DEP SPECIFICATION

WELDING OF PIPELINES AND RELATED FACILITIES (AMENDMENTS/SUPPLEMENTS TO ISO 13847:2000)

DEP 61.40.20.30-Gen.

February 2011

(DEP Circular 07/12 has been incorporated)

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE

DEM1

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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and give recommendations for the welding of carbon steel pipeline systems and related facilities.

This DEP is based on ISO 13847:2000 (including Technical Corrigendum 1).

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards.

This is a revision of the DEP with the same number dated January 2010. See [1.5] regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil refineries, chemical plants, gas plants, exploration and production facilities and supply/distribution installations. Application in other facilities may also apply.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the 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, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

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

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

The **Principal** is the party that initiates the project and ultimately pays for it. 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 capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Pipeline criticality categories:

Term	Definition
Non-critical pipelines	Pipelines identified as non-critical in accordance with DEP 31.40.00.10-Gen.

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Term	Definition
Critical pipelines	(a) Pipelines identified as critical in accordance with DEP 31.40.00.10-Gen. and having an operational design maximum axial stress ≤90% SMYS or installation stress ≤100% SMYS. (b) All offshore pipelines and all pipelines designated for sour service, if not also designated as "critical - high strain"
Critical high-strain pipelines	Critical pipelines having an operational maximum axial stress > 90 % SMYS or installation stress > 100 % SMYS. Such pipelines may also be designated for sour service. The applicable requirements for pipelines in this category, additional to those for critical pipelines, are given in Annex E. Due to the wide range of conditions covered by this category, Annex E is for guidance only – the Principal shall specify the requirements in the Project Specification.

1.3.3 Acronyms

AUT	automated ultrasonic testing
AWT	all weld tensile
AYS	actual yield strength
SCR	steel catenary riser
SENT	single edged notch tensile (fracture toughness specimen)
SSC	sulphide stress cracking
WPQR	welding procedure qualification record

1.4 CROSS-REFERENCES

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

1.5 SUMMARY OF CHANGES

This DEP is a revision of the DEP of the same number dated January 2010. This DEP has been split into this Specification and a DEP Informative containing background information and the process safety requirements indicated by use of the capitalised term "SHALL [PS]" have been carefully reviewed.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of “DEPs on the Web”, available through the Global Technical Standards web portal http://sww.shell.com/standards and on the main page of the DEPs DVD-ROM.

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1.7 DUAL UNITS

Amended per
Circular 07/12
Dual units have been incorporated throughout this DEP.

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

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PART II GENERAL REQUIREMENTS

Part III of this DEP is written as amendments and supplements to ISO 13847:2000, including Technical Corrigendum 1. Wherever reference is made to ISO 13847, it shall be understood to mean ISO 13847 (including Technical Corrigendum 1) as amended/supplemented by this DEP.

For ease of reference, the clause numbering of ISO 13847 has been used throughout Part III of this DEP.

Unless specified otherwise in this DEP, all occurrences of the word “should” in ISO 13847 shall be replaced with the word “shall”.

Clauses in ISO 13847, which are not mentioned in this DEP, shall remain valid as written.

Tables and figures in this DEP not replacing the corresponding item in ISO 13847 are numbered in relation to the DEP clause.

The criticality category and all required information, such as upper and lower design temperature, sour service conditions etc., shall be contained in a project specification which shall be applied in conjunction with this DEP and ISO 13847. The project specification shall also contain any technical requirements, in addition to this DEP, necessitated by individual installation or operational conditions. The requirements for critical high-strain pipelines shall be stated in the Project Specification.

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PART III AMENDMENTS/SUPPLEMENTS TO ISO 13847:2000 (plus Corrigendum No. 1, 2001)

1. SCOPE

Delete from the second paragraph of this clause:

"and a specified minimum yield strength of 555 MPa (80 ksi) or less."

Add to the second paragraph of this clause:

"and a specified minimum yield strength of 485 MPa (70 ksi) or less."

Add to this clause:

Unless otherwise agreed by the Principal, the following processes shall not be used:

- Self-shielded flux-cored arc welding (SSFCAW)
- Semi-automatic gas metal arc welding (GMAW)

Gas shielded flux cored arc welding (GSFCAW) shall not be used for the root passes of single-sided welds.

Cellulosic SMAW electrodes shall not be used for the welding of fittings, or for pipe-to-pipe welds if the wall thickness is greater than 25 mm (1 in), or for deep water (>240 m (800 ft) water depth) pipelines.

