



Exploration & Production

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS PVV 929

**In-service inspection for HIC/SSCC checks on
pressure vessels**

01	10/03	Change of Group name and logo
00	08/01	First issue
Rev.	Date	Notes



Contents

1. Scope	3
2. Reference documents.....	3
3. Equipment.....	4
3.1 Ultrasonic.....	4
3.2 Radiographic.....	4
4. Inspection method	5
4.1 Visual inspection	5
4.2 Ultrasonic inspection	5
4.3 Radiographic inspection.....	6
5. Inspection programme.....	6
5.1 Nozzle and liquid outlet piping.....	6
5.2 Heads	7
5.3 Body flanges and head flanges	7
5.4 Shells.....	7
5.5 Welds.....	7
5.6 Identification of thickness measurement points	7
6. Inspectors qualification	7
6.1 U.T. inspectors.....	7
6.2 Radiography inspectors	7
Sketch 1 - Wall thickness check.....	8
Sketch 2 - Head Inspection	9
Sketch 3 - Flange Inspection	10



1. Scope

Not applicable

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.

Standards

Reference	Title
DIN 54 109	Non-Destructive Testing; Image Quality and Radiographs Recommended Practice for Determining Image Quality Values and Image Quality Classes
ASTM E 317	Standard Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Systems Without the Use of Electronic Measurement Instruments

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
ASME V	Non-destructive examination

Other documents

Reference	Title
Not applicable	



Total General Specifications

Reference	Title
Not applicable	

3. Equipment

3.1 Ultrasonic

- Apparatus: Wall thickness gage KK - DM2 or similar
- Krautkramer USK7 - or similar

3.1.1 Probes

The probes set shall include at least the following probes or their equivalents:

- Longitudinal wave probes - Type SE
 - KK - MSEB 2H
 - KK - MSEB 4H
 - KK - SEB 4KF8 (For nozzles < 2")
 - KK - SEZ 5M5 (For nozzles < 2")
- Single longitudinal wave probes
 - KK - K4N
 - KK - K6N
- Shear wave probes
 - KK - MWB 45 N2
 - KK - MWB 60 N2
 - KK - MWB 70 N2
 - KK - MWB 45 N4
 - KK - MWB 60 N4
 - KK - MWB 70 N4

3.1.2 Accessories

- Calibration blocks V1 - V2
- Step block = 5-20 mm

3.2 Radiographic

- Gamma source: IR 19260 curies
- Films: Type Kodak A or similar
- Penetrameters: 10 ISO 16, 6 ISO 12, 1 ISO 7 ([DIN 54 109](#)).

4. Inspection method

4.1 Visual inspection

The pressure vessels shall be internally inspected during the programmed shutdowns.

4.2 Ultrasonic inspection

The equipment shall be checked and calibrated according to [ASTM E 317](#) (Vertical and horizontal linearity, stability).

4.2.1 U.T. Straight beam scanning

The purpose of the U.T. scan is to detect any defects within the steel wall, and particularly any laminations.

The full U.T. scan shall be performed on selected areas by using S.E. probes, in A. scan technique.

- Wall thickness calibration on two back wall echos
- Frequency: 4 MHz
- Sensibility: second back wall echo at 80% of the full screen height
- Size evaluation of anomalies: by using the -6 dB drop method.

For each inspected area, the following data shall be reported on detected anomalies:

- Shape and direction
- Depth
- Size
- Back wall and anomaly echo amplitudes
- Location.

The minimum and maximum wall thicknesses shall be reported and located.

Note 1: In case of doubt between a lamination and a banded structure, an additional check shall be carried out by using a lower frequency probe (2 MHz).

Note 2: The U.T. scan inspection may be performed on painted surface only if paint has not deteriorated and if it is adherent to the wall surface.

Note 3: During periodical inspection, the evaluation of new anomalies shall be carried out on bare metal (i.e. after having removed any painting and after having cleaned the wall surfaces).

4.2.2 Wall thickness checks

The wall thickness shall be checked on referenced points (see paragraph 6) on bare metal by using digital wall thickness gage (Krautkramer DM2 or equivalent).

The calibration shall be checked at least every twenty measurements.

Note: In case of detected metal loss, the minimum wall thickness area shall be localised by using U.T. scanning.

4.2.3 Weld inspection

The weld inspection shall be carried out in accordance with **ASME V** - Article 5.

4.3 Radiographic inspection

The profile radiographic method shall be used only on nozzles for confirmation of anomalies detected by U.T.

