IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Comments concerning requests for determining of combustion and explosion properties of dusts

Knowledge of the combustion and explosion behaviour of the dusts concerned is required for robust design of installations and processes, assessment of explosion risks associated with the handling of dust-raising solids, and production of the explosion-protection documentation (Table 1). For orientation purposes, data can be obtained in the first instance from the GESTIS-STAUB-EX database, which is freely accessible on the Internet (www.dguv.de/ifa/gestis/gestis-staub-ex/index-2.jsp). The limitations of applicability stated there must be observed. For precise conclusions to be reached regarding the combustion and explosion behaviour of dusts, however, the required parameters should be determined by experiments on a case-by-case basis.

Table 1: Overview of the safety parameters and their significance

Safety parameter	Significance/protective measure
Particle size	Influences the sedimentation and dispersion properties of the dusts; dust particles with a diameter of d > 500 µm are generally classified as not explosive.
Moisture content	The explosibility of a dust is substantially reduced when its moisture content is greater than 30%.
Electrical resistance (R_D)	High electrical resistance can give rise to elevated electrostatic charging and is consequently a source of ignition; low electrical resistance can cause sparking in electrical contacts. Observe protection of electrical equipment (IP 5X, IP 6X with conductive dusts).
Combustion class (CC)	Additional measures for fire protection, cleaning and the avoidance of sources of ignition must be taken in consideration of the combustion class.
Self-heating (SH)	Supplementary protective measures must be taken where substances are stored in silos and in heaps, and in the event of thick dust deposits/caking.
Minimum ignition temperature of deposited/raised dust (MIT)	Hot surfaces present an ignition source; surface temperatures must therefore be limited in explosive zones.
Lower explosive limit (LEL)	Exceeding of the LEL leads to the formation of a hazardous explosive atmosphere; areas in which the LEL is exceeded must be identified and the frequency with which it is exceeded must be estimated for classification into zones. If the dust concentration is reliably below the LEL, further protective measures and zone classifications can be reduced
Maximum explosion pressure (Pmax)	Planning and design of engineered measures for explosion protection, such as explosion pressure relief, explosion suppression and explosion decoupling.

Safety parameter	Significance/protective measure
Kst value	Planning and design of engineered measures for explosion protection, such as explosion pressure relief, explosion suppression and explosion decoupling.
Minimum ignition energy (MIE)	The minimum ignition energy is used for estimation of whether potential ignition sources may cause ignition of the dust under consideration.
Limiting oxygen concentration (LOC)	Use of inertization specifically in order to prevent the formation of a hazardous explosive atmosphere.

Information concerning the scope of testing, sample selection and sample quantity

It is not generally necessary for all parameters of the dusts in question to be tested. The intended or existing safety concept normally determines which parameters are relevant.

Since sampling is not performed by the laboratory, the customer is responsible for ensuring that the sample is taken at a representative time and location. Only laboratory analyses of representative dust samples permit a realistic estimation of the explosion hazards. Note that during sampling, the process or the particle properties of the material may lead to concentration of fine components. The representative sample is generally tested in the laboratory in its original state. Very coarse sample material may be sieved in order to perform the laboratory testing using the fraction d < 2000 µm.

Should the request contain no information on this aspect, the sample is fractionated for the various tests (in accordance with VDI Guideline 2263, Part 1). Fractionation is performed for tests on deposited dust with a sample fraction of < 250 µm. Tests on dust clouds are generally performed with a fraction of < 63 µm. This assures that the results from different test bodies are comparable, and takes account of a possible concentration of fine dust, for example in a dust collector.

If no information is available on the combustion and explosion behaviour of a certain dust, tests should first be performed regarding its combustion behaviour and explosibility. Testing in the first instance in accordance with Fee Nos 14030 and 14080 is appropriate in this case (see Section 4, "Laboratory tests" on the request form). Should the results of these tests not be conclusive, further tests should be performed in accordance with Fee Nos 14092 or 14100, where this is possible with the sample quantity submitted. This permits robust assignment to a dust explosion class or the classification as "not explosive". The test in the 1 m^3 container in accordance with Fee No 14100 is always performed on sample material in the original state.

Where a risk of spontaneous combustion exists, tests are recommended in the first instance in accordance with Fee No 14050 and, depending upon the result and the process and plant conditions such as storage quantity and temperature, in accordance with Fee No 14051 (in the original state).

Should information be required on the ignition properties of the dusts, particularly in association with friction and grinding sparks, electrostatic discharge or hot surfaces, tests in accordance with Fee Nos 14110, 14111, 14112, 14120 are beneficial. The tests in accordance with Fee No 14120 and, where deposited dust is to be considered, also with Fee No 14040, provide indications of whether for example hot surfaces on plant equipment are capable of igniting a dust/air mixture or dust deposited on the surfaces. Experience has shown that surfaces with temperatures not exceeding 135 °C are not able to ignite dust clouds and dust deposits with a depth of less than 5 mm. The parameters do not need to be determined in such cases.

Where a risk cannot be ruled out of electrostatic charging or electrical components being penetrated by dust, the specific electrical resistance should ideally be determined.

Further information on the subject is available from the personnel specially trained in explosion protection at your accident insurance institution and from the IFA's dust explosion laboratory:

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Instructions for dispatch of the samples

The samples should be packed such that no sample material can escape from the transport container during shipment. Suitable transport containers include wide-neck tubs or tin cans with quick-release lids, fabric or other tear-resistant sacks, and double-corrugated cardboard cartons as the outer packaging. Do not dispatch samples loose in cartons or thin refuse sacks.