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TECHNICAL SPECIFICATION

HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

WELDING

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1. SCOPE AND OBJECTIVES

This specification covers welding of steel in earth covered natural gas Pipelines with appurtenant above-ground piping, as well as welding of piping within Metering and regulating stations.

For the welds, the requirements of the following reference documents, listed in order of precedence, shall be fulfilled

2. REFERENCES

2.1 Reference Documents

- Job Spec. DSF-SPC-PIP-002
  [Steel Pipe]
- Job Spec. No. DSF-SPC-PIP-004 [Welding Inspection]
- Job Spec. No. DSF-SPC-CIV-004
  [Measuring-up and as built documentation]

2.2 Reference Codes and Standards

- EN ISO 3138
  [Petroleum and natural gas industries — Steel pipe for pipeline transportation systems]
- EN 1594
  [Gas supply systems - Pipelines for maximum operating pressure over 16 bar - Functional requirements]
- EN 12732
  [Gas supply systems – Welding steel pipework - Functional requirements]
  EN ISO 9712 [Non-destructive testing – Qualification and certification of NDT personnel – General principles]EN ISO 9606-1 [Qualification testing of welders. Fusion welding. Steels]

3. QUALIFICATIONS, PERSONNEL, EQUIPMENT AND MATERIALS

For specific projects Contractor shall be required to exhibit its ability to perform complex welding operations through an EN ISO 3834-2 certification.

The Contractor shall provide all necessary personnel, equipment and materials. The equipment shall include:

- Welding machines and generators suitable for pipeline welding.
- Preheating equipment which ensures uniform preheating around the whole circumference of welding ends.
- Internal and external line-up clamps.
- Protective canopies (or umbrellas and wind shield collars) so that welding can be carried out even in relatively bad weather.
- Weather proof, insulating mats for the thermal insulation of girth welds (at least 1.5 x D wide).

The Contractor has to supervise the site, the welders, and their work during the entire working period. For this purpose he shall use a team consisting of one welding Engineer and sufficient number of welding foremen who will ascertain that the qualified procedures are properly applied and will aid in the immediate solution of problems or difficulties.

Welding electrodes shall be stored treated and handled by the Contractor according to the Manufacturer's instructions.

Only sufficient welding electrodes and other consumablesl for a normal workday will be issued. At the end of the work day all materials not used will be returned to the store where the relative humidity is less than 50%.

Damaged or unidentified filler metals shall not be used and shall be discarded.

3.1 WELDING PROCEDURES AND WELDERS

3.2 WELDING PROCEDURE SPECIFICATIONS

3.2.1 GENERAL

The Contractor shall submit detailed welding procedure specifications complying with EN 12732. All dimensions, all combinations of materials to be joined and all repair welding shall be covered by the procedure specifications.

The procedure specifications are subject to approval by the Owner's representative.

3.2.2 LINING – UP

Line-up clamps shall be used for all girth welds. Internal clamps shall be used wherever possible and may not damage the internal coating.

Joints, which cannot be line-up with either internal or external line-up clamps, may be tack welded. These tack-welds shall be ground out before the root bead is completed.

3.2.3 PRE-AND POST HEATING

Depending on the material grade and other parameters the Contractor shall implement a suitable preheating temperature which will also be verified during the welding process qualification. DESFA expects the applied preheat temperature to be in accordance with the guidelines described in EN -1011-2.

This preheating temperature shall be checked by thermocouples or any other suitable method.

Interpass and preheat temperatures shall be maintained during all welding operations.

Repair welding performed on project materials shall be preheated in the same way as initial welds.

Post - heating (stress - relieving) is only applicable where it is indicated in the project material or required by use of certain materials types.

3.2.4 MANUAL ARC WELDING

When using external line-up clamp, the root bead shall be laid uphill. The clamp may be removed only after 50% of the root bead has been laid. In case that 50% cannot be accomplished, Construction Supervision should be informed for further action.

Internal line-up clamps shall not be released until the root bead is completed.

For pipe of diameter DN > 300, downhill welding shall be performed by at least 2 welders, working concurrently on each side of the circumference.

Downhill welding shall not be performed for welding of fittings, valves as well as for welding of structural elements to pipeline components (see also, paragraph 5.3).

For pipe of diameter DN > 750 welding tack welds of length less than 80-100 mm shall not be allowed. Tack welds shall be equally distributed on the circumference. The tack welds should be completely removed by grinding before the completion of the root bead.