The inspection shall be carried out according to **ASME V** - Article 2 with the following additional requirements:

- Density = 2 to 3
- Penetrameter visibility:

Wall thickness (mm)	Minimum wire size visible (mm)
8-10	0.16
10-16	0.20
16-25	0.25
25-40	0.32
40-63	0.40
63-80	0.50

5. Inspection programme

5.1 Nozzle and liquid outlet piping

On each vessel the following inspection tasks shall be performed:

- 100% external U.T. scanning according to paragraph 5.2.1.
- Wall thickness checks according to paragraph 5.2.2 (see sketch 1).
 - Self reinforced nozzles: Four points at 90° on a same circumference, for each wall thickness.
 - Longwelding neck: Four points at 90° on a same circumference.
 - Piping (Bends and tubes):
 - . Bends: Three points on the extrados
 - . Tubes: Four points at 90° on a same circumference.
- Profile radiography, if lamination is detected by U.T.

Double wall gammagraphy shall be used in case of metal loss detected by U.T.

Every nozzle will be radiographed in single wall method to complete the zero point data.



5.2 Heads

The heads shall be inspected by U.T. straight beam scanning on two 200 mm wide bands (see sketch 2).

5.3 Body flanges and head flanges

The flanges shall be externally inspected by U.T. straight beam scanning on every area between bolts by using single longitudinal wave probes (see sketch 3).

5.4 Shells

The shells shall be inspected by U.T. straight beam scanning on 100 mm wide band on each side of the longitudinal welds (see sketch 4).

Wall thickness checks shall be performed all along the vessel height on the opposite side of the longitudinal welds according to the grid pattern shown on sketch 4.

5.5 Welds

The welds shall be inspected if anomalies are detected by U.T. straight beam in the vicinity of the welds.

5.6 Identification of thickness measurement points

All checked points shall be permanently marked on the relevant pieces of material in order to ensure that any further measurement will be done exactly at the same location.

