

DEP SPECIFICATION

MANUFACTURE, TESTING, AND INSPECTION OF WELDABLE STRUCTURAL STEEL PLATE GRADES 345-552 N/MM² (50-80 KSI) FOR SPECIAL/CRITICAL STEEL APPLICATIONS IN DEEPWATER OFFSHORE STRUCTURES (BASED ON ASTM A20)

DEP 37.81.20.33-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies minimum requirements for manufacture, testing and inspection of weldable structural steel plate Grades 345-552 N/mm² (50-80 ksi) for use in special/critical steel (Material Quality Level 1 and 1-PREQUAL) applications in the fabrication of deepwater offshore structures, manufacture of rig and well systems, marine mechanical, or mooring system equipment intended for application on deepwater offshore structures.

Steel plates governed by this DEP are identified on Approved for Construction (AFC) drawings and in project documents by the prefix "GR" followed by the grade (minimum yield strength in N/mm²) and the suffix "A", "AZ", "AA" or "AAZ" (indicative of Material Quality Level 1 or 1-PREQUAL and whether or not through thickness, i.e., "Z" direction, tensile testing is required), e.g., GR345A or GR345AZ.

This DEP is based on ASTM A20.

This new DEP-Gen. incorporates the content of and supersedes the former EPP standard DEP 37.81.20.33-EPP dated February 2006. See (1.5) for a summary of the main changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorized 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 authorized 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 and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. 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 regard 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 word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
"A"	Steel designation suffix indicating Material Quality Level 1 "Special" steel requiring prequalification in accordance with either API RP 2Z or EN 10225 Annexes E, F and G plus API RP 2Z Section 5.
"AA"	Steel designation suffix indicating Material Quality Level 1-PREQUAL "Critical" steel requiring prequalification in accordance with (Appendix 1).
"AAZ"	Steel designation suffix indicating Material Quality Level 1-PREQUAL "Critical" steel requiring prequalification in accordance with (Appendix 1) and through thickness properties.
"AZ"	Steel designation suffix indicating Material Quality Level 1 "Special" steel requiring through thickness properties requiring prequalification in accordance with either API RP 2Z or EN 10225 Annexes E, F and G plus API RP 2Z Section 5.
AFC Drawings	Approved for Construction drawings.
BOP	Bead on plate test.
CTOD	Crack tip opening displacement. The crack tip opening displacement is the crack displacement resulting from the total deformation (elastic plus plastic) at specifically defined location near the original (prior to force application) crack tip.
CTS	Controlled thermal severity test.
CVN	Charpy V-notch.
Delivery Condition +M	Applies to the thermomechanical rolled delivery condition. Thermomechanical rolling (a.k.a. thermomechanical control processing, or TMCP) leading to the delivery condition +M can include processes with an increasing cooling rate with or without tempering including self tempering but excluding direct quenching and quenching and tempering or quenching and ageing.
Delivery Condition +N	Applies to the normalized or normalized rolling delivery condition. Normalized rolling (a.k.a controlled rolling) is a rolling process in which the final deformation is carried out in a particular temperature range leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing.
Delivery Condition +Q	Applies to the quenched and tempered or quenched and aged delivery condition. The quenching operation consists of cooling a ferrous product more rapidly than in still air. Quenching also includes direct quenching. The tempering operation refers to a heat treatment applied to a ferrous product generally after quench hardening or other heat treatment to bring the properties to the required level. It consists of heating to specific temperatures ($<A_{c1}$) and soaking one or more times followed by cooling at an appropriate rate.
DWT	Drop weight test.
FATT	Fracture appearance transition temperature.
Grade	Minimum yield strength in N/mm^2 .
HAZ	Heat affected zone.
LAST	Lowest anticipated service temperature.

Term	Definition
MPS	Manufacturing Procedure Specification. Reference ISO 9000 Paragraphs 2.7.2.c, 2.7.2.e, 3.4.5 and 3.7.3. The MPS shall clearly define the sequence of operations and process controls to be implemented at each manufacturing step as well as specifically annotate any procedures, processing parameters, or requirements that deviate from this DEP. It is required that the MPS be approved by the Principal and Contractor, if applicable.
Pcm	Ito-Bessyo composition parameter.
PMI	Positive material identification.
PWHT	Post weld heat treatment.
QP	Quality Plan. Reference ISO 9000 Paragraphs 2.7.2.b and 3.7.5. The Quality Plan shall include inspection and test requirements and provide columns or spaces for the Principal and Contractor, if applicable, to indicate 3rd-party inspector inspection activities, e.g., monitor, witness, hold points, etc. for the operations to be undertaken. It is required that the QP be approved by the Principal and Contractor, if applicable. A QP is also known as an Inspection and Test Plan (ITP).
δc	The value of CTOD at the onset of unstable brittle crack extension or pop-in when $\Delta a_p < 0.2$ mm (0.008 in).
δm	The value of CTOD at the first attainment of a maximum force plateau for fully plastic behavior.
δu	The value of CTOD at the onset of unstable brittle crack extension or pop-in when the event is preceded by $\Delta a_p > 0.2$ mm (0.008 in).

