

## საქართველოს სტანდარტი

მტვრის სპონტანური აალების ქცევის განსაზღვრა

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English Version

## Determination of the spontaneous ignition behaviour of dust accumulations

Détermination de l'aptitude à l'auto-inflammation des accumulations de poussières

Bestimmung des Selbstentzündungsverhaltens von Staubschüttungen

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## Foreword

This document (EN 15188:2007) has been prepared by Technical Committee CEN/TC 305 "Potentially explosive atmospheres - Explosion prevention and protection", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

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For relationship with EU Directive 94/9/EC, see informative Annex ZA, which is an integral part of this document.

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## Introduction

The self-ignition behaviour of combustible dusts depends on their chemical composition as well as on related substance properties. It also depends on the size and geometry of the body of material, and, last but not least on the ambient temperature.

The reason behind self-heating (or possibly self-ignition) is that the surface molecules of combustible dust particles undergo exothermic reactions with the oxygen in air transported into the void volume between the particles even at normal temperatures. Any heat then released will cause the temperature of the reactive dust-air system to rise, thus accelerating the reaction of additional dust molecules with oxygen, etc. A heat balance involving the heat produced inside the bulk (quantity and surface of reactive surface molecules, specific heat producing rate) and the heat loss to the surroundings (heat conductivity and dimension of the bulk, heat transfer coefficient on the outside surface of the bulk and the size of the latter) is decisive as to whether a steady state temperature is reached at a slightly higher temperature level (the heat loss terms are larger than the heat production term), or whether temperatures in the bulk will continue to rise up to self-ignition of the dust, if heat transport away from the system is insufficient (in this case the heat production term is larger than all heat losses).

The experimental basis for describing the self-ignition behaviour of a given dust is the determination of the self-ignition temperatures ( $T_{SI}$ ) of differently-sized bulk volumes of the dust by isoperibol hot storage experiments (storage at constant oven temperatures) in commercially available ovens. The results thus measured reflect the dependence of self-ignition temperatures upon dust volume.

Plotting the logarithms of the volume/surface ratios [ $\lg(V/A)$ ] of differently sized dust deposits versus the reciprocal values of the respective self-ignition temperatures [ $1/T_{SI}$  in  $K^{-1}$ ] or following other evaluation procedures – described in Annex A – one produces straight lines, allowing interpolation, to characterise the self-ignition behaviour of dust deposits of a different scale and of a different bulk geometric shapes (see 5.1). Experience has shown that the spread of slopes of such straight lines determined by different laboratories using differently constructed ovens is fairly large. This is the reason why scale up of those results to industrial scale will lead to non-negligible errors in  $T_{SI}$ .

Experience has shown, that it seems necessary to prescribe the installation of a unique inner chamber into the oven, surrounding the dust samples and the thermocouples, with an also prescribed air flow through this chamber. In this way the spread of results should be minimised. Decisions on the design of this inner chamber and on the amount of air flow respectively other test setups leading to comparable results have to be carried out later on.

If it is possible based on suitable thermo analytic test procedures (adiabatic, isothermal or dynamic tests) to derive a reliable formal kinetic model, which describes the heat production of the substance as a function of temperature, then the volume dependency of the self-ignition temperature may be calculated according to the methods described in Annex A.