The root bead shall be ground after its completion, before starting the hot pass. Hot pass shall be performed immediately after the root bead.

The weld cap bead and visual inspection criteria shall cover the requirements of EN 12732.

Where possible, the welding repairs of the root pass shall be made uphill, from the inside.

For casing pipes all weld grooves shall be completely filled using at least three passes.

With casing pipes made from steel Grade L360 or higher the welding works shall fulfill the requirements for the welding of gas lines as specified herein.

3.2.5 AUTOMATIC WELDING

If automatic welding is used, the Contractor shall demonstrate that all characteristics of the weld will cover the mechanical requirements of the pipes.

3.2.6 QUALIFICATION OF WELDING PROCEDURES

All welding works shall be covered by procedures qualified in accordance with EN 12732.

All welding qualifications shall be performed under site conditions at full pipe lengths and with similar welding equipment as the one that will be used during construction works.

Non Destructive and destructive testing shall be performed on welded test joints as required by EN 12732. Charpy –V impact tests shall also be performed for qualification purposes. Acceptance criteria for impact tests shall be in accordance with the piping material at the minimum pipeline design temperature.

All the results from the procedure qualification records shall be submitted to the Owner representative for approval of welding procedures.

At their sole discretion the Owner representative may approve the use of already established, qualified and documented procedures not more than 2 years old.

For welding of casing pipes made of steel L290 or less qualification of the welding procedures is not required.

3.3 QUALIFICATION OF WELDERS

Prior to performance of any production welding all welders shall qualify for the relevant welding procedures according to EN 12732, & EN ISO 9606-1.

The qualification tests are acceptable if they meet the requirements for visual examination and for radiographic examination. The criteria for acceptance or rejection of each of these requirements are as specified in EN 12732. The testing shall be carried out by an approved laboratory at the Contractor's expense. Welder performance test certificates shall be issued and kept on site during the whole working period.

Welder qualification tests may be performed together with welding procedure qualification tests.

These certificates are only valid for 6 months after last welding.

Each welder has to wear always in a well visible position his certified label with his photo, name and individual symbol.

The Owner Representative can request requalification of a welder when has reason to question his ability to make welds according to the specifications.

4. WELDING PREPARATION

4.1 GENERAL

Items material grade, wall thickness, and pressure ratings shall conform to the requirements laid down in the applicable drawings and specifications.

All requirements for welding preparation contained in the qualified welding procedure specification shall be strictly followed.

4.2 INSPECTION OF MATERIALS

Each pipe or component shall be visually inspected to ensure that it has not sustained any visually determinable damage. Disposition of damaged items shall be resolved in consultation with the Owner representative.

4.3 CLEANING

The Contractor is responsible for ensuring that all pipes are completely cleaned internally. With pipes of smaller diameter (where manual cleaning is impossible) pipes shall be cleaned by brush attached behind the internal line-up clamp.

All weld ends shall be cleaned mechanically with a wire brush. The cleaned area shall extent at least 25 mm from the end. Burs, serrations, notches mill scale, rust and dirt shall be removed, if necessary by grinding.

4.4 JOINT DESIGN AND FIELD CUTTING

Where items with different wall thickness are to be joined by welding, the ends shall be prepared by grinding according to FIGURE 1 in this specification, FIGURE 2 and FIGURE 3. The Joint design shall be in compliance with the one specified in the approved welding procedure.

Field cutting is only acceptable with pipes, bends and elbows and shall be made by machine oxygen cutting, which at the same time bevels the ends. If manual oxygen cutting is applied, the specified bevel on the cut end shall be performed by beveling machine. If helical welded pipes are cut, it must be observed that any skelp-end weld is no closer to a butt weld than 3 x nominal diameter.

The coating, if any, shall be cut 150 mm back from the new end. Afterwards, the land, the external, and the internal surface shall be ground in order to remove arc burns and burnt material.

Prior to field cutting, the Contractor shall check that all usable segments will bear complete markings. If this is not fulfilled, the Contractor shall place a new set of marks on the applicable sections before cutting.

This shall be done in the presence of a person authorized to transfer markings. Items with either no unauthorized marking are not fit for use and will be considered damaged by the Contractor.

All items (pipes, fittings, rust of pipes etc) where full traceability is not possible shall be rejected. Any such case shall be brought to the attention of Owner.