For all tie-in welds employing external clamps, the root pass shall be made using vertical-up welding. Vertical-up welding shall be used for all passes of pipe to fitting welds.

3. TERMS AND DEFINITIONS

Add to this clause:

General and specific definitions in [Part I, 1.3] shall also apply.

3.6 COMPANY

In this term, replace "Company", *by* "Principal"

Add new term:

3.20 AUTOMATIC WELDING

Welding process in which the welding parameters and torch guidance are controlled electronically without manual intervention.

4. SYMBOLS AND ABBREVIATED TERMS

Add to this clause:

Acronyms in [Part I, 1.3.3] shall also apply.

5. WELDING PROCEDURE SPECIFICATION TESTING AND APPROVAL

In this section replace all references to ISO 9956-1 *by* ISO 15609 1 *and all references to* ISO 9956-3 *by* ISO 15614-1.

5.1 GENERAL

Add to this clause

All welds SHALL [PS] be specified by a WPS and qualified by a WPQ in accordance with the requirements of this DEP.

5.2 WELDING PROCEDURE SPECIFICATION

Add to this clause:

Technical information to be included in the WPS shall be that listed in [Table 5.2-1].

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The following, non-technical information shall be included in the WPS:

- WPS number and cross-reference to the WPQR
- Revision number
- Contract number
- Project title
- Contactor's Logo
- Contractor's signature.
- Principal's signature
- Certifying Authorities signature/stamp (where required)

Table 5.2-1 Variables to be specified in the WPS and essential variables

Item	Variables to be specified in WPS	Essential variables for non-critical pipelines	Essential variables for critical pipelines and critical high-strain pipelines
Process	Welding process/combination of welding processes	Any change	Any change
	Equipment used		Any change in equipment type and model for mechanised/automatic welding
Pipe and Fitting material	Steel strength grade	Any increase	Any change
	Heat treatment condition between pipe and pipe or pipe and fitting (TMCP, Q + T, Normalised)	Any change	Any change
	Carbon Equivalent (CE) and/or Pcm of parent material	Any increase in CE > 0.03, or Pcm > 0.02 (Note 1)	(a) for non-sour service: Any increase in CE > 0.03 , or Pcm > 0.02 (b) for sour service: Any increase in CE> 0.02 or Pcm > 0.015 (Note 1)
	Manufacturer for pipe or fittings including bends		Any change, unless otherwise agreed by the Principal
Diameter and wall thicknesses	Nominal outside diameter "D"	Any decrease more than 0.5 D or increase of more than 1.5 D from that qualified	Any change, unless otherwise agreed by the Principal
	Nominal wall thickness "t"	Any decrease of more than 0.75t or increase of more than 1.5t from that qualified	Any change, unless otherwise agreed by the Principal
Joint design	Type of bevel	Any change	Any change

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Item	Variables to be specified in WPS	Essential variables for non-critical pipelines	Essential variables for critical pipelines and critical high-strain pipelines
	Angle of bevel	Any change outside the approved tolerance in the approved WPS For mechanised/automatic GMAW: Restricted to range: 0° to +5° included angle	Any change outside the approved tolerance. in the agreed WPS For mechanised/automatic GMAW: Restricted to range:-0° to +5° included angle
	Root gap	Any change outside the tolerance in the approved WPS	Any change outside the tolerance in the approved WPS
	Root face	Any change outside the tolerance in the approved WPS.	Any change outside the tolerance in the approved WPS.
	Use of temporary backing	Any change	Any change
Filler metal to be specified for each run	Size	Any change	Any change
	Number of wires used	Any change	Any change
	Manufacturer and Trade Name	Any change unless agreed with Principal	Any change
	Classification and minimum specified yield strength	Any change	Any change
	Flux classification and trade name	Any change unless agreed with Principal	Any change
	Drying operation or pre treatment	Any change unless otherwise agreed by the Principal.	Any change unless otherwise agreed by the Principal
Electrical characteristics to be specified for each run	Current type (ac or dc) and Polarity	Any change	Any change
	Arc voltage	±10%	±10%
	Current	±10%	±10%
	Arc energy (kJ/mm) (ft-lb/in) $\frac{\text{volts} \times \text{amps}}{1{,}000 \times u}$ where u is the welding speed expressed in mm/s (in/s)	Any change 10% above the maximum arc energy qualified or 10% below the minimum arc energy qualified.	Any change 10% above the maximum arc energy qualified or10% below the minimum arc energy qualified.
Miscellaneous	Contact tip to work distance. (SAW, GMAW, GFCAW)	Any change more than 5 mm (0.2 in).	Any change more than 5 mm (0.2 in).
	Welding head angle relative to pipe tangent (SAW, mechanised/automatic GMAW:	±5°	±5°

