DEP SPECIFICATION

CARBON AND LOW ALLOY STEEL PIPELINE FLANGES FOR USE IN OIL AND GAS OPERATIONS (AMENDMENTS/SUPPLEMENTS TO ISO 15590-3) AND LOW TEMPERATURE CARBON STEEL FLANGES FOR PIPING (AMENDMENTS/SUPPLEMENTS TO ASTM A350 GR LF2)

DEP 31.40.21.34-Gen.

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DESIGN AND ENGINEERING PRACTICE

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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the manufacture and supply of carbon steel and low alloy pipeline flanges, under both sour and non-sour service applications and low temperature carbon steel flanges to ASTM A350 LF2 which is predominately used for piping applications to match ASTM A333 Gr 6 pipe.

This DEP is organised in the following way.

Part III	CARBON AND LOW ALLOY STEEL PIPELINE FLANGES (AMENDMENTS/SUPPLEMENTS TO ISO 15590-3)
Part IV	LOW TEMPERATURE CARBON STEEL FLANGES FOR PIPING (AMENDMENTS/SUPPLEMENTS TO ASTM A350 GR LF2)

Part III amends, supplements and deletes various clauses of ISO 15590-3, and follows the clause numbering of ISO 15590-3 for easy reference. All clauses of ISO 15590-3 not modified by this DEP remain valid as written.

In addition to the flange types included in ISO 15590-3, swivel ring flanges and anchor flanges are also covered by this DEP.

Part IV amends, supplements and deletes various clauses of ASTM A350, and follows the clause numbering of ASTM A350 for easy reference.

Bolting and gaskets are excluded from the scope of this DEP.

This is a revision of the DEP of the same number dated June 2007 and supersedes Shell U.K. Exploration and Production Standard EPE ES/207 . 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 authorisation to any documents, data or information to which the DEPs may refer.

This DEP is primarily intended for use in oil and/or gas transmission pipelines and related facilities. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall 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.

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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.

NOTE: In ISO 15590-3, the term Purchaser or User is used. In this DEP, the term Purchaser or User shall be understood to mean the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Bevel	Replaces the term "welding end" as used in ISO 15590-3.
Defect (in NDT)	A discontinuity or group of discontinuities whose indication(s) do not meet specified acceptance criteria.
Flaw/ discontinuity (in NDT)	An interruption, which may be either intentional or unintentional, in the physical structure or configuration of a pipe.
Indication (in NDT)	Evidence of a discontinuity that requires interpretation to determine its significance.
Minimum design temperature	The minimum temperature to which the pipeline or section of pipeline may be exposed during normal operational activities, including start-up and shut-down operations and controlled blowdown, but excluding abnormal situations such as pipeline ruptures.
Sample product	Flange selected for inspection and/or testing.
Test unit	The number of flanges to be accepted or rejected together, on the basis of the tests carried out on sample products.
Test welding ring	Sample of tubular material from the forging required for use in welding procedure and welder approval testing.

1.3.3 Abbreviations

Term	Definition
CE	Carbon equivalent
ID	Nominal internal diameter
MPQ	Manufacturing Procedure Qualification
WPAR	Welding procedure approval record
WPS	Welding procedure specification

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 VI).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated June 2007. This is a major revision of DEP 31.40.21.34-Gen. and the changes are too numerous to list here.

The base ISO standard ISO 15590-3 has not undergone any revision since the 2004 edition.

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This DEP was revised due to the program to update the DEPs and retire all local/regional standards. In this respect, this DEP includes the requirements of the following former regional standards (now retired):

- Shell U.K. Exploration and Production standard EPE ES/207, Rev 2: Standard low temperature carbon steel flanges – supplement to ASTM A350 Gr LF2

The previous edition of this DEP covered only the carbon steel and alloy steel pipeline flanges. This revision includes the low temperature carbon steel flanges for piping.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the “Give feedback” link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://sww.shell.com/standards. Select “Submit DEP Feedback”, fill in the online form and submit.
DEP Standard Form (Other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com.

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

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

Part III of this DEP is written as amendments and supplements to ISO 15590-3. Wherever reference is made to ISO 15590-3, it shall be understood to mean ISO 15590-3 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of ISO 15590-3 has been used throughout Part III of this DEP.

Clauses in ISO 15590-3, which are not mentioned in this DEP, shall remain valid as written.

