

PIPE COLD BENDING PROCEDURE

Revision Table			
Revision	Date	Paragraph	Description
1.0	2016-04-26	All	Initial Issue
2.0	2016-06-21	Cover Page	Revise procedure title

Approved by

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Title: Corporate Quality Manager, Western Canada

Signature:

Date: 2016-06-21

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1.0 Purpose

- 1.1 This work instruction provides the technical requirements for cold bending of small bore seamless and seam welded piping (3 inch nominal pipe size and under) and pipe embeds. It shall be considered as a supplemental work instruction to DCM-AQ-MA-02 Quality Control Manual (Latest Edition).
- 1.2 This procedure also provides the methods required for qualifying the bending equipment used to bend carbon and stainless pipe to the requirements of this work instruction

2.0 Definition

- 2.1 Cold Bending- The application of mechanical force used to shape or bend carbon or stainless steel shapes.

3.0 Application

- 3.1 Any project requiring cold bending of carbon or stainless steel piping.

4.0 Responsibility

- 4.1 The Corporate Quality Manager is responsible for development, issuance and maintenance of the procedure.
- 4.2 The project Quality Control Supervisor is responsible for verifying qualification of bending equipment, inspections and the monitoring of the bending operations through surveillance conducted, and ensuring that the proper documentation completed and filed.
- 4.3 Quality personnel are responsible for examining, and monitoring pipe bending process to ensure that the requirements of this procedure are being met.
- 4.4 The Superintendent or his designee shall be responsible for pipe bending operations which shall comply with the requirements of this procedure.

5.0 Methods (Cold Bending)

- 5.1 Cold bending of pipe shall be performed within the following specified material temperature limits:
- 5.2 For austenitic stainless steel - not higher than 176.6 °C (350 °F) nor lower than 4.5°C (40 °F).
- 5.3 For carbon and galvanized steel - not higher than 537.7°C (1000 °F) nor lower than 4.5°C (40 °F).
- 5.4 Prior to bending, pipe shall be free of scale, dirt, oil, grease or other deleterious material.
- 5.5 Dies or benders shall be wiped clean prior to application of bending lubricant or bending operation.
- 5.6 After bending carbon steel piping and prior to bending stainless steel piping, the bending shoes shall be cleaned by swabbing 10-30 minutes with 20-25% nitric acid heated to 48.8°C – 71.1°C (120°F - 160°F) and thoroughly rinsed with demineralized-quality water to remove acid.
- 5.7 All pipe bending shall be performed using qualified bending equipment.
- 5.8 Bending requirements for seam welded austenitic stainless steel pipe are as follows:

6.0 Bending requirements for Austenitic Stainless Steel Pipe

- 6.1 For single or multiple bends made in the same plane, the pipe shall be oriented so that, whenever possible, the seam is positioned along the neutral axis of the bend (top or bottom of a horizontal bend).
- 6.2 For multiple bends in more than one plane, bends shall be confined first to the neutral axis, then to the inside bend radius, and then to the outside bend radius.
- 6.3 All stainless steel pipe, identified by the mill markings or material certifications as "welded," shall be visually examined to locate the weld seam
- 6.4 Pipe bends shall maintain a circular cross section.
- 6.5 Bends shall be smooth, free from cracks, surface defects, buckles, and wrinkles.
- 6.6 Production bends shall be checked for percent ovality whenever ovality visually appears to be questionable, even though the bending machine has been satisfactorily qualified.
- 6.7 If any defects are found, the pipe bend shall be marked as scrap and discarded.

7.0 Pipe Bending Equipment Qualification

- 7.1 Each pipe bending machine shall be qualified at the jobsite prior to production bending.
- 7.2 Qualification shall consist of performing test bends on each pipe size, material type, and schedule to demonstrate that the following pipe minimum wall and ovality requirements can be met:
- 7.3 Each pipe to be tested shall be bent to a 90° bend (+ 3°) at the smallest bend radius for the particular pipe size, type and schedule permitted by the applicable Contract Specification.
- 7.4 Each pipe bend shall be sectioned in four (4) pieces in accordance with the Pipe Bending Machine Qualification Form (Figure 1).
- 7.5 Wall thickness and ovality shall be measured on each piece.
- 7.8 Minimum wall thickness after bending shall not be less than 87.5 % of the nominal wall thickness of the pipe being bent.
- 7.9 Ovality after bending shall not exceed 8%, as determined by ASME B31.3.
- 7.10 All required measurements and calculations shall be documented on Figure 1. Once the bending machine has been found acceptable, further qualification is not required.
- 7.11 Pipe bending machine qualification shall be witnessed and documented by the QC Inspector on the document shown in Figure 1.
- 7.12 Each qualified pipe bending machine shall have an attached document delineating the bend radius, type of material, and pipe schedule which can be formed by the applicable machine, based on the machine qualification.
- 7.13 **Surface Irregularities**

Pipe wall conditions, e.g. ovality, buckling, wrinkling, or flattening, due to machine malfunction shall be cause for machine requalification prior to the continuance of any production beyond the point of discovery.

8.0 Quality Assurance

- 8.1 Project Quality Control Supervisor and / or Quality Control Inspectors shall conduct periodic surveillance and audits to assure compliance with the contract, Codes and work procedure requirements. Project Quality surveillance and audit shall be documented and administratively controlled as described in DCM-AQ-MA-02.
- 8.2 Nonconforming items identified during construction shall be controlled and dispositioned in accordance with Section 12 of DCM's ASME Quality Control Manual (DCM-AQ-MA-02).
- 8.3 The QCS shall compile and maintain records are required by the procedure and DCM's ASME Quality Control Manual.

9.0 References

- Applicable Contract Specifications
- ASME B31.3 / ASME B31.1
- ASME Quality Control Manual (DCM-AQ-MA-02)



PROCEDURE
PIPE BENDING PROCEDURE

FIGURE 1- PIPE BENDING MACHINE QUALIFICATION FORM

PIPE BENDING MACHINE QUALIFICATION FORM

Bender _____ Shoe No. _____

Pipe Mat'l _____ Size _____

Sch _____ Seamless _____ Welded _____

Avg. dia (in) before bending _____

Cut No.	1	2	3	4	5	6	7	8
Max Dia (in) after bend	_____	_____	_____	_____	_____	_____	_____	_____
Min Dia (in) after bend	_____	_____	_____	_____	_____	_____	_____	_____
Difference (in)	_____	_____	_____	_____	_____	_____	_____	_____
% Difference	_____	_____	_____	_____	_____	_____	_____	_____

Min Wall Thickness before bending _____

Min Wall Thickness after bending _____

Does cut violate min wall? Yes _____ No _____

% Ovality = Dia. Max – Dia. Min (After Bend)

Performed By _____ Date _____

QA Witness _____ Date _____

Approved _____ Date _____

Measuring and Test Equipment Used _____ Calibration Due Date _____