



International
Standard

ISO 13947

**Metallic powders — Test method for
the determination of non-metallic
inclusions in metal powders using a
powder-forged specimen**

*Poudres métalliques — Méthode d'essai permettant de
déterminer la teneur en inclusions non métalliques dans les
poudres métalliques à l'aide d'une éprouvette frittée-forgée*

**Third edition
2024-11**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 2, *Sampling and testing methods for powders (including powders for hardmetals)*, in collaboration with the European Committee for Standardization (CEN) Technical Board, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 13947:2011), which has been technically revised.

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The main changes are as follows:

- added option of hardening by quenching directly after forging.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Metallic powders — Test method for the determination of non-metallic inclusions in metal powders using a powder-forged specimen

WARNING — This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

1 Scope

This document specifies a metallographic test method for determining the non-metallic inclusion level in metal powders using a powder-forged specimen. This test method is applicable to repress powder-forged test specimens in which there has been minimal lateral flow (<1 %). The core region of the powder-forged test specimen must not contain porosity detectable at 100x magnification.

This test method can also be applied to determine the non-metallic inclusion content of powder-forged steel parts. However, in parts where there has been a significant amount of material flow, the near-neighbour separation distance needs to be changed, or the inclusion sizes agreed between the parties need to be adjusted.

This test method is not applicable for determining the non-metallic inclusion level of parts that have been forged such that the core region contains porosity. At the magnification used for this test method, residual porosity is hard to distinguish from inclusions. Too much residual porosity makes a meaningful assessment of the inclusion population impossible.

This test method can also be applied to materials that contain manganese sulphide (admixed or prealloyed), provided the near-neighbour separation distance is changed from 30 µm to 15 µm.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM E3, *Standard guide for preparation of metallographic specimens*

ASTM E768, *Standard guide for preparing and evaluating specimens for automatic inclusion assessment of steel*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Principle

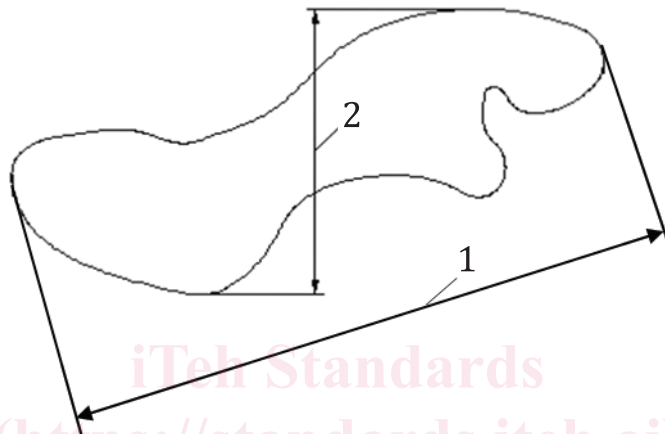
A section representing the core region of the test specimen (part) is cut from the test piece (part) prior to metallographic grinding and polishing; mounting the section is optional.

The polished sample is examined microscopically at a magnification of 100x and a note is made of inclusions greater than a predetermined size.

The maximum Feret's diameter is used to determine inclusion size. A Feret's diameter is a calliper diameter, as illustrated in [Figure 1](#).

The fragmented nature of some inclusions means that their size determination is somewhat complicated. The concept of near-neighbour separation shall be used in determining inclusion size. According to this concept, if an inclusion is within a certain distance of its neighbouring particles, it is considered a member of an inclusion cluster or agglomerate. Detected features within 30 µm of one another are considered part of the same inclusion (except manganese sulphide, for the sulphides, the near-neighbour separation distance is changed from 30 µm to 15 µm). The concept is illustrated schematically in [Figure 2](#).

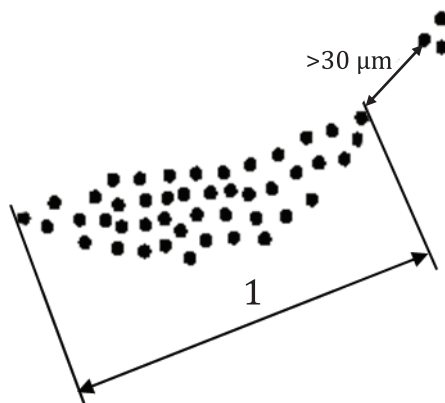
The non-metallic inclusion level of the test specimen (part) is reported as the number of inclusions, per 100 mm², greater than or equal to the predetermined size.



Key

- 1 maximum Feret's diameter
- 2 Feret's diameter

Figure 1 — Schematic illustration of Feret's diameter



Key

- 1 maximum Feret's diameter

Figure 2 — Schematic illustration of “near-neighbour” concept and maximum Feret's diameter