

TECHNICAL SPECIFICATION

CARBON AND ALLOY STEEL FITTINGS (AMENDMENTS/SUPPLEMENTS TO ASTM A 234)

MESC SPE 76/200

June 2013

MESC SPECIFICATION DOCUMENT



This document is restricted. Neither the whole nor any part of this document may be disclosed to any third party without the prior written consent of Shell Global Solutions International B.V., The Netherlands. The copyright of this document is vested in this company. All rights reserved. Neither the whole nor any part of this document may be reproduced, stored in any retrieval system or transmitted in any form or by any means (electronic, mechanical, reprographic, recording or otherwise) without the prior written consent of the copyright owner.

PREFACE

MESC (Materials and Equipment Standards and Code) SPE documents reflect the views, at the time of publication, of:

Shell Global Solutions International B.V. (Shell GSI)

and/or

Shell International Exploration and Production B.V. (SIEP)

and/or

other Shell Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Shell Operating Units. Where appropriate they are based on, or reference is made to, international, regional, national and industry standards.

The objective is to set the recommended standard for good design and engineering practice applied by Shell 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 Shell companies for their consideration and decision to implement. This is of particular importance where MESC SPEs may not cover every requirement or diversity of condition at each locality. The system of MESC SPEs is expected to be sufficiently flexible to allow individual Operating Units to adapt the information set forth in MESC SPEs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use MESC SPEs they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those practices, which will achieve the same level of integrity as reflected in the MESC SPEs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

The right to use MESC SPEs is granted by Shell GSI, in most cases under Service Agreements primarily with Shell companies and other companies receiving technical advice and services from Shell GSI or another Shell Service Company. Consequently, three categories of users of MESC SPEs can be distinguished:

- 1) Operating Units having a Service Agreement with Shell GSI or other Shell Service Company. The use of MESC SPEs by these Operating Units is subject in all respects to the terms and conditions of the relevant Service Agreement.
- 2) Other parties who are authorized to use MESC SPEs subject to appropriate contractual arrangements (whether as part of a Service Agreement or otherwise).
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, Shell GSI disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any MESC SPE, combination of MESC SPEs or any part thereof, even if it is wholly or partly caused by negligence on the part of Shell GSI or other Shell Service Company. The benefit of this disclaimer shall inure in all respects to Shell GSI and/or any Shell Service Company, or companies affiliated to these companies, that may issue MESC SPEs or require the use of MESC SPEs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, MESC SPEs shall not, without the prior written consent of Shell GSI, be disclosed by users to any company or person whomsoever and the MESC SPEs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies, which shall only be made by users with the express prior written consent of Shell GSI. The copyright of MESC SPEs vests in Shell GSI. Users shall arrange for MESC SPEs to be held in safe custody and Shell GSI may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

All administrative queries should be directed to the MESC SPE Administrator in Shell GSI.

TABLE OF CONTENTS

PART I	INTRODUCTION	4
1.1	SCOPE.....	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	4
1.3	DEFINITIONS	4
1.4	CHANGES SINCE PREVIOUS EDITION.....	4
1.5	COMMENTS ON THIS MESC SPE.....	5
PART II	AMENDMENTS/SUPPLEMENTS TO ASTM A 234:2011.....	6
PART III	REFERENCES	9

PART I INTRODUCTION

1.1 SCOPE

This MESC SPE specifies requirements for carbon and alloy steel fittings.

This specification shall apply in addition to the applicable MESC Buying Description, purchase order or requisition sheet.

This specification only applies to carbon and alloy steel fittings to ASTM A 234, Grades WPB/WPBW, WP1/WP1W (0.5Mo), WP5/WP5W (5Cr-0.5Mo), WP9/WP9W (9Cr-1Mo), WP11/WP11W Class 2 (1.25Cr-0.5Mo) and WP22/WP22W Class 3 (2.25Cr-1Mo).

This specification is written as amendments and supplements to ASTM A 234:2011, which are covered in Part II of this MESC SPE. The clause numbering of ASTM A 234: 2011 has been retained and any amendments are identified as 'Add', 'Modify to read' or 'Delete'. Any clauses of ASTM A 234: 2011 that are not amended or supplemented by this MESC SPE, shall apply as written.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this MESC SPE is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them.

This MESC SPE is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and, where applicable, supply/distribution installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this MESC SPE 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 safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this MESC SPE 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 MESC SPE as closely as possible.

1.3 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 or maintenance 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 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.

