TECHNICAL SPECIFICATION

WELDING ON PRESSURISED PIPES
(AMENDMENTS/SUPPLEMENTS TO ANSI/API RP 1107)

DEP 30.10.60.30-Gen.

December 1998

DESIGN AND ENGINEERING PRACTICE

PREFACE

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Shell International Oil Products B.V. (SIOP)
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The Hague, The Netherlands,

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The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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PART I INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for the welding of fittings, sleeves, branches or attachments onto pressurised carbon steel pipelines and on-plot piping using SMAW welding only. This DEP is not applicable to tanks or vessels, or to pipelines and piping transporting category A fluids operating below 10 bar (ga).

NOTE: Fluid categories are defined in DEP 31.40.00.10-Gen.

Part II of this DEP provides amendments and supplements to clauses of ANSI/API RP 1107. The Section numbering in Part II follows that of ANSI/API RP 1107. Where clauses of ANSI/API RP 1107 are not amended or supplemented by this DEP they shall apply as written.

Design verification and safety aspects of welding on pressurised pipes are addressed in DEP 31.38.60.10-Gen.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them (i.e. the distribution code is “F”, as described in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, gas plants, chemical plants, oil and gas production facilities, and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic, and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Batch	Equivalent term for lot of electrodes (used by AWS)
Buttering	Weld metal deposited on the surface(s) of the parent material(s) to give build-up
Company	Term used in ANSI/API RP 1107 which shall be taken to mean the Principal
Run pipe	The pressurised pipe to which a fitting, sleeve, branch, or attachment will be welded.

1.4 ABBREVIATIONS

AWS	American Welding Society
BGAS	British Gas Approval Scheme
CSWIP	Certification Scheme of Welding Inspection Personnel
HAZ	Heat Affected Zone
NDT	Non-Destructive Testing
OD	Outside Diameter
PQR	Procedure Qualification Record(s)
pWPS	Preliminary Welding Procedure Specification(s)
SMAW	Shielded Metal Arc Welding
SMYS	Specified Minimum Yield Strength
WPS	Welding Procedure Specification(s)

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (Part III).

1.6 INFORMATION TO BE SUPPLIED BY THE PRINCIPAL

The following information shall be supplied by the Principal to the Contractor at the enquiry stage of the order:

- Location of the welding operation.
- Fluid and process conditions in the pipeline or piping.
- Specification of pipe, fittings, and repair materials.
- Applicable safety regulations.
- Which of the Contractor's quality system procedures and records will be subject to agreement (Part II - 8.2.1 of this DEP).
- Whether the Contractor's selected welding electrodes are to be agreed.
- Whether contract-specific qualification of welding procedures and welders is required or whether pre-qualified procedures and welders may be used (Part II - 2.1 of this DEP).
- Whether qualification welding and/or production welding will be witnessed by the Principal.

- Whether thermocouple locations for qualification welding are to be agreed (Part II - 2.5 of this DEP).
- Whether the Contractor's welding inspection personnel may be certificated by specific alternative agencies (Part II - 5.6 of this DEP).
- The specific documentation to be submitted upon completion of the work (Part II - 8.3 of this DEP).

PART II AMENDMENTS/SUPPLEMENTS TO ANSI/API RP 1107

1. GENERAL

1.1 SCOPE

Delete this section and replace with the following:

This DEP applies to SMAW welding only.

1.2 DEFINITION OF TERMS

Delete sections 1.2.2.1 and 1.2.2.2.

1.3 EQUIPMENT

Delete from first sentence “gas or arc”.

Delete from second sentence “gas-welding equipment must be operated according to the flame characteristics and within the tip sizes given in the qualified welding procedure”.

Add the following:

Welding and cutting plant, instruments, cables, and accessories shall comply with the Principal’s safety regulations. The Contractor shall control welding equipment in accordance with ISO 3834-2 and shall control inspection and test equipment in accordance with ISO 10012-1.

1.4 MATERIALS

1.4.1 Pipe, fittings, and repair materials

Add the following:

Specifications advised by the Principal shall also be applicable.

1.4.2 Filler metal

1.4.2.1 Type and size

Delete this section and replace with the following:

Electrodes shall be of the basic coated low-hydrogen type: class EXX16 or EXX18 of ANSI/AWS A5.5, or an equivalent alternative class and specification. For sour service, the electrodes shall not deposit weld metal containing more than 1.0 wt % nickel (Ni).

The level of testing for all electrodes shall be Schedule K of ANSI/AWS A5.01 which shall be taken as Schedule J plus chemical analysis for the particular electrode sizes which are not required to be chemically analysed by ANSI/AWS A5.5. For alternative electrodes, the level of testing shall be at least the same.

The batch classification shall be C3 of ANSI/AWS A5.01.

Electrode inspection certificates for each batch shall be in accordance with ISO 10474 3.1.B.

For welds that contact the run pipe, the electrodes shall be suitable for downhill welding and this shall be clearly stated in the Manufacturer/Supplier’s datasheets. For other welds, electrodes may be of the type normally used for uphill welding. The electrodes shall have type approval by a certifying authority such as DnV or Lloyd's.

Each electrode shall have the AWS or other appropriate classification marked on the flux near the grip end. Electrodes which do not have this marking shall be removed from the job site to the satisfaction of the Principal.

Buttering runs shall be deposited with 3.25 mm diameter electrodes.

1.4.2.2 Storage and handling of filler metal

Delete this section and replace with the following:

Electrodes shall be stored in accordance with the Manufacturer's instructions in their original containers which shall be marked with the Manufacturer's name, the consumable trade name, and the batch number. Electrodes in containers which are not identifiable and traceable shall be removed from the job site to the satisfaction of the Principal.

Electrodes shall be treated and handled in accordance with the Manufacturer's instructions to achieve the lowest practicable diffusible hydrogen content in the deposited weld metal.

Electrodes shall not be baked more than twice.

Electrodes that show signs of damage or deterioration, e.g. cracked or flaked coating, rusty or dirty core wire, shall be discarded to the satisfaction of the Principal.

1.4.3 Shielding gases

Delete this section including 1.4.3.1 and 1.4.3.2.

1.5 REFERENCED PUBLICATIONS

Add the following:

See also Part III of this DEP.

Add the following section:

1.6 QUALITY ASSURANCE SYSTEM

The Contractor should maintain and operate a quality assurance system in accordance with ISO 9001 or ISO 9002. The Contractor may maintain and operate a quality assurance system based on an alternative standard which may be considered by the Principal for agreement.

NOTE: Attention is drawn to the possible use of the complementary requirements of ISO 3834-2.

2. QUALIFICATION OF WELDING PROCEDURES

2.1 PROCEDURE QUALIFICATION

Add the following:

Separate pWPS shall be prepared for groove and fillet welds.

Welders proposed by the Contractor to perform procedure qualification testing shall be experienced and, for pipeline work, shall have demonstrated prior welding performance using the selected type of electrode and welding direction. The Contractor shall have maintained records of the proposed welders demonstrating satisfactory experience and performance.

