	Induction Bends Specification (30° 45° 90° 5D NPS 18",12",10",8",6')		Rev:	P3
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Project	Maintenance of Kamad Pipelines			
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Approved PEI				

TECHNICAL SPECIFICATION FOR INDUCTION BENDS

This is an enquiry specification for induction bends for the costruction of piggable oil pipelines.
This specification details the minimum technical requirements for manufacture, testing, and inspection of induction bends.

1. CODES AND STANDARDS:

The latest revision of the following Codes, Standards and Specifications shall apply unless otherwise indicated and shall form an integral part of this specification.
The tests shall be executed by SUPPLIER in accordance/compliance with EN 10204 3.1 and this Technical Specifications document.
Further specific details shall be issued in the Scope of Work and shall be approved by PEI.

ASME B31.4	Pipe line transportation system for liquid hydrocarbons and other liquids
ASME V	Boiler and Pressure Vessel Code Section V: Non Destructive Examination
BS EN ISO 6507-1	Metallic materials. Vickers hardness test. Test method
BS EN 10160	Ultrasonic Testing of Steel Flat Product of Thickness Equal or Greater than 6 mm (Reflection Method)
API 5L	Specification for Line Pipe
ASME B16.49	Factory-Made, Wrought Steel, Buttwelding Induction Bends for Transportation and Distribution Systems
ISO 15590-1	Petroleum and Natural Gas Industries - Induction

	Bends, Fittings and Flanges for Pipeline Transportation Systems - Part 1; Induction Bends
BSEN 10204	Metallic Products - Types of Inspection Documents
EN 10204 3.1	Metallic Products - Inspection Certificate
API RP 5LW	Recommended Practice for Marine Transportation of Line Pipe on Barges and Marine Vessels
API RP 5L1	Recommended Practice for Railroad Transportation of Line Pipe
ASNT-TC-1A	Recommended Practice. Personnel Qualification and Certification in Non-Destructive Testing

2. BASE PIPE

Manufactured and tested in accordance with the requirements of API 5L .

SUPPLIER shall be responsible for the supply of the base pipe suitable for induction bending to the requirements of this specification. Materials will only be accepted provided that they are accompanied by certificates to EN 10204 3.1 demonstrating that the material offered has equivalent fundamental material mechanical properties to those listed in API 5L.

The Specification of pipe used, Manufacturer and the Laboratories in which the testing is performed shall be approved by PEI.

3. MANUFACTURING PROCEDURE

The procedure for induction bending shall be submitted to PEI to approval prior to commencement of production. This procedure shall include all proposed operations and tests, together with all appropriate parameters and acceptance criteria.

Bending shall be carried out without mandrels using progressive local induction heating at the point where the pipe is being bent in accordance with ASME B16.49/ ISO 15590-1.

Once the bending operation has commenced any stoppage shall not be permitted until the entire bend is completed.

Post-bend heat treatment shall be applied over the entire bend and tangent lengths unless the SUPPLIER can demonstrate that the specified properties are achieved in the as-bent condition. Heat treatment procedures shall be submitted to COMPANY for approvals part of the induction bending procedure.

4. TEST BENDS

One additional bend for each combination of diameter, wall thickness, material grade and base pipe manufacturing route shall be made for test purposes.

The following examinations and mechanical tests shall be performed on the test bend in compliance with the methods and requirements of the applicable specification for the base pipe. All tests shall be performed on a bend in the final heat treated condition. The results of all mechanical tests shall be in accordance with the requirements of API 5L.

- The bend shall be non-destructively tested in accordance with this Specification.
- The dimensions of the bend shall meet the requirements of this Specification.
- Tensile tests shall be performed on transverse and longitudinal specimens in accordance with the requirements of ASME B16.49.
- Sets of three Charpy V-notch impact test specimens shall be taken in accordance with ASME B16.49 requirements.
- Full wall macro sections of parent metal shall be removed from the locations specified in ASME B16.49. The macro sections shall be polished and Vickers hardness tested in accordance with BS EN 6507 Part 1. The number and location of the hardness indents and the maximum hardness shall be in accordance with the specification for base pipe.

5. PRODUCTION BENDS

All production bends shall be manufactured using the approved and qualified manufacturing procedure. Any variation in procedure, or deviation from the bend forming parameters used for the test bend, shall be cause for rejection.

All production bends shall be non-destructively examined in accordance with the requirements of Section 6 of this Specification.

