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**NATIONAL STANDARD OF THE
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**Non-destructive testing - Nonlinear ultrasonic longitudinal
second harmonic method for structural damage in metals**

无损检测 组织结构损伤非线性超声检测方法

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Table of Contents

1 Scope	1
2 Normative references	1
3 Terms and Definitions	1
4 Methodology Overview	2
5 Detection system	3
6 Testing procedures	6
7 Test Records and Reports	9

Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for standardization work Part

1. Structure and drafting rules for standardization documents" Drafting. Please note that some of the contents of this document may involve patents. The issuing organization of this document does not assume the responsibility for identifying patents. This document is proposed and coordinated by the National Technical Committee for Standardization of Nondestructive Testing (SAC/TC56). This document was drafted by: East China University of Science and Technology, Shanghai Institute of Materials Co., Ltd., Chongqing University, Shanghai Special Equipment Supervision and Inspection Technology Co., Ltd. Technical Research Institute, Dongfang Boiler Co., Ltd. of Dongfang Electric Corporation, Jiangsu Special Equipment Safety Supervision and Inspection Institute, Guoneng Boiler Pressure Container Inspection Co., Ltd., Wuhan Zhongke Innovation Technology Co., Ltd., China Special Equipment Testing and Research Institute, Huaneng International Power Co., Ltd. Shanghai Shidongkou Second Power Plant of China Power Co., Ltd. The main drafters of this document are: Xuan Fuzhen, Xiang Yanxun, Jiang Jiansheng, Liu Lishuai, Ding Jie, Deng Mingxi, Xiao Biao, Zheng Yang, Tan Yunhua, Ding Xiaoping, Hao Xiaojun, Lin Guanghui, Chen Xiaoming, Zhao Yanyan, Li Xuan, and Xie Jing. Nondestructive testing of tissue structure damage Nonlinear ultrasound Detection Methods

1 Scope

China's national general method for detecting structural damage in metals by nonlinear ultrasonic longitudinal second harmonic measurement. Conventional ultrasonic testing finds discontinuities that reflect sound - cracks, inclusions, voids - which means it finds damage only once it has become a defect. Most of a component's life is spent accumulating damage that reflects nothing: dislocation structures from fatigue, precipitates from thermal ageing,

creep cavities, irradiation defects. These change the material's elastic nonlinearity, so a pure sine wave passing through the material comes out distorted, and the amplitude of the second harmonic relative to the fundamental measures the accumulated damage. That gives a way to assess remaining life before a crack exists, which for pressure vessels, turbine components and reactor internals is the assessment that matters. The method applies to fatigue, plastic, creep and irradiation damage in metals between 10 and 300 mm thick.

This document describes a general method for nonlinear ultrasonic longitudinal second harmonic detection of structural damage in metallic materials. This document is applicable to the fatigue, plasticity, creep, irradiation and other structural damage of metal materials with a thickness between 10mm and 300mm. Nonlinear ultrasonic testing.

2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this document. For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to This document.

GB/T 12604.1 Nondestructive testing terminology Ultrasonic testing

GB/T 27664.2 Non-destructive testing - Performance and inspection of ultrasonic testing equipment - Part

3 Terms and definitions

The terms and definitions defined in GB/T 12604.1 and the following apply to this document.

3.1 Ultrasonic waves with a finite amplitude propagating in a medium generate ultrasonic waves with a frequency different from the excitation frequency.

Note. The nonlinear ultrasonic wave specified in this document mainly refers to the second harmonic of ultrasonic longitudinal wave.

3.2 Ultrasonic waves have a limited and large amplitude when propagating in a medium.

3.3 fundamental wave Ultrasonic waves whose center frequency is the excitation frequency.

3.4 Second harmonic wave Ultrasonic waves with a center frequency of twice the excitation frequency.

3.5 Microstructure damage When metal materials are subjected to external stress, strain, heat, chemical environment, etc., their microscopic structure undergoes irreversible changes or local changes. The phenomenon of destruction.

Note. Structural damage includes dislocation slip and proliferation, precipitation phase evolution, local phase transformation, grain boundary coarsening, micropores, microcracks, etc.

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