The Principal shall advise the Contractor at the enquiry stage of the contract whether qualification welding, NDT and destructive testing is to be witnessed and whether suitable previously qualified welding procedure specifications of the Contractor may be used without re-testing.

2.2 RECORDS

Add the following:

Parameter records should be generated by an arc monitoring system with print-out capability. Materials certificates for the test assembly shall form part of the records.

The final production WPS and supporting PQR shall be agreed by the Principal prior to production welding.

2.3 PROCEDURE SPECIFICATION

b. Delete the first sentence and replace with the following:

   Pipe, fitting, and backing strip materials specification and grade.

c. Delete the third sentence, items 1-3, and the fourth sentence and replace with the following:

   1. Less than 60.3 mm
   2. 60.3 mm up to and including 168.3 mm
   3. Over 168.3 mm up to and including 323.9 mm
   4. Over 323.9 mm

   Thickness groups for pipes shall be as follows:

   1. 4.8 mm up to and including 12.5 mm
   2. Over 12.5 mm up to and including 25 mm
   3. Over 25 mm

   Thickness groups for fittings shall be as follows:

   1. Up to and including 12.5 mm
   2. Over 12.5 mm up to and including 25 mm
   3. Over 25 mm.

d. Add the following:

   Pipeline and piping operating limits shall be as defined in sections 3.3.3 and 3.3.4 of DEP 31.38.60.10-Gen.

e. Add the following:

   Dimensional tolerances and the pass sequence shall be shown.

f. Add the following:

Trade name of electrodes shall be shown. The number and sequence of runs shall be matched with those of the sketch in (e) above. The overall sequence of welding shall be shown on a sketch of the full assembly arrangement.

h. Delete the item.

m. Add the following:

Fillet welds onto the pipe shall be performed in the vertical position with downhill progression.

Preheat requirements shall be as stated in (4.8).

Add the following new items:

n. Preheat maintenance and maximum interpass temperatures shall be shown and shall be in accordance with (4.8).

o. The number of welders shall be shown. For pipe of 323.9 mm OD and larger, at least two welders shall be deployed for fillet welds.

p. The qualified arc energy range shall be shown for each pass.

q. Alignment method shall be shown.

r. Partial completion of a joint shall not be allowed.

2.4 ESSENTIAL VARIABLES

b. Add the following:

The SMYS of the material used in qualification welding shall set the upper limit of the strength groupings for items 1 and 2.

An increase in carbon equivalent greater than 0.03, or decrease greater than 0.06 of any of the materials compared to those employed for the qualification test.

Carbon Equivalent = C + (Mn/6) + ((Cr + Mo + V)/5)) + ((Ni + Cu)/15))

c. Delete item 1 and replace with the following:

Any change in joint dimensions and fit-up outside of qualified tolerances.

f. Add the following:

Any changes in the filler material, including Manufacturer.

Add the following new items:

k. Any change in electrical characteristics, polarity etc.

l. Any change to the qualified temperatures for preheating and a change from resistance or induction heating to propane torches.

m. Any change to the qualified interpass temperatures.

n. Any change in the number of welders.

o. Any change in the welding parameters which result in an arc energy variation greater than +/- 10% from that qualified.

p. Any changes resulting from the heating/strength nomograms or the process flow and velocity conditions in DEP 31.38.60.10-Gen.

2.5 WELDING OF TEST ASSEMBLY

Add the following:

The test assembly shall simulate the proposed welding within the allowable qualification ranges for diameter, thickness and carbon equivalent. For reduced branch fittings, the test assembly shall consist of a pipe nipple and a suitable reduced branch fitting with the groove in the H-L045 position as defined in ISO 9606-1.

NOTE: H-L045 is equivalent to the more common “6G” designation.

Thermocouples for monitoring inner pipe wall temperature shall be attached to the bore of the run pipe. Temperature recording shall be by continuous chart recorder. A periodic sampling recorder such as used for heat treatment shall not be acceptable. The temperature measurements shall be used in the heating/strength nomograms in DEP 31.38.60.10-Gen.

Welding of the test assembly shall be monitored by the Contractor and all welding parameters shall be recorded. An arc monitoring system should be used for this purpose. The Principal shall have access to the welding machines for use of its own arc monitoring equipment.

2.6 PROCEDURE QUALIFICATION TESTS

2.6.1 Preparation

Add the following:

The test assembly shall be subjected to visual examination during welding and shall be visually examined and non-destructively tested not sooner than 24 hours after completion of test welding. Visual examination and NDT shall be in accordance with (5). Acceptance criteria shall be as stated in (6). The inspection report form shall be signed by the person performing the inspection. If the inspection is performed by a contract inspection agency, the report form shall also be signed by the Contractor.

Test specimens shall be cut from the test assembly after satisfactory visual examination and non-destructive testing. Wall thickness in Table 2 of ANSI/API RP 1107 shall mean attachment wall thickness.

Macro specimens shall be separate from nick break specimens. The macro-section shall be taken such that each welder's portion of the weld is examined. At least one macro-section shall be taken at the intersection of the circumferential fillet weld and the longitudinal groove weld. All macro-sections shall be subjected to a hardness survey with rows of indentations as shown in (Figure A), and to depth of weld penetration measurements. Hardness indent spacing and location in the HAZ shall be in accordance with EN 1043-1. Groove welds shall also have a minimum of two macro-hardness surveys.

Sufficient specimens shall be taken to qualify both the welding procedure specification and each welder. Where several welders are employed, this shall necessitate testing of each welder's portion such that it is subjected to at least one macro-section, one side bend (or one face and one root bend), and one nick break.

For reduced branch fittings, four macro-hardness sections shall be taken. Hardness indent row locations shall be as shown in (Figure A).

2.6.6 Macro-section tests - fillet welds

Add the following:

This section shall also be applied to groove welds.

2.6.6.1 Preparation

Add the following:

See also section (2.6.1).

2.6.6.3 Acceptance Criteria

Add the following:

For material designated to meet the requirements of either 'sour service', NACE MR0175 or DEP 31.40.20.31-Gen., the maximum hardness shall be 248 HV10.

For material not designated to meet the requirements of either 'sour service', NACE MR0175 or DEP 31.40.20.31-Gen., the maximum hardness shall be 325 HV10.

These criteria shall also be applied to the three traverses required for fillet welds.

If only one hardness result exceeds the specified maximum then three further indentations shall be made in close proximity to the one which failed so that they do not mutually interfere. If all of the further tests are below the specified maximum then the test shall be accepted.

The macro-sections shall be examined at a magnification of x5 and the macro-photographs of the same magnification, showing the hardness indentations, shall be included in the PQR.

For groove welds, the visual examination of the macro-sections shall show no imperfections which would render the weld unacceptable under the requirements of this DEP.