1.4 CHANGES SINCE PREVIOUS EDITION

The previous edition of this MESC SPE was dated **September 2012. Cooling in still air option added to hot finishing.**

1.5 COMMENTS ON THIS MESC SPE

Comments on this MESC SPE may be sent to the MESC SPE Administrator at MESC@shell.com. Shell staff may also post comments on this MESC SPE on the Surface Global Network (SGN) under the Standards folder.

PART II AMENDMENTS/SUPPLEMENTS TO ASTM A 234:2011

6.7 *Add* If galvanising is specified, galvanising shall be in accordance with ASTM A 153, Grade B.

7.2 *Modify to read:*

Fittings furnished to Grades WPB or WPBW, when forged or extruded from welded pipe, shall be supplied in the normalised or hot finished condition.

Fittings furnished to Grades WPBW, furnished from plate, shall be supplied in the stress relieved or normalised condition. The plate material shall be supplied in the normalised condition. If sour service is specified, normalising shall consist of heating to a uniform temperature not less than 815 °C (1500 °F), followed by cooling in still air or in the cooling chamber of an atmosphere-controlled furnace. Fittings furnished to Grade WPB, supplied in the hot finished condition, shall be provided with a certificate that hot finishing was executed within a temperature range of 845 °C to 945 °C (1550 °F to 1735 °F), followed by cooling in an atmosphere-controlled furnace **or cooling in still air**.

7.3 *Modify to read:*

Fittings furnished to Grades WP5, WP9, WP11 or WP22, and fittings forged or extruded from welded pipe to Grades WP5W, WP9W, WP11W or WP22W shall conform to one of the following two options:

1. The fittings shall be supplied in the normalised and tempered condition. The tempering temperature shall be 740°C±8°C (1365°F±14°F). The tensile properties shall be in accordance with Class 1 of ASTM A 387.
2. The fittings shall be supplied in the normalised and tempered condition. The minimum tempering temperature shall be 720°C (1330°F). After all processing, one sample from each heat shall undergo three simulated PWHT cycles at 730°C ±5°C (1345°F ± 10°F) with a holding time as per ASME B31.3 Table 331.1.1 for each cycle. Tensile tests according to ASTM A335 shall be performed after each cycle. If results from all tests are conform ASTM A335, all fittings from that heat are accepted.

Fittings manufactured from plate to Grades WP5W, WP9W, WP11W or WP22W shall conform to one of the following two options:

1. The plate to ASTM A 387 shall be supplied in the normalised and tempered condition. The tempering temperature shall be 740°C±8°C (1365°F±14°F). The fittings shall be furnished in the post weld heat treated condition. The post weld heat treatment temperature shall be 715 °C ±10°C (1318 °F±18°F). The tensile properties shall be in accordance with Class 2 of ASTM A 387.
2. The plate to ASTM A 387 shall be supplied in the normalised and tempered condition. The minimum tempering temperature shall be 720°C (1330°F). The tensile properties shall be in accordance with Class 2 of ASTM A 387. The fittings shall be furnished in the post weld heat treated condition. The post weld heat treatment temperature shall be 715 °C ±10°C (1318 °F±18°F). After all processing, one sample from each heat shall undergo three simulated PWHT cycles at 730°C ±5°C (1345°F ± 10°F) with a holding time as per ASME B31.3 Table 331.1.1 for each cycle. Mechanical tests according to ASTM A691 paragraph 8.1 shall be performed after each cycle. If all results meet ASTM A691 requirements, all pipes from that heat are accepted.

8.1 For fittings furnished to Grades WPB or WPBW, the following shall apply:

- The carbon content shall not exceed 0.23 %.

- Supplementary requirement S3 shall apply, although CE shall not exceed 0.43.

For fittings furnished to Grade WP11 or WP11W, the following shall apply:

- The material shall meet the following additional chemical requirements by heat analysis:

Element	C	P	S	Cu	Ni	X-bar
Max allowed	0.15%	0.012 wt%	0.007 wt%	0.20%	0.30%	14 ppm

X-bar shall be calculated with the following formula:

$$X - \text{bar} = \frac{10P + 5Sb + 4Sn + As}{100}, \text{ with P, Sb, Sn and As values in ppm.}$$

For fittings furnished to Grades WP22 or WP22W, the following shall apply:

- The phosphorous content shall not exceed 0.010 %.
- The sulphur content shall not exceed 0.010 %.

8.5 *Add* If sour service is specified for fittings furnished to Grade WPB, the sulphur content shall not exceed 0.010 %.

