

DEP SPECIFICATION

POSITIVE MATERIAL IDENTIFICATION (PMI) PROGRAM

DEP 31.10.00.10-Gen.

September 2011

ECCN EAR 99

DESIGN AND ENGINEERING PRACTICE

DEM1



© 2011 Shell Group of companies

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, published or transmitted, in any form or by any means, without the prior written permission of the copyright owner or Shell Global Solutions International BV.

This document contains information that is classified as EAR99 and, as a consequence, can neither be exported nor re-exported to any country which is under an embargo of the U.S. government pursuant to Part 746 of the Export Administration Regulations (15 C.F.R. Parts 746) nor can be made available to any national of such country. In addition, the information in this document cannot be exported nor re-exported to an end-user or for an end-use that is prohibited by Part 744 of the Export Administration Regulations (15 C.F.R. Parts 744).

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of Shell Global Solutions International B.V. (Shell GSI) and, in some cases, of other Shell Companies.

These views are based on the experience acquired during involvement with the design, construction, operation and maintenance of processing units and facilities. Where deemed appropriate DEPs are based on, or reference international, regional, national and industry standards.

The objective is to set the recommended standard for good design and engineering practice to be applied by Shell companies in oil and gas production, oil refining, gas handling, gasification, chemical processing, or any other such facility, and thereby to help 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 DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual Operating Units to adapt the information set forth in DEPs to their own environment and requirements.

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

The right to obtain and to use DEPs is restricted, and is typically granted by Shell GSI (and in some cases by other Shell Companies) under a Service Agreement or a License Agreement. This right is granted primarily to Shell companies and other companies receiving technical advice and services from Shell GSI or another Shell Company. Consequently, three categories of users of DEPs can be distinguished:

- 1) Operating Units having a Service Agreement with Shell GSI or another Shell Company. The use of DEPs by these Operating Units is subject in all respects to the terms and conditions of the relevant Service Agreement.
- 2) Other parties who are authorised to use DEPs 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 DEP, combination of DEPs or any part thereof, even if it is wholly or partly caused by negligence on the part of Shell GSI or other Shell Company. The benefit of this disclaimer shall inure in all respects to Shell GSI and/or any Shell Company, or companies affiliated to these companies, that may issue DEPs or advise or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of Shell GSI, be disclosed by users to any company or person whomsoever and the DEPs 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 DEPs vests in Shell Group of companies. Users shall arrange for DEPs 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 DEP Administrator in Shell GSI.

TABLE OF CONTENTS

1.	INTRODUCTION	4
1.1	SCOPE	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	4
1.3	DEFINITIONS	5
1.4	CROSS-REFERENCES	6
1.5	SUMMARY OF MAIN CHANGES	6
1.6	COMMENTS ON THIS DEP	6
1.7	DUAL UNITS	7
2.	GENERAL	8
3.	PMI PROGRAM MAIN ELEMENTS	9
4.	POSITIVE MATERIAL IDENTIFICATION	10
4.1	EXTENT OF ALLOY COMPONENTS SUBJECT TO PMI	10
4.2	ALLOY ELEMENTS REQUIRED TO BE EVALUATED DURING PMI TESTING	10
4.3	MATERIALS AND COMPONENTS NOT SUBJECT TO PMI TESTING	10
4.4	TIMING AND LOCATION OF PMI CHECKS	11
4.5	WELDING CONSUMABLES	11
4.6	GENERAL REQUIREMENTS FOR CERTIFICATION	12
4.7	CONTROLS FOR CARBON STEEL MATERIALS	12
4.8	PMI OF GASKETS	13
5	EXAMINATION EQUIPMENT / TEST METHOD	14
6	MATERIAL TRACEABILITY	15
6.1	GENERAL	15
6.2	MARKING	15
6.3	COLOUR CODING	15
7.	MATERIAL IDENTIFICATION	17
7.1	GENERAL	17
7.2	MATERIAL IDENTIFICATION CODES	17
7.3	REJECTED MATERIAL	18
8.	INSPECTION REPORT	19
9.	REFERENCES	28

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and provides recommendations for alloy material control and handling practices to be applied during all phases of a project to guard against the installation of rogue materials for pressurized equipment.

The material control elements in this DEP apply to bulk and specialty components, fabricated piping and equipment, and both on-site and at off-site fabrication.

Alloy materials as it pertains to this DEP, includes any materials that contain alloying elements such as chromium, nickel or molybdenum that are intentionally added to enhance the mechanical or physical properties and/or corrosion resistance. The term alloy includes special grades of carbon steel such as low temperature (LT) and sour service grades.

This DEP defines the minimum required sample (percentage), elemental analysis requirements and other verification steps based on the alloys of construction and the component type.

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 of the same number dated December 2007; 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 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 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 word **SHALL [PS]** indicates a Process Safety related requirement per this DEP.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

term	definition
Alloy material	Any metallic material (including welding filler materials) that contain alloying elements that are intentionally added to enhance mechanical or physical properties and corrosion resistance, or a combination thereof (e.g. Chromium, Nickel, or Molybdenum).
Alloy System	A piping system or pressure equipment for which a specific alloy material has been selected to suit the process conditions to which it will be exposed.
Distributor	A warehousing supplier for one or more manufacturers or suppliers of alloy materials or components.
Level of Examination	The specified percentage of the number of components (or weldments when specified) to be examined in an inspection lot.
Fabricator	One who fabricates piping systems or portions of a piping system as defined by ASME B31.3, or process pressure equipment, instrumentation or machinery.
Heat of material	Heat (melt) from which materials or components having the same physical or chemical properties are produced.
Inspection lot	A group of items or materials of the same type from a common source from which a sample is to be drawn for examination. NOTE: An inspection lot does not include items from more than one heat.
Inspection Test Plan	A step by step plan outlining special inspection steps that should occur during the fabrication/assembly process.
Lot size	The number of items available in the inspection lot at the time a representative sample is selected.
Material Manufacturer	An organization that performs or supervises and directly controls one or more of the operations that affect the chemical composition or mechanical properties of a metallic material.
Material Nonconformance	A positive material identification (PMI) test result that is not consistent with the selected or specified alloy.