3. WELDER QUALIFICATION

3.1 PURPOSE

Add the following:

See also (2.1). For qualifying welders other than those who successfully weld a procedure qualification test assembly, a welder qualification test assembly shall be welded.

Test welding shall be monitored by the Contractor. Each welder shall be assigned an identifying number, letter, or symbol by the Contractor so that each portion of the test assembly welds can be assigned to a particular welder.

3.2 WELDING OF TEST ASSEMBLY

Add the following:

For the welding of reinforced set-on branches and pre-formed split tees, the test assembly shall be that shown in Figure 11 of ANSI/API RP 1107. For reduced branch fittings, a complete fitting/pipe nipple assembly shall be welded with the groove in the H-L045. position.

3.3 ESSENTIAL VARIABLES FOR WELDER QUALIFICATION

Delete this complete section, including items a to e, and replace with the following:

Any change which necessitates requalification of the welding procedure specification shall require requalification of welders.

3.5 PERFORMANCE QUALIFICATION TESTS - DESTRUCTIVE TESTING

3.5.1 Sampling of test welds

Add the following:

Test specimens shall be cut from the test assembly after the welds have successfully passed the visual examination and non-destructive testing. Cooling of the test assembly shall occur naturally for a minimum period of 24 hours.

Add new section:

3.5.4 Macro-section test procedures and test acceptance criteria - groove welds

Two macro-sections shall also be taken from groove welds to qualify the welding procedure and the welders. Where more than two welders are employed on groove welds, further macro-sections shall be taken to qualify each additional welder (2.6.1).

For reduced branch fittings, welders shall be qualified by acceptable macro-section only.

Preparation shall be as stated in 2.6.6.1. of ANSI/API RP 1107. The acceptance criteria shall be as stated in (2.6.6.3).

3.7 RECORDS OF QUALIFIED WELDERS

Add the following:

The Contractor shall maintain the list of qualified welders and the qualification records. The list and records shall be agreed by the Principal prior to production welding.

Add the following new section:

3.8 RENEWAL OF WELDER QUALIFICATION

A welder's qualification shall expire when:

- He has not welded with the low-hydrogen SMAW process for more than three months.
- He has not welded with low hydrogen vertical down electrodes for more than three months (for circumferential fillet welders).
- When the Principal has reason to doubt the ability of the welder to make acceptable welds as defined in this DEP.

Requalification shall be in accordance with this DEP.

4. SUGGESTED MAINTENANCE WELDING PRACTICES

Change title as follows:

4. MAINTENANCE WELDING

4.1 GENERAL

Delete the existing section and replace with the following:

a. Paint, coating, or wrapping material shall be carefully removed from the run pipe for a length extending to 600 mm on either side of the proposed location of the extremities of the fitting. Hammering, chiselling, or grinding shall not be performed.

b. The section of the run pipe to which the branch pipe or fitting is to be attached shall be thoroughly cleaned with a wire brush for a distance extending to a minimum of 150 mm either side of the branch or fitting. After cleaning, the run pipe shall be visually examined for laps, cracks, pitting or other form of damage. The fitting shall be located so as to avoid welding on minor flaws in the run pipe.

c. For full encirclement tees or sleeves, the run pipe shall be measured with callipers to ensure that ovality is acceptable for accommodation of the proposed tee or sleeve.

d. For hot-tapping operations, the area of the run pipe which will be cut out and an appropriate surrounding area shall be examined ultrasonically to ensure freedom from laminations and other discontinuities which may interfere with such operations. The test method shall be straight beam pulse-echo in accordance with ASTM E 213 using a 75 mm square grid.

NOTE: Acceptance criteria will be specific to each operation. The Principal and/or the Contractor should evaluate all indications to determine whether they will adversely interfere with cutting.

e. The specific areas of the run pipe where attachment welds are to be made shall be 100% ultrasonically and magnetic particle inspected over a band of 150 mm minimum width centred over the proposed weld locations to ensure freedom from detrimental discontinuities. The ultrasonic test method shall be straight beam pulse-echo in accordance with ASTM E 213. The magnetic particle inspection procedure shall be in accordance with ASTM E 1444. Linear indications evaluated as cracks, or incomplete fusion in longitudinal weld seam areas, shall not be acceptable. Positive confirmation of wall thickness of the run pipe shall also be obtained over the complete circumference of the pipe at these locations in accordance with ASTM E 797.

NOTE: Acceptance criteria will be specific to each operation. The Principal and/or the Contractor should evaluate all indications to determine whether they will adversely interfere with welding.

f. The minimum separation of the attachment fillet welds from the existing girth welds should be one run pipe outside diameter. When fillet welds can only be located within six times the wall thickness of the thicker material (usually the tee) from an existing girth weld, the existing girth weld shall be ultrasonically and radiographically examined to ensure freedom from detrimental discontinuities. If the run pipe is of the spiral weld type, the fitting should be located such that the seam weld avoids the coupon to be removed.

NOTE: A coupon support may have to be welded to the spiral weld pipe after completion of the split tee to assist retrieval of the cut coupon.

g. The possibility of fouling or build-up of deposits, including pyrophoric scale, inside the pipe shall be considered from a review of pigging data. Particular attention is required for dead ends or where pigging data are unavailable. Radiography may be used to confirm or detect such deposits. Prior inspection reports shall also be evaluated in order to assess the soundness of the hot tapping area.

h. Where the seam weld in the run pipe crosses the fillet weld zone, the reinforcement on the seam weld shall be ground flush with the pipe surface over a length extending 50 mm beyond each end of the proposed fitting.

4.2 ALIGNMENT

4.2.1 Offset

Delete the existing section and replace with the following:

A yoke-type clamp as shown in Figure B shall be used to achieve an offset up to a maximum of 1.59 mm.

4.2.2 Root opening (complete encirclement fittings)

Delete the existing section and replace with the following:

The two halves of the fitting should be clamped together around the pipe by means of a yoke - type clamp as shown in Figure B.

Before the fitting is finally clamped together, carbon steel backing strips shall be inserted into the machined recesses at the roots of the longitudinal welds. The backing strip material shall remain within the essential variables of the welding procedure qualification and shall be agreed by the Principal.

The backing strip extension beyond the edges of the fitting shall be a minimum of 150 mm to allow attachment of suitably sized run-on/run-off plates.

Before the fitting is clamped, all visible surface grease in and around the recess of the branch flange shall be removed by solvent cleaning.

4.3 BEVELS

Delete the existing section and replace with the following:

Immediately prior to welding, the fusion faces and the adjacent material shall be free from planar defects, tears, moisture, scale, rust, paint, grease or other matter that may be detrimental to the weld. Cleaning shall extend to a minimum of 25 mm from the edge of the fusion faces on both the internal and external surfaces of the fitting.

Defective bevels shall be repaired by grinding. Where grinding is inappropriate, welding and grinding may be employed to repair the bevel subject to agreement of the WPS and PQR by the Principal.

