



BSI Standards Publication

Non-destructive testing — Ultrasonic guided-wave testing using the phased-array technique

National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Non-destructive testing — Ultrasonic guided-wave testing using the phased- array technique

*Essais non destructifs — Essais par ondes ultrasonores guidées
utilisant la technique multiélément*



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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.

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This document was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 3, *Ultrasonic testing*.

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

To improve guided-wave tests, coverage will be extended from above-ground to underground facilities, and the technology will transition from single-element use to multi-element phased-array technology. Noticeable advantages in using the phased-array ultrasonic guided-wave technique over the conventional single-element technique are improvements in the signal-to-noise ratio (SN ratio) and in the testing reliability in harsh environments like buried or coated pipelines.

A low signal-to-noise ratio in buried or coated pipe reduces the sensitivity and the range of conventional guided-wave testing. The phased-array guided-wave focusing method presented in this document can overcome this issue. Beam focusing and steering with the proper mode selection is a key benefit.

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1 Scope

This document specifies a concept of application of phased-array guided-wave testing for various types of inaccessible structures, including buried pipelines.

Materials considered are carbon steel and stainless steel. This document does not include principles and criteria for underground facilities and the phased-array ultrasonic guided-wave testing scheme.

Furthermore, this document consists of an optimized process to draw reliable test results on inaccessible pipe cases. This document provides guidance on the use of phased-array guided-wave testing for various types of inaccessible structures, including buried pipelines made of carbon steel and stainless steel. The methodology outlined in this document includes an optimized process for achieving reliable test results on inaccessible pipe cases, with adjustments made to the beam pattern of the GW's focus location based on the defect type, location, and frequency. The process also takes into consideration the distribution diagram of the guided waves and the characteristics of the selected mode, with optimal focusing and steering achieved by adjusting the excitation time delay for each transducer based on the number of circumferential arrangement intervals of a given array probe.

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 5577](#), *Non-destructive testing — Ultrasonic testing — Vocabulary*

[ISO 9712](#), *Non-destructive testing — Qualification and certification of NDT personnel*

[ISO 18211](#), *Non-destructive testing — Guided-wave testing of above-ground pipelines and plant piping using guided-wave testing with axial propagation*

[ISO 23243](#), *Non-destructive testing — Ultrasonic testing with arrays — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 5577](#), [ISO 18211](#) and [ISO 23243](#) 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/>

4 Personnel requirements

The personnel performing phased-array ultrasonic guided-wave testing shall be qualified in accordance with [ISO 9712](#) (Level 1 with an additional 6-month training).

If [ISO 9712](#) is not applicable to a specific situation, such as in cases where the relevant industrial sector has established other equivalent standards, those standards shall be used instead.