



**International
Standard**

ISO 24832-1

**Natural gas upstream area —
Determination of pore structure
and mineral content for shale —**

**Part 1:
Scanning electron microscopy with
energy dispersive spectrometer**

*Gaz naturel zone amont - Détermination de la structure poreuse
et de la teneur en minéraux du schiste —*

*Partie 1: Microscopie électronique à balayage avec spectromètre
à dispersion d'énergie*

**First edition
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Sample Document

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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).

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This document was prepared by Technical Committee ISO/TC 193, *Natural gas*, Subcommittee SC 3, *Upstream area*.

A list of all parts in the ISO 24832 series can be found on the ISO website.

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.

Introduction

Shale gas, as an unconventional oil and gas resource, is an important component of the world's energy transformation process. According to the 2015 statistical data from the International Energy Information Agency, the global technically recoverable shale gas reserves have reached 214 trillion cubic meters. Compared with other conventional oil and gas resources, shale gas is stored in the shale developed with micron-sized mineral grains and nanoscale pores, presenting an overall tight structure. This poses significant challenges for measuring fundamental mineral content and characterizing the pore structure of shale reservoirs. In shale gas production practices worldwide, considering measurement resolution, operation generality and result reliability, two methods are widely used:

- scanning electron microscopy (SEM) with energy dispersive spectrometer (EDS);
- focused ion beam – scanning electron microscopy (FIB-SEM) with EDS.

These two methods allow for direct observation and quantification of the mineral composition of shale at the two-dimensional scale, and nano scale pore structure in both two and three dimensions.

This document aims to improve the accuracy and consistency of analyses, standardize shale evaluation practices and promote global data comparability to facilitate international cooperation among researchers, laboratories, exploration and production companies (E&P companies) and other stakeholders in the natural gas industry.

This document facilitates precise, multi-tier quantitative assessment of shale pores, crucial for reservoir and resource evaluation, as well as optimizing drilling targets and fracturing designs. Such precision is paramount for effective exploration and development of shale gas resources.

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Natural gas upstream area — Determination of pore structure and mineral content for shale —

Part 1: Scanning electron microscopy with energy dispersive spectrometer

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1 Scope

This document describes the principles, equipment, materials, testing procedures, quality control and test reports for determining shale pore structure and mineral content using scanning electron microscopy (SEM) with energy dispersive spectrometer (EDS).

This document is applicable to the analysis of pore structure by field emission SEM and mineral content of shale samples by SEM with EDS in shale gas exploration and development.

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.

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 5725-6, *Accuracy (trueness and precision) of measurement methods and results — Part 6: Use in practice of accuracy values*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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/>

3.1 image

two-dimensional representation of the specimen surface generated by scanning electron microscopy

[SOURCE: ISO 16700:2016, 3.2, modified — Note 1 to entry has been deleted.]

3.2 charging effect

due to the lack of sufficient conductive pathways, the phenomenon of charge accumulation occurs on the surface of the sample when it is bombarded by an incident electron beam