Where the fitting thickness is greater than twice the run pipe wall thickness, the fitting shall be chamfered at 45° to enable fillet weld leg lengths of two times the run pipe wall thickness, see (Figure E(d)).

4.6 CLEANING

Delete the existing section and replace with the following:

Each run of weld metal shall be thoroughly cleaned with hand or power tools before a further run is applied. Visible flaws such as cracks, cavities and other deposition faults shall be removed before deposition of further weld metals.

4.7 WELDING SEQUENCE

Delete the existing section and replace with the following:

a. General

   The welding sequence for split tees shall be as shown in Figure C. The welding sequence and bead deposition sequence for reinforced set-on branches shall be as shown in Figure D. Bead deposition sequences for circumferential fillet welds shall be as shown in Figure E. The bead deposition sequence for reduced branch fittings shall be as shown in Figure F.

   Stops and starts shall be carefully ground. Stops and starts in adjacent passes shall be staggered by a minimum of 25 mm.

b. Longitudinal groove welds

Longitudinal groove welds shall be welded simultaneously and at no time shall welding cause fusion between the fitting and the run pipe.

Welding shall commence from the centre of the fitting and progress to the ends. This method of working shall continue until one third of the total cross-sectional area of the welds has been deposited over the entire weld length, after which welding may progress in the desired direction.

c. Circumferential fillet welds

Circumferential welding shall only commence after completion of the longitudinal welds.

A buttering technique shall be used on the run pipe wall as shown in the passes 1-3 of Figure E(c). Additional reinforcement shall be applied over the buttering layer where the gap between the fitting and run pipe exceeds 1.5 mm as shown in passes 4 - 6 of Figure E(c). The first buttering pass shall be deposited as close as possible to the fitting without impinging or making any attachment to it. The fillet leg length and gap between the pipe and fitting shall determine the number of buttering passes required. Pass 6 or its equivalent shall be deposited as close as possible to the extremity of pass 3 or its equivalent without impinging on the run pipe wall.

The first pass in the throat of the fillet: pass 7 in Figure E(e) shall not extend beyond one electrode run-out length before being reinforced by deposition of pass 8. This technique shall be used progressively around the joint until the throat of the fillet is sealed, i.e., a block sequence may be used only for passes 7 and 8.

Welding shall be performed using stringer beads in a temper bead technique.

The second circumferential fillet weld shall only be started after completion and cooling of the first fillet. At no time shall both circumferential fillet welds be attempted simultaneously.

Add the following new sections:

4.8 PREHEATING AND INTERPASS TEMPERATURE

(a) General

Oxy-propane rosebud torches shall be used for heating. Oxy-fuel welding or cutting torches shall not be used. Where difficulties are encountered in achieving correct preheat and interpass temperatures, the Contractor shall use induction or resistance heating methods.

Measurement of preheating, preheat maintenance, and interpass temperatures shall be in accordance with ISO 13916.

(b) Longitudinal groove welds

Prior to the commencement of welding, both seams shall be heated simultaneously to 250 °C over a minimum band width of twice the thickness of the fitting either side of the weld preparation. After welding has commenced, the preheat maintenance temperature shall be 150 °C.

(c) Circumferential fillet welds

With the fitting in position on the live pipeline, a minimum length of 300 mm of the weld zone shall be preheated to 250 °C. The temperature of the run pipe within this zone shall be monitored and the time taken for the zone to cool to 150 °C shall be recorded. This recorded time shall define the time limits between the cessation and the re-commencement of preheat during welding for the deposition of the first two layers of the weld metal including the buttering runs on the run pipe. Thereafter, the temperature shall be monitored so that welding does not occur when the weld zone is at a temperature of less than 150 °C.

4.9 NUMBER OF WELDERS

For longitudinal groove welds where the fitting is 750 mm or more in length, at least two welders shall work on each seam.

For circumferential fillet welds on pipe of 323.9 mm OD and higher, two welders shall be

employed working on the opposite sides of the pipe. At no time shall the welders' weld pools have less than 50 mm separation.

4.10 STRAY ARCS

Damage from stray arcs shall be repaired in accordance with a repair procedure approved by the Principal. Repair by welding shall only be performed on the parent material of the fitting. Repair welding shall not be performed on the run pipe.

4.11 PARTIALLY COMPLETED JOINTS

Joints shall not be left partially completed.

4.12 RECORDS

Monitoring of welding parameters during production welding should be by arc monitoring system with print-out facility. The frequency of monitoring shall be shown in the Contractor's test and inspection plan for the project or contract.

5. INSPECTION AND TESTING OF MAINTENANCE WELDS

5.2 VISUAL INSPECTION

Delete the existing section and replace with the following:

All welds shall be inspected by visual inspection during and after welding in accordance with EN 970 to ensure that preheat and interpass temperature requirements are met, that slag is removed between the passes, and that an acceptable profile is maintained. Post-welding visual inspection for acceptance/rejection shall not be performed sooner than 24 hours after completion of the joint.

5.3 NON-DESTRUCTIVE TESTING

Add the following:

Magnetic particle inspection shall be performed on the completed buttering layers prior to deposition of further weld metal. The completed assembly welds shall be magnetic particle inspected not sooner than 24 hours after completion of the joint. All magnetic particle inspection shall be performed in accordance with ASTM E 1444.

5.4 CERTIFICATION OF NON-DESTRUCTIVE TESTING PERSONNEL

5.4.1 Procedures for certifying non-destructive testing personnel

Delete the existing section and replace with the following:

The Contractor's non-destructive testing personnel shall be certificated in accordance with ISO 9712 to NDT Level 2 or higher.

5.6 QUALIFICATION OF WELDING INSPECTORS

The Contractor's welding inspection personnel shall hold a valid qualification of one of the following:

- CSWIP Senior Welding Inspector
- BGAS Senior Welding Inspector or Senior Pipeline Inspector
- Alternative agency agreed by the Principal.

6. STANDARDS OF ACCEPTABILITY: NON-DESTRUCTIVE TESTING (INCLUDING VISUAL)

6.5 CRACKS

Delete the existing section and replace with the following:

Cracks shall not be acceptable. Welds or buttering layers found to contain cracks shall result in the depressurisation of the line until such time as the Principal gives further instructions.

6.6 UNDERCUTTING

Add the following:

Undercut shall be treated by grinding and blending provided that the specified minimum wall thicknesses for the pipe and fitting are maintained. Disc grinders shall not be used on the run pipe.

7. REPAIR OF REMOVAL OF DEFECTS

7.2 REMOVAL AND PREPARATION FOR REPAIR OF DEFECTS

Add the following:

Defects shall be removed by grinding only.

Repair welding shall only be performed using qualified welding procedure specifications distinct from the original fillet or groove welding procedure specification. Three repair types should be qualified to cover all eventualities: full thickness, partial penetration mid-thickness, and cap. Qualification of one type of repair shall not qualify other types of repair.