All weld ends produced by field cutting shall be examined visually by the Contractor's foreman or engineer for presence of laminations. Any evidence of laminations or lamination-like defects shall be reported to the client representative. Further to this, ultrasonic inspection for laminations shall be carried out on weld ends selected on a spot-check basis by the Owner representative.

Laminations with dimension in circumferential direction exceeding 6 mm shall be cut off as specified above.

4.5 ALIGNMENT AND OFF-SET

The seam of longitudinal welded pipes shall, as far as possible, be placed in the upper third of the pipe circumference. Where buildings are situated within 20 m from the pipeline any longitudinal seam shall be turned away from the buildings.

Longitudinal and helical seams shall at girth welds be offset at least 100 mm from each other (exceptions may be made for factory bends, tees, or field bends consisting of 2 or more bends).

For electric-resistance welded pipes, these requirements only apply if the seams can be seen.

When lining up the internal offset of the pipe ends may never exceed 1.6 mm (high/low) for pipes with the same wall thickness. For items with different wall thickness, the internal offset may never exceed 2.4 mm.

Where offset is caused by the pipe's ovality, the pipe may be turned to reduce theoffset.

4.6 PREHEATING

The welding ends with no welding procedure requirements for preheating shall be heated sufficiently to remove any humidity before laying the root bead.

Where preheating is required the preheated zone shall extent approx. 60 mm to each side of the seam. Only equipment giving an evenly distributed heat around the whole circumference may be used.

Acetylene burners shall not be used. The temperature shall be checked with heat sensitive crayons or another suitable method.

5. WELDING

5.1 GENERAL

All welding shall be performed by qualified welders and strictly in accordance with qualified welding procedures.

Welding shall be suspended by the Contractor when prevailing weather conditions will impair the quality of the works, e.g. airborne moisture, blowing sand or high winds, and during thunderstorms.

Stray arcing outside the weld groove is not permitted.

Should stray arcing outside this area occur, this shall be brought to the attention of the Owner representative who may require any so damaged section to be repaired or cut out at the Contractor's expense.

The pipe shall not be moved until the root seam is completely finished.

Each pass shall be completed around the whole circumference before the next pass is started.

On completion of the cap bead, the weld and the pipe surface shall be cleaned of weld spatter and other deposits and shall then be wrapped with a weatherproof insulating mat to ensure a slow cooling of the weld zone and to give protection against rain and wind.

5.2 WELDING OF FITTINGS, VALVES etc.

The fittings shall be welded stress-free. Joints shall as far as possible be made from girth welds.

Any limits to the temperature indicated in Contractor instructions or on butt-welding ends shall be adhered to in order to avoid deterioration of heat-sensitive elements (sealings, etc).

Back welding is permitted with internal offsets not exceeding 2.4 mm provided that the approval of the Owner representative has been obtained in each case. If the offset exceeds 2.4 mm extraneous material shall be removed (see FIGURE 1).

If smaller diameter girth welds are not accessible from the inside, a short section (not less than one pipe diameter) may be cut from the pipe to be connected and used as a crossover, allowing backwelding of the root bead between crossover and fitting (see FIGURE 2).

5.3 WELDING OF STRUCTURAL ELEMENTS TO PIPELINE COMPONENTS

Only welds specified on the drawings are permitted.

Structural elements shall be welded in accordance with approved procedures.

5.4 WELDING OF CASING PIPE

Any protrusion of the root bead into the pipe more than 2 mm shall be ground away.

The Contractor shall visually check that the axes of adjacent casing pipes lie along a straight line.

6. STANDARD OF ACCEPTABILITY

6.1 TEST METHODS, EXTENT AND PERFORMANCE OF TESTING

Reference is made to Job Spec. No. DSF-SPC-PIP-004

6.2 REQUIREMENTS OF WELD SEAMS

Radiography, Magnetic Particle and Dye Penetran Testing.

For pipelines and equipment designed in accordance with EN 1594, results shall be evaluated according to ELOT EN 12732 table G.4 Tier 1 and to the following rules with the provision that these rules shall prevail.

- Sharp, incomplete root penetration is unacceptable, unless otherwise specified.
- Incomplete root penetration : Acceptable if:
- The length does not exceed 10 mm.
- The depth does not exceed 25% of the wall thickness with a max of 2 mm.
- In any continuous 300 mm weld length the total length does not exceed 25 mm.
- Between individual defects there is at last 100 mm clear weld :

• Slag lines: See EN 12732 Table G.4 Tier 1.