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 (9).

1.5 SUMMARY OF MAIN CHANGES

This new DEP-Gen incorporates the content of and supersedes the former EPP standard DEP 37.81.20.33-EPP dated February 2006. This revision has been a major re-write of the standard and the changes are too numerous to list here.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using the DEP Feedback Form by:

- Entering comments directly in the DEP Feedback System on the Technical Standards Portal <http://www.shell.com/standards> (mandatory for users with access to Shell Wide Web);
- Clicking on the DEP Feedback Form button on the DEPs DVD-ROM main page (for users without access to Shell Wide Web);
- Requesting a copy of the DEP Feedback Form from the Administrator at standards@shell.com (for users without access to Shell Wide Web).

For the last two options, the completed DEP Feedback Form can be attached to an email and submitted to the Administrator at standards@shell.com. Only feedback that is entered into the Feedback Form will be considered.

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.

2. GENERAL

2.1 QUALITY REQUIREMENTS, QP AND MPS

The plate Manufacturer/Supplier shall implement an ISO 9001 Quality Management System or equivalent as approved by the Principal. A QP/ITP and an MPS shall be specifically developed for each order and shall be approved by the Principal prior to commencement of manufacturing operations. Table 1 defines a minimal list of manufacturing steps and process control variables that shall be defined, including acceptable ranges and aim values where applicable, in the MPS. The MPS for "AA" and "AAZ" suffix grades, which have been specified for weldability prequalification, shall specifically annotate any procedures, processing parameters, or requirements which are outside the essential variable ranges defined in (Appendix 1) of this DEP.

2.2 CONTRACTOR PROCUREMENT SPECIFICATION AND APPROVAL BY THE PRINCIPAL AND CONTRACTOR, IF APPLICABLE, OF THE PLATE MANUFACTURER/SUPPLIER AND MANUFACTURING FACILITIES

This DEP may be used directly for procurement or, at the Contractor's option, the Contractor may prepare a detailed Procurement Specification which is compatible with the Contractor's document format and quality system. As a minimum, the Contractor's Procurement Specification shall incorporate all requirements contained herein and shall require approval by the Principal. The plate Manufacturer/Supplier and manufacturing facilities, as identified in the MPS, shall require approval by the Principal.

2.3 LOWEST ANTICIPATED SERVICE TEMPERATURE (LAST)

The default LAST is -10 °C (14 °F) unless otherwise specified in project documents or on AFC drawings.

2.4 WELDABILITY PREQUALIFICATION

"A" and "AZ" grade shall, prior to the start of full production, be prequalification in accordance with either API RP2Z or EN 10225 Annexes E, F and G plus API RP2Z Section 5 and approved as such by the Principal. Once weldability prequalification has been successfully accomplished, manufacturing steps and process control variables for production plate shall fall within the essential variable range tolerances, relative to the prequalification plate(s), as defined in API RP2Z Section 5.

"AA" and "AAZ" grades shall, prior to the start of full production, be prequalified for weldability in accordance with ASTM A20 Supplementary Requirement S25 and API RP 2Z, and approved as such by the Principal as follows. The plate Manufacturer/Supplier shall produce a sufficient quantity of prequalification plate(s) of the maximum thickness specified for each grade to be provided. The prequalification plate(s) shall be fully tested and inspected for compliance with all requirements of this DEP. Additional requirements for weldability prequalification shall be as defined in (Appendix 1). Once weldability prequalification has been successfully accomplished, manufacturing steps and process control variables for production plate shall fall within the essential variable range tolerances, relative to the prequalification plate(s), as defined in (Appendix 1).

2.5 ADDITIONAL REQUIREMENTS

Plate thicknesses, sizes and any special or additional dimensional tolerances (e.g., flatness), non-destructive testing, marking, surface finish (other than as rolled) or other requirements not covered specifically by this DEP will be addressed in project documents or on AFC drawings and subsequently included in the plate procurement documents. If such additional requirements are specified, they shall be included in the MPS.

2.6 UNDERLYING INDUSTRY SPECIFICATION(S)

The plate shall be manufactured and tested (except as noted herein) in accordance with ASTM A20 except that repair welding of rejectable plate defects by the plate