term	definition
Material Supplier	An organization that supplies material furnished and certified by a material manufacturer, but does not perform any operation intended to alter the material properties required by the applicable material specification. NOTE: Material Manufacturer and Supplier may be the same party if the Manufacturer supplies directly to the shop fabricator, field fabricator, or purchaser.
Material Verification Program	A documented quality assurance procedure used to assess metallic alloy materials (including weldments and attachments where specified) to verify conformance with the selected or specified alloy material designated by the owner/user.
Mill Test Report (MTR)	A certified document that permits each component to be identified according to the original heat of material from which it was produced and identifies the applicable material specification (including documentation of all test results required by the material specification).
Positive material identification (PMI) testing	Any physical evaluation or test of a material to confirm that it is consistent with the selected or specified alloy material designated by the Principal. Evaluations or test may provide either qualitative or quantitative information that is sufficient to verify the nominal alloy composition (this DEP accepts only quantitative testing for PMI).
Pressure-containing components	Items that form the pressure-containing envelope of the operating components and piping systems. This generally includes on-line instrumentation up to and including the first isolation valve of off-line instrumentation.
Random	Selection process by which choices are made in an arbitrary and unbiased manner.
Representative sample	One or more items selected at random from the inspection lot that are to be examined to determine the acceptability of the inspection lot.
Rogue material	Equipment or piping components that accidentally end up in a specific alloy (or special carbon steel) system, but do not meet the materials selection criteria for that system. This includes welding consumables.
Standard reference materials	Sample materials for which laboratory chemical analysis data are available and are used in demonstrating test instrument accuracy and reliability.

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 DEP is a revision of the DEP of the same number dated February 2011.

More specific guidance and requirements on color coding are now included in Section 6.3.1.

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.

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

An approved PMI program that meets the requirements contained in this DEP and covers all new construction project work SHALL [PS] be implemented. The PMI program SHALL [PS] cover the minimum required sample (percentage), the elemental analysis requirements and other material verification steps contained in this DEP, based on the alloys of construction and the component type. The requirements contained in this DEP SHALL [PS] be incorporated into the materials quality assurance systems to be applied during all phases of a project in order to guard against the installation of rogue materials that may adversely affect the integrity of the plant pressure envelope and process reliability. Additional PMI may be specified if deemed necessary by the Principal.

For simplicity, the more commonly used term Positive Materials Identification (PMI) is used throughout this DEP. Wherever reference is made to Positive Materials Identification or PMI, it shall be understood to include the broader aspects of alloy material control and handling practices.

Alloy materials as it pertains to this DEP, shall be understood to include any materials that contain alloying elements such as chromium, nickel or molybdenum that are intentionally added to enhance the mechanical or physical properties and/or corrosion resistance. In this DEP, the term alloy shall be understood to include special grades of carbon steel such as low temperature (LT) and sour service grades.

When alloy materials are specified for hydrofluoric acid service or sour service (e.g. low temperature grades and residual element control) PMI SHALL [PS] be implemented to guard against rogue materials that can lead to loss of containment of the pressure envelope or process reliability incidents.

PMI shall be applied to both individual material components and fabricated assemblies (e.g., piping spools), as specified in this DEP.

The components requiring PMI in this DEP shall be understood to include the pressure containing parts that form the pressure envelope of the equipment or whose failure could affect the pressure retaining capability of the equipment or component. PMI of non-pressure retaining components shall be specified if there is a significant reliability risk due to component failure.

Any deviation from the examination requirements or a reduction in the percentage of PMI specified in this DEP (e.g. based on the severity of service) shall be subject to approval of the Principal and shall be verified by the required technical authority.

Further guidance on material verification can be found in *API RP 578 Material Verification Program for New and Existing Alloy Piping Systems*.

3. PMI PROGRAM MAIN ELEMENTS

The elements covered by the PMI program shall include:

- Levels of examination, including alloy elements required for PMI, examination equipment / methods, materials and components not subject to PMI testing, and rejected material.
- Documentation, records, receipt and issuing of materials, PMI testing of welding consumables, controls for carbon steel materials, and PMI of gaskets.
- Material traceability during fabrication and machining, the timing and location of PMI in accordance with the Inspection and Test Plan (ITP), including transfer of markings and color-coding.
- Material identification of components on which PMI tests are performed, e.g. the material identification code system on components.
- Inspection reports documenting the PMI examination for component (e.g. for piping, with line number and pipe spec, including the spool or fabrication drawing) showing the locations of PMI tests by the shop/field fabricator or field constructor.

The PMI program shall include definition and management controls for the following work processes:

- Receipt of Materials - controls for segregation and storage of materials, material test report validation and PMI and component identification from the suppliers per the scope of this specification.
- Issuance of Materials – Controls for the issuance and tracking of materials and components and welding consumables during fabrication. This includes controls during fabrication, such as the segregation of materials, materials traceability and identification during the fabrication process. This includes segregation of tools where applicable to prevent contamination.
- Surplus Materials – the control and traceability of surplus materials, including the return and accounting of all surplus or rejected materials.

The PMI program output shall include the compilation of auditable material traceability records in accordance with (8). These records shall be included as part of the handover documentation packages and shall include final field verification on completed systems.