- Isolated slag inclusions: See EN 12732 Table G.4 Tier 1.
- Gas cavities: See EN 12732 Table G.4 Tier 1.
- Cracks: Unacceptable.
- Undercut: Acceptable if:

- The depth is less than 0,5 mm and the length is less than 50 mm.
- The undercut has no sharp bottom :
    - Lack of fusion : Acceptable if:
- It does not accrue in the root.
- Has a max length of 10 mm and a width of 3 mm.
- Along every 300 mm of weld length the sum of lacks of fusion does not exceed 25 mm.
- It runs parallel to the plate surface.

For piping designed in accordance with EN 13480 results shall be evaluated according to ELOT EN 12732 table G.1.

6.2.1 ULTRASONIC

The result from radiography shall have precedence over ultrasonic, except in cases where linear indications evaluated as cracks exist.

Linear indications are unacceptable if the echo height exceeds the reference level minus 6 decibel, and the length exceeds 10 mm. The reference level corresponds to an indication from a 3 mm side- drilled hole.

6.2.2 NON DESTRUCTIVE EVALUATION BY AUTOMATIC ULTRASONIC TESTING (AUT)

Automatic Ultrasonic examination of welds may be applied as alternative to the radiographic technique under the terms that will be agreed in the contract. The Automatic Ultrasonic Testing (AUT) shall cover the requirements set in DESFA specification DSF-SPC-PIP-004.

7. REPAIRS

Repair or removal of defects shall be carried out in accordance with EN 12732 and the following instructions.

Repair in a previously repaired area will not be permitted.

Defects found in the seam which are unacceptable as per the requirements specified above, shall be removed by grinding before repair welding.

If a welder is aware of a minor defect during the laying of one of the beads, he must remove the defect by grinding before the next bead is commenced, fill up the groove by welding uphill and continue normal welding.

Disposition of weld seams with cracks (including crater cracks) shall be as follows:

Length of Crack, L	**Weld Bead**	**Disposition**
L ≤4 mm	All	Repair
4 mm < L ≤ 50 mm	Root, Hot Pass	Cut out
	Filler, Cap	Repair
L > 50 mm	All	Cut out

Repairs may only be performed after this disposition has been approved by the Owner representative in each case.

The repair of all weld seams with cracks (except crater cracks) is subject to approval by the client representative.

The repair groove shall be examined by magnetic particle examination if possible, alternatively of the crack.

If cracks occur repeatedly, the reason for this shall be investigated and disclosed as described in Owner Specification, Job Spec. No. DSF-SPC-PIP-004.

8. STRESS RELIEVING

Stress relieving of weld seam shall only be carried out where this is indicated in the project material and according to the directions given therein.

9. MARKING OF WELD SEAMS

Every girth weld shall be numbered by the Contractor according to a system, which will be specified by the Owner representative. This number shall be painted on the pipe coating on one side of the joint between 0.5 m and 1.0 m from the seam, together with pipe number and pipe length, to facilitate completion of the pipe book.

10. PIPE LOG

For each pipeline and each pressure test section, the Contractor shall fill out the relevant forms and enter these in a pipe log.

As the work progresses, the Contractor shall present the pipe log forms to the Owner representative. Before the start of a pressure test, the completed pipe log for the section in question shall be handed over to the Owner representative (see Job Spec. No. 499/3).

11. CLEANING AFTER WELDING

The surface shall be clean. All loose rust and mill scale shall be removed by brushing immediately before welding inspection.

12. CLOSING OF PIPE ENDS

During welding on a pipeline segment all open pipe ends of that segment shall be kept closed with a plug or cap.

At interruptions in the pipeline construction, the Contractor shall close the ends of the pipe strings. The closure shall be tight enough to prevent any entry of foreign body.

Plugs or caps may not be fixed by welding or by any other method, which damages the pipe. They shall be securely attached to the pipe and shall remain in place until the string is laid.

