



Standard Practice for X-Ray Determination of Retained Austenite in Steel with Near Random Crystallographic Orientation¹

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INTRODUCTION

The volume percent of retained austenite (face-centered cubic phase) in steel is determined by comparing the integrated chromium or molybdenum X-ray diffraction intensity of ferrite (body-centered cubic phase) and austenite phases with theoretical intensities. This method should be applied to steels with near random crystallographic orientations of ferrite and austenite phases because preferred crystallographic orientations can drastically change these measured intensities from theoretical values. Chromium radiation was chosen to obtain the best resolution of X-ray diffraction peaks for other crystalline phases in steel such as carbides. No distinction has been made between ferrite and martensite phases because the theoretical X-ray diffraction intensities are nearly the same. Hereafter, the term ferrite can also apply to martensite. This practice has been designed for unmodified commercial X-ray diffractometers or diffraction lines on film read with a densitometer.

Other types of X-radiations such as cobalt or copper can be used, but most laboratories examining ferrous materials use chromium radiation for improved X-ray diffraction peak resolution or molybdenum radiation to produce numerous X-ray diffraction peaks. Because of special problems associated with the use of cobalt or copper radiation, these radiations are not considered in this practice.

1. Scope

1.1 This practice covers the determination of retained austenite phase in steel using integrated intensities (area under peak above background) of X-ray diffraction peaks using chromium K_{α} or molybdenum K_{α} X-radiation.

1.2 The method applies to carbon and alloy steels with near random crystallographic orientations of both ferrite and austenite phases.

1.3 This practice is valid for retained austenite contents from 1 % by volume and above.

1.4 If possible, X-ray diffraction peak interference from other crystalline phases such as carbides should be eliminated from the ferrite and austenite peak intensities.

1.5 Substantial alloy contents in steel cause some change in peak intensities which have not been considered in this method. Application of this method to steels with total alloy contents exceeding 15 weight % should be done with care. If

necessary, the users can calculate the theoretical correction factors to account for changes in volume of the unit cells for austenite and ferrite resulting from variations in chemical composition.

1.6 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

2. Significance and Use

2.1 *Significance*—Retained austenite with a near random crystallographic orientation is found in the microstructure of heat-treated low-alloy, high-strength steels that have medium (0.40 weight %) or higher carbon contents. Although the presence of retained austenite may not be evident in the microstructure, and may not affect the bulk mechanical properties such as hardness of the steel, the transformation of retained austenite to martensite during service can affect the performance of the steel.

¹ This practice is under the jurisdiction of ASTM Committee E04 on Metallography and is the direct responsibility of Subcommittee E04.11 on X-Ray and Electron Metallography.

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