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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 31211.3-2026

**Non-destructive testing - Ultrasonic guided-wave testing - Part
3: Test method on phased-array technique**

无损检测 超声导波检测 第3部分：相控阵法

(English Translation)

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is Part 3 of GB/T 31211 "Nondestructive Testing - Ultrasonic Guided Wave Testing". GB/T 31211 has published the following...

part.

---Part 1: General Provisions;

---Part 2: Magnetostriction;

---Part 3: Phased Arrays.

This document is modified to adopt ISO 4773:2023 "Nondestructive testing using phased array technology - Ultrasonic guided wave testing".

This document has undergone the following structural adjustments compared to ISO 4773:2023.

---Chapters 4 to 9 correspond to Chapters 5 to 10 of ISO 4773:2023; Chapter 4 has been deleted.

The technical differences between this document and ISO 4773:2023, and the reasons therefor, are as follows.

---ISO 5577 has been replaced by the normatively referenced GB/T 12604.1, and ISO 23242 has been replaced by GB/T 12604.13.

---The personnel requirements (see Chapter 4 of ISO 4773:2023) have been removed to adapt to my country's technical conditions and increase operability;

---ISO 18563-3 (see 6.2) has been replaced with the normatively referenced GB/T 42399.3 for ease of use in this document, adding [further details needed].

Operability;

---Delete the last three paragraphs in A.5 because the content is duplicated from the preceding text.

The following editorial changes have been made to this document.

---To align with existing standards, the standard name has been changed to "Nondestructive Testing. Ultrasonic Guided Wave Testing Part 3: Phased Array Method".

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed and is under the jurisdiction of the National Technical Committee on Standardization of Nondestructive Testing (SAC/TC56).

Introduction

Ultrasonic guided wave testing technology, as an important component of non-destructive testing, is widely used in petroleum, chemical, electric power, marine engineering, transportation, and other industries.

Detection of internal and external defects in waveguide structures such as pipes, tracks, and shells in the field, including detection in areas inaccessible by structures with cladding or concealment.

It has outstanding advantages, with long single detection distance and high work efficiency, providing an important technical means to ensure the safe operation of equipment.

Ultrasonic guided wave testing technology includes various methods such as magnetostrictive, piezoelectric ultrasound, electromagnetic ultrasound, and laser ultrasound. GB/T 31211 is established.

The ultrasonic guided wave testing standard system aims to clarify the general technical requirements for phased array guided wave testing, play a fundamental supporting role, and better promote...

The widespread application of phased array ultrasonic guided wave testing technology will facilitate the standardized implementation of various specific ultrasonic guided wave testing methods. GB/T 31211 is proposed to be...

---Part 1: General Provisions. The purpose is to specify the requirements for the cross-sectional geometry of ultrasonic guided waves in pipes, rods, plates, wires, profiles, etc.

The general requirements for inspecting structural components.

---Part 2: Magnetostriction. The aim is to specify a magnetostrictive ultrasonic method for the rapid detection of cross-sectional losses in structural members.

Wave detection method.

---Part 3: Phased Array Method. The aim is to define the methods for handling various inaccessible structures (including buried pipes made of carbon steel and stainless steel).

The specific requirements for phased array guided wave detection.

Non-destructive testing, ultrasonic guided wave testing Part 3: Phased Array

1 Scope

This document specifies the requirements for conducting phased array ultrasonic guided wave testing on various inaccessible structures such as buried pipelines.

This document applies to carbon steel and stainless steel. This document does not establish principles or criteria for testing underground facilities and phased array ultrasonic guided wave systems.

Furthermore, this document provides an optimized procedure for obtaining reliable test results in cases involving unreachable pipelines. This document also provides a method using phase control.

This document describes various guidelines for ultrasonic guided wave testing, including for buried pipelines made of inaccessible structures such as carbon steel and stainless steel.

Methods for obtaining reliable inspection results for unreachable pipeline cases include determining the focal position of the guided waveguide (GW) based on defect type, location, and frequency.

The program adjusts the beam pattern based on the selected waveguide pattern and characteristics of the chosen pattern, based on the given array probe's circumference.

The number of probes is arranged in a certain direction, and the focus and deflection are optimized by adjusting the excitation delay of each probe.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included.

For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies.

GB/T 12604.1 Nondestructive testing terminology - Ultrasonic testing (GB/T 12604.1-2020, ISO 5577:2017, MOD) GB/T 12604.13 Nondestructive testing terminology-Part 13: Array ultrasonic testing (GB/T 12604.13-2023) ISO 23243:2020, IDT GB/T 42399.3 Nondestructive testing instruments - Performance and testing of phased array ultrasonic equipment - Part 3: Combined systems (GB/T 42399.3-2023, ISO 18563-3:2015, IDT) GB/T 45377 Non-destructive testing of ground pipelines and plant area pipelines - Axial long-distance guided wave testing (GB/T 45377-2025) ISO 18211:2016, MOD)

3 Terms and Definitions

The terms and definitions defined in GB/T 12604.1, GB/T 12604.13 and GB/T 45377 apply to this document.

4 Phased Array Ultrasonic Guided Wave Detection Principle

Phased array ultrasonic guided wave detection is a technique that synthesizes multiple ultrasonic beams with phase differences by using the time delay between different ultrasonic probes.

Phased array ultrasonic waveguide technology can focus and deflect ultrasonic beams.

Early methods only used the synthesis of body wave signals, as shown in Figure 1. A similar principle was applied to guided wave signal synthesis, and this was used in lifting ultrasound.

Guided wave detection reliability and signal strength.

The phased array probe is divided into torsional mode and multi-mode (torsional, longitudinal) modules, with each module connected to a multi-channel instrument. Multi-channel mode...

The blocks run in a time-delay sequence, and the ultrasonic beam is focused and deflected to the area to be detected.