Add new sections:

7.5 REPAIR WELDING PROCEDURE SPECIFICATION QUALIFICATION

The test coupon produced for the original weld shall be used for qualifying repair welding procedure specifications.

Inspection requirements shall be as for the original welding procedure specification qualification.

Destructive test requirements shall be as follows and test repair welds shall have sufficient length to extract all of the necessary specimens:

- Full thickness repair: identical to the original weld requirements;
- Mid-thickness partial penetration repair (groove): 1 tensile, 1 nick break, 1 side-bend, 1 macro-hardness;
- Mid-thickness partial penetration repair (fillet): 1 nick break, 2 macro-hardness;
- Cap repair - 2 macro-hardness.

The acceptance criteria shall be as stated in (Part II - 2.) of this DEP.

7.6 REPAIR WELDER QUALIFICATION

A welder who successfully welds a repair welding procedure qualification test weld shall be considered qualified for the specific type of repair performed.

Add the following section:

8. DOCUMENTATION

8.1 GENERAL

All required documentation shall be in the English language unless otherwise specified by the Principal.

8.2 PRE-WELDING DOCUMENTATION

The Contractor's contract-specific quality plan shall be submitted for agreement by the Principal prior to the commencement of welding.

NOTE: Review by the Principal of a draft quality plan at the enquiry stage may assist the process.

8.2.1 Content of the quality plan

The format and issue of the quality plan shall be consistent with the document control element of the Contractor's quality system.

The content of the quality plan should be based on ISO 10005 and shall include the following:

1. Identification of the contract to which the plan is to be applied.
2. Reference to ANSI/API RP 1107 and this DEP.
3. Location of the work.
4. Identification of the individuals responsible for controlling the activities defined in the plan.
5. Identification of the individuals with the authority to interface directly with the Principal.
6. Identification of all subcontractors.
7. The quality plans of all subcontractors.
8. All sequenced activities for the contract and references to the quality system procedures and work instructions which will be applied to these activities.
9. Where requested by the Principal, copies of specific quality system procedures.
10. Test and inspection frequency and acceptance criteria.
11. The location of each inspection and test point in the activity sequence.
12. Points where the Principal has established witnessing or verification requirements.

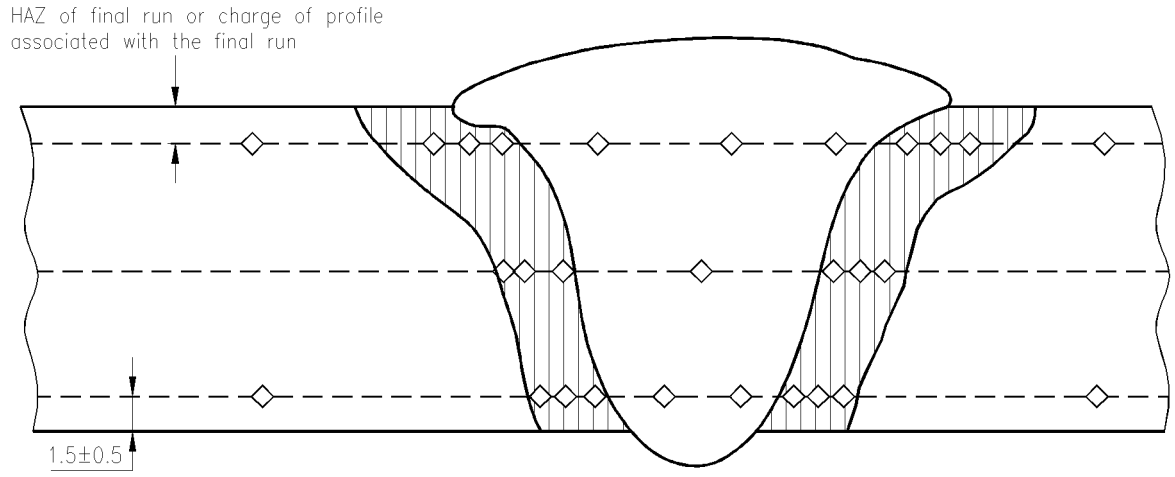
8.3 FINAL DOCUMENTATION

The Principal shall specify the final documentation requirements in the contract document.

