

DIN/TS 8204

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**Gießereiwesen –
Durchstrahlungsprüfung –
Vergleichsbilder für Gusseisen mit Kugelgraphit und Gusseisen mit
Lamellengraphit;
Text Englisch**

Founding –
Radiographic testing –
Reference images for spheroidal graphite cast irons and grey cast irons;
Text in English

Fonderie –
Contrôle par radiographie –
Radiogramme de référence pour fontes à graphite sphéroïdal et pour fontes à graphite
lamellaire;
Texte en anglais

Gesamtumfang 17 Seiten

DIN-Normenausschuss Gießereiwesen (GINA)

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Foreword

This Technical Specification has been prepared by the committee NA 036-00-03 AA “Test methods for cast materials” of the DIN Standards Committee foundry practice.

Technical Specifications are not part of the body of German Standards.

A Technical Specification developed in accordance with the pre-standard procedure is the result of standards work which DIN does not publish as a standard because there are certain reservations regarding content, or because it was not prepared in accordance with the normal procedures for standards work.

No draft of this Technical Specification has been published.

Comment on experience with this Technical Specification should be sent

- preferably as a file by e-mail to gina@din.de in the form of a table. The template for this table is available for download from <http://www.din.de/stellungnahme>;
- or as hard copy addressed to the DIN-Normenausschuss Gießereiwesen (GINA) (DIN standards committee foundry practice), DIN e. V., Am DIN-Platz, Burggrafenstraße 6, 10787 Berlin, Germany.

Attention is drawn to the possibility that some of the elements of this Technical Specification may be the subject of patent rights. DIN shall not be held responsible for identifying any or all such patent rights.

Introduction

Radiographic testing (film techniques or techniques using digital detectors) provides information about the type, size and localization of an internal volumetric discontinuity.

This document provides reference radiographs for castings (wall thicknesses > 20 mm up to 400 mm) made from grey cast irons and spheroidal graphite cast irons with internal discontinuities.

Production radiographs of iron castings should be compared to the reference radiographs of this document in order to classify any internal discontinuities by assigning each of them to a discontinuity class. These are compared to the classification specification agreed between the manufacturer and the purchaser to find out whether the discontinuities are acceptable.

NOTE Discontinuity classes assigned to a section of the casting, based on indications detected by prior ultrasonic inspection, do neither correspond to the discontinuity classes by radiographic inspection, nor can be converted into each other by calculation. Both methods give different information about type, size and depth of an internal discontinuity, which best supplement each other.

The reference radiographs given in this document were produced on heavy plates which were machined from a batch of approximately 100 t castings with purpose-made internal discontinuities (types A to D, with different severity levels) in the course of a R&D programme in a team of 13 heavy-wall cast iron foundries, 3 customers, 4 Notified Bodies and a specialized test house.

The reference radiographs were produced according to testing class A of former DIN 54111-2 that was substituted by DIN EN 12681-1 by using the following radiation sources:

- a) Ir-192 for wall thicknesses of 20 mm to 100 mm;
- b) Co-60 for wall thicknesses of 50 mm and 100 mm (exceptionally up to 180 mm in DGZFP Guideline D5);
- c) Linear accelerator (9 MeV) for wall thicknesses of 50 mm, 100 mm, 200 mm and 400 mm;

Film system classes C3 and C5 were used (linear accelerator: C1) according to DIN EN ISO 11699-1.

The set of reference radiographs of VDG P541 allows evaluating heavy-wall (> 50 mm to at least 400 mm) castings made from spheroidal graphite cast irons.

For comparison purposes, metallographic cross section images are included for representative discontinuities. They were made by sectioning of surplus test plates with comparable defects (same discontinuity class).

The plates on which the original radiographic films were recorded in 2000 were re-exposed using identical radiation sources in 2016. The exposure technique was performed in accordance with DIN EN 12681-1. Additionally, different IQI types (IQI: image quality indicator) were super-exposed to enable contrast adaption to digital production radiographs. The films were digitized subsequently.

For comparison with the ASTM reference radiograph catalogues the following IQI types were used simultaneously during exposure:

- a) wire type IQI according to DIN EN ISO 19232-1;
- b) step/hole type IQI according to DIN EN ISO 19232-3;
- c) hole type IQI according to ASTM E 1025.

All three types are used to adjust the contrast of the image.

The influence of penetrated wall thickness on the image contrast was investigated too. An addition of (defect-free) extra plates to a test plate with internal discontinuities to simulate higher wall thicknesses led to comparable results (for both, indication contrast and image quality based on IQI perception) as a single-piece heavy-wall plate of the same thickness. Thus, thin plates can be used to evaluate higher wall thickness, just taking into account a limited loss of physical quality.

More reference radiographs were produced in the course of an earlier industrial project, documented in DGZFP Guideline D5. For those, only digital data of the original exposed films exist. A repetition of the radiographs, using digitized radiography according to DIN EN 12681-2 was impossible, as the castings had been sectioned for publication of the DGZFP Guideline D5. In spite of that, the reference images of the DGZFP Guideline D5 supplement the reference images of the former VDG P541 catalogue to the lower wall thickness range and are included in this document.

In ASTM extensive work was done to investigate the differences in indication contrast comparing digitized films of the ASTM E 155 Aluminum catalogue and exposures using digital detector arrays (DDA) and identical hardware (Al plates with indications of different severity as described in ASTM E 155). As a result, all original films were digitized according to scanning class DS in ISO 14096-2. The flaw visibility is identical when using both detectors (film or DDA), if the basic spatial resolution of the digitized film image is equal to the basic spatial resolution of the DDA image.

Annex A contains examples with reference images for spheroidal graphite cast irons and the information where the complete set of reference images including a software provided on a CD-ROM can be purchased.

1 Scope

This document classifies internal discontinuities (imperfections) in castings made from spheroidal graphite cast irons and grey cast irons (only in DGZFP Guideline D5) by comparison to reference radiographs (films or digital images).

The following types of discontinuities are classified:

- a) Type A: Porosity and gas holes (entrapped cold shots);
- b) Type B: Entrapped sand and slag inclusions;
- c) Type C: Shrinkage;
- d) Type D: Cracks (only in DGZFP Guideline D5);
- e) Type Z: Dross.

Other types of discontinuities are currently not addressed due to lack of examples.

Categories and severity levels for each type of discontinuity represented by the reference radiographs in this document are classified by this document, DIN EN 12681-1 and DIN EN 12681-2.

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.

ASTM E 94, *Standard Guide for Radiographic Examination Using Industrial Radiographic Film*

DIN EN 12681-1, *Founding — Radiographic testing — Part 1: Film techniques*

DIN EN 12681-2, *Founding — Radiographic testing — Part 2: Techniques with digital detectors*

DIN EN ISO 19232 (all parts), *Non-destructive testing — Image quality of radiographs*

3 Terms and Definitions

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

DIN and DKE maintain terminological databases for use in standardization at the following addresses:

- DIN-TERMinologieportal: available at <https://www.din.de/go/din-term/>
- DKE-IEV: available at <http://www.dke.de/DKE-IEV>

3.1 Exposure and prorating

3.1.1

production radiograph

radiograph performed on a casting which is under review for compliance with this document