Each production bend shall be tested and results recorded using a gauging pig. The diameter of the gauging plate shall be 95% of the nominal internal diameter. Details of the gauging pig shall be submitted to PEI for approval.

6. DIMENSIONS

All bends shall be supplied to the following dimensional tolerances:

- The wall thickness at any location on the finished bend shall not be less than the specified minimum wall thickness as defined in the datasheet. The wall thickness of the sacrificial bend shall be measured ultrasonically at 150 mm intervals along the pipe at eight locations spaced equidistantly around the circumference of the pipe between the start and stop point of bending, the wall thickness of production bends shall be measured in the body and at both ends of each bend at the intrados, extrados and one neutral axis.
- The inside diameter measured at each of the bend tangent ends shall be within the tolerances specified in the specification for base pipe.
- Out of roundness, measured as the difference between maximum and minimum outside diameter, shall not exceed 2.5% of the nominal pipe outside diameter in the body of the bend. At the ends of the bend, out of roundness shall be within the tolerances specified in the specification for base pipe.
- The ends of all bends shall be cut square to the axis of the bend, within a tolerance of 1.5 mm.
- Out of plane tolerance shall be within the limits shown in Figure 3.2.
- The bend angle shall be within ± 0.5 degrees of the specified value.

- Any irregularities in the surface contour of the bend caused by the bending process shall be minimised. All irregularities shall blend smoothly into the adjoining surfaces.

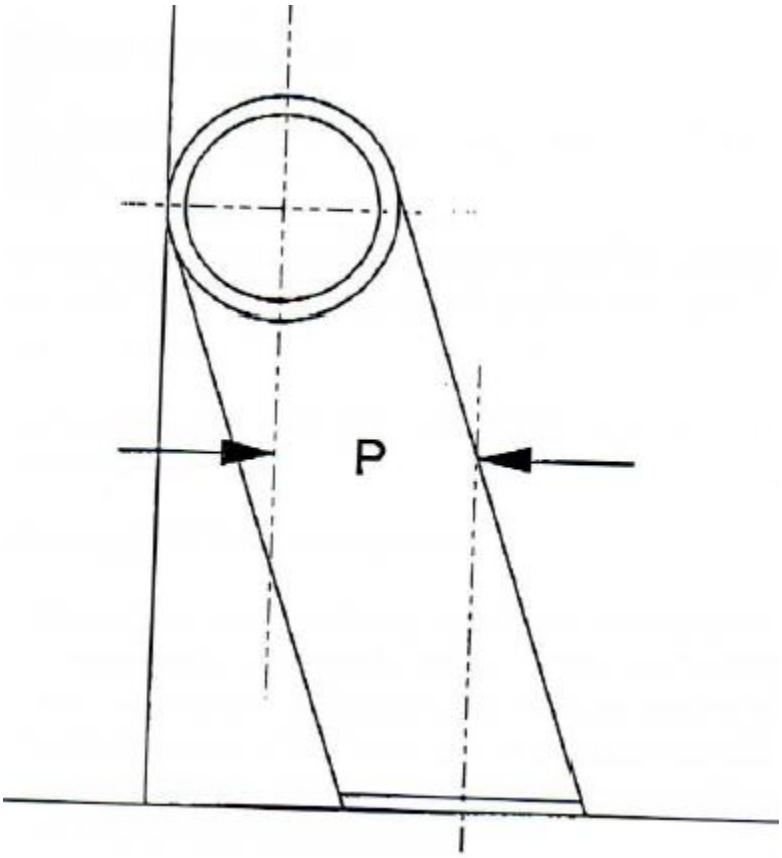

Figure 3.2 Out of Plane of Formed Bends

Out of plane (p) shall not exceed 4.76 mm

7. PIPE ENDS

Bends shall be provided with bevel ends.

8. NON-DESTRUCTIVE TESTING

Non-destructive testing shall be performed on all bends in the final heat treated condition.

Procedures for all non-destructive testing shall be submitted to PEI and third party inspection for approval prior to commencement of testing and shall include techniques used and acceptance criteria.

SUPPLIER shall only use NDT personnel qualified to ASNT-SNT-TC-1A level 2 or agreed equivalent.

