

Manufacture of Structural Steel Forgings for Primary Offshore Applications

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Contents

	Page
1 Scope	1
2 Normative References	1
3 Terms, Definitions, Abbreviations, and Acronyms	2
3.1 Terms and Definitions	2
3.2 Abbreviations and Acronyms	3
4 Manufacturing and Quality Requirements	4
4.1 Quality Plan (QP) and Manufacturing Procedure Specification (MPS)	4
4.2 Manufacturer, Facility, and Subcontractor Approval	5
4.3 Lowest Anticipated Service Temperature (LAST)	5
4.4 Service Categories	5
4.5 Critical Sections	5
4.6 Forging Specifications	5
4.7 Traceability	5
4.8 Information Supplied to the Forging Manufacturer	6
4.9 Documents Requiring Approval by Purchaser and Contractor	6
4.10 Preproduction Meeting	7
4.11 Post-job Production Histograms	7
4.12 Certificates	7
5 Manufacturing Process and Chemical Composition	7
5.1 Steel Making and Refining Practice	7
5.2 Chemical Composition	8
5.3 Forging Process	10
5.4 Repair Welding	10
6 Heat Treatment	11
6.1 Heat Treatment Process Control Requirements	11
6.2 Quenching	11
6.3 Heat Treatment Furnace Records/Charts, Temperatures, and Cycle Times	11
7 Qualification Test Sample (QTS)	11
7.1 Forgings Represented by QTS	11
7.2 QTS Dimensional Requirements	11
7.3 Heat Treatment of QTSS	12
8 Mechanical Properties and Tests	12
8.1 Tensile Tests	12
8.2 Hardness Tests	13
8.3 CVN Tests	14
8.4 Retesting	15
9 Weldability of Service Category B Forgings	15
9.1 SCB Welding Prequalification	15
9.2 Tensile Tests	16
9.3 CVN Testing	16
9.4 Macrosection Microhardness Survey	17

Contents

	Page
10 NDE of Forgings	17
10.1 Ultrasonic Testing (UT)	17
10.2 Magnetic Particle Examination (MT)	18
10.3 Visual Examination (VT)	20
10.4 Documentation of NDE Results	20
11 Dimensional Inspection	20
12 Material Test Report	20
Annex A (normative) Supplementary Requirements	21
Annex B (informative) API Monogram Program	23
Bibliography	26
Tables	
1 Industry Standard Chemical Composition Specifications	8
2 Elemental Limits	9
3 A707-modified Chemical Composition	10
4 Tensile Properties and Hardness Requirements	13
5 CVN Absorbed Energy Requirement—Service Category A and B	14
6 CVN Absorbed Energy Requirements—Service Category C	15

Introduction

This specification is based on the experience acquired during the design, construction, operation, and maintenance of offshore processing units and facilities, as supplemented with the experience of operating companies with topsides, fixed platforms, floating structures (e.g. TLPs, spars, etc.), and their tendons and risers. Forgings in these applications tend to be limited production components, with relatively few replications, and receive more intense scrutiny than routine mass production runs.

Where appropriate this specification is based on, or reference is made to, international, regional, national, and industry standards.

This is a manufacturing specification for the forging itself. It is anticipated that geometric design for both service requirements and forging feasibility will have been agreed collectively between the contractor, manufacturer, and purchaser before this specification is invoked. Attendant issues regarding system reliability, geometric design, incorporation into the overall construction, operation, and maintenance are not addressed in this specification. Those electing to use this specification as a reference for their needed level of performance quality should carefully consider all of these attendant issues.

Manufacture of Structural Steel Forgings for Primary Offshore Applications

1 Scope

Forgings manufactured to this specification are intended for use in the fabrication of offshore structures, marine risers, TLP tendons and pipelines, or other system components intended for application on permanent offshore structures. This specification defines the minimum requirements for manufacture, testing, and inspection of carbon and low-alloy steel forgings, including extrusions and heavy-wall seamless tubular product, grades 345 N/mm² to 586 N/mm² (50 ksi to 85 ksi) for use in primary steel applications.

