Instruction – bend testing

1. Scope

This instruction specifies the procedure for bend testing of test pieces in connection to qualification testing of welders in steel, ISO 9606-1.

In cases where bend testing is used to supplement radiography when evaluating welding samples carried out using processes: 131, 135, 138, or 311, two bend test samples must be removed. One sample should be bent with the face outward (face bend test) and the second bent with the root side of the weld outward (root bend test).

In cases where bend testing is used as an alternative to radiography or ultrasonic testing, the complete examination length shall be tested. Dividing is done in pieces of the same length, where all will be tested. Half of the length is bent with the root side outwards and the other half with the face side outwards. If the material is > 12 mm in thickness, bend tests may be done laterally (see ISO 970).

Testing shall be done at room temperature (23 ±5 °C)

NOTE: According to ISO 9606-1, side bend testing can be applied to butt weld thicknesses of over 12 mm, as well as fracture testing. This testing method is not described in this instruction.

2. References

ISO 9606-1  Qualification testing of welders – Fusion welding
Part 1: Steels

ISO 5173  Destructive tests on welds in metallic materials — Bend tests

ISO 5817  Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections

3. Extraction of test pieces

Test pieces can be removed using thermal or mechanical processes. Shearing shall only be used for materials < 8 mm. For thermal cutting, at least 8 mm must be mechanically removed from each side to remove heat-affected materials.
a. Specimen size

Thickness should be the same as the base material thickness.
Specimen thickness from plate samples should be minimum 1.5 x thickness, but at least 20 mm thick.

For tube samples:
Tube diameter < 50 mm
Width corresponding to base material thickness (mm) + 0.1 × tube diameter (mm), but at least 8 mm
Tube diameter > 50 mm
Width corresponding to base material thickness (mm) + 0.05 × tube diameter (mm), but at least 8 mm and at most 40 mm.

4. Preparation of test specimens

The edges of the tensile surface of the test piece shall be rounded mechanically to a radius of maximum 0.3 × test piece thickness (mm), but no more than 3 mm.

The bend zone is to be worked flat (excess weld metal, excess penetration removed) and be free from scratches or instructions across the test piece. Undercuts shall not be removed.
Processing may be done by machining or grinding, with appropriate precautions being taken to avoid superficial hardness increase.

5. Testing equipment

Testing may take place in a press or by bending over rollers (see figures 1 and 2). The equipment must have the appropriate capacity to complete the bending.

6. Conducting the test

a. Centering the weld

It is essential that the weld is placed in the centre of the bend zone. Unless the position of the weld is clearly marked or displayed, the position of the weld can be determined by lightly macroetching the surface of the test piece.
b. Testing with a former

The test shall be carried out by placing the test piece on two supports consisting of parallel rollers or U-type jig, with the weld at the mid-point between the rollers. The piece is bent by loading gradually and continuously in the middle of the span, on the centre of the weld, with a former (three-point bending) perpendicular to the test surface. The bending continues until a bend angle of 180° is achieved.

The test is carried out by placing the test piece on parallel support rolls with the weld centred between the rollers.

The diameter of the former shall be 4× the thickness of the test piece. For materials with a metal elongation of less than 20%, the diameter of the former is calculated as:

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diameter = \frac{100 \times \text{test piece thickness (mm)}}{\text{minimum elongation} \%} - \text{test piece thickness}
\]

Figure 1
7. Evaluation of test results, acceptance criteria

After bending, the outer surface and sides of the test rod should be examined. The test pieces may not show any defects greater than 3 mm in any direction. Fractures in the edge of the test piece should not be taken into account if there is no evidence that the defect is caused by incomplete penetration, slag or other defects. In case of other, non-acceptable internal discontinuities (beyond quality level B according to ISO 5817) such as bidding errors appear, this results in a failure.

8. Dokumentation

The examiner verifies the results of the protocol for monitoring and testing in welding tests.