FIGURE 1

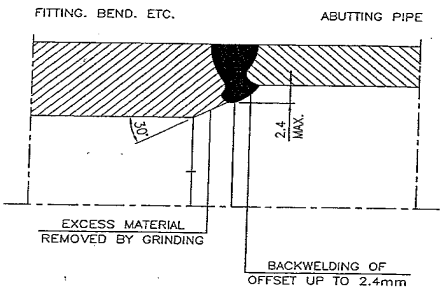

FITTING. BEND. ETC.
ABUTTING PIPE
30°
2.4 MAX.
EXCESS MATERIAL REMOVED BY GRINDING
BACKWELDING OF OFFSET UP TO 2.4mm

FIGURE 2

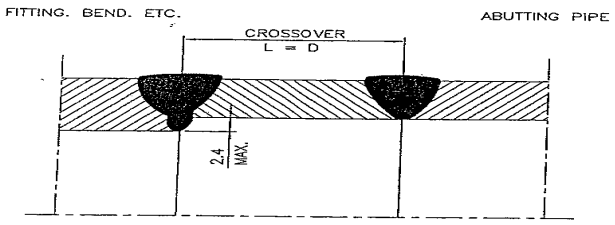
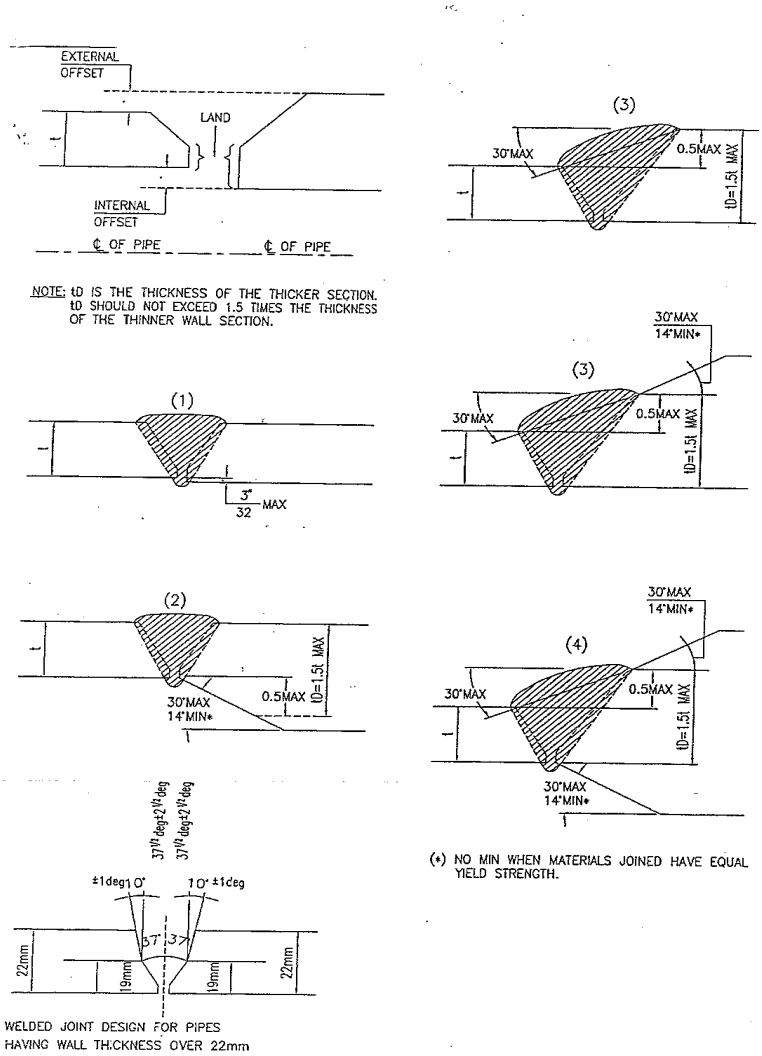


FIGURE 3


EXTERNAL OFFSET
LAND
INTERNAL OFFSET
℄ OF PIPE
℄ OF PIPE
NOTE: tD IS THE THICKNESS OF THE THICKER SECTION. tD SHOULD NOT EXCEED 1.5 TIMES THE THICKNESS OF THE THINNER WALL SECTION.
(1)
3" MAX 32
(2)
30°MAX 14°MIN*
0.5MAX
tD=1.5t MAX
(3)
30°MAX
0.5MAX
(4)
(*) NO MIN WHEN MATERIALS JOINED HAVE EQUAL YIELD STRENGTH.
37½ deg±2½deg
±1deg
10°±1deg
22mm
19mm
WELDED JOINT DESIGN FOR PIPES HAVING WALL THICKNESS OVER 22mm