

Digitalization of Industrial Radiographic Films

Specification

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the sections, subsections and enumerates thereof.

Technical Requirement: A provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by imperative nature.

Recommended Practice: A provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by verbs of a nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

"The present Standard is the exclusive property of PETRÓLEO BRASILEIRO S.A. - PETROBRAS, for internal use in the Company, and any reproduction for external use or disclosure, without previous and express authorization from the owner, will imply an unlawful act pursuant to the relevant legislation through which the applicable responsibilities shall be imputed. External circulation shall be regulated by a specific clause of Secrecy and Confidentiality pursuant to the terms of intellectual and industrial property law."

CONTEC

Comissão de Normalização
Técnica

SC - 27

Non-Destructive Tests

Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard [N-1](#). For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

Foreword

This Standard is the English version (issued in 04/2012) of PETROBRAS N-2896 REV. A 02/2011, including its Erratum - 04/2012. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

1 Scope

1.1 This Standard sets forth the mandatory requirements for the process of digitalization of industrial radiographic films, using radiographic scanners, aiming at acquiring digital images which may or not be used for interpretation and opinion report, supplementing the National Standards and offshore and international Standards for applicable projects.

1.2 This Standard does not deal with signal processing.

1.3 This Standard applies to procedures started as from the date of its edition.

1.4 This Standard contains only Technical Requirements.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies (including amendments).

[JCGM 200:2008](#) - International Vocabulary of Metrology - Basic and General Concepts and Associated Terms (VIM);

ABNT [NBR NM 314:2007](#) - Ensaios Não Destrutivos - Radiografia Industrial - Terminologia;

ABNT [NBR 15782:2009](#) - Ensaios Não Destrutivos - Radiografia Industrial - Digitalização de filme;

ASME [Boiler and Pressure Vessel Code - Section V: 2010](#) - Nondestructive Examination;

NOTE For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 Terms and Definitions

For the purposes of this document, the terms and definitions given in [JCGM 200:2008](#), ABNT [NBR NM 314:2007](#), ABNT [NBR 15782:2009](#) and the following apply.

3.1

addition

insertion of a new paragraph or insertion of text within a paragraph

3.2

change

replacement of a paragraph or a partial change within a paragraph

3.3**deletion**

exclusion of a paragraph or any part of it

3.4**base standard**

design, manufacturing, construction and assembly standards related to the inspected equipment and supplementary standards mentioned herein.

4 General Terms

4.1 The digitalization of industrial films should be performed according to the Base Standards, except for the substitutions, additions and cancelling mentioned in the specific conditions.

4.2 In cases where a Base Standard mentioned in Section 2 is not mentioned in Section 5 of the specific conditions, such Base Standard should be applied in its entirety to the relevant items of the industrial films digitalization procedure.

5 Specific Conditions**5.1 Change, Addition and Suppression of ABNT [NBR 15782:2009](#)****5.1.1 Item 3.10 - Digitalization of Industrial Radiographic Films System - Change**

A digitalization of industrial radiographic films system comprises the radiographic scanner, image visualization unit for scanned images on a screen (monitor) and a software and image visualization software version.

5.1.2 Item 3.12 - Dynamic Range - Addition

Physical number of bits for the resolution in gray tones.

5.1.3 Item 4.2 - Change

All other professionals involved with the digitalization of radiographical films should have specific training in film digitalization techniques and be certified by ER-N3 certified by the "Sistema Nacional de Qualificação e Certificação em Ensaios Não Destrutivos - SNQC-END". This training should qualify professionals for the operation of the digitalization system to be used.

5.1.4 Item 5.1 - Table 1 - Change
Table 1 - Variables of the Written Procedure

Requirements	Essential variable	Non essential variable
Issuer name, numbering and revision indication		X
Purpose		X
Reference Standards for procedure elaboration and qualification	X	
Type of radiation source (specifying radioactive isotope or maximum tension of the X-ray equipment)		X
Digitalization of industrial radiographic films system		
1- Manufacturer and model of scanner, specifying:		
a) size of scanner pixel (in μm);	X	
b) focal spot size of scanner (in μm);	X	
c) dynamic range;		X
d) spatial resolution (in pl/mm);	X	
e) density range;	X	
f) dynamic range of the digitalization system;	X	
g) sensitivity to contrast in terms of optical density;	X	
h) spatial linearity;	X	
i) maximum film size for digitalization;		X
2 - Manufacturer and model of monitor, specifying:		
a) monitor characteristics: luminance, luminance rate, resolution, pixel size and dynamic range;	X (see Note)	
b) physical size and viewable area of monitor		X
3 - Image visualization software		
a) imaging processing system used	X	
b) imaging processing system version		X
Sequence of imaging processing steps:		
a) contrast enrichment operations;		X
b) magnification (zoom);		X
Storage:		
a) image identification;		X
b) file format;		X
c) media (including data loss protection);		X
Reference film serial number		X
Reference film certification date and expiration date		X
Scanner stability inspection periodicity		X
Digitalized radiographic film identification system		X

NOTE Replacing the monitor with another having the same luminance, luminance rate, resolution, pixel size and dynamic range characteristics do not constitute an essential variable.

5.1.5 Item 5.2 - Suppression**5.1.6 Item 6.2 b - Change**

A minimum of 5 radiographic films should be used. Radiographic density used for the procedure qualification should be representative of the range specified in the radiographic procedure used, and an X-Ray with minimum specified density and one with maximum specified density is mandatory. All scanned images should show the image quality indicators in a clear way, according with the original film.

5.1.7 Item 6.3 - Change

All documentation related to qualification, including 5 radiographic films and its respective scanned images should be attached to the procedure.

5.1.8 Item 9.2 - Change

The dynamic range should be at least 8 bits (256 gray levels).

5.1.9 Item 11.1 - Change

Scanned images should be identified with an exclusive, non duplicated code, created by the user, allowing its traceability to the equipment, piping or duct subject to radiography.

5.1.10 Item 11.3 - Change

No writing or change in the radiography or its scanned image is allowed.

5.2 Change, Addition or Deletion of ASME [Section V:2010](#) - Article 2 - Mandatory Appendix - Appendix VI - Digital Image Acquisition, Display, Interpretation, and Storage of Radiographs for Nuclear Applications**5.2.1 VI-222 "Written Procedure" - Change**

Authorized Nuclear Inspector (ANI) should be changed to "PETROBRAS".

5.2.2 VI-223 "Personnel Requirements" - Change

When referring to Article 1, only "inspectors certified by the national or international central certification programs, such as the ASNT Central Certification Program (ACCP)" should be used.

5.2.3 VI-261 "Procedure Demonstration" - Change

Replace ANI by PETROBRAS.

5.2.4 VI-261 "Procedure Demonstration" - Addition

A minimum of 5 radiographic films should be used for qualification. Radiographic density used for the procedure qualification should be representative of the range specified in the radiographic procedure used, and an X-Ray with minimum specified density and one with maximum specified density is mandatory. All scanned images should show the image quality indicators in a clear way, according with the original film.

REV. A

[illegible]