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TECHNICAL SPECIFICATION

Doc No: DSF-SPC-PIP-011

Rev. 1

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HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

BENDS

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REVISION HISTORICAL SHEET

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1. SCOPE AND OBJECTIVES

This specification covers the use of bends in natural gas lines and M/R Stations. All type of bends used in NG projects are covered by this document including factory made hot bends, field bends and elastic bends. Depending on the type of bend, the requirements of the following, listed in order of precedence, shall be fulfilled:

- This specification.
- DESFA Standard Drawing No. STD-00-11-06.
- ELOT EN 14870-1
- ELOT EN 1594.

2. REFERENCES

2.1. Reference Documents

- Job Spec. No. DSF-SPC-PIP-031
[Hot Bends]
- Std Drawings STD-00-11 -06
[Field Bends for Pipeline Sections]

2.2. Reference Codes and Standards

- ELOT EN 1594
[Gas supply systems - Pipelines for maximum operating pressure over 16 bar-
Functional requirements]
- ELOT EN 14870-1
[Petroleum and natural gas industries. Induction bends, fittings and flanges for
pipeline transportation systems. Induction bends]

3. GENERAL

The pipeline shall be laid in such a way that it follows the outline of the terrain as closely as possible except where otherwise indicated on the longitudinal section.



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The application of bends should be limited to sudden changes of direction or gradient. Adjustment to the outline of the terrain shall, where possible, be made by suitable excavation of the trench, so that the pipe can follow the trench by elastic deformation only. If the Contractor so wishes and it can be agreed with the Owner Representative, field bends may be applied. The Contractor shall only use factory-made bends where stated on the longitudinal sections. Where technological reasons prevent him from using bends exactly as specified, he is responsible for implementing the changes in accordance with the technical requirements and requirements outlined in this specification.

4. ELASTIC BENDS

Changes of direction or gradient with elastic deformations - elastic bends - shall be made in circular arcs with minimum radius as defined on the longitudinal sections.

5. FIELD BENDS

Changes of direction or gradient, which cannot be made with elastic bends, shall be made with field bends, produced by the Contractor in accordance with the standard drawings and the longitudinal sections.

When making tie-ins, the Contractor shall position bends so that the cutting of pipe is avoided as much as possible.

Field bends shall be made in the field by bending straight pipe with a suitable bending machine. Over the whole bent section, these bends shall have a constant radius as prescribed in the applicable standard drawing STD-00-11 -06.

For the control of bending radius, the Contractor shall, for each diameter used, provide a 2.5 m long gauge constructed with the prescribed radius. Suitable and well- supporting matrices shall be used when precoated pipes are bent. After completion of the field bending all areas of the bend shall be within the minimum allowable wall thickness of the abutting pipe.

If the surface temperature of the coating on the sunlight site is exceeding 50°C, special precautions shall be taken by the Contractor without extra cost for the Owner.

The bending itself may only take place when the surface temperature of the coating is 50°C or less.



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Measures to be taken during periods of time where the temperature specified above cannot be ensured by usual procedures, may be:

- Shielding against direct sunshine.
- Water cooling.
- Bending operations only to take place in the morning.

Specific measures to be applied shall receive the approval of the Owner representative.

Maximum allowable tolerance of the final field bend angle (after bending) shall not exceed $\pm 0,5^\circ$.

Step angle measurement shall be done by means of an instrument with measuring capability of 0,25 degree or better.

Contractor shall provide and use instruments for step bend angle measurement of 1% accuracy for the full measuring range or otherwise specified for calibration.

The bending machine shall be operated by a skilled person with experience in the production of field bends.

No wrinkles shall occur in the pipe material, and the difference between the maximum and minimum diameters shall at no place exceed 3% of the nominal diameter D.

Bending in steps shall be made in accordance with the applicable standard drawing STD-00-11-06. Pipes may not be bent closer to the ends than shown on the standard drawing and no cuts may be made closer than 2 m (1.5 m for pipes $DN \leq 300$ from the bent section).

When bending spiral-welded pipes, only pipes not containing skelp ends may be used. When bending longitudinally welded pipes, the weld seam shall be placed in the tensile side 30° - 45° from the neutral axis. However, in the case of crossings having a length that allows the use of only two pipes, each containing both an over bend and a sag bend, the longitudinal weld seam shall lie along the neutral axis.

Irrespective of longitudinally or spiral welded pipes being used at these crossings, the over bend and the sag bend should be separated by at least 1.0 m of straight pipe in order to ensure the required roundness of the pipe.

The cross-section of all field bends shall be controlled by pulling through of a gauging pig. The pig shall consist of two gauging plates, each with a diameter of 97% of the theoretical minimum internal pipe diameter (= nominal external diameter minus tolerance for under-diameter, minus



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2 x wall thickness), separated by a distance of one pipe diameter. The gauging plates shall be of a material, which ensures that they will not be damaged deformed or worn during the construction period. The Contractor shall check the geometry of the bend in the presence of the Owner Representative if the latter so requires.

The Contractor shall maintain a record of all bends constructed, including pipe number, pipe length, angle of bend and location in the pipeline.

Pipes that are rendered unusable through incorrect bending will be charged to the Contractor's account. Pipe coating, which is damaged during bending, shall be repaired by the Contractor at his own expense.

All bends constructed shall be legibly paint-marked with angle and scope (over bend or sag bend, etc.).

6. FACTORY-MADE BENDS

Changes of direction or gradient, which cannot be made either with elastic bend or field bends shall be made with factory-made bends supplied by the Owner.

For pipes which shall allow the passage of scraper pigs, the bending radius shall be $R=5xD$.

For other pipes, bends with $R = 1.5xD$, $3xD$ or $5xD$ may be used, after Owner approval.

If bends supplied in accordance with Job Spec. No. DSF-SPC-PIP-031 is cut in the field, the portion not immediately required shall be marked with its new angle.

Small remaining portions of these bends are not returnable to the Owner, if the Owner representative can show that they could have been avoided.