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<b>OIL AND NATURAL GAS CORPORATION LTD.</b>  <b>INDIA</b>						
<b>K.P.V</b>			<b>REPRODUCED FROM REV.0 &amp; ISSUED FOR BID</b>	<b>13</b>	<b>12.1.05</b>	<b>0</b>
<b>B.P.M</b>			<b>REPRODUCED FROM REV.0 &amp; ISSUED FOR BID</b>	<b>13</b>	<b>10.05.04</b>	<b>0</b>
<b>A.K.M.</b>			<b>REPRODUCED FROM REV.0 &amp; ISSUED FOR BID</b>	<b>11</b>	<b>23.7.03</b>	<b>0</b>
<b>A.K.S.</b>		<b>V.K.K.</b>	<b>ISSUED FOR BID</b>	<b>14</b>	<b>17.12.90</b>	<b>0</b>
<b>PREPARED BY</b>	<b>REVIEWED BY</b>	<b>APPROVED BY</b>	<b>REMARKS</b>	<b>NO. OF PAGES</b>	<b>DATE</b>	<b>REV.</b>
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<p><b>1.0 SCOPE</b></p> <p>This specification covers the minimum requirements for manufacture and supply of long radius bends made from carbon steel line pipes for use in submarine pipeline systems handling sour/non-sour hydrocarbons in liquid or gaseous phase and injection water.</p> <p><b>2.0 REFERENCE DOCUMENTS</b></p> <p>Reference has been made in this specification to the latest edition of the following codes, standards and specifications:</p> <ul style="list-style-type: none"> <li>a. ANSI B 31.8 : Gas Transmission and Distribution Piping Systems</li> <li>b. ANSI B 31.4 : Liquid Petroleum Transportation Piping System.</li> <li>c. MSS-SP-75 : Specification for High Test Wrought Welding Fittings</li> <li>d. DNV 1981 : Rules for Submarine Pipeline Systems</li> <li>e. Company Specifications for Line Pipe <ul style="list-style-type: none"> <li>2020A : Specification for Carbon Steel Seamless line Pipe for submarine Pipelines.</li> <li>2020B : Specification for Carbon Steel Seamless Line Pipe (Sour Service) for Submarine Pipelines.</li> <li>2020C : Specification for Carbon Steel SAW Line Pipe for Submarine Pipelines.</li> <li>2020D : Specification for Carbon Steel SAW Line Pipe (Sour Service) for Submarine Pipelines.</li> </ul> </li> </ul> <p>In case of conflict between the requirements of this specification and the requirements of above referred documents, the requirements of this specification shall govern.</p>				
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3.0

MATERIALS

3.1

Bends shall be fabricated from steel line pipe manufactured in accordance with the latest revision of the Company Specifications referred in Section 2.0. The type of pipe to be used for fabrication of bends shall be as indicated in the Material/Purchase Requisition. Pipes with positive tolerance on wall thickness shall be selected for manufacturer of long radius bends.

3.2

Unless specified otherwise in the material/purchase requisition, The line pipes shall be procured by the Manufacturer.

3.3

All mechanical properties of the bends after finishing shall be same as the relevant pipe specification referred in clause 3.1. The test procedures shall be as per the relevant pipe specification as referred in clause 3.1. The following tests shall be conducted on finished bends:

3.3.1

Tensile Test

One tensile test shall be conducted on the base material of finished bend for each heat of steel used, to establish yield strength, ultimate tensile strength and elongation. The specimen shall be taken longitudinal or transverse to the pipe axis as specified in the relevant pipe specification.

In case of bends of Nom. Dia. 18 inch and larger, the specimen shall be taken one at inside radius and one at outside radius of the bend.

3.3.2


Fracture Toughness Test

Charpy-V-notch impact tests shall be conducted for each heat of steel used at the same temperature as specified in the relevant pipe specifications referred in Clause 2.0.

Three base material specimens shall be taken longitudinal or transverse to the pipe axis as specified in the relevant pipe specification. In case of bends of Nom. Dia. 18 inch and larger, the base material specimens shall be taken at the outside radius of the bend.

Additionally, in case of bends fabricated from SAW pipes, the transverses weld material specimen shall be taken with weld in the middle.

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3.3.3

**Guided Bend Test**

In case of bends fabricated from SAW pipes, one face and one root guided bend weld test shall be performed on samples cut from one bend per heat of steel.

