

DEP SPECIFICATION

SPARK IGNITED AND COMPRESSION IGNITED ENGINES

DEP 31.29.80.30-Gen.

February 2013

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE



© 2013 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. Part 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. Part 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 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	5
1.1	SCOPE.....	5
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	5
1.3	DEFINITIONS	5
1.4	CROSS-REFERENCES	7
1.5	SUMMARY OF MAIN CHANGES	7
1.6	COMMENTS ON THIS DEP	8
1.7	DUAL UNITS.....	8
1.8	ORDER OF PRECEDENCE	8
2.	BASIC REQUIREMENTS.....	9
2.1	APPLICABLE STANDARDS.....	9
2.2	RANGE OF APPLICATION	9
2.3	FUEL AND LUBRICANT CONSUMPTION.....	9
2.4	FUEL COMPOSITION	9
2.5	RESPONSIBILITY	9
2.6	OFFSHORE INSTALLATION	10
2.7	EMISSION CONTROLS	10
2.8	WEATHERIZATION.....	11
2.9	TROPICALIZATION.....	11
2.10	WINTERIZATION.....	11
2.11	NOISE CONTROL	11
2.12	INSTALLATIONS IN HAZARDOUS AREAS	11
2.13	ELECTRIC MOTORS AND COMPONENTS.....	11
3.	ENGINE AND AUXILIARIES DESIGN.....	11
3.1	GENERAL	11
3.2	ENGINE COMPONENTS	12
3.3	FUEL SYSTEM	13
3.4	IGNITION SYSTEM	13
3.5	LUBRICATION SYSTEM	14
3.6	ENGINE COOLING SYSTEMS	15
3.7	ENGINE ELECTRICAL SYSTEM	16
3.8	STARTING SYSTEMS.....	16
3.9	SPEED GOVERNING	16
3.10	OVER SPEED PROTECTION	17
3.11	TORSIONAL VIBRATION.....	17
3.12	LATERAL VIBRATION AND VIBRATION SUPPRESSION	17
3.13	CRANKCASE EXPLOSION RELIEF	17
3.14	BASEPLATE	17
3.15	PIPING	18
4.	INSTRUMENTATION AND CONTROLS.....	18
4.1	GENERAL	18
4.2	START AND STOP SEQUENCE	18
4.3	DISPLAY OR CONTROL PANEL.....	18
4.4	MONITORING AND PROTECTION	19
4.5	CUSTOMER CONNECTIONS.....	20
5.	INSTALLATIONS IN HAZARDOUS AREAS.....	20
6.	SPECIAL TOOLS	20
7.	INSPECTION AND TESTS.....	21
8.	PRESERVATION FOR SHIPPING.....	21
9.	MANUFACTURER'S INFORMATION	21
10.	REFERENCES	22

APPENDICES

APPENDIX 1	ENGINE MONITORING AND PROTECTION INSTRUMENTATION	24
-------------------	---	-----------

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for stationary spark ignited gas fueled engines (SI) and compression ignited engines (CI) used to power compressors, generators, pumps, and similar services. It is intended to cover the basic engine and its essential auxiliaries produced as a proprietary item by an engine Manufacturer. This DEP does not include packaging with the driven equipment nor is it intended to cover integral engines driving compressors.

All statements regarding engine power in this DEP are in accordance with ISO 3046-1.