9. FIGURES

Figure A Hardness indent locations

(a) Longitudinal groove weld



(b) Circumferential fillet weld

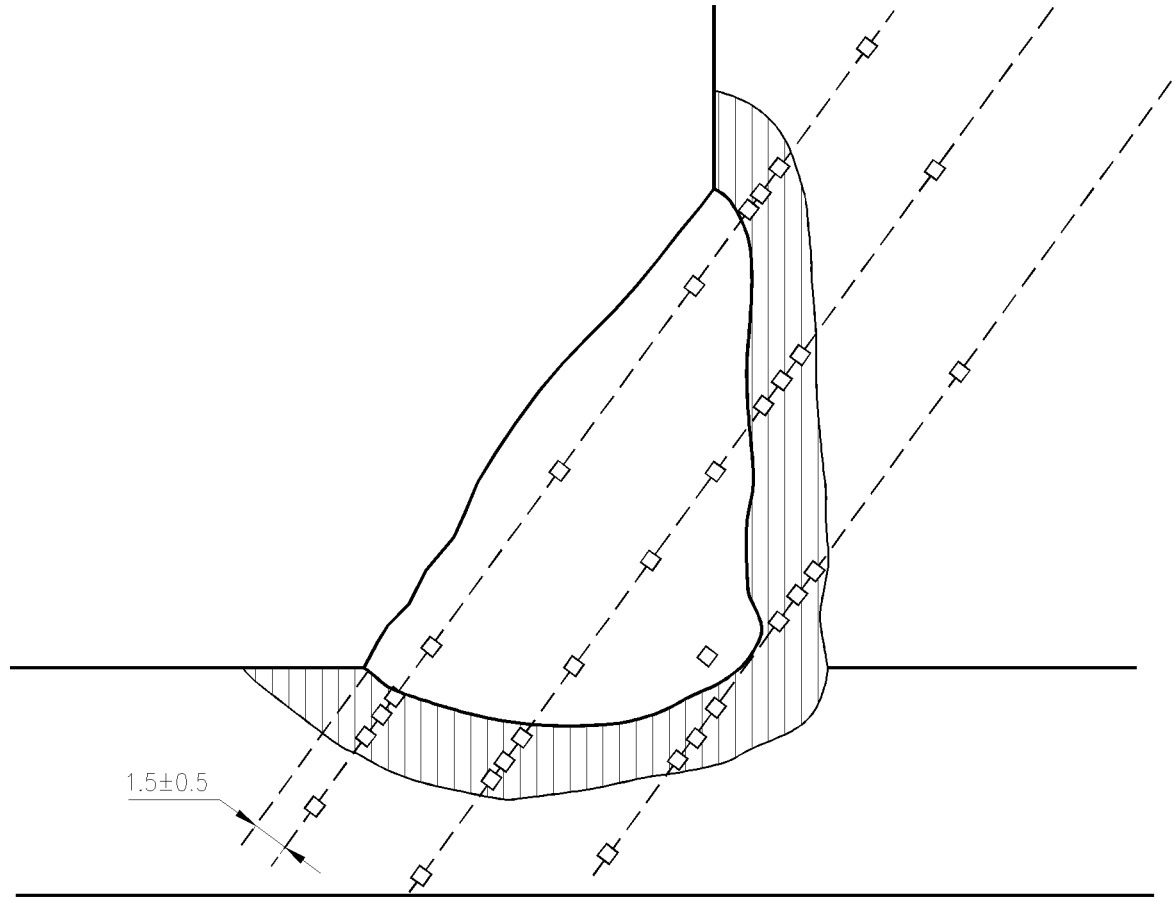
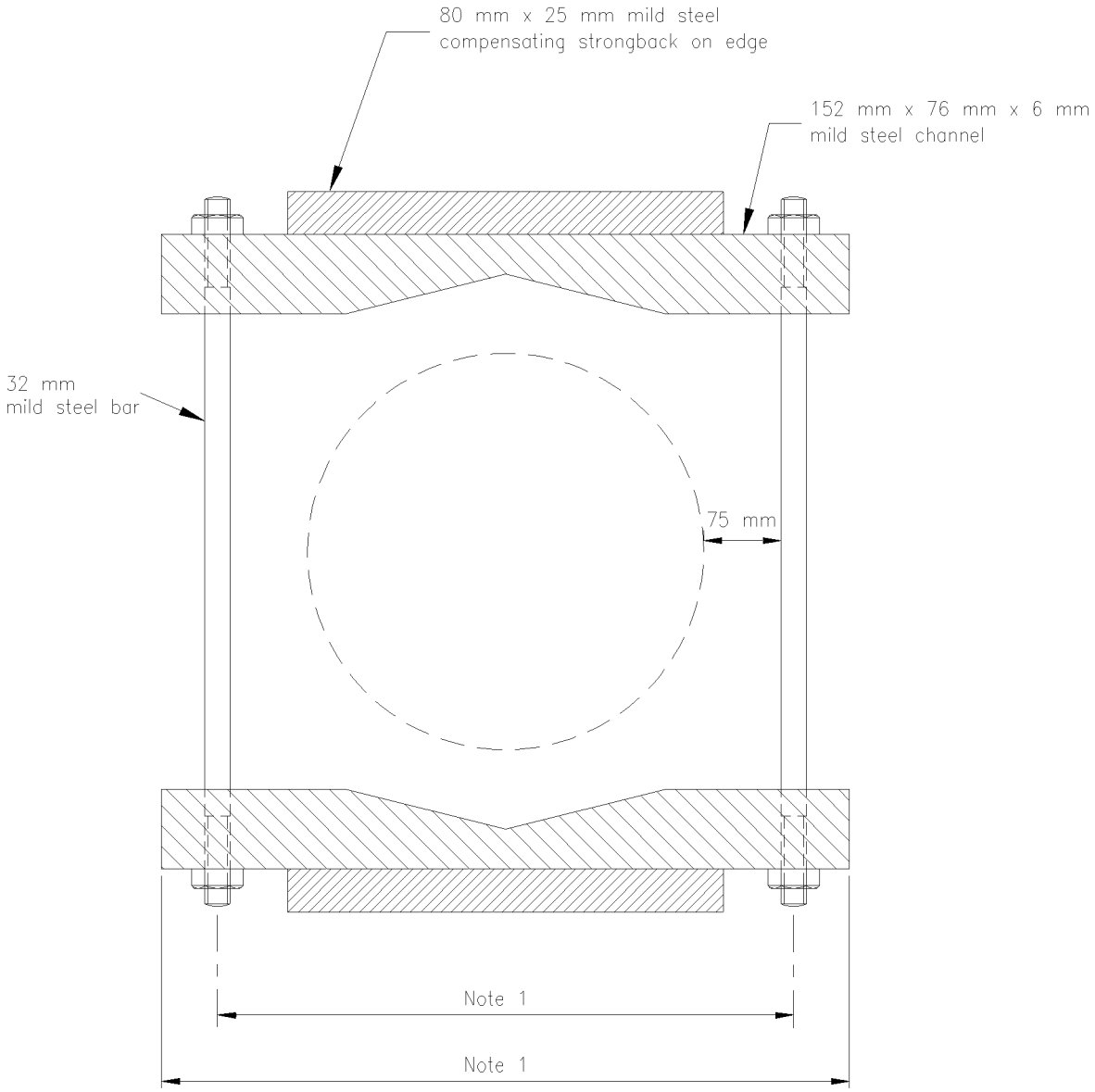


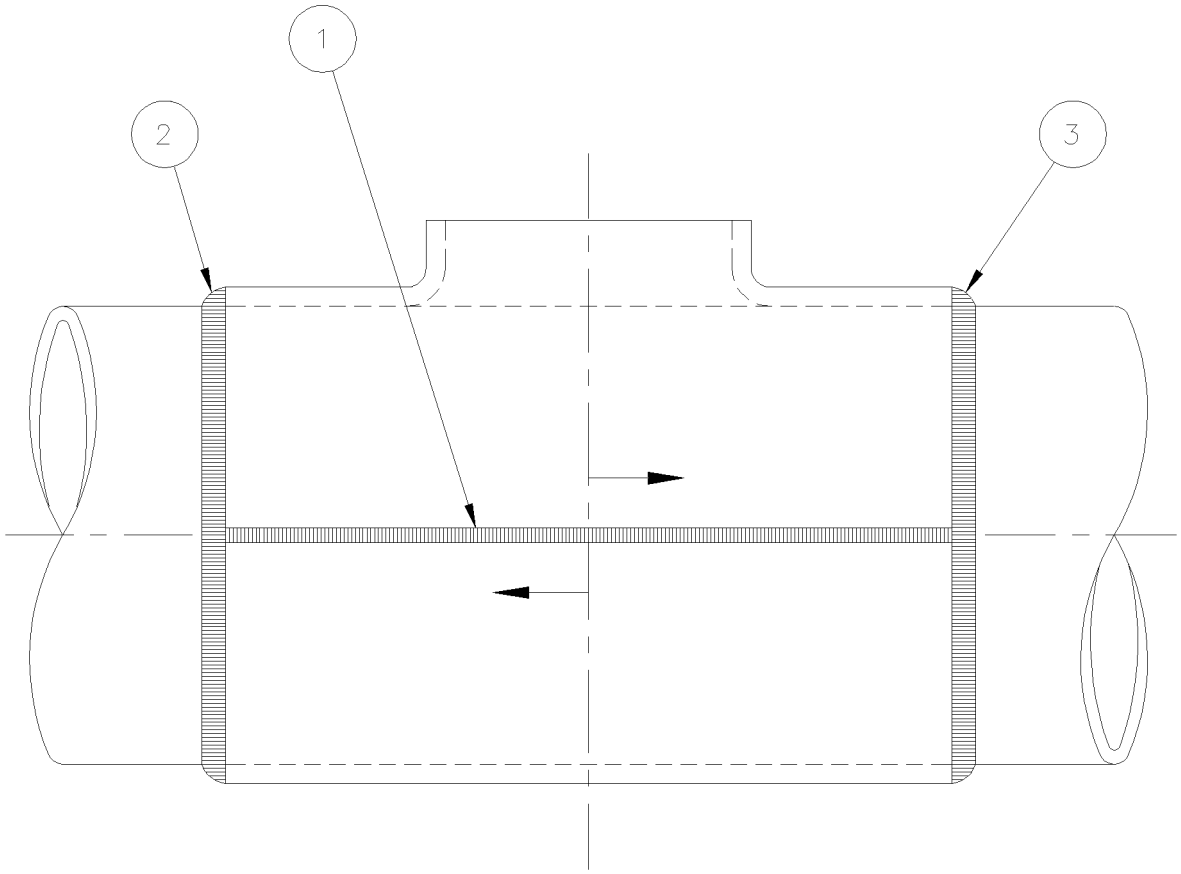
Figure B Yoke-type clamp for encirclement fittings