3.3.4

**Hardness Test**

Hardness shall be measured "thru thickness", at following locations on the finished bends:

a.

Base metal, HAZ and weld metal.

b.

At spots where dents, bulges or wrinkles have been formed on the bends.

The acceptance values and procedure shall be as per the relevant line pipe specification referred in clause 2.0 of this specification.

4.0

**MANUFACTURE**

4.1

Bends shall be manufactured by hot bending the pipe using the following method(s):

4.1.1

For pipe nominal diameter 4" though 16", the bends may be manufactured either.

i.

By high frequency induction heating and forming,

OR

ii.

By packing the pipe with dry silica sand and hot bending.

4.1.2


For pipe nominal diameters 18" and larger, the bends shall be manufactured by high frequency induction heating and forming only.


4.1.3

**Pre-qualification**


The bending procedure shall be proposed by specifying the induction frequency, time, temperature, bending, method and equipment etc. for approval. The approved bending procedure shall be qualified in presence of

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<p>clients or third party inspector. The bending procedure qualification shall include the following tests as specified for the base pipe.</p> <ol style="list-style-type: none"><li>1. Mechanical Testing</li><li>2. Hardness Testing</li><li>3. Charpy V Notch Impacting Testing</li><li>4. CTOD Testing</li><li>5. HIC Testing NACE TM-02-84</li><li>6. SSCC Test.</li></ol> <p>Separate bending qualifications procedure shall be proposed and qualified for different bending process. The bending execution shall be in accordance with the qualified procedure and shall not be interrupted till the finish. The bends produced by such an interrupted bending shall be rejected.</p> <p>4.2 The temperature prior to and during forming shall be determined by an optical pyrometer. These data shall be recorded for inspection. Hot forming shall be performed above the upper critical temperature of the metal and shall be in the range of 815-995°C. Bends shall be supplied in as normalized condition.</p> <p>4.3 When bending SAW pipes, the weld shall be located at approx. 10<sup>0</sup> from the neutral zone, measured at outside of the bend as indicated in Figure 4.3.</p> <p>4.4 All bends shall be provided with a tangent length at the ends. In case the angle of the bend is less than or equal to 45 degree, the tangent length shall be 500 mm and for bend angle greater than 45 degree the tangent length shall be 1000 mm.</p> <p>4.5 Bend angle and bend radius shall be as indicated in the Material/Purchase Requisition.</p> <p>4.6 Unless otherwise specified differently in the Material/Purchase Requisition, the bevels at the ends shall be as per the relevant pipe specification.</p> <p>4.7 Bends shall not have any circumferential joint.</p>				
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4.8 No repair by welding is allowed on any part of the bends.				
4.9 Bulges and dents on the body of the bends (excluding a length of 100 mm from the ends) are permitted from the original contour of the pipe provided these deviations do not exceed 6.0 mm. The same shall not extend (in any direction) over a distance of more than 25% of nominal diameter of the bend.				
4.10 The excess weld material at the inside of the bend in case of bends made from SAW pipes, shall be removed over a distance of 100 mm at both ends.				
4.11 Tolerances				
The dimensions of bends shall be controlled to make sure that they are manufactured according to the tolerances indicated below, in addition to the requirements of MSS-SP-75. However the ends of finished pipe bend shall meet the dimensional tolerances of the relevant pipe specification referred in clause 3.1				
4.11.1 Bend Angle : ( ± ) 0.5 Degree from the specified angle.				
Bend Radius : ( ± ) 1% of bending nominal diameter.				
4.11.2 The Manufacturer shall check the wall thickness of the pipe before and after bending at four uniformly spaced points around the circumference repeated along the entire length of bend, at intervals, either at distances approximately equal to pipe diameter or 300 mm whichever is less. The measured wall thickness shall be at least equal to:				
t min = 0.95 ( t nom. - t )				
t nom= nominal wall thickness as specified in the material/purchase requisition.				
t = 0.35 mm for a wall thickness smaller than 10 mm				
t = 0.50 mm for a wall thickness 10 mm or more.				
4.11.3 Out of roundness tolerance on the body and ends of the bend shall be as follows:				