For pipeline flanges the Manufacturer should undertake a Manufacturing Procedure Qualification. This may be historical. In both cases, the MPQ should be approved by the Principal.

Part IV of this DEP is written as amendments and supplements to ASTM A350. It contains the additional requirements for materials, manufacturing, testing and inspection of closed die, open die and ring rolled forged flanges and flanged branch fittings to ASTM A350 Grade LF2, for use in process piping applications to match ASTM A333 Gr 6 pipe.

For flanges manufactured to ASTM A350, the use of rolled or forged bars subsequently machined to the final shape requires prior approval from the Principal and is limited to a starting bar diameter of 200 mm (8 in). In such cases, the mechanical testing specimens shall be extracted from the finished component areas of the bar.

Wherever reference is made to ASTM A350, it shall be understood to mean ASTM A350 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of ASTM A350 has been used throughout Part IV of this DEP.

Clauses in ASTM A350, which are not mentioned in this DEP, shall remain valid as written.

The minimum forging ratio shall be 4:1 unless otherwise approved by the Principal and demonstrated as acceptable in the MPQ.

(Appendix 1) is applicable to flanges manufactured to ASTM A350 LF2 only.

The Manufacturer and Suppliers should maintain and operate a quality assurance system in accordance with ISO 9001 or equivalent.

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PART III AMENDMENTS/SUPPLEMENTS TO ISO 15590-3

9 Testing and inspection

9.2 Extent of testing and inspection

Replace this section with:

Mechanical testing samples shall consist of a prolongation, or sacrificial forging. The testing of separately forged bars should not be permitted.

The extent of testing and inspection to be performed shall be stated in Table 3 for each heat. Locations for the test pieces to be taken from a flange forging shall be in accordance with ASTM A370, 1/4t x t, or as established by agreement.

9.3 Chemical composition

Add second paragraph:

Retainer rings for swivel ring flanges should have the same composition as the flanges.

Replace values in Table 4 as follows:

Nitrogen concentration for non sour service: 0.012 % maximum

Phosphorous concentration for sour service: 0.020 % maximum

Add to Table 4 the following Notes:

e V+Nb+Ti shall not exceed 0.15 %.

f Cr+Mo+Ni+Cu shall not exceed 0.6 %.

9.4 Physical testing

9.4.4 Hardness requirements

Replace "Hardness indent locations for flanges shall be by agreement." *with:*

Three through thickness macrosections shall be taken at 120° intervals from the hub and ring of the test flange, and from the test swivel ring.

Macrosections may be extracted from forging prolongations.

Three hardness traverses shall be made on each macrosection as follows:

- 1.5 ± 0.5 mm from the outer surface
- Mid-thickness
- 1.5 ± 0.5 mm from the inner surface

Each traverse shall consist of five indents.

9.4.6 HIC tests

Replace this section with the following:

If HIC testing is specified, the test procedures and acceptance criteria shall be in accordance with NACE TM0284 as amended by DEP 30.10.02.16-Gen.

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9.5 NDT

9.5.1 NDT personnel and procedures

Add to this section:

NDT procedures shall have the approval of the applicable NDT level 3 individual.

9.5.3 Visual inspection

Add new subsections:

9.5.3.1 Bevel faces

The bevel faces shall be machined and shall be free from cracks, laminations, notches, scores, pits, etc.

9.5.3.2 Remainder of flange

Laminations, cracks, slivers, notches, scores, pits, etc., shall be considered as defects.

9.5.3.3 Method

All internal and external surfaces of the flanges shall be examined visually for surface defects in accordance with EN 13018.

9.5.4 MT/PT inspection

Add to this section:

9.5.4.2 Requirements

Delete first line and replace:

All weld-end of flange faces shall be examined. All flanges shall be examined.

Delete third line.

Replace the following in the 5th line:

"Complete removal of defects shall be verified by local visual inspection aided, if necessary by suitable NDT methods"

with:

"Complete removal of defects shall be verified by local visual inspection aided by a MT or PT examination"

9.5.5 UT inspection

Add to this section:

9.5.5.1 Method

Replace 1st line:

The final 50 mm of each end of the flange shall be UT inspected for the detection of laminar imperfections in accordance with ISO 11496. The reference standard shall be a flat bottom hole.

Ultrasonic inspection for longitudinal and transverse imperfections shall be carried out in accordance with EN 10228-3 Quality class 2. UT shall be carried out after all heat treatment has been completed.

Delete 2nd line.