Service categories A, B, and C (SCA, SCB, and SCC) reflect forging geometry and method of incorporation into the overall system, rather than levels of criticality. They may also be designated by the user (purchaser) as described in 4.4 to reflect moderately different but standardized levels of performance.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Recommended Practice 2Z, *Preproduction Qualification for Steel Plates for Offshore Structures*, Fourth Edition

ASME Boiler and Pressure Vessel Code (BPVC) ¹, Section V: Nondestructive Examination; Article 9: Visual Examination, 2007

ASME Boiler and Pressure Vessel Code (BPVC), Section VIII: Rules for Construction of Pressure Vessels, 2007

ASTM A275 ², *Standard Practice for Magnetic Particle Examination of Steel Forgings*

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A751, *Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products*

ASTM A788, *Standard Specification for Steel Forgings, General Requirements*

ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*

ASTM E23, *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*

ASTM E110, *Standard Test Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers*

ASTM E2375, *Standard Practice for Ultrasonic Testing of Wrought Products*

ASTM E384, *Standard Test Method for Knoop and Vickers Hardness of Materials*

ASTM E709, *Standard Guide for Magnetic Particle Testing*

ASTM E1444-12, *Standard Practice for Magnetic Particle Testing*

¹ ASME International, 3 Park Avenue, New York, New York 10016-5990, www.asme.org.

² ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

ASTM E2375, *Standard Practice for Ultrasonic Testing of Wrought Products*

BSI BS 2M 54 ³, *Specification for Temperature Control in the Heat Treatment of Metals*

EN 10204 ⁴, *Metallic products. Types of inspection documents*

ISO 6507-1 ⁵, *Metallic materials. Vickers hardness test. Test method*

ISO 9015-1, *Destructive tests on welds in metallic materials. Hardness testing. Part 1: Hardness test on arc welded joints*

ISO 10474, *Steel and steel products—Inspection documents*

MIL-STD-1684 ⁶, *Control of Heat Treatment*

SAE AMS-STD-2154 ⁷, *Inspection, Ultrasonic, Wrought Metals, Process for*

SAE AMS-STD-2750, *Pyrometry*

3 Terms, Definitions, Abbreviations, and Acronyms

3.1 Terms and Definitions

For the purposes of this document, the following definitions apply.

3.1.1

contractor

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.

NOTE The purchaser may undertake all or part of the duties of the contractor.

3.1.2

critical region for nondestructive examination

The region of the forging defined or approved by the purchaser in contract documents or drawings, where additional or more stringent requirements are needed based on design considerations.

3.1.3

critical section for mechanical properties

The section of the forging defined or approved by the purchaser in contract documents or drawings and used to determine effective forging thickness.

3.1.4

forging

The product of a substantially compressive plastic working operation that consolidates the material and produces the desired shape.

NOTE The plastic working may be performed by a hammer, press, forging machine, or ring rolling machine and must deform the material to produce a wrought structure.

³ British Standards Institution, Chiswick High Road, London W4 4AL, United Kingdom, www.bsigroup.com.

⁴ European Committee for Standardization, Avenue Marnix 17, B-1000 Brussels, Belgium, www.cen.eu.

⁵ International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, www.iso.org.

⁶ U.S. Department of Defense, Document Automation and Production Service, Building 4/D, 700 Robbins Avenue, Philadelphia, Pennsylvania 19111-5094, <http://assist.daps.dla.mil>.

⁷ SAE International 4000 Commonwealth Drive, Warrendale, Pennsylvania 15906-0001, www.sae.org.

**3.1.5
grade**

Minimum yield strength, in N/mm².

**3.1.6
manufacturer**

The party that manufactures forged components, materials, equipment, and services to perform the duties specified by the contractor.

**3.1.7
material test report**

mill certificate

Document including results of chemical analyses, mechanical properties tests, visual and nondestructive tests, and dimensional inspections.

**3.1.8
purchaser**

The party that acquires the components.

NOTE The purchaser may utilize an agent or consultant to act for, and on behalf of, the purchaser.

**3.1.9
quality heat treatment
QHT**

The collective sequence of heat treatments performed to achieve final properties.

**3.1.10
Service Category A
SCA**

Forgings, other than bar-shaped forgings, not intended to contain, or form part of, structural fabrication weldments.

**3.1.11
Service Category B
SCB**

Forgings, other than bar-shaped forgings, intended to contain, or form part of, structural fabrication weldments.

**3.1.12
Service Category C
SCC**

Bar-shaped forgings.

NOTE Impact toughness requirements for SCC components are based on round bar geometry.

3.2 Abbreviations and Acronyms

For the purposes of this document, the following abbreviations and acronyms apply.

AFC	approved for construction drawings
Ar3	the temperature at which austenite begins to transform to ferrite during cooling
AOD	argon oxygen decarburization
CEV	carbon equivalent value, $(CEV) = C + (Mn/6) + (Cr + Mo + V)/5 + (Ni + Cu)/15$, elements wt%