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<p style="text-align: center;"><b>Body</b></p> <p>Measurements of the outside diameter shall be taken in the plane of the bend at locations where wrinkles are present (OD max.) and at locations where wrinkles are not present (OD Min.) Out of roundness shall be considered acceptable, if the value of</p> $\frac{\text{OD max.} - \text{OD min.}}{\text{OD nom.}} \text{ does not exceed } 2\%.$ <p>The measurements shall be made over the circumference of the bend either at distances approximately equal to pipe diameter or 300 mm whichever is less.</p> <p style="text-align: center;"><b>Ends</b></p> <p>Out-of-roundness over a length of 100 mm from the end shall comply the requirements of relevant company specification referred in clause 3.1.</p> <p><b>5.0 INSPECTION AND TESTS</b></p> <p><b>5.1</b> The Manufacturer shall perform all inspection and tests as per the requirements of this specification and MSS-SP-75 prior to shipment, at his works. Such inspection and tests shall be, but not limited to the following:</p> <ol style="list-style-type: none"> <li>a. Verify that the unfinished product arriving at Manufacturer's shop is in full compliance with the pipe specification as referred in clause 3.1 of this specification.</li> <li>b. Visual Inspection.</li> <li>c. Dimensional and tolerances check as per MSS-SP-75 and requirements of Section 4.0 of this specification.</li> <li>d. Check heat treatment, if carried out, as required and maintain its records.</li> <li>e. Temperature against time recorder charts for each induction heating.</li> </ol>				
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f. Material properties shall be checked to meet the requirements of Section 3.0 of this specification.

g. The non-destructive inspection on the finished bend shall be carried out as given below:

- All seam weld of bends fabricated from longitudinal SAW line pipe shall be fully radiographed and acceptance limits shall be as per pipe specification as referred in clause 3.1 of this specification.
- The full circumference of both ends of each bend after bevelling shall be ultrasonically tested for laminations over a length of 25 mm and acceptance limits shall be as per pipe specification as referred in clause 3.1 of this specification.

h. Bend shall be subjected to hydrostatic test at a pressure equal to the test pressure indicated in the relevant line pipe specification mentioned in clause 3.1.

i. Gauging pig shall be passed through each bend to demonstrate the compliance to the out of roundness requirements mentioned in Section 4.0 of this specification. Diameter of the gauging pig (Dg) shall be calculated using the following formulae:

$D_g = D - 2t - S$

**Where**

$S = 0.01D + 0.4t + 5I$


D = Nominal outside diameter of pipe


t = Nominal wall thickness of pipe


I = 20% of t, max. 5 mm

5.2 Company's Inspector reserve the right to perform stage wise inspection and witness tests on all bends as indicated in clause 5.1 at Manufacturer's works, prior to shipment.