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Item	Variables to be specified in WPS	Essential variables for non-critical pipelines	Essential variables for critical pipelines and critical high-strain pipelines
	Additional for mechanised/automatic GMAW: • Number of welding heads for each pass. • Separation of welding heads • Oscillation (frequency, width, dwell time on side-wall) . • Pulsing characteristics (frequency, amplitude, shape, base level, delay and crater fill).	Any change	Any change
Position	Angle of pipe axis to the horizontal	Any change exceeding ±25°	Any change exceeding ±25°
Direction of welding	Vertical-up, Vertical Down	Any change	Any change
Time between passes	Time between completion of root and start of second pass.	Any increase over the time recorded during qualification testing.	Any increase over the time recorded during qualification testing.
Line-up clamps	The type of line up clamp (if used) i.e. internal or external	Any change	Any change
	Number of passes before removal of line-up clamp	Any reduction	Any reduction
Cleaning	Method, including inter-run cleaning, final surface cleaning, power or hand tool	No restriction provided consistent results are obtained.	No restriction provided consistent results are obtained
Pre-heat	Method of applying heat		Any change unless otherwise agreed with Principal.
	Method of measuring temperature		Any change unless otherwise agreed with Principal.
	Minimum preheat temperature	Any reduction; or an increase > 50ºC (90ºF)	Any reduction; or an increase > 50ºC (90ºF)
	Maximum and minimum interpass temperature for each run.	Any increase, over 25°C (45ºF) above that qualified, any reduction below the preheat temperature.	Any increase, over 25°C (45ºF) above that qualified, any reduction below the preheat temperature
Post-weld heat treatment	Temperature range	Any change	Any change
	Hold time	Any change	Any change
Shielding gas	Flow rate	Any flow greater or less than that qualified, with ±15 % tolerance.	Any flow greater or less than that qualified, with ±15% tolerance

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Item	Variables to be specified in WPS	Essential variables for non-critical pipelines	Essential variables for critical pipelines and critical high-strain pipelines
	Composition	A change of ±10% in the gas % content.	A change of ±10% in the gas % content
Number and sequence of weld beads for mechanised/automatic welding processes	Number of weld beads deposited and sequence of deposition.	Any change (One additional run – "stripper pass" – is permitted in productions)	Any change (One additional run – "stripper pass" – is permitted in productions)
Lay barge move-up (Offshore) or pipe movement (onshore)	Minimum number of passes before lay barge move-up or pipe movement This shall not be less than 2 complete passes unless otherwise agreed with Principal.	N/A	Any reduction
Interruption in welding	Number of runs completed before cooling to ambient temperature.	Any reduction from the number of runs recorded during qualification testing	Any reduction from the number of runs recorded during qualification testing
Forced cooling after weld completion	When AUT is employed, the method of forced cooling after completion of welding to facilitate testing. The maximum temperature at the beginning and end of cooling shall be specified.	Any change, unless otherwise agreed with Principal	Any change, unless otherwise agreed with Principal

NOTE: 1. Carbon Equivalent = $C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$

Pcm = $C + \frac{Si}{30} + \frac{Mn + Cu + Cr}{20} + \frac{Ni}{60} + \frac{Mo}{15} + \frac{V}{10} + 5B$

where elements are expressed in % by weight.

5.3.1 Preliminary WPS

Add to this clause:

The proposed welding procedure specifications (WPSs), for all welding procedures including repair welding, shall be submitted to the Principal for review a minimum of two weeks prior to the proposed date of welding qualification.

- The WPS proposals shall be endorsed and signed by the Contractor's authorised representative prior to submission.
- The Principal shall review, then indicate approval of the WPS proposals after any clarifications by endorsing "APPROVED FOR QUALIFICATION", the contract number, the date, and signature.
- After approval by the Principal, each WPS shall be qualified in accordance with this specification. All qualification testing shall be witnessed by the Principal.

To qualify mechanised/automatic welding procedures, three test welds shall be made for each welding procedure. All three shall be subjected to non-destructive testing and at least one shall be subject to mechanical testing.

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