If sour service is specified for fittings furnished to Grade WPBW, the following requirements shall apply:

- In order to ensure effective resistance against both Hydrogen Induced Cracking (HIC) and Sulphide Stress Corrosion (SSC), the chemical composition shall be as per Table 3, unless ASTM A 516 Grade 65 is more restrictive.
- Supplementary requirement S54.2 and S54.3 of ASTM A 516 shall apply, although CE shall not exceed 0.43, irrespective of the specified wall thickness.
- The micro-alloying elements Boron (B), Titanium (Ti), Niobium (Nb) and Vanadium (V) shall not be intentionally added to the steel, unless approved by the Principal.
- The plate shall be vacuum-treated, fully deoxidised, desulphurised and dephosphorised. The manufacturing / rolling process shall result in a homogeneous microstructure with no significant ferrite / perlite banding.
- For plate with sulphur content of 0.001 % and higher, calcium treatment shall be applied for inclusion shape control. The calcium content shall not exceed 3 times the sulphur content.

Table 3 *Add*

Table 3 – Chemical composition for sour service		
Single elements	Identification	Maximum wt. %
Carbon	C	0.20
Manganese	Mn	1.30
Phosphorous	P	0.01
Sulphur	S	0.002
Silicon	Si	0.40
Copper	Cu	0.40
Nickel	Ni	0.40
Chromium	Cr	0.30
Molybdenum	Mo	0.12
Vanadium	V	0.015
Niobium	Nb	0.015
Titanium	Ti	0.02
Boron	B	0.0005
Combined elements	Cr + Mo	0.30
	Ni + Cu + Cr + Mo	0.72
	V + Nb	0.02

- 8.6 *Add* If sour service is specified, the weld metal deposit shall not contain more than 1.00 % Nickel.
- 9.5 *Add* Fittings furnished to Grades WPBW, WP1W, WP5W, WP9W, WP11W and WP22W, shall be furnished from same grade of plate or welded pipe as shown in the buying description.
- 10.2 *Add:*
Hardness testing shall be carried out on welded fittings at a frequency of one fitting out of every ten per heat. Testing shall be carried out after post-weld heat treatment. No part of the weld, heat affected zone or base metal shall exceed 248 HV 10.
- 15.3 *Add* For fittings furnished to Grades WPBW and specified for sour service, and for fittings furnished to Grades WP1W, WP5W, WP9W, WP11W or WP22W, the following requirements shall apply:
- Magnetic Particle examination shall be carried out in accordance with ASTM A 960, supplementary requirement S69. The wet method shall be used.
 - The acceptance criteria for welds shall be in accordance with ASME B31.3, Table 341.3.2 for Severe Cyclic Conditions, Criteria A. For other surfaces and for butt-welding end preparations, there shall be no linear indications longer than 1.6 mm (0.063 in).
- 15.4 *Add* For fittings furnished to Grades WPBW and specified for sour service and manufactured from plate material, the following requirements shall apply:
- The plate shall be checked for laminations by ultrasonic examination in accordance with EN 10160 with acceptance levels S₁ and E₄.
 - The plate material shall be HIC tested in accordance with MESC SPE 74/125 after a simulation of the final heat treatment of the fitting.
- 19.6 *Add* If sour service is specified, the word "SOUR" shall be marked on the pipe directly behind the ASTM designation.

PART III REFERENCES

In this MESC SPE, reference is made to the following publications:

NOTES:

1. Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.
2. Most of the referenced external standards are available to Shell staff on the SWW (Shell Wide Web) at <http://sww05.europe.shell.com/standards>.

SHELL STANDARDS

Hydrogen Induced Cracking sensitivity test MESC SPE 74/125

Fittings to ASME B16.9 MESC SPE 76/110

AMERICAN STANDARDS

Factory-Made Wrought Buttwelding Fittings ASME B16.9

Process Piping ASME B31.3

Issued by:

*American Society of Mechanical Engineers
ASME International
Three Park Avenue, M/S 10E
New York, NY 10016, USA*

Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware ASTM A 153

Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service ASTM A 234:2011

Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium- Molybdenum ASTM A 387

Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service ASTM A 516

Standard Specification for Common Requirements for Wrought Steel Piping Fittings ASTM A 960

Issued by:

*American Society for Testing and Materials
1916 Race Street, Philadelphia
19103, USA*

EUROPEAN STANDARDS

Ultrasonic Testing of Steel Flat Product of Thickness Equal or Greater Than 6 mm (Reflection Method) EN 10160

Issued by:

*Comité Européen de Normalisation
Secrétariat Central
Rue de Stassart 36
B-1050 Brussels
Belgium*

Copies can also be obtained from national standards