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Determination of flow rate of metallic powders - Calibrated funnel method (Gustavsson flowmeter)

金属粉末流动性的测定 标准漏斗法(古斯塔弗森流速计)

[ISO 13517:2020, Metallic powders - Determination of flow rate by means of a calibrated funnel (Gustavsson flowmeter), IDT]

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1 Scope

This document specifies a method for determining the flow rate of metallic powders, including powders for hardmaterials, and mixes of metallic powders and organic additives (such as lubricants), by means of calibrated funnel (Gustavsson flowmeter).

This document applies to the determination of the flowability of powders capable of flowing freely through a specified pore size.

2 Normative references

No normative references are listed in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

4 Principle

Measure the time required for 50 g of metallic powder to flow through the orifice of a calibrated funnel of standardized dimensions.

5 Apparatus

5.1 Calibrated funnel, with the dimensions shown in Figure 1 (see Chapter 6 for the calibration of the funnel). The dimensions of the flowmeter funnel, including the orifice, are not to be considered controlling factors. Determine the working flow rate of the funnel using reference grit as specified in Chapter 6.

The funnel shall be made of a non-magnetic, corrosion-resistant metallic material with sufficient wall thickness and hardness to withstand distortion and excessive wear.

5.2 Stand and horizontal vibration-free base, capable of supporting the funnel rigidly, e.g., as indicated in Figure 2.

5.3 Balance, of sufficient capacity, capable of weighing the test portion to an accuracy of ±0.05 g.

6 Calibration of the funnel

6.1 Calibration by the manufacturer of the funnel

The manufacturer shall calibrate the funnel as follows:

a) Put the reference grit (5.5) in a clean open glass bottle; dry it in the air at 110 °C for 60 min;

b) Cool the reference grit to room temperature in a desiccator;

c) Weigh 50.0 g ± 0.1 g of the grit;

d) Operate according to the test procedures in Chapter 8;

e) Use the same 50 g of grit to repeat the above procedures, until the deviation of the five measurement results is less than 0.4 s;

f) The average value of the five measurement results shall be within the range of 40.0 s ± 0.5 s, and marked at the bottom of the funnel.

6.2 Calibration by the user of the funnel

The flow rate of the reference grit shall be determined by the above method. If the flow rate exceeds 40.0 s/50 g ± 0.5 s/50 g, a correction factor shall be used when measuring different powders. Use reference grit to measure the new flow rate value of the funnel. The correction factor is obtained by dividing 40.0 by this new flow rate value.

Whether a calibration is required or not, it is recommended that the users periodically calibrate the funnel.

It is recommended that, before a correction factor is adopted, the cause of the change be investigated. If the flow rate decreases, it is probable that repeated use has burnished the orifice, and the correction factor is adjusted. An increase in flow rate may indicate a coating of soft powder on the orifice. This coating should be carefully removed and the calibration test repeated.

When the funnel is used for a period of time, if the reference grit flow time decreases to less than 37 s during calibration, it is recommended to stop using the funnel.

7 Sampling

7.1 The mass of test sample shall be at least 200 g.

7.2 The powder shall be tested in the as-received condition. In certain cases, and after agreement between the supplier and user, the powder may be dried. If the powder is

susceptible to oxidation, the drying shall take place in a vacuum or in inert gas. If the powder contains volatile substances, it shall not be dried.

7.3 Immediately before the test, weigh out 50.0 g ± 0.1 g of test portion.

7.4 Alternatively, weigh 90 g ~ 110 g of test portion, to a precision of ±0.1 g or better.

Note: The intention of the alternative execution is to facilitate full automation of measurement of flow and apparent density of powders.

7.5 The determination shall be carried out on three test portions in parallel.

8 Test procedures

Plug the funnel outlet with a dry finger and pour the sample into the funnel. Note that the powder shall fill the small hole in the lower end of the funnel. When opening the small hole of the funnel, start the timing device (5.4), and start timing; stop timing when all the powder in the funnel has flowed out. Record the time used, accurate to 0.1 s.

Alternatively, the orifice of the funnel can also be kept open. Pour the test portion into the funnel, with the rest of the procedure being the same as above.

If the powder does not flow when the orifice is opened, a tap on the funnel to start the flow is permitted. If the powder does not flow after a tap, or if the flow stops during the test, the powder is considered to possess no flowability according to the test method described in this document.

9 Expression of results

Calculate the arithmetic mean of the three determination results, and report the data in s/50 g, rounded to the nearest 1 s/50 g.

If the alternative size of the test portion according to 7.4 is applied, the result of each determination shall be divided by the mass of the sample, and then be multiplied by 50 g to calculate the flow rate of the 50 g of sample. Then calculate the arithmetic mean of the calculated values of the three determinations, and express the result in s/50 g.

If a correction factor (6.2) should be used, the average shall be multiplied by this correction factor.

10 Precision

Test two kinds of plain iron powders and four kinds of mixed powders of iron or bronze in several laboratories to evaluate the precision of the method. Compositions of the mixes are presented in Table 1.

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