6. Inspectors qualification

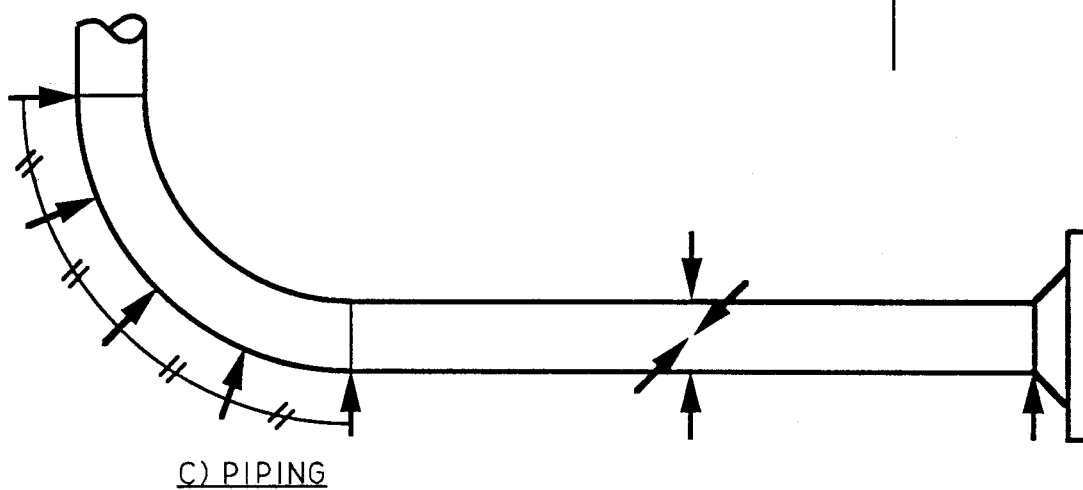
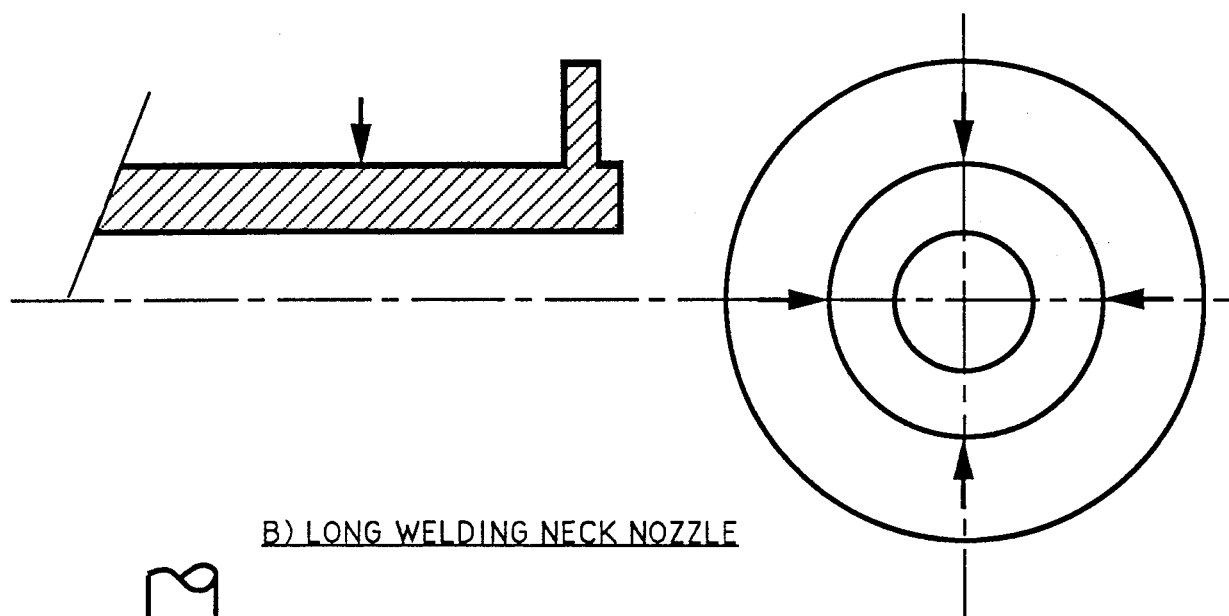
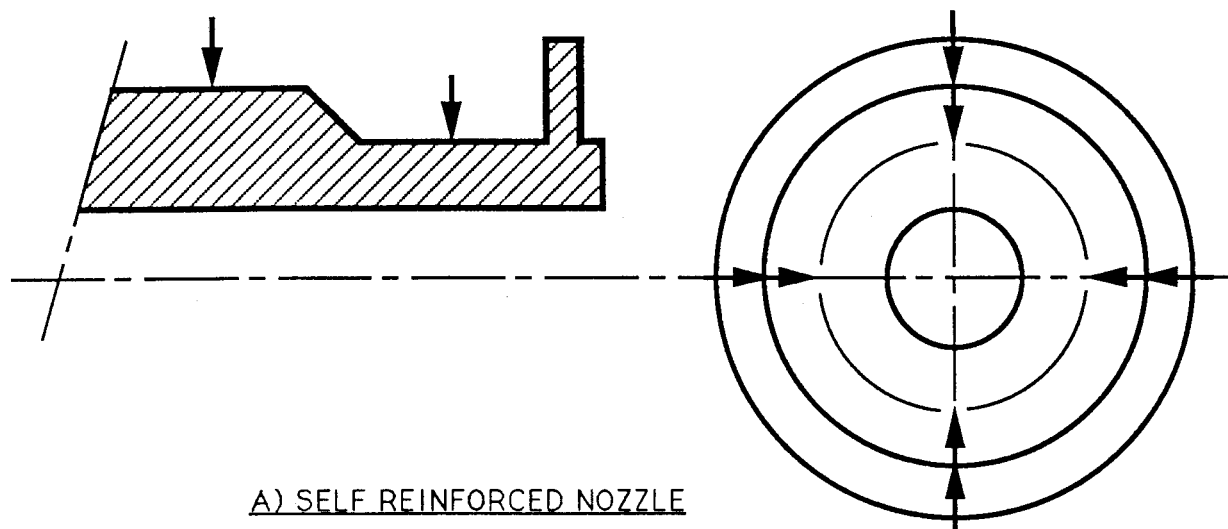
The inspectors shall be qualified according to the following:

6.1 U.T. inspectors

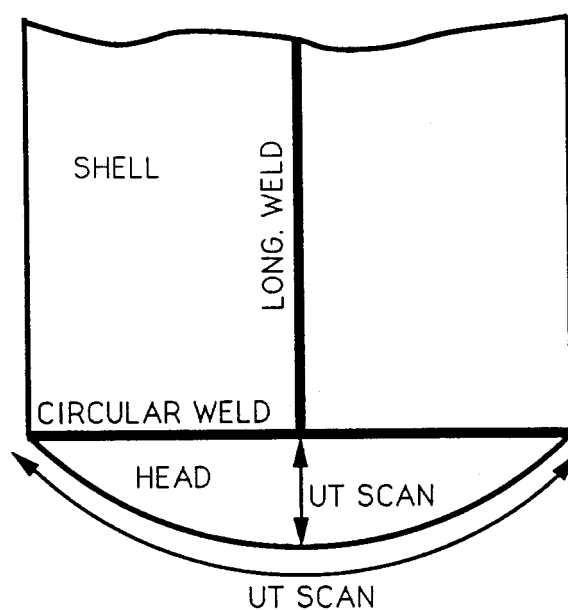
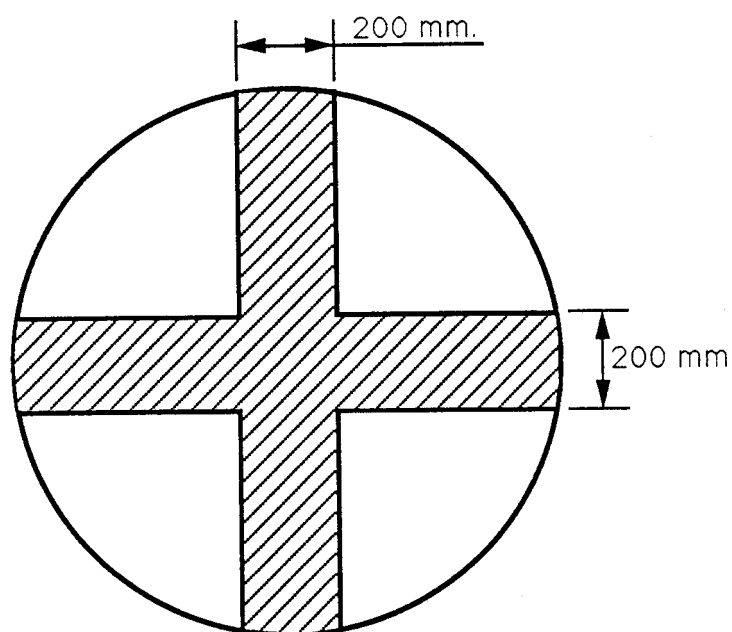
U.T. Qualification 3.8 according to CSWIP-UST-1-79 or COFREND level 2 or ASNT level 2.

6.2 Radiography inspectors

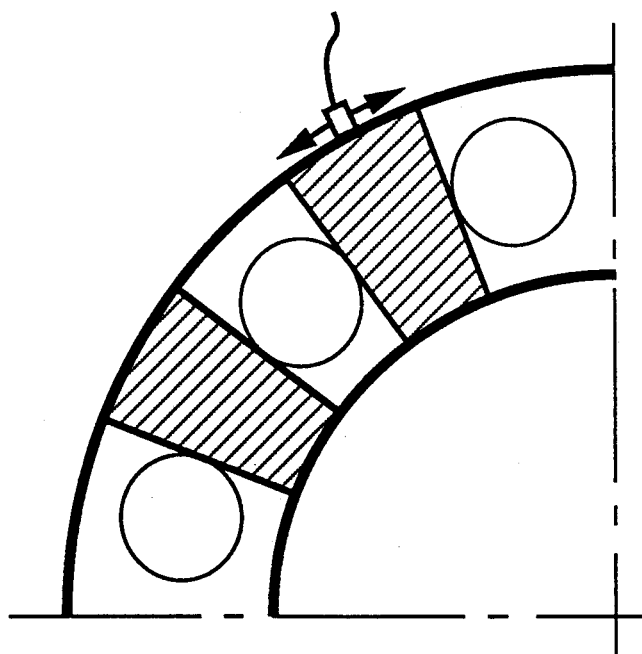
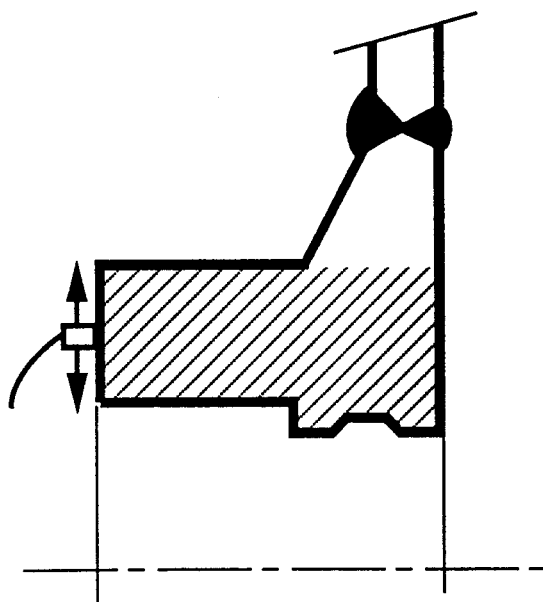
Gammagraphy - industrial radiologist according to CSWIP-RAD-2-79 or COFREND level 2 or ASNT level 2.



Sketch 1 - Wall thickness checks



Sketch 2 - Head Inspection



Sketch 3 - Flange inspection