

Standard Operating Procedure Pipe Bending – MIL-STD-1627	SOP No. 5.049
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1 Purpose

- 1.1 To establish a standard procedure for performing pipe bending in accordance with MIL-STD-1627.

2 Scope

- 2.1 This procedure covers material procurement, pipe bending, heat treatment, inspection requirements, acceptance criteria and documentation for piping and tubing being bent in accordance with MIL-STD-1627C (SH), dated 30 September 1994.

3 Responsibilities

- 3.1 The Project Manager (PM) is responsible for coordination with the customer and with company personnel to ensure that the customer's requirements as defined in specifications and drawings are incorporated into the project plans and followed to procure materials, perform the bending services, and meet all acceptance criteria.
- 3.2 The Bending Department Manager (BDM) is responsible for ensuring that this procedure is implemented to meet customer requirements, including procedure qualifications, material receiving inspections, bending process, post bending inspections, job records maintenance, and customer required documentation.

4 References

- 4.1 MIL-STD-1627C (SH), 30 Sep 1994, *Bending of Pipe or Tube for Ship Piping Systems*.
- 4.2 ASME B31.3, 1999, *Process Piping*.
- 4.3 NAVSEA T9074-AS-GIB-010/271-Not1, 16 Feb 1999, *Requirements for Nondestructive Testing Methods*.
- 4.4 Various Federal, Military and ASTM Specifications for pipe and tube materials per MIL-STD-1627C.

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5 Procedure

5.1 Material

- 5.1.1 Customer Supplied Material: Material supplied by others is received and inspected to verify conformance with the customer requirements for type, size, wall thickness and condition.
- 5.1.2 Purchased Material: Purchased material is ordered per customer specifications and received and inspected to verify conformance with the customer requirements for type, size, wall thickness and condition.
- 5.1.3 Base Material Condition: The anneal or temper of the material, at least in the vicinity of each bend, shall be verified to be in accordance with MIL-STD-1627C paragraph 4.1.1, or replacement or pre-bending heat treatment is required. [The material should be procured to the correct condition.]
- 5.1.4 Material Documentation and Traceability:
 - 5.1.4.1 Material Test Reports (MTR) and any other documentation required by the customer will be ordered with the material.
 - 5.1.4.2 Material markings will be matched to the documents and the customer requirements to verify conformance.
 - 5.1.4.3 Prior to cutting material, markings will be transferred, copied, or coded on the material as necessary to maintain traceability.
 - 5.1.4.4 Material documentation will be maintained with the job records.

5.2 Pre-bending Preparations

- 5.2.1 Cleanliness of the pipe prior to bending, inside and outside, shall be sufficient to prevent nicks and gouge marks at the finished bends.
- 5.2.2 Wall thickness of the pipe shall be sufficient that the backwall of the finished bend meets the minimum design or specified thickness.
- 5.2.3 Condition of the surfaces to be bent shall be free of dents, nicks and gouges in excess of the finished bend acceptance standards.

5.3 Bending Process

- 5.3.1 Lubricants may be used in bending operations as long as the type does not conflict with MIL-STD-1627C paragraph 4.2.1. [Excludes excessive VOCs; sulfur, chlorine or carbon ingredients on stainless steel; sulfur or chlorine on copper or nickel containing alloys; and numerous metals or halogens on materials for service above 400°F.] A record of the type of lubricant used, if any, must be made.
- 5.3.2 Usage of loose fillers for internal support when mandrels are not available must conform to MIL-STD-1627C paragraphs 4.4 and 4.5.
- 5.3.3 Material controls regarding the tool types permitted to contact various pipe materials must conform to MIL-STD-1627C paragraph 4.5.

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- 5.3.4 The type of bending machine is classified as Rotary. If Rotary-With-Booster is to be used, separate qualification is required.
- 5.3.5 Piping shall not be bent to a radius less than 2D, except for copper and brass pipe as noted in MIL-STD-1627C paragraph 5.4.1.
- 5.3.6 When bending longitudinally welded pipes, the weld shall not be located in a principal axis (ref. MIL-STD-1627C paragraph 5.4.2).
- 5.3.7 The pipe bending temperature is classified as Cold.
- 5.3.8 Adjustments and corrections to bend angles, out-of-round conditions, buckles, bulges and dents may be made if in conformance with MIL-STD-1627C section 5.6.
- 5.4 Inspection Process
 - 5.4.1 Individual bends and multi-bend parts or assemblies will be inspected and reported according to customer requirements.
 - 5.4.2 Inspection personnel shall be trained and tested in accordance with typical industry standards.
 - 5.4.3 Inspection records shall be maintained with the job records.
- 5.5 Acceptance Standards
 - 5.5.1 Acceptance criteria shall be in accordance with MIL-STD-1627C section 5.9, and/or to customer specifications as specifically provided for in the project plans.
- 5.6 Post-bending Processes
 - 5.6.1 Post-bending heat treatment shall not be performed unless specifically provided for in the project plans, in which case it shall conform to MIL-STD-1627C section 5.7.
 - 5.6.2 Post-production cleaning other than general cleanliness, special surface treatments and special packaging requirements must be specifically provided for in the project plans.
- 5.7 Procedure Qualification
 - 5.7.1 Bends to a radius 5D or greater do not require procedure qualification.
 - 5.7.2 Bends to a radius less than 5D require procedure qualification for each material group listed in MIL-STD-1627C paragraph 5.2.
 - 5.7.3 Each type of bending machine requires separate procedure qualification.
 - 5.7.4 Unless the customer specifies otherwise, test specimens for procedure qualification shall be made, either:
 - a) Two production bends at the smallest radius for the system, which qualifies that pipe size and wall thickness only, per MIL-STD-1627C paragraph 5.2.1; or

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b) Two 90° bends for each pipe size, one the thickest and one the thinnest wall used in production, for the various pipe sizes per MIL-STD-1627C paragraph 5.3.1, to qualify ranges of sizes for production.

5.7.5 A Qualification Test Report shall be submitted, if necessary, according to customer requirements.

5.7.6 The **Appendix** (form FN 5.049.1) to this procedure shall be used to document job specific information necessary for procedure qualification under MIL-STD-1627C section 5.1.

5.8 Records

5.8.1 Records of procurement notes, incoming material inspections, bending process notes, bend inspection results, any rework and acceptance notes, post-bending process notes, and any non-conformance reports, shall be contemporaneously made and become part of the job records.

5.8.2 Documents and qualifications received from the customer and copies of reports and certifications provided to the customer shall become part of the job records.

5.8.3 Unless specified otherwise, job records will be maintained for at least three-years after delivery or the end of the contract. Refer to MIL-STD-1627C paragraph 6.4 regarding disposition of records.

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Document Approval


 Bending Manager

2-5-04
 Date


 Operations Manager

2-5-04
 Date


 Quality Assurance Manager

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 Date

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