The following NDT shall be performed:

- The entire outer radius of the bend from neutral axis to neutral axis shall be ultrasonically inspected using a shear wave technique. A reference standard with longitudinal and transverse notches equivalent to 5 percent of the nominal wall thickness of the pipe and in accordance with the requirements of API 5L SR 4 shall be used. All discontinuities exceeding the reference standard shall be recorded and investigated.
- A 50 mm wide circumferential band at the final cut ends of the bend shall be ultrasonically tested for laminations in accordance with BS EN 10160.
- The entire outer surface of each bend shall be magnetic particle tested in accordance with ASME Section V Article 7 or approved equivalent. Acceptance limits for the ultrasonic and magnetic particle testing shall be in accordance with the specification for base pipe.

Minor surface imperfections may be removed by grinding and provided that the minimum wall thickness, as specified in the requisition, is maintained and not sharp notch results. The ground area shall be inspected by magnetic particle testing approved procedures to ensure removal! of defects and the wall thickness shall be checked by ultrasonic examination. Surface imperfections which cannot be removed within these limits shall be cause for rejection of the bend.

9. MARKING

Marking shall be done in accordance with ASME B16.49, and including the following:

- The original pipe number and bend suffix shall be hard stamped on both ends of each bend.
- Each bend shall be marked internally with the following information using paint stencils:
  - Pipe original individual identification number and bend suffix
  - Purchase order / item number
  - Material grade symbol
  - Nominal pipe size (NPS)
  - Nominal wall thickness

- Bend radius
- Bend angle

Any sections of unused straight pipe shall be marked with the original pipe number and suffix (if more than one).

10. CERTIFICATION

Materials shall be delivered by the Supplier with Certificates in accordance with EN 10204 3.1 to supplier's account including the information required by ASME B16.49/ ISO 15590-1.

11. RETENTION OF RECORDS

As API 5L.

12. HANDING AND STORAGE

The SUPPLIER shall submit to PEI for approval, procedures for handling, stacking during storage, and stacking and securing bends for shipment, no welding of temporary attachments for handling, stacking or securing shall be permitted.

All handling, loading and unloading shall be done in such a manner as to minimise damage using slings or padded hooks.

Rail cars, trucks, lighters, ships or other conveyances shall be cleaned of debris or any substance that might damage the bends prior to loading and suitable timber and other dunnage shall be used to protect the bends against damage in transit.

Loading onto or into rail cars, trucks. lighters, ships or other conveyances shall be performed in accordance with API RP 5L1 or API RP 5LW as appropriate, and in all cases in accordance with the approved handling procedures. No on-deck overseas shipment shall be permitted.

Finished bends to be stored for a significant period of time at the mill or marshalling yard shall be stored in a manner to prevent corrosion.

Bends shall not rest on projections which could result in point stresses or be allowed to rub on an adjacent object. Pipe stresses shall be limited to prevent loading which results in out-of-roundness.

13. BEND DATA SHEET

Item Description	Value					Remarks
Nominal Pipe Size	12”	10”	8”	6"	18"	
Base pipe supplied by	Supplier					
Base pipe certification	EN 10204 3.1					
Line pipe specification	API 5L					See section 2
Material Grade	L360 (X52) PSL1/PSL2 SEAMLESS					See section 2
Nominal Outer Diameter	323.9 mm	273.1 mm	219.1 mm	168.27 mm	457.2 mm	
Nominal Wall Thickness	0.375” 0.406" 0.438"	0.365” 0.438" 0.5"	0.344" 0.375" 0.438"	0.312" 0.344" 0.375"	0.438" 0.5"	
Minimum Wall Thickness Tolerance	-1mm					
Minimum Tangent Length	Acc to the applicable std above					
Tangent end preparation	Internally tapered to match adjacent line pipe					Note 1
Nominal Wall Thickness of adjacent line pipe	Acc to Nominal Wall Thickness of the induction bend					
Test Bends	1-off					See section 4
Inside diameter of bend tangents	as per API 5L Table B					
Gauging	Gauge diameter plate shall be not less than 95% of minimum ID of pipe bends					

Item Description	Value	Remarks
Out of Plane tolerance for bends	as shown In Figure 3.2	
Out of roundness	as specified in Section 6	
Bend angle	as specified in Section 6	
Minimum design temperature	0°C	
Hardness	as per API 5L for PSL 1 / PSL2 pipe	
Mechanical Properties	as per API 5L for PSL 1/ PSL2 pipe	
Charpy Impact Test	as per API 5L for PSL 1/PSL2 pipe	
Chemical Composition	as per API 5L for PSL 1/PSL2 pipe	

Notes:

1. Where internal machining is required, the angle of the internal taper, measured from the longitudinal axis, shall be no larger than 14 degrees.