This is a revision of the DEP of the same number dated December 2000; 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 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 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 **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Auxiliaries	That equipment necessary for the operation of the engine but not an intrinsic part of the engine. Auxiliaries are provided by the engine Manufacturer, but could be manufactured by a third party.
BICERA valve	Crankcase Explosion Relief device
Hazardous area	An area in which an explosive gas mixture is or may be expected to be present in a quantity such as to require special precautions for the construction, installation and use of electrical apparatus.
ISO Power	The continuous power output of the engine at rated speed at the standard ambient conditions given in ISO 3046-1 (77 °F (25 °C) and 29.61 in Hg (100 kPa)) using dry natural gas with a LHV of 920 BTU/ft ³ (36.2 mJ/Nm ³). The ISO power is to be derated to the service power at the most severe ambient conditions under which the engine will operate as defined above.
Lean and Ultra Lean Burn Engines	These engines admit as much as 75 % more air than is theoretically needed for complete combustion in the combustion chambers. The air / fuel ratio is such that the engine exhaust contains up to 9 % oxygen. The higher air to fuel ratio results in a cooler combustion chamber temperature. This, in turn, produces very low levels of NO _x but may produce excessive levels of CO. The CO must then be reduced by using an oxidizing catalyst in the exhaust stream.
Package	This refers to the complete assembly of the engine, its auxiliaries, the driven machine and controls with or without a baseplate which fulfils the Principal's desire for generation of electricity or the movement of gas or liquid. The package may include any associated process equipment relating to the driven machine. Liability for the package is to the Contractor or the Principal, depending on who the contract is with.
Packager	The Packager is the party responsible for the design, fabrication, assembly and testing of a package.
Requisition	Information exchanged prior to order placement using data/requisition sheets or project specific specifications, or similar documents that describe the conditions of service of the application.
Rich Burn Engine	The "rich burn" engine is as close to a true stoichiometric engine as is possible. It is used with catalytic converters to achieve high emissions performance. It is a low technology, environmentally dirty engine. Combined with external exhaust scrubbers and catalyst after after-treatment it is capable of producing some of the cleanest emissions available. The air / fuel ratio is generally 0.5% oxygen in the exhaust. Because of the low oxygen it does not burn all of the fuel. It is normally tuned to produce equal amounts of CO and NO _x . The CO and NO _x are converted to CO ₂ and N ₂ in the catalytic converter. The disadvantages of this type of engine include the high operating cost due to the exhaust treatment required and the high maintenance cost of due to the elevated exhaust temperatures.

Service Power	The engine power available at the most severe ambient conditions in accordance with ISO 3046-1. It is the continuous power available at the drive coupling of the engine after deduction of all losses including engine driven components and auxiliaries. The Manufacturer shall state the auxiliaries driven by the engine and their power absorbed in computing the rated power. For the computing of power as defined in ISO 3046-1, engine driven lubricating oil pumps and separate lubricators for valve gear or cylinders are regarded as engine components and not auxiliaries.
Vital Service	A service in which, if equipment fails in operation or fails when called upon to operate, an unsafe condition on the installation or jeopardy to life or major damage to the installation can be caused. The requisition will identify whether the service is vital.

1.3.3 Abbreviations

Term	Definition
BICERA	British Internal Combustion Research Association
CI	Compression ignited engine, typically a diesel fueled engine
CSA	Canadian Standards Association or CSA International is a Nationally Recognized Testing Laboratory
DF	Dual fuel engines, typically an engine that uses a portion of natural gas as an ignition source to burn a combination of natural gas and diesel. Ratios of fuels could include over 50 % natural gas, as defined as what is currently available in the industry.
ESD	Emergency Shutdown Device
FM	FM Approvals LLC is a Nationally Recognized Testing Laboratory
SAE	Society for Automotive Engineers
SI	Spark ignited engine, typically a natural gas fueled engine
UL	Underwriters Laboratories Inc is a Nationally Recognized Testing Laboratory

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 (10).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated December 2000. This revision also incorporates the contents of DEP 31.29.90.30-Gen. Since modifications to the original documents were extensive, the entire document should be reviewed.

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://swwww.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.

1.8 ORDER OF PRECEDENCE

In the event of conflict between documents relating to the inquiry or purchase order, the following hierarchy of documents shall apply:

- First level: purchase order and variations thereto
- Second level: data/requisition sheets and drawings
- Third level: this DEP

Any apparent conflict between the requirements of this DEP and any other relevant document in the purchase order shall be notified to the Principal for clarification purposes.