



Exploration & Production

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 630

TOFD Inspection

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1. Scope

This specification defines the Company's minimum requirements and provides a system of general conditions to perform TOFD (Time Of Flight Diffraction) inspection on butt welds of fine grain C-Mn steel. TOFD may be used as a substitution to radiographic examination for circular and longitudinal welds of Pressure Vessels.

The use of TOFD inspection in lieu of radiographic examination must be submitted to Company acceptance before to proceed.

Welds examined by TOFD shall be made as per Company relevant specifications.

TOFD Inspection shall be carried out according [XP CEN/TS 1451](#), with the amendments and clarifications stated in the present specification.

In addition to material requirement detailed in scope of [XP CEN/TS 1451](#), this specification does not cover TOFD inspection of welds on other alloys or castings, for which a verification of relevance of TOFD has to be carried out, according to metallurgical structure.

This specification does not cover TOFD inspection of T-joints or welds on material with variable thickness.

TOFD technique is not allowed on any wall thickness for which radiographic inspection is possible with a crossed wall thickness less or equal than 35 mm. Lower thicknesses shall be X-ray inspected.

TOFD, as a substitution to radiographic examination, shall conform to appropriate specification and code which define the stage of application within fabrication and heat-treatment schedule.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

The order of precedence of the applicable documents shall be:

- The Purchase Order/Requisition
- The Project Particular Specification (PPS)
- The present General Specification
- The Codes and Standards in reference.

Unless otherwise specifically indicated in writing by the Company, the Supplier shall work in accordance with the requirements specified herein and the applicable requirements of the latest editions at date of Contract award of the referenced Codes and Standards, whenever requested in the present specification.

Where this specification states no overriding requirements, the referenced Codes and Standards shall apply in full.

Standards equivalent to those referred to herein shall not be substituted without written approval from the Company. Approval of equivalent standards will not, in any way, remove responsibility from Supplier to meet the requirements of the standards referred to and amended herein, in the event of conflict.

The Supplier shall equip himself with copies of all the reference specifications referred to in this specification and shall make them readily available to all inspection personnel involved on the work.

Standards

Reference	Title
EN 473	Qualification and certification of NDT personnel
EN 583-1	Non destructive testing - Ultrasonic examination - Part 1: General principles
EN 1714	Non Destructive Examination of Welds - Ultrasonic examination of welded joints
EN 12668-1	Non-Destructive Testing - Characterisation and verification of ultrasonic examination equipment - Part 1: Instruments
EN 12668-2	Non-Destructive Testing - Characterisation and verification of ultrasonic examination equipment - Part 2: Probes
EN 12668-3	Non-Destructive Testing - Characterisation and verification of ultrasonic examination equipment - Part 3: Combined equipment
EN 15617	Non-destructive testing of welds - Time-of-flight diffraction technique (TOFD) - Acceptance levels
XP CEN/TS 14751	Technical specification - Welding - used of TOFD for examination of welds
XP ENV 583-6	Non-Destructive testing Ultrasonic examination - Part 6: TOFD technique as a method of detection and sizing discontinuities

Professional Documents

Reference	Title
CSWIP-ISO-NDT-11/93-R	Requirements for the Certification of Personnel Engaged in Non-Destructive Testing. Part 1c: Time of Flight Diffraction Ultrasonic Testing of Welds in Ferritic and Non-Ferritic Materials, Levels 1, 2 and 3
IS.US.319.22	Requirements for TOFD certification

Regulations

Reference	Title
Not applicable	



Codes

Reference	Title
ASME Section VIII div. 1 and div. 2	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels - Division 1 and Division 2 Alternative Rules
BSI PD 5500	Unfired fusion welded pressure vessels

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP COR 170	Materials for Sour Service (Upstream Applications). Specification for design
GS EP PVV 211	Design and fabrication of pressure vessels according to ASME VIII
GS EP PVV 212	Design and fabrication of pressure vessels according to BSI PD 5500
GS EP PVV 611	Welding of pressure containing piping and equipment
GS EP PVV 612	Piping and Equipment subject to severe sour service. Metallurgical
GS EP PVV 622	Piping and Equipment subject to intermediate sour service. Metallurgical

3. Definitions

All abbreviations are those employed in [XP CEN/TS 14751](#).

4. General remarks on the capabilities of the technique

TOFD technique has to be carried out in conjunction with other NDT techniques. As a minimum, UT (pulse echo technique) and MPI examination on all accessible sides of welds shall be performed in addition to TOFD.

Detection of surface discontinuities close to or connected with the scanning surface or with the opposite surface is limited. Ultrasonic inspection with creeping waves may be required by Company if defects located near surface in the weld are detrimental to the service conditions.

Complementary NDT technique shall be implemented to detect the transverse defects (refer to § 14).



5. Examination levels

Unless otherwise specified in this specification, TOFD examination shall be in accordance with [XP CEN/TS 14751](#) Level C.

6. Information required prior to testing

In addition to [XP CEN/TS 14751](#), a project particular TOFD procedure shall be submitted for Company acceptance. This detailed procedure shall explain how Contractor comply with the present Specification and shall be used (after Company acceptance) as written test instruction according to [XP CEN/TS 14751](#) level C.

Prior to perform any TOFD examination, the base metal and the welds shall be inspected with other NDT techniques. At least:

- Welds and adjacent steel shall be inspected by MPI. Acceptable indications shall be noted to be examined in conjunction with TOFD examination results
- Welds shall be fully inspected by UT according to a procedure in compliance with the applicable code or specification. Acceptable indications shall be noted to be examined in conjunction with TOFD examination results.

7. Requirements for personnel and equipment

7.1 Personnel qualifications

In addition to [XP CEN/TS 14751](#), the following requirements are mandatory:

TOFD Ultrasonic operators shall be certified according to [CSWIP](#), [IS.US.319.22](#) or equivalent.

For [IS.US.319.22](#) certification, the following modules shall be selected:

- Module G for butt welds on pressure vessel with a thickness lower than 120 mm
- Modules G & T for butt welds on thick pressure vessels ($t > 120$ mm)
- Modules G& C for clad pressure vessels.

TOFD procedure shall be drawn up by a UT-TOFD Level 3 individual.

TOFD acquisition shall be performed by a UT-TOFD Level 2 operator.

The interpretation and evaluation according to acceptance levels of TOFD ultrasonic inspection data shall be done by a UT-TOFD Level 2 [IS.US.319.22](#) certified.

The final data package shall be reviewed by a UT-TOFD Level 3 individual. The review shall include the ultrasonic data record, the data interpretations and the flaw evaluations / classification performed by another qualified UT-TOFD Level 2 or 3 individual.

Personnel in charge of TOFD shall be different from the one in charge of UT (echo to amplitude technique) examination.