning systems, escape routes, design, suitable equipment and safety systems appropriate for the zone concerned).

2.3 Shot blasting

2.3.1 General

The usual mechanical surface pre-treatment before thermal spraying is shot blasting. Metallic blasting agents acc. to DIN EN ISO 11124 or non-metallic blasting agents acc. to DIN EN ISO 11126 are used as blasting agents. BGR 500 Section 2.24 provides information on safety measures for shot blasting operations.

2.3.2 Blasting dust – Formation – Disposal

Due to the adhesive agent breaking up on impact and the blasting off of particles of the workpiece surface, depending on the base material and the impurities on the surface, dusts may form during blasting that contain hazardous substances, and these must be disposed of in accordance with GefStoffV.

In general the official regulations on disposal must be observed for dusts that form (see KrW./AbfG etc.).

2.3.3 Blasting rooms

With blast rooms a distinction is made between enclosed blasting systems that do not involve any operators, e.g. externally-operated manual blast chambers, roller blasting systems, continuous blasting systems or wheel blasting systems and blast rooms that are manned during blasting. Where possible shot blasting should be performed in enclosed or mechanised systems.