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**Metallic Powders, Excluding Hardmetals –
Method for Testing Copper-Base Infiltrating Powders**
(ISO 14168:2011, IDT)

金属粉末（不包括硬质合金） 铜基浸渗粉检验方法

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Metallic Powders, Excluding Hardmetals – Method for Testing Copper-Base Infiltrating Powders

1 Scope

This Document specifies the method for testing copper-base infiltrating powders.

2 Normative References

The provisions in following documents become the essential provisions of this Document through reference in this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

ISO 2738 Sintered Metal Materials, Excluding Hardmetals – Permeable Sintered Metal Materials – Determination of Density, Oil Content and Open Porosity

NOTE: GB/T 5163-2006 Sintered Metal Materials, Excluding Hardmetals – Permeable Sintered Metal Materials – Determination of Density, Oil Content and Open Porosity (ISO 2738:1999, IDT)

ISO 3325 Sintered Metal Materials, Excluding Hardmetals – Determination of Transverse Rupture Strength

NOTE: GB/T 5319-2002 Sintered Metal Materials, Excluding Hardmetals – Determination of Transverse Rupture Strength (ISO 3325:1996, IDT)

ISO 3927 Metallic Powders, Excluding Powders for Hardmetals – Determination of Compressibility in Uniaxial Compression

NOTE: GB/T 1481-2002 Metallic Powders, Excluding Powders for Hardmetals – Determination of Compressibility in Uniaxial Compression (ISO 3927:2017, IDT)

ISO 3995 Metallic Powders – Determination of Green Strength by Transverse Rupture of Rectangular Compacts

NOTE: GB/T 5160-2002 Metallic Powders – Determination of Green Strength by Transverse Rupture of Rectangular Compacts (ISO 3995:1985, IDT)

ISO 4492 Metallic Powders, Excluding Powders for Hardmetals – Determination of Dimensional Changes Associated with Compacting and Sintering

The composition of the skeleton samples, including the type of material and the green density, shall also be a matter of agreement between the parties concerned. The uniformity of the skeleton samples may be determined by measuring the mass. The mass shall not vary from the mean by more than $\pm 0.5\%$.

6.2 The recommended copper infiltrant compact is a cylinder nominally 12.7 mm in diameter compacted from a copper or copper-based infiltrant mix. Normally the copper infiltrant mix shall also contain a dry lubricant. The composition of the copper infiltrant, including the type of lubricant and the mass and green density of the copper infiltrant compact, shall be a matter of agreement between the parties concerned. The uniformity of the copper infiltrant compacts shall be determined by weighing. The mass of any compact shall not vary by more than 0.5 % from the mean.

6.3 The recommended copper infiltrant compact, when placed on the skeleton sample, has a contact area of 126.5 mm². Since the copper infiltrant loading mass per unit contact area can affect the test results, this shall be a matter of agreement between the parties concerned and shall be reported in the test report.

6.4 An alternative specimen is the transverse rupture bar described in ISO 3995, ISO 4492 and ISO 3325. The advantage of using this specimen is that the transverse rupture strength can be measured, as well as the copper infiltrant efficiency.

6.5 Alternatively, skeleton samples may be made of any iron-base structural piece, of composition and sintered or green density that are acceptable to the parties concerned. Likewise, the copper infiltrant compact may be any available shape that is acceptable to the parties concerned, with composition, lubricant, mass and green density a matter for agreement between the parties concerned. The mass of the skeleton and copper infiltrant compact shall not vary by more than 0.5 % from the mean.

7 Test Procedure

7.1 Weigh the skeleton samples and accurately measure the dimensions. Prepare three portions of copper infiltrant compact to be measured.

The density of the skeleton sample is determined either by calculation from the mass and dimensions or by weighing in air and water as described in ISO 2738. If the method of ISO 2738 is used to determine the density, do not use any sample that was used for water displacement density testing for subsequent copper infiltration. In this case, three additional samples shall be made for the density measurement. These three specimens shall be made of the same powder mix and according to the same procedure as the skeleton samples to be used for the copper infiltration. The reported density of the skeleton samples shall be the calculated mean value of the three samples.

The skeleton samples are placed on a suitable tray or container for transporting the samples

through the copper infiltrating furnace. The type of tray or container shall be agreed upon by the interested parties. Care shall be taken to avoid contact with materials that would react with the skeleton or the copper infiltrant. The skeleton samples are normally positioned with one punch face surface facing up.

7.2 The weighed copper infiltrant compact shall be approximately centered on the upward-facing punch face surface of skeleton sample. The symbol for this mass is m_1 . The fixing mode of skeleton sample and copper infiltrant compact shall be determined through negotiation between the parties concerned. Use a small amount of sticky sucrose solution or other adhesive between the two parts, or some other method of keeping the infiltrant compact in place. The samples shall not touch each other but shall be spaced well apart.

A reference copper infiltrant, which has been agreed upon by the parties concerned, shall be tested at the same time as the copper infiltrant under test. Comparison between the reference and the tested copper infiltrant serves to verify that the test conditions, particularly furnace conditions and atmosphere, are not abnormal.

The skeleton samples for comparison shall also be run through the copper infiltrating furnace cycle without an infiltrant compact in contact. After the furnace treatment, the mass of these three skeleton samples that do not infiltrating copper shall be marked m_2 . This value represents the mass of the original skeleton adjusted for the mass loss in the furnace treatment resulting from the reducible oxides, decarburization, loss of other volatiles, and the volatilization of lubricants when green skeleton samples are used.

7.3 Specific copper infiltration conditions shall be a matter of agreement between the parties concerned. It is suggested that the following copper infiltration data be determined and recorded:

- heat-up time and rate, cooling time and rate, time and temperature for copper infiltration;
- range of furnace temperatures during copper infiltration;
- furnace atmosphere, including moisture content at inlet to furnace or sampled from the hot zone, and the rate of flow with respect to the cross-section of the furnace hearth.

7.4 Observe and note the appearance of the copper infiltrated samples as each tray is removed from the furnace. Weigh each copper infiltrated sample plus any residue, taking precautions to include the mass of any loose residue which may have fallen off. Any loose residue lying in the tray shall be assigned to this mass if it can be established that it has definitely come from this particular specimen and not from one of its neighbors. The mean mass of the copper infiltrated samples is given the symbol m_3 .

Remove all loose residue by inverting the copper infiltrated samples and reweigh with the loose residue absent. In the case of a residue-free powder, the copper infiltrated samples can be weighed as they are. Those copper infiltrants which produce a slightly adherent "button" will require a scraping action to remove this form of residue before weighing the sample. The mean mass of the cleaned copper infiltrated samples is given the symbol m_4 .

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