Add to / begin 3rd line with:

For laminar imperfections:

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9.5.5.2 Requirements

Replace first line:

All flanges shall be examined.

9.6 Dimensions

9.6.3 Flange-face finish

Add to this section:

A temporary preservation compound specified by the Principal shall be applied to all flange faces after machining.

9.9 Repair welding

Replace this section with:

Weld repairs are not permitted.

Repairs may be made by machining or grinding if the remaining thickness is equal to, or greater than, the required minimum design thickness. In all cases where repairs are made as a result of imperfections or defects being disclosed by NDT, the repaired area shall be visually inspected and subjected to MT for confirmation of defect removal.

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PART IV AMENDMENTS/SUPPLEMENTS TO ASTM A350 (GR LF2 LOW TEMPERATURE CARBON STEEL FLANGES)

5 Manufacture

Replace Section 5.4 with the following:

5.4 *Heat Treatment:*

Forgings shall be delivered in the normalised condition.

The Manufacturer shall submit a procedure for heat treatment of forgings, which shall be subject to written approval by the Principal prior to the commencement of heat treatment of any items required by the order.

The heat treatment procedure shall contain, as a minimum, full details of the following:

a) furnace types and heating media,

b) loading pattern(s) and limitation(s),

c) methods of temperature control,

d) soak temperatures and times with tolerances,

e) details of cooling.

6 Chemical Composition

Add a new subclause 6.1.2:

6.1.2 The carbon content (on product analysis) shall be 0.23 % maximum and the carbon equivalent shall not exceed 0.43 % (again on product analysis).

7 Mechanical Properties

7.1 *Tension Tests*

Add new subclauses 7.1.5 and 7.1.6:

7.1.5 The samples for mechanical testing shall be taken from each cast of steel in each heat treatment lot.

The test specimens shall be taken from fully heat treated and finished forgings.

Tensile tests for ring-rolled flanges shall be taken in two directions from approximately the same locations as the Charpy specimens as shown in Figure 25.

7.1.6 Separate test bars or coupons shall not be used. If specimens are removed prior to finish machining, the Manufacturer or Nominated Supplier shall demonstrate that the location and orientation of specimens is identical to that from finish-machined forgings testing.

7.2 *Impact Test*

7.2.4 *Test Method*

Add the new subclause 7.2.4.4:

7.2.4.4 Charpy impact test specimens shall be taken, machined and tested in accordance with ASTM A350, modified by the following requirements:

The impact specimen position and orientation shall be as specified in (Part IV, Appendix 1).

All specimens shall be notched perpendicular to the fitting surface.

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Full size (10 mm x 10 mm) specimens shall be used wherever possible. Where this is not possible the larger of three-quarter size (7.5 mm x 10 mm) or half size (5 mm x 10 mm) or quarter size (2.5 mm x 10 mm) specimens shall be used.

The test temperature and absorbed energy requirements for full-sized specimens shall be -50 °C and 40 Joules minimum (average of three specimens), 28 Joules minimum (single specimen).

	Average	**Single specimen**
7.5 mm x 10 mm	32 Joules	23 Joules
5 mm x 10 mm	28 Joules	20 Joules
2.5 mm x 10 mm	15 Joules	11 Joules

Where a forging or fitting size does not permit the extraction of impact test specimens 10 mm x 2.5 mm or larger, a sample shall be extracted from the corresponding position for metallographic examination. The forging or fitting represented by the sample will only be acceptable if:

(a) The microstructure is consistent with the specified heat treatment.

(b) The grain size (measured or estimated in accordance with ASTM E112) is 7 or finer.

7.3 *Hardness Test:*

Replace clause 7.3.1 with the following:

7.3.1 The hardness of forgings supplied to this Standard shall be 197 HB maximum.

11. Rework and Retreatment

11.3 *Repair by Welding*

Replace clause 11.3 and subclauses 11.3.1 through 11.3.8 with the following:

Weld repairs shall not be permitted.

12 Inspection

Replace clause 12.1 with the following:

12.1 Magnetic particle inspection by the wet method, in accordance with ASTM A275, shall be carried out over the entire accessible surfaces of all flanges. Inspection shall be carried out in the finish-machined condition.

Linear indications are not acceptable.

Unacceptable surface indications identified by visual or magnetic particle inspection shall be explored and, where permissible within thickness and other design constraints, may be removed by grinding and re-inspected by magnetic particle inspection.

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