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<p>Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection, to the Company's Inspector. Inspection and tests performed or witnessed by Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests. Under no circumstances any action of the Purchaser's Inspector shall relieve the Manufacturer of his responsibility for the material and quality of the bends.</p>				
6.0	<b>TEST CERTIFICATE</b>			
<p>The Manufacturer shall submit the following Certificates:</p>				
<p>a. Certificates of chemical analysis, mechanical tests, corrosion tests, NDT, dimensional inspection and hydro test carried out on pipe used for fabrication of bends.</p>				
<p>b. Certificates of mechanical tests including hardness tests carried out on finished bends.</p>				
<p>c. Certificates of required non-destructive test inspection for bends.</p>				
<p>d. Certificates of heat treatments, if any for bends.</p>				
<p>e. Certified reports of hydrostatic test for bends.</p>				
<p>f. Certified reports of dimensional tolerance for bends.</p>				
<p>g. Certificates of all other tests as required in this specification.</p>				
<p>The certificates shall be valid only when signed by Company's Inspector. Only those bends which have been certified by Company's Inspector shall be dispatched from Manufacturer's work.</p>				
7.0	<b>MARKING, PACKING AND SHIPMENT</b>			
7.1	All bends shall be marked as per MSS-SP-75.			
7.2	All loose and foreign material i.e. rust, grease, etc. shall be removed from inside and outside of the bends.			
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7.3	A coat of antirust paint shall be applied on the bends for protection during transit and storage. Type of paint shall be as agreed upon with the Purchaser.			
7.4	Both ends of all bends shall be suitably protected to avoid any damage during transit by means of metallic or high impact plastic bevel protectors.			
7.5	Package shall be marked legibly with indelible marking ink to indicate the following:  a. Order Number b. Package Number c. Manufacturer's Name d. Size (Inches) and wall thickness (mm) e. Radius of bend (mm) and bend angle			
8.0	DOCUMENTATION			
8.1	All documents shall be in English language.			
8.2	At the time of bidding, bidder shall submit the following documents:  a. Reference list of previous supplies of bends of similar specifications and similar service.  b. Clause-wise lists of deviation from this specification, if any.  c. Brief description of manufacturing and quality control facilities of the Manufacturer's works.			
8.3	Within three weeks of placement of order the Manufacturer shall submit six copies of the manufacturing and quality control procedures for pipe and bends.  Once the approval has been given by Company any change in material and method of manufacture and quality control shall be notified to Company whose approval in writing of all such changes shall be obtained before the bends are manufactured.			
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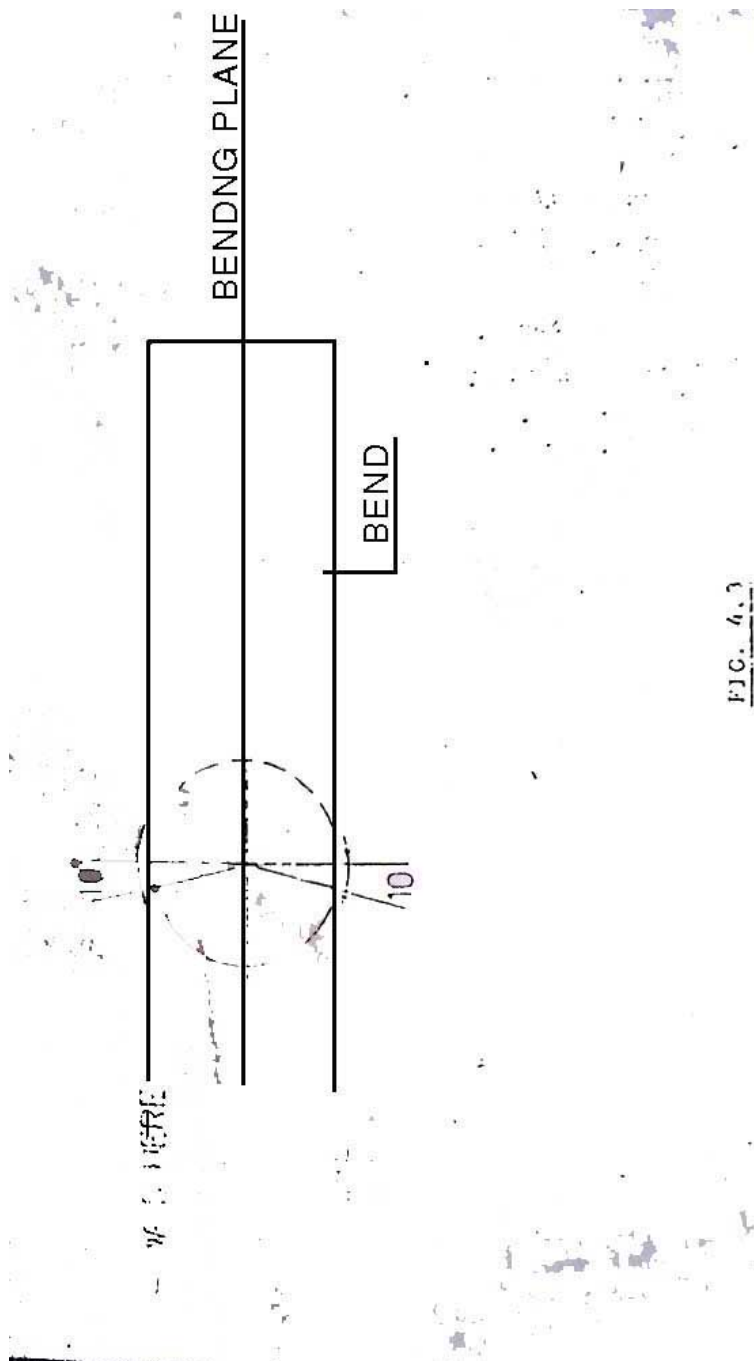
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<div>8.4      Within four weeks from the approval date Manufacturer shall submit six copies of the documents as stated in clause 8.3 above.</div> <div>8.5      Prior to shipment, the Manufacturer shall submit six copies of test certificates as listed in clause 6.0 of this specification.</div>				
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