NOTES:

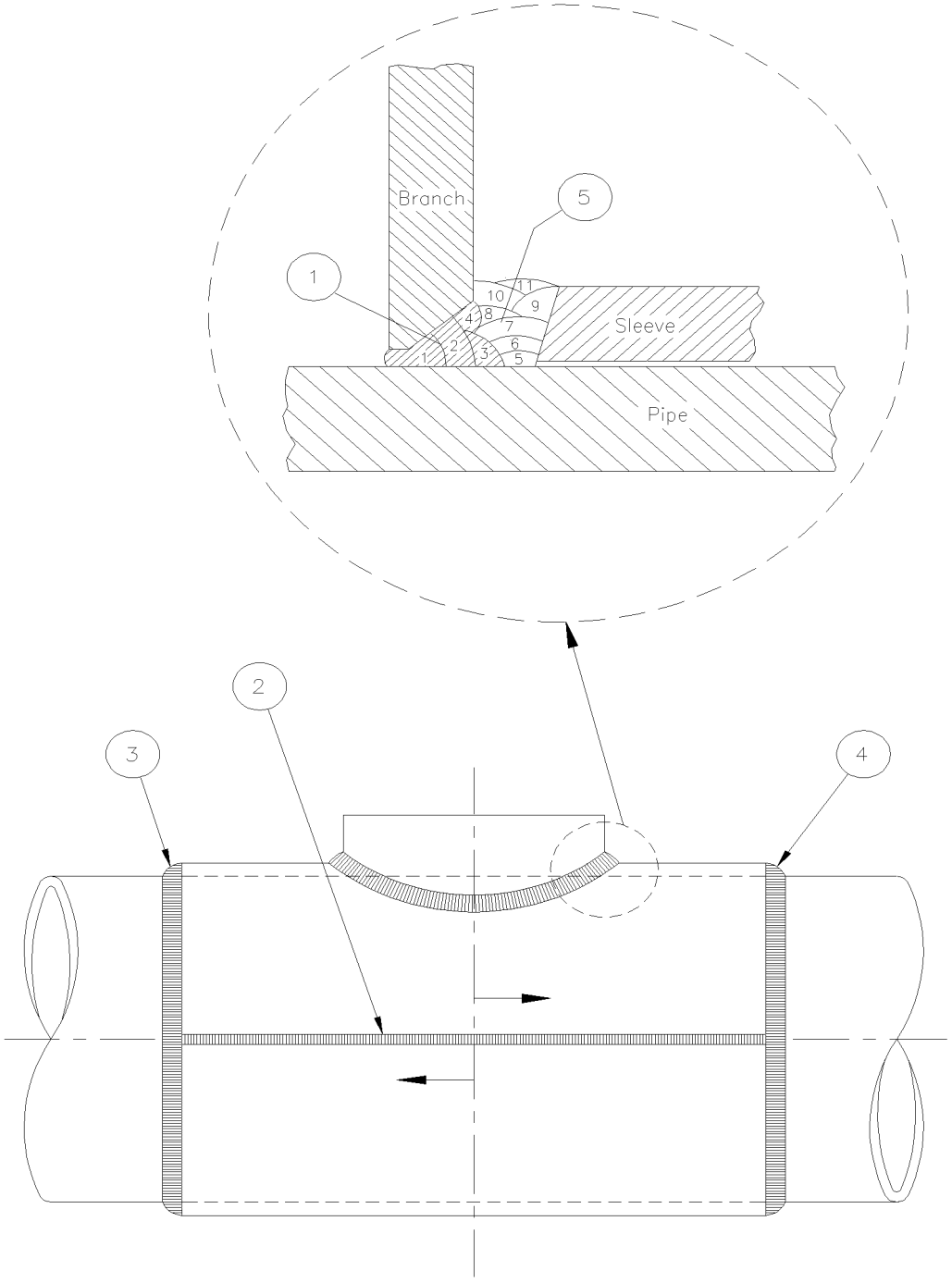
1. These dimensions are dependent on fitting size. Allowance should be made for gap of at least 75 mm between the bar and the fitting.
2. Dimensions are typical and may vary with pipe size, encirclement fitting thicknesses etc.

Figure C Welding sequence for split tees



NOTE: Welding of longitudinal welds to commence in the centre of tee. Weld starts shall be overlapped and ground. Welding to continue in this manner until 10mm to 12mm in cross sectional thickness is deposited.

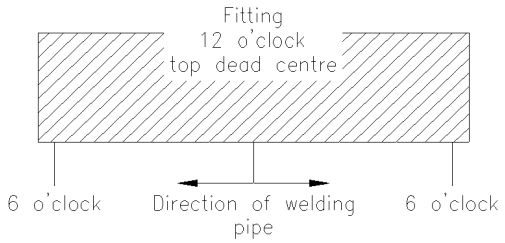
Figure D Welding and bead deposition sequence for reinforced set-on branches



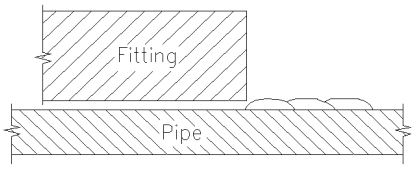
NOTE: 1. Welding of longitudinal welds to commence in the centre of sleeve. Weld starts shall be overlapped and ground. Welding to continue in this manner until 10mm to 12mm in cross sectional thickness is deposited.

2. Number of weld passes is indicative only.

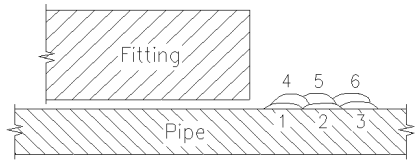
Figure E Weld bead deposition sequence for circumferential fillet welds



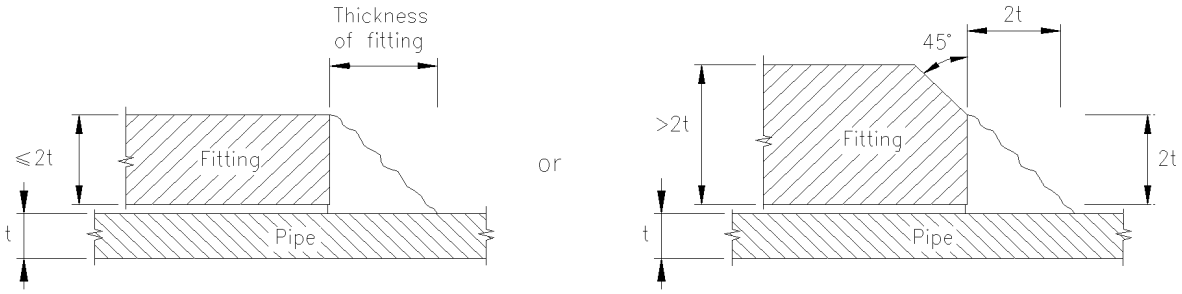
(a) Sequence of deposition (vertical downhill technique)



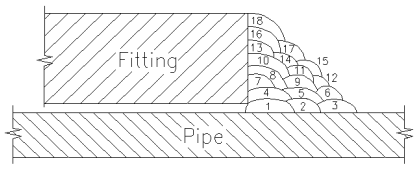
(b) Detail of buttering layer onto pipe



(c) Suggested method of reducing gap between pipe and fitting before welding into fillet throat

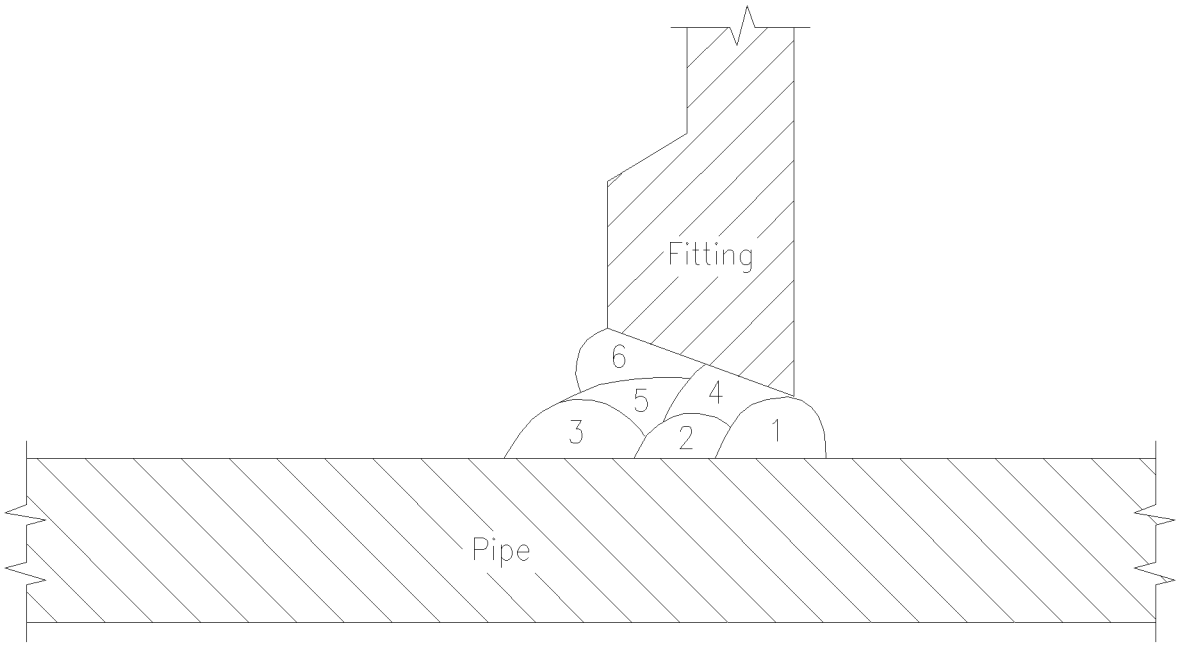


(d) Dimension of fillet leg length to suit thickness of fitting



(e) Weld bead deposition sequence

Figure F Weld bead deposition sequence for reduced branch fittings



Note: Number of weld passes is indicative only

PART III REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments, supplements, revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Hot-tapping on pipelines, piping, and equipment	DEP 31.38.60.10-Gen.
Pipeline engineering	DEP 31.40.00.10-Gen.
Linepipe for use in oil and gas operations under sour conditions	DEP 31.40.20.31-Gen.

AMERICAN STANDARDS

Pipeline maintenance welding practices	ANSI/API RP 1107, Third edition, April 1991

Issued by:
American Petroleum Institute
Publications and Distribution Section
1220 L Street Northwest
Washington DC. 20005
USA

Filler metal procurement guidelines	ANSI/AWS A5.01
Specification for low alloy steel electrodes for shielded metal arc welding	ANSI/AWS A5.5

Issued by:
American Welding Society
550 NW Le Jeune Road
PO Box 351040,
Miami FL 33130
USA

Ultrasonic examination of metal pipe and tubing	ASTM E 213
Measuring thickness by manual ultrasonic pulse-echo contact method	ASTM E 797
Magnetic particle examination	ASTM E 1444

Issued by:
American Society for Testing and Materials
100 Barr Harbor Drive,
West Conshohocken,
Pennsylvania 19428-2959
USA

Sulphide stress cracking resistant metallic materials for oil field equipment	NACE MR0175

Issued by:
NACE International
1440 South Creek Drive
Houston, Texas 77084
USA

EUROPEAN STANDARDS

Non-destructive examination of fusion welds - Visual examination	EN 970
Destructive tests on welds in metallic materials - Hardness testing Part 1. Hardness test on arc welded joints	EN 1043-1

Issued by:
Comité Européen de Normalisation
Secrétariat Central
Rue de Stassart 36
B-1050 Brussels
Brussels

INTERNATIONAL STANDARDS

Quality requirements for welding - Fusion welding of metallic materials - Part 2: Comprehensive quality requirements	ISO 3834-2
Quality systems - Model for quality assurance in design, development, production, installation and servicing	ISO 9001
Quality systems - Model for quality assurance in production, installation and servicing	ISO 9002
Approval testing of welders - Fusion welding - Part 1: Steels	ISO 9606-1
Non-destructive testing; qualification and certification of personnel	ISO 9712
Quality management; guidelines for quality plans	ISO 10005
Quality assurance requirements for measuring equipment - Part 1: Metrological confirmation system for measuring equipment	ISO 10012-1
Steel and steel products; inspection documents	ISO 10474
Welding - Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature	ISO 13916

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