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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 15445.3-2025

**Representation of results of particle size analysis - Part 3:
Adjustment of an experimental curve to a reference model**

粒度分析结果的表述 第3部分：试验曲线的参考模型拟合

(English Translation)

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is Part 3 of GB/T 15445 "Representation of Particle Size Analysis Results". GB/T 15445 has already published the following parts.

- Part 1: Graphic Representation;
- Part 2: Calculation of average particle size/diameter and moments of each order from particle size distribution;
- Part 3: Reference Model Fitting of Experimental Curves;
- Part 4: Characterization of the hierarchical process;
- Part 5: Computational Methods for Granularity Analysis Using the Log-Normal Probability Distribution;

---Part 6: Qualitative and quantitative description of particle shape and morphology.

This document is equivalent to ISO 9276-3:2008 "Representation of results of particle size analysis - Part 3: Reference model fitting of test curves".

This document includes a new chapter on "Terms and Definitions".

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed and is under the jurisdiction of the National Technical Committee on Standardization of Particle Characterization, Sorting and Screening (SAC/TC168).

Introduction

The cumulative particle size distribution curve exhibits an S-shape, making it difficult to fit to a model distribution function or perform statistical comparisons. However, by employing appropriate...

Coordinate system [such as log-normal distribution, Rosin-Rammler distribution, or Gates-Gaudin-Schutzman distribution] the Hmann distribution (double logarithmic coordinate system) can transform such S-shaped curves into straight lines, thus overcoming the aforementioned defects. In industry, particle target particles...

Degree distribution can also be described by a distribution model.

In this transformed coordinate system, classical linear regression assumes that the squared deviations between the experimental points and the theoretical line have the same mean.

This assumption applies only to the transformed cumulative distribution system, not its linear representation; hence, it is called quasi-linear regression. It should be specifically noted that the coordinates...

Expanding the scale can cause the squared deviations at both ends of the chart to differ by orders of magnitude. Furthermore, the sum of squared deviations obtained through this method differs from any...

Simple distributions show no correlation and cannot support statistical tests.

Figure 1 shows the experimental data from Appendix A of GB/T 15445.1-2008, which presents the sieving measurement results in the range of 90 μm to 11.2 mm.

Example of results.

Indexing symbol explanation.

Q3 --- Cumulative volume distribution or cumulative mass distribution;

x --- particle size;

Y --- Quantiles of the standard normal distribution;
 1 --- Quasi-linear regression (complete straight line);
 --- Quasi-linear fitting points;
 ---Q3 data points.

Figure 1. Log-normal distribution plot (vertical axis represents the standard normal coordinates, indicating the cumulative distribution value after transformation by inverse standard normal distribution);

The horizontal axis is a logarithmic scale, representing particle size, and an example of its quasi-linear regression (a complete straight line).

The mathematical processing methods described above for nonlinear coordinate systems conform to the principle of quasi-linear regression. Specifically, the nonlinear transformation of the Y-axis leads to...

Nonlinear transformation of Y-direction deviation (e.g., different calculation methods are required for the deviation of the distribution tail and the central region).

To compensate for the nonlinear effect of the Y-axis nonlinear transformation on the difference in Y values, a weighting factor can be introduced into the quasi-linear regression (see Appendix E).

Nonlinear regression can provide optimal fit results and offers the greatest flexibility, such as supporting statistical tests, cutoff, or multimodal distributions.

It can fit the cloth and match any model, but this requires pre-setting initial approximations and relies on numerical mathematical algorithms.

At the untransformed scale, the standard deviation of the residuals between the test points and the model can be used to quantify the degree of alignment and support the statistical ratio of the test distribution.

Comparison. If this value is greater than 0.05 (example threshold), it indicates that the reference model is not applicable.

Particle characterization, such as the cumulative distribution or frequency distribution of particle size, varies greatly depending on the method and instrument used.

GB/T 15445 aims to promote the synergy of particle characterization methods and facilitate the transformation of analytical data. It consists of six parts.

---Part 1: Graphical Representation. Granularity analysis is represented using histograms, frequency, and cumulative distributions. The aim is to define the measurement...

The standard terminology used to derive the above distributions from quantitative data is as follows.

---Part 2: Calculation of mean particle size/diameter and moments from particle size distribution. The aim is to provide some relevant formulas for a given...

The particle size distribution is calculated to determine the average particle size or average diameter and the moment values for each order.

---Part 3: Reference Model Fitting for Experimental Curves. The aim is to define a reference model for fitting experimental curves within a statistical framework.

The model method was proposed, and the evaluation criteria for the residual bias after fitting were clarified.

---Part 4: Characterization of the Grading Process. The aim is to provide a mathematical foundation for characterizing the grading process.

---Part 5: Computational Methods for Granularity Analysis Using the Log-Normal Probability Distribution. The cumulative granularity distribution follows a log-normal probability distribution.

This provides a theoretical basis for the particle size characterization method of particle systems based on the particle size distribution function, aiming to clearly verify the results obtained using the particle size distribution function.

calculate.

---Part 6: Qualitative and Quantitative Description of Particle Shape and Morphology. The purpose is to define the qualitative and quantitative description of particle shape and morphology.

Rules and terminology for quantitative expression.

GB/T 15445 specifies different methods for expressing particle characterization analysis results in its six parts.

Expression of particle size analysis results Part 3: Reference Model Fitting of Experimental Curves

1 Scope

This document specifies the method for fitting experimental curves to a reference model within a statistical framework, and clarifies the evaluation of residual bias after fitting.

The estimation criteria. This reference model can also serve as a basis for the target granularity distribution for maintaining product quality.

This document applies to the fitting process of the following reference models.

a) Normal distribution (Laplace-Gaussian distribution). Applicable to powders or natural products (such as pollen